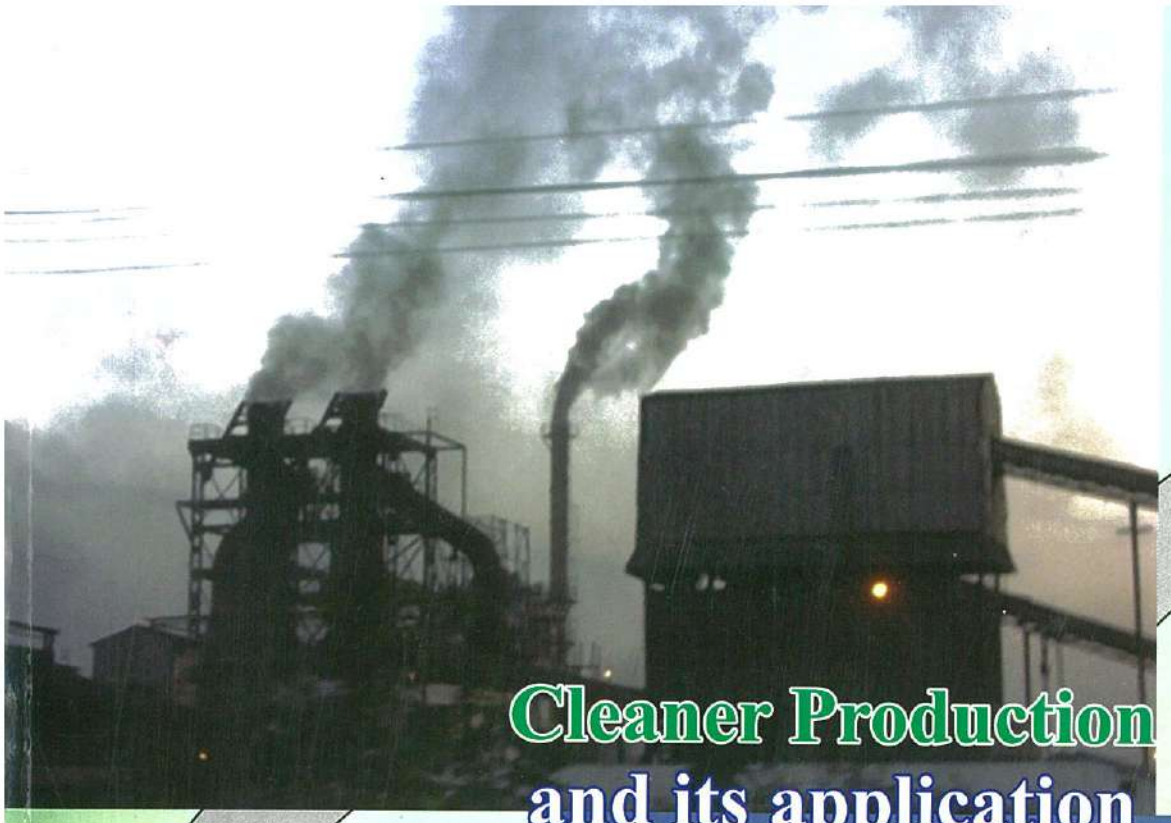
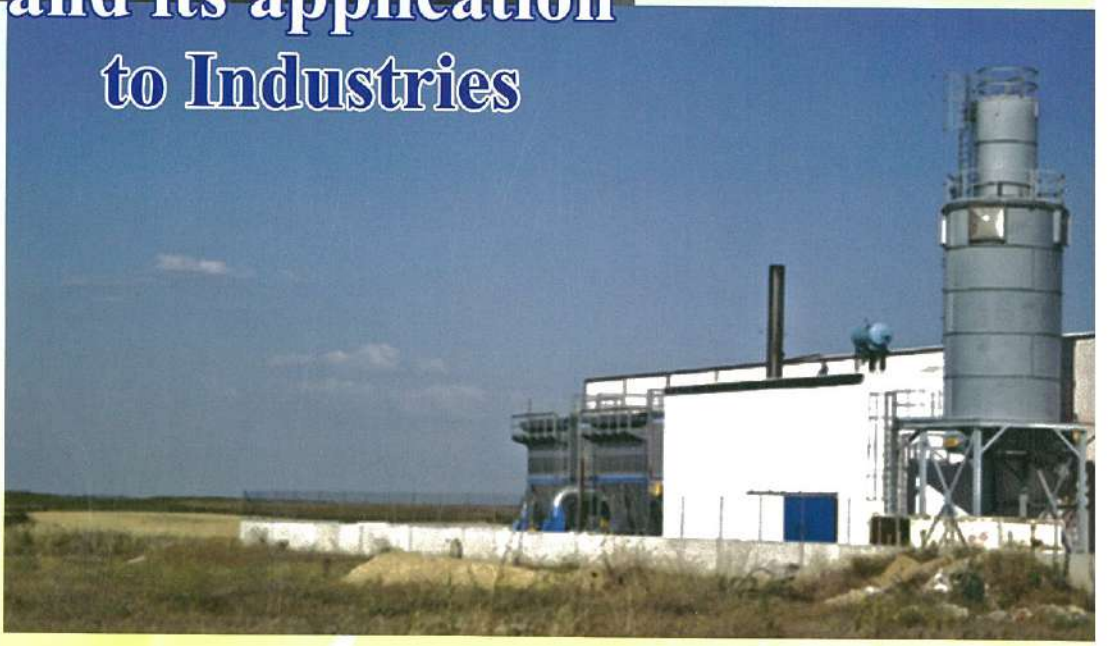


Cleaner Production and its application to Industries



GUJARAT CLEANER PRODUCTION CENTRE

Gandhinagar, Gujarat.

June 2010

Errata:

Chapter	Page	Error
One	18	Heading No. 3 reads : Soil Contamination Should read: Soil Pollution
One	21	Under Heading Hazardous Waste Second line reads : Hazardous wastes can be liquids, solids, contained gases, or Sludge's. Should Read: Hazardous wastes can be liquids, solids, contained gases or Sludges
One	30	Heading No. 9 reads : Radioactive Contaminations Should read: Radioactive pollution
Two	38 Fig no 2.2	First line reads : L Original perception: Focus on Quantity alone Should read: 1. Original perception: Focus on Quantity alone
Six	71	First line reads : Successful Cleaner Production Demonstration Projects for Different sector Should read: Successful Cleaner Production Demonstration Projects for Different sector

<table>
<tr><td></td><td></td><td>In the table of Successful Cleaner Production Demonstration Projects for Chemical sector.
In Fourth row of table:
Replace "To carry out sulphonation with sulphur trioxide and avoid generation of spent acid" with "To install thermometer and pressure gauges to measure desired temperature and pressure respectively".

Add " To carry out sulphonation with sulphur trioxide and avoid generation of spent acid" at sixth row of table: In Technology Change</td></tr>
<tr><td>Seven</td><td>85 & 86</td><td><table><tr><td>Reads</td><td>Should read:</td></tr><tr><td>Reaction 1 Mol Wt 18</td><td>Reaction 1 Mol Wt 36</td></tr><tr><td>Reaction 2 Mol Wt 36.5</td><td>Reaction 2 Mol Wt 73</td></tr><tr><td>Reaction 3Mol Wt 18</td><td>Reaction 3 Mol Wt 36</td></tr><tr><td>Reaction 4 Mol Wt 36.5</td><td>Reaction 4 Mol Wt 73</td></tr></table></td></tr>
<tr><td>Annexure</td><td>178</td><td>On this page "Sachivaiaya" should read as "Sachivalaya"</td></tr>
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Message

The concept of Cleaner Production is very simple – prevention is better than cure; a stitch in time saves nine. However, when it comes to implementation, it becomes as difficult as the first barrier to cross is the thinking of the industry. Nevertheless, the work done by the team is very uplifting. A lot many CP assessments have been done by the Centre. Being recognized as an ENVIS centre by MoEF on Cleaner Production / Technology is an achievement by itself. Being proactive, the State government has also included CP and CT as a part of Industrial Policy 2009 and floated number of financial support schemes towards implementation of CP and CT.

This book will be helpful to all – industrialists, academicians, students and consultants -when they wish to understand Cleaner Production in simple language with case studies they can relate to.

I congratulate Mr. Bharat Jain and his whole team for this compilation. They have worked untiringly and zealously to promote Cleaner Production in Gujarat and I wish GCPC all the success in their future endeavors.

Maheswar Sahu, IAS
Dt. 28/7/2010
Principal Secretary,
Industries and Mines Department,
Government of Gujarat

Foreword

Cleaner Production is a comparatively new approach to deal with environmental concerns and grasping the opportunities arising from those challenges. It aims at avoiding the generation of waste and emissions, by making more efficient use of materials and energy, through modifications in the production processes, input materials, operating practices and/or products and services. Although Cleaner Production was pioneered by large processing industries, it has become evident that it is, likewise, applicable to small and medium sized enterprises in manufacturing, construction and service sectors.

Cleaner Production requires a new way of thinking about processes and products, and about how they can be made less harmful to human beings and to the environment. For successful implementation, the concept must be effectively communicated within the organization. Employees at all levels, including senior management, should be actively involved.

Gujarat Cleaner Production Centre has been established by the State Government and is actively engaged in the promotion of Cleaner Production (CP)/Clean Technology (CT) through its various activities like Orientation Programmes, CP Assessment Projects, CT Assessment Projects etc. It has taken up demonstration projects in many industries in various sectors, e.g. Dyes & Dye Intermediates, Pharmaceuticals, Textile, Fish Processing, Petrochemicals, Electroplating, Pulp & Paper Industry, and also service sectors like Hotels and Hospitals. Results of these projects are very encouraging and industries are getting economical as well as environmental benefits.

To disseminate the concept, GCPC has made very good efforts in compiling this book. The book illustrates how selected industries in different industry sectors were able to implement Cleaner Production practices and technologies.

This book is primarily aimed at introducing students at institutes for higher education, company management, civil servants, professional designers and process engineers to the possibility and advantages of cleaning of product and production. It deals with the possibility for environmental improvement of product and production process. It outlines the methodology for generating option for Cleaner Production. Moreover, the case studies given in the book are real case studies which have been conducted by GCPC.

I congratulate the GCPC team for having compiled a book on Cleaner Production in such lucid and clear language. GCPC is truly geared up to meet the challenges of pollution problems in Gujarat and try to solve them with proactive measures like Cleaner Production.

Arvind Agarwal, IAS
Dt. 15/7/2010
Chairman,
Gujarat Cleaner Production Centre

Preface

Industrialization brought economic growth to Gujarat. The industrialization which started in 1960s in Gujarat brought in abundant prosperity. This was however, one side of the coin. Rapid industrialization brought in issues of deforestation and pollution.

All businesses use resources of one kind or another to produce products and deliver services for meeting needs of other businesses and / or communities. In this process, some resources remain unspent, or unwanted products get produced because 100% conversion or transfer of resources is seldom possible. This waste when discharged to the environment causes pollution.

The world over, has gone through the cycle of ignoring the problem, then dilution, treatment and finally prevention. The Pollution Prevention (P2) comprises of Waste Minimization also termed as Cleaner Production.

It was recognized that Cleaner Production was the need of the day and hence, Gujarat Cleaner Production Centre (GCPC) was established under GIDC with technical support of UNIDO. GCPC over the years has conducted many CP assessment projects. A subject named "Cleaner Production" has also been included in curriculum of engineering at graduate and post-graduate level.

There was a need of having a book dealing with concepts, tools, methodologies and case studies, which will be helpful to the professionals, students and industries to understand and implement CP.

This gave birth to the idea to publish this book. The case studies explained here are those which GCPC have themselves carried out. The chapters provide adequate details to readers.

Realising the importance of Environmental Information, the Government of India, in December, 1992, established an Environmental Information System (ENVIS) as a plan programme. The focus of ENVIS since inception has been on providing environmental information to decision makers, policy planners, scientists and engineers, research workers, etc. all over the country. Since environment is a broad-ranging, multi-disciplinary subject, ENVIS has, therefore, developed itself with a network of institutions/ organisations for the programme to cover the broad subject areas of environment with a Focal Point in the Ministry of Environment & Forests. Gujarat Cleaner Production Centre has been recognized as an ENVIS centre since 2003 on "Cleaner Production and Technology" under "Chemicals, Wastes and Toxicology". GCPC has been compiling, collating and disseminating information on CP/CT and has been publishing newsletter since 2003. This book is being published under the aegis of ENVIS

Upon study of Cleaner Production, it was found that it has its roots in Indian culture. Indian culture has preached Cleaner Production as a way of life. And hence, a whole chapter has been dedicated to Indian culture also.

I express my gratitude to all team members of GCPC who contributed in compiling the book.

Bharat Jain
Member Secretary
Gujarat Cleaner Production Centre

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1. POLLUTION

WHAT IS POLLUTION ?

One hundred years ago, Claude Monet painted scenes of London through its smoggy atmosphere. That was local pollution. What is relatively new and even more worrying is global pollution - that is pollution emitted locally that has global effects.

The first example that arose in **1952** was the severe black smog (smoke + fog) that affected London during the period of Friday 5th to Tuesday 9th December 1952, today seen as the worst air pollution event in the history of the United Kingdom. Earlier reports suggested that 4000 died prematurely and 100,000 were made ill by the **Great Smog**, but more recent research has shown that the number of smog-related deaths was underestimated and is now thought to be considerably higher - around 12,000. The London Smog of 1952 is acknowledged as one of the most significant pollution episodes in history in terms of its impact on environmental research, government regulation, and public awareness of the relationship between air quality and health.

Rachel Carson's Silent Spring, which in **1962** exposed the hazards of the pesticide DDT (Dichlorodiphenyltrichloroethane), eloquently questioned humanity's faith in technological progress and helped set the stage for the environmental movement.

DDT, the most powerful pesticide the world had ever known exposed nature's vulnerability. Unlike most pesticides, whose effectiveness is limited to destroying one or two types of insects, DDT was capable of killing hundreds of different kinds at once. Developed in 1939, it first distinguished itself during World War II, clearing South Pacific islands of malaria-causing insects for U.S. troops, while in Europe being used as an effective de-lousing powder. Its inventor was awarded the Nobel Prize.

Silent Spring took **Carson** four years to complete. It meticulously described how DDT entered the food chain and accumulated in the fatty tissues of animals, including human beings, and caused cancer and genetic damage. A single application on a crop, she wrote, killed insects for weeks and months, and not only the targeted insects but countless more and remained toxic in the environment even after it was diluted by rainwater. Carson concluded that DDT and other pesticides had irrevocably harmed birds and animals and had contaminated the entire world food supply. The book's most haunting and famous chapter, "A Fable for Tomorrow," depicted a nameless American town where all life -- from fish to birds to apple blossoms to human children -- had been "silenced" by the insidious effects of DDT.

The next example that arose in the **1980s** was damage to the Earth's **Ozone** layer. International action through the Montreal Protocol has been taken to phase out the use of the chemicals responsible although full recovery of the ozone layer will take at least a century.

The Bhopal disaster was an industrial catastrophe that took place at a pesticide plant owned and operated by Union Carbide India Limited (UCIL) in Bhopal, Madhya Pradesh, India on December 3, 1984. Around 12 AM, the plant released methyl isocyanate (MIC) gas and other toxins, resulting in the exposure of over 500,000 people. Estimates vary on the death toll. The official immediate death toll

was 2259 and the government of Madhya Pradesh has confirmed a total of 3787 deaths related to the gas release. Other government agencies estimate 15,000 deaths. Others estimate 8000 to 10,000 died within 72 hours and 25,000 have since died from gas-related diseases.

POLLUTION

From times immemorial, man has been interacting with environment. But the word **"Pollution"** has entered the environment dictionary sometime back in the last century. So what is Pollution???

Pollution is defined in many ways.....

- Undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities.
- The discharge of a toxic or contaminating substance that is likely to have an adverse effect on the natural environment or life.

But the correct definition for pollution is "Any undesirable change in physical, chemical or biological characteristics of air, land, water or soil".

This means that the pollution created centuries back was within the regenerating or carrying capacity of nature. However, industrialization has changed the characteristics of nature beyond what it can recuperate.

Types Of Polution

The major forms of pollution are described below along with the particular pollutant relevant to each of them and its environmental effect:

1. Air Pollution
2. Water Pollution
3. Soil Pollution
4. Solid Waste
5. Visual Pollution
6. Noise Pollution
7. Light Pollution
8. Thermal Pollution
9. Radioactive Contamination

1. Air Pollution

One of the formal definitions of air pollution is as follows - 'The presence in the atmosphere of one or more contaminants in such quality and for such duration as is injurious, or tends to be injurious, to human health or welfare, animal or plant life'. It is the contamination of air by the discharge of harmful substances. Air pollution can cause health problems and it can also damage the environment and property. It has caused thinning of the protective ozone layer of the atmosphere, which is leading to climate change.

Common examples include carbon monoxide, sulfur dioxide, chlorofluorocarbons (CFCs), and nitrogen oxides produced by industry and motor vehicles. Photochemical ozone and smog are created as nitrogen oxides and hydrocarbons react to sunlight.

The substances that cause air pollution are called air pollutants. Pollutants that are pumped into our atmosphere and directly pollute the air are called primary pollutants. Primary pollutant examples include carbon monoxide from car exhausts and sulfur dioxide from the combustion of coal.

Further pollution can arise if primary pollutants in the atmosphere undergo chemical reactions. The resulting compounds are called secondary pollutants. Photochemical smog is an example of this.

1.1 Sources and Causes

The source of pollution may be in one country but the impact of pollution may be felt elsewhere. The discovery of pesticides in Antarctica, where they have never been used, suggests the extent to which aerial transport can carry pollutants from one place to another. Probably the most important natural source of air pollution is volcanic activity, which at times pours great amounts of ash and toxic fumes into the atmosphere. The eruptions of such volcanoes as Krakatoa in Indonesia, Mt. St. Helens in Washington, USA and Katmai in Alaska, USA, have been related to measurable climatic changes.

Motor vehicle emissions are one of the leading causes of air pollution. China, United States, Russia, Mexico, and Japan are the world leaders in air pollution emissions; however, Canada is the number two country, ranked per capita. Principal stationary pollution sources include chemical plants, coal-fired power plants, oil refineries, petrochemical plants, nuclear waste disposal activity, incinerators, large livestock farms (dairy cows, pigs, poultry, etc.), PVC factories, metals production factories, plastics factories, and other heavy industry.

1.2 Air Pollutants

TABLE 1.1:- THE COMPOSITION OF CLEAN DRY AIR, AND THE APPROXIMATE TOTAL MASS OF DIFFERENT ATMOSPHERIC CONSTITUENTS

	CONCENTRATION (VOLUME PERCENT)	TOTAL MASS (MILLIONS OF TONS)
Major Components		
Nitrogen (N_2)	78.09	4,220,000,000
Oxygen (O_2)	20.95	1,290,000,000
Argon (Ar)	0.93	72,000,000
Carbon dioxide (CO_2)	0.032	2,700,000
Minor Components		
Neon (Ne)	0.0018	70,000
Helium (He)	0.00052	4,000
Methane (CH_4)	0.00015	4,600
Krypton (Kr)	0.0001	16,200
Hydrogen (H_2)	0.00005	190
Nitrous oxide (N_2O)	0.00002	1,700

Carbon monoxide (CO)	0.00001	540,
Xenon (Xe)	0.000008	2,000
Ozone (O_3)	0.000002	190
Ammonia (NH_3)	0.0000006	21
Nitrogen dioxide (NO_2)	0.0000001	9
Nitric oxide (NO)	0.00000006	3
Sulfur dioxide (SO_2)	0.00000002	2
Hydrogen sulfide (H_2S)	0.00000002	1

http://www.umich.edu/~gs265/society/pollution.htm

Listed below are the major air pollutants and their sources.

Carbon monoxide (CO) is a colorless, odorless gas that is produced by the incomplete burning of carbon-based fuels including petrol, diesel and wood. It is also produced from the combustion of natural and synthetic products such as cigarettes. It lowers the amount of oxygen that enters our blood. It can slow our reflexes and make us confused and sleepy.

Carbon dioxide (CO2) is the principal greenhouse gas emitted as a result of human activities such as the burning of coal, oil, and natural gases.

Chlorofluorocarbons (CFC) are gases that are released mainly from air-conditioning systems and refrigeration. When released into the air, CFCs rise to the stratosphere, where they come in contact with few other gases, which lead to a reduction of the ozone layer that protects the earth from the harmful ultraviolet rays of the sun.

Lead is present in petrol, diesel, lead batteries, paints, hair dye products, etc. Lead affects children in particular. It can cause nervous system damage and digestive problems and, in some cases, cause cancer.

Ozone occurs naturally in the upper layers of the atmosphere. This important gas shields the earth from the harmful ultraviolet rays of the sun. However, at the ground level, it is a pollutant with highly toxic effects. Vehicles and industries are the major source of ground-level ozone emissions. Ozone makes our eyes itch, burn, and water. It lowers our resistance to colds and pneumonia.

Nitrogen oxide (NO_x) causes smog and acid rain. It is produced from burning fuels including petrol, diesel, and coal. Nitrogen oxides can make children susceptible to respiratory diseases in winters.

Suspended Particulate Matter (SPM) consists of solids in the air in the form of smoke, dust, and vapour that can remain suspended for extended periods and is also the main source of haze which reduces visibility. PM (liquid or solid particles) dispersed in air is generally classified as ultra fine (size less than 0.1 mm), fine (0.7-1 mm) and coarse (1-200 mm). The finer of these particles, when breathed in can lodge in our lungs and cause lung damage and respiratory problems.

Sulphur dioxide (SO_2) is a gas produced from burning coal, mainly in thermal power plants. Some industrial processes, such as production of paper and smelting of metals, produce sulphur dioxide. It is a major contributor to smog and acid rain. Sulfur dioxide can lead to lung diseases.

Table 1.2: National Ambient Air Quality Standards* in India

Pollutant	Time Weighted Average	Concentration in Ambient Air		
		Industrial Area	Residential, Rural and Other	Sensitive Area
Sulphur Dioxide (SO_2)	Annual 24 hours	80 µg/m3 120 µg/m3	60 µg/m3 80 µg/m3	15 µg/m3 30 µg/m3
Oxides of Nitrogen (NO_2)	Annual 24 hours	80 µg/m3 120 µg/m3	60 µg/m3 80 µg/m3	15 µg/m3 30 µg/m3
Suspended Particulate Matter (SPM)	Annual 24 hours	360 µg/m3 500 µg/m3	140 µg/m3 200 µg/m3	70 µg/m3 100 µg/m3
Respirable** Particulate Matter (RPM)	Annual 24 hours	120 µg/m3 150 µg/m3	60 µg/m3 100 µg/m3	50 µg/m3 75 µg/m3
Lead (Pb)	Annual 24 hours	1.0 µg/m3 1.5 µg/m3	0.75 µg/m3 1.00 µg/m3	0.50 µg/m3 0.75 µg/m3
Carbon Monoxide(CO)	8 hours 1 hour	5.0 µg/m3 10.0 µg/m3	2.0 µg/m3 4.0 µg/m3	1.0 µg/m3 2.0 µg/m3

* Ministry of Environment and Forests, Government of India notification, 1994

** Particle size less than 10 µm

1.3 Societal Effects:

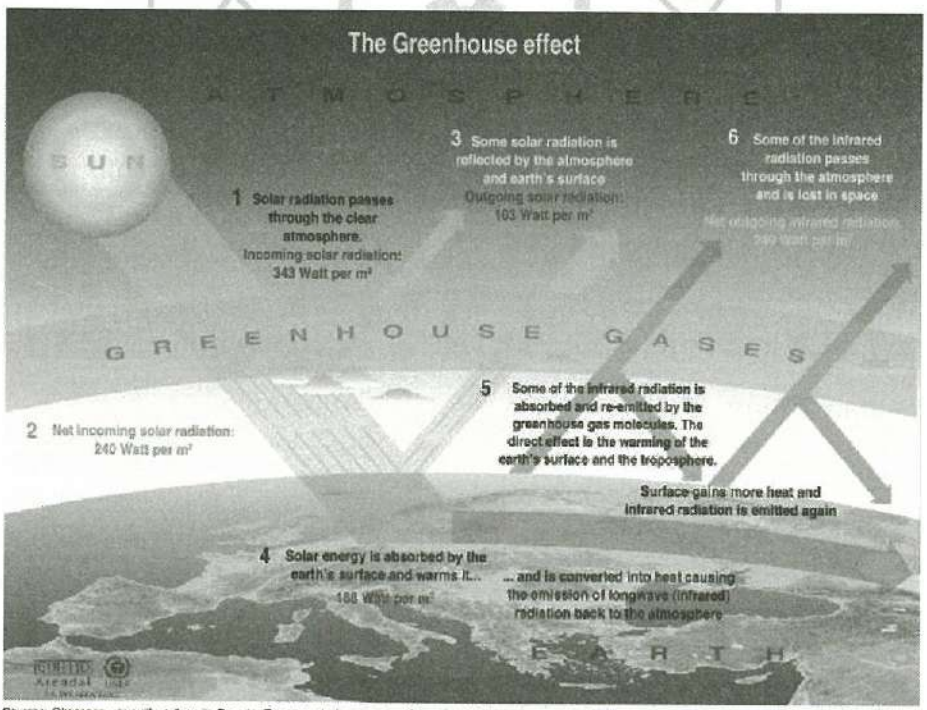
People are mostly oblivious to the effects of air pollution. They know it's out there and it is a problem but excepting skin cancer, there have been very few deaths with a direct link to air pollution. It is probably because of this that people aren't as concerned with air pollution as they should be. Air pollution has always been around, and has actually been on a decline since the 1960s (when coal was the major source of energy). It is relatively easy to decrease the amount of pollutants we emit (each year new laws arise that crack down on the amount of certain substances that can be released into the air), but the harm has already been done, and next to impossible to fix. The ozone layer is the part of the atmosphere that keeps ultraviolet rays from penetrating humans and plants. But because of all the air pollution, various chemicals are slowly destroying the ozone layer. Each year the concentration of

the ozone decreases by approximately two percent and the ozone layer over the South Pole is already fifty percent of its natural concentration. Ozone depleters (the majority of which are chlorofluorocarbons or CFCs) react with ultraviolet radiation and break down into their component atoms, especially chlorine, bromine and fluoride. These component atoms then go on to steal an oxygen atom from the ozone layer (opposite to the reaction which forms O3), thereby destroying the ozone layer.

This loss of protection from UV rays can result in an increase of human skin cancer, damage to various parts of the eyes as well as cause a breakdown of the immune system. With health being such a major issue in our society today, people have become scared by this "outbreak" of cancer. People know that the ozone layer is slowing depleting and that there is a health risk involved with being in the sun for extended periods of time. But very few people know that there is a connection between this breakdown of the ozone layer and air pollution. Instead of trying to control pollution emissions they just cut back on their time outdoors, or wear more sunscreen. Ultraviolet rays can also cause major environmental problems. These rays enter the atmosphere and can kill small aquatic organisms, such as plankton. When these small life forms decompose they release carbon dioxide, CO2, another gas which can cause the ozone layer to break down, thus resulting in a continuous cycle.

Another danger of air pollutants is that before their concentration rises high enough in the atmosphere to break down the ozone layer, they are the leading cause of the greenhouse effect.

To understand GH effect first, we need to understand how the earth's temperature is regulated **(Refer Fig 1.1 for the Greenhouse Effect).**



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography, United States Environmental Protection Agency (EPA), Washington: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Fig 1.1 :- The Greenhouse Effect

www.joabbess.com/.../

The Earth absorbs the heat energy of sunshine mainly at the surface in the form of visible light and nearby wavelength. To maintain a steady temperature, a balancing amount of energy is then radiated upwards from the surface at longer, infrared wavelengths. Some of the gases in the atmosphere which are present naturally, particularly water vapour, carbon dioxide and methane, absorb some of this infrared radiation so acting as 'blankets' over the surface. They pass the absorbed heat to other atmospheric gases through molecular collisions. The greenhouse gases also radiate in the infrared range. Radiation is emitted both upward, with part escaping to space, and downward toward Earth's surface. The surface and lower atmosphere are warmed by the part of the energy that is radiated downward, making our life on earth possible.

Close control is thereby kept on global temperature, with the Earth's surface nearly 30°C warmer than it would otherwise be, providing an average climate for the Earth very suitable for human life. It is called the 'greenhouse effect' because the glass in a greenhouse possesses similar properties to the atmosphere.

Other GHG's with their Global Warming Potential (GWP) accounted in terms of their CO_2 equivalent are given in table below:

Table 1.3: - Global Warming Potential of GHG

Gas	GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydro-fluorocarbons (HFC)	11700
Perfluorocarbon (PFC)	9500
Sulphur Hexafluoride (SF_6)	23900

http://www.cogeneration.net/Global_Warming_Potential.htm

Increases in the amount of gases such as carbon dioxide in the atmosphere are occurring because of emissions from human activities such as the burning of fossil fuels (coal, oil and gas) or through deforestation. These increases are sufficient to lead on average to substantially increased warming.

Over the past 200 years human activities have increased the amount of carbon dioxide in the atmosphere by over 30% - well beyond the range of its natural variation during the last million years or more. If the increase continues and if adequate action is not taken to stem it, the atmospheric carbon dioxide content will reach double its pre-industrial value during the 21st century.

As a result the average rate of warming of the climate is expected to be greater than at any time during the last 10,000 years. This is not necessarily bad; some communities may experience a net benefit. But many ecosystems and humans will find it difficult to adjust to this rapid rate of change.

These are some of the effects of pollution that our society is actively worried about. The subject of the greenhouse effect is highly publicized and therefore people know about the risks concerning this topic.

Even though people know about the greenhouse effect, they fail once again, to see the why behind this event. People believe that the greenhouse effect is due to the ozone layer breaking down and in turn more ultraviolet rays enter our atmosphere which is the reason the temperature is increasing. Although this belief isn't entirely accurate it is close enough for our purposes. As in the case with the problems of the ozone layer, society fails to see that this is all a result of air pollution.

2 Water pollution

Water pollution is the presence of any material in the water that is harmful to plants or animals, or affects its taste and odor, or detracts from any use that can be made of it.

When toxic substances enter lakes, streams, rivers, oceans, and other water bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water whereby the quality of the water deteriorates, affecting aquatic ecosystems. Pollutants can also seep down and affect the groundwater deposits.

2.1 Source and Causes

Sources of Water pollution are surface runoff, leaching to groundwater, liquid spills, wastewater discharges, eutrophication and littering.

Unlike air pollution where the leading emission factors are natural, water pollution is mostly caused by human involvement. There have been many ways scientists have looked at the human effect on water systems. There are many areas of polluting substances that cause disruption or change in the chemical make up of the world's waters, and affect the aquatic environment. Several areas overlap with one another. Some basic pollutants include, oxygen using wastes, radioactive material, sediments and inorganic chemicals. Other well-documented water pollutants include oil (i.e. tanker spills), synthetic organic compounds (i.e. pesticides) and toxic metals (i.e. mercury).

Water pollution has many sources. The most polluting of them are the city sewage and industrial waste discharged into the rivers. The facilities to treat wastewater are not adequate in any city in India. Presently, only about 10% of the wastewater generated is treated; the rest is discharged as it is into water bodies. Due to this, pollutants enter groundwater, rivers, and other water bodies. Such water, which ultimately ends up in our households, is often highly contaminated and carries disease-causing microbes. Agricultural run-off, or the water from the fields that drains into rivers, is another major water pollutant as it contains fertilizers and pesticides.

Domestic sewage refers to waste water that is discarded from households. Also referred to as sanitary sewage, such water contains a wide variety of dissolved and suspended impurities.

It amounts to a very small fraction of the sewage by weight. But it is large by volume and contains impurities such as organic materials and plant nutrients that tend to rot. The main organic materials are food and vegetable waste, plant nutrient come from chemical soaps, washing powders, etc. Domestic sewage is also very likely to contain disease-causing microbes. Thus, disposal of domestic waste water is a significant technical problem. Sewage generated from the urban areas in India has multiplied manifold since 1947.

Today, many people dump their garbage into streams, lakes, rivers, and seas, thus making water bodies the final resting place of cans, bottles, plastics, and other household products. The various substances that we use for keeping our houses clean add to water pollution as they contain harmful chemicals. In the past, people mostly used soaps made from animal and vegetable fat for all types of washing. But most of today's cleaning products are synthetic detergents and come from the petrochemical industry. Most detergents and washing powders contain phosphates, which are used to soften the water among other things. These and other chemicals contained in washing powders affect the health of all forms of life in the water.

Agricultural Run off

The use of land for agriculture and the practices followed in cultivation greatly affect the quality of groundwater. Intensive cultivation of crops causes chemicals from fertilizers (e.g. nitrate) and pesticides to seep into the groundwater, a process commonly known as leaching. Routine applications of fertilizers and pesticides for agriculture and indiscriminate disposal of industrial and domestic wastes are increasingly being recognized as significant sources of water pollution.

The high nitrate content in groundwater is mainly from irrigation run-off from agricultural fields where chemical fertilizers have been used indiscriminately.

Industrial effluents

Wastewater from manufacturing or chemical processes in industries contributes to water pollution. Industrial wastewater usually contains specific and readily identifiable chemical compounds. During the last fifty years, the number of industries in India has grown rapidly. But water pollution is concentrated within a few sub sectors, mainly in the form of toxic wastes and organic pollutants. Out of this, a large portion can be traced to the processing of industrial chemicals and to the food products industry. In fact, a number of large- and medium-sized industries in the region covered by the Ganga Action Plan do not have adequate effluent treatment facilities. Most of these defaulting industries are sugar mills, distilleries, leather processing industries, and thermal power stations. Most major industries have treatment facilities for industrial effluents. But this is not the case with small-scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender.

2.2 Water pollutants

Oil is made up of crude petroleum and refined petroleum products such as gasoline. Crude petroleum is made up of an integral mix of compounds of hydrocarbons and refined petroleum, the actual effective pollutant, is a simpler mix of "fewer components." Oil pollution results from normal tanker operations, offshore oil productions, oil waste in sewage systems and spills. Oils spills are the most public of mass water pollution (i.e. Exxon Valdez) and have both long and short-term effects on regional waters. 25% of spilled oil evaporates in the first days after the spill and through several other processes. Emulsification is the distribution of a liquid into another liquid. There are two main emulsification processes that can happen in the water and two consequences for living organisms. In oil pollution there is oil-in-water and water-in-oil. The former is stabilized throughout the chemical action between the water and oil, not only at the surface but throughout the body of water as well.

It can sink to the bottom, which involves the sediments in the ocean floor. Water-in-oil is more commonly seen in "flushing" which is a spread on the surface and what is most commonly seen lying on the surface of the water after a spill. Oil is also picked up by aquatic organisms and other aquatic life. Oxidation occurs as oil is a oxygen consuming waste and is quickly photo oxidized by microorganism providing the strongest source of degradation. Oxygen up-take in needy organisms is thus slowed down in this way.

Toxic metals are made up of heavy metals, light metals, and trace metals. Heavy metals have five times the density of water, whereas light metals have less. Heavy metals are made up of seven basic elements that are found frequently in the Earth in aquatic and terrestrial environments. Trace metals display natural compounds of metal. The latter carry more contaminants than the heavy metals because of their great effects on living organisms. As Table: 1.4 shows, metals in certain quantities are needed. Some trace metals, although involved in the soil and water cycle, have small concentrations and it is when the concentrations are too high that they contaminate and pollute water. They are transmitted through direct use of mining in ores, in the burning of fossil fuels. The trace elements end up in water systems through atmospheric rain, agricultural run-off, mining wastes and domestic sewage. One the key factors of metal pollution is that they cannot biologically or chemically breakdown in nature. This stability also lets them be carried long distances through air and water. Mercury has shown to be a good example of how contamination of trace metals has severe effects and will be discussed in the next section on effects on society **(Refer Table 1.4: METALS ESSENTIAL TO LIFE).**

Table 1.4:- METALS ESSENTIAL TO LIFE

ELEMENT	COMMENTS
Light Abundant Metals	
Sodium	Principal extra cellular cation
Magnesium	Activates many enzymes
Potassium	Principal cellular cation
Calcium	Major component of bone; required for some enzymes
Heavy Trace Metals	
Vanadium	Essential in lower plants, certain marine animals and humans
Chromium	Essential in higher animals, related to insulin activity
Manganese	Activates several enzymes
Iron	Most important transition metal ion: essential in hemoglobin and many enzymes
Cobalt	Activates several enzymes, in vitamin B12
Copper	Essential in oxidative and other enzymes and hemocyanin
Zinc	Activates many enzymes
Molybdenum	Activates several enzymes
Tin	Essential in rats; function unknown

Synthetic organic pesticides are compounds that include insecticides, fungicides, and other pests that inhibit human conduct. There are chlorophenoxy acids, organophosphates, carbamates and chlorinated hydrocarbons. Discussing chlorinated hydrocarbons, the most dominant of these pollutants, is necessary because of their persistence or staying power. They resist breakdown for approximately two years before they disappear. Because of the great length of time that is required for degradation these hydrocarbons can invade areas of the environment they were not meant for and spread into soils, runoffs and water environments. Their toxic effects on living organisms pervade fatty membranes around nerves and disrupt the movement of ions between the fibers.

Several different kinds of waste are **oxygen consumer.** There is a certain concentration of oxygen needed in the world's oceans to support life. However, when waste is present in the water that is easily broken down by the presence of oxygen, it decomposes first and this lowers the oxygen levels necessary to sustain the "natural biota" for that water. Radioactive materials escape from ore processing, nuclear power plants and use of nuclear weapons. Just as radioactivity has harmful effects on humans these effects translate to aquatic life and invade water supplies around the world if not properly contained.

2.3 Societal Effects

Society's main concern with water pollution has mostly been realized through our own concern for drinking water. Contaminants of all kind have been studied for possible harm on humans, and subsequent discoveries led to seeing the effects on other life in water. Water as a carrier of pathogenic organisms that can put health at risk was the primary reason for pollution control. More recently pollution was personalized when Americans saw pictures of seals and other sea life drowning in oil slick from spills, with drastic consequences. Water birds can often be so covered in oil slick that they can no longer fly and feathers lose their insulation properties in cool water temperatures. Many surrounding plant life on the shoreline are also coated and vegetation rates decrease. Photosynthesis of plants is also affected below the water, where light intensity is decreased by 90%, two meters below the surface because of oil "flushing". Long-term effects, although still being studied, are based on the chemical messaging that is adversely affected by oil compounds in the water. Similarly they also might be involved and enter in the marine food chain. These facts helped increase awareness, inform the public and change policy on oil tanker practices.

In this same manner, DDT decades after its discoverer Paul Mueller won the Nobel Price for chemistry because of its insecticidal properties, was shown causing severe damage in water life systems. Nevertheless an abundance of pesticides of all kinds are still used in many areas and often are hard to contain in specific areas. As for metals, Mercury has wrought the largest scare to humans as its toxic effects from our actions have had repercussions. Mercury is used in three major ways by human processing electrical apparatus, chlor-alkali industry, and paint. Humans are exposed to mercury through production of other elements, the burning of coal, and the accelerated weathering of rocks and soils. Although there are different compounds of mercury affecting different aspects of body processes, there are also central breakdowns. Toxic action occurs through the binding of sulfur molecules in enzymes and cell walls that inhibit normal activity and depending on amount paralyzes or kills. All damage is permanent. Humans' greatest risk is through food poisoning. This was shown in the "Minamata disease" where 44 people died and more were paralyzed because of eating contaminated

shellfish and other fish. Because of the biological amplification of mercury in aquatic life and in humans, the methyl mercury wastes from a shoreline plastics factory increased the mercury amount in the fish in great amounts.

The effects of water pollution are not only devastating to people but also to animals, fish, and birds. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of lakes and rivers. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. Eventually, it is a hazard to human health. Nobody can escape the effects of water pollution.

The individual and the community can help minimize water pollution. By simple housekeeping and management practices the amount of waste generated can be minimized.

3 Soil contaminations

Soil contamination is the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage tanks, application of pesticides, percolation of contaminated surface water to subsurface strata, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. The occurrence of this phenomenon is correlated with the degree of industrialization and intensity of chemical usage.

3.1 Sources and Causes

Soil contamination can come from widespread sources or from concentrated, localized sources.

Industrial pollution is often accidental, caused by spillage during loading/unloading, broken pipes, etc. However, it is sometimes chronic and more insidious, for example when an underground tank leaks for years or small amounts of liquid spill onto a cracked cement slab week after week.

There are many kinds of soil contaminants depending on the type of pollution as shown in Table 1.5.

Table 1.5:- Soil Contaminants and their source.

Pollution source	Contaminants
Spreading of processed municipal and industrial sludge and liquid manure	Nitrates, phosphates, heavy metals
Use of pesticides and herbicides Industry	More or less persistent compounds Heavy metals, hydrocarbons, acids, solvents, tar, radioactive substances, other more or less persistent compounds, etc.
Fall-out from urban and industrial atmospheric pollution	Heavy metals, dioxins, acids, etc ...
Hydrocarbon storage (from gas stations to oil depots)	Hydrocarbons

Landfills	Heavy metals, microorganisms, acids, various chemical products associated with industrial waste, etc
Ammunition depots, former battlefields	Complex and persistent compounds

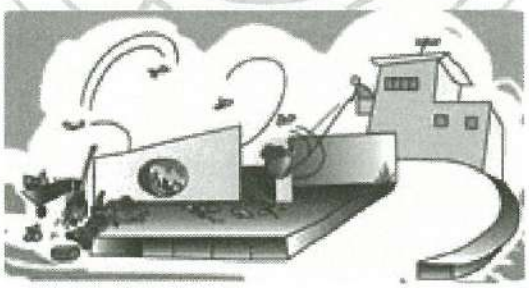
3.2 Societal effects

The major concern is that there are many sensitive land uses where people are in direct contact with soils such as residences, parks, schools and playgrounds. Other contact mechanisms include contamination of drinking water or inhalation of soil contaminants which have vaporized. There is a very large set of health consequences from exposure to soil contamination depending on pollutant type, pathway of attack and vulnerability of the exposed population. Chromium and many of the pesticide and herbicide formulations are carcinogenic to all populations. Lead is especially hazardous to young children, in which group there is a high risk of developmental damage to the brain and nervous system, while to all populations kidney damage is a risk.

Chronic exposure to benzene at sufficient concentrations is known to be associated with higher incidence of leukemia. Mercury and cyclodienes are known to induce higher incidences of kidney damage, some irreversible. PCBs and cyclodienes are linked to liver toxicity. Organophosphates and carbamates can induce a chain of responses leading to neuromuscular blockage. Many chlorinated solvents induce liver changes, kidney changes and depression of the central nervous system. There is an entire spectrum of further health effects such as headache, nausea, fatigue, eye irritation and skin rash for the above cited and other chemicals. At sufficient dosages a large number of soil contaminants cause death.

4 Solid Waste

What is solid waste?



Since the beginning, humankind has been generating waste, be it the bones and other parts of animals they slaughter for their food or the wood they cut to make their carts. With the progress of civilization, the waste generated became of a more complex nature. At the end of the 19th century the industrial revolution saw the rise of the world of consumers. Not only did the air get more and more polluted but the earth itself became more polluted with the generation of nonbiodegradable solid waste. The increase in population and urbanization was also largely responsible for the increase in solid waste.

Each household generates garbage or waste day in and day out. Items that we no longer need or do

not have any further use for, fall in the category of waste, and we tend to throw them away. There are different types of solid waste depending on their source. In today's polluted world, learning the correct methods of handling the waste generated has become essential. Segregation is an important method of handling municipal solid waste. One of the important methods of managing and treating wastes is composting.

4.1 Sources and Causes

Solid waste can be classified into different types depending on their source:

a) Household waste is generally classified as municipal waste,

b) Industrial waste as hazardous waste, and

c) Biomedical waste or hospital waste as infectious waste.

Municipal solid waste

Municipal solid waste consists of household waste, construction and demolition debris, sanitation residue, and waste from streets. This garbage is generated mainly from residential and commercial complexes. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing. In 1947, cities and towns in India generated an estimated 6 million tones of solid waste, in 1997, it was about 48 million tones. More than 25% of the municipal solid waste is not collected at all; 70% of the Indian cities lack adequate capacity to transport it and there are no sanitary landfills to dispose of the waste. The existing landfills are neither well equipped nor well managed and are not lined properly to protect against contamination of soil and groundwater.

Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminum foils, plastics, and other such nonbiodegradable items that cause incalculable harm to the environment. In India, some municipal areas have banned the use of plastics and they seem to have achieved success. For example, today one will not see a single piece of plastic in the entire district of Ladakh where the local authorities imposed a ban on plastics in 1998. Other states should follow the example of this region and ban the use of items that cause harm to the environment. One positive note is that in many large cities, shops have begun packing items in reusable or biodegradable bags. Certain biodegradable items can also be composted and reused. In fact proper handling of the biodegradable waste will considerably lessen the burden of solid waste that each city has to tackle.

There are different categories of waste generated, each take their own time to degenerate as illustrated in the Table: 1.6 below.

Table 1.6:-The type of litter we generate and the approximate time it takes to degenerate

Type of litter	Approximate time it takes to degenerate the litter
Organic waste such as vegetable and fruit peels, leftover foodstuff, etc.	a week or two.
Paper	10-30 days
Cotton cloth	2-5 months
Wood	10-15 years
Woolen items	1 year
Tin, aluminum, and other metal items such as cans	100-500 years
Plastic bags	one million years?
Glass bottles	undetermined

http://coe.mse.ac.in/solitewaste.asp

Hazardous waste

Hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment. The universe of hazardous wastes is large and diverse. Hazardous wastes can be liquids, solids, contained gases, or sludge's.

Industrial and hospital waste is considered hazardous as they may contain toxic substances. Certain types of household waste are also hazardous. Hazardous wastes could be highly toxic to humans, animals, and plants; are corrosive, highly inflammable, or explosive; and react when exposed to certain things e.g. gases. India generates around 7 million tones of hazardous wastes every year, most of which is concentrated in four states: Andhra Pradesh, Bihar, Uttar Pradesh, and Tamil Nadu.

Household wastes that can be categorized as hazardous waste include old batteries, shoe polish, paint tins, old medicines, and medicine bottles.

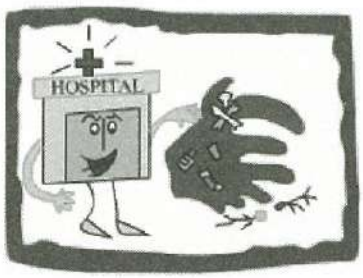
Hospital waste contaminated by chemicals used in hospitals is considered hazardous. These chemicals include formaldehyde and phenols, which are used as disinfectants, and mercury, which is used in thermometers or equipment that measure blood pressure. Most hospitals in India do not have proper disposal facilities for these hazardous wastes.

In the industrial sector, the major generators of hazardous waste are the metal, chemical, paper, pesticide, dye, refining, and rubber goods industries.

Direct exposure to chemicals in hazardous waste such as mercury and cyanide can be fatal. Waste

products from nuclear power stations etc. are becoming a serious problem. They should be put where the radiation can do no harm. Unfortunately, there is no way of stopping a radioactive nucleus from emitting radiation.

Hospital waste



Hospital waste is generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities in these fields or in the production or testing of biological. It may include wastes like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc. These are in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific and discriminate manner. It has been roughly estimated that of the 4 kg of waste generated in a hospital at least 1 kg would be infected.

Surveys carried out by various agencies show that the health care establishments in India are not giving due attention to their waste management. After the notification of the Bio-medical Waste (Handling and Management) Rules, 1998, these establishments are slowly streamlining the process of waste segregation, collection, treatment, and disposal. Many of the larger hospitals have either installed the treatment facilities or are in the process of doing so.

4.2 Societal effects

Groundwater Contamination

If waste isn't discarded properly on land, when it rains the waste is soaked and is then carried through the landfill, eventually making its way into the water you may drink. Especially dangerous chemicals are volatile organic compounds, or VOCs, which usually come from household cleaners and industrial solvents used in operations like dry cleaning. These compounds have been linked to everything from cancers to birth defects.

Disease Outbreaks

Another danger, especially with open pits, comes from the spread of diseases--usually carried by rodents and bugs. An example of this is malaria, which festers in open areas with standing water and particularly hot and muggy temperatures. In addition, there may be a propensity for people to scavenge wastes in landfills and open pits, which again can create unsanitary conditions and aid the spread of disease.

Habitat Destruction

Disposal locations may encroach upon existing habitat for native flora and fauna, especially when sited in areas near wetlands. In some cases, people have taken steps to reclaim the land by capping the landfill and later attempting to grow vegetation on it.

Climate Change

As waste begins to break down, methane is produced. Methane is considered a greenhouse gases that is responsible for some of the spike in the earth's temperatures.

Air Quality

When wastes are burned, especially toxic chemicals like dioxin, they're released into the surrounding environment and can then cause serious public health risks.

Cumulative Health Effects

Even low concentrations of toxins can eventually build up inside body tissue to become negative to a person's health. Common pesticides such as DDT and Dioxin have low concentrations in water because they are not readily soluble in water, but can dilute within animal fats. In humans, the build up of toxins leads to sickness. Animals can become sick and pass toxins on to predators.

5 Visual pollution

Visual pollution is an aesthetic issue, referring to the impacts of pollution that impair one's ability to enjoy a vista or view. The term is used broadly to cover visibility, limits on the ability to view distant objects, as well as the more subjective issue of visual clutter, structures that intrude upon otherwise "pretty" scenes, as well as graffiti and other visual defacement.

Visual pollution, can refer to the presence of overhead power lines, motorway billboards, scarred landforms (as from strip mining), open storage of trash or municipal solid waste.

5.1 Sources and Causes

Visibility is a measure of how far and how well people can see into the distance. Haze obscures visibility. It is caused when light is absorbed or scattered by pollution particles such as sulfates, nitrates, organic carbon compounds, soot, and soil dust. Nitrogen dioxide and other pollution gases also contribute to haze. Haze increases with summer humidity because sulfate and other particles absorb moisture and increase in size. The larger the particles, the more light they scatter.

Utility boilers and vehicular emissions are both major sources of haze-causing pollution. The haze problem is greatest on the east coast of the United States because of the higher levels of pollution and humidity in that region. The pollution that causes haze can travel thousands of miles, and improving regional visibility requires interstate cooperation. Wood smoke is a contributor in the west, and forest fire smoke and windblown dusts are natural sources of haze.

Visual blight-billboards, power lines, cell towers, even ugly buildings-is literally in the eye of the

beholder. It is subjective. To the businessman, a well-placed billboard may be a thing of beauty. But to the traveler whose view of the rolling hills or the rustic village is obstructed, it is visual pollution.

5.2 Societal Effects

Haze is most dramatically seen as a brownish-grey cloud hovering over cities, but it also obscures many beautiful vistas in U.S. national parks. At Acadia National Park in Maine, visual range on a clear day can be 199 miles. On a hazy day, that can be reduced to 30 miles. At its worst, haze at Grand Canyon National Park was so severe that people could not see across the 10-mile wide canyon. An enormous coal-fired electric plant, the Navajo Power Generating Station, about 80 miles north of the Grand Canyon, was thought to be the source of the pollution causing canyon haze. In 1985 researchers at Colorado State University injected methane-containing deuterium into the power plant's smoke emissions. Deuterium is not normally present in the air. When monitors determined the presence of deuterium in canyon air, researchers were able to demonstrate that the plant was responsible for much of the canyon haze. The result was a landmark settlement in which Navajo's owners agreed to a 90-percent cutback in sulfur dioxide emissions by 1999.

The pollutants that cause haze are also a health concern because they often result in respiratory problems among humans and other species. Controls designed to reduce the pollution from vehicular and smokestack emissions will also reduce visual pollution.

In Southeast Asia, haze caused by massive forest fires cost billions of dollars in health care and lost tourist revenue in the last decade. Fires in Sumatra and Borneo affected not only Indonesia, but also Malaysia, Singapore, and Thailand. Most fires were set deliberately, and often illegally, to clear land for planting and development and to cover up illegal logging. Some of the fires spread to peat deposits beneath the forest, and these may continue to burn for years.

Fig 1.2:- Example of Visual Pollution at Los Angeles

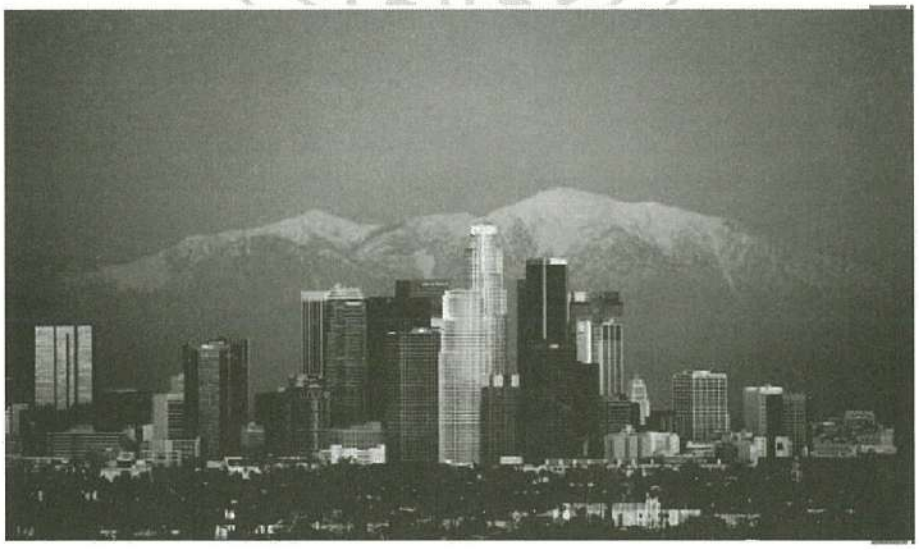


Fig 1.2 A:- The Los Angeles skyline with mountain peaks visible in the background

Fig 1.2 B: - A similar perspective of the Los Angeles skyline, but with much of the scenery obscured by smog.

Billboards proliferated in the 1940s and 1950s, spurred by the growth of automobile traffic and construction of interstate highway system, but in 1965 Lady Bird Johnson, wife of President Lyndon Johnson, attacked their growing presence on nation's roadways. "Ugliness is so grim," the first lady proclaimed, and she fought for and won passage of the Highway Beautification Act of 1965. This groundbreaking law prompted a number of states, including Alaska, Hawaii, Maine and Vermont, to ban billboards totally; there were loopholes, however.

Sensitivity to visual pollution has led utility companies to bury power and telephone lines in some communities. The latest fight against visual pollution centers on cell towers, needed to provide cellular telephone service.

One solution has been to disguise cell towers as trees or cacti. Graffiti, spray-painted names and messages, are a form of urban visual blight. Attempts to curb graffiti by banning the sale of spray paint to minors have had little effect.

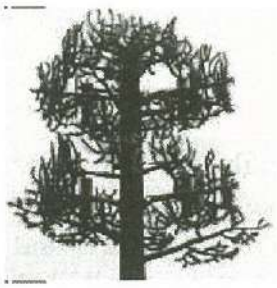


Fig 1.4:- The top of a ninety-five-foot-tall wireless phone antenna made to look like a cypress tree, blending with the other cypress trees in Metairie, Louisiana, and neighborhood. (AP/Wide World Photos.)

6 Noise Pollution

Noise pollution (or environmental noise) is displeasing human-, animal- or machine-created sound that disrupts the activity or balance of human or animal life. The word noise comes from the Latin word **Nausea** meaning seasickness.

6.1 Sources and Causes

The source of most outdoor noise worldwide is transportation systems, including motor vehicle noise, aircraft noise and rail noise. Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential area.

Other sources of indoor and outdoor noise pollution are car alarms, emergency service sirens, office equipment, factory machinery, construction work, grounds keeping equipment, barking dogs, appliances, power tools, lighting hum, audio entertainment systems, loudspeakers, and noisy people

The sources of noise pollution vary. In some places noise from construction projects predominates, while in others it is vehicular traffic or noise from airports. Other sources include the noise in occupational settings or even the noise of simultaneous conversations. It also seems from a number of studies that intermittent noise is more of a problem than noise of a similar intensity which is constant.

6.2 Societal Effects

Noise pollution affects nearly every aspect of life and probably has damaging physical effects as well. The best-studied and best-defined effect on physical health is the effect of noise on hearing. The research results are clear: loud or sustained noise can damage hearing. The source of the noise is not very important; it can be a pile driver or rock music. What is important is that it can have a lasting impact.

Noise pollution also impacts people's sleep. It can result in mood problems and adversely affect job performance.

Several research studies suggest that noise can cause high blood pressure. Others say that psychiatric diseases can be caused by noise. Some of these studies are controversial and are contested by other researchers because so many variables such as age, overall state of health, diet, smoking and drinking habits, socioeconomic factors, and other sources of environmental and social stress must also be taken into account.

It is clear, however, that noise, even though a "non-specific stressor", does cause a physical response. It elicits the same responses as a perceived physical threat would produce: it activates the nervous system, causes the muscles to tense and the heart rate and respiratory rate to increase and prepares the body to fight or to run away. This response-called the "fight or flight" response--underlies all responses to stress.

The long-term effects of this kind of stimulus, of being ready to flee or give battle, are not completely understood. Being continuously under stress is something like sitting on the edge of your chair or

waiting for the other shoe to drop. Your body isn't quite sure what will happen next or how to respond, and that state constant confusion has been implicated in the development of a number of diseases.

It is also important to remember that people who sense that they have some control over what happens in their lives are impacted less strongly by stressors than those who feel they have no control, and noise is something over which we have very little control.

Noise affects us in another significant way: people exposed to noise feel a greater sense of frustration and annoyance than people whose environment is not as noisy. Annoyance is the expression of the negative feelings experienced when one's activities or the enjoyments of one's surroundings are disrupted. Annoyance can have a major impact on the quality of life and is generally a variable examined when studying the impact of noise.

In addition to the other environmental pollutants, noise can affect not only our moods but also our physical well being, and, just like water and air pollution, must be subject to greater study and more stringent controls.

7 Light Pollution

Light pollution is one of the least known types of pollution, but its effects on human health and the environment can be just as serious as some better-known forms of pollution.

The alteration of the natural quantity of light in the night environment due to the introduction of artificial light is a true pollution. "Pollution" means "impairment of the purity of the environment". Light pollution stands for "pollution of the light": pollution of the natural light due to manmade light.

Light pollution is probably best described as artificial light that is allowed to illuminate, or pollute, areas not intended to be lit.

Light pollution is most severe in large cities and other built-up areas, but can be a problem in rural areas as well. Light is one of the most difficult pollutants to identify, because one person's irritating light pollutant is another's expensive billboard, or beautifully lit patio.

7.1 Sources and Causes

There are five basic types of light pollution:

Light Trespass is one of the most annoying. A streetlight or a neighbor's porch light that shine through your window from outside is an example of light trespass.

Glare is a more dangerous type of light pollution. It is caused by excessive contrast between light and dark areas in a field of vision, and it particularly affects road safety. Excessively bright or badly shielded lights can temporarily blind drivers or pedestrians, leading to accidents. Such lighting can also impact on the ecology and wildlife of an area, and affect the behavioral patterns of mammals, birds, insects and fish.

Another form of light pollution that commonly affects road safety is clutter. Clutter refers to excessive groupings of lights, especially bright or flashing lights, which can distract or confuse drivers.

Over-illumination refers simply to the excessive or inefficient use of lighting. Leaving lights on when they are not being used is over-illumination; so is poorly designed lighting that illuminates areas that don't need to be illuminated, or illuminates areas more brightly than necessary.

Sky Glow refers to the "glow" effect that appears over populated areas at night. It is primarily a combination of reflected light from illuminated areas and badly directed light escaping into the sky, where it is scattered by the atmosphere and redirected back at the ground.

Light pollution is an offshoot of industrialization. Lighting, advertising, commercial properties, offices, factories, streetlights, and illuminated sporting venues are some of the sources of light pollution. This form of pollution is most severe in highly industrialized, densely populated areas of North America, Europe, and Japan, but even relatively small amounts of light are enough to cause discomfort and problems.

Artificial light gets up into the sky in two ways. By far the greater proportion of upward light arises because the design or installation of many light fittings allows a significant fraction of the light produced to be emitted above the horizontal, so it goes up into the sky - this is the direct upward light. A much smaller proportion is upward light which is reflected upwards from roads, pavements and buildings - this is the indirect upward light.

7.2 Societal Effects

In addition to the effects on road safety described above, light pollution affects human health in other ways.

Over-illumination both during the day and at night has been shown to lead to increased headaches and anxiety levels, higher levels of worker fatigue and stress, insomnia, and decreased sexual functioning.

Night-time exposure to light reduces the body's natural production of melatonin, an important hormone that helps regulate the immune system and serves as an antioxidant, among other functions. Reduced melatonin levels are believed to be responsible for unusually high rates of cancer in night workers, and women exposed to light at night through bright master bathroom nightlights or similar have increased rates of breast cancer. Unusually low levels of melatonin have also been observed in individuals with autism, though the exact causes and effects of this correlation are unknown at this time.

Light pollution also has environmental effects. Migrating birds, nocturnal moths, and sea turtle hatchlings are among the animals known to be disoriented by excessive illumination, sometimes fatally. At least 4-5 million birds per year are estimated to die due to collisions caused by light pollution.

Light pollution has also been associated with an increase in algae blooms on lakes, which can lower water quality and kill aquatic plants and animals.

Over-illumination is also responsible for significant amounts of energy waste in the United States and around the world, an estimated 2 million barrels of oil per day in the United States alone.

Finally, light pollution is the bane of astronomers both amateur and professional, and they have been instrumental in raising awareness of the problem.

Not all effects of light pollution can be measured. How can one value its loss? How one can measure awe and wonder that a person has on beholding the brilliance and incalculable vastness of the stars at night?

8 Thermal Pollution

The broadest definition of thermal pollution is the degradation of water quality by any process that changes ambient water temperature. Thermal pollution is usually associated with increases of water temperatures in a stream, lake, or ocean due to the discharge of heated water from industrial processes, such as the generation of electricity. Increases in ambient water temperature also occur in streams where shading vegetation along the banks is removed or where sediments have made the water more turbid. Both of these effects allow more energy from the sun to be absorbed by the water and thereby increase its temperature. There are also situations in which the effects of colder-than-normal water temperatures may be observed. For example, the discharge of cold bottom water from deep-water reservoirs behind large dams has changed the downstream biological communities in systems such as the Colorado River.

8.1 Sources and Causes

The sources and causes of thermal pollution are varied, which makes it difficult to calculate the extent of the problem. Also, because the negative effects of thermal pollution may not directly affect human health, it is not as well known as other types of pollution. The nuclear power industry is tightly regulated; therefore, the impact of nuclear power plants on the environment, including its production of thermal pollution, usually in the form of warm water, is better documented. According to the U.S. Energy Information Administration, as of December 31, 2007, there were 104 nuclear power plants operating in the United States. The contribution of less regulated, but possibly more extensive thermal polluters is more difficult to ascertain. These include polluted runoff, or nonpoint source pollution, which may be caused by rainfall or snowmelt washing sediment and pollutants into surrounding bodies of water, and the removal of vegetation from the banks of rivers or coastal areas.

The major sources of thermal pollution are electric power plants and industrial factories. In most electric power plants, heat is produced when coal, oil, or natural gas is burned or nuclear fuels undergo fission to release huge amounts of energy. This heat turns water to steam, which in turn spins turbines to produce electricity. After doing its work, the spent steam must be cooled and condensed back into water. To condense the steam, cool water is brought into the plant and circulated next to the hot steam. In this process, the water used for cooling warms 5 to 10 Celsius degrees (9 to 18 Fahrenheit degrees), after which it may be dumped back into the lake, river, or ocean from which it came. Similarly, factories contribute to thermal pollution when they dump water used to cool their machinery.

8.2 Societal Effects

The primary effects of thermal pollution are direct thermal shock, changes in dissolved oxygen, and the redistribution of organisms in the local community. Because water can absorb thermal energy with only small changes in temperature, most aquatic organisms have developed enzyme systems that operate in only narrow ranges of temperature. These stenothermic organisms can be killed by sudden temperature changes that are beyond the tolerance limits of their metabolic systems. The cooling water discharges of power plants are designed to minimize heat effects on local fish communities. However, periodic heat treatments used to keep the cooling system clear of fouling organisms that clog the intake pipes can cause fish mortality. A heat treatment reverses the flow and increases the temperature of the discharge to kill the mussels and other fouling organisms in the intake pipes. Southern California Edison had developed a "fish-chase" procedure in which the water temperature of the heat treatment is increased gradually, instead of rapidly, to drive fish away from the intake pipes before the temperature reaches lethal levels. The fish chase procedure has significantly reduced fish kills related to heat treatments.

Small chronic changes in temperature can also adversely affect the reproductive systems of these organisms and also make them more susceptible to disease. Cold water contains more oxygen than hot water so increases in temperature also decrease the oxygen-carrying capacity of water. In addition, raising the water temperature increases the decomposition rate of organic matter in water, which also depletes dissolved oxygen. These decreases in the oxygen content of the water occur at the same time that the metabolic rates of the aquatic organisms, which are dependent on a sufficient oxygen supply, are rising because of the increasing temperature.

The composition and diversity of communities in the vicinity of cooling water discharges from power plants can be adversely affected by the direct mortality of organisms or movement of organisms away from unfavorable temperature or oxygen environments. A nuclear power-generating station on Nanwan Bay in Taiwan caused bleaching of corals in the vicinity of the discharge channel when the plant first began operation in 1988. Studies of the coral Acropora grandis in 1988 showed that the coral was bleached within two days of exposure to temperatures of 91.4°F. In 1990 samples of coral taken from the same area did not start bleaching until six days after exposure to the same temperature. It appears that the thermo tolerance of these corals was enhanced by the production of heat-shock proteins that help to protect many organisms from potentially damaging changes in temperature. The populations of some species can also be enhanced by the presence of cooling water discharges. The only large population of sea turtles in California, for example, is found in the southern portion of San Diego Bay near the discharge of an electricity generating station.

9 Radioactive Contaminations

When an uncontrolled distribution of radioactive material is given in the environment it is called radioactive contamination. This distribution is also given accidentally or slowly through any process which uses radioactive matters. The biological effects of internally deposited radionuclides depend greatly on the activity and the biodistribution and removal rates of the radionuclide, which in turn depends on its chemical form. The biological effects may also depend on the chemical toxicity of the deposited material, independent of its radioactivity.

9.1 Sources and causes

Radioactive contamination is typically the result of a spill or accident during the production or use of radionuclides (radioisotopes), an unstable nucleus which has excessive energy. Contamination may occur from radioactive gases, liquids or particles. For example, if a radionuclide used in nuclear medicine is accidentally spilled, the material could be spread by people as they walk around. Radioactive contamination may also be an inevitable result of certain processes, such as the release of radioactive xenon in nuclear fuel reprocessing. In cases that radioactive material cannot be contained, it may be diluted to safe concentrations. Nuclear fallout is the distribution of radioactive contamination by a nuclear explosion. Containment is what differentiates radioactive material from radioactive contamination. Therefore, radioactive material in sealed and designated containers is not properly referred to as contamination, although the units of measurement might be the same.

9.2 Societal Effects

In practice there is no such thing as zero radioactivity. Not only is the entire world constantly bombarded by cosmic rays, but every living creature on earth contains significant quantities of carbon-14 and most (including humans) contains significant quantities of potassium-40. These tiny levels of radiation are not any more harmful than sunlight, but just as excessive quantities of sunlight can be dangerous, so too can excessive levels of radiation.

Low level contamination

The hazards to people and the environment from radioactive contamination depend on the nature of the radioactive contaminant, the level of contamination, and the extent of the spread of contamination. Low levels of radioactive contamination pose little risk, but can still be detected by radiation instrumentation. In the case of low-level contamination by isotopes with a short half-life, the best course of action may be to simply allow the material to naturally decay. Longer-lived isotopes should be cleaned up and properly disposed of, because even a very low level of radiation can be life-threatening when in long exposure to it. Therefore, whenever there's any radiation in an area, many people take extreme caution when approaching.

High level contamination

High levels of contamination may pose major risks to people and the environment. People can be exposed to potentially lethal radiation levels, both externally and internally, from the spread of contamination following an accident (or a deliberate initiation) involving large quantities of radioactive material. The biological effects of external exposure to radioactive contamination are generally the same as those from an external radiation source not involving radioactive materials, such as x-ray machines, and are dependent on the absorbed dose.

Biological effects

The biological effects of internally deposited radionuclide depend greatly on the activity and the biodistribution and removal rates of the radionuclide, which in turn depends on its chemical form. The biological effects may also depend on the chemical toxicity of the deposited material, independent of

its radioactivity. Some radionuclides may be generally distributed throughout the body and rapidly removed, as is the case with tritiated water. Some radionuclides may target specific organs and have much lower removal rates. For instance, the thyroid gland takes up a large percentage of any iodine that enters the body. If large quantities of radioactive iodine are inhaled or ingested, the thyroid may be impaired or destroyed, while other tissues are affected to a lesser extent. Radioactive iodine is a common fission product; it was a major component of the radiation released from the Chernobyl disaster, leading to many cases of pediatric thyroid cancer and hypothyroidism. On the other hand, radioactive iodine is used in the diagnosis and treatment of many diseases of the thyroid precisely because of the thyroid's selective uptake of iodine.

The Responses of Business to Pollution

All type of industries use resources of one kind or another to produce products and deliver services for meeting needs of other businesses and / or communities. In this process, some resources remain unspent, or unwanted products get produced as waste because 100% conversion or transfer of resources is seldom possible. This waste when discharged to the environment causes pollution. These waste many be solid, liquid or in gaseous form as discussed in previous chapter.

WASTES ARISE FROM

TRANSPORTATION: -	**Unnecessary movement of men and materials.**
PROCESS: -	**Unnecessary steps or ineffective methods.**
OVER PRODUCTION: -	**Producing more than necessary.**
MOTION: -	**Unnecessary motion.**
WAITING TIME: -	**Ideal time of machine or men.**
DEFECTS: -	**Goods that do not meet quality specifications.**
INVENTORY: -	**Excessive work-in-progress.**

Historically, businesses have responded to pollution in four ways.

1. Firstly, by ignoring the problem. This always leads to maximum damage to the environment. This damage is not limited only to the local-scale or neighbourhood; it can occur at the regional and in some cases even the global scales.

2. Secondly, by prescribing to the doctrine "the solution to pollution is dilution"; i.e. by diluting or dispersing pollution so that its effects are less harmful or apparent.

3. Thirdly, by trying to treat pollution through the so-called end-of-pipe approach.

4. Fourthly (and most recently), through the prevention of pollution and waste generation at the source itself.

Figure 1.5 illustrates this trend.

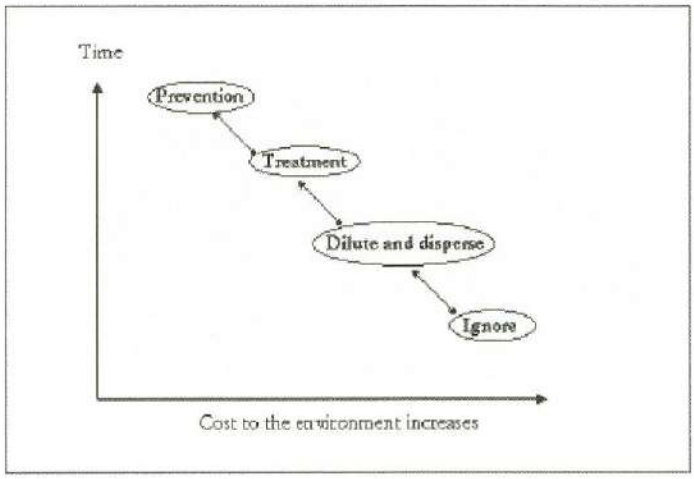


Fig 1.5 :- Response of Businesses to Environmental Pollution

Waste Hierarchy

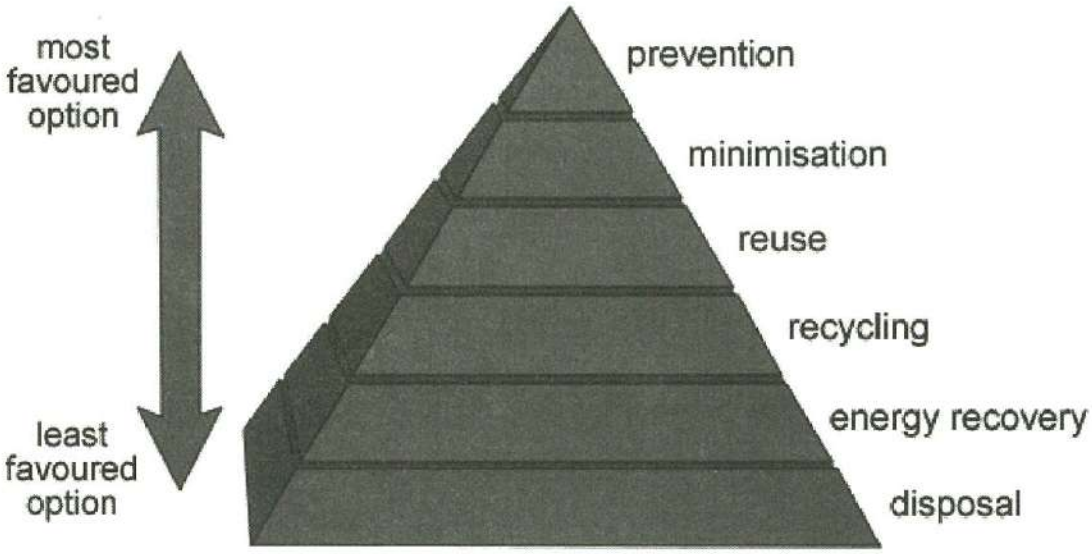
The **waste hierarchy** refers to the 3Rs of reduce, reuse and recycle, which classify waste management strategies according to their desirability. The 3Rs are meant to be a hierarchy, in order of importance.

The waste hierarchy has taken many forms over the past decade, but the basic concept has remained the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

Some waste management experts have recently incorporated a 'fourth R': "Re-think", with the implied meaning that the present system may have fundamental flaws, and that a thoroughly effective system of waste management may need an entirely new way of looking at waste. Source reduction involves efforts to reduce hazardous waste and other materials by modifying industrial production. Source reduction methods involve changes in manufacturing technology, raw material inputs, and product formulation. At times, the term "pollution prevention" may refer to source reduction.

Another method of source reduction is to increase incentives for recycling. Many communities in the United States are implementing variable rate pricing for waste disposal (also known as Pay As You Throw - PAYT) which has been effective in reducing the size of the municipal waste stream.

Source reduction is typically measured by efficiencies and cutbacks in waste. Toxics use reduction is a more controversial approach to source reduction that targets and measures reductions in the upstream use of toxic materials. Toxics use reduction emphasizes the more preventive aspects of source reduction but, due to its emphasis on toxic chemical inputs, has been opposed more vigorously by chemical manufacturers. Toxics use reduction programs have been set up by legislation in some states, e.g., Massachusetts, New Jersey and Oregon.



Rethinking Waste

The 3Rs are categories at the top of our disposal options. They include a variety of initiatives for disposing of discards. Generally, options lowest on the list are least desirable.

Reduce - to buy less and use less. Incorporates common sense ideas like turning off the lights, rain barrels, and taking shorter showers, but also plays a part in Composting/Grasscycling (transportation energy is reduced), low-flow toilets, and programmable thermostats. Includes the terms Re-think, Precycle, Carpool, Efficient, and Environmental Footprint/Foodprint.

Reuse - elements of the discarded item are used again. Initiatives include Hand-Me-Downs, Garage Sales, Quilting, and Composting (nutrients). Includes the terms Repair, Regift and Upcycle.

Recycle - discards are separated into materials that may be incorporated into new products. This is different from Reuse in that energy is used to change the physical properties of the material. Initiatives include Composting, Beverage Container Deposits and buying products with a high content of post-consumer material.

Generate - capturing useful material for waste to energy programs. Includes Methane Collection, Gasification and Digestion, and the term Recover.

Incinerate - high temperature destruction of material. Differs from Gasification in that oxygen is used; differs from burning in that high temperatures consume material efficiently and emissions are controlled.

Devastate - to discard into the natural environment, or to "trash" the planet. Includes Litter, Burn Barrels, Unnecessary Vehicle Idling, and Dumping discards onto land or into water.

2. WHAT IS CLEANER PRODUCTION?

INTRODUCTION

The purpose of this chapter is to aware the readers about fundamental concept, tools and methodologies of Cleaner Production, and to prepare them for action in the future. It is aimed at university students and professionals who would like to acquire training in **CP**, or to learn about its main concepts in order to incorporate these into a more heterogeneous view of environmental techniques. It is conceived as a guide to introduce **CP** to future professionals, using experience gained during the development period of **CP**.

Since the 1960's, mostly, problems with emissions of pollutants from industrial sources to the environment were addressed by the utilization of end of pipe pollution control technologies. These approaches reduced the direct release of some pollutants to achieve regulatory compliance but did not really solve the problems. Often, the pollutants were only transferred from one sink to the other. Additionally, end-of-pipe treatment is very cost intensive with huge operation and maintenance charges.

Since 1972, pollution control patterns have begun to change. During the 1970s and 1980s, various concepts and strategies emerged, such as minimization of wastes, source reduction instead of end-of-pipe treatment, pollution prevention, and "no or less" waste generation process.

Cleaner production (CP) on the contrary is a common sense approach: Instead of treating waste and emissions in end-of-pipe treatment plants, we try to define ways to prevent the production of the pollutants. This approach includes organizational changes, motivation and training for good housekeeping as well as changes in raw materials, process technology, internal and external recycling. The basic idea is a change of the end-of-pipe question: "What shall we do with waste and emissions?" to the cleaner production question: "Where do waste and emissions come from and what can we do to prevent their production at the source?"

2.1 CP Concept

Cleaner production is a pro-active and integrated solution to pollution problems by eliminating or reducing pollutants at the source during the course of production processes.

Cleaner production, with great vitality and buoyancy, begins a new era of "Pollution Prevention" in the history of environmental protection and will become the best approach for pollution control in this new century.

Cleaner Production concepts have consequences for the whole life cycle of a product and can foster improvements in product design, selection of raw materials, efficiency in production and/or energy usage, safety during manufacture and consumer use, reparability, and recyclables.

Cleaner production involves commitment of top management, teamwork and a vision to understand the strategic advantages to business by being environmental friendly.

***Cleaner Production**, as a means of pollution prevention rather than pollution treatment, has strengthened the concept of environmental protection.*

More specifically, Cleaner Production aims to reduce the consumption of natural resources per unit of production, the amount of pollutants generated, and their environmental impact, while making alternative products and processes financially and politically more attractive. As the European Environmental Agency states, *"Cleaner Production is about the creation of a truly sustainable economy"*. Cleaner Production brings economic benefits via increased resource efficiency, innovation and reduction of pollution control costs. Cleaner production has become a fundamental policy in various countries around the world to achieve their objective of sustainable development.

Cleaner Production is a forward-looking, 'anticipate and prevent' philosophy.

Understanding cleaner production

Cleaner production is about considering the entire life cycle of products, including:

- product design
- selection of raw materials
- production and assembly of the final product
- consumer use
- managing all used products at the end of their life

Conventional production

- Processes not designed for waste prevention
- No use of by-products
- Expensive end-of-pipe pollution control technology
- Expensive waste treatment, transport and disposal

Conventional production approaches to pollution management are generally after -the- event and it is reactive

Cleaner production

- Processes designed for minimum waste
- Maximum use of by-products
- Savings through reduced pollution control technology, and reduced waste treatment, transport and disposal
- Minimum impact on the environment

Clean production

- Zero waste
- Total use of by-products
- Zero impact on the environment

Cleaner production is not limited to individual facilities, but extends itself to products and services including customers and communities.

We all know a clean, healthy environment is important for our future. Cleaner production can help in protection of our natural environment. By reducing our demand on non-renewable resources, and recycling and re-using products and resources, we can reduce impact on the natural environment.

Present production systems are linear. Cleaner production systems are cyclical. They try to imitate nature's processes. Wastes are used as secondary materials so that fewer new materials and less energy and water are required.

2.2 The Evolution of Cleaner Production

In the previous section, cleaner production has been closely intertwined with productivity. It is important to understand the evolution of the concept of productivity in the context of cleaner production.

2.2.1 Milestones in the Field of Productivity and Environmental Management

Traditionally, productivity has been defined as the amount of output per unit of input used. An increase in productivity entails an increase in the amount of output and / or a decrease in the amount of input.

Productivity is also impacted by the internal organization of a business; in other words, improving organizational effectiveness can be one way of improving productivity. At first, productivity improvement focused on *quantity;* i.e. outputs. As the markets developed and competition increased, ***cost effectiveness*** became the key factor towards success. Therefore, a ***cost reduction*** approach was used to improve profitability or organizational effectiveness; viz. productivity.

Next, growing consumer preferences and competition ushered in the era of the ***quality*** drive. With its advent, productivity was measured not only in terms of the quantity produced, but also in terms of the percentage of production that met the required quality.

The ***consistency*** of delivering the utmost *quantity* of a product at the desired level of *quality* in a cost-effective manner became the third generation concept in the productivity movement. Consistency could be ensured only by influencing the internal organization of a business, and hence a number of management systems emerged - and subsequently, the international standard on Quality Systems viz. the ISO 9000 series.

While the productivity concept expanded, the field of environmental management also matured and broadened (Figure 2.1).

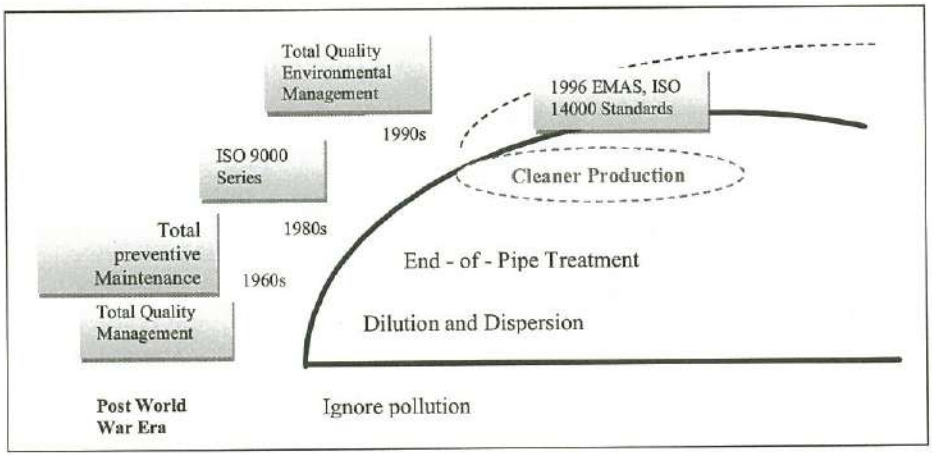


Fig 2.1 :-Tracking the Influence of Quality Programmes on Productivity

The earlier concepts of *"ignore", "dilute" and "treat"* pollution changed to *"prevent pollution", "re-utilize wastes or generated by products"* and finally *"treat" and "dispose of"* residues in a secured manner. This change took place because of a variety of reasons listed below:

- Pressures from the neighbourhood and environmental non governmental organizations (NGOs) increased dramatically. By ignoring or practicing dilution, businesses attracted legal suits, lost their reputation in the market and subsequently faced closure.
- The standards on pollution control became stringent across multiple media; viz. air, water and solids. Enforcement became stricter, requiring significant investments in treatment and disposal facilities. This required substantial funds and the acquisition of extensive tracts of land. A radical turnaround was needed in thought processes for preventing pollution at the source itself, if the business was to survive and operate cost-effectively.

The emphasis on pollution prevention needed to have support from the internal organization of the business, with the commitment of its top management. This was promulgated by Environmental Management Systems (EMS) such as the ISO 14000. This led ensuring consistency in environmental performance and establishing the strategic importance of environmental thinking in business. Around this time, the environmental factor got integrated into productivity improvement programmes (e.g. TQM to TQEM). Here, the concepts of resource vulnerability, life cycle assessment and waste as an economic burden, were brought to the fore through environmental management, thus reinforcing the need to internalize environmental issues in business.

The need to fundamentally change the approach to business by using natural resources efficiently, and taking a holistic life-cycle view of product generation was recognized in the 1990s. Efficient use of natural resources translates into environmental protection, and also results in the improvement of productivity. Consequently, as **Figure 2.2** shows, the conventionally held view of productivity grew steadily from the earliest *'quantity based'* and *'cost reduction'* approaches, to incorporate 'quality of the product' and finally, to respond to 'environmental' concerns.

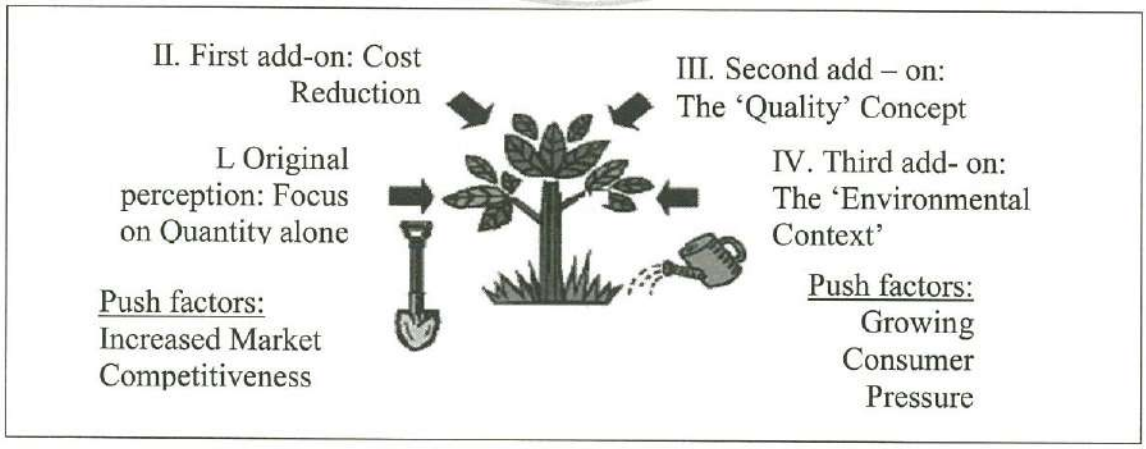


Fig 2.2 :- Growth in the concept of productivity

At this juncture, trends in productivity and environmental management intersected and influenced each other in developing a common strategy such as cleaner production.

Cleaner Production definitions...

Improvements to a production process so the process uses less energy, water or other input, or generates less waste or less environmentally harmful waste.

- Any manufacturing or production process which assist with the reduction of waste, the reduction emissions and energy reduction.
  (www.wastenot.ie/5.13.1did-597726202-amp-pageUrl--Classification-2-5-7.html)
- *The introduction of revised processes, management and housekeeping practices from the beginning to the end of the business process, including redesign of products, with the emphasis on reducing waste and pollution at source.*
- *Cleaner Production is about making more efficient use of the materials and energy we employ when we conduct our business while minimizing the generation of wastes and emissions.*

Cleaner production means increasing production efficiency while at the same time minimizing waste and the pollution of our environment.

UNEP Definition of Cleaner Production

The official United Nations definition of Cleaner production is:

"Cleaner production means the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment".

Cleaner production is:
A **continuous process: achieving a progressive reduction in resource use and waste generation.**
An **integrated approach: it deals with more than just waste.**
An **economical method: to reducing ecological and environmental health risks**

Cleaner production specifically focuses on:

- ***Production processes:*** *conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process.*
- ***Products:*** *reducing the environmental impact along the lifecycle of product, from raw materials extraction to its ultimate disposal.*
- ***Services:*** *incorporating environmental concerns into designing and delivering services.*

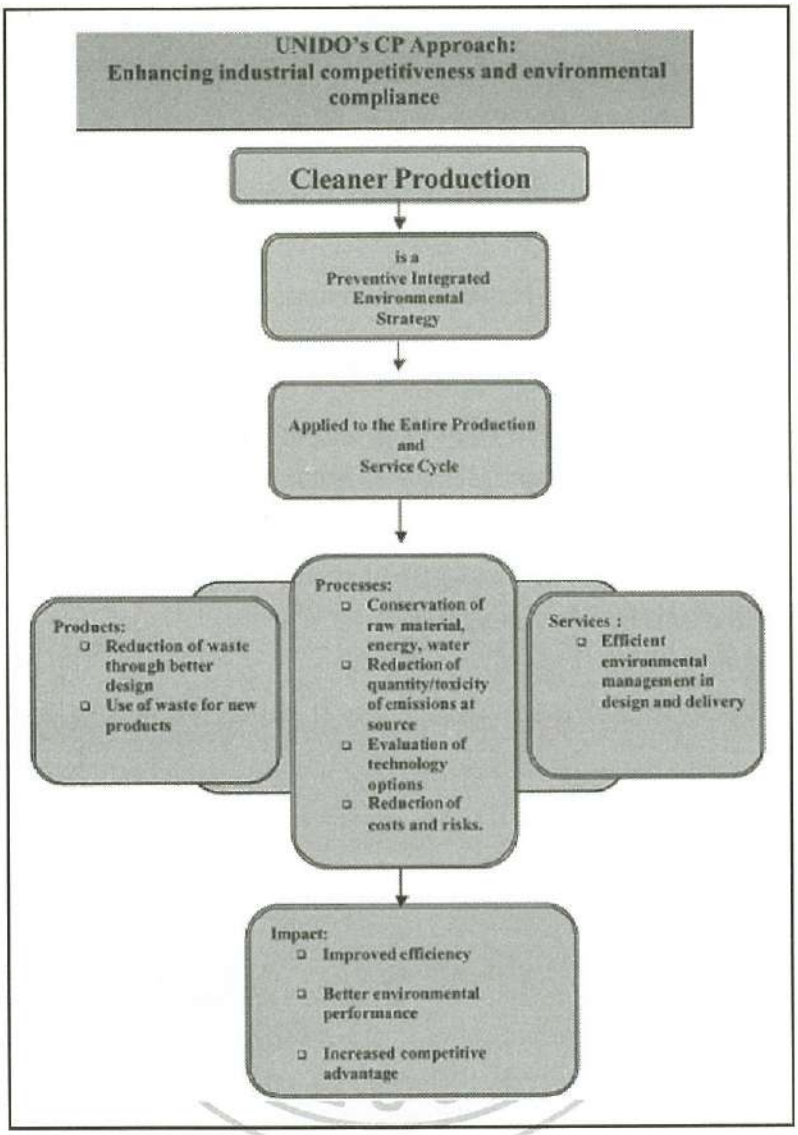


Fig 2.3 :- The definition of Cleaner Production

2.3 Other Terminologies And Their Relationship To Cleaner Production

At the time UNEP embarked on the overarching concept of cleaner production in 1990, a number of quite similar concepts existed and many others subsequently emerged. In the real world, some of these concepts are better applied in some places rather than others. It is important therefore to clarify what cleaner production is in relation to some of these concepts.

Equally importantly, if we want to communicate cleaner production to different stakeholders, we have to use the words they are willing to hear.

Concepts similar to cleaner production may be grouped into six parts - *parallel approaches, allied approaches, developmental approaches, product-related approaches, service-related approaches, and associated tools.* Each of these approaches is discussed below:

Parallel approaches

Green Productivity : It is a term used by the Asian Productivity Organization (APO) to address the challenge of achieving sustainable production. APO started its Green Productivity Programme in 1994. Just like cleaner production, green productivity is a strategy for enhancing productivity and environmental performance for overall socio-economic development. The concept of green productivity and cleaner production are almost synonymous.

Eco-Efficiency : The term was coined by the World Business Council for Sustainable Development (WBCSD) in 1992. It is defined as the delivery of competitively priced goods and services that satisfy human needs and ensure quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity. This concept is favored by many in the industrial sector. The concepts of eco-efficiency and cleaner production are almost synonymous.

Waste Minimization: The concept of Cleaner Production was introduced by the U.S. Environmental Protection Agency (USEPA). In this concept, waste and pollution reduction occurs on-site, at the source through changes of input raw materials, and /or technology changes, good operating practices and product changes. Compared to Waste Minimization, Cleaner Production is in one sense broader, in that it also includes off-site recycling of waste, but in another sense, it is narrower, since it does not cover product (re)design to minimize all life cycle impacts.

Pollution Prevention: The terms cleaner production and pollution prevention are often used interchangeably. The distinction between the two tends to be geographic - pollution prevention is mostly used in North America, while cleaner production is used in other parts of the world. Both concepts focus on a strategy of continuously reducing pollution and environmental impact through source reduction - i.e. eliminating waste within the process rather than at the end-of- pipe. However, cleaner production includes the aspect of reduction of impacts and risks across the life cycle of a product, and in this sense is a more comprehensive concept than pollution prevention.

Source Reduction : This is a term that is rather synonymous with cleaner production - reducing generation of wastes or contaminants at the source, and thereby reducing releases that could pose hazards to the environment and public health.

Toxics Use Reduction : Toxics use reduction is the elimination or avoidance of toxic substances in products or processes so as to reduce risks to the health of workers, consumers, and the public, and to minimize adverse effects on the environment. Toxics use reduction is a special case of cleaner production since it focuses specifically on the aspect of reducing toxicity / hazards.

Allied approaches

Energy Efficiency : This is essentially a sub-set of cleaner production. The concepts of energy conservation and renewable energy often have strong elements of cleaner production.

Occupational Health and Safety: It is often the case that efforts to protect the health and safety of workers will require reducing emissions at the source, by changing raw materials or modifying the

process. To all intents and purposes, this is Cleaner Production, a more indirect way, efforts to make the working environment safer for workers will result in better productivity.

Materials Management: Since the purpose of materials management is to manage materials more efficiently and reduce losses and waste, it comes very close to cleaner production.

Product-related approaches

Design for the Environment (DFE): DFE is the systematic consideration, during product design, of issues associated with the environment over the entire life cycle of a product. This approach attempts to create financial and environmental savings by redesigning products to reduce environmental impact. The object is to minimize or eliminate anticipated waste generation and resource consumption in all the phases of the life cycle; viz. raw material sourcing, production, product distribution, use, and disposal. DFE is also called *eco -design.*

Product -Service Systems: This concept focuses on creating a community-wide system for ensuring the best use and reuse of products. As with DFE, this concept focuses on the product element of cleaner production.

Service- related approaches

Sustainable Tourism: This term has strong links with cleaner production. Sustainable tourism requires tourist services to reduce their use of material and energy intensity and to reduce their generation of pollution.

Developmental Approaches

Sustainable Development : This term is defined as development that meets the needs of present generations without compromising the ability of future generations to meet their own needs. The strategy of cleaner production is driven by the vision of sustainable development.

Industrial Rationalization : This is a term that deals with large-scale shifts in patterns of industrial production. Since it is often used in circumstances where inefficient industrial sectors are being phased out, it often has a strong, but generally unrecognized, component of cleaner production.

Miseà Niveau : A French term that corresponds to industrial upgrading, this term is used in circumstances where entire industrial sectors are being upgraded and modernized. Such modernization (again) often contains a generally unrecognized component of cleaner production, since modern technologies are often more efficient in their consumption of material inputs.

Associated Concepts

Triple Bottom Line : A methodology for measuring and reporting on financial, environmental and social performance, this tool can have incorporated into it strong elements of cleaner production. Indeed, several cleaner production centres today have been experimenting with this tool as a way of pushing forward the cleaner production agenda.

Figure 2.4 illustrates the position of cleaner production with respect to some of the concepts outlined above, as well as the reactive approach of end-of-pipe treatment discussed earlier.

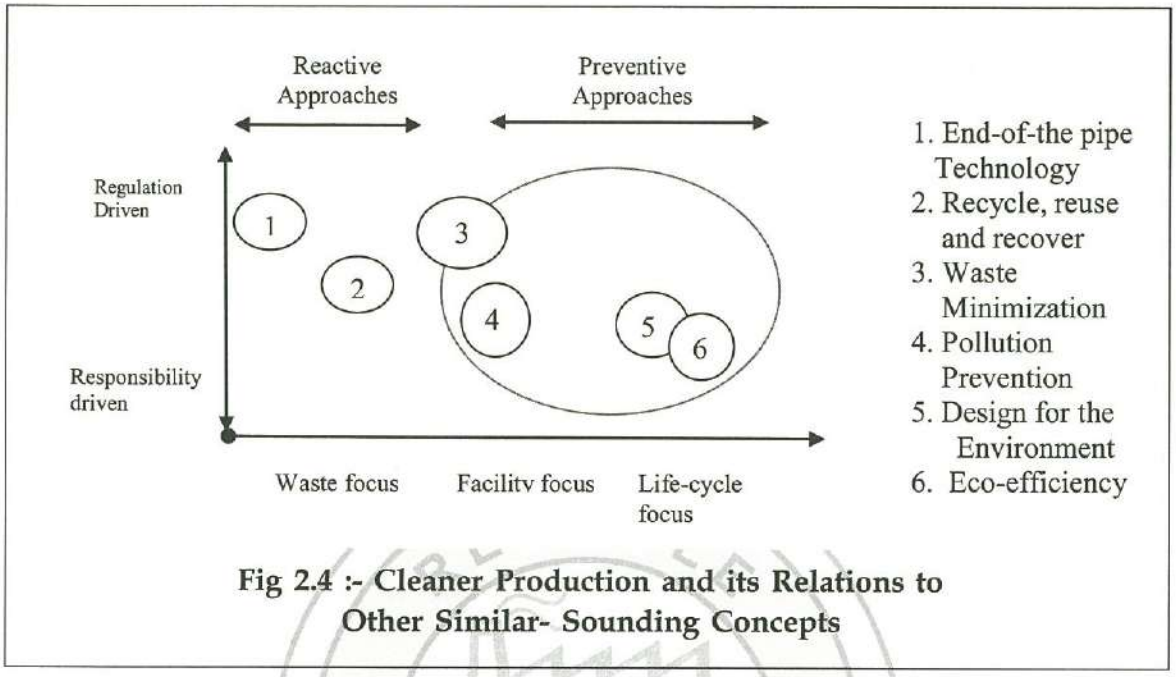


Fig 2.4 :- Cleaner Production and its Relations to Other Similar- Sounding Concepts

2.4 Benefits of CP

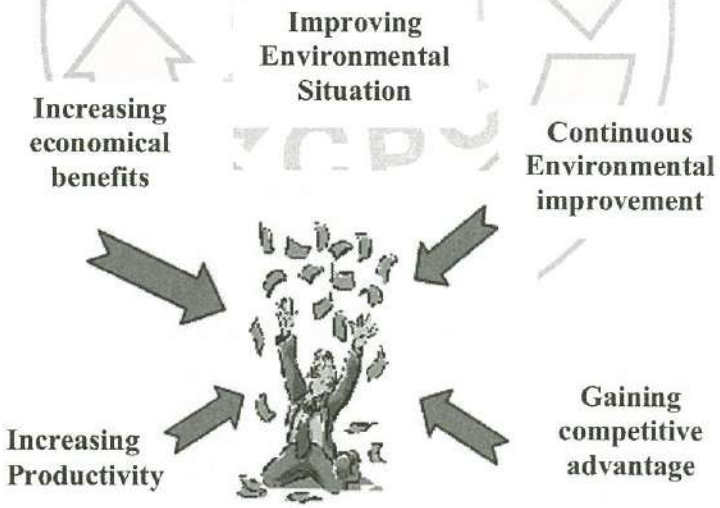


Fig 2.5 :- Benefits of CP

The advantages of implementing CP are multifaceted.

Properly Implemented CP

Always

- Reduces long-term liabilities which companies can face many years after pollution has been generated or disposed at a given site

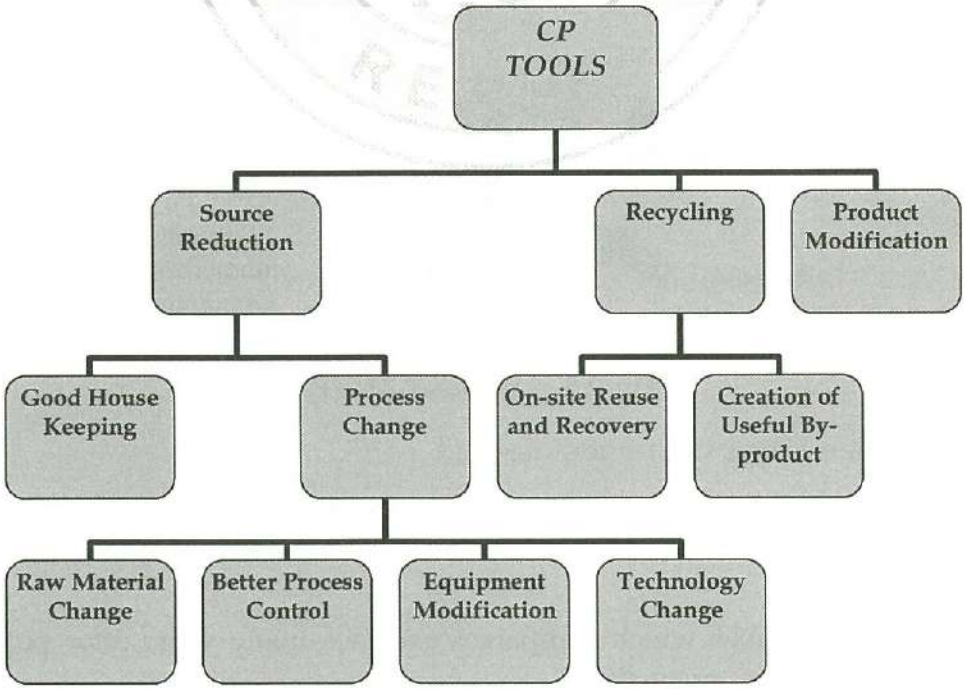
Usually

- Increases profitability
- Lowers production costs
- Enhances productivity
- Provides a rapid return on any capital or operating investments required
- Increases product yield
- Leads to the more efficient use of energy and raw materials
- Results in improved product quality
- Increases staff motivation
- Relies on active worker participation in idea generation and implementation
- Reduces consumer risks
- Reduces the risk of environmental accidents is supported by employees, local communities, customers and the public

Often

- Avoids regulatory compliance costs
- Leads to insurance savings
- Provides enhanced access to capital from financial institutions and lenders is fast and easy to implement
- Requires little capital investment

2.5 CP Tools



Cleaner Production options or measures could be grouped into three major categories

1. Waste Reduction at Source
2. Recycling; and
3. Product Modification

Waste Reduction at Source options are sub-divided into "Good Housekeeping" and "Process Change" Options.

Good Housekeeping usually means changing existing practices or introducing new ways of operating and maintaining equipment. Appropriate provisions to prevent spills and to encourage good workplace attitudes are included in this category of Cleaner Production options. Good housekeeping options are normally inexpensive and their pay-back period is short.

Repair leakages, close taps when not in use, raw material conveyor to reduce material handling losses, insulation of digesters etc.

Process Change includes four types of options: Change in raw material, Better Process Control, Equipment Modification and Technology change.

Change of raw material options includes the use of less hazardous materials or raw materials of higher quality aimed at reducing the quantity / toxicity of waste generated from the process. Existing raw materials could be substituted with less polluting ones.

Substituting existing toxic dyes with non-toxic dyes to reduce effluent and product toxicity, use of H_20_2 bleaching instead of chlorine based bleaching to avoid generation of toxic absorbable organic halides (AOX).

Better process control aims at optimizing the process parameters / conditions like pH, temperature, pressure, residence time etc., to ensure operation of the existing processes at higher efficiency and with lower waste and emission generation. This may be achieved for example, by training the operators or by adding monitoring and control devices to the machinery.

Example: Optimization of pulping process for extended cooking with NaOH.
Equipment modification includes small changes to existing equipment, such as installing drip pans, installing fluid coupling in blenders, pumps activation through level controlling mechanisms etc., which aims at reducing the waste generation caused due to poor equipment design. This may be achieved for example, by training the operators or by adding monitoring and control devices to the machinery.

Technology change constitutes the replacement of technology, processing sequence and / or synthesis pathway in order to minimize waste and emission generation during the production process.

Example: Installation of Screw press and counter current multistage vacuum washers for pulp washing.

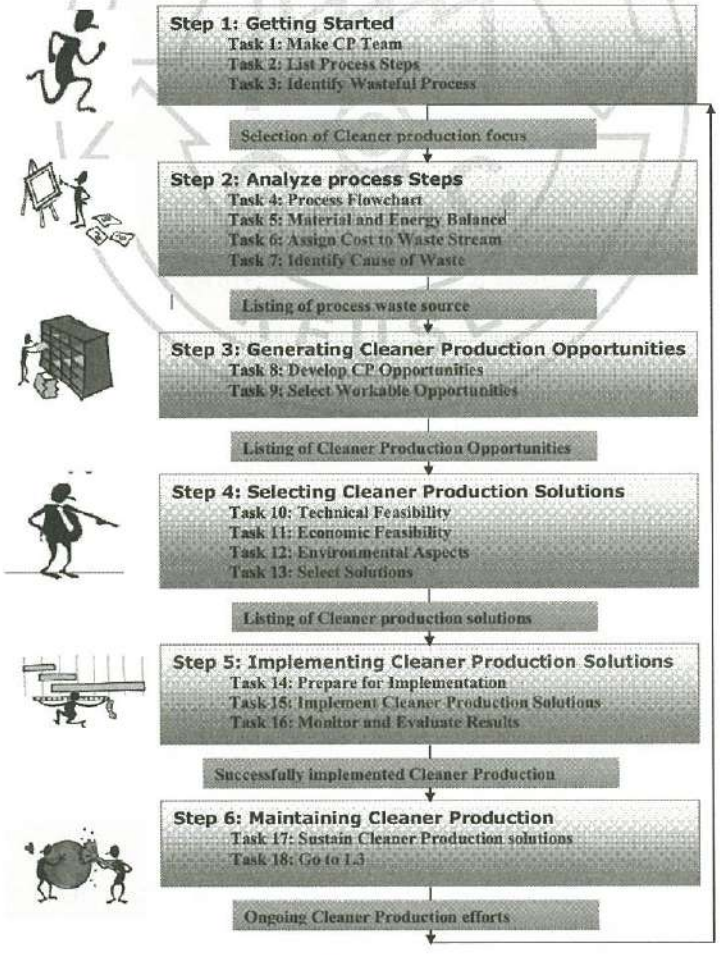
Recycling is the-on-site recovery and reuse of wasted materials and energy. The recovered materials may either be reused in the same process or used for another purpose, for example in producing useful by-products, like creation of ligno sulphates from black liquor or lignin recovery from black liquor for use as soil conditioner.

Product Modification: Product changes involve altering the product in order to reduce waste during manufacture, use and disposal i.e. during the product life cycle. These are among the among more difficult waste minimization techniques to effect. Examples include changing the composition of the product or producing a substitute by alternative product to perform the same function.

- Produce high yield verities of paper
- Produce unbleached paper instead of bleached paper
- Production of paper with high ash content
- Production of non-perfumed tissue napkins.

2.6 CP Methodology

The systematic CP methodology developed under DESIRE project contains 18 tasks under six steps as described below:



Step1. Getting Started
Planning and organization of the Cleaner Production audit, including the establishment of a project team, baseline data collection and the selection of the audit focus.

Step 2. Analysing process steps
Evaluations of the unit operations relevant to the selected audit focus in order to quantify waste generation, its costs and its causes.

Step 3. Generating Cleaner Production Opportunities
Development and preliminary selection of workable Cleaner Production opportunities.

Step 4. Selecting Cleaner Production Solutions
Assessing the technical feasibility, financial viability and environmental desirability of preliminary selected CP options in order to select feasible CP solutions.

Step 5. Implementing Cleaner Production Solutions
Actual implementation of the techno-economically viable CP solutions and monitoring of the results achieved by their implementation.

Step 6. Sustaining Cleaner Production
Tools and techniques for sustaining the implemented CP solutions and elaborating the scope in other areas.

Six Step CP Methodology with Details of 18 Tasks

Step 1: Getting Started
In order to prepare for the Cleaner Production assessment, the following tasks need to be executed.

Task 1 Make Cleaner Production Team
The CP Team shall be made up of representatives from the various major sections in the company that will have an interest in Cleaner Production. Size and composition of the CP team shall be according to the company's organizational structure. The team should be capable of identifying potential CP areas, developing CP solutions and implementing them. To this end, input from both in house and external experts might be needed.

Task 2 List process steps (Unit Operations)
All process steps in the unit should be specified, including utilities, storage and waste management facilities, in order to get a proper understanding of all manufacturing processes.

The team should highlight major and obvious waste generating areas and, if possible, identify the reasons for waste generation. In addition, housekeeping and process control practices should be assessed carefully. Special attention should be paid to periodic activities e.g. washing and regeneration (of catalysts, absorbents etc.) as these are often highly wasteful but still overlooked.

Task 3 Identify and select wasteful process steps (Audit focus)
Without going into details, the team should broadly assess all process steps in terms of quantum of waste, severity of impact on the environment, expected Cleaner Production opportunities, estimated

benefits (cost savings) etc. Such assessments are effective tools in focusing on one or a few process steps (audit focuses) for detailed CP analysis.

Step 2 : Analyzing Process Steps

This step in CP methodology covers the detailed data collection and evaluation for the selected processes. This information will enable the generation and evaluation of Cleaner Production opportunities in the subsequent phases. In this step the following tasks need to be addressed.

Task 4 Prepare process flow chart

A schematic representation of the selected process steps (audit focus) is essential with the purpose of identifying all process steps and the sources of wastes and emissions. The flow chart should list and - to some extent - characterize the input and output streams for each process step. Given the historic development of the production processes, it is not always easy to establish a correct process flow diagram but it is crucial for the smooth development of the Cleaner Production audit.

Task 5 Make material and energy balance

Material and Energy balances are necessary to quantify the process losses (wastes) during processing. Later balances can be used to monitor results / achievements of the implementation of Cleaner Production options. Normally a preliminary balance (approximate) should be derived, given the lack of records and the lack of data on composition of input and output material streams and complex recycle streams. It may be worthwhile to draw component balances for important resources, e.g. water and fibre balance in paper industry, print paste balance in the textile finishing industry, oil balance in vanaspati industries etc.

Task 6 Assign costs to waste streams

In order to get the top management's commitment and to estimate the approximate savings potential the cost of the waste stream should be evaluated. A preliminary estimate can be made with a calculation of the cost of raw material and intermediate product lost with the waste stream (like fibre loss in the pulp and paper industry). A more detailed analysis might reveal additional costs, including the cost of raw materials in waste, the manufacturing cost of material in waste, cost of product in waste, cost of treatment of waste, cost of waste disposal, waste tax etc.

Task 7 Review of process to identify waste causes

A review of the processes should locate and highlight the causes of waste generation (cause analysis). A wide variety of possible causes should be considered, including for instance poor housekeeping, operational and maintenance negligence, poor raw material quality, poor layout, bad technology, inadequately trained personnel, employee de-motivation etc.

Step 3 : Generating Cleaner Production Opportunities

Having identified and assigned causes of waste generation, the audit team can move on to determining Cleaner Production opportunities which eliminate these causes The following tasks need to be undertaken to this end.

Task 8 Developing Cleaner Production opportunities

The team having analyzed the data and possible causes for waste generation is now equipped for

eliminating waste causes, which in turn minimize waste generation. Finding such options, depends on knowledge and creativity of the team members, much of which comes from their educational background and work experience. Techniques like brain-storming, group discussions etc. might be applied to boost option generation. Ideas from outside viz. personnel from similar operations, equipment supplier and consulting engineers should be encouraged.

Task 9 Select workable opportunities

The Cleaner Production opportunities are now screened in order to weed out those, which are impractical and to select those, which are directly implementable (not requiring feasibility analysis). This screening process should be simple, fast and straight forward and may often be only qualitative. The remaining opportunities are then subjected to more detailed feasibility studies

Step 4 : Selecting Cleaner Production Solutions

The feasibility of the workable Cleaner Production opportunities is to be evaluated in order to select the most practical set of Cleaner Production solutions. The CP opportunities should be subjected to the following assessments.

Task 10 Assess technical feasibility

Before selecting solution proposed the Cleaner Production opportunity should be subjected to technical evaluation to ascertain whether it will work for the specific application or not. To this end, impact of the proposed Cleaner Production opportunity on process, product quality, production rate etc. has to be evaluated. In addition, an inventory has to be made of the necessary technical changes for the implementation of the CP opportunity.

Task 11 Assess financial viability

In SMEs financial viability is the key parameter in the evaluation of Cleaner Production opportunities. For the evaluation of low investment options priority should be given to the simple analysis methods like pay back calculations. However in case of high investment options a rigorous evaluation method (example Internal Rate of Return) is necessary to assess economic viability.

Task 12 Evaluate environmental aspects

In most cases the environmental benefits of Cleaner Production programme are obvious. However, for options having complexity in involving changes of raw materials or process chemistry, care should be taken to assess whether or not a net reduction of toxicity and quantity of waste and emissions occurs.

Task 13 Select solutions for implementation

The results of the technical, financial and environmental evaluation have to be combined in order to select the most practical and viable set of CP solutions. Proper documentation of the selected solutions will be highly useful in obtaining approval and funds for the actual implementation of the solutions.

Step 5 : Implementing Cleaner Production Solutions

The Cleaner Production solutions that emerge from above analysis now have to be implemented. A significant number of solutions might be implemented as soon as they are identified (i.e. repairing of leaks and enforcement of working instructions), while others would require a systematic plan of implementation. To this end, the following tasks should be undertaken.

Task 14 Prepare for implementation

This includes arranging required finances, establishing task forces, preparing detailed technical drawings, planning for undertaking implementation etc. Good liaison, awareness and information dissemination should assist in obtaining the involvement of key departments and persons.

Task 15 Implementing Cleaner Production solutions

Implementing Cleaner Production solutions is similar to any other routine Industrial modification / expansion. In order to achieve the optimum results, the in-house training of manpower should not be missed out and should be considered as an important activity.

Task 16 Monitor and evaluate results

Environmental and economic performance evaluation of all the implemented CP options is needed to assess causes for deviation (if any) of the results obtained from the results expected as well as to inform management and to sustain its commitment for Cleaner Production.

Step 6 : Sustaining Cleaner Production

It might seem in the first place that Cleaner Production programme is completed upon the implementation of the feasible CP solutions. However, the team still faces the major challenge of sustaining CP programme in order to further reduce wastes and improve profits in the future. This basically consists of the two tasks.

Task 17 Sustain Cleaner Production solutions

Generally for areas like housekeeping and process optimization, employees tend to return to the wasteful, old practices if not continuously motivated to sustain the improved practices. Developing own benchmarks and regular comparison of current scenario is therefore crucial in order to monitor on-going achievements and sustaining CP solutions. Rewards and recognition schemes could ensure the ongoing involvement of the employees.

Task 18 Identify and select wasteful process steps

Having improved the environmental performance of selected Wasteful processes new selection should be made as the focus for next Cleaner Production audit. The newly selected audit focus shall be subjected to all the steps starting from Step 2.

2.7 CLEANER PRODUCTION AND ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

Environmental Management Systems

Environmental management systems are becoming more and more common in industry in many countries. Companies that trade internationally are actively looking to voluntary environmental guidance and standards, in particular ISO 14001, to document their commitment to the environment in order to increase their business potential and the public image.

An environmental management system (EMS) is a program of continuous environmental improvements. As a part of the overall management system of an organization, EMS is designed to achieve environmental goals, manage environmental issues, and continually improve environmental performance. EMS sometimes also is referred to as total quality environmental management. Some of the benefits of EMS are:

- Improved control and efficiency
- Reliable regulatory compliance
- Reduced environmental liabilities
- Easier access to loans
- Enhanced corporate image
- Reduced insurance premiums

ISO 14000 covers:

14001 Environmental Management Systems - External certification, integrating EMS with management policies and procedures, etc. (covered in more detail below).

14010 Environmental Auditing - Requirements for principles for auditing, auditing EMS and qualifications for auditors, for both certification and internal self-auditing.

14020 Eco-Labeling - Requirements for labelling products as environmentally responsible. There are three kinds of labels: seal of approval for products that meet specified requirements for products within a product class; single claim labels for recycled content, energy efficiency, etc.; and an environmental report card for life-cycle and comparison of manufacturing and use of products.

14030 Environmental Performance Evaluation - Methods to measure, analyse, assess, and describe an organization's environmental performance against certain criteria.

14040 Life cycle Assessment - Tool to evaluate environmental attributes associated with a product, process, or service. This tool will look at a product from raw material extraction through manufacturing, distribution, use, recycle, and final disposal. The results may be used on the eco-labels.

14050 Terms and Definitions - ISO Guide 64: Environmental Aspects in Product Standards: Tool to encourage considering the environment in product design and development and to encourage the use of life-cycle and other methods in developing standards. This Guide will influence other parts of ISO and other standards organizations.

ISO 14001 is most widely implemented in industry. Compliance with ISO 14000 requires:

- Set an environmental policy.
- Define goals and objectives.
- Commit to achieving and maintaining compliance with local environmental laws.
- Commit to the prevention of pollution.
- Plan and enact continuous review and improvement.
- The goal of ISO 14001 is to promote a common approach to environmental management, enhance a company's ability to attain and measure environmental performance, and facilitate trade.

A cleaner production program is an integral part of a larger environmental management system. Without a very strong cleaner production program, implementing an EMS is very difficult. Thus, cleaner production is a strong base on which a company or organization can build an outstanding

environmental management system. Once executive level managers have decided to establish a cleaner production program, they should convey this commitment to all employees through a formal policy statement.

In terms of Cleaner production the focus of management should be on prevention rather than on cure of avoiding environmental problems. The inclusion of commitment to prevention in the environmental policy is one prerequisite of the common management standards like the EMAS regulation, ISO14001 or the British Standard. But how can a formalized environmental management system help to start and run processes of continuous improvement and voluntary self regulation? It is to conclude from several experiences that Cleaner Production and common environmental management standards fit well together and support each other in helping an organization to really decrease its environmental effects.

Analysing environmental management systems implemented on the basis of cleaner production (CP) projects demonstrates that CP supplies management and employees with systematic tools to decrease the environmental impact and at the same time CP saves costs from inefficient use of materials and energy and motivates the organization as well by creating awareness throughout the enterprise. Such CP management strategies are heading for:

- Productivity of materials
- Energy efficiency
- Material flow management
- Preventive environmental protection
- Sustainable use of natural capital
- Service orientation
- Legal compliance

As discussed above, ISO 14000 covers much broader subjects of Environment Management like Ecolabelling and LCA. Ecolabelling is a tool where a product is given an ecolabel based on its eco-friendliness. This ensures that the industry is continually striving to improve its whole life cycle.

Life Cycle Assessment, as the name itself suggests consists of studying the environment impacts of the whole life cycle of product from cradle to grave. This will aid in recognizing the affect wherein environment impact is maximum and needs improvement.

It is to conclude that implementation of EMS in a company will inculcate a culture of pollution prevention in a continuous cycle, the basic of Cleaner Production.

3. WHAT IS NOT CP?

Some techniques are at times confused with CP. Following techniques are not considered as CP options:

- Off site recycling
- Transfer hazardous waste
- Waste treatment
- Concentrating hazardous or toxic constituents to reduce volume
- Diluting constituents to reduce toxicity or hazard

Off- site recycling

Off-site recycling is vastly preferable to other forms of waste handling because it helps to preserve raw materials and reduces the amount of material that will require disposal. However, compared with closed-loop recycling (or reuse), performed at the production site, there is likely to be more residual waste that will require disposal. Further, waste transportation and the recycling process itself carry the risks of worker exposure and of release into the environment.

Waste treatment

Waste treatment involves changing the form or composition of a waste stream through controlled reactions to reduce or eliminate the amount of pollutant, its toxicity and/or its disposal site space requirements. Examples include detoxification, incineration, decomposition, stabilization, and solidification or encapsulation.

Concentrating hazardous or toxic constituents to reduce volume

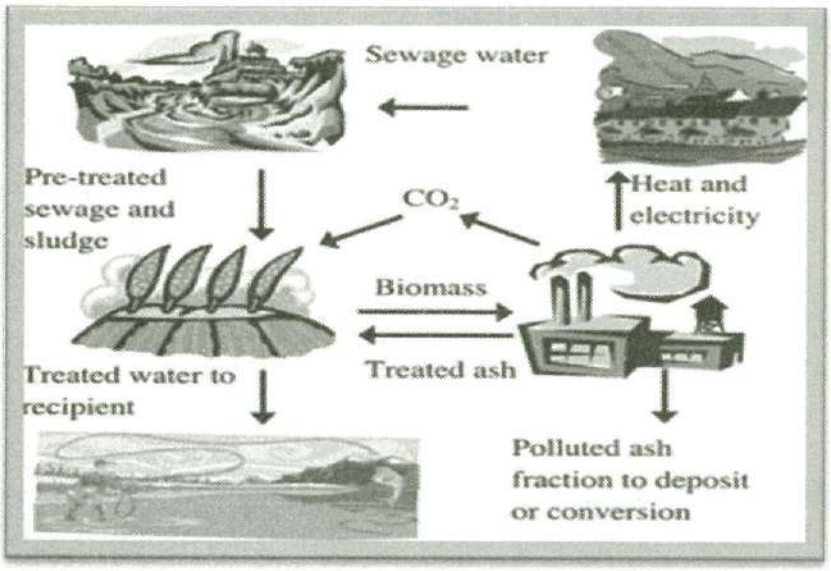
Volume reduction operations, such as de-watering, are useful treatment approaches, but they do not prevent the creation of pollutants. For example, pressure filtration and drying of a heavy metal waste sludge prior to disposal decreases the sludge water content and waste volume, but it does not decrease the amount of heavy metal in the sludge.

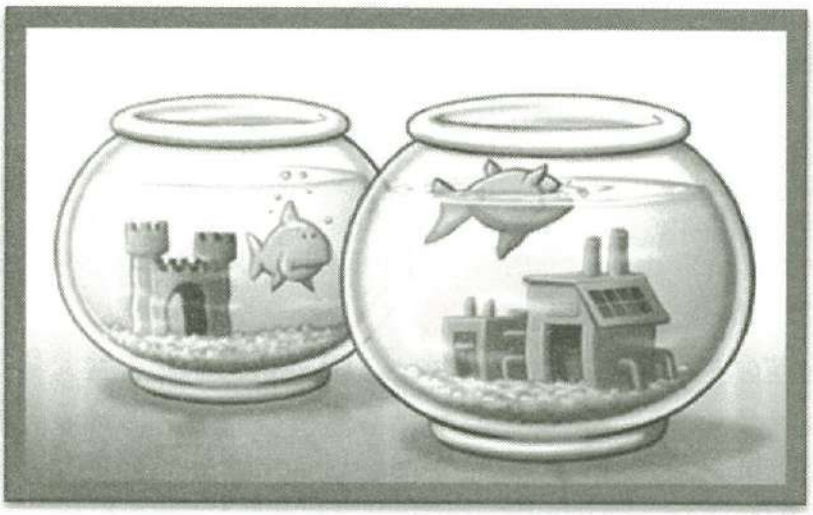
Diluting constituents to reduce hazard or toxicity

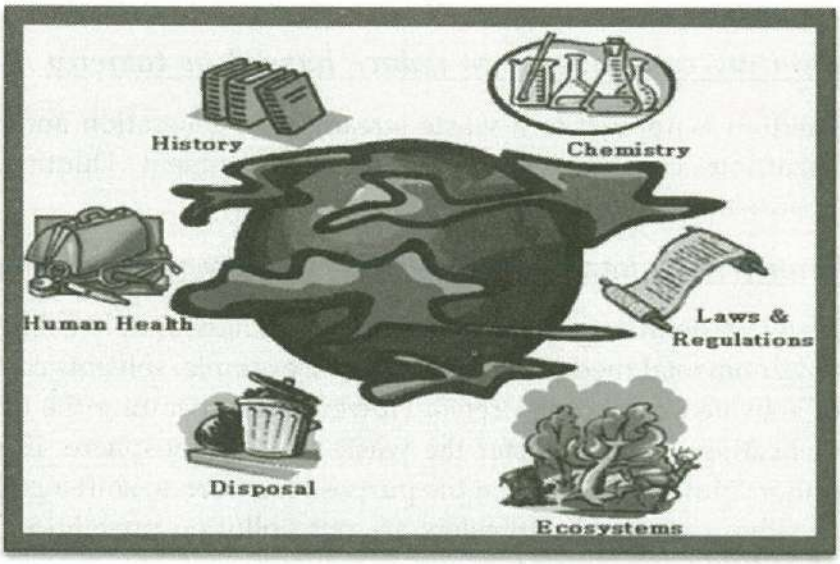
Dilution is applied to a waste stream after generation and does not reduce the absolute amount of hazardous constituents entering the environment. Dilution is not an acceptable method of waste treatment.

Transferring hazardous or toxic constituents from one environmental medium to another

Many waste management practices to date have simply collected pollutants and moved them from one environmental medium to another. For example, solvents can be removed from waste water by means of activated carbon absorbers. However, regenerating the carbon requires the use of another solvent or heating, which transfer the waste to the atmosphere. In some cases, transfer is a valid treatment option. However, too often the purpose has been to shift a pollutant to a less tightly regulated medium. In either case, media transfers are not pollution prevention.


Sewage water
Pre-treated sewage and sludge
CO_2
Heat and electricity
Biomass
Treated ash
Treated water to recipient
Polluted ash fraction to deposit or conversion




History
Chemistry
Human Health
Laws & Regulations
Disposal
Ecosystems

4. WHY CP NOT ADOPTED?

Economic growth in the last decade, and the pattern of growth is expected to persist in most countries in the coming years. While most of them already have strong industrial development policies in place, cleaner production is mostly in the planning phase. The expanding industrial sector aggravates environmental problems in most Asian countries. Largely because the present entrepreneurial spirit or focus is devoted to profit making and securing persistent production growth.

Small and medium-sized enterprises account for more than 90% of enterprises in most countries in the region. Their dominance has made the situation even worse. Many SMEs do not have knowledgeable managers who are familiar with modern management practices, which would and should emphasize green productivity or continual improvement. They know little or nothing about cleaner production and are not aware of the options available to them and the associated benefits. Even if they are to take action to tackle an imminent environmental problem, they would commonly resort to the more familiar end-of-pipe (EOP) pollution control methods. Moreover, they do not realize that EOP measures are not totally effective for dealing with the varying patterns and quantities of production they currently experience. Secondly, SMEs are usually short of staff that is knowledgeable about cleaner production, making cleaner production implementation difficult.

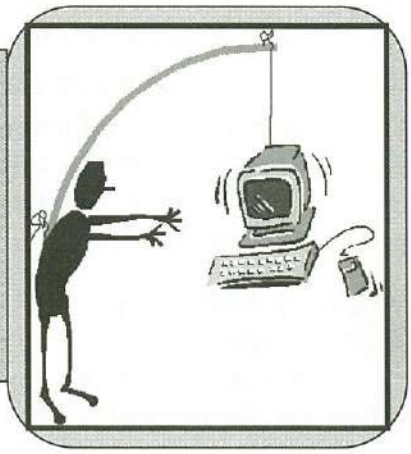
Environmental legislations or regulations in most Asian countries are not oriented to encouraging waste minimization or continual environmental performance improvement in the industries. EOP is often accepted as a "quick-fix" solution to satisfy relevant legislations. In addition, legislations are sometimes not effectively enforced. Resources are sometimes inappropriately priced, leading to the frequent abuse of our precious and limited resources.

Cleaner production holds out the promise of improving the environmental performance of Industry while at the same time improving a firm's bottom line. If this is true, then it would be expected that firms would be rushing to implement it. And yet, despite a shortage of concrete data, there is a general consensus that, the widespread adoption of cleaner production remains a largely unfulfilled ambition.

In consulting a wide range of industry representatives, it became clear that the majority of barriers to cleaner production confronted by firms could be placed into one of two categories: those that were internal to the firm and those that were external to the firm.

BARRIERS TO CLEANER PRODUCTION

Not surprisingly, given the substantial modification to management culture entailed, there may be significant internal barriers to the adoption of cleaner production processes and practices within firms. In addition, there may also be external barriers which are largely outside of the firm's capacity to change. This chapter seeks to identify the major internal and external barriers to the adoption of cleaner production, and their relative influence on firm behavior.



INTERNAL BARRIERS:

☞ **A lack of information and expertise**

A major hurdle to the widespread adoption of cleaner production is the inaccessibility of appropriate information and expertise. In the economist's language, there is positive transaction costs associated with the attainment of information. Despite the considerable potential of cleaner production to improve a firm's competitiveness, in many instances they are incapable of exploiting such opportunities because of ignorance. Firms may lack information about specific clean technologies, thus contributing to risk and uncertainty regarding the adoption of the technology. Even to the extent that they are aware of these opportunities, a lack of appropriate skills and expertise prevents firms from acting upon them. This may be compounded by irregular decision making - firms may not review cleaner production issues on a regular enough basis to benefit from the available information.

Small and medium sized enterprises (SMEs), in particular, suffer from a lack of resources and expertise to devote to implementing best environmental practice. Commonly, SMEs also have difficulty in understanding the concept and terminology associated with the notion of cleaner production. Managing large volumes of information on environmental policy and business strategy is a major problem even for large firms, and many SMEs are likely to suffer from "information overload" and need good independent guidance.

☞ **A low awareness of environmental issues**

Related to the issue of difficulty in accessing information, some firms may also have conceptual obstacles to pollution prevention and cleaner production. Unfortunately, as one industry representative stated, "Managing environmental affairs is [often] seen as insurance - insurance against an expensive and public disaster, and insurance against prosecution of officer and directors. Therefore these efforts have a negative reward feed back - they are successful if nothing happens. The challenge we face is turning the tables around to achieve a positive feedback for change."

Conceptual obstacles to cleaner production may include:

(i) Underrating the environment in firm policy;

(ii) A narrow view of the relationship between firm policy and the environment, resulting in confusion about the definition of prevention;

(iii) The idea that protecting the environment is costly;

(iv) Having a high resistance to change;

(v) Viewing legal established standards as the only goal and guideline; and

(vi) The view that the production process is a black box, that is, that inputs to the process can be altered in an attempt to control outputs without an attempt to understand the internal workings of the process - such firms are skeptical of the need to internalize environmental awareness in all parts of the organization.

☞ **Competing business priorities, in particular, the pressure for short term profits**

Because corporations are judged by markets, investors and others, principally on short-term performance, they have difficulty justifying investment in cleaner production processes and technologies, even when there are demonstrably attractive long term financial returns.

For instance, one industry representative commented that "many managers would be reluctant to spend money on improving environmental performance, unless such investment also produced an immediate or early economic return.

The tendency for firm and divisional management to sacrifice longer term economic wealth for an increase in reported short term profits is a fundamental flew in many management practices which may inhibit the adoption of cleaner production. In particular, it encourages reducing tangible and intangible investments which may undermine future competitiveness. Management procedures which aim to quantify and take account of market prices for longer term investments such as research and development, employee training, flexible manufacturing processes, high quality suppliers, and customer loyalty, will greatly benefit the cause of cleaner production.

It is clear that those firms which are economically marginal often cannot afford the luxury of a long-term view to cleaner production. For them, the likelihood of ignoring potentially attractive cleaner production technologies in order to achieve short-term profit is very high indeed. Ironically, such firms may also be the most heavily reliant on old, inefficient plant and technology and management processes and, as a result, have the most to gain from cleaner production practices. Governments may inadvertently prolong the life of economically marginal firms by the use of inappropriate subsidies.

- **Bounded rationality in decision making processes**

Even if we assume that all decision makers within a firm have access to perfect information, in reality, they may be unable to process all the information they have. This is referred to as bounded rationality. Managers are not "perfect mathematicians" with unlimited information processing capabilities. Inevitably, because of time and concentration constraints, they can only juggle a limited number of balls at any one time. In many cases, these "balls" will be issues other than cleaner production. As one industry representative stated "many companies are so busy doing business and focusing on down sizing that the infrastructure is lacking to investigate cleaner production".

Closely related to the concept of bounded rationality, are the management theories of "Stakeholders" and "satisfying". In essence, these theories propose that management has to satisfy a number of key stakeholders, and only once this has been achieved can they engage in managerial discretion. For example, management must satisfy the needs of shareholders and employees before they can contemplate other discretionary issues such as cleaner production.

- **Financial obstacles**

Despite the potential for cleaner production to generate substantial cost-savings, pollution prevention in firms may be inhibited by several real or perceived internal financial obstacles. Risk and uncertainty in the performance of certain technologies and management practices may result in reluctance by firms to invest in cleaner production. This may be exacerbated by internal vested interests in maintaining the status quo, low government charges for the disposal of waste streams, incompatible internal investment policies, or an incomplete calculation and allocation of environmental costs

- **Lack of communication in firms**

A lack of communication in firms, or as one industry representative referred to it, "the silo mentality", for example, between engineers and accountants can be a significant handicap to decision making processes which aim to integrate cleaner production considerations. As one industry representative

pointed out, the "issue that breaks the whole [cleaner production] program down is lack of a good communication strategy within companies". Management that is less than fully aware of the potential benefits available through cleaner production because of communication barriers is unlikely to be enthusiastic in its implementation. Beyond potential difficulties in communication, professional groups within a firm may form themselves into rival political factions, with significant activity being directed at maintaining and improving their respective power bases rather than being directed at a coherent cleaner production strategy. Difficulties with communication relevant to cleaner production within firms may in part be overcome by:

- Reducing the isolation of environmental affairs managers and their teams;
- Balancing top-down communication of policy directives with bottom-up approaches;
- Fostering a sense of responsibility for a cleaner environment and public health amongst the workforce; and
- Removing organizational obstacles, such as bureaucratic and rigid structures, which make it difficult to introduce new ideas

☞ **Middle management inertia**

In larger firms, in particular, excessive bureaucratic layers of middle management may frustrate attempts to introduce a cleaner production culture, even when there is a strong commitment from upper management. Middle managers are in many cases resistant to change they perceive as a potential threat to their power and status within an organization, or they may simply be reluctant to part with familiar work practices. Middle managers are also notoriously risk averse and tend to view developments in the context of their own job security. In this regard they are unlikely to be enthusiastic supporters of cleaner production if it is perceived as disruptive to the status. One industry representative suggested that it was important to "give specific performance indicators for middle management to meet environmental objective"

☞ **Labour force obstacles**

In addition to middle management inertia, several aspects of a firm's wider labour force may present obstacles to cleaner production. Problems may occur where there is:

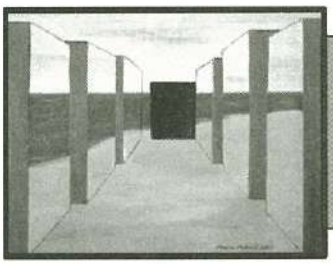
- A lack of personnel in charge of management, control, and implementation of waste reduction technology;
- Reluctance to employ trained engineers for the alleged time-consuming design of waste reduction technologies;
- An inability to manage an additional program within the firm;
- Increased management requirements with the implementation of waste reduction technologies;
- A reluctance to engage in restructuring necessary for cleaner production which involves substantial job turnover , in senior management as well as in line functions and
- A resistance on the part of engineers who have acquired the skills and professional techniques to manage and expand the existing system to acquire the new knowledge and skill that new technology often demands.

☞ **Difficulty in implementing Cleaner Technology**

Firms may have substantial investments in existing technologies, with associated investments in the staff whose skill and expertise is necessary to operate them. Firms may be reluctant to engage in activities that retire expensive equipment before the end of its useful life. Changes in systems and technology may also make certain employees obsolete, and therefore induce organizational structural protection of the existing system

Opportunities for cleaner technologies also vary between industry sectors. In those sectors where technology does not change rapidly, for example mature industry sectors, and where it is hardest to justify investing the capital in new plant and equipment, there will be less opportunity for firms to modify their production processes to implement cleaner production.

EXTERNAL BARRIERS



In addition to the internal barriers identified, there are a number of external barriers to cleaner production over which firms have little or no direct control. Key external barriers include:

☞ **The failure of existing regulatory approaches**

Conventional regulatory approaches have in many cases proved to be counterproductive to the uptake of cleaner production. Overly prescriptive regulatory standards may restrict flexibility and stifle innovation. By assuming that regulators are in the best position to determine appropriate action, regulation may engender an attitude of complacency on the part of firm management - there is no need for them to take responsibility for integrated environmental management planning whilst regulators remain as the standard setters.

Conventional regulation also fails to accommodate the significant variation between different industrial sectors and firms sizes, both in the nature of their environmental problems, and their capacity to develop and implement solutions. New entrants, which may bring more sophisticated cleaner production processes and technologies, may be discouraged from entering the market by lengthy regulatory and legal approval proceedings. Even performance based regulation, whilst allowing firms greater flexibility in how they achieve their regulatory commitments, may inadvertently restrict the adoption of cleaner production processes. By providing mandatory minimum performance standards, which necessarily must be applied to a wide range of business circumstances and capacities, there is little incentive for firms to substantially exceed these minimum requirements through, *inter alia*, innovative cleaner production solutions. In short, performance based regulation encourages a "lowest common denominator" approach to cleaner production.

Further drawbacks of conventional regulation include:

- Uncertainty about regulatory framework in areas offering scope for cleaner production investment;

- Uneven and inconsistent enforcement, which gives rise to an inequitable treatment of firms with the same environmental impacts;
- A complex and costly inspection system;
- Regulators not promoting cleaner production;
- Inducing a culture of "regulatory resistance" amongst industry; an unequal regulatory burden between firms which produce large volumes of emissions and can afford to pay for clean-up and firms with small volumes and limited resources; and
- Little encouragement for innovation designed to prevent pollution at its source at best, it forces the pace of innovation only in clean-up technology and at worst it may encourage minimal compliance with little or no innovative effort by firms.

☞ **Difficulty in accessing Cleaner Technology**

Investment in new, cleaner technology is a major decision for firms to undertake. In addition to the substantial costs of new technology, there are several potential external barriers which may discourage or prevent firms from updating their existing plant and equipment. SMEs, in particular, are susceptible to a range of complexities that serve to undermine their ability to access new technologies, even when they may benefit financially from them. These can be summarized as:

- The complexity of new technology;
- The level of technological specificity (industry case studies made by the OECD (1995b) show that new clean technologies may be hard to transfer from one user to another);
- The performance capability of technology under certain economic requirements and process design standards;
- The lack of (some) alternative substances to substitute for the hazardous components and proven cleaner technologies;
- Unproven technologies;
- Poor service from suppliers;
- A lack of integrated systems from suppliers (i.e. complete solutions for process or product changes as opposed to provision only of technology or of consultancy service);
- Problems of obtaining realistically priced solutions for problems that could not be overcome through "low-tech" cleaner production measures;
- The high cost of cleaner production solutions compared to end-of pipe technologies; and
- Cleaner technologies which have relatively higher prices and lower quality because of low scale production and inferior materials (inferior from a non-ecological point of view).

In contrast, end-of-pipe technological equipment has attractions as it is tried and tested, and easily fitted and readily available from suppliers. The risks are fewer. If the device does not work the firm can continue to produce, installing add-on technology can be a neat public statement of the firm's

commitment to the environment, and may be easier for people to appreciate the adoption of new technology.

Discontinuities in technology may be another external barrier to cleaner production. This occurs when technology is "bundled" into complex systems - one component of a system cannot be replaced or upgraded without necessitating changes to the whole system. This bundling of technology makes it difficult for firms to upgrade discrete components of the manufacturing process to achieve cleaner production. This is because bundled technology requires excessively expensive "lumpy" investments, only some of which may be relevant to the desired environmental improvement. In contrast, unbundled technology spreads the cost of incorporating clean technology: firms are able to improve the operations in manageable steps.

☞ **Difficulty In Accessing External Finance**

The implementation of cleaner production processes and technologies has been hindered by a lack of access to finance. SMEs in particular are frequently unable to make investments in cleaner technologies for a wide variety of financial reasons including a lack of available external capital and the absence of appropriate funding mechanisms.

☞ **Perverse Economic Incentives**

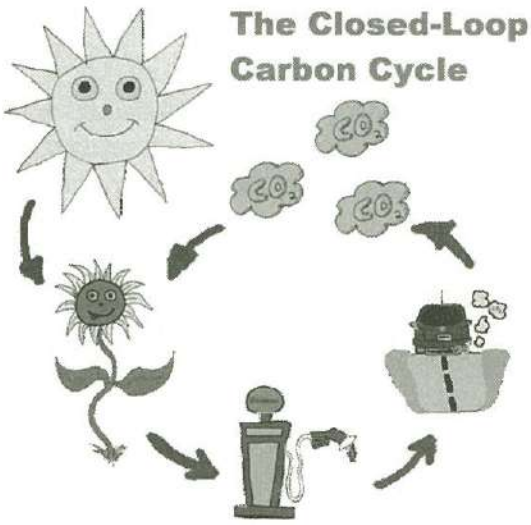
Economic subsidies for business resource inputs may be a significant disincentive to cleaner production. For example, the price of energy has an important influence on energy conservation. Relatively high unit prices for energy stimulate efficiency for existing technologies as well as efforts to develop and use cleaner energy efficient technologies. To the extent that governments reduce the price of energy, or the prices of relatively polluting fuels, through subsidies, they will inhibit the financial benefits of cleaner production. Perverse economic incentives may apply to a range of business inputs and subsequently filter through the myriad of firm management decisions

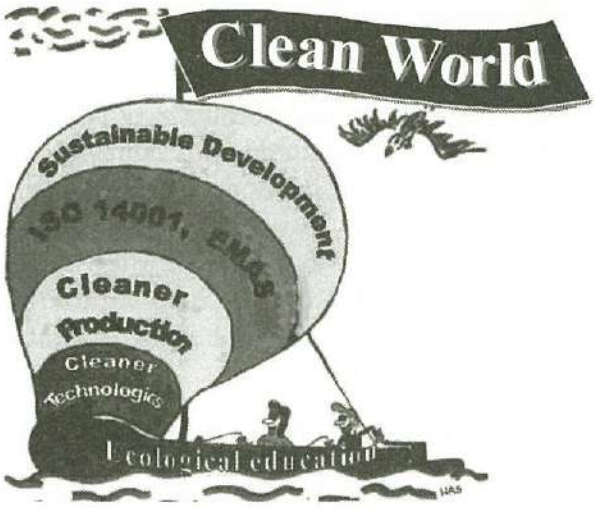
☞ **An Absence Of Markets For Recycled Goods**

Many firms are discouraged from recycling their waste products externally because of a lack of suitable markets. Ultimately, for recycling and re-use to be sustainable in the longer term, markets must be demand driven, not supply driven. Although, strictly speaking, cleaner production refers to the prevention of waste rather than it's recycling or re-use, such activities can form an important component of an overall environmental management strategy. In this respect, the development of sophisticated recycling markets for waste material is an essential pre-requisite.

☞ **Economics cycles**

Prevailing economics cycles will have a major impact in the capacity of firms to engage in cleaner production processes, and in particular, to purchase clean technologies. For example, during periods of recession, Australian firms tend to limit expenditure on new plant and equipment. Domestic economic cycles will be influenced by global trends, with the potential, for example, for a global recession to exacerbate a domestic recession.





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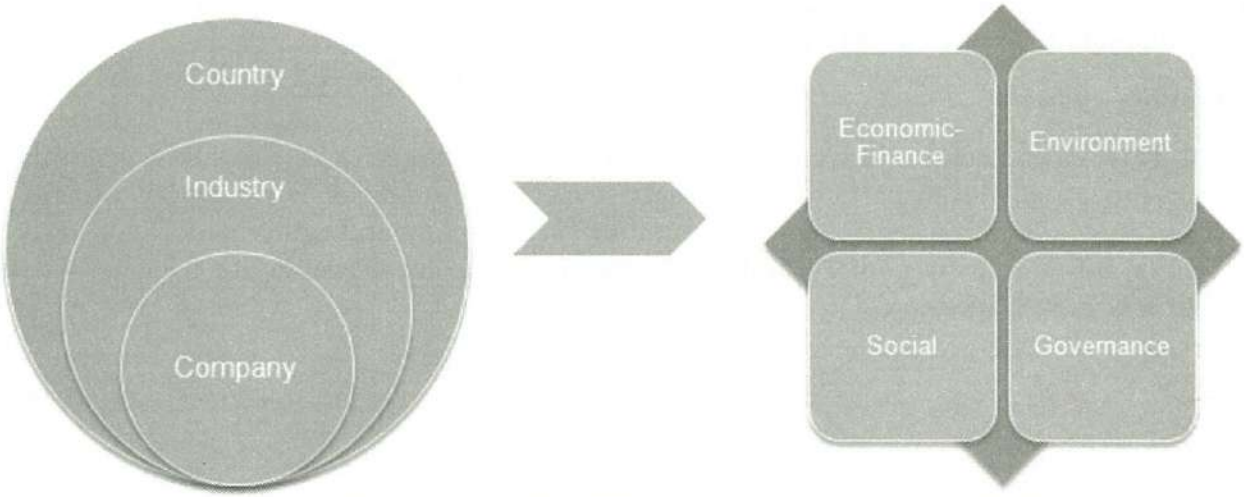


5. WHY NOT ADOPT CP?

It just makes good business sense. Companies that deploy "cleaner production" and embrace Environmental Management Systems not only benefit the environment but generally benefit the bottom line. They are more efficient in their use of energy, of raw materials and are more profitable. These are the companies that will be around over the longer term because they will remain competitive in an ever more competitive global environment.

The potential motivators and drivers for the adoption of cleaner production by industry are many and varied, including, as the terms of reference correctly highlight, regulatory systems, market forces, industry guidelines, information and award schemes, and other incentive schemes.

INTERNAL MOTIVATORS AND DRIVERS:

- **Environmental Management Systems And Continuous Improvement**

As mentioned earlier, Environmental Management Systems (such as ISO 14000 and BS 7750) have the potential to play a crucial role in the adoption of a "cleaner production mindset" within business management structures. Fundamentally, environmental management systems require a reorientation of firm priorities from a static model of discrete environmental solutions to a dynamic one where cleaner production is integrated into a firm's core continuous improvement activities. The benefits of this approach are twofold: first, firms are much more likely to identify cleaner production processes that deliver productivity improvements, thereby enhancing the firm's competitive position; and, second, environmental management systems entail a structured ongoing improvement in environmental performance through cleaner production processes that cannot be delivered through conventional outcome focused or technology specific regulation.

One industry representative suggested that environmental management systems, such as ISO 14000, may not in fact be intrinsic drivers of cleaner production: "there are other environmental management structures that are just as effective therefore it is a structure and not necessarily a driver". As a result, environmental management systems may require another motivator or driver to pre-date them.

- **Voluntary Initiatives**

There is strong evidence that voluntary initiatives on the part of firms can engender substantial cleaner production improvements in both industrial and commercial enterprises. Benefits may flow to participating firms through financial savings, favorable public relations, and enhanced corporate morale.

- **Environmental Leadership**

Harnessing the power of environmental leadership can be a potent tool in the furtherance of cleaner production objectives. Environmental leadership refers to the management process within firms. Those firms in which senior management demonstrates a strong commitment to the principle and practice of cleaner production are likely to experience a "trickle down effect" whereby all layers of the firm experience a much greater corporate environmental commitment

Environmental leadership can have a positive impact on the employees, particularly where they can see improvements in the local environment which may results from their actions. A key element in environmental leadership, as a factor affecting decisions on environmental management and cleaner production, is the sense of accountability to local communities and also, increasingly important, to financial stakeholders (shareholders, banks and insurers). Good relations with local authorities are also seen as important, particularly given the need for planning permission for new plants or sites.

- Corporate Environmental Reports

Corporate environmental reporting can be a useful way for firms to effectively disseminate information about their environmental performance activities, but more than that, it can be used as an internal diagnostic tool for cleaner production. The very act of compiling a corporate environmental report necessarily entails of degree of introspection that may reveal previously hidden opportunities for cleaner production. Corporate environmental reporting is still in its infancy; however, there are some potentially exciting developments which should have positive repercussions for cleaner production

- Environmental Accounting

Various forms of environmental accounting (including full cost accounting) attempt to temper the dominance of narrow financial accounting systems. These recognize appropriate environmental valuations and balancing financial accounting systems with physical and other forms of information in management processes. There is considerable potential for environmental accounting to make a substantial contribution to both business success and sustainable development.

- Improvements In Productivity

A potentially powerful motivator for the adoption of cleaner production is improvements in productivity. Because of the substantial overlaps between good management generally and cleaner production in particular, firms have the opportunity to realize significant cost savings.

Depending in part on length of time the technologies and associated management systems in use, firms may achieve cost savings: through better energy and waste management; decreased demand for raw materials; reduced storage requirements for waste and toxic materials; and less pollution control expenditure. Productivity gains from cleaner production are not just a theory - there are numerous examples which demonstrate the financial benefits that can accrue to individual firms. For example, the United Nations Environment Programme has published a compilation of case studies in different countries and industrial sectors. The examples shown in this report demonstrate a rapid pay-back period, in the order of six months to two years. This compares favourably with other investments. In Australia, the Commonwealth's Cleaner Production initiative has also produced a number of case studies where firms have improved their productivity and reduced costs (EPA 1996).

EXTERNAL MOTIVATORS AND DRIVERS:

- Innovative Regulation And Pollution Prevention

Recognizing the substantial failure of conventional command and control regulation to foster a culture

of cleaner production within firms, a number of innovative approaches have been developed in recent years. Government of Gujarat has institutionalized **Promotion and Propagation of Cleaner Production through Gujarat Cleaner Production Centre.** The Forests and Environment Department has instituted Gujarat Cleaner Production Award for SMEs and Large Scale Industry, which implement CP practically and achieves significant / exemplary environmental benefits and improvement and increasing the productivity at the same time.

(Details are annexed at Annexure 1 - Annexure 2).

- Negotiated Self-Regulation

Key feature of innovative government regulation is a shift from single pollutant and single media approaches to "integrated pollution control". This requires regulators and industry to take account of all the ways in which a facility generates pollution and waste, and avoids the transfer of pollution from one media to another

- Economic Incentives

Negotiated self-regulation between industry and government is a viable alternative, or supplement, to conventional regulatory approaches designed to increase the adoption of cleaner production. Negotiated self-regulation involves target-setting by government and industry, without resorting to legal sanctions, allowing industry to decide the most appropriate ways to meet the targets and thereby encouraging innovative and flexible solutions. Consultation or dialogue on long-range policy goals between government and key "target groups" is a major element for arriving at voluntary agreements.

Economic incentives, through the use of instruments such as taxes, subsidies, and load-based licenses, may be employed to accelerate the adoption of cleaner production. Incentives may be positive, in the form of subsidies and tax deductions, or negative, in the form of taxes and charges. Either way, the incentives work by using a price signal to bring to the attention of management opportunities for cleaner production that would otherwise go unnoticed. A key consideration in the use of economic incentives is the extent to which they can accurately target the desired environmental objective. In the case of cleaner production, this may entail focusing on specific environmentally preferable technologies and/or environmental management systems.

The Industries Department, Government of Gujarat has also issued Government Resolution through the Industry Policy 2009 which provides incentives to industries to adopt holistic approach to Environment Management. (Details are annexed at Annexure 3 - Annexure 4).

- Codes Of Practice

Industry codes of practice are a potentially effective driver of cleaner production. In principle, codes of practice may have several advantages over more conventional forms of government regulation, including: (i) "industry ownership" which may result in a greater commitment to making the code work; (ii) more flexible and cost-effective solutions; (iii) greater sensitivity to market circumstances; and (iv) employing a language that is more readily understood by operators in a specific industry. Industry codes of practice can be a valuable vehicle for promoting appropriate cleaner production

benchmarks within an industrial sector. In order to overcome concerns that codes of practice lack, they may be introduced with a backdrop of regulation only to be employed if and when a code has demonstrably failed.

- **Education And Training**

Education and training will be a vital component of any cleaner production strategy, in particular, to overcome the limited resources of many SMEs. They are also critical to changing attitude and behavior. With any education campaign, the critical issue is being able to effectively target and deliver the message to the intended audience. They work best when they exploit the self-interest of the target audience. In some cases, this may require lateral solutions.

- **Industry Networking**

The sharing of information and expertise, particularly between SMEs, can greatly assist firms in implementing cleaner production. Information exchange can be facilitated by the creation of informal or formal industry networks. The majority of industry networks have been established on a sectoral or sub-sectoral basis; however, they can also be organized along geographical lines. The primary function of networking is to provide firms with a forum to learn from others experiences, however, it can also play a number of other roles, including: the distribution of government sponsored information; the commissioning of external advice and expertise; and acting as a clearing house for new technologies. One industry representative suggested the use of networks between industry sectors to promote markets for the recycling and re-use of waste products.

- **Buyer Supplier Relations**

Larger firms, in particular, may be able to impose product and process preferences on other firms, using their market power to influence the behaviour of upstream suppliers and downstream buyers. For example, firms may require their suppliers to comply with certain cleaner production processing standards and may in fact subject them to an independent assessment of their environmental performance. The interchange between industrial buyers and suppliers generates incentives to innovate and to respond to market demands.

Given the difficulties government faces in regulating SMEs directly, supply chain pressure reinforced by government policy may prove to be an effective complementary strategy. However, supply chain pressure needs to be conducted in a spirit of partnership in order to avoid suppliers feeling persecuted by new and heavy demands for information. Established working relations with suppliers for achievement of quality management goals could go beyond any current unregulated practices which weed out poor performers, and put pressure on them, but were ineffective at raising standards, setting meaningful goals and setting priorities for action.

Some larger firms have taken steps to influence the behavior of SMEs through the practice of product stewardship or cradle-to-grave policies. This entails taking corporate responsibility for the life cycle of a product, from the extraction and consumption of raw materials, through its manufacture, use, and to its final disposal. For example, Dow Chemicals insists on conducting a cleaner production audit before it agrees to supply a new customer with hazardous material, and routinely audits its distributors.

Government can play an indirect role in encouraging, facilitating and rewarding such practices, but, more importantly, can play a direct role by exerting its own supply chain pressure through its procurement policies.

- **Financial Institutions**

Financial institutions, including banks, insurers and investors may play an increasingly important role in encouraging the adoption of cleaner production by firms. Environmental performance, as measured through the adoption of sophisticated cleaner production processes, is increasingly regarded as an indicator of business health. Good environmental management reflects good management in general. To the extent that this perception is shared by financial institutions, pressure on firms to adopt cleaner production processes will be that much greater. There is also the desire to avoid businesses that may face costs associated with environmental liability. Government could play a positive role in providing information such that good environmental performers may be recognized and rewarded in the market place.

- **Community Perceptions And Involvement**

Research demonstrates that, apart from government regulation, community perceptions can play a critical role in determining the environmental performance of firms. For example, the chemical industry is sensitive to community criticism and has subsequently gone to great lengths through its Responsible Care initiative to address community concerns. As one industry representative said "companies generally recognize that it is better to get onto the front foot and actively demonstrate to the community that they are doing the right thing in terms of environmental practice, rather than continually having to react to community pressure in ways which appear negative and unresponsive". Official award schemes may be one way for firms to demonstrate to the community that they have implemented cleaner production. The publicity which may accompany an award can serve as an educative function, by raising public awareness about surrounding circumstances and focusing attention on critical issues. Awards may be conferred in recognition of exemplary behavior by third parties, as well as by industry.

- **Environmental Auditors**

Performance of firms has been a significant development in recent years. Auditors can provide firms with significant commercial incentives. Specifically, their professional services may reduce exposure to litigation and criminal penalties, improve risk management, operating performance and planning, reduce costs through recycling, waste minimization and material substitutions (which might otherwise not be identified as viable) and achieve environmental goals more efficiently and with less application of government resources.

- **Green Consumers**

Growing public sensitivity to environmental issues is reflected in consumer behavior. Collectively, such consumers have the economic muscle to demand that environmentally unsound products are either improved or replaced. Firms which are in a position to demonstrate their credibility as environmentally responsible corporate citizens through cleaner production processes and benefit from

consumer preferences will thus enjoy a competitive advantage. Indeed, consumer preferences may be more exacting than government regulatory requirements. Substantial public relations and marketing advantages can flow from a legitimately earned reputation as a cleaner production firm. It should be noted, however, that customer influence will be stronger in relation to products rather than processes. Green consumer pressure may be limited by information gaps on the consumer side, partly due to the fact that the environmental aspects are only one aspect of a product, and the "free rider" behavior of other consumers. Consumers may also be susceptible to sophisticated marketing strategies which undermine genuine environmental concerns.

- INTERNATIONAL TRADE INCENTIVES

In an increasingly globalised world economy, the power of our major trading partners to influence the production processes of our domestic firms will inevitably grow. This power can be exercised formally through, for example, specific importation requirements, or informally, through the consumer preferences of regional markets.

BENEFITS OF CP

- **CLEANER PRODUCTION AND OPERATIONAL IMPROVEMENTS TO BUSINESS**
  - **Increase Profitability**
    Reduce operating costs
    Increase product yield
    Improve product quality and market share
    Control pollution cost-effectively
  - **Business sustainability**
    Improved regulatory compliance and reduced reputation risk
    Retain/grow market share
    EMS supply chain pressure
    "Green" labeled products
    Improve working conditions
    Reduce liability risks
    Health / Safety / Environment
    Secure access to financial capital and good quality staff
  - **Effective Management**
    People and their creativity
    Information and training
    Effective metering
    Effective tools and systems for data interpretation and action
    Operational methods and control

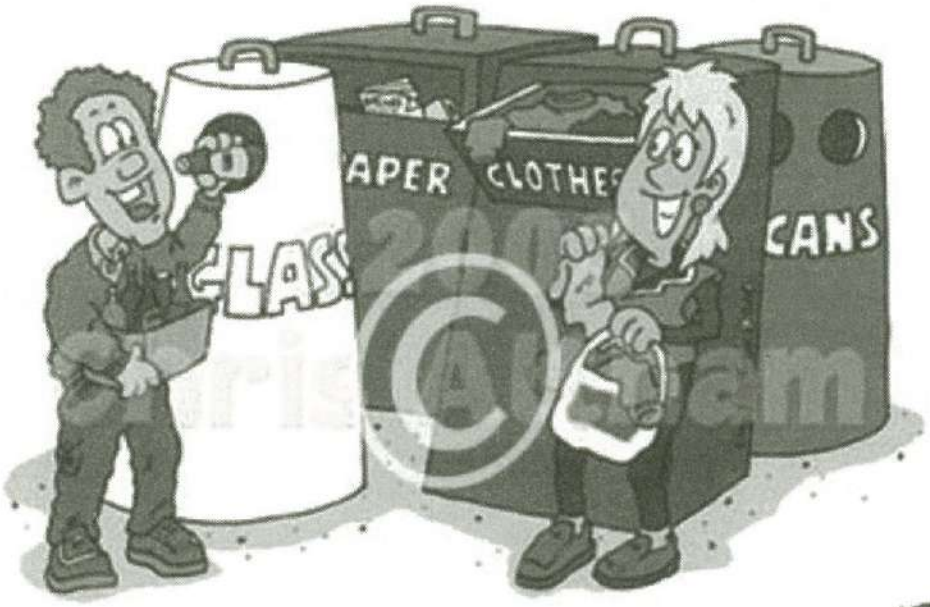
- **Technical Development**
  - Add technology
  - Change technology
  - Change raw materials
  - Change product design
- **Benefit - Reduce Operating Costs**
  - True costs of waste include
  - Waste treatment and disposal
  - Raw material/ingredient cost
  - Waste energy
  - Excessive water demand
  - Effluent generation
  - Packaging
  - Factory/office consumables
  - Product rejects and returns and rework of intermediates
  - Wasted time and effort

The true costs of waste are significant

- Can be 5-20 times what enterprise staff think of as the costs of waste
- Typically 4-10% of sales turnover
- These costs can often be cut by 25% at least.

Chemicals Handling

Fire Extinguished



Notice Board

Use Trolley

6. CP TOOLS FOR DIFFERENT SECTORS

SUCESSFUL CLEANER PRODUCTION DEMONSTRATION PROJECTS FOR DIFFERENT SECTORS

Cleaner Production tools have already been discussed in the previous chapter (figure below depicts the CP tools). This chapter gives some examples on CP tools in different sectors

	CHEMICAL
GOOD HOUSEKEEPING	▪ Smooth flooring of the area the collection of spillage. ▪ To plan the production activity of the derivatives so that vessel washing cycle can be minimized. ▪ To elevate the exhaust of the tray dryer so that moist air can be dispersed away from the dryer. ▪ Timely repair/sealing of water and steam leakages from pipes, valves, flanges etc. ▪ Control of leakages and spillages in the handling and preparation of chemicals and additives.
INPUT MATERIAL CHANGE	▪ Application of Anthraquinones as pulping additive. ▪ Using Poly-Aluminium Silica Sulphate instead of Alum. ▪ Substituting chlorine based bleaching by chlorine free bleaching. ▪ Use better quality of Iron for reduction to reduce consumption.
BETTER PROCESS CONTROL	▪ To use hot alkaline wash water to neutralize acidity as fast as possible. This shall reduce quantity of wash water. ▪ To carry out sulphonation with sulphur trioxide and avoid generation of spent acid. ▪ Optimize the usages of NaOH & KOH as per the Stochiometry.
EQUIPMENT MODIFICATION	▪ Installation of level controllers ▪ Use pump with longer siphon/suction pipe ▪ Timer on centrifuge. ▪ Use of Agitated Neutch filter in place of Neutch and centrifuge.
TECHNOLOGY CHANGE	▪ U-Tube Jet Dyeing instead of winch dyeing ▪ Falling film evaporators instead of multi effect evaporators ▪ Enzymatic de-hairing ▪ Cold pad- batch dyeing ▪ Change reduction process to catalytic hydrogenation or use of some other reducing agent
ON-SITE REUSE AND RECOVERY	▪ Print paste recovery from textile printing belts. ▪ To purify sulphuric acid and recycle partially to process to match water balance.

CREATION OF USEFUL BY-PRODUCT	▪ Use iron sludge for by-product such as ferrous sulphate and filler in brick or for road making ▪ Recovery of sodium chloride & salting it as byproduct. ▪ Solar evaporation of effluent and Recovery of the salt. ▪ Application of screening rejects in board manufacture. ▪ Use of cashew nut - shell oil as coating for corrosion prevention.

FISH PROCESSING UNIT

GOOD HOUSE KEEPING	▪ Separate crusher room from the processing hall. ▪ Use of chutes to capture offal from the filleting tables. ▪ Place PVC catch trays around skinning machine to capture solid material that falls from machines. ▪ Regular maintenance of machines by correcting knives alignment & keeping them sharp. ▪ Keep the finished products covered with plastics bags in basket instead of keeping them in cartons & repacked in small packing as per market demand.
BETTER PROCESS CONTROL	▪ Use of spray (e g 3 second on 3 second off) instead of using running hoses for cleaning & rinsing of fish. ▪ Use flat-jet nozzle with spray angle of upto 60^0 ▪ Apply sanitizers as a fine spray to cleaned surface instead of final rinse with hot water
EQUIPMENT MODIFICATION	▪ Use de heading machine for better yield. ▪ Provide vacuum arrangement underneath the belt of IQF.
PROCESS CHANGE	▪ Use continuous rather than batch processes to reduce the frequency of cleaning. ▪ Use of SS made / aluminum allied trays instead of plastic trays for efficient cooling. ▪ Use of high conductivity aluminum allied foil instead of plastics trays for better heat transfer.
TECHNOLOGY CHANGE	▪ Installation of R.O plant & reusing of treated water in the process areas
ON-SITE REUSE AND RECOVERY	▪ Reuse chlorinated wash water after filtration from 0.2 mm mesh screen in non-critical application like preliminary washing of R/M, cleaning floors etc. ▪ Reuse relatively clean waste water for other application, like thawing waste water could be used for offal fluming or for initial cleaning steps in dirty areas. ▪ In-house reuse of plastics bags & wrappers. ▪ Rain water collection & charging of bore well.

PULP AND PAPER CLUSTER

GOOD HOUSE KEEPING	▪ Use of Hopper or other equipment for unloading the drums and bags. ▪ Proper maintenance and if possible use gland less equipment or proper insulations ▪ Proper segregation of raw material Selling of plastic waste ▪ Insulation of steam line
INPUT MATERIAL CHANGE	▪ Substituting chlorine bleaching by chlorine free bleaching.
BETTER PROCESS CONTROL	▪ Increase boiler efficiency by putting boiler on automatic control with maximum condensate return and flat steam recovery ▪ Installation of a level indicator on the white water tank to avoid an overflow to the wastewater treatment plant ▪ Uniform pressure to ensure high dewatering efficiency ▪ Installation of flow controller on hydro pulper ▪ Controlled water pressure for edge cutting nozzles on paper machine
EQUIPMENT MODIFICATION	▪ Installation of VFD Drive ▪ Conversion of V-belts to cogged V belts ▪ Replacing of electrical chokes by electronic ballast ▪ Installation of hydrodynamic separator on pulper ▪ Promotion of dewatering on wire
ON-SITE REUSE AND RECOVERY	▪ Utilization of recycled water instead of fresh water to clean strainers ▪ Water from the vacuum pump can be reused for paper roll trimming ▪ Using white water to dilute rejects in tank in the first step of cleaning to reduce water consumption. ▪ Fiber recovery from waste water, water recycling using membrane filtration
CREATION OF USEFUL BY-PRODUCTS	▪ Fiber recovery used to produce low grade paper
PRODUCT MODIFICATION	▪ Produce high yield varieties of paper. ▪ Produce unbleached instead of bleached paper.

ELECTROPLATING

GOOD HOUSEKEEPING	• Repair or replacement of leaking pipelines. • Turn off taps when not in use. • Use of Drain boards between process and rinse tanks • Use of protective gloves while working • Tilt parts so that fluid will flow off the part.

INPUT MATERIAL CHANGE	▪ Avoid use of Cyanide. Zinc - Chloride Plating can be used as alternative. ▪ Using less toxic plating solutions (e.g. zinc instead of cadmium.) ▪ Use of trivalent passivation instead of hexa-valent passivation
BETTER PROCESS CONTROL	▪ With draw work pieces at slower rates and allow sufficient drainage time. ▪ Position work pieces so that only a small surface area comes in contact with the solution surface as they are removed from the process bath. ▪ Installation of flow restrictors. ▪ Semi automation in barrel plating ▪ Set up of laboratory to check the Factors/parameters regularly
EQUIPMENT CHANGE ON-SITE REUSE AND RECOVERY	▪ Installation of Scrubber in the ducting system ▪ Installation of R.O. plant. ▪ Use of Spray rinse system. ▪ Nickel metal can be recovered using Metal recovery techniques (e.g., Ion Exchange, Reverse Osmosis, Solar evaporation) ▪ Counter current rinsing

HOSPITALS

GOOD HOUSEKEEPING	▪ Printing both side on paper for the reduction in paper waste ▪ Use cloth materials instead of paper ▪ Regularly check toilet flappers valves and flush mechanism of leaks
BETTER PROCESS CONTROL	▪ Reduction in water losses while dish washing ▪ Use Floor cleaning nozzles with on off control ▪ Automatic water level controller for water storage tanks
EQUIPMENT MODIFICATION	▪ Conversion of petrol vehicles into CNG ▪ Replacement of Existing Tube lights with CFLs
TECHNOLOGY CHANGE	▪ Solar Lighting - Street light- Garden lights ▪ Solar AC ▪ Solar Cooker for cooking ▪ Solar Water Heater ▪ Eco friendly energy efficient evaporative cooling system ▪ Solar refrigeration / Cold storage for kitchen
ON-SITE REUSE AND RECOVERY	▪ Rain water harvesting
CREATION OF USEFUL BY-PRODUCTS	▪ Vermi composting of kitchen waste

HOTELS

GOOD HOUSE KEEPING	▪ Improved house keeping in kitchen ▪ Reduction in water losses while dish washing ▪ Equip guest bath rooms with amenity dispensers rather than keeping the individual packaged amenities ▪ Indoor Air Quality - Pollution Control through indoor plantation
INPUT MATERIAL CHANGE	▪ Use cloth materials instead of paper ▪ Minimize the use of aerosol products ▪ Avoid using non degradable disposable items
BETTER PROCESS CONTROL	▪ Use Floor cleaning nozzles with on /off control ▪ Implementation of automatically on/off Sprinkling system for irrigation. ▪ Automatic Water Level Controller for Water Storage Tanks. ▪ Auto On/Off Switch for all pumps.
EQUIPMENT MODIFICATION	▪ Lighting system with sensors in the passage ▪ Replacement of LPG cylinder into PNG for kitchen ▪ Replacement of Existing Tube lights with CFLs
TECHNOLOGY CHANGE	▪ Solar Lighting - Street light- Garden lights ▪ Solar Water Heater ▪ Solar AC ▪ Solar refrigeration/Cold storage for kitchen ▪ Solar Air heater for winter ▪ Solar Steam Generation System ▪ Solar Sign Boards ▪ Use of solar cooker
ON-SITE REUSE AND RECOVERY	▪ Used cooking oil is processed and use it again, after which it is sent for candles or soap making ▪ Rain water harvesting ▪ Reuse, donate or recycle the amenities(soaps, shampoo, etc)
CREATION OF USEFUL BY-PRODUCTS	▪ Managing biodegradable waste through vermi composting.

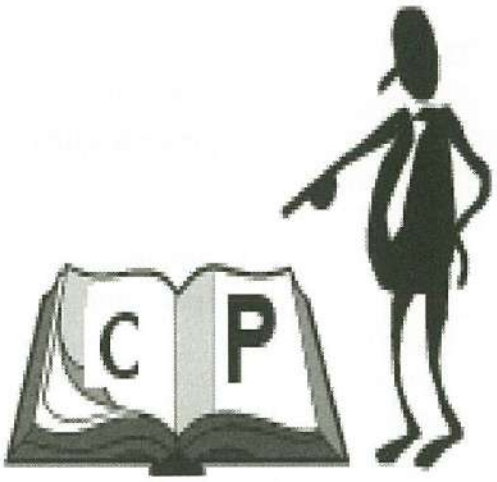
DAIRY SECTOR

GOOD HOUSEKEEPING	▪ Insulation of steam line.
INPUT MATERIAL CHANGE	▪ Uses of PNG (Piped Natural Gas) instead of diesel in sweet section. ▪ Using RO water as cooling water
BETTER PROCESS CONTROL	▪ Reducing pasteurization temperature from 78-80^0 C to 76-78^0 C ▪ Installation of online oxygen trims control system for boiler efficiency improvement. ▪ Installation of an automatic boiler blow down system.
EQUIPMENT MODIFICATION	▪ Change of pouch filling machine from Pneumatic to Mechanical type. ▪ Installation of level controller for boiler makes up water addition ▪ Installation of desuperheater on the refrigeration compressor
TECHNOLOGY CHANGE	▪ Installation of Anaerobic Digester for Treatment of Whey and generation of power from the gas.
ON-SITE REUSE AND RECOVERY	▪ Started collecting the condensate of CIP Plate Heat Exchanger which was drain. ▪ Heat recovery from can washer waste water
CREATION OF USEFUL BY-PRODUCTS	▪ Started separation of serum obtained after pre-separation to recover fat which was drained earlier without separation. ▪ Started separation of whey to recover milk fat.

7. CP METHODOLOGY

This Chapter explains the different steps involved while carrying out CP assessment. Each step is explained with the help of case study.

STEP 1. GETTING STARTED



The first step is the preparation for conduction of Cleaner Production Assessment in the industry. This step comprises of the elements of planning and organization of the CP assessment, including the establishment of a project team, performing a preliminary survey and the selection of audit focus. In order to prepare for the CP assessment, the following tasks need to be executed.

1. *Designate CP team:*

A cleaner production team is formed to coordinate the Cleaner Production Assessment, get the various measures implemented and bear the overall responsibility. The team should be made up of representatives of groups that will have a major interest in the results of the CPA. Depending on the need, external experts can be included in the team.

Case Study

CP team should comprise of Personal from ground level like workers operators,, from management level like Plant In-charge, Head of Energy department etc. it becomes easy to involve the people from every level to go in depth for finding the suitable CP options.

A CP assessment was done in a small scale industry manufacturing DEMAP(Diethyl Meta-Amino Phenol**). A Cleaner Production Team was formed comprising following members Director of the company, Production Manager of the company, Chemist & Plant In-charge of the company and the Staff of GCPC.**

2. *List process steps:*

The team should familiarize itself with the manufacturing processes, waste treatment and disposal facilities and list all the process steps. Preparation of sketches of process layout, drainage system, vents and other material- loss areas would be useful.

- Intermittent activities like washing or catalyst regeneration should be recorded as the operation often gets overlooked. This helps in ensuring that important steps of waste generation are not overlooked.
- Periodic, intermittent and continuous discharge streams should be appropriately labeled.
- In addition, housekeeping and process control practices should be assessed carefully.
- The obvious CP opportunities should be implemented immediately without waiting for the detailed feasibility analysis.

In order to study the above mentioned details, our experience says that frequent walk through visits are helpful. Walk through visit will let you know the step by step process of the unit. It will also let you know the house keeping practiced in the unit. During visit you can find the way the consumption of raw material is monitored.

Ethylation

Inputs	Process steps	Product / by product	Process Conditions	Time	Remarks
1. Metanilic Acid 2. Caustic Lye of mother liquor	**1. Metanilic acid Preparation**	Sodium salt of metanilic acid **[A]**	Mixing At normal temperature	30 mins	Handling losses of M.A.
1. [A] 2. Ethyl chloride 3. Caustic lye	**2. Ethylation**	Reaction mass **[B]**	96-100°C 22kg / cm^2	6 to 8 hrs	Two reactors of same size are used.
1. [B] 2. Caustic lye 3. Cooling water	**3. Dumping**	Salt [c] Diethyl Metanilate **[D]**	----	2 to 2.5 hrs	----
[D]	**4. Cooling Vessel**	**[D]**	----	1 hr	----
[D]	**5. Neautch Filtration**	Wet cake of DEM [E] Mother liquor	----	3 to 4 hrs	----
[E]	**6. Centrifuge Filtration**	**DEM [F]** Mother liquor	----	3 batches part (8 hrs)	----

Fusion

Inputs	Process steps	Process Conditions	Time	Remarks
• DEM • KOH • H_2O	**1. Fusion** • Addition of KOH (230°C) • Addition of DEM. • Reaction maintain at 280°C. • H_2O charging	280°C	22hrs	1. Ash from wood 2. Fumes 3. Spillage
[G] • Hot water (3 times washing)	**2. Neutch Filter** • Addition of fusion slurry by pipe. (2 times) • Separation of salt & product • Washing with hot H_2O for salt. (3 times)	----	4 hrs	Salts generated

Neutralization & Dehydration

Inputs	Process steps	Product / by product	Process Conditions	Time	Remarks
1. Filtrate [H] 2. Ice 3. water 4. HCl / H_2SO_4	**1. Neutralization** • Addition of filtrate in 2 tanks. • Addition of ice for getting temp. 25-30oC • Maintaining of pH by addition of HCl/ H_2SO_4	Reaction mass [G]	25-30°C pH: neutral	2.5 hrs	Floor becomes slippery because of ice crushing
[G]	**2 . Neutch filter** (2 nos of Neutch filters are used)	Wet cake [I]	----	1 hr	Effluent from centrifuge (7000 lt)
[I]	**3. Centrifuge** (2 nos of centrifuges are used)	Wet cake [J]	----	8 hrs	Size of centrifuges is less hence time increases because of 7 rotations.

Inputs	Process steps	Product / by product	Process Conditions	Time	Remarks
[J] Steam	**4. Dehydration** • Manual addition of wet cake • Supply of steam • Water separation by condensation	Liquid slurry of product DEMAP [K]	----	8 hrs	Loss from steam pipe
[K]	**6.. Flakers machine** • Supply of slurry in flakers drum • Layer formation of the surface • Collection of flakes	**Flakes of DEMAP** **PRODUCT**		1 hr	
	Or				
	6. Natural Drying • For Lumps (Collection of liquid slurry in 2 tanks & natural drying)			12 hrs.	
	Or				
	6. Dryer Fluidized bed dryer				

3. *Identify and select wasteful process steps:*

In multi process type industries, it may be difficult to start detailed cleaner production activities in the complete unit. If the industry under study is such an industry, it might be simpler, effective and more convincing to start with fewer, or may be only one process step. These steps could be the most waste generation step and/ or should have high cleaner production potential.

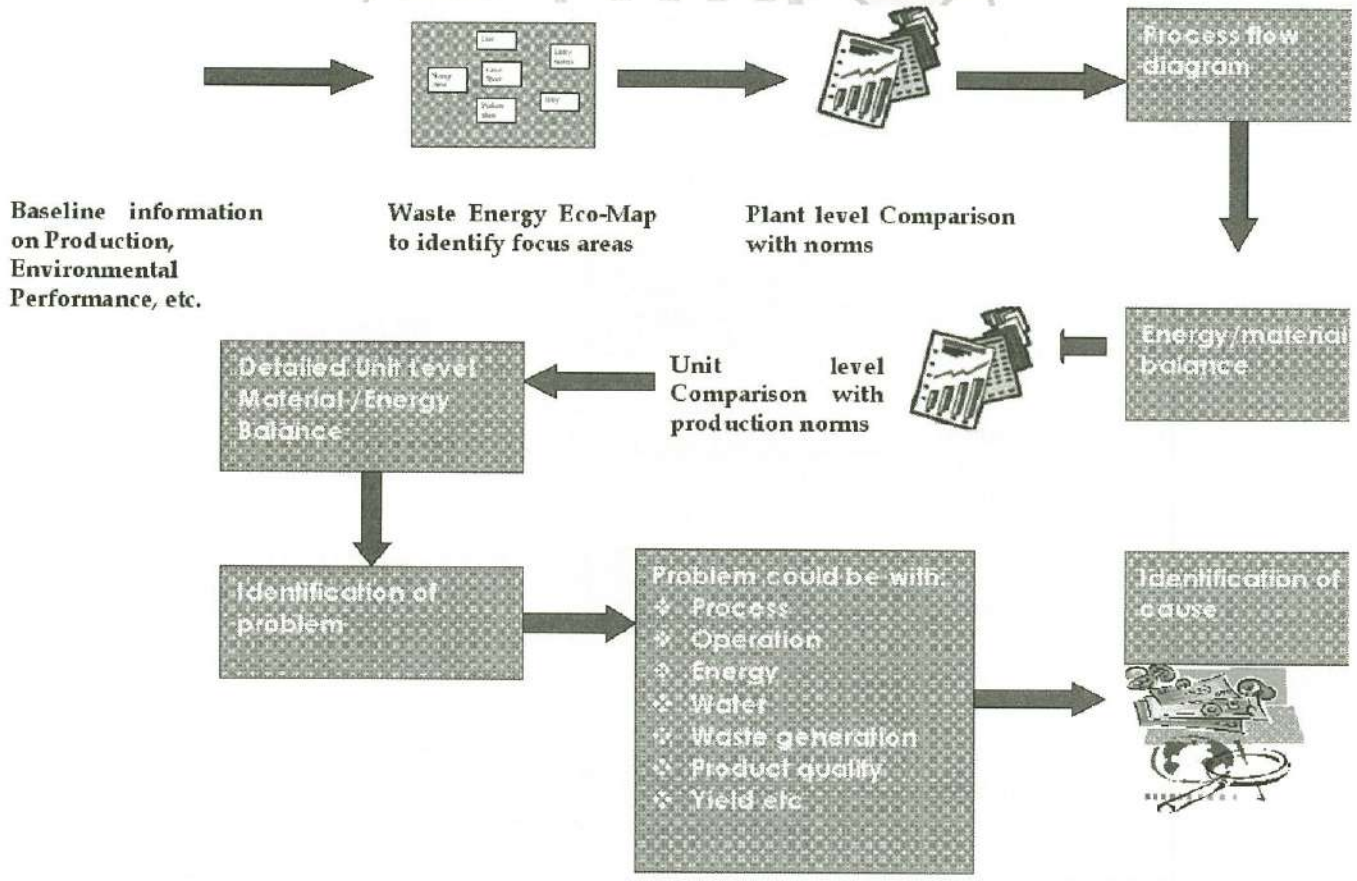
- Preliminary assessment at this stage is effective tools in focusing on one or few process steps for detailed CP analysis.

Based on the experience it was found that walk though visits are very important. Discussions with the workers, operator plays important role in knowing the wasteful process. Workers best know where the process generates the waste, whereas the material consumption is not monitored properly, as they are dealing with the practices everyday.

Major Production steps with the waste streams.

Sr. No.	Major Step	Major wastes	Observations
1.	ETHYLATION - ISOLATION - FILTERATION & CENTRIFUGE	Wet cake of salt generally NaCl; Loss of material while handling	Material handling needs precautions Insulations are not proper
2.	FUSION - FILTRATION	Solid waste - mixed salt with impurities Effluent	Fumes from the fusion vessel are irritating Material transfer practice needs change i.e. lift
3.	NEUTRALISATION - FILTERATION & CENTRIFUGE - EVAPORATION - SETTLING	Effluent	Ice consumption generated more effluent

STEP 2 ANALYZING PROCESS STEPS

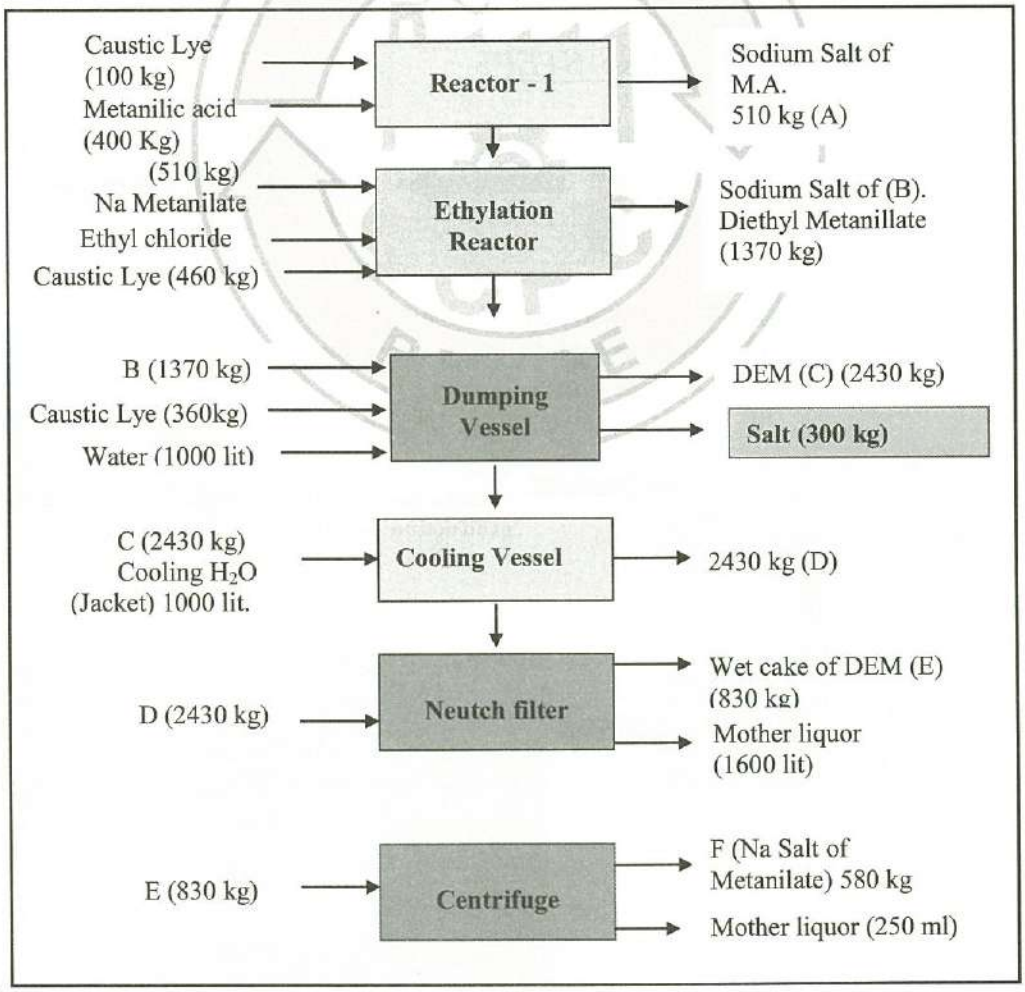


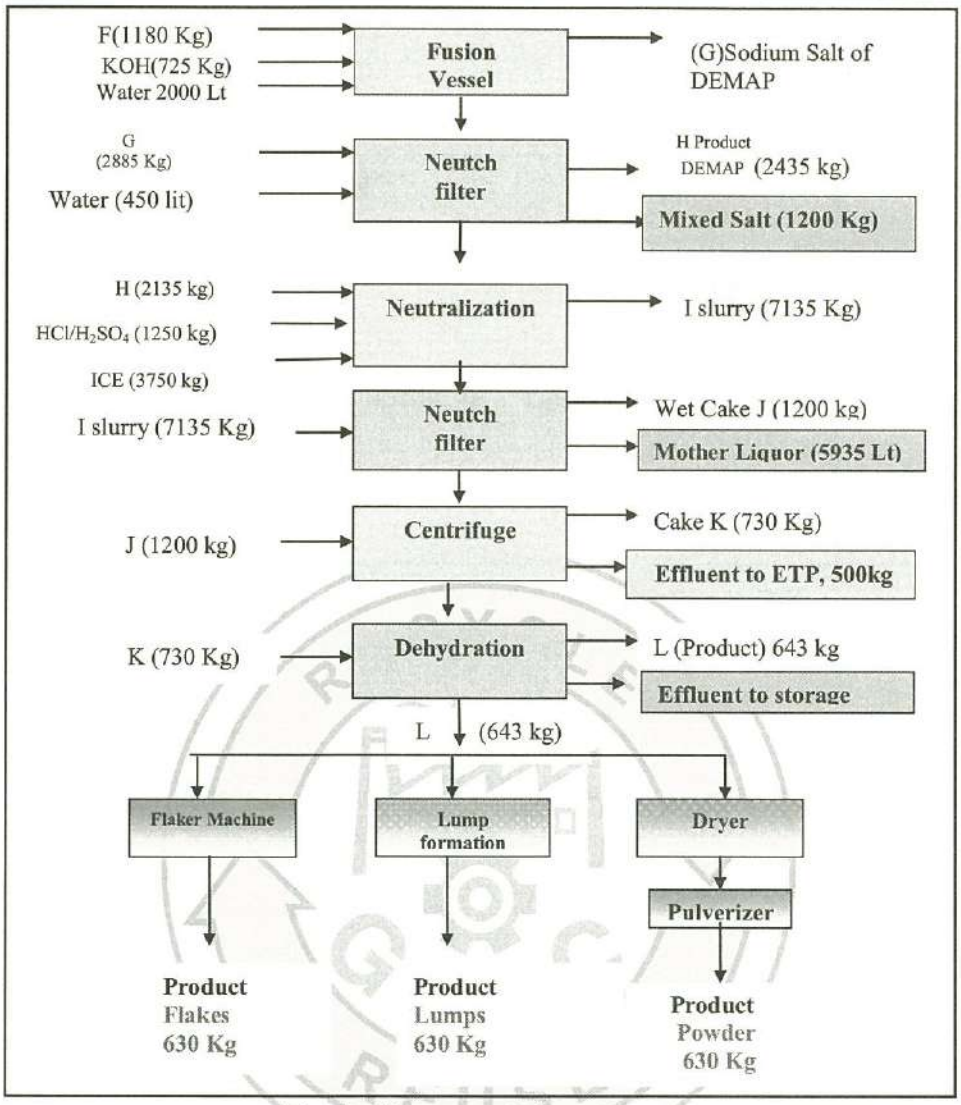
Having identified the audit focus for detailed CPA, the next obvious step is evaluation of the unit operation relevant to the selected audit focus and preparation of material/energy balance in order to quantify waste generation, its costs and its causes. This step incorporates a deeper examination of the audit focus area. The detailed analysis of the selected process steps, generate the required data for CP option generation. The detailed analysis for the CP Assessment incorporates the following tasks.

4. Prepare process flow chart:

Flow charts are diagrammatic/schematic representation of production, with the purpose of identifying process steps and the source of waste streams and emissions. A flow chart should list and to an extent, characterize the input and out put streams, taking special care of the recycle streams. Preparation of a detailed correct process flow diagram is a key step in the entire analysis and forms the basis for compilation of material and energy balance.

- The free or less costly inputs like water, air, etc. should be shown, as these can end up in being the major cause of waste.
- Also specify the materials which are used occasionally and /or which do not appear in output streams (for example; catalyst, coolant oil).
- The periodic /batch continuous steps should be appropriately highlighted.
- A process flowchart shows the system boundaries.





Block diagram of the process

5. Make material and energy balances:

Material and energy balances are important for any CP assessment - since they make it possible to identify and quantify previously unknown losses or emissions. Later on, these balances are also useful for monitoring the advances made in CP program and evaluating the cost and benefits.

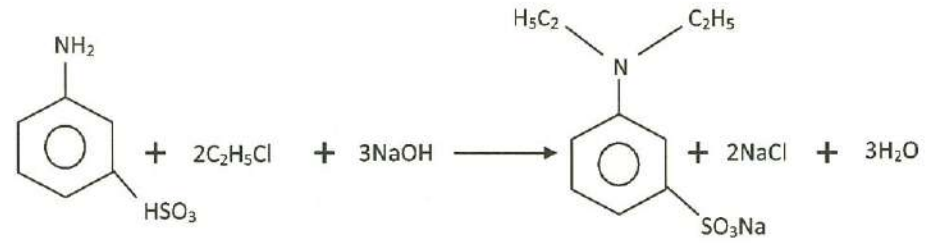
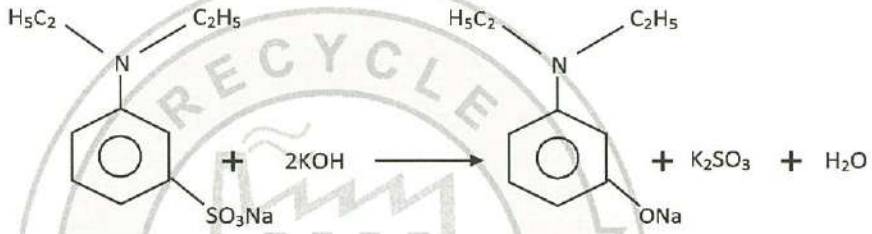
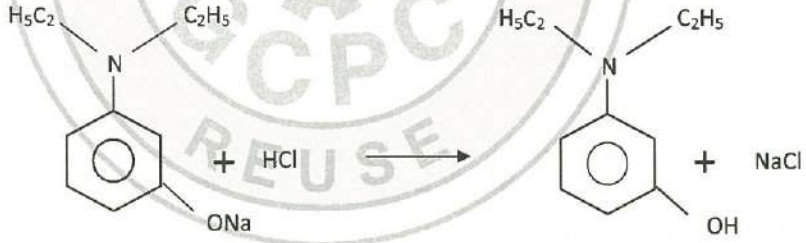
Given the lack of record and lack of data on composition of inputs and outputs it is very difficult to make a perfect material balance. This preliminary material balance throws open CP opportunities, which can be profitably exploited.

It is always advisable to establish the overall material balance across each process plant. Next the CP audit focus should be addressed and the material balance refined for this section.

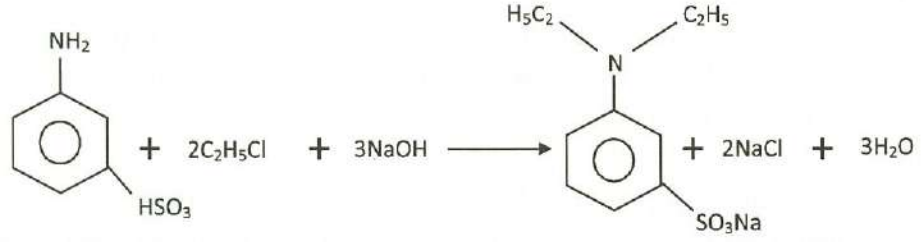
- Material balances performed over the duration of a complete production run are typically the easiest to construct and are reasonable accurate.
- It is worth while to draw competent balance for important resources.
- A detailed monitoring and analysis of the waste stream should be undertaken to establish a reliable material balance.

Material Balance

Chemistry of Synthesis

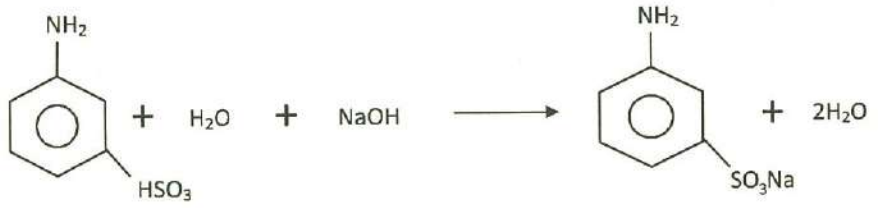
Unit Process	Reaction
ETHYLATION	 METANILIC ACID SODIUM METANILATE
FUSION	 SODIUM METANILATE SODIUM SALT OF DIETHYL META-AMINO PHENOL
NEUTRALIZATION	 SODIUM SALT OF DIETHYL META AMINO PHENOL DIETHYL META-AMINO PHENOL

Stochiometry of the reactions:
Ethylation
Reaction



METANILIC ACID SODIUM METANILATE

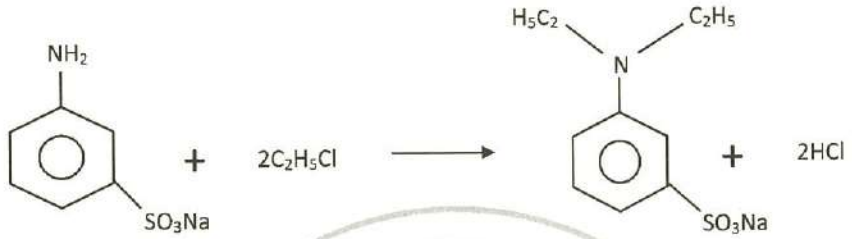
1.



METANILIC ACID

Mol Wt	173	18	40	195	18

2.



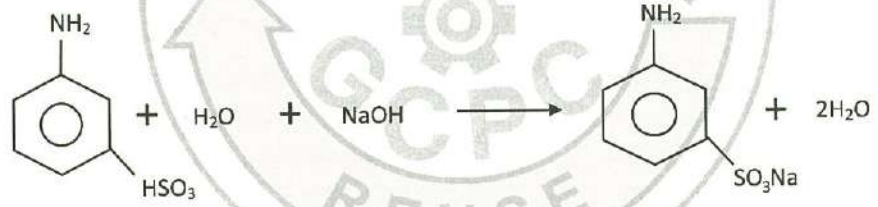
SODIUM METANILATE

Mol Wt	195	64.5	251	36.5

3. $HCl + NaOH \longrightarrow NaCl + H_2O$

Mol Wt	36.5	40	58.5	18

1.



METANILIC ACID

Mol Wt	173	18	40	195	18

Sodium Metanilate Produced:

1 mole of Metanilic Acid produces 1 mole sodium metanilate

173 kg Metanilic Acid produces 195 kg of sodium metanilate
410 kg of Metanilic Acid will produce

$$= \frac{410 \times 195}{173} \quad = \textbf{462.13 kg of sodium metanilate}$$

NaOH required

1 mole of Metanilic Acid requires 1 mole of Sodium hydroxide
i. e., 173 kg Metanilic Acid requires 40 kg Sodium hydroxide

410 kg of Metanilic Acid will require

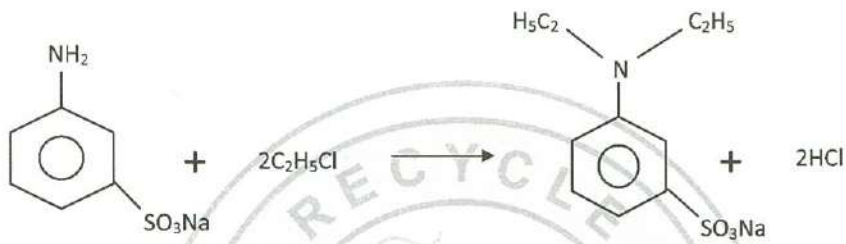
$$= \frac{410 \times 195}{173} \quad = \textbf{94.79 kg of Sodium hydroxide}$$

Water

1 mole of Metanilic Acid requires 1 mole of Water
i.e.,173 kg Metanilic Acid requires 18 kg of Water
410 kg of Metanilic Acid will require

$$= \frac{410 \times 18}{173} \quad = \textbf{42.65 kg Water}$$

2.



Mol Wt	195	64.5	251	36.5

Sodium Salt of Diethyl Metanilate (Na salt of DEM)

1 mole of Sodium salt of metanilate produces 1 moles of Sodium DEM
i.e., 195 kg produces 251 kg of Sodium DEM
462.13 kg will produce

$$= \frac{462.13 \times 251}{195} \quad = \quad \textbf{594.84 kg DEM}$$

Ethyl Chloride

1 mole of Na Metanilate requires 2 mole of Ethyl Chloride
i.e., 195 kg Na Metanilate requires (64.5×2) kg of Ethyl Chloride
462.13 kg of will require

$$= \frac{462.13 \times 2 \times 64.5}{195} \quad = \quad \textbf{305.71 kg Ethyl Chloride}$$

HCl produced

1 mole of Na Metanillate produces 2 mole of Hydrogen Chloride
i.e., 195 kg Na Metanillate produces (36.5×2) kg of Hydrogen Chloride
462.13 kg of Na Metanillate will require

$$= \frac{462.13 \times 2 \times 36.5}{195} \quad = \quad \textbf{173 kg HCl}$$

Water

1 mole of Na Metanilate produces 2 mole of Water
i.e., 195 kg Na Metanilate produces (18×2) kg of Water
462.13 kg of Na Metanilate will require

$$= \frac{462.13 \times 2 \times 18}{195} = \textbf{85.31 kg Water}$$

3. $HCl + NaOH \longrightarrow NaCl + H_2O$

Mol Wt **36.5** 40 58.5 18

NaOH

1 mole of HCl requires 1 mole of NaOH
i.e., 36.5 Kg HCl requires 40 kg NaOH
Hence 173 Kg HCl will require

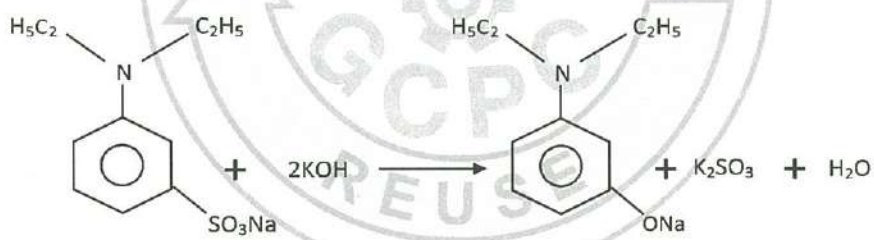
= 189.56 Kg NaOH

KCl

1 mole of HCl 1 mole of NaCl
i.e., 36.5 Kg HCl 58. 5 kg NaCl
Hence 173 Kg HCl will require

= 273 Kg KCl

Fusion



SODIUM METANILATE — SODIUM SALT OF DIETHYL META-AMINO PHENOL

Mol Wt 251 112 187 158 18

Sodium Salt of Diethyl Meta-Amino Phenol

- 1 mole of Sodium Metanilate produces 1 mole of Sodium Salt of Diethyl Meta-Amino Phenol
  i.e., 251 kg Sodium Metanilate produces 187 kg of Sodium Salt of Diethyl Meta-Amino Phenol
  594.84 kg of Sodium Metanilate will produce

$$= \frac{594.84 \times 187}{251} = \textbf{443.17 kg Sodium salt of DEMAP}$$

KOH

1 mole of Sodium Metanilate requires 2 mole of KOH
i.e., 251 kg Sodium Metanilate requires 112 kg of KOH
594.84 kg of Sodium Metanilate will require

$$= \frac{594.84 \times 112}{251} \qquad = \textbf{265.426 kg KOH}$$

Water

1 mole of Sodium Metanilate produces 1 mole of Water
i.e., 251 kg Sodium Metanilate produces 18 kg of Water
594.84 kg Sodium Metanilate will produce

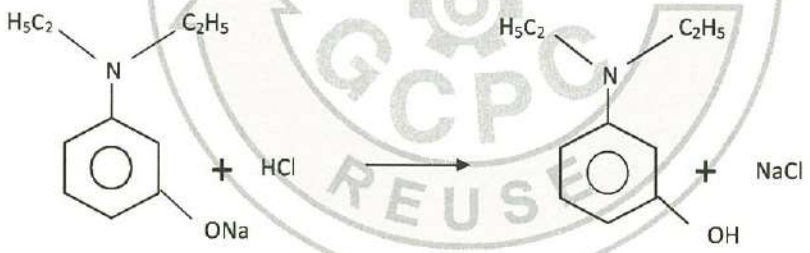
$$= \frac{594.84 \times 18}{251} \qquad = \textbf{42.657kg Water}$$

K_2SO_3

1 mole of Sodium Metanilate produces 1 mole of K_2SO_3
i.e., 251 kg Sodium Metanilate produces 158 kg of K_2SO_3
594.84 kg of Sodium Metanilate will produce

$$= \frac{594.84 \times 158}{251} \qquad = \textbf{374.44 kg } \mathbf{K_2SO_3}$$

Neutralization



SODIUM SALT OF DIETHYL META AMINO PHENOL — DIETHYL META-AMINO PHENOL

Mol Wt	187	36.5	165	58.5

DEMAP

- 1 mole of Sodium Salt of Diethyl Meta-Amino Phenol produces 1 mole of Diethyl Meta-Amino Phenol

  i.e., 187 kg Sodium Salt of Diethyl Meta-Amino Phenol produces 165kg of Diethyl Meta-Amino Phenol

  443.17 kg of Sodium Salt of Diethyl Meta-Amino Phenol will produce

$$= \frac{443.17 \times 165}{187} \qquad = \textbf{391.03 kg DEMAP}$$

HCl

1 mole of Sodium Salt of Diethyl Meta-Amino Phenol requires 1 mole of HCL

i.e., 187 kg Sodium Salt of Diethyl Meta-Amino Phenol requires 36.5 kg of HCL

443.17 kg of Sodium Salt of Diethyl Meta-Amino Phenol will require

$$= \frac{443.17 \times 36.5}{187} \quad \textbf{=86.5 kg HCl}$$

NaCl

1 mole of Sodium Salt of Diethyl Meta-Amino Phenol produces 1 mole of NaCl

i.e., 187 kg Sodium Salt of Diethyl Meta-Amino Phenol produces 58.5 kg of NaCl

443.17 kg of Sodium Salt of Diethyl Meta-Amino Phenol will produce

$$= \frac{443.17 \times 58.5}{187} \quad = \textbf{138.64 kg NaCl}$$

6. Assign cost to waste stream:

In order to assess the profit potential of waste streams, a basic requirement is to assign cost to them. This cost essentially reflects the monetary loss due to waste. Apparently, waste stream does not appear to have any quantifiable cost attached to it, except the treatment and disposal cost. A detailed analysis will reveal additional costs such as cost of raw material in the waste, the manufacturing cost of the material in waste, cost of product/ by product and of course the cost of waste treatment and disposal.

The costs for each waste stream/emission and also the total cost per unit of waste (Rs./Kl or Rs/Kg) should be worked out. Theses figures are of great help in working out the feasibility of the cleaner production measures.

Results of material balance

Table:7.1 Percentage of Excess of Raw Material

Process Step	Raw Material	Stochiometric requirement	Actual use	% Excess
Ethylation	Caustic Lye	191	460	58
	Ethyl chloride	306	400	23.5
Fusion	KOH	531	725	26.75
Neutralization	HCl	173	1250	86

Table:7.2 Yield of Product

Product	Stochiometric Production Kg	Actual Production Kg	% Yield
DEMAP	782	630	80.56%

Losses in terms of Cost:

Table :7.3 Total Loss due to excess raw material usage

Batch	Month	Annual
Rs. 16,522	Rs. 4,29,563/-	Rs. 51,54,764/-

Table :7.4 Loss in terms of product

Batch	Month	Annual
Rs. 36,480	Rs. 9,48,480/-	Rs. 1,13,81,760/-

7. Review of process to identify causes:

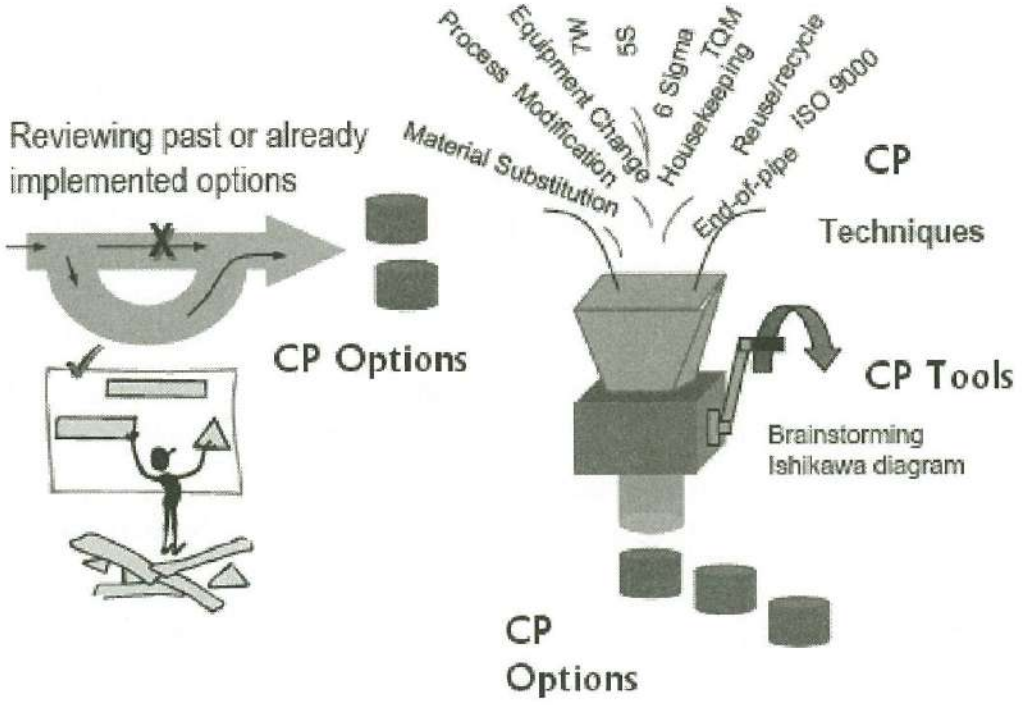
Using the material and energy balances developed, cause analysis should be conducted to locate and pinpoint the causes of waste stream that would subsequently become the tools for evolving CP measures. There could be wide variety of causes for waste generation ranging from simple lapses of housekeeping to complex technological reasons.

A few questions that are useful in waste cause analysis are:

- Why is the waste generated?
- What is the purpose of various chemicals that are added in each step?
- Is the quantity of chemicals being used in excess of the required quantity?
- What is the environmental impact of various chemicals being used in the process?
- What is the status of housekeeping conditions?
- Is it possible to reduce the quantum of waste generated by making some modifications in equipment design?
- Is the operational/maintenance negligence in waste generation?
- What are the latest technological advances available for the industry?
- What is the recycle/recovery/reuse value of the waste stream?

Sr. No.	Major Step	Major wastes	Observations
1.	ETHYLATION - ISOLATION - FILTERATION & CENTRIFUGE	Wet cake of salt generally NaCl; Loss of material while handling	Material handling needs precautions Insulations are not proper
2.	FUSION - FILTRATION	Solid waste - mixed salt with impurities Effluent	Fumes from the fusion vessel are irritating Material transfer practice needs change i.e. lift
2.	NEUTRALISATION - FILTERATION & CENTRIFUGE - EVAPORATION - SETTLING	Effluent	Ice consumption generated more effluent

STEP 3 GENERATING CP OPPORTUNITIES



Having identified and assigned causes to waste generation, the cake is now ready for baking, i.e. determined opportunities. This step is for the development and preliminary selection of workable CP opportunities.

The following task needs to be undertaken to determining CP opportunities.

Cause- option Analysis Description

Waste Stream No.	Waste Stream Description	Causes	Option No.	CP options
1	Loss of raw material because of transportation and handling losses	Improper handling & transportation practice.	1.	Improved & Good House Keeping practices
			2.	Workers training for improved techniques
			3.	Use of Hopper & trolleys
2	Excess raw materials resulted in higher effluent.	Traditional practices	4.	Optimization of raw material requirement as per the stochiometry
3	Sodium Chloride salt.	Excess addition of caustic lye	5.	Use of NaOH as per the stochiometric requirement
			6.	Recovery of sodium chloride & selling it as byproduct
			7.	Install neutch filter after ethylation.
4	Material loss in centrifuges & Neutch & higher time requirement	Improper handling & transportation practice	8.	Install the neutch filter under the dumping vessel so that transformation can be eliminated.
		Improper plant layout	9.	Train the workers for the good practice.
		Smaller size of centrifuge than required.	10.	Use of larger & deep Neutch filter
			11.	Use vacuum in neutch filter
			12.	Use of Agitated neutch filter in place of neutch and centrifuge
			13.	Timer on Centrifuge

Waste Stream No.	Waste Stream Description	Causes	Option No.	CP options
5	Fumes from the fusion vessel	Material addition is not done in proper way	14.	Addition of the material as described in detail in next chapter
		Hopper was not used.	15.	Use of Hopper
		Use of wood for heating which takes more time in controlling the temperature.	16.	Use of Natural Gas for heating.
6	Mixed Salt from Neutch filter	Excess use of NaOH in the ethylation and excess use of KOH in Fusion	17.	Proper recovery on NaCl in the first step
			18.	Optimize the usages of NaOH & KOH as per the stochiometry.
		Recovery of Sodium chloride is not proper in the ethylation step.	19.	Ethylation with KOH
			20.	Fusion with NaOH
			21.	Separation of Sodium Sulphite and Potassium Sulphite as by product.
7	Effluent from the Neutch filter	Higher quantity of ice usages in neutralization	22.	Optimize the consumption of raw material
		Consumption of less concentrated and more quantity of Acid during the neutralization	23.	Higher concentration acid so that less quantity would be required.
		Excess amount of raw material usage.	24.	Use of Chilling plant & jacketed vessel for neutralization
			25.	Solar evaporation of effluent and recovery of the salts.
			26.	Separate plant for the waste treatment and recovery of salts as byproduct.

Waste Stream No.	Waste Stream Description	Causes	Option No.	CP options
8	Material loss at centrifuges & higher time requirement in filter after neutralization	Size of the Centrifuge is smaller than requirement. Hence it needs to centrifuge 7 times to filter the whole batch. Poor house keeping practice in the filter section	27.	Use of larger size of centrifuge to conserve the time and material losses so as to reduce repeatedly handling of material.
			28.	Use of timer on Centrifuge
			29.	Worker's Training for good house-keeping practice.
9	Wood ash from fusion vessel	Use of wood as fuel	30.	Use of Natural Gas
10	Spillage on the floor due to ice crushing	Ice crushing on the floor	31.	Use of bucket elevator
			32.	Use of chilling plant for cooling
11	Heat losses due to insulation leakages	Insulations are broken at many places Maintenance is poor	33.	Proper maintenance to overcome the heat losses due to leakages in insulations.
12	Loss of DEM and Higher time consumption in transportation of DEM	Distance of filtration area and fusion vessel is quite large, so manual transportation of 40 bags takes more time Manual transportation increases the material loss	34.	Use of lift for the transportation of DEM
13	Losses during sieving & packaging	Improper practice.	35.	Use of plastic bags at floor to collect the material.
14	Energy losses	Lack of maintenance Use of large capacity motors Higher time required	36.	Fluid coupling on motors
			37.	Installation of new motor on centrifuge
			38.	Timer on centrifuge

Waste Stream No.	Waste Stream Description	Causes	Option No.	CP options
15	---	-	39.	Use of air compressor for charging ethyl chloride instead of nitrogen

8. Develop Cleaner Production opportunities:

Once the origin and causes of waste and emissions are known, the assessment process enters the creative phase. The team, ready with data and causes to waste generation, should now start looking for possible methods of reducing waste by eliminating waste causes. Finding potential options depends on the knowledge and creativity of team members, much of which comes from their education and work experience. The process of finding CP opportunities should take place in an environment, which stimulates creativity and independent thinking.

- Techniques like "brainstorming", "group discussion" etc. might be applied to boost option generation. The use of CP techniques facilitates the task of determining CP Opportunities.
- External source, such as personnel from similar operations, equipment, supplier and consulting engineers should also be examined.

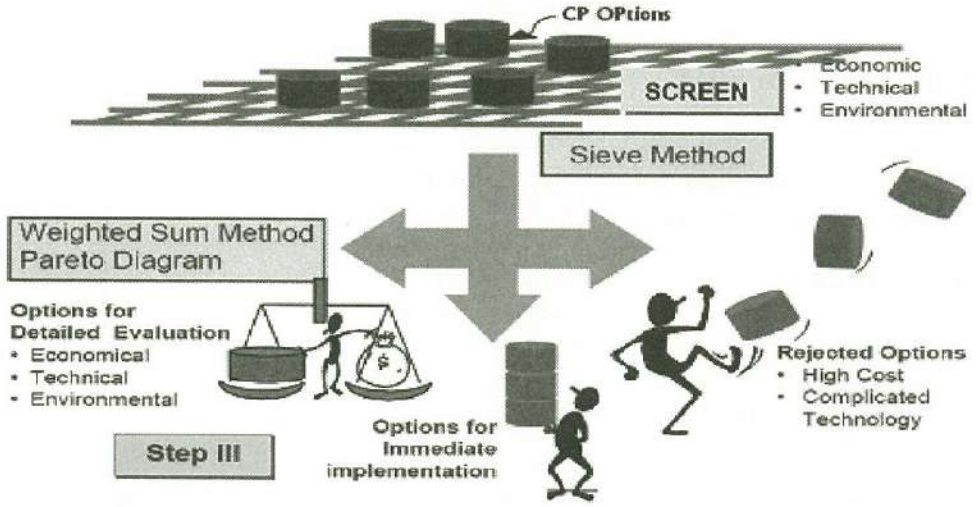
9. Select Workable Opportunities:

Now the need is to screen the cleaner production opportunities developed and weed out those that are impractical.

This weeding out process should be simple, fast and straightforward and may often be only qualitative. There should be no ambiguity or bias. Avoid unnecessary effort of doing detailed feasibility analysis of opportunities that are impractical or non feasible.

- Implement low cost/ no cost options immediately.
- Drop impractical options or options with marginal value.

The remaining cleaner production opportunities are then subjected to a more detailed feasibility analysis.



Screening of CP Options :

Options No.	CP options	Category	Directly Implementable	Needs further analysis	Rejected
1	Improved & Good House Keeping practices	GHK	√		
2	Workers training for improved techniques	GHK	√		
3.	Use of Hopper & trolleys	Equipment Modification	√		
4.	Optimization of raw material requirement as per the stochiometry	Source Reduction		√	
5.	Use of NaOH as per the stochiometric requirement	Better Process Control		√	
6.	Recovery of sodium chloride & selling it as byproduct	Useful by products		√	
7	Install the Neutch filter after Ethylation.	Equipment Installation		√	
8.	Install the Neutch filter under the dumping vessel so that transformation can be eliminated.	Equipment Modification (Layout change)		√	
9.	Train the workers for the good practice.	GHK	√		
10.	Use of larger & deep Neutch filter	Equipment Modification		√	
11	Use vacuum in Neutch filter	Better process control		√	
12	Use of Agitated neutch filter in place of Neutch and centrifuge	Equipment Installation		√	
13	Timer on Centrifuge	Equipment Modification	√		
14.	Addition of the material as described in detail in alternate process	Process Change		√	

Options No.	CP options	Category	Directly Implementable	Needs further analysis	Rejected
15.	Use of Hopper	Equipment Modification	√		
16.	Use of Natural Gas for heating.	Better process control (fuel change)			√
17.	Proper recovery on NaCl in the first step	Better process control		√	
18.	Optimize the usages of NaOH & KOH as per the stochiometry.	Better Process control Sources reduction		√	
19.	Ethylation with KOH	Input material change		√	
20.	Fusion with NaOH	Input Material Change		√	
21	Separation of Sodium Sulphite and Potassium Sulphite as by product.	Useful Byproduct		√	
22.	Optimize the consumption of raw material	Better Process control		√	
23.	Higher concentration acid so that less quantity would be required.	Source Reduction			√
24.	Use of Chilling plant & jacketed vessel for neutralization	Equipment Installation			√
25.	Solar evaporation of effluent and recovery of the salts.	Useful by product		√	
26.	Separated plant for the waste treatment and recovery of salts as byproduct.	Useful byproduct		√	
27.	Use of larger size of centrifuge to conserve the time and material losses due to repeatedly handling of material.	Equipment Modification		√	

Options No.	CP options	Category	Directly Implementable	Needs further analysis	Rejected
28.	Use of timer on Centrifuge	Equipment Modification	√		
29.	Worker's Training for good house keeping practice.	GHK	√		
30.	Use of Natural gas				√
31.	Use of bucket elevator	Equipment Modification	√		
32.	Use of chilling plant	Better Process Control			√
33.	Proper maintenance to overcome the heat losses due to leakages in insulation.	Better Process Control	√		
34.	Use of lift for the transportation of DEM	GHK Equipment Installation		√	
35.	Use of plastic bags at floor to collect the material.	GHK	√		
36.	Fluid coupling on motors	Equipment Modification		√	
37.	Installation of new motor on centrifuge	Better process control Equipment modification		√	
38.	Timer on centrifuge	Equipment Modification	√		
39.	Use of air compressor for charging ethyl chloride instead of nitrogen	Process Change			√

STEP 4: SELECTING CLEANER PRODUCTION SOLUTIONS

The step is for assessing the technical feasibility, financial viability and environmental desirability of preliminary selected CP options in order to develop feasible CP solutions.

The selection of cleaner production solution for implementation requires that it should not only be techno- economically viable but also environmentally desirable. The short listed opportunities are studied from the following angles.

10. Assess technical feasibility :

The technical evaluation determines whether a proposed cleaner production option will work for the specific application. You can start the evaluations by examining the impact of the proposed measures on process, product, production rate, safety etc. in case of significant deviation from the present process practices laboratory testing, trial runs might be required to assess the technical changes for the implementation of the CP opportunities.

Typical technical evaluation criteria are listed below:

- Will it reduce waste?
- Is the system safe for workers?
- Will the product quality be improved or maintained?
- Is the new equipment, materials, or procedures compatible with the existing production system?
- Is additional man power required?
- Will there be any training requirements?
- Will the existing utilities take care of the new equipment?
- Will there be production stoppage for implementation?
- Will the system create other environmental problems?

11. Evaluate environmental aspects:

Assess the options for cleaner production with respect to their impact on the environment. In many cases the environment advantage is obvious: there is a net reduction in the toxicity and or quality of waste. Other impacts could be changes in treatability of the waste, changes in applicability of environmental regulation etc. other than the legislative environmental requirement benefits, the benefits due to resource conservation or reduction in green house gases (GHGs) should also be included in the environmental aspects analysis. Environmental aspects may not be as compelling as economic aspects. However, in the days to come, and as already happening in developed countries, environmental aspects would become the most important ones, irrespective of the economic viability.

Other major environmental consideration for CP solutions could be:

- effect on number and toxicity of waste streams
- risk of transfer to other media
- environmental impacts of the alternate CP solutions
- energy consumption

12. Assess economic viability:

Economic viability would often be the key parameter to promote or dissuade cleaner production. For a smooth take off, it is, therefore essential that the first few cleaner production measures should be economically very attractive. Such a strategy helps in creating more interest and sustains commitment.

Options requiring little investment but involving more of procedural changes (house keeping measures, operational improvements) do not need an intensive economic analysis and simple methods like " pay back" period could be used. However as cleaner production measures tend to become more involved and capital intensive, you may use other profitability analysis methods viz. return on investment (IRR) or net present value (NPV) to get a total picture.

A few difficulties in assessing economic viability could be:

- Most accounting systems do not reveal the total costs of continuing to pollute.
- The complexity also arises as CP solutions.
    - Affect multiple areas
    - Have long time horizons
    - Have probabilistic benefits

Select solutions for implementation:

The technical, economical and environmental assessment should now be put together to look in to the Cleaner Production measures in totality. Understandably, the most attractive ones would be those having best financial benefits, provided technical feasibility is favorable.

However, in a growing number of cases-especially when active pressure groups are present-environmental priority is taking over.

At this stage one should document the work done so far. Apart from becoming a reference document for seeking approvals in implementation, the document would also be useful to you in obtaining finance from external institutions, reporting status to other agencies, and establishing base levels for performance evaluation and review.

- A CP implementation plan should be developed at this stage incorporating the priority of implementation resource required, and time frame.

No.	Option	Technical Feasibility *			Economic Feasibility			Environmental Benefits
		Tech. Req.	Impact on product quality	Impact on Operation"	Investment (one time) INR	Anticipated Saving per Year INR	Payback	
4	Optimization of raw material requirement as per the stochiometry	Nil	+	Nil	-	30, 00, 000/-	-	Reduction in waste generation Reduction in TDS, COD
5	Use of NaOH as per the stochiometric requirement	Nil	+	Nil	-	3,60,000/-	-	Reduction in Waste generation
6	Recovery of sodium chloride & selling it as byproduct	+	Nil	Nil	**	72,00,000/-	**	Reduction in solid waste.
7	Install the Neutch filter after Ethylation	-	+	+	30,000/-	72,000/-	5 months	Reduction is solid waste Less amount of TDS in effluent
8	Install the Neutch filter under the dumping vessel so that transportation can be eliminated.	Nil	Nil	+	5,000/-	-	-	Reduction in transportation & handling losses Reduction in energy cost.
10	Use of larger & deep Neutch filter	Nil	Nil	+	-	-	-	Overcome the problem of spillage of material
11	Use vacuum in Neutch filter	+	+	-	**	**	**	

No.	Option	Technical Feasibility *			Economic Feasibility			Environmental Benefits
		Tech. Req.	Impact on product quality	Impact on Operati on"	Investment (one time) INR	Anticipated Saving per Year INR	Payback	
12	Use of Agitated Neutch filter in place of Neutch and centrifuge	+	+	-	8,00,000/-	3,76,050/-	2 years 2 months	Energy conservation: 49656 uints/year Improved house keeping No spillage of material on floor
14	Use of Agitated Neutch filter in place of Neutch and centrifuge	+	+	-	30,000/-	12,36,00	Immediate	Reduction/elimination in quantity of solid waste generation Recovery of salts from the effluent Less quantity of effluent generation Less TDS in effluent
17	Proper recovery on NaCl in the first step	+	+	+	A per the option no 5 & 6			
18	Optimize the usage of KOH as per the stochiometry.	+	+	-	-	18,72,000/-	-	Reduction in waste streams
19	Ethylation with KOH	+	+	-	-	18,72,000/-	-	Reduction in pollution load Recovery of useful material and hence less TDS in effluent Water and fuel conservation.

No.	Option	Technical Feasibility *			Economic Feasibility			Environmental Benefits
		Tech. Req.	Impact on product quality	Impact on Operation"	Investment (one time) INR	Anticipated Saving per Year INR	Payback	
20	Fusion with NaOH	+	+	+	20,00,000/-	57,42,480/-	2.5 months	Elimination of generation of solid waste of mixed salts as wet cake Recovery of useful material Less amount of TDS in Effluent
21	Separation of Sodium Sulphite and Potassium Sulphite as by product.	+	Nil	Nil	**	18,64,656/-	< 2 Years	Elimination of solid waste.
25	Solar evaporation of effluent and recovery of the salts.	+	Nil	Nil	Rs. 3,00,000/- Based on the final design costing can be calculated	**	**	Energy savings Waste minimization and recovery of useful material
26	Separate plant for the waste treatment and recovery of salts as byproduct.	+	Nil	Nil	Cost analysis can be planned after detail designing			Makes the zero-discharge unit Energy savings Recovery of useful materials.
27	Use of larger size of centrifuge to conserve the time and material losses due to repeated handling of material.	Nil	+	+	Ethylation section 1,50,000/- Neutralization section 3,00,000/-	1,14,780/-	1.4 year	Improved house keeping Reduction in transportation and manual handling Energy savings up to 37,644 Units per year

No.	Option	Technical Feasibility *			Economic Feasibility			Environmental Benefits
		Tech. Req.	Impact on product quality	Impact on Operation"	Investment (one time) INR	Anticipated Saving per Year INR	Payback	
34	Use of lift for the transportation of DEM	Nil	Nil	+	30,000/-	**	**	Reduction in transportation losses Reduction in spillage
36	Fluid coupling on motors	Nil	+	+	*	**	**	Energy savings
37	Installation of new motor on centrifuge	Nil	Nil	Nil	15,000/-	87,960/-	Energy saving up to 17,880 units	

STEP 5: IMPLEMENTING CLEANER PRODUCTION SOLUTIONS:

Actual implementation of the workable CP measures and monitoring of the results achieved by their implementation are taken up at this step.

It could happen that a large number of solutions get implemented as soon as they are identified (leakage sealed, taps closed, idle running stopped etc.) However, several others would require a systematic plan of implementation. The tasks to be undertaken to achieve this are indicated below.

10. Prepare for implementation:

To take up the job of implementation, requires the Cleaner Production team as well as other people in the industry to be prepared. The preparation would include, arranging finances, establishing linkages in case of multi-department solutions, technical preparations etc. The above tasks require (in addition to technical aspects) a careful handling of the concerned persons, to ensure their support and co-operation throughout implementation.

- Good liaison, awareness and information dissemination assist implementation.
- Checklists of tasks involved, agencies / departments to be approached, contacts needed, provide good help.

Selection of CP solutions

No.	CP opportunities	Feasibility						Total Score	Rank
		Technical		Economical		Environmental			
		30 %		50 %		20 %			
4	Optimization of raw material requirement as per the stochiometry	2	0.6	3	1.5	3	0.6	2.7	1
5	Use of NaOH as per the stochiometric requirement	1	0.3	1	0.5	1	0.3	1.1	11
6	Recovery of sodium chloride & selling it as byproduct	2	0.6	1	0.5	2	0.4	1.5	8
7	Install the Neutch filter after Ethylation	2	0.6	2	1.0	1	0.4	2.0	7
8	Install the Neutch filter under the dumping vessel so that transportation can be eliminated.	2	0.6	3	1.5	2	0.4	2.5	4

10	Use of larger & deep Neutch filter	1	0.3	1	0.5	2	0.4	1.2	10
11	Use vacuum in Neutch filter	2	0.6	1	0.5	1	0.2	1.3	9
12	Use of Agitated Neutch filter in place of neutch and centrifuge	3	0.9	2	0.5	3	0.6	2.0	7
14.	Alternate Process	2	0.6	3	1.5	2	0.6	2.7	3
17.	Proper recovery on NaCl in the first step	1	0.3	1	0.5	2	0.4	1.2	10
18.	Optimize the usages of KOH as per the stochiometry.	1	0.3	3	1.5	2	0.4	2.2	6
19.	Ethylation with KOH	2	0.6	3	1.5	3	0.6	2.7	3
20.	Fusion with NaOH	1	0.3	3	1.5	3	0.6	2.4	5
21	Separation of Sodium Sulphite and Potassium Sulphite as by product.	1	0.3	3	1.5	3	0.6	2.4	5
25.	Solar evaporation of effluent and recovery of the salts.	1	0.3	2	0.6	2	0.4	1.3	9
26.	Separated plant for the waste treatment and recovery of salts as byproduct.	2	0.6	2	1.5	2	0.4	2.5	4
27.	Use of larger size of centrifuge to conserve the time and material losses due to repeatedly handling of material.	2	0.6	1	1.5	2	0.4	2.5	4
34	Use of lift for the transportation of DEM	2	0.6	1	0.5	1	0.2	1.3	9
35	Fluid coupling on motors	1	0.3	1	0.5	1	0.2	1.0	12
36	Installation of new motor on centrifuge	3	0.9	3	1.5	2	0.4	2.8	2

10. Implementation cleaner production solutions:

Implementing Cleaner Production Solutions is similar to any other industrial modification and does not require elaboration here. The task comprises layout and drawing preparation, equipment fabrication / procurement, transportation to site, installation and commissioning. To the extent possible, the implementation team should be aware of the job and its purpose, as several useful suggestions have often emerged from the implementation crew.

- Simultaneous training of manpower should not be missed out, as an excellent measure may fail miserably if not backed by adequately trained people.
- Reward and recognition schemes could safeguard the ongoing involvement of the employees.

15. Monitor and evaluate results:

Performance evaluation of all the implemented CP solutions is need as part of the management information system to sustain there commitment for Cleaner Production. Match the results obtained, with those estimated / worked out during technical evaluation, and establish causes for deviation, if any. The team should ensure that the concerned personnel are made aware of the results.

- The implementation job is considered to be over, only after successful commissioning and sustained stable performance over a reasonable length of time.

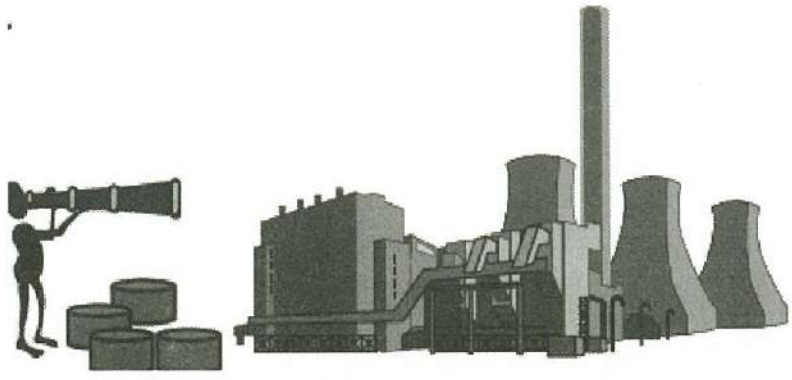
STEP 6: SUSTAIN CLEANER PRODUCTION

Sustaining Cleaner Production is a challenge. The tools and techniques for sustaining the implemented CP solution and elaborating the scope in other areas is the focus of this step.

The biggest challenge in Cleaner Production, in a SME lies in sustaining Cleaner Production. The euphoria of a Cleaner Production programme dies out very soon and the situation returns to where it started. The zeal and tempo of the Cleaner Production team also wanes off.

16. Sustaining Cleaner Production Solutions:

Backing out from commitment, predominance of production at any cost, absence of rewards and appreciation to performers, and shifting priorities are some of the commonly encountered reasons that one should check and avoid. Usually the housekeeping and process optimization related solutions are not sustained if the employees are not continuously motivated to sustain the improved practices.



The monitoring and review of the implemented measures should be presented, in such a manner that it fans the desire for minimizing waste.

- Involvement of as large a number of employees as possible, and rewarding the deserving ones, is a sure key to long-term sustenance.

17. Identify & Select wasteful Process steps:

Having implemented Cleaner Production solutions in the area under study, the Cleaner Production team should go back to step 2 "Analyzing process steps" and identify and select the next wasteful steps. The cycle continues, till all the steps are exhausted by then, in the step taken first, additional cleaner production opportunities could be identifiable and the cycle would continue.

- CP philosophy must be developed within the company and integrated into its activities. All successful CP Programmes to date have been founded on this premise.

BENEFITS OF CLEANER PRODUCTION

Use of cleaner production can produce multiple benefits for industrial sectors and service sectors. These include:

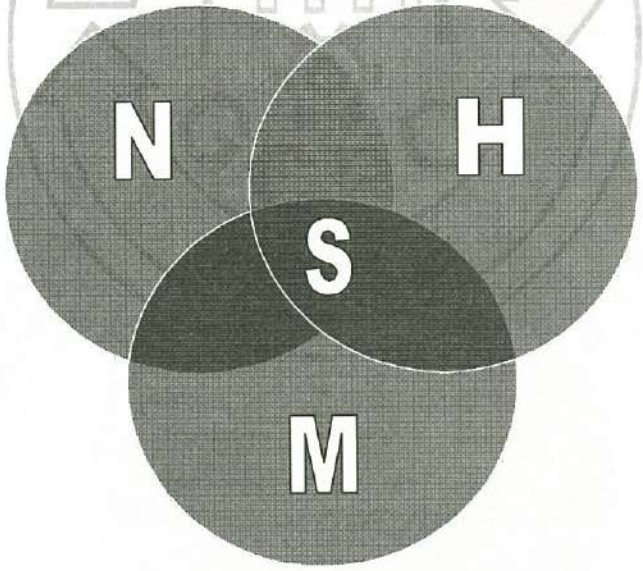
- Gaining community support as a result of improved environmental management
- Ensuring environmental protection which goes beyond strictly regulatory approaches
- Reducing overall costs by improving the efficiency of energy and water use, eliminating disposal and transport costs for wastes, and anticipating and preventing problems instead of treating them
- Increasing local productivity - through greater certainty in schedules and budgets, improved working conditions, more efficient use of resources
- Gaining competitive advantage through the quality of the local environment.

8. CP & SUSTAINABLE DEVELOPMENT

1) RIO DECLARATION & AGENDA 21:

In term, sustainable development is rooted in the 1987 Report of the World Commission on Environment and Development (commonly known as Brundtland Report). Since the 1992 United Nations Conference on Environment and Development (UNCED) in Rio, sustainable development has been progressively embraced by leading industries, national governments, international organizations and financial institutions. There is, however, no uncontested operational definition of sustainability, although there is widespread agreement on the general, non-operational definition adopted by the Brundtland Commission: sustainable development is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). Sustainable development will be a defining element of the future global economy and society: it is seeing the goal as integrating, rather than trading off, or balancing, the three goals of: economic development; environmental protection and restoration; and social equity and well being. Visually and conceptually, progress towards 'sustainability' is optimally attained through strategies and actions at the intersection of three covering circles (see figure 1). This illustrates graphically that sustainability is achieved at the nexus of excellent managerial and production systems, in alignment with and restorative to natural systems, in optimal service of human prosperity and development (Rowledge et all, 1999: p 29).

Natural Capital
Integrative and restorative interaction with natural ecosystem constraints and resources



Human Capital
Optimal contribution to employees, customers and global society

Manufactured Capital
world class strategy and execution, excellent business design, product and service design, production capability and core competence development

S = Sustainable Development Domain
N = Natural Capital
H = Human Capital
M = Manufactured Capital

Fig 8.1 :- A model for sustainability: the nexus of economic/manufacturing, natural and human systems (from Rowledge et all, 1999).

The 1992 United Nations Conference on Economic Development (UNCED) recognized and endorsed the role of cleaner production in sustainable development in Agenda 21. UNEP launched their Cleaner Production Program in 1990. The Program continues to be the major focus of its activities, and includes:

- fostering information exchange among countries;
- capacity building in developing countries through joint UNIDO/UNEP National Cleaner Production Centers; and
- Undertaking demonstration projects in developing countries.

The World Commission on Environment and Development (WCED), entitled "Our Common Future", defined sustainable development as -

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organizations on the environment's ability to meet present and future needs."

A common view of sustainable development is that the three domains of nature, economy and society including culture must all develop but not at the expense of each other. That is why sustainable development issues, prescriptions and tools always cut across the three domains. After the 1992 Rio Summit, 178 nations adopted Agenda 21, a set of guidelines for development in the 21st century. The 40 chapters of Agenda 21 cover issues that cut across the three domains.

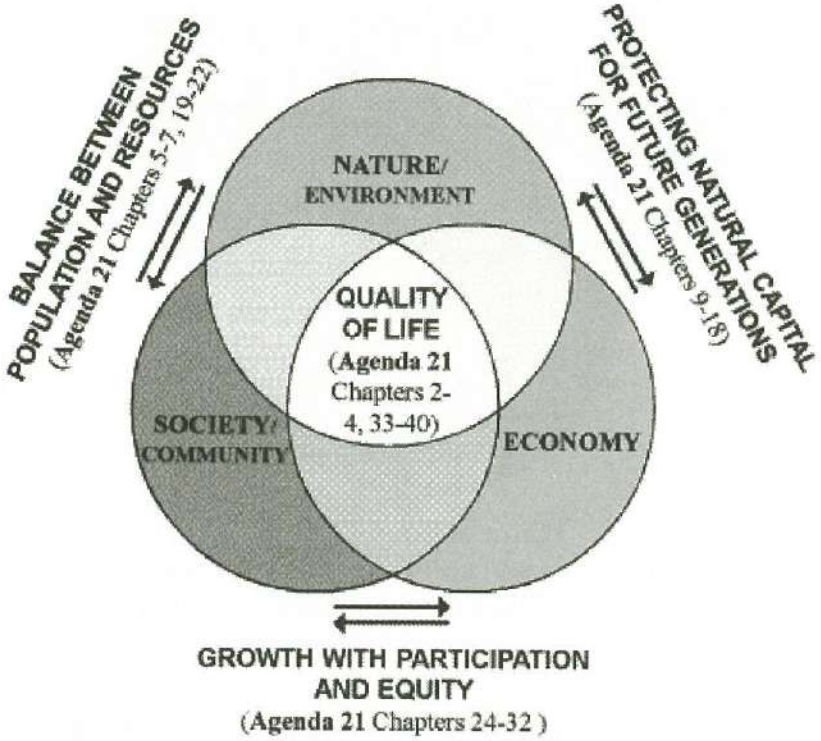


Fig 8.2 :- Sustainable Development Issues in Agenda 21

Principle 15 of the Rio declaration states that, "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environment degradation".

Cleaner production provides a practical way of moving towards sustainable development. Cleaner production allows the producers of goods and the providers of services to produce more with less - less raw material, less energy, less waste, and thus, less environmental impact and greater sustainability. Cleaner production is the step beyond waste management - it deals with the source of the problem, rather than the symptoms.

Cleaner production is not a new concept. It is a logical extension of our desire to conserve materials and reduce waste. It requires a person to examine what they are doing and look for better, more efficient ways to do it - ways that result in increased productivity, reduced resource inputs and reduced waste and most importantly reduced risk of environmental impact.

Cleaner production techniques are dynamic, and although industry has improved its environmental performance over the last two decades, there is continuing room for improvement. Improvement, which when implemented through cleaner production, leads both to improved economic efficiency and environmental protection.

As the following diagram developed by the World Business Council for Sustainable Development (WBCSD) illustrates, encouraging cleaner production is a multi-faceted process.

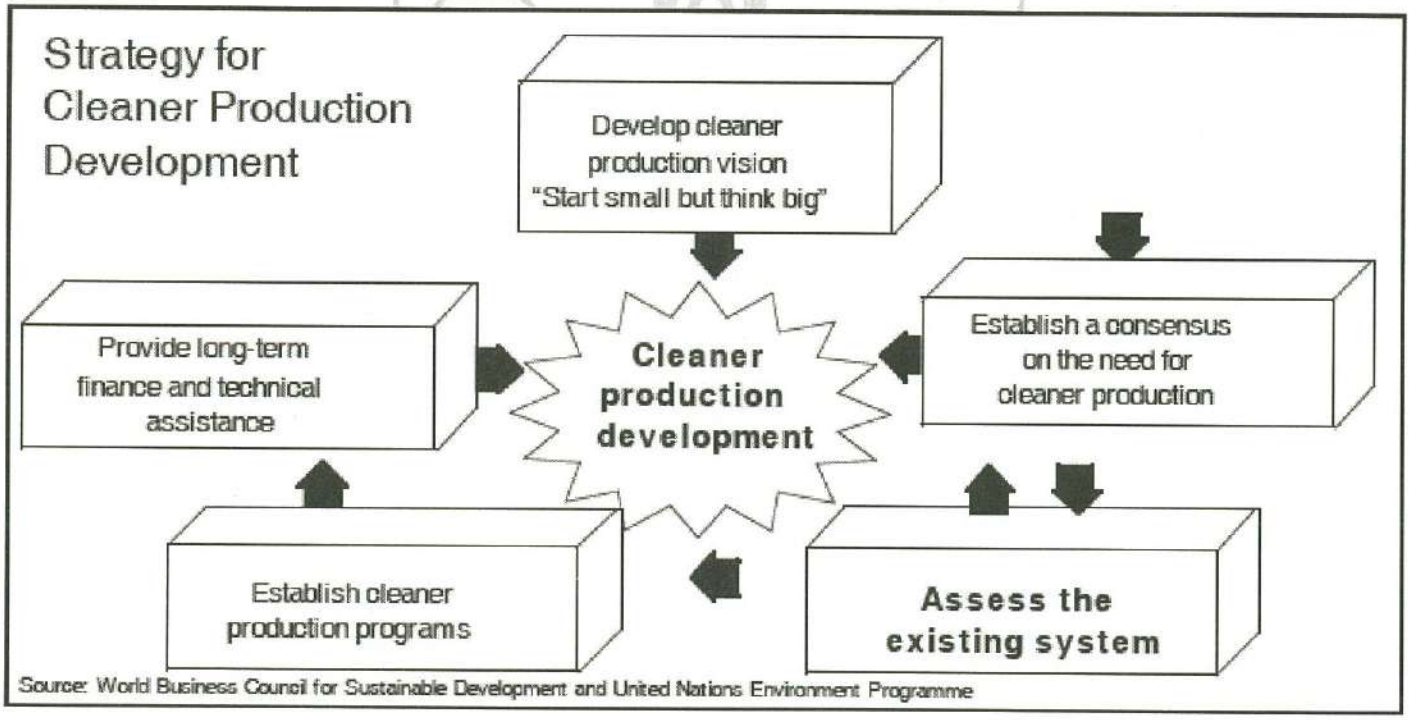


Fig 8.3 :- Strategy for Cleaner Production Development

In an overview of Agenda-21, it is mentioned about 'Cleaner Production' and 'Cleaner Technology' as under:

"Waste minimization has emerged at the top of the hierarchy of industrial and municipal waste management options that range from reduction at source, to recycling and reuse, to treatment and safe disposal. Waste minimization involves the elimination of waste generation through technological and managerial change. It is also a part of broader, preventive approach towards urban environmental management that includes pollution prevention and cleaner technology strategies."

"Reducing waste generation, recycling wastes into productive activities, finding safe ways of disposing the wastes that remain and dealing with illegal trade in hazardous wastes are essential to managing chemicals and waste in a healthy habitable clean world."

"Environmentally **sound technologies** are fundamental to the transition to sustainable development. Development practices since the industrial revolution have been energy and resource consumptive and polluting to an unsustainable degree. The Earth's natural systems can provide neither infinite natural resources nor an endless capacity to assimilate wastes. Consequently, pollution abatement and recycling technologies are essential ingredients of sustainable development."

"The global need to environmentally sound technology extends to sectors and requires a much greater international effort in scientific cooperation and technology transfer. The related programmes of Agenda 21 deal with issues of science for sustainable development and environmentally sound technology as they apply to sustainable development. The developed countries have over time built up a substantial base of scientific and technological knowledge that should be shared with the developing world to ensure a rapid transition to environmentally sound and sustainable development. In particular, the modalities of the access to this technology on favourable terms, including preferential and concessional terms, will be important to the early and widespread achievement of the goals of sustainable development at national, regional and global levels. At the same time, the indigenous knowledge and cultural heritage of developing countries must be integrated with modern knowledge and technology to ensure a viable transition to more sustainable lifestyles and responsible use of the Earth's resources."

2) BUSINESS CHARTER FOR SUSTAINABLE DEVELOPMENT:

The Business Charter for Sustainable Development provides businesses worldwide with a basis for sound environmental management.

Principle 2 of the Charter requires that all policies, programme and practices are integrated into each business as an essential element of management in all its functions.

It urges the management to imbibe a culture of continuous improvement through Principle 3.

Principle 6 (Products & Services) and 8 (Facilities and Operations) guides industries to check that their facilities, operations, products and services are efficient in terms of energy and materials and minimize adverse impact on environment. Research should also be conducted to minimize adverse impacts as per principle 9.

Principle 10 endorses the Precautionary Approach. The Charter advocates promoting the principles to contractors and suppliers and also transfer of technology throughout industrial & public sectors.

3) BASEL CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENT OF HAZARDOUS WASTES AND THEIR DISPOSAL:

Basel Convention was adopted by The Conference of The Plenipotentiaries on 22nd Mar 1989 and entered into force in May 1992.

THE MAIN OBJECTIVES FOR THIS CONVENTION ARE:

- Reduce transboundary movement of Hazardous waste
- Minimize the creation of such wastes
- Prohibit their shipment to countries lacking the capacity to dispose of hazardous waste in "Environmentally Sound Manner (management)."

The key principles related to CP/CT as in Environmentally Sound Management (ESM) are

- Prevention and minimization of generation of wastes (= CP mandate)
- Requires capacity buildings, policy reforms and promotion and use of cleaner technologies and production methods.

References of CP/CT in the convention are as under:

The preamble:

"The most effective way of protecting human health and environment is the reduction of their (hazardous wastes) generation to a minimum in terms of quantity and/or hazard potential."

Obligations (Article4):

"ensure that the generation of hazardous wastes and other wastes is reduced to a minimum, taking into account social, technological and economic aspects."

International co-operation (Article10):

Co-operate in developing of environmentally sound technologies with a view to eliminating the generation of wastes.

Capacity building:

The Secretariat is to assist Parties in waste minimization efforts. (Article16).

Regional Training Centers are to promote waste minimization and cleaner production in developing countries (Article 14).

4) THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE OZONE LAYER:

This protocol entered into force on 1st JAN 1989 as mentioned in the Article-16

The substances that are actively involved in depletion of ozone layer are CFCs, Carbon tetrachloride, Methyl chloroform, Hydrochlorofluorocarbons, Hydrobromofluorocarbons, Methyl bromide and Bromochloromethane.

Under this protocol "to take appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify ozone layer."

By recognizing that world-wide emissions of certain substances can significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment.

The precautionary measures for controlling emissions of certain chlorofluorocarbons that has to be taken at national and regional levels.

5) UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC):

The scientific findings that the earth is getting warmer and may lead to irreversible adverse impacts had lead to the framing of The United Nations Framework Convention on Climate Change (UNFCCC) which was adopted on MAY 9 1992 at the United Nations Headquarters in New York.

The main objective of this convention is to stabilize atmospheric concentration of **Green House Gases** like Carbon dioxide(CO2), Methane(CH4), Nitrous oxide(N2O), Hydrofluorocarbons(HCFCs), Perfluorocarbons(PFCs) AND sulphur hexafluoride(SF6) "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system."

The high profile event hosted by Kyoto, Japan in Dec 1997 has resulted in consensus decision called **"KYOTO PROTOCOL"** is an international agreement of 159 countries, under which "industrialized countries will reduce their combined green house gases emissions by at least 5% compared to 1990's levels by the period 2008-2012." This protocol gives flexibility mechanisms as under:

- Emission trading
- Joint implementation
- Clean Development Mechanism

In this convention they mentioned the Sustainable Development by Cleaner Technology or **Clean Development Mechanism (CDM)** as: "allows emission reduction projects that assist in creating sustainable development in developing countries to generate 'certified emission reductions' (CERs) for use by the investor."

6) STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS:

The convention is basically "Global treaty aiming to protect human health and the environment from persistent organic pollutants (POPs).The convention was adopted in May 2001 and entered into force on 17th May 2004.

POPS ARE CHEMICALS THAT

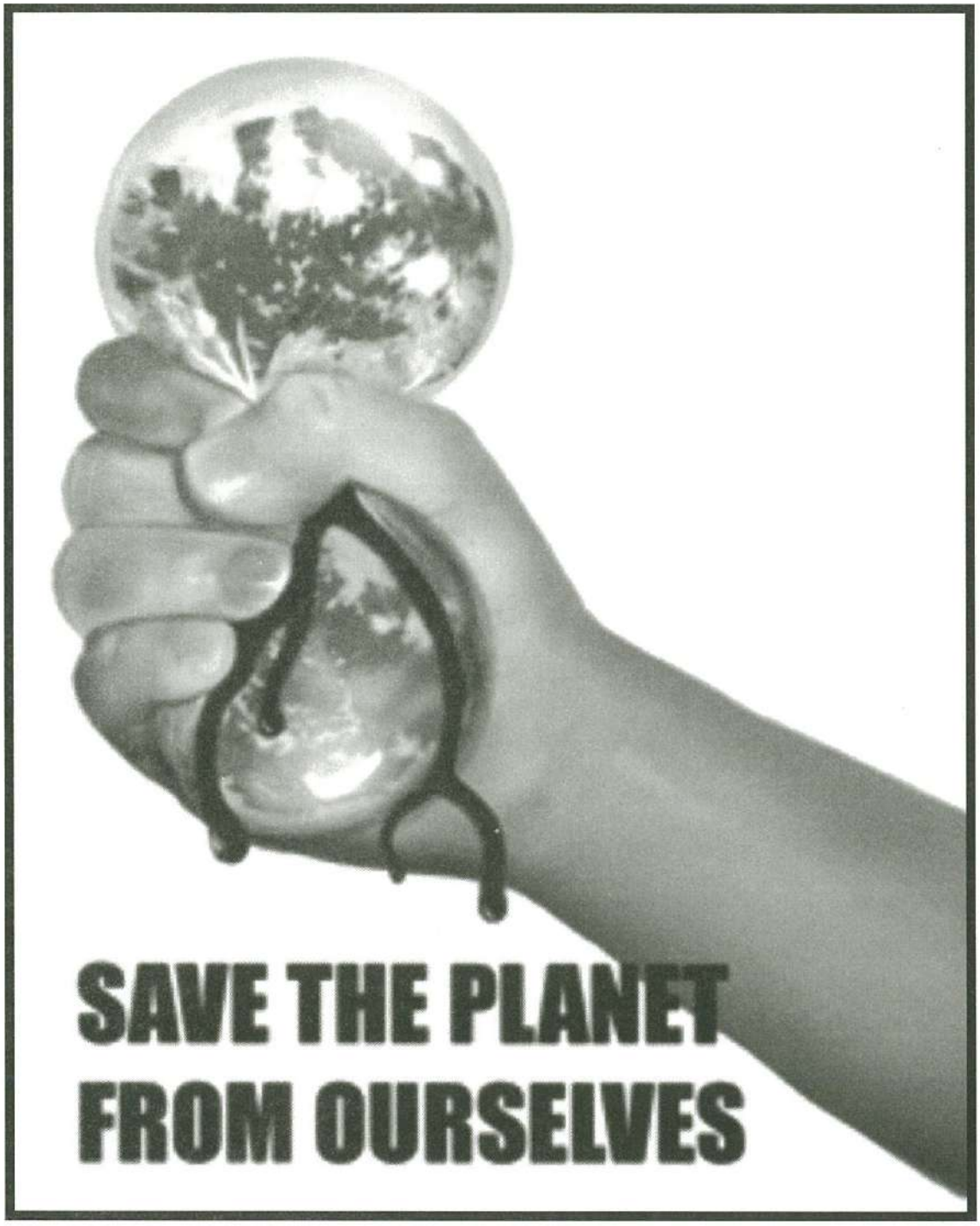
- Remain intact in the environment for long periods
- Become widely distributed geographically
- Accumulate in the fatty tissues of living organisms; and
- Are toxic to humans and wildlife

There are mainly 12 POPs, classified as under:

- Pesticides: Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Mirex, Toxaphene, Hexachlorobenzene
- Industrial Chemicals: Hexachlorobenzene, PCBs
- By products (Unintended): Hexachlorobenzene, PCBs, Chlorinated dioxins, Chlorinated furans

CP in the Stockholm Convention

- Cleaner Production is relevant as a strategy for practical implementation of the precautionary approach
- Precaution and prevention are operationalised throughout the text, and mentioned in:
    - o preamble and objective
    - o Article 3:Measures to reduce or eliminate releases from intentional production and use
        - provisions on the listing of new POPs.
        - control provisions on intentionally produced POPs
    - o Article 5: Measures to reduce or eliminate releases from unintentional production
        - control provisions on unintentionally produced POPs
        - text on determination of the BAT
        - The provisions on implementation.


SAVE THE PLANET
FROM OURSELVES

9. CP NETWORK

Cleaner Production has been promoted both by United Nation Environment Programme (UNEP) and United Nation Industrial Development Organization (UNIDO).The UNIDO Cleaner Production (CP) programme and network aims at building national CP capacities, fostering dialogue between industry and government and enhancing investments for transfer and development of environmentally sound technologies. Through this programme, UNIDO is bridging the gap between competitive industrial production and environmental concerns.

UNIDO's CP programme represents an innovative approach, which increases competitiveness, facilitates market access and strengthens the productive capacity of developing economies taking into consideration the two other dimensions of sustainable development, environmental compliance and social development.

UNIDO believes that CP can only be sustained if capacity is in place to adopt and adjust it to local conditions.

UNEP'S CLEANER PRODUCTION ACTIVITIES

UNEP's Cleaner Production Activities began in response to UNEP's Governing Council Decision in 1989. From the beginning, UNEP has been providing leadership and encouraging partnerships to promote the concept of Cleaner Production on a worldwide scale.

UNEP'S CLEANER PRODUCTION OBJECTIVES

- Increase worldwide consensus on a Cleaner Production 'vision'
- Catalyse implementation of policies and strategies, environmental management systems, environmentally sound technologies, products and the establishment of National Cleaner Production Centres
- Support the growing network of organisations dedicated to promoting Cleaner Production activities
- Help enhance capabilities through training and education
- Encourage demonstration projects and provide technical assistance

Our activities bring together international organisations, governments, industry, non-governmental organisations and academics.

THE CLEANER PRODUCTION NETWORK

National Cleaner Production Centres

Since its inception in 1989, UNEP's Cleaner Production Programme has played a catalytic role in promotion of Cleaner Production concept. In 1994, a joint UNIDO-UNEP National Cleaner Production Centres Programme (NCPC Programme) was launched with an objective of increasing the competitiveness and productive capacity of industry, specifically, SMEs, through the implementation

of Cleaner Production and the application, adaptation and diffusion of Environmentally Sound Technologies. In 2007, the Programme encompassed activities in 37 countries. UNIDO and UNEP view the NCPC Programme as a cornerstone to their activities to foster what UNIDO refers to as sustainable industrial development and UNEP refers to as Sustainable Consumption and Production.

The network of National Cleaner Production Centres includes representatives from governmental organisations, multilateral organisations, industrial stakeholders, development banks, academia and other non-governmental organisations (including professional associations such as the World Cleaner Production Society, World Environment Centre, World Business Council on Sustainable Development, etc.). Network members have launched their own Cleaner Production initiatives, and have the opportunity to meet every second year at UNEP's International High-Level Seminar on Cleaner Production to exchange results and experiences.

CPC Activities

A key part of the informal international network is the UNIDO/UNEP Programme for National Cleaner Production Centres (NCPCs), which is designed to promote and implement preventative environmental solutions, particularly cleaner production. National Cleaner Production Centres promote, coordinate and facilitate Cleaner Production activities within each country while building local capacity. The Centres train and advise clients on how to find the best solutions for specific problems, rather than delivering ready made solutions.

- **OBJECTIVES**

The objectives of the programme

Increase competitiveness :

Experience shows that the application of cleaner production can significantly improve the

competitiveness of industry and reduce the negative environmental impact of existing production processes due to the efficient use of water, energy and raw materials.

Open access to new markets:
The programme provides the national industries with the necessary tools that will help them fulfil the increasing demands of global markets and sub-contracting companies. It will thus facilitate their access to regional and global markets with environmentally sound products.

Stimulate public – private partnerships:
The programme is based on a multi-stakeholders approach and involves the different levels of industry, government, academia and the financial sector. Through its cooperation with these important sectors the NCPCs foster the establishment of a national CP network that promotes the concept in the respective countries and enhances investments in the transfer and development of environmentally sound technologies.

Promote CP investments and CP technology development and transfer:
The programme enhances the development and transfer of know-how on CP techniques and technologies. The Centres and the national experts trained by them do not deliver ready-made solutions; rather they train and advise the clients on how to find the best solution for their specific problems. Due to this, the problem solving process brought by the Centre will not remain a one-time-exercise, but will become an integrated and progressive part of the overall management of the companies. In this way, the NCPC's methodology will also generate continuous demand for CP and other environment related services.

- **CORE SERVICES**

To enhance environmental and social responsibility, competitiveness and export-potential of national enterprises, the Centres offer five interrelated core services:

Technical Assistance and In-plant Assessments
NCPCs work with enterprises at plant level to solve CP-related problems. Through in-plant assessments and specific technical solutions, NCPCs create models of successful applications that demonstrate that the concept of CP can be applied to the national industrial sector and that avoiding waste can be turned into profit. They identify CP options and evaluate their environmental and economic benefits. Depending on local demand, NCPCs develop several different assessment programmes and combine CP with other related instruments, for example CP + environmental management systems, CP + health and safety and CP + labour issues. Assessments are combined with training of company staff to ensure sustainability and foster continuous improvement, thereby enhancing the productivity of the participating companies.

Training
Training in CP is conducted through workshops, seminars and on-the-job training during in-plant assessments. It takes due account of the specialized needs of NCPC target groups, which include industry, sectoral institutions, government officials, research institutes, financial institutions, universities

and consultants. The training of national CP experts to become qualified CP assessors is carried out over several months and combines theory with practical work at the plant level. These CP experts are trained in specific areas, such as CP technology assessment, energy efficiency, CP policy, data management, multilateral environmental agreements (Global Environment Facility, Kyoto Protocol, etc.), health and safety, implementation of environmental management systems (for example ISO 14000) and other subjects. Training also includes awareness raising activities for companies and institutions and their participation at assessments.

CP Technology and Investment Promotion

Access to financing is one of the key elements in CP implementation. NCPCs have to cooperate closely with the banking system and government authorities. To facilitate the transfer of CP technologies to developing countries, a number of national experts is being trained to identify and formulate CP investment projects applying UNIDO's investment methodology and instruments. The identified projects are submitted to national, regional, bilateral and multilateral investment funds and institutions as well as to UNIDO's Investment and Technology Promotion Offices. The Centres also work closely with government and industry in identifying and formulating investment projects to be submitted to multilateral environmental protocols (such as GEF). In this way, companies gain access to financial support, which allows them to obtain the investment needed for introduction of CP techniques and technologies.

Information Dissemination

This component is crucial for creating a CP network at all levels. At the national level, the Centre provides such technical information as available technologies for solving environmental problems in certain processes, shares experience with interested partners and promotes its services through databases, brochures and newsletters. Active co-operation with other national parties for the introduction of CP is a prerequisite for the success of the programme. These parties include industry and industrial organizations, financial institutions, training institutions, government, specific sub-sectoral institutions, universities and research institutes. At the international level, the collected and generated information is shared among UNIDO NCPCs. All Centres are connected by e-mail and Internet giving them access to UNIDO and UNEP on-line resources of CP information (case studies, sectoral reviews and technologies) as well as the UNIDO NCPC database.

CP Policy Advice

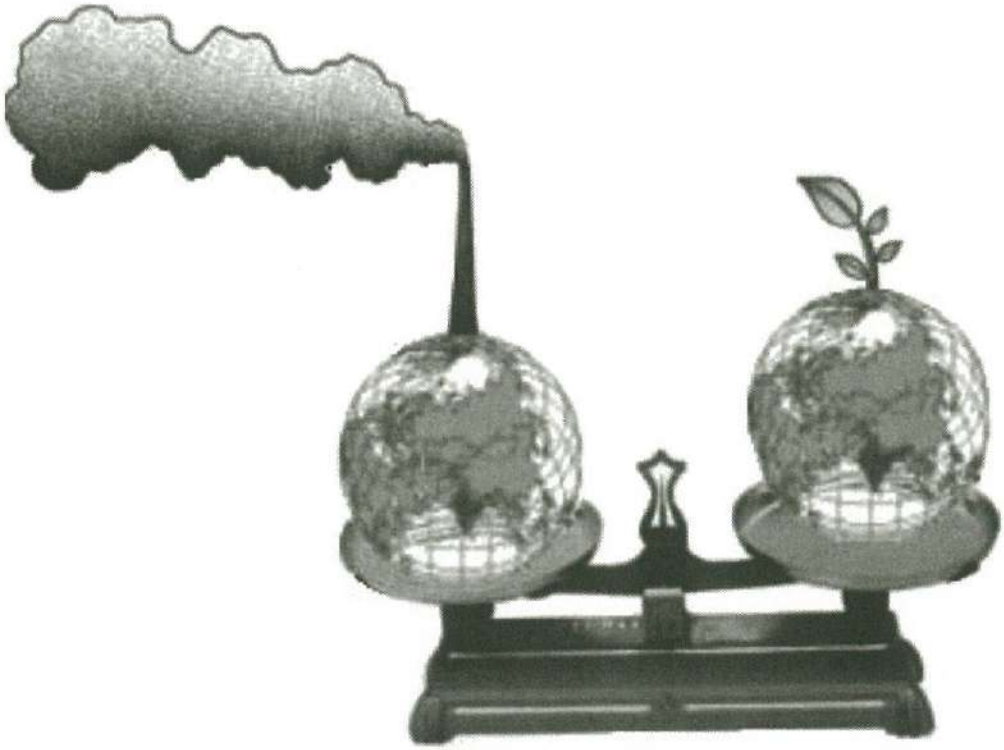
The sustainability of the CP concept will only become general practice in industry if effective environmental regulations and policies that support the application of CP are in place. Besides administrative measures such as licensing, this involves economic measures including the introduction of realistic charges for disposal and utilities such as energy and water. A package of incentives to industry is crucial to a country's CP policy. Through their practical experience at the plant level, cooperation with other important national stakeholders and access to the international expertise provided by UNIDO, the Centres are well prepared to provide substantive inputs to their respective governments and policy making institutions to formulate CP policies and support the dissemination of the CP concept and its implementation by enterprises.

An evolving NCPC Programme

In 2007/2008 UNIDO, in cooperation with UNEP and the Governments of Austria and Switzerland, carried out an independent programme evaluation of the UNIDO-UNEP Cleaner Production (CP) Programme. The evaluation noted that the core element of the prorgamme is the building up and strengthening of local institutions to provide CP services. The majority of the interventions were geared towards the establishment of new centres, although in many cases these centres are hosted in existing organisations (such as Chambers of Industry or Universities). The evaluation concluded that in terms of institutional building and strengthening approach to the programme has been appropriate for the situation in most developing and transition countries. The study also identified a number of areas where improvements can be made. In 2008-9 UNIDO and UNEP are working out a joint Cleaner Production Programme Strategy and activity programming to reinvigorate the NCPCs and capture the synergies that exist with other similar efforts.

A national network (as opposed to a centre) has been established in Cuba. In a new development, a sector-specific cleaner production centre has been established in Russia, focusing on the oil and gas industry. Cleaner production projects have been and are being undertaken in Macedonia and Ukraine, with the possibility of Centres being established at a later date.

Austria and Switzerland are the main donors, providing more than half (61%) of the total funds of the UNIDO CP programme, which amounts to more than 18 MIO.



10. STEPS FOR SUSTAINABLE DEVELOPMENT IN GUJARAT

The rapid growth of the industries in the last few years has resulted into the improved industrial production leading to the economic success and improved standard of living in the State. At the same time, the rapid industrialization together with urbanization has also resulted into several environmental worry. While Gujarat is leading in providing maximum CETP's, TSDF's, incinerators and provided very cost intensive treated waste water disposal schemes, the state is also takes lead in taking sustainable industrial development.

Following actions have been taken by the Gujarat State.

- Establishment of Gujarat Cleaner Production Centre
- Industrial policy 2003 & 2009 announces financial assistance scheme for implementing CP measures.
- Institution CP Award to encourage, appreciate and motivate industries.

GUJARAT CLEANER PRODUCTION CENTRE - INTRODUCTION

Realizing the potential of C.P., for the industries located in Gujarat State, Gujarat Cleaner Production Centre (GCPC) was established in August 1998 with the technical support of NCPC and UNIDO and with the financial support of GIDC. There are about 43 CP centers established in all over the world with the support of UNIDO/UNEP. GCPC is one of the 4 regional Cleaner Production Centre of India. GCPC as a cell of GIDC started its activities of promoting Cleaner Production in the industries.

To promote the Cleaner Production concept on larger scale Government of Gujarat, Industries and Mines Dept. has established Gujarat Cleaner Production Centre vide GR No. GID/102007/2561/G dated 12/02/08, as a separate entity, to be governed by Governing Council.

Gujarat Cleaner Production Centre has been registered under Society Act-1860 and Trust Act-1950 in August 2008 and now has a Separate entity.

GCPC plays an important role in education, permeating and providing knowledge as well as expertise to tackle with various environmental issues that the various sectors of the industry shall need to address in the current scenario or in the near future. GCPC believes in prevention rather that cure.

GCPC is actively engaged in the promotion of Cleaner Production (CP)/Clean Technology (CT) through its various activities like Orientation Programmes, CP Assessment Projects, and C.T. Assessment Projects etc. It has taken up demonstration projects in many industries of various sectors i.e. Dyes & Dye Intermediates, Pharmaceuticals, Textile, Fish Processing, Petrochemicals, electroplating, pulp & paper industry, and also service sectors like hotels and hospitals etc.

OBJECTIVES OF GCPC ARE AS UNDER:

- To create awareness on Cleaner Production / Clean Technologies / Technology Up gradation
- To provide cost effective training to industrial personnel/ students on Cleaner Production (CP) / Clean Technology (CT) assessment and implementation.
- To Organize and conduct Cleaner Production demonstration projects in different clusters.
- To develop expertise and thus provide consultancy / advisory services on cleaner Production methodologies.
- To assist Government in making policy issues on CP/CT
- To prepare guidelines and manuals preferably in local language on Cleaner Production.
- To promote Local Cleaner Production Centres.
- To initiate actions for establishing on institution for training people on CP/ CT with pilot plant facilities etc.

As per Government Resolution (GID-102007-2561-G) of Industries and Mines Department, dated 12/02/08, the first Members of Governing Council (GC) of Gujarat Cleaner Production Centre are as under:

Vice Chairman & Managing Director, Gujarat Industrial Development Corporation, Gandhinagar	Chairman
Member Secretary, Gujarat Pollution Control Board, Gandhinagar	Member
Director (Environment) Forests and Environment Department, GoG, Gandhinagar	Member
Technical Advisor (Chemical), Industries Commissionerate, Gandhinagar	Member
Head of the Department, Environment Engineering Department, LD college of Engineering, Ahmedabad	Member
President, Federation of Industries Association	Member
Sr. Engineer, GIDC, Gandhinagar	Member Secretary

Activities Of GCPC

GCPC is actively engaged in the following activities : -

[1] Orientation Programmes :

To achieve its goals, GCPC has started its activities from the first step i.e. C.P. Awareness Programmes. Because the concept of CP is new for the industries as their mind sets are convinced on End Of Pipe (EOP) concept and traditional ways of production, it is necessary to make the industries aware about C.P. GCPC has so far conducted more than 50 Orientation Programmes in various Industrial Estates as well as in engineering institutions.

[2] CP Assessment Projects :

This is most crucial step of CP wherein detail study of process, waste streams, cause options are studied. After this exercise CP potentials with options are identified and each option is evaluated from technical, financial and environmental point of view. It takes about 4 to 6 months duration. At the end, the report suggesting CP tools is handed over to entrepreneurs for its implementation. Gujarat State has industries in all sector i.e. Chemical, Fertilizers, Pharmaceuticals, Electroplating, Engineering etc. Chemical Industries of Gujarat are producing @ 51% of total national production of chemicals. It is in this context, GCPC has given priority to Chemical Industries for Demonstration Projects. GCPC has so far completed 24 demonstration projects in various sectors i.e. Dyes & Dye Intermediates, Chemical & Petrochemical, Pharmaceutical, Fish Processing, **pulp and paper**, **electroplating** and also service sectors like **hospitals** and **hotels**.

[3] Training Programmes :-

One of the major services of GCPC is Training Programme. GCPC has conducted many training programmes in various industrial estates and academic institutions. Main purpose of the Training Programme is to train the industry people as well as engineering students of related field, about the Cleaner Production / Clean Technology with Methodology.

[4] Dissemination Programme :-

Even though cleaner production has explicit benefits, the concept has not totally picked up in Gujarat due to the absence of a coherent and close working group to facilitate the dissemination of information and to provide guidance to the needy. In the absence of such a group, the success of CP has been confined to few industries without any multiplier effect. The centre has accepted the challenge and is seriously working to spread the CP/CT concept and to achieve multiplier effect, dissemination programme have been organized in the industrial estates. Here, the success stories of units are discussed by the demonstrating unit to motivate other industries.

[5] Awareness programs on Energy Efficiency

The aim of the training program is to update industries with new technologies and services relevant to Energy Efficiency. Knowledge about new funding mechanisms, financing structures and how to develop bankable energy efficiency projects is also given. The program is aimed at Senior, middle management of organizations/ industries / establishments that have energy as one of the key cost components and would like to manage it to gain competitive advantage.

[6] GCPC-CDM Cell

Ministry of Environment and Forests, Government of India has identified Forests and Environment Department, Government of Gujarat as the State Level Nodal Agency for CDM Projects. The Department has constituted 'Clean Development Mechanism Cell 'and Director (Env) functions as Projector Director. The project is executed jointly with Gujarat Cleaner Production Centre (GCPC), Gandhinagar.

Activities of CDM CELL:

CDM Cell constituted will help industries through:

- Awareness Programme on CDM for the Industries
- Collect data on Potential of CDM in Gujarat Assist Dept. and Industries in preparing PCN (Project Conceptual Note) and PDD (Project Design Document)
- Arrange meeting of industries with the experts

[7] ENVIS Centre

GCPC is also functioning as a ENVIS (Environment Information System) -NODE on the subject area "Cleaner Production And Technology" under World Bank Assisted Environment Management Capacity Building Technical Assistance (EMCBTA) Project of Ministry Of Environment & Forests (MoEF), Government of India. The activities under this project comprise of:

a) Dissemination of CP information through website

b) Publication of News Letter on Cleaner Production and Technology.

c) Identification of Information/data gaps in the specified subjects areas and actions taken to fill these gaps.

d) Data Base Creation on Cleaner Production & Technology.

e) Contribution of News Items for ENVIS News Letter.

f) To establish and operate a distributed clearinghouse to answer and channel queries related to Cleaner Production and Technology.

g) To establish linkages with information users, carriers and providers from among government, academia, business and Non Government Organizations including that with ENVIS.

h) To have linkages with information sources in the country and abroad for increasing the information contents.

[8] Gujarat Cleaner Production Award

Gujarat is also the first state who declared the policy for Cleaner Production and also award for the Cleaner Production Implementation in SMEs. The Forests and Environment Department, Government of Gujarat has taken initiative in a proactive way to tackle the Industrial Pollution issues through promotion of Cleaner Production for Sustainable Development. The F & E Dept. and GCPC have also promoted Cleaner Production and Cleaner Technology among the industries of Gujarat State by Capacity Building, Awareness Programme, Demonstration Projects and CP Award etc.

The award is given to one of the best among these industries particularly from the angle of adoption and successful implementation of Cleaner Production and showing exemplary work in forms of raw material and energy conservation, reduction in pollution, increase in productivity etc. Award is given to the unit getting significant financial and environmental benefits & improvement in the productivity.

- The Awardees are selected by the committee constituted by the State Government for this purpose.
- The award is in the form of Certificate and a Trophy which may be retained permanently by the industry.

[9] Projects as Dissertation for the Students

One of the activities of Centre is capacity building of students. GCPC has guided 6 students of Final year M. Sc. Environmental science of S.P. University, V. V. Nagar, for their thesis at Post graduate level and one student of final year M.E. (Env. Engg.) of Gujarat University.

Forests and Environment Department, GoG has also issued GR's for popularizing the concept of Cleaner Production. The first GR on CP was BJT-10.2005-3215-P which took various measures to tackle the industrial pollution through Promotion and Propagation of Cleaner Production, a tool to achieve the Sustainable Development.

It gives financial assistance to promote and undertake various activities including the CP clinic cum awareness programme for different industrial and service sectors, intensive training programme, CP database creation, practical demonstration projects, CP dissemination workshops, etc.

To further motivate the industries, Gujarat Cleaner Production Award was instituted through GR. No. ENV-10.2004-61-P on Dated: 29 June 2004 for SME's. It was then extended to large scale through GR. No. ENV-10.2004-61-P on Dated: 3rd Jan. 2007. A certificate of Appreciation and a trophy is awarded to the selected industry from SME and Large Scale Industry.

Industrial Policy 2009 provides financial assistance to industries implementing CP.

Schemes of Assistance for Environment Protection Measures and Infrastructure

Industries & Mines Department, Government of Gujarat, vide Resolution No.BGT/1008/499 (1)-G provides financial assistance for various schemes to achieve Sustainable Development. Some of the activities covered are

- Incinerators/ Pyrolysis / Plasma Reactor: waste to energy
- Fuel projects: such as waste plastic to diesel, rubber waste to diesel/ steam/ energy
- Common Solvent Recovery Plant
- Common Spent Acid Separation plant
- Use of Gypsum in agricultural Land
- Road Making- Iron Sludge
- Recovery of waste from E-waste/Electroplating waste/ photography waste.
- Recovery of ODS from old equipment.

- Upgradation of existing plant through clean innovative measures including cleaner production and clean technologies.
- Obtaining Carbon Credits through CDM Projects.
- Reducing Carbon Foot Print by 20% through Life Cycle Assessment (LCA) and related measures.

Industries & Mines Department, Government of Gujarat, vide Resolution No.BGT/1008/499 (2)-G, took various steps to minimize the wastes at sources and providing better working condition through various measures mentioned below.

- Implementation of Cleaner Production and Cleaner Technology measures, etc.
- Substitution & Optimization of raw material including catalyst.
- Rain water harvesting.
- Encouraging Environment Management System- setting up of Environment Management Cell.
- Installation of Solar System leading to atleast 5% energy saving.

By taking measures as mentioned above, Govt. Of Gujarat is proving to be a beacon in terms of Environment management.

11. CASE STUDIES

CASE STUDY OF PULP AND PAPER

General Introduction

The demonstration factory of Paper & Boards. Mill is situated in G.I.D.C, Vapi- 396 195. Mill was established in year 1991. The quality of paper produced is between 230 to 450 GSM as per market requirement.

For this product used paper is raw material. The manufacturing process is continuous.

Employ strength of the unit is 134 persons including technical persons.

The major plant utility consumption are freshwater, recycle water, electricity and fuels like lignite.

Sr. no.	Utility	Consumption
1	Water	10 KL/Ton (Fresh)
2	Electricity	1500KVA 330-360 KWH/Ton of paper
3	Lignite	300-330 kg/Ton of paper

During manufacturing process industry generates waste water, which is treated by primary treatment in the plant and recycles.

Major Plants and Processes

The whole process is divided into four sections as follow:

- *Pulping*
- *Paper Making*
- *Coating*
- *Packaging*

✦ Equipment used in pulping section

Hydro pulper, Fine Screen, Johnson Screen, Pressure Screen, Hill Screen, Rotary Thickener, Thickener, Thickener chest, Dumping Chest, Refining Chest, Stock Chest, Double disc refiner, TDR refiner, Head Box, Deflaker, Pit, Centri Cleaner

✦ Equipment used in Paper making section

Mould part, 1st press, 2nd press, 3rd press, Pre dryer group, 1st post dryer, 2nd post dryer, Pre calendar, Pre coater, Top coater, Post calendar, Brush roll, Mesurex, Propeller

Detailed Flow Diagram

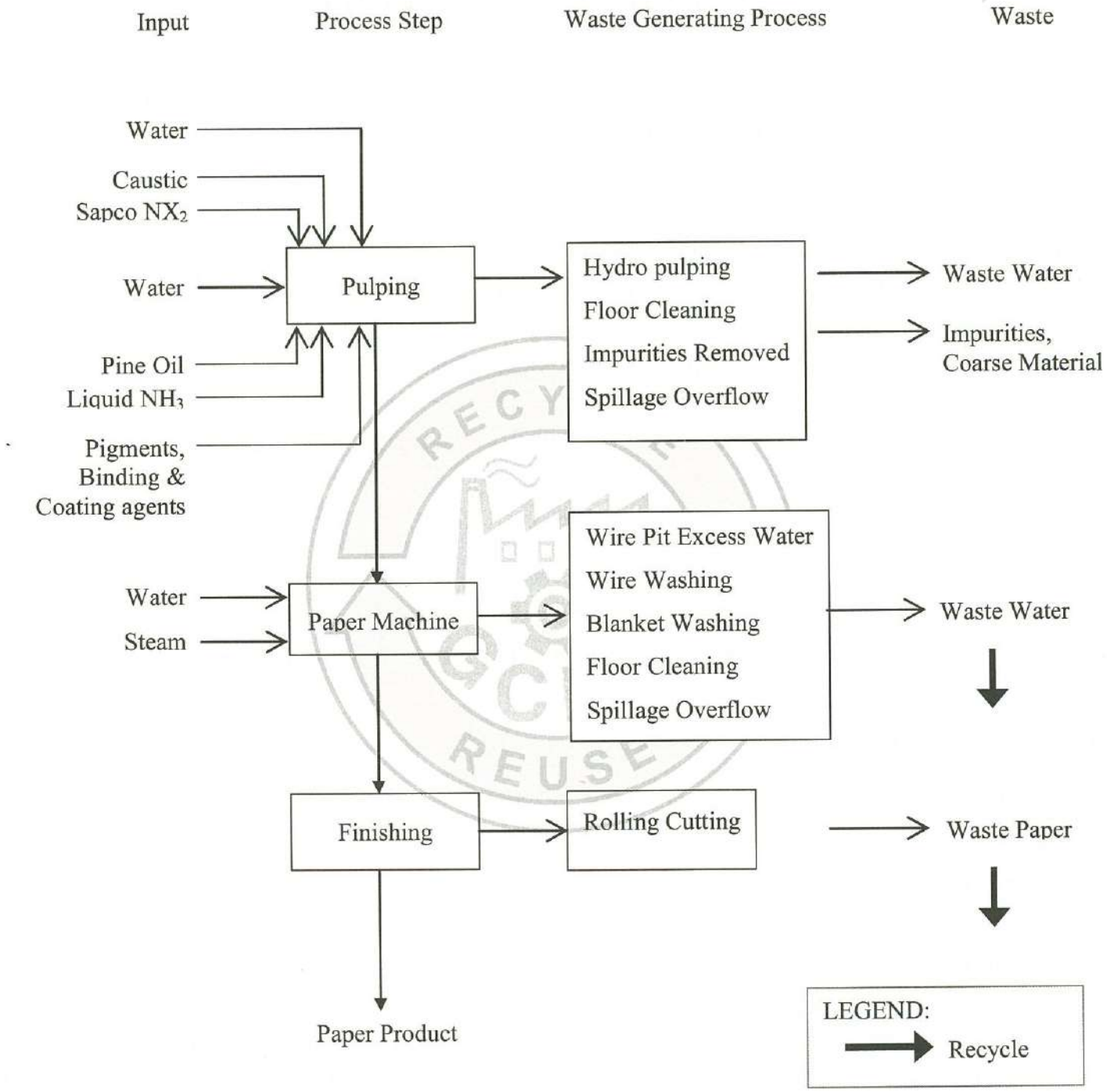


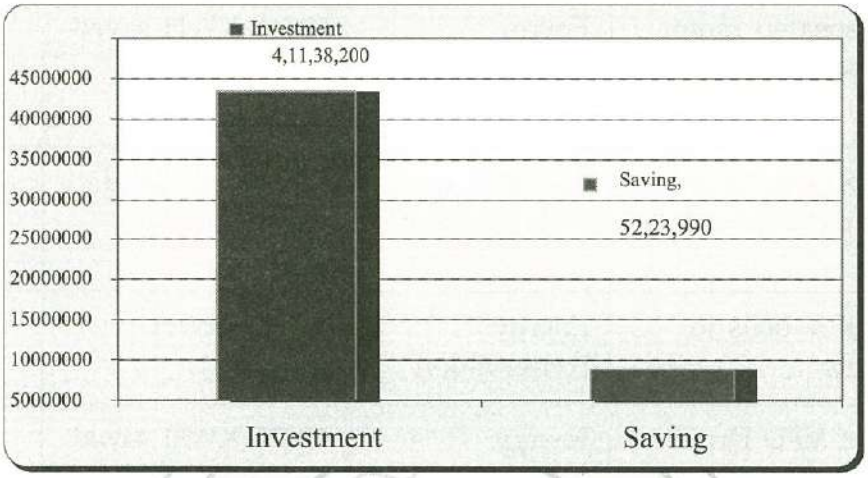
Fig 11.1 :- Schematic Diagrams of Pulp & Paper Processing Indicating Raw Material Input and Waste Output

Implemented Cleaner Production Options and results:

SR NO.	CP SOLUTIONS	CP TOOLS	BENEFITS	COST BENEFITS (SAVINGS / YEAR IN RUPEES)
1.	Avoidance repeated motor burning (overloaded of motors)	Energy conservation	62040 KWH saved	50, 000
2.	Converting present single shaft M/C drive running on 200	Energy conservation	415 KWH saved	6,68,150
3.	Conversion of V-belts to cogged V belts	Energy conservation	12728 KWH saved	63,640
4.	Installation of VFD Drive On 120 Hp Vacuum Pump	Energy conservation	42021 KWH saved	2,10,105
5.	Installation of VFD Drive On 15 Hp Chest Pump	Energy conservation	4758 KWH saved	23,790
6.	To Put VFD Drive On 50 Hp Id Fan Of The Boiler	Energy conservation	110124 KWH saved	5,50,620
7.	Replacing of electrical chokes by electronic ballast	Energy conservation	13663 KWH saved	68,315
8.	Installation of low pressure drop centricleaners	Energy conservation	Recovery and reuse of fibers, Improved clarity of white water. Reduction in waste disposal.	664360
9.	Avoidance of excess specific energy consumption	Energy conservation	Energy conservation 5,85,004 KHW Saved	29,25,000

RESULTS

The implementation of CP solutions resulted in both financial as well as environmental benefits. The unit was able to benefit annually by about Rs. 5223990 through the implementation of CP solutions, with an investment of Rs 41138200



PayBack Period is 7.9 years

Case study of Electroplating

Introduction

The demonstration factory GIDC, Dared, Jamnagar which is established in 1975.

The factory is involved in the Manufacturing of pressure cooker's safety valve (different size), parts of domestic filter, and some other automobile parts as well as its electroplating as captive part. Mainly Nickel Chrome plating is done at the unit.

The major plant utility consumption is freshwater, DM water and electricity. The source of water is bore water as well as GIDC supply.

DESCRIPTION OF THE PRODUCTION PROCESSES

Major steps of process are described as under.

1. **Stripping**
2. **Polishing**
3. **Wiring & Racking**
4. **Alkaline Cleaning in Ultra Sonic Bath & 1st,2nd Rinsing**
5. **Acid wash & 1st,2nd Rinsing,**
6. **DM Water wash**
7. **Nickel Plating & 1st,2nd and 3rd Rinsing**

8. **Chrome Plating & 1st,2nd Rinsing,**
9. **Rinsing**
10. **Drying**
11. **Final Inspection**

Stripping

Parts must be stripped and or sandblasted down to the bare metal. All paint, dirt, oil, grease, rust, old plating, and other materials are removed.

Polishing

Polishing is the abrasive removal of surface metal, using a series of abrasive belts or wheels. The first step that of coarse cutting and/or grinding, working the metal progressively smoother with finer grits. The end result is highly polished metal with most pitting, scratches, and other impurities removed.

Wiring & Racking

Hooks, racks, and other methods are used to hold the parts, as well as providing electrical current to the parts attached to the racks.

Alkaline Cleaning in Ultra Sonic Bath & 1st, 2nd Rinsing

Before parts are plated with nickel, they are cleaned with alkaline solution. After ultrasonic cleaning, two wash are given with water.

Acid wash & 1st, 2nd Rinsing:

After ultrasonic cleaning, the parts are washed with acid, and then 2 wash are given with bore water for cleaning purpose.

DM Water wash

Articles coming from different companies rust of corrosion surface therefore they are first cleaned to prepare surface for the plating so parts must be flawlessly cleaned before plating. The slightest speck of dirt or grease will cause a reject. A series of alkaline cleaning in ultra sonic bath, acid, and DM water solutions are used to guarantee a spotless surface.

Nickel Plating

Here the articles which are big in size such as pressure cooker's safety valve (different size), parts of domestic filter, and some other automobile parts as well as its electroplating as captive part etc. are plated in Nickel bath.

Articles from the final rinse tank are taken to the Nickel plating tank. Plating tank contains articles to be platted as cathode and zinc rod as anode. The solution in which electric current is passed contains the Nickel solution that liberates the Ni, which gets deposited on the articles to be platted. The pH of the solution is maintained at around 4-5. Nickel provides the deep luster and protection needed for long lasting chrome. Parts are submerged in the nickel- plating solution for about 45 minutes. Brighteners added in the nickel bath to improve the brightness of the articles.

After Nickel plating, three washes with tap water are given to the material. The first drag out which is next to the Chrome bath contain higher amount of Ni.

Chrome Plating

Chrome is a protective coating over the nickel, which prevents the nickel from tarnishing. Here the articles are plated same as in Nickel plating. After Chrome plating, two washes with tap water are given to the material. The first drag out which is next to the Nickel bath contain higher amount of Cr.

Drying

After chrome plating the articles are rinsed in tap water and are dried in an oven. The temperature inside the oven is kept around 40 - 50 ^{0}C.

Final Inspection

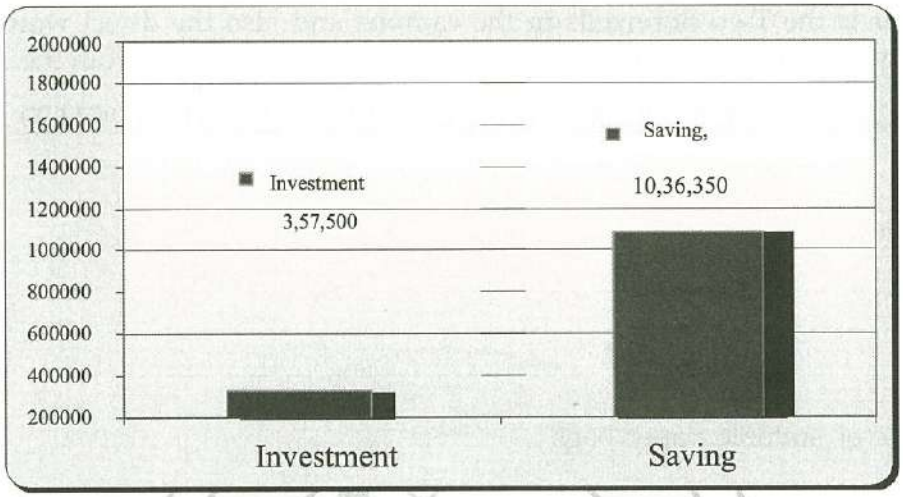
Parts are cleaned and inspected.

Implemented Cleaner Production Options and results:

SR NO.	CP SOLUTIONS	CP TOOLS	BENEFITS	COST BENEFITS (SAVINGS / YEAR IN RUPEES)
1.	**Installation of R.O. plant.**	Technology Change	• **Reduce pollution, ETP load.** • **Reduces water consumption.** • **Reuse of treated water in the process areas.**	330750/-
2.	**Use of** Air knives **over process tanks.**	Improved Process Condition	• **Water conservation** • **Reduced pollution load** • **Chemical conservation**	22050/-
3.	**Use of Drain boards.**	Good House Keeping	• **Reduces drag out & contaminant** • **Water Conservation**	22050/-
4.	**Use of Spray rinse system.**	Improved Process Condition	• **Water Conservation** • **Reduces drag out.**	330750
5.	**Nickel metal can be recovered using Metal recovery techniques (e.g., Ion Exchange, Reverse Osmosis, Solar evaporation)**	Improved Process Condition	• **Reuse of Raw Material**	330750

RESULTS

The implementation of CP solutions resulted in both financial as well as environmental benefits. The unit was able to benefit annually by about Rs. 1036350 through the implementation of CP solutions, with an investment of Rs. 357500



Payback Period: 0.35 year

Case study of Hospitals

Introduction

The demonstration unit for hospitals located at Gandhinagar, Gujarat. .In order to select audit focus area a walk through survey in the hospital was conducted to know about the departments and their related activities and to identify major waste streams.

Function

As being the major general hospital of the district, it is related with the health of the people. The hospital also having the facility for the major operations and having different departments related with the health of the human beings.

Utilities

The source of water is the Two Borewells in the campus and also the direct water supply from the government. Supply department, Gandhinagar and Electricity is available from the Torrent Power Ltd.

MAJOR WASTE GENERATION FROM VARIOUS DEPARTMENTS INCLUD COLOUR

General Waste

- Kitchen waste
- Glass
- Paper
- Plastic
- White plastic or suitable paper bags

Specific Waste

(Also called clinical, medical or infectious waste)

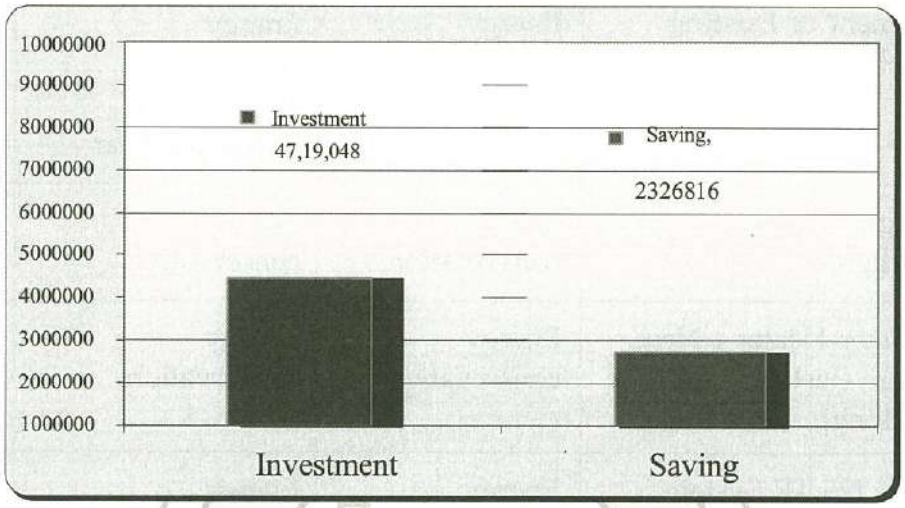
- Anatomical waste
- Solid dressings, swabs and all other
- Contaminated waste
- Materials other than from cases of infectious diseases which can be recycled.
- Sharps (in sharps container)
- Plaster Of Paris
- Laboratory and post mortem waste
- Pharmaceutical waste
  - fluids and liquids (to sewerage system)
  - expired cytotoxic drugs
  - vaccines (treatment prior to disposal)
- Chemical waste (solvents)
- Biological hazard
- Cytotoxic waste
- Radioactive waste

Implemented Cleaner Production Options and results:

Option No.	CP Solution	CP Tool	Environmental Benefits	Anticipated Saving per Year (INR)
1.	Replacement of Existing Tube lights with CFLs	Energy conservation	Energy conservation 309520 KWH Saved per year	12, 07,128
2.	Solar Lighting - Street light-Garden lights	Energy conservation	Energy conservation	8,541
3.	Solar Water Heater (New System as existing system is not working)	Energy conservation	Energy conservation	14, 297
4.	Solar AC (25 TR System)	Energy conservation	Energy conservation	5,40,000
5.	Eco friendly energy efficient evaporative cooling system	Energy conservation	Energy conservation	1,90,750
6.	Replacement of LPG cylinders with gas pipe lines in the kitchen	Energy conservation	Energy conservation	28,220
7.	Automatic Water Level Controller for Water Storage Tanks	Energy conservation	Water and Energy Conservation	19,600
8.	Auto On/Off Switch for all pumps	Energy conservation	Water and Energy Conservation	19,600
9.	Conversion of diesel vehicles into CNG	Energy conservation	Energy conservation	2,98,680

RESULTS

The implementation of CP solutions resulted in both financial as well as environmental benefits. The unit was able to benefit annually by about Rs. 2326816 through the implementation of CP solutions, with an investment of Rs 4719048

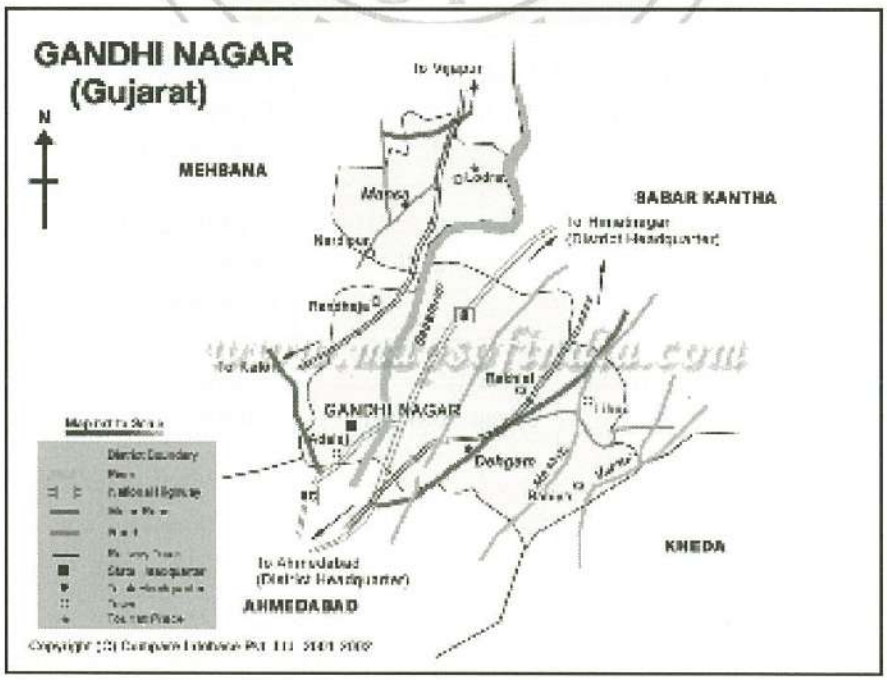


Payback Period: 2 years

HOTEL

Introduction

The demonstration unit has been established on 26th January 1991 and is located, Gandhinagar, Gujarat.



Utilities

WaterAt the hotel, the source of water supply is own bore well from where water is fetched up daily to the overhead tank from where it is distributed to all the section of the hotels. The daily water consumption is about 60,000 liters per day.

Electricity

The connected load of hotel is 110 KW, which is connected from the Torrent Power Ltd.

SELECTION OF CP ASSESSMENT FOCUS

Hotel is the Three Star Hotel located at Gandhinagar, Gujarat. In order to select audit focus area a walk through survey in the Hotel was conducted to know about the departments and their related activities and to identify major waste streams. During walkthrough survey following were the CP Focused Areas identified as shown in Table

CP Focused Areas identified during initial survey:

Focused Area for CP
Leakages in pipe lines
Kitchen waste : Vermi composting
Housekeeping/Cleaning material waste
Office waste: Paper, Packaging Wastes
Water conservation
Energy conservation
Good Housekeeping in Kitchen, Stores, Terrace and Reception

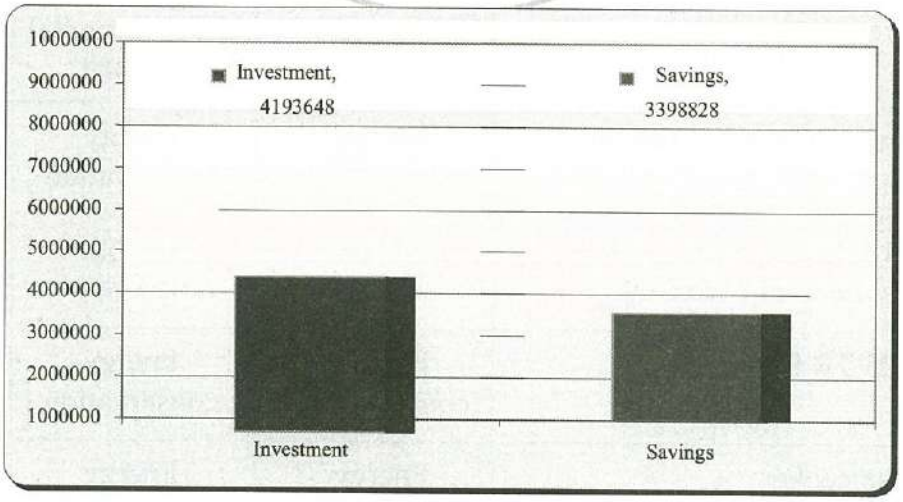
CP Implemented Options and Results :

Sr. No.	CP Solutions	CP Tool	Enviornmental Benefit	Financial Saving (Rs./year)
1.	Replacement of Existing Tube lights with CFLs	Energy conservation	Energy conservation	46,691
2.	Solar Water Heater (New System as existing system is not working)	Energy conservation	Energy conservation	14,297
3.	Solar AC (25 TR System)	Energy conservation	Energy conservation	5,40,000
4.	Use of solar cooker	Energy conservation	Energy conservation	27,900

Sr. No.	CP Solutions	CP Tool	Enviornmental Benefit	Financial Saving (Rs./year)
5.	Eco friendly energy efficient evaporative cooling system	Energy conservation	Energy conservation	1,90,750
6.	Lighting system with sensors in the passage	Energy conservation	Energy conservation	52,500
7.	Replacement of LPG with Pipeline gas	Energy conservation	Energy conservation	23,62,800
8.	New water tank at ground floor for the kitchen usages.	Energy conservation	Energy conservation	27,000
9.	Automatic Water Level Controller for Water Storage Tanks	Energy and Water Conservation	Water contamination will be avoided Improved safety of staff	91,260
9.	Auto On/Off Switch for all pumps	Energy and Water Conservation	Energy and Water Conservation	45,630

RESULTS

The implementation of CP solutions resulted in both financial as well as environmental benefits. The unit was able to benefit annually by about Rs. 33,98,828 through the implementation of CP solutions, with an investment of Rs. 41,93,648.



Payback period: 1.3 years

CASE STUDY OF DAIRY INDUSTRY

GENERAL INTRODUCTION

Demonstration of Cleaner Production Implementation Project in Dairy sector conducted which is located in Gandhinagar Gujarat. Major products of the company are Butter Milk, Flavored Milk, Ice-Cream, Ghee Sweets (In Festival Season). Capacity of plant is 1.50 lacs liters per day. The average milk production is 4536000 liters per Month, Average production of Ghee is 1.5 to 2.0 MT per day. Two boilers are used for steam generation, Natural gas/FO fired boiler having capacity 2 TPH. Annual furnace oil consumption, MT - 468. The unit takes electricity supply from the Torrent Power. The contract demand is 600 kW.

MAJOR PLANTS AND PROCESSES

Pasteurization and Cream section

Pouch making section

Ghee section

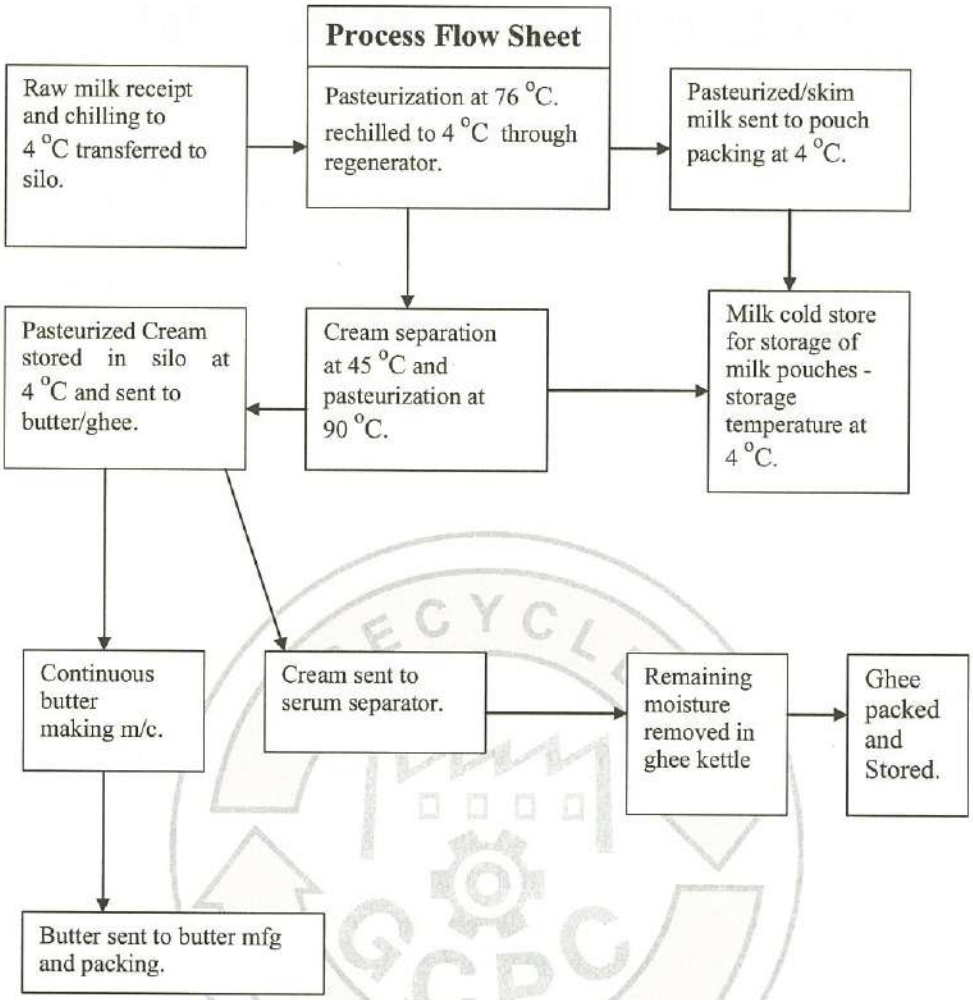
Buttermilk section

RMRD section

PROCESS DESCRIPTION

Raw milk is processed in the dairy to manufacture variety of products. Process flow steps are as follows:

- Raw milk receipt and chilling - Raw milk is received in tankers at 8 - 10 ° C. It is chilled to 4 ° C in raw milk chillers and stored in raw milk silos.
- Milk pasteurization - For pasteurization, milk has to be heated to 75 °C and held for 16 seconds at this temperature and then chilled to 4 °C.
- Heating section - In the heating section, milk is heated to the required temperature by hot water/steam.
- Regenerative section - In the regenerative section, hot milk gives up its heat to preheat the cold incoming milk thus reducing the heat load on the heating section. And thus reducing the heat load on the cooling section.
- Chilling section - In this section, the precooled milk from the regenerative section is chilled to 4 °C and sent to the intermediate storage tanks.
- Milk pouching and storage - Pasteurized milk is sent to the pouching section from the pasteurized milk silos. It is packed in pouches by pneumatic/mechanical packing machines.
- Ghee production - Milk cream is separated by passing it through cream separator, where most of the moisture is removed. The remaining water is removed by evaporating it by heating the ghee kettle upto a temperature of 105 °C.
- Buttermilk - Buttermilk is prepared in a batch process. First prepared curd in a tank. The dahi is then diluted with water and pasteurized and chilled before packing it in pouches.
- Ice-cream - Ice-cream mix is prepared and pasteurized in a PHE. The ice-cream mix is then transferred to an ageing tank. The ice-cream is then prepared in a freezer machine with injection of compressed air.



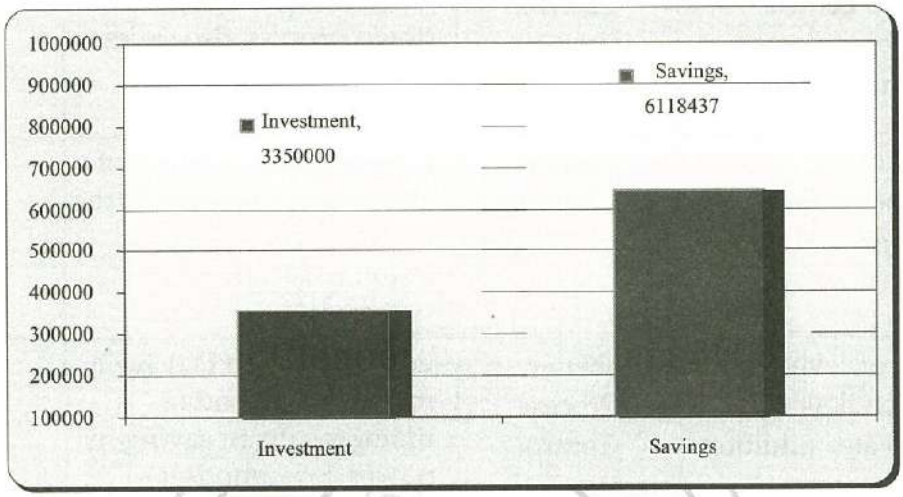
Implemented Cleaner Production Options and results

SR NO.	CP SOLUTIONS	CP TOOLS	BENEFITS	COST BENEFITS (SAVINGS / YEAR IN RUPEES)
1.	Uses of PNG (Piped Natural Gas) instead of diesel in sweet section.	Process Change Options	Reduction of fuel consumption with environment benefits.	7,68,000
2.	Replacement of high speed mechanical packing machine in place of pneumatic pouch packing machine.	Technology Change	Weight variation in milk quantity. No air requirement. It results in saving energy and fuel.	13,06,437

SR NO.	CP SOLUTIONS	CP TOOLS	BENEFITS	COST BENEFITS (SAVINGS / YEAR IN RUPEES)
3.	Installation of online oxygen trims control system for boiler efficiency improvement.	Better Process Control	It results in saving energy, automating the blow down process also saves significant amounts of water.	3,59,000
4.	Installation of an automatic boiler blow down system.	Better Process Control	It reduces the wastage of water and also reduces the amount of furnace oil required for the combustion.	3,52,000
5.	Installation of level controller for boiler makes up water addition	Better Process Control	By installing VFD drive it maintain the load of motor results in saving in power consumption.	1,13,000
6.	Installation of VFD drive for CP Tools air compressor	Better Process Control	It makes the water of desired TDS which results in boiler operation efficiently and reduces the stack heat loss and carbon emission.	1,79,000
7.	Using RO water as cooling water.	Recycling	Reduction of Heat Losses.	1,66,000
8.	Heat recovery from can washer waste water	Recycling	It reduces the loss of heat by recover in water heating for the boiler operation.	18,96,000
9.	Installation of desuperheater on the refrigeration compressor	Equipment Modification	It reduces losses of Heat.	9,79,000
10.	Insulation of steam line.	Equipment Modification	It reduces losses of Heat.	
11.	Installation of crate washer.	Better Process Control	It increases the yield of production.	
12.	Reuse of whey by preparing whey powder.	Recycling		

RESULTS

The implementation of CP solutions resulted in both financial as well as environmental benefits. The unit was able to benefit annually by about Rs. 61, 18,437 through the implementation of CP solutions, with an investment of Rs.33, 50,000.



Payback period: 0.55 year

12. CP AND INDIAN CULTURE

Cleaner Production, the word was coined by UNEP and UNIDO in 1989. However, the concept has been taught by Indian culture thousands of years back. It is infused in the Indians never to waste anything. 'Best out of Waste" is a concept popular among the housewives.

The second annual survey conducted by the National Geographic Society and international polling firm GlobeScan on environmentally sustainable behaviour, the results of which were released on 13th May 2009, showed that Indian consumers have taken the top spot with a Greendex score of 59.5. The Chinese retained the third spot with 55.2. At the bottom of the ladder in the 17-country survey are over-consumptive Americans (43.7), Canadians (43.5) and Japanese (49.3).

So, what has put Indians at the top of the Green ladder? It was driven by above-average performance on all four sub-indices, including first-place rankings for food and goods. Indians are the most frequent consumers of self-grown food, with 35% eating what they grow several times a week or daily. Indians are also the least frequent consumers of beef, which requires greater energy to grow – only 22% consume beef weekly compared to an average of 63% for the 17 countries surveyed.

Indian consumers also topped the goods sub-index score. Their top status is due in part to having lower-than-average rates of ownership of large appliances and electronics. Also, the rate of those buying used goods, avoiding environmentally unfriendly products and excessive packaging, and buying environmentally friendly products is the highest.

Indian consumers continued to rank third on the transportation sub-index, based on the fact that they are second-most likely to live close to their usual destinations and second-least likely to own a car or truck (54%). Among those who drive, Indians tend to have lower-than-average annual mileage rates. Besides, they are the most likely to own and use motorcycles or scooters and second most likely to drive a compact car, after the Mexicans. In addition, walking or riding a bike is up seven points from the past year (to 57%).

As regards housing, Indians ranked second only to Brazilians. Factors contributing to their high ranking include a low incidence of having home heating (41%) and hot running water (38%) and a high incidence of using on-demand electric water heating (45% among those with hot running water), and using solar energy to heat water (15%).

Erstwhile departments in universities are getting converted overnight into schools of environmental studies and scholars are busy selecting research problems, imitating what is going on in western laboratories, forgetting that concern for the environment was the foundation on which Indian culture was fashioned.

Every devout Indian starts his daily routine with a prayer to mother Earth:

Samudra vasan, devi parvata stana mandal
Vishnu patni namastubhyam pada sparsam ksamasva me,

(Ocean as your garment, mountains as your breasts, O' consort of Vishnu, forgive me for treading on you)

Our Aryan ancestors living amidst sylvan surroundings and concerned about the preservation of the pristine purity of the environment prayed:

Madhu vata rtayate
(let the wind waft pure air)
Madhu k s aranti sindhava h
(let rivers pour sweets to us)
M a dhweerna h santvo s adhee h
(let plants be nectar to us)
Madhu naktamuto s asi
(sweet be the night and day)
Madhumat p a rthivam rajah
(let the dust of the earth be sweet to us)
Madhu dyaurastu nah pit a
(sweet be our father in heaven)
Madhu m a nno vanaspati h
(may the trees be full of sweets)
Madhu m a nastu Suryah
(let the Sun be gracious to us)
Madhvee g a v¢ bhavantu nah
(let our cattle provide sweets to us)
Rigveda 1-90

India had all along adopted a conservation ethic, it strongly emphasizes a strong continuing relationship between man and nature. "The Indian culture.... has always looked upon the trees and plants of the earth as the manifestation of God's protecting and preserving power. Man, in his turn, is to reciprocate this vital function by being the protector of trees and plants. This is to be his relationship with all life around him." (Qazi, p. 17, quoting Swami Chidananda)

The importance of nature to Indian was described by Swami Nirvedananda (pp. 204-05): " God manifests Himself as nature. This is one of the outstanding spiritual truths preached by Hinduism.." An entire mountain range, for example—the Himalaya or the Vindhya, is looked upon as a holy thing. The sea is another holy object. So also are several rivers, such as the Ganges, the Jumna, the Godavari, the Saraswati, the Narbada, the Indus (Sindhu) and the Kaveri. The rivers and mountains are the bodies of their presiding deities who are worshipped by the Hindus. These deities are superior manifestations of God."

The significance of natural objects is indicated in other aspects of Indian culture. The folktales of India demonstrate a continuing interrelationship between animals and humans, even to the point that at times humans give birth to animals (Beck et al.) The title of the book the Speaking Tree comes from the tale of a tree which rebuked Alexander the Great for the futility of conquering India, and foretold his doom. (Lannoy)

The lover of nature is found in this poem credited to pious monks of the 5th century B.C. (Basham, p.457):

"When the drum of the clouds thunders in heaven,
and all the ways of the birds are thick with rain,
the monk sits in the hills in ecstasy
and finds no joy greater than this.

"When by rivers covered with flowers,
and gaily adorned with reeds of varied hue,
the goodly monk sits on the bank in ecstasy
and finds no joy greater than this.

"When the rain pours down at night,
and elephants trumpet in the distant thickets,
the monk sits in the hills in ecstasy,
and finds no joy greater than this.

Mountains have a special significance, as Tewari notes (p.63): "In India the Himalayas are regarded as the abode of Gods and a source of spiritual inspiration by not only Hindus but followers of other religions too." These beliefs led to cultural patterns. "People living in the hills had.. developed a life style in which animal husbandry and agriculture formed the mainstay of the subsist enable economy. Natural forests.. never let them down even during times of famine.. (Tewari, p, 63)

Similarly Tewari (p. 32) describes the significance of natural things: "It is not for nothing that our ancient scriptures emphasize the importance of preserving and improving plant life. Our ancient sages had the age-old wisdom to realize that trees and plants, apart from having timber and medicinal values maintained essence of life on earth."

And not long ago, "The Father of our Nation", Gandhiji, had advocated "ahimsa" or non-violence which is closely connected with his views on nature and love for all life on earth. He promoted that man should live in harmony with nature. Gandhiji looked at nature and man as interwoven and interdependent. He noted that the so-called development that did not give importance to maintaining a balance between the two would have serious consequences.

Gandhiji was not against industrialization. He wanted India to be self-reliant, but he wanted it without the negative points - exploitation of labour, environmental degradation, displacement of poor, etc. He felt that resources should be utilized in a sustainable manner. He was totally opposed to western industrialization, where the earth's resources were being ruthlessly exploited for material growth of the society.

To quote Gandhiji:

> *"God forbid that India should ever take to industrialism after the manner of the West. The economic imperialism of a single tiny Island kingdom is today keeping the world in chains. If an entire nation of 300 million took to similar economic exploitation it would strip the world bare like locusts."*

And he has also foretold that a proactive approach would be required to reactive approach.

> *"A technological society has two choices. First it can wait until catastrophic failures expose systemic deficiencies, distortion and self-deceptions.....Secondly, a culture can provide social checks and balances to correct for systemic distortion prior to catastrophic failures."*

The Swadeshi movement was a good example of using existing natural and human resources to manufacture items of everyday use with minimum damage to the surrounding environment. Gandhiji was a vegetarian as are a large section of Indians. This is Sustainable Development, which we are all discussing today, is all about.

> *"If we follow the swadeshi doctrine, it would be your duty and mine to find our neighbours who can supply our wants and to teach them where they do not know how to proceed, assuming that there are neighbours who are in want of healthy occupation. Then every village of India will almost be a self-supporting and self-contained unit, exchanging only such necessary commodities with other villages as are not locally produceable."*

Does it not have a ring of Life Cycle Assessment and Chemical Leasing? That was thought of years back in India.

According to Gandhian philosophy, man needs comfort but not luxury; it is need and not greed that should determine man's requirements. And it is exactly that Cleaner Production teaches, to use what is required and not to waste.

> *"The Earth provides enough to satisfy every man's need, but not every man's greed."*

Gandhiji's ashrams were perfect examples of self-reliance: all inmates took care of their own chores and participated in all the activities. They were located in rural areas and all inmates led a community life, making their own clothes and handicrafts, planting trees, and growing crops and vegetables.

Used envelopes and small pieces of paper were never thrown away; short notes and letters were written on reverse.

In the 1920s and 1930s, when taking his daily bath in Sabarmati, he consciously used minimal water. On being asked why he was using the river water so sparingly when he could use as much as he desired, he remarked that all that was flowing in the river was not his.

He had foretold the crisis that we are facing currently and said:

> *"A time is coming when those who are in mad rush today of multiplying their wants, will retrace their steps and say; what have we done?"*

And are we not at that stage – trying to curb our GHG emissions, POP's and making our process more efficient?

Thus, the above discussion shows that the Indian consumes what they bare.

❑ BIBLIOGRAPHY

Chapter :- 1

http://en.wikipedia.org/wiki/Pollution
http://www.thefreedictionary.com/pollution
http://duhaime.org/LegalDictionary/P/Pollution.aspx
http://www.jri.org.uk/brief/climatechange.htm
Silent Spring is a book written by Rachel Carson and published by Houghton Mifflin in September 1962. The book is widely credited with helping launch the environmental movement.
http://en.wikipedia.org/wiki/Great_Smog
http://en.wikipedia.org/wiki/Bhopal_disaster
www.thefreedictionary.com/pollution
http://duhaime.org/LegalDictionary/P/Pollution.aspx
www.unep.org/tunza/children/pdfs/Fact_sheets/Ozone.pdf
http://coe.mse.ac.in/kidscorner.asp
http://www.epa.gov/air/criteria.html
http://www.umich.edu/~gs265/society/pollution.htm
http://www.cogeneration.net/Global_Warming_Potential.htm
http://wiki.answers.com/Q/What_is_the_definition_of_water_pollution
edugreen.teri.res.in/
http://www.sciencedaily.com/articles/s/soil_contamination.htm
http://en.wikipedia.org/wiki/Soil_contamination
http://upenvis.nic.in/waste.htm
environmentandpeople.org/SolidwasteManagement.html
http://coe.mse.ac.in/solitewaste.asp
http://www.epa.gov/roe/glossary.htm
edugreen.teri.res.in/EXPLORE/solwaste/types.htm
www.envisassam.nic.in/biomedical-waste.asp
http://www.ehow.com/about_5074838_effects-improper-solid-waste-disposal.html
www.encyclopedia.com/doc/1G2-3408100264.html
www.pollutionissues.com/Ve-Z/Visual-Pollution.html
www.encyclopedia.com/doc/1G2-3408100264.html
pollutionissues.com
en.wikipedia.org/wiki/Noise_pollution
www.absoluteastronomy.com/topics/Noise_pollution

www.karmayog.org › Noise Pollution
hubpages.com/hub/Light-Pollution
www.savethenight.eu/What%20is.html
www.environmental-protection.org.uk/.../light-pollution/
simple.wikipedia.org/wiki/Light_pollution
http://www.pollutionissues.com/Te-Un/Thermal-Pollution.html
www.naturalstandard.com/monographs/.../generic-thermalpollution.asp
http://pkukmweb.ukm.my/~ahmad/kuliah/manusia/artikel/thermal.htm
www.scribd.com/doc/24451039/Never-Earth
www.energy-environment.net/environmental_pollution.html
en.wikipedia.org/wiki/Radioactive_contamination
www.absoluteastronomy.com/.../Radioactive_contamination
http://www.experiencefestival.com/radioactive_contamination_-_biological_effects
en.wikipedia.org/wiki/Radioactive_contamination

Chapter: 2

www.centric.at/.../tempus-croatia—cleaner-production-centre-rijeka-2006—2009
www.chinacp.org.cn/eng/cptools/cpt_book00.htm
www.unep.fr › SCP Branch › Themes › Cleaner Production
https://www.epa.qld.gov.au/environmental.../cleaner_production.html
www.unep.fr/shared/publications/other/WEBx0072xPA/.../Part1.doc
www.answers.com/topic/productivity
en.wikipedia.org/wiki/Productivity
http://www.qpmg.com/tqm.htm
www.derm.qld.gov.au/environmental.../industry/.../glossary.html
www.global-enviro.com.au/cp.htm
www.unep.fr › SCP Branch › Themes › Cleaner Production
www.unido.org/index.php?id=o4460
en.wikipedia.org/wiki/Sustainable_energy
en.wikipedia.org/wiki/Triple_bottom_line
www.centric.at/.../cleaner-production-and-environmental-management-systems-ems
www.centric.at/services/...production/...production...environmental.../iso-14000

Chapter: 3

www.p2pays.org/ref/03/02383/02383.pdf
www.p2pays.org/ref/18/17144.pdf
www.epa.gov/region6/6en/xp/electron.pdf
web.epa.state.oh.us/opp/tanbook/fppgch1.txt

Chapter: 4

sunzi.lib.hku.hk/hkjo/view/41/4100225.pdf
http://www.unep.fr/scp/cp/understanding/industries.htm
http://www.eeaa.gov.eg/seam/Manuals/FoodSectorReport/Part%20C.PDF
www.p2pays.org/ref/23/22032.pdf

Chapter: 5

http://www.chinacp.org.cn/eng/cptools/cpt_book06.htm
www.iccwbo.org/id386/index.html
http://www.gdrc.org/uem/green-consumer.html
http://www.un.org/esa/sustdev/sdissues/technology/cleanerproduction.pdf
http://www.p2pays.org/ref/23/22032.pdf

Chapter: 7

www.unep.fr/.../session09C_CP_Methodology
http://www.necz.org.zm

Chapter: 8

glcmun.org/Economic%20and%20Social%20Council%20Study%20Guide.pdf
http://www.p2pays.org/ref/13/12028.pdf
http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm
http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163
http://www.epd.gov.hk/epd/misc/corp-env/epd-eng/annex1.htm
http://www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf

www.pops.int/documents/guidance/beg_guide.pdf

http://unfccc.int

www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf

Chapter: CP network

www.unido.org/doc/4460

http://www.unep.fr/scp/cp/

http://www.unido.org/index.php?id=o5138

https://www.onudi.org.ar/index.php?id=o5136

http://www.unido.org/index.php?id=o5133

Chapter: CP and Indian Culture

http://www.ias.ac.in/currsci/nov10/articles9.htm

H:\preservation of India's culture and environment.htm

ERIC: ED318665

Title: Environment and Culture in India.

Authors: Leuthold, David

Publication Date: 1989-00-00

ANNEXURE : 1

Award for Exemplary Application of the Cleaner Production Implementation in Small and Medium Scale Industry in Gujarat State

Government of Gujarat
Forests and Environment Department
Resolution No. : ENV-10.2004-61-P
Block 14, 8th Floor, Sachivalaya, Gandhinagar
Dated the 29th June, 2004

PREAMBLE :

Under the World Bank assisted Environmental Management Capacity Building - Technical Assistance project, the State Government in the Forests and Environment Department took initiatives in a proactive way to tackle the industrial pollution issues through promotion and propagation of Cleaner Production (CP). The Forests and Environment Department built the capacity of the industrial entrepreneurs, environmental consultants, academic institutions and the NGOs in the State in addition to implementation of various practical CP demonstration projects in selected industrial sectors. The results of the CP approaches adopted by the industrial sectors are quite encouraging. The Government is keen to sustain the CP initiatives and achieve the multiplier effect of CP in the State. It was under active consideration of the State Government to institute an award every year to appreciate an industry, which implements the CP practically and achieves significant / exemplary environmental benefits and improvement and increasing the productivity at the same time.

RESOLUTION :

After careful consideration, the State Government in the Forests and Environment Department hereby institutes an award namely "Gujarat Cleaner Production Award" starting from the year 2004. A certificate of appreciation and a trophy shall be awarded every year to one industry in small or medium scale sector from the State.

The winner of the award shall be selected by a committee consisting of the following :

1.	The Principal Secretary/Additional Chief Secretary, Forests and Environment Department, Govt. of Gujarat, Sachivalaya, Gandhinagar.	**Chairman**
2.	The Principal Secretary / Additional Chief Secretary, Industries and Mines Department, Govt. of Gujarat, Sachivalaya, Gandhinagar.	**Member**
3.	The Vice Chairman & Managing Director, Gujarat Industrial Development Corporation, Udyog Bhavan, Sector 11, Gandhinagar	**Member**
4.	The Director or his senior representative, National Cleaner Production Centre, New Delhi.	**Member**
5.	The Director or his senior representative, National Productivity Council, Productivity House, Lodhi Road, New Delhi	**Member**
6.	The Member Secretary, Gujarat Pollution Control Board, Gandhinagar	**Member**
7.	The Member Secretary, Gujarat Cleaner Production Centre, Gandhinagar	**Member**
8.	The Director(Environment), Forests and Environment Department, Government of Gujarat, Sachivalaya, Gandhinagar.	**Member Secretary**

The committee shall consider the applications received from the industrial entrepreneurs of Gujarat, who have successfully implemented the CP in their unit / industry and would decide the winner for the award. The committee would also prepare detailed guidelines including application format, eligibility criteria, selection procedure, etc.

The committee shall also decide the format of the certificate of appreciation to be issued by the Government of Gujarat.

The Forests and Environment Department assumes the responsibility as a Nodal Department and would receive and scrutinize the applications from the industries in this regard.

The entire expenditure in this regard shall be borne by the Gujarat Cleaner Production Centre, Gandhinagar.

By order and in the name of the Governor of Gujarat,

HARDIK SHAH
Jr. Technical Officer & Ex-Officio
Under Secretary to the Government,
Forests and Environment Department.

Copy To :

1. *The Secretary to the His Excellency, the Governor of Gujarat, Rajbhavan, Gandhinagar
2. The Principal Secretary to the Hon'ble Chief Minister, Sachivalaya, Gandhinagar
3. The PS to Hon'ble Minister (Forests and Environment), Sachivalaya, Gandhinagar
4. The PS to the Hon'ble Minister of State (Industries), Sachivalaya, Gandhinagar
5. The PS to the Chief Secretary, Sachivalaya, Gandhinagar
6. The Secretary, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi - 110 003
7. Mr. David Hanrahan, Advisor, the World Bank, 70, Lodhi Estate, New Delhi - 110 003
8. The Chairman, Gujarat Pollution Control Board, Sector 10-A, Gandhinagar.
9. The Chairman, Gujarat Industrial Development Corporation, Udyog Bhavan, Sector 11, Gandhinagar
10. The Member Secretary, Gujarat Pollution Control Board, Sector 10-A, Gandhinagar
11. All Departments of Secretariat, Sachivalaya, Gandhinagar
12. All Members of the committee
13. The Member Secretary, Gujarat Cleaner Production Centre, Udyog Bhavan, Sector 11, Gandhinagar
14. The Secretary, Gujarat Chamber of Commence and Industries, Ashram Road, Ahmedabad
15. All Industries Association
16. All CETP and TSDF management companies in Gujarat State
17. All Branches of the Forests and Environment Department, Sachivalaya, Gandhinagar
18. Select File of 'P' Branch, Forests and Environment Department, Sachivalaya, Gandhinagar


LETS SAVE
WATER
SAVE EVERY
DROP

ANNEXURE : 2

Award for Exemplary Application of the Cleaner Production Implementation in Large Scale Industry in Gujarat State

Government of Gujarat
Forests and Environment Department
Resolution No. : ENV-10.2004-61-P
Block 14, 8th Floor, Sachivalaya, Gandhinagar
Dated the 3rd January, 2007

Read : The Forests and Environment Department, Government of Gujarat's even number GR dated 29-6-2004

PREAMBLE :

The Government of Gujarat in the Forests and Environment Department, vide the Resolution read as above, instituted an award namely "Gujarat Cleaner Production Award" for the small and medium scale sectors from the year 2004 and constituted the selection committee thereof. Implementation of the Cleaner Production in Gujarat has shown encouraging results in terms of natural resources conservation, pollution control & increase in productivity. Even the large-scale industries have taken up Cleaner Production activities and obtained the benefits thereof. It was therefore under consideration to institute the Cleaner Production Award for the Large Scale Sector Industries also to motivate them so that they continue with the Cleaner Production activities & reap the benefits thereof.

RESOLUTION :

After careful consideration, the State Government in the Forests and Environment Department hereby also institutes an award namely **"Gujarat Cleaner Production Award"** in large-scale sector industries starting from the year 2006-07. A certificate of appreciation and a trophy shall be awarded every year to one industry in large-scale sector from the State.

The winner of the award shall be selected by the committee constituted by this Department's Resolution dated 29-6-2004 read as above. Other terms and conditions for the committee would remain the same as mentioned in the said Resolution.

By order and in the name of the Governor of Gujarat,

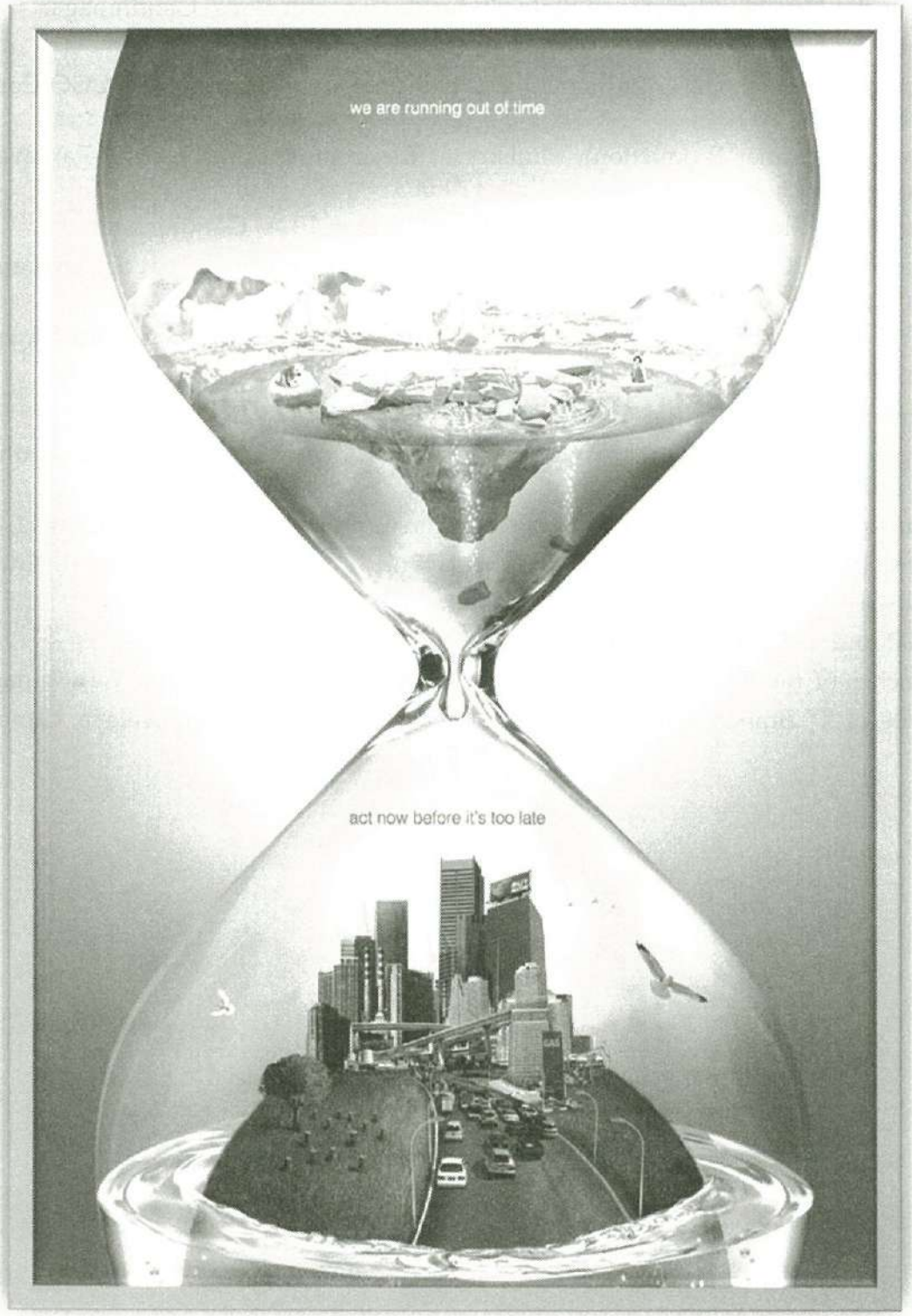
(HARDIK SHAH)
Under Secretary to the Government,
Forests and Environment Department.

Copy to :

1. *The Secretary to the His Excellency, the Governor of Gujarat, Rajbhavan, Gandhinagar
2. The Principal Secretary to the Hon'ble Chief Minister, Sachivalaya, Gandhinagar

3. The PS to Hon'ble Minister (Forests and Environment), Sachivalaya, Gandhinagar
4. The PS to the Hon'ble Minister of State (Forests and Environment), Sachivalaya, Gandhinagar
5. The PS to the Hon'ble Minister of State (Industries), Sachivalaya, Gandhinagar
6. The PS to the Chief Secretary, Sachivalaya, Gandhinagar
7. The Secretary, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi - 110 003
8. The Director (Cleaner Production), Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi - 110 003
9. The Chairman, Gujarat Pollution Control Board, Sector 10-A, Gandhinagar.
10. The Chairman, Gujarat Industrial Development Corporation, Udyog Bhavan, Sector 11, Gandhinagar
11. The Member Secretary, Gujarat Pollution Control Board, Sector 10-A, Gandhinagar
12. All Departments of Secretariat, Sachivalaya, Gandhinagar
13. All Members of the Selection Committee
14. The Director General, National Productivity Council, Utpadakta Bhavan, 5-6, Lodhi Road, New Delhi – 110 003,
15. The Member Secretary, Gujarat Cleaner Production Centre, Udyog Bhavan, Sector 11, Gandhinagar
16. The Secretary, Gujarat Chamber of Commence and Industries, Ashram Road, Ahmedabad
17. All Industries Associations
18. All CETP and TSDF management companies in Gujarat State
19. All Branches of the Forests and Environment Department, Sachivalaya, Gandhinagar
20. Select File of 'P' Branch, Forests and Environment Department, Sachivalaya, Gandhinagar

* By letter.


we are running out of time
act now before it's too late

ANNEXURE : 3

Gujarat Industrial Policy, 2009

Schemes of assistance for Environment Protection Measures - MSME Units

Government of Gujarat
Industries & Mines Department
Resolution No. BGT/1008/499(2) - G
Sachivalaya, Gandhinagar
Dated: 11-6-2009

Read:

1. G. R. IMD No. APN-102003-1161 (9) - I, dated 10/06/2004 .
2. Gujarat Industrial Policy, 2009

Preamble

The Industrial Policy, 2009 of State Government lays emphasis on inculcating systematic approach among the industries for holistic development that includes environment management as infrastructure. The earlier schemes for assistance to Environment Protection Measures and Infrastructure have emphasised upon setting up of common environment infrastructure plants viz. Common Effluent Treatment Plants (CETPs) and Treatment, Storage & Disposal Facilities (TSDFs). The need to deal with all aspects of environment management has arisen. Also emphasis on pollution prevention at source with issues like rational utilisation of resources and cleaner processes and technologies need to be highlighted. The recent developments like plasma technology, pyrolsis, technologies for converting "waste to energy & fuel", etc., that have taken place in environment management, also need to be incorporated and the emphasis has to be on green/clean processes and green/clean technologies. For sustainable development, it is necessary to introduce substantial changes in the working and practices of the industries. Wife this view, an incentive scheme for encouraging green practices is required to be put in place for MSME industrial units.

Resolution

After careful consideration/ Government of Gujarat has decided to introduce schemes that endeavour for a total green management in the industries of Gujarat.

1.0 Definitions

1.1 Previous scheme

Previous Scheme means scheme for assistance to Environment Protection Measures declared vide Govt. resolution no. APN/102003/1161(9)/I dated 10/06/2004.

1.2 Private Institution

Private institution means any industry association/ industrial house, institution or industry registered under Societies Act, Trust Act, Partnership Act or the Companies Act.

1.3 Public Institution

Public institution means GIDG, GPCB, other Board/ Corporations and local authorities like Nagarpalika, Municipal Corporation, Urban Development Authority, and District Panchayat etc.

1.4 MSME Enterprise

An enterprise which satisfies the conditions of Micro, Small and Medium Enterprise (MSME) as defined under the Micro, Small and Medium Enterprises Development (MSMED) Act, 2006 as amended from time to time and having acknowledgement of Entrepreneurs' Memorandum (EM) filed with respective District Industries Centre (DIC) or any registration as a medium sector enterprise as per the Industrial Policy of Government of India, will be termed as Micro, Small or Medium enterprises as the case may be.

1.5 New enterprise

New enterprise means the MSME which commences commercial production/ services, during the operative period of this scheme and has obtained acknowledgement of filing EM with the concerned DIC or IBM with GoI.

1.6 Existing enterprise

Existing enterprise means which is in operation before the commencement date of this scheme.

1.7 Project Cost

Project cost means the cost as appraised by the financial institution or any other institution approved by State Empowered Committee.

1.8 Gross Fixed Capital Investment

Gross fixed capital investment means investment in fixed capital viz. Land, Building, Plant & Machinery before it commences expansion/ diversification/ modernization and/ or it obtains sanction of financial assistance from Banks/Financial Institutions.

1.9 Eligible Fixed Capital Investment:

Eligible fixed capital investment means the capital investment made in the fixed assets viz. Land, Building, Plant & Machinery, Utilities, etc. excluding preliminary and pre-operative expenses during the operative period of the scheme.

2.0 Scheme -1: Scheme of assistance for Environment Management to MSMEs

The Scheme will be known as a Scheme of assistance for Environment Management to MSMEs.

2.1 Eligible Unit

Any MSME unit engaged in manufacturing and who intends to set up facilities for waste management/ pollution prevention and abatement will be eligible for assistance under this Scheme.

2.2 Eligible Activities

The follow ing facilities setup with application of Innovative / State of art technology will be considered as an eligible activity:

(i) Substitution & Optimization of raw material including catalysts
(ii) Rainwater harvesting
(iii) Any other pre-identified environment management project
(iv) Implementation of cleaner production and clean technology measures, etc.

2.3 Quantum of Assistance

2.3.1 The following quantum of assistance shall be provided:

Sr. No.	Eligible Activity	Quantum of Assistance per project
A	Substitution & Optimization of raw material Including catalysts	Upto 25% of cost of plant & machinery; ceiling of Rs 10 lakh per project.
B	Rainwater harvesting	Upto 50% of cost of fixed capital investment; ceiling of Rs 5 lakh per project
C	Any other pre-identified environment management project	Upto 25% of cost of plant & machinery; ceiling of Rs 10 lakh per project
D	Implementation of cleaner production and clean technology measures, etc.	Upto 50% of cost of plant & machinery; ceiling of Rs 10 lakh per project.

2.3.2 Sanctioning Authority:- The quantum of assistance under activity at sr. no A and D would be decided by State Level Committee, on the basis of scrutiny of the project report of the eligible activity to be carried out by the Gujarat Cleaner Production Center (GCPC). The quantum of assistance under activity at sr. no C would be decided by State Level Committee, and the quantum of assistance of activity at sr. no. B will be decided by District Level Committee.

3.0 Scheme - 2: Scheme for assistance to encouraging Green practices and environmental audit to MSMEs

The Scheme will be known as a scheme for assistance to encouraging "Green" practices and environmental audit to MSMEs.

3.1 Eligible Units

Eligible Unit means any MSME engaged in manufacturing and who intends to encourage green practices in its unit.

3.2 Eligible Activities

(i) Use of Clean, Efficient and Innovative Pollution Control Equipments in industries
(ii) Periodic Environmental Audits except those covered under Rules and Judgements
(iii) Encouraging Environment Management System - setting up of Environment Management Cell
(iv) Purchase of new equipments/ systems related to safety, occupational health for a cluster of industries (minimum 10 industries in a cluster)
(v) Installation of Solar System leading to at least 5% energy saving

3.3 Quantum of Assistance

Sr. No.	Eligible Activity	Quantum of Assistance per project
A	Use of Clean, Efficient and Innovative Pollution Control Equipments in industries	Upto 25% of cost of equipments; or maximum Rs. 2.5 lakh/ Units
B	Periodic Environmental Audits except those covered under Rules and Judgements	Upto 50% of fees of audit services; or maximum Rs.25,000/ audit
C	Encouraging Environment Management System - setting up of Environment Management Cell	Upto 25% of cost of equipments; or maximum Rs 5 lakh/ plant once in a lifetime
D	Purchase of new equipments/systems related to safety, occupational health for a cluster of industries (minimum 10 industries in a cluster)	Upto 25% of cost of equipments; or maximum Rs 25 lakh/ cluster. The assistance under the scheme will be provided to industrial association or SPY formed by the Industrial Units.
E	Installation of "Solar System leading to atleast 5% energy saving	Upto 25% of cost of system; Rs 2.5 lakh / plant

The quantum of assistance under activity at sr. no. A, B, C and E would be decided by the District Level Committee and activity at sr. no. D would be decided by State Level Committee.

4.0 Other conditions

(i) The applicant shall have to obtain prior permission/ Sanction under the relevant scheme before implementation,

(ii) The eligible unit that avails incentive under this resolution shall not be eligible for any incentive for the same purpose/process/ Equipments under any other incentive scheme of the State Government, unless specified otherwise. However, the unit may avail the benefit of an incentive under any of the schemes of the Government of India,

(iii) Environment audit by independent empanelledz auditor approved by either the State Empowered Committee or GPCB is compulsory for each year,

(iv) The unit shall have to operate and maintain plants and equipments for 5 years for which the assistance is availed.

(v) If the unit is liable to pay any outstanding Government dues and pending Court case/s, it shall not be entitled for any assistance under this scheme unless it gets itself cleared of all such pending issues with State.

(vi) The unit has to provide the details of production, consumption of raw material/catalyst, water power & parameter of pollution as and when asked for by Industries Commissionerate/ GPCB.

(vii) The unit shall submit annual return of the performance of the project formulated by Industries Commissionerate (IC).

(viii) Industries Commissioner shall issue detail guidelines separately under the scheme.

(ix) Any dispute/interpretation or contention under this scheme will be referred to the State Empowered Committee as constituted under G. R. No BGT/1008/499(1)/G dated 11/6/2009 and decision of the Committee shall be final and binding on the applicants.

5.0 Procedure

5.1 For Assistance under schemes

(i) The applicant unit has to apply in the prescribed application form with the relevant documents to the Industries Commissionerate or concerned District Industrial Centre.

(ii) The assistance will be sanctioned by a State Level Committee constituted as under.

Industries Commissioner	Chairman
Chief Engineer, GIDC	Member
Representative of GPCB	Member
Director, GEMI or his senior representative	Member
Member Secretary, GCPC or his senior representative	Member
Joint/Deputy Industries Commissioner	Member Secretary

(iii) The assistance will be sanctioned by District Level Committee constituted as under.

Collector	Chairman
District Development Officer	Member
Regiona 1 Manager of GIDC	Member
Regional officer of GPCB	Member
President of leading industries association	Member
General Manager, DIC	Member Secretary

6.0 Repeal & Saving

(i) The following Government Resolution (G. R.) is hereby repealed:
G.R. IMD No, APN-102003-1161 (9) -1, dated 10/06/2004

(ii) The sanctioned cases under the above repealed G.R. will continue to get benefit as per that G. R. All the pending applications will be considered under the new G. R. if they are eligible under the new scheme. The pending applications and projects sanctioned under earlier scheme are to be completed by 30th June 2010. The assets created and paid for up to 30th June 2010 will be considered.

7.0 Operative Period

The schemes will come in to force from the date of issue of this G. R. and shall remain in force for five years. The schemes under this G.R. will be reviewed after two years with reference to intended outcome/ actual performance and financial implications.

8.0 Expenditure

The expenditure under the Scheme will be met from the sanctioned grant of the respective financial year under the following budget head:

Demand No.	:	49
Major Head	:	2851 - Village & Small Industries
Minor Head	:	(102) Small Scale Industries
Sub Head	:	(16) IND (1) Financial Assistance to Industries - Subsidies (C) to others (Plan)

This issues with the concurrence of Finance Department dated 8-6-2009 on this department file of even number.

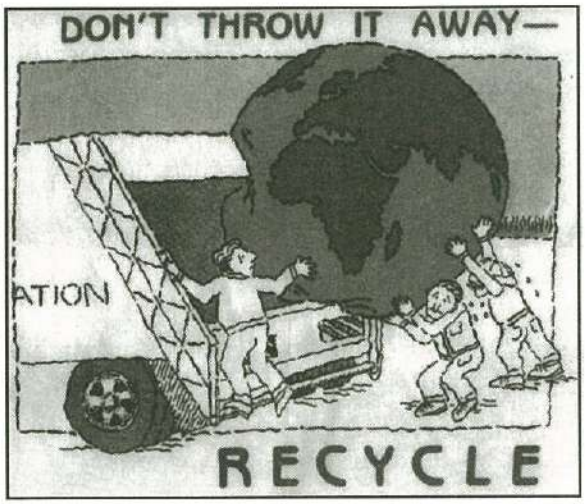
By order and in the name of the Governor of Gujarat.

(Shridevi Shukla)
Deputy Secretary
Industries and Mines Department

Copy to:

1. Secretary to Hon. Governor of Gujarat, Gandhinagar. *
2. Principal Secretary to Hon. Chief Minister, Sachivalaya, Gandhinagar.*
3. P.S. to Hon. Minister of State (Industries), Sachivalaya, Gandhinagar.
4. P.S. to all Hon. Ministers, Sachivalaya, Gandhinagar.
5. Advisor to Chief Minister, Sachivalaya, Gandhinagar.
6. Under Secretary to Chief Secretary, Sachivalaya, Gandhinagar.
7. Principal Secretary, Finance Department, Sachivalaya, Gandhinagar.
8. Personal Secretary to Principal Secretary, I & M. Department, Sachivalaya, Gandhinagar.
9. Principal Secretary, Forest & Environment Department, Sachivalaya, Gandhinagar.
10. Chief Executive Officer, Gujarat Infrastructure Board Development, Udhyog Bhavan, Gandhinagar.
11. V.C. & M.D., Gujarat Industrial Development Corporation, Udhyog Bhavan, Gandhinagar.
12. Industries Commissioner, Udhyog Bhavan, Gandhinagar.
13. Chairman, Gujarat Pollution Control Board, Gandhinagar.
14. Accountant General, Rajkot / Ahmedabad.
15. Under Secretary (Budget), I & M. Department, Sachivalaya, Gandhinagar
16. Select File.

* By letter


DON'T THROW IT AWAY—
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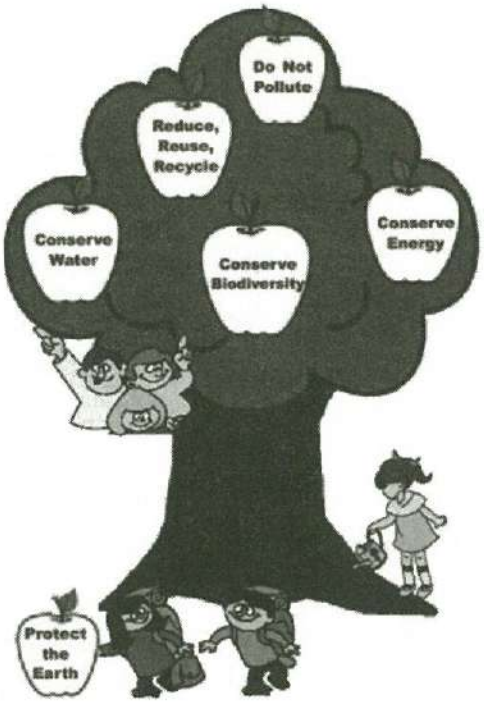
RECYCLE


Do Not Pollute
Reduce, Reuse, Recycle
Conserve Water
Conserve Biodiversity
Conserve Energy
Protect the Earth


THE FUTURE OF THE ENVIRONMENT

ANNEXURE : 4

Gujarat Industrial Policy, 2009

Schemes of assistance for Environment Protection Measures and Infrastructure

Government of Gujarat
Industries & Mines Department
Resolution No. BGT/1008/499(1) - G
Sachivalaya, Gandhinagar
Dated: 11-6-2009

Read:

1. G. R. IMD No. CET-102000-4216-G dated 22/07/2004
2. G. R. IMD No. CET-102000-4216 (1) - G dated 17/02/2005
3. Gujarat Industrial Policy, 2009

Preamble

The Industrial Policy, 2009 of State Government lays emphasis on inculcating systematic approach among the industries for holistic development that includes environment management as infrastructure. The earlier schemes for assistance to Environment Protection Measures and Infrastructure have emphasised upon setting up of common environment infrastructure plants viz. Common Effluent Treatment Plants (CETPs) and Treatment, Storage & Disposal Facilities (TSDFs). The need to deal with all aspects of environment management has arisen. Also emphasis on pollution prevention at source with issues like rational utilization of resources and cleaner processes and technologies need to be highlighted. The recent developments like plasma technology, pyrolsis, technologies for converting "waste to energy & fuel", etc., that have taken place in environment management, also need to be incorporated and the emphasis has to be on green/clean processes and green/clean technologies. For sustainable development, it is necessary to introduce substantial changes in the working and practices of the industries. With this view, an incentive scheme for encouraging green practices is required to be put in place.

Resolution

After careful consideration, Government of Gujarat has decided to introduce schemes that endeavour for a total green management in the industries of Gujarat.

1.0 Definitions

1.1 Previous scheme

Previous Scheme means scheme for financial assistance for common effluent treatment plant declared vide Government Resolution (G.R.) no. CED /102000/4216/G dated 22/07/2004.

1.2 Private Institution

Private institution means any industry association/ industrial house, institution or industry restored under Societies Act, Trust Act, Partnership Act or the Companies Act.

1.3 Public Institution

Public institution means GIDC, GPCB, other board/ corporations and local authorities Like Nagarpalika, Municipal Corporation, Urban Development Authority, and District Panchayat etc.

1.4 MSME Enterprise

An enterprise which satisfies the conditions of Micro, Small and Medium Enterprise (MSME) as defined under the Micro, Small and Medium Enterprises Development (MSMED) Act, 2006 as amended from time to time and having acknowledgement of Entrepreneurs' Memorandum (EM) filed with respective District Industries Centre (DIC) or any registration as a medium sector enterprise as per the Industrial Policy of Government of India, will be termed as Micro, Small or Medium enterprises as the case may be.

1.5 New enterprise

New enterprise means the new project of environment which commences commercial production/ services during the operative period of this scheme and has obtained necessary permission under environment law from state government and Government of India.

1.6 Existing enterprise

Existing enterprise means which is in operation before the commencement date of this scheme.

1.7 Project Cost

Project cost means the cost as appraised by the financial institution or any other institution approved by State Empowered Committee.

1.8 Gross Fixed Capital Investment

Gross fixed capital investment means investment in fixed capital viz. Land, Building, Plant & Machinery before it commences expansion/ diversification/ modernization and/ or it obtains sanction of financial assistance from Banks/Financial Institutions.

1.9 Eligible Fixed Capital Investment:

Eligible fixed capital investment means the capital investment made in the fixed assets viz. Land, Building, Plant & Machinery, and Utilities, etc. excluding preliminary and pre-operative expenses during the operative period of the scheme.

2.0 Scheme - 1: Assistance to Common Environmental Infrastructure Facilities (CIEFs) in PPP

The scheme will be known as scheme for Financial Assistance to Common Environmental Infrastructure Facilities (CIEFs) in Public Private Partnership (PPP).

2.1 Eligible Unit

Any private or public institution shall be eligible under the scheme.

2.2 Eligible Projects

2.2.1 Common Waste Management Infrastructure Projects

(i) Incinerators
(ii) Co-incineration of waste in cement and blast furnaces

(iii) Incineration / Pyrolysis / Plasma Reactor: waste to energy
(iv) Fuel Projects: such as waste plastic to diesel, rubber waste to diesel/ steam/ energy
(v) Common Solvent Recovery Plant
(vi) Common Spent Acid separation plant
(vii) Use of Gypsum in agricultural Land
(viii) Road Making - Iron Sludge
(ix) Biotechnology Solution for Waste Treatment & Waste Management

Each project should have linkages to waste exchange centre/ bank, hazardous waste generating industries and user agencies.

2.2.2 Common Infrastructure Projects

(i) Common effluent treatment plant
(ii) Collection, storage & disposal facility
(iii) Common conveyance pipeline for treated effluent disposal
(iv) Recycling of treated waste water for industrial/ other use
(v) Common Spray Drying System
(vi) Plants for making building and other useful environment friendly materials from the flyash

2.2.3 Any other Environment Management project as approved by the empowered committee based on the project submissions

2.2.4 Common Desalination Plant and Recycling of wastewater

2.3 Quantum of Assistance

2.3.1 Scheme - 1: Assistance to Private Developer

(i) In the form of viability gap funding of upto 20% of the project cost by GIDB.
(ii) Selection of the private institution shall be carried out through competitive bidding process specified under section 9 of the Gujarat Infrastructure Development Act 1999 for viable new proposals.
(iii) The quantum of Government of Gujarat (GOG) assistance can be increased depending upon the need of the project in particular area and additional assistance granted by GOG will be recovered in a phased manner through PPP partner as may be decided by the Empowered Committee.

2.3.2 Scheme - 2: Assistance to Professional agency

(i) Assistance up to 25% of eligible fixed capital investment in the Project.
(ii) The professional agency means any legal entity registered under Societies Act, Trust Act or Companies Act having sector-specific knowledge.
(iii) The project should be undertaken by professional agency having special know-how in environment science/ environment engineering / environment management or relevant area as may be approved by the State Empowered Committee.

2.4 Constitution and Accountability of Joint Venture (JV)/ Special Purpose Vehicle (SPV)

(i) The JV / SPV shall be established for the Common Environmental Infrastructure Facility (CEIF) with equity participation of Gujarat Industrial Development Corporation (GIDC) and private institution.

(ii) The private partner in a JV/ SPV shall be an anchor entrepreneur or a group of entrepreneurs.

(iii) GIDC may contribute equity participation in the SPV to the extent of 11% to 26% of the total project equity.

(iv) The JV/SPV shall be responsible for development of the project on develop, finance, construct, maintain and operate basis.

(v) The state government may provide land to the SPV on lease. Wherever the land is provided by Government/ its agencies, Government/ its agency may nominate one or two nominees in the board of directors of the SPV. The ownership of the government land shall remain with Government/ its agency.

(vi) The success of the scheme lies on SPV and hence formation of SPV, in terms of its executive committee and the key operators, should be sustainable. The Part time/ Full time Members/ Directors in the SPV would not be from amongst the user industries, except one representative of the user industries association.

(vii) Atieast 50% of the members/directors shall be professional in environment science/ environment engineering / environment management. The Chief Executive Officer (CEO) shall be a professionally qualified person in the field of Enviroinment Science / Environment Engineering / Environment Management/ Chemical Engineering/ Civil Engineering with background of environmental management.

(viii) Every proposal will show cost / pay of CEO as a part of the cost of the project.

(ix) The CEO will be responsible for implementation, operation & maintenance of the project as well as for strong monitoring and reporting to the Government. The CEO may certify the progress made by the SPV; including causes for delay in implementation and possible solutions and actions.

(x) The JV/SPV shall conduct energy and water audit at least once in a year.

2.5 Other Conditions

(i) The JV/SPV of Common Environmental Infrastructure Project availing incentive under this scheme will not be entitled to avail incentives under any other scheme of the State Government, unless specified otherwise. However, the industrial units coming up in the Common Environmental Infrastructure Facility (CEIF) area will be eligible to avail incentives available to them under separate schemes of the State Government.

(ii) Disbursement of the assistance will be done by Industries Commissioner after due verification of the assets.

(iii) GIDC will operate as a nodal agency and will give Build-Own-Operate-Transfer (BOOT)/ Build-Operate-Transfer (BOT) concession for development.

(iv) The Common Environmental Infrastructure Facility (CEIF) should provide world class facilities for environment improvement

(v) Any expenditure to-be incurred by the office of Industries Commissioner for PPP projects under this scheme, such as expenses for hiring of advisory services for bid process management, advertisement for tendering process, monitoring, etc., as may be sanctioned by Industries Commissioner, shall be met from funds provided for the scheme under this GR.

2.6 Monitoring Authorities

2.6.1 Apex monitoring body

Industries Commissioner and Gujarat Infrastructure Development Board will be responsible for monitoring of the CEIF projects as may be decided by the State Empowered Committee.

2.6.2 District level monitoring

District level monitoring shall be done by the committee of the following members.

Collector	Chairman
Regional Manager of GIDC	Member
Representative of GPCB	Member
General Manager, DIC	Member-Secretary

3.0 Scheme - 2: Financial Assistance under Non PPP Projects

The scheme will be known as scheme for financial assistance for common waste management and pollution prevention & abatement through Non-PPP projects.

3.1 Eligible Unit

Any private or public institution shall be eligible under the Scheme.

3.2 Eligible Activities

Following facilities setup with application of Innovative / State of the art technology will be considered as an eligible activity.

(i) Recovery of waste from E-waste/ Electroplating waste/ photography waste
(ii) Recycling facilities for hazardous waste generated during ship breaking activities
(iii) Recovery of Ozone Depleting Substances (ODS) from old equipment
(iv) Up-gradation of existing plant through clean innovative measures including cleaner production and clean technologies

3.3 Quantum of Assistance

The following assistance will be provided for investing in fixed capital investment for the specified activity:

Sr. No.	Eligible Activity	Quantum of Assistance per project
A	Recovery of waste from E-waste/ Electroplating waste/ photography waste	Upto 50% of eligible fixed capital investment with ceiling of Rs. 4 crore
B	Recycling facilities for hazardous waste generated during ship breaking activities	Upto 50% of eligible fixed capital investment with ceiling of Rs. 1 crore
C	Recovery of ODS from old equipment	Upto 25% of eligible fixed capital investment with ceiling of Rs. 1 crore
D	Up-gradation of existing plant through clean innovative measures including cleaner production and clean technologies	Upto 50% of eligible fixed capital investment with ceiling of Rs. 2 crore

The quantum of assistance under activity at sr. no. D would be decided on the basis of scrutiny of the project report of the eligible activity to be carried out by the Gujarat Cleaner Production Center (GCPC).

4.0 Scheme - 3: Scheme for assistance forobtaining carbon credits (CERs and VERs) and reducing carbon footprints

The Scheme will be known as a Scheme for assistance for obtaining carbon credits (CERs and VERs) and reducing carbon footprints.

4.1 Eligible Units

(i) For Activity A:
Private and Public institutions who decide to form a cluster of minimum 10 industrial units shall be eligible.

(ii) For Activity B:
Any industrial unit that decides to reduce its carbon footprint by 20% through Life Cycle Assessment (LCA) and related measures shall be eligible.

4.2 Eligible Activities

(i) Activity A: Obtaining Carbon Credits through CDM Projects.

(ii) Activity B: Reducing Carbon Foot Print by 20% through Life Cycle Assessment (LCA) and related measures.

4.3 Quantum of Assistance

The following quantum of assistance shall be provided:

Sr. No.	Eligible Activity	Quantum of Assistance per project
A	Seed Money for obtaining Carbon Credits through CDM Projects	Upto Rs 25 lakh per cluster of minimum 10 Industrial units.
B	Reducing Carbon Foot Print by 20 % - through life cycle analysis and related measures	Upto 50% of expenses to be incurred, maximum Rs. 5 lakh per project

The quantum of assistance would be decided on the basis of scrutiny of the project report of the eligible activity carried out by the Gujarat Cleaner Production Center (GCPC) or any other agency approved by the Government.

5.0 Scheme - 4: Scheme for strengthening the Regulation and Environmental Compliance

The Scheme will be known as a scheme for strengthening the Regulation and Environmental Compliance.

5.1 Eligible Activities

(i) Carrying out Industrial Zoning on the basis of Environmental Aspects, existing and proposed infrastructure including Environmental Infrastructure and availability of land, leading to zoning atlas

(ii) Providing support to GPCB/ Gujarat Environmental Management Institute (GEMI) for strengthening third party audit and its follow up action

(iii) Provide support to GPCB in partnership with GEMI to start ITIs/ Polytechnics / Engineering courses on Environment management as well as for in-house training of personnel

(iv) Scientific report/ Pilot projects on cleaner production and technology, safety, human health and environment through institutions (including IITs, NITs, Scientific and R & D institutions, GEMI, GCPC, Science & Engineering Colleges of the State) recognized by Govt. Of Gujarat / Govt Of India

(v) Placing sensors for Air / Water / Land Pollution levels in vulnerable areas for regular monitoring

(vi) Any other activity as approved by the State Empowered Committee

5.2 Quantum of Assistance

Need based support will be provided as may be decided by the State Empowered Committee.

6.0 Other conditions

(i) The applicant shall have to obtain prior permission/ Sanction under the relevant scheme before implementation.

(ii) The eligible unit that avails incentive under the scheme shall not be eligible for any incentive for the same purpose/process/Equipments under any other incentive scheme of the State Government, unless specified otherwise. However, the unit may avail the benefit of an incentive under any of the schemes of the Government of India.

(iii) Environment audit by independent empanelled auditor approved by either the State Empowered Committee or GPCB is compulsory for each year.

(iv) The unit shall have to operate and maintain plants and equipments for 5 years for which the assistance is availed.

(v) If the unit is liable to pay any outstanding Government dues and pending Court case/s, it shall not be entitled for any assistance under this scheme unless it gets itself cleared of all such pending issues with State.

(vi) The unit has to provide the details of production, consumption of raw material/catalyst, water power & parameter of pollution as and when asked for by Industries Commissionerate/ GPCB.

(vii) The unit shall submit annual return of the performance of the project formulated by Industries Commissionerate (IC).

(viii) Industries Commissioner shall issue detail guidelines separately under the scheme.

(ix) Any dispute/interpretation or contention under this scheme will be referred to the State Empowered Committee and decision of the Committee shall be final and binding on the applicants.

7.0 State Empowered Committee

(i) The State Empowered Committee consisting of following members is constituted for strengthening the Regulation and Environmental Compliance and dispute resolution under the scheme.

Add.Chief/Principal Secretary (Industries & Mines Department)	Chairman
Add.Chief/Principal Secretary (Finance Department)	Member
Add.Chief/Principal Secretary (Ports & Transport Department)	Member
Add.Chief/Principal Secretary (Revenue Department)	Member
Add. Chief/Principal Secretary (Forest & Environment Department)	Member
Principal Secretary/Secretary (Roads & Building Department)	Member
Principal Secretary/ Secretary (Water Resources, Water Supply & Kalpasar Department)	Member
Vice Chairman & Managing Director, GIDC	Member
Industries Commissioner	Member
Add. IC/ Principal Chief Industrial Advisor	Member Secretary

8.0 Procedure

(i) The applicant unit has to apply in the prescribed application form with the relevant documents to the Industries Commissionerate or concerned District Industrial Centre.

(ii) The project having a cash assistance of more than Rs. 25 lakhs will be scrutinized by a committee constituted as under. This committee will also sanction the application having a cash assistance upto Rs. 25 lakhs.

Add. Industries Commissioner	Chairman
Chief Engineer, GIDC	Member
Representative of GPCB	Member
Director, GEMI or his senior representative	Member
Member Secretary, GCPC or his senior representative	Member
Joint/ Deputy Industries Commissioner	Member Secretary

(iii) For assistance under PPP project the applications under Scheme will be received by the IC and selection of private developer on competitive basis will be taken up by the Industries Commissioner in consultation with GIDB. VGF assistance for the project will be approved by the State Empowered Committee.

(iv) The applications under other Scheme will be received by the IC. The IC will submit the application to the State Empowered Committee after review and scrutiny.

9.0 Repeal & Saving

(i) The following Government Resolutions are hereby repealed:
   (a) GRIMD No. CET-102000-4216-G dated 22/07/2004
   (b) GRIMD No. CET-102000-4216 (I) - G dated 17/02/2005

(ii) The sanctioned cases under the above repealed GRs will continue to get benefit as per terms and conditions of respective GRs. The applications pending may opt for new scheme if it is eligible under the scheme however projects under implementation and sanctioned under the old scheme should be completed by 30th June 2011 and assistance will be disbursed for the assets which have been installed and paid for up to 30th June 2011 will be considered.

10.0 Operative Period

The schemes will come in to force from the date of issue of this Government Resolution (GR) and shall remain in force for five years. The schemes under this GR will be reviewed after two years with reference to intended outcome, actual performance and financial implications.

11.0 Expenditure

The expenditure under the Scheme will be met from the sanctioned grant of the respective financial year under the following budget head:

Demand No.	:	49
Major Head	:	2852 - Industries
Minor Head	:	(800) Other Expenditure
Sub Head	:	(22) IND (3) - Development of Infrastructure Facilities Subsidies (C) to others (Plan)

This issues with the concurrence of Finance Department dated 8-6-2009 on this department file of even number.

By order and in the name of the Governor of Gujarat.

(Shridevi Shukla)
Deputy Secretary
Industries and Mines Department

Copy to:

1. Secretary to Hon. Governor of Gujarat, Gandhinagar. *
2. Principal Secretary to Hon. Chief Minister, Sachivaiaya, Gandhinagar.*
3. P. S. to Hon. Minister of State, (Industries), Sachivaiaya, Gandhinagar.
4. P. S. to all Hon. Ministers, Sachivaiaya, Gandhinagar.
5. Advisor to Chief Minister, Sachivaiaya, Gandhinagar.
6. Under Secretary to Chief Secretary, Sachivaiaya, Gandhinagar.
7. Principal Secretary, Finance Department, Sachivaiaya, Gandhinagar.
8. Personal Secretary to Principal Secretary, I & M. Department, Sachivaiaya, Gandhinagar.
9. Principal Secretary, Forest & Environment Department, Sachivaiaya, Gandhinagar.
10. Chief Executive Officer, Gujarat Infrastructure Board Development, Udhyog Bhavan, Gandhinagar.
11. V.C. & M.D., Gujarat Industrial Development Corporation, Udhyog Bhavan, Gandhinagar.
12. Industries Commissioner, Udhyog Bhavan, Gandhinagar.
13. Chairman, Gujarat Pollution Control Board, Gandhinagar.
14. Accountant General, Rajkot / Ahmedabad.
15. Under Secretary (Budget), I & M. Department, Sachivaiaya, Gandhinagar
16. Select File.

* By letter

Notes

Notes

Before CP Laboratory

This book meant for students of Chemical Engineering and Environmental Engineering, professionals and industries, focuses on minimization of waste by excellent management of any sector of Industries. It covers the basic attitude to design alternate options of existing process for waste reduction and select the best alternative to be adopted. Few case studies are presented to understand the basic need of Cleaner Production by innovative ideas.

After CP Laboratory

SALIENT FEATURES

- Focus on Waste minimization right at the source rather than treatment of waste, leading to understanding of the Cleaner Production.
- It includes the basics requirement for Cleaner Production and proper methodology for assessing the CP options.
- Some case studies of different sectors are covered in the text.
- New innovative ideas of thinking will developed in students right from the beginning of their careers and also for the Industrialists as well.

GUJARAT CLEANER PRODUCTION CENTRE

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