Cleaner Production Case Studies

Gujarat Cleaner Production Centre
(Established by Industries & Mines Department, GoG)

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Foreword

Gujarat Cleaner Production Centre (GCPC) was established by **Industries & Mines Department, Government of Gujarat** under **Gujarat Industrial Development Corporation** (GIDC) with the technical support of **United Nations Industrial Development Organization** (UNIDO) in 1998. GCPC is working on the principle of Cleaner Production (a proactive way to tackle the industrial pollution issues through promotion of CP for Sustainable Development). It promotes Cleaner Production and Clean Technology through various services like Orientation Programme, Assessment Projects, Training and Dissemination Programs. GCPC also acts as an ENVIS centre for **Ministry of Environment, Forest and Climate Change** (MoEFCC), Govt. of India on "Cleaner Production and Technology". It imparts knowledge as well as expertise to tackle with various environmental issues to different industries.

The Industries & Mines Department and Forests & Environment Department, Government of Gujarat have initiated various steps in order to promote and propagate Cleaner Production in state of Gujarat by making various Policies and Awards. Under this many financial assistance schemes have been included in Gujarat Industrial Policy, 2015. Also, **Gujarat Cleaner Production Award** is given to one of the best Industry in Small and Medium Scale Industries as well as Large Scale, who have successfully implemented Cleaner Production and showing exemplary works in form of Water & Energy conservation, Waste water & Solid waste reduction. A trophy and one year Additional Consent are given to the Winning Industries.

GCPC has compiled case studies of CP implementation in various Sectors. The Cleaner Production case examples are taken from the Applications/Nominations received under Gujarat Industrial Policy and Gujarat Cleaner Production Award. The case studies are having various options of Process Modifications, Recycle and Reuse through Waste recovery, Equipment modification with the use of advance technology intervention which can be replicated to the other Industries.

Hope this will be useful to all the concern. Feedback and Comments are invited.

Dr. Bharat Jain
Member Secretary
Gujarat Cleaner Production Centre

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Intervening Technology/ Technique	**Re-use of ETP Sludge & Dry Finish Dust in Manufacturing Process of Electrical Insulators, Water Conservation Measures, Reuse of water from Sewage Treatment Plant, Installation of VFD for Blower Motors and Power Compressors.**

About the industry	M/s. Aditya Birla Insulators is the country's largest, and the world's fourth largest manufacturer of electrical insulators. It is located at West Bengal and Halol in Gujarat. The company specialises in the production of High-strength equipment porcelains for use in SF6 circuit breakers, instrument transformers, condenser bushings, disconnections and insulators for the traction system of the Indian Railways, and high-end transmission products up to 765 kV system voltages.
Implemented Techniques/ Technology	**Before** 1. In routine ETP operation 4-5 MT/day sludge was generated and this sludge required to be disposed. Aditya Birla Insulators initiated a project to recycle the ETP sludge in the existing process. The samples were analyzed in-house as well as third party analysis was also carried out. After complete analysis, it was found that there is huge potential for in-house use after purification and chemical correction. 2. The dewatering process in filter presses generates wastewater which was flowing to ETP. The fresh water was used for willet pumps' gland cooling, Ferro filter backing, vibrator cleaning and floor cleaning which goes to ETP. **After** 1. The laboratory conducted series of lab trials and plant trials. All results were encouraged and successfully transferred in to product without any abnormality. Recycling solid waste to reuse it in final product manufacturing process. As a result of this, whole ETP has become one of the best and clean areas of the industry. 2. The dewatering process in filter presses generates water which was flowing to ETP, this water was collected in the tank where sedimentation takes places hence resulting in the separation of mud from water and as a result of this, the waste water from filter press get recycled which in turn gets utilized for willet pumps' gland cooling, Ferro filter backing, vibrators cleaning and floor cleaning. The treated water from Plant is now being used for gardening in plant premises.  

	• VFD (Variable Frequency Drive) for blower motors is installed to control the air by reducing the speed of blower motor. As per requirement, changing the frequency of VFD resulted in reduction of power consumption. Also, Installation of VFD at compressor in close loop, in order to maintain the desirable pressure at the output resulted in power saving. Installation of VFD at willet pump in close loop to maintain the pressure by reducing the motor speed through pressure transducer resulted in achieving constant pressure at the output of pump with power saving.	
Benefits	**Before CP**	**After CP**
Environmental	In routine ETP operation 4-5 MT sludge was generated and thereby disposed. Major water and energy losses occurred during manufacturing processes.	1. Resue of waste water: 140 KL / day 2. Reuse of water from STP: 50 KL / day 3. Saving after installation of VFD for blower motors :- 183600 KWH / Year 4. Saving after installation of VFD at willet pump :- 350400 KWH / Year

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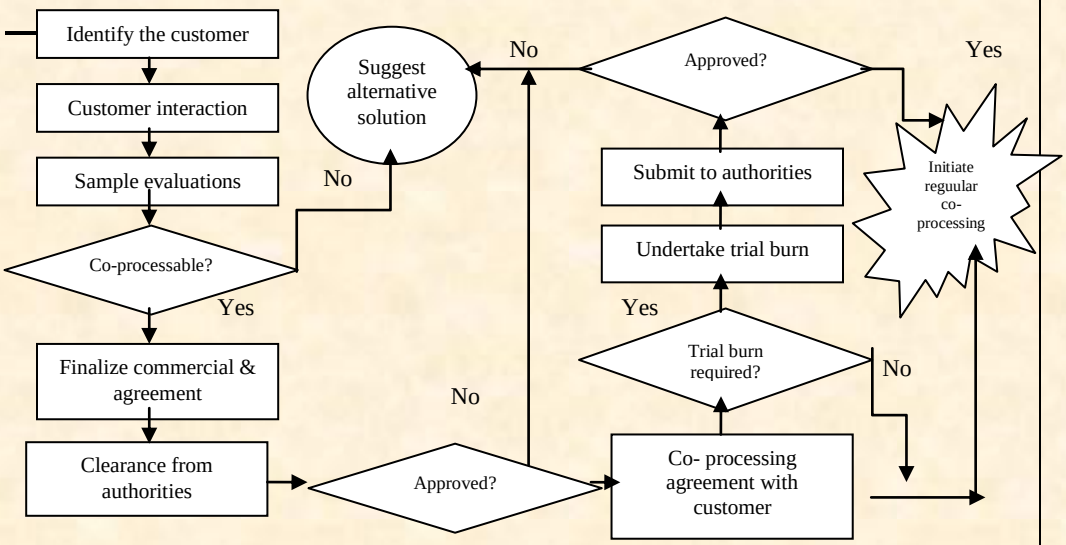
Intervening Technology/ Technique	**Co-processing of Hazardous and Non Hazardous Wastes as Alternate Fuel in Cement Kiln.**

About the industry	M/s. Ambuja cement is the largest cement manufacturing company located in Ambujanagar, Gujarat. Company engaged in manufacturing of **Portland Pozzolana Cement (PPC) using fly ash, Ambuja PLUS**, high quality cement with a promise of "more strength".
Implemented Techniques/ Technology	**Before** • Gujarat, Maharashtra and Andhra Pradesh are the top three Hazardous Waste generating states in India. The relative contributions by these States are 28.76 %, 25.16 % and 8.93 % respectively. In Gujarat state, the management and disposal of waste polythene bags and other non-recyclable polythene/plastic wastes was a serious problem for local bodies like municipalities and corporations. **After** • With a proactive approach for this problem, Gujarat Pollution board (GPCB) has come forward and encouraged the cement industries in the state, for utilizing these plastic and polythene wastes as co-fuel in the cement kilns. • High temperature in the cement kiln ensures the proper combustion, dissociation and disposal of wastes in an environment friendly manner as its heat value can be utilized for the cement manufacturing process.  AFR facility at Ambuja Cement Limited, Ambujanagar: • System for Co-processing of Solid waste • System for Co-processing Liquid waste

System for Co-processing of Solid waste

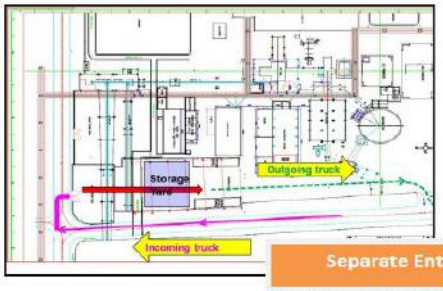
Pre-processing of Solid Waste:

Industry is using following methods to prepare the best quality waste acceptable to their Cement Kilns at Ambuja Cement.

- **Blending:** Different categories of materials are being blended to get the waste mix best suited to Cement Kilns. Industry normally blends biomass with plastic waste / RDF. TDI tar and spent Carbon are blended to their coal.
- **Segregation**: All the materials, irrespective of their categories are segregated for acceptable size and foreign material inside i.e. Stones, Steel pieces, over size material etc. Any material beyond 75 mm and 150 mm are segregated.
- **Shredding:** Industry is operating shredders for shredding of biomass to required size. Industry generally shredding the biomass below 75 mm size and 150 mm
- **Drying:** The wastes received are being co-processed at first in first out basis. The stored waste like plastic waste, RDF and biomass are exposed to atmosphere for sun drying / natural ventilation for reducing the moisture content.

Covered Storage Area

Leach proof Geometric membrane



Separate Entry & Exit Way System

Proper Fire Hydrant System

Display of SOPs (local Language) in Storage Yard

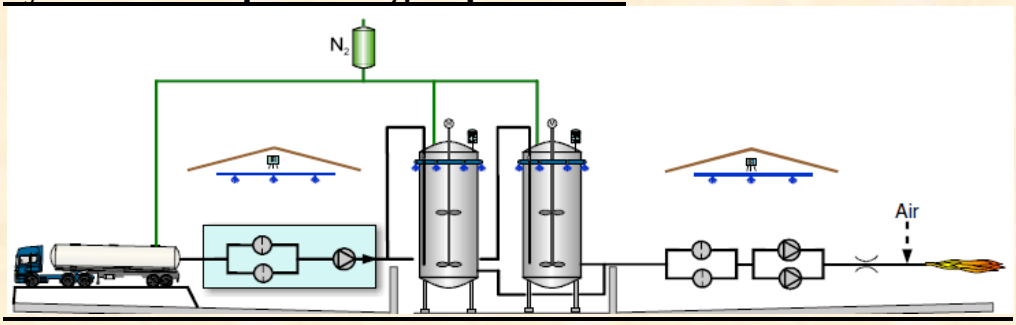
Feeding Systems for Solid Waste

Feeding system i.e. hopper starts from inside the storage yard hence no internal transportation is required. Material is feed into the hopper by winch system and transported through closed chain conveyor system for feeding of the solid waste at Calciner.

Feeding System inside Storage Area

Properly Closed Chain Conveyor System

System for Co-processing Liquid waste

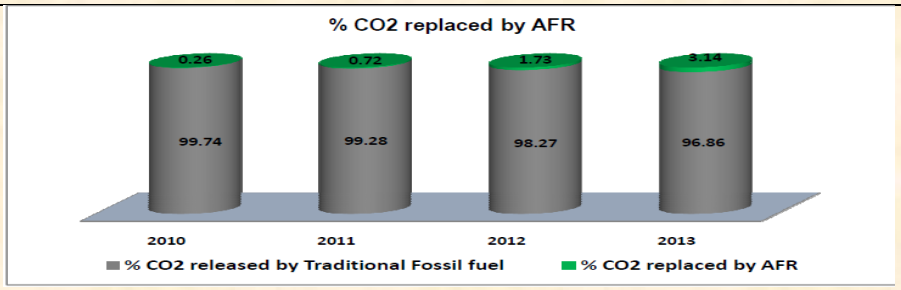


- The waste mix liquid is received in closed body tankers from waste generators or from TSDF (Treatment, Storage & Disposal Facility). It is connected with unloading pumps installed in the liquid AFR shed. The tanker is brought to standstill on the parking bay.
- The tanker is then connected with earthing to ensure proper grounding. After fixing wheel chokes, a sample of liquid is drawn and tested in AFR lab for parameters viz. Compatibility, %Water, %Chloride, %Sulfur, pH, and Calorific value. Once the parameters are within limits, the liquid is pumped into settling tank (capacity 40 KL) having the screens to remove any coarse solids/sediments. The liquid from settler is pumped in to storage tank with the help of centrifugal type unloading pumps and filtered through Basket filters.
- There are two storage tanks (2 x 250 KL capacity). The storage tank farm is provided with retention safety basin, spark arresters, level sensors and other safety devices. The storage tanks are equipped with mechanical agitators (propeller type mixers) to homogenize the liquid.
- Finally, the homogenized liquid is fed from storage tank to plant. In order to ensure accurate dosing of liquid with variable density and viscosity to make Positive displacement of pumps, variable frequency drives are installed. The pump can feed the liquid at 3 TPH. The liquid passes through the Coriolis flow meter measuring the liquid flow by Coriolis force between moving mass and perpendicular oscillating tube.

	The quantity/flow of liquid are controlled from central control room. The liquid is fed into pre-heater through twin fluid atomization nozzle where the liquid is atomized by compressed air into very fine droplets ensuring complete combustion of liquid in the pre-heater.
Benefits	
Economical	

Sr. no	Fuel	Fuel consumption before CP	Fuel consumption after CP
1.	Electricity, KWH/ tonne of Product	**92.71**	**88.21**
2.	Furnace oil. Liter / tonne of product	-	-
3.	Coal/lignite, Kg/ tonne of product	**110.69**	**96.34**
4.	Natural gas, Sm3/ tonne of product		
5.	LDO, Liter / tonne of product	**0.10**	**0.50**

Environmental



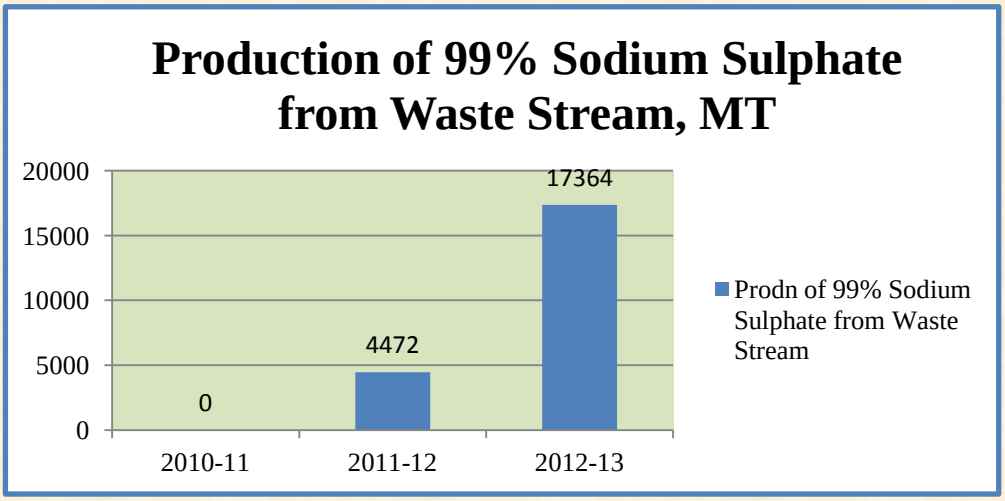
(1) Substitution of fast depleting limited natural resources of limestone 25 – 30%.
(2) Conservation of fossil fuels like Coal, Oil & Gas etc can be achieved due to the substitution of clinker with fly ash be achieved.
(3) 15 – 20% Electrical energy savings which will reduce further conserve fossil fuels due to avoidance of electricity generation.
(4) CO_2 reduction (direct): 220 – 280 kg CO_2 /t PPC (for Cement with 27 - 35% by mass fly ash).
(5) CO_2 reduction (indirect): 1 kWh in specific power consumption reduces CO_2 emissions by 1 kg hence reduction in CO_2 emissions is expected to be 13 – 17 kg / t PPC (for Cement with 27 - 35% by mass fly ash).
(6) Possibility of releasing vast space occupied by wet fly ash ponds.
(7) Avoidance of ground water contamination due to open storage of fly ash.
(8) Environment friendly disposal of fly ash and creating economic value while conserving the fast depleting natural resources (coal, limestone).

***

Intervening Technology/ Technique	**Creation of Wealth from High TDS Waste Stream through "Waste Recovery Plant"**

About the industry	M/s. Atul Limited (Aromatics Division) is the largest manufacturer of p-Cresol in the world located at Ankleshwar, Gujarat. Aromatics Division is also the largest producer of p-Anisic Aldehyde and p-Anisyl Alcohol in the world and also the leading manufacturer of Manganese Sulphate and Sodium Sulphite.
Implemented Techniques/ Technology	**Before** • p-Cresol process consists of mainly three unit processes i.e. sulphonation, high temperature caustic fusion and acidification. In past, acidification of Sodium Cresolate was done using Sulphuric acid in an aqueous phase. This was generating liquid waste stream having high TDS. Treating this high TDS stream in MEE was generating solid mixture which was not saleable and considered to be a solid waste **After** • New technology for acidification is developed and adopted for acidification of Sodium Cresolate using only Sulphur di-oxide in a continuous process. The major achievement is to generate Sulphur Di-oxide gas from high TDS Liquid Waste Stream of p-Cresol process. This helped industry to recycle methodology and also helps to reduce water consumption per MT of product . • After acidification with SO_2, aqueous phase contains mainly Sodium Sulphite. Therefore, waste stream containing mixed salt in dissolved form, was converted into a much purer aqueous stream containing mainly Na_2SO_3 which is partly recycled in the process and partly taken in Waste recovery plant for SO_2 generation for Sodium Cresolate neutralization. • Waste stream containing Sodium Sulphite is acidified using Sulphuric acid to generate SO_2 which is used for acidification of Sodium Cresolate for Cresols production. Pure Sodium Sulphate solution is generated as a result of acidification of aqueous waste stream which is fed to MEE plant to recover saleable pure 99% anhydrous Na_2SO_4 powder. The entire process is continuous and closed loop. Condensate from MEE plant is partly recycled in the p-Cresol process and partly used in the cooling tower operation.

Multi-Effect Evaporator (MEE) System for handling high TDS streams

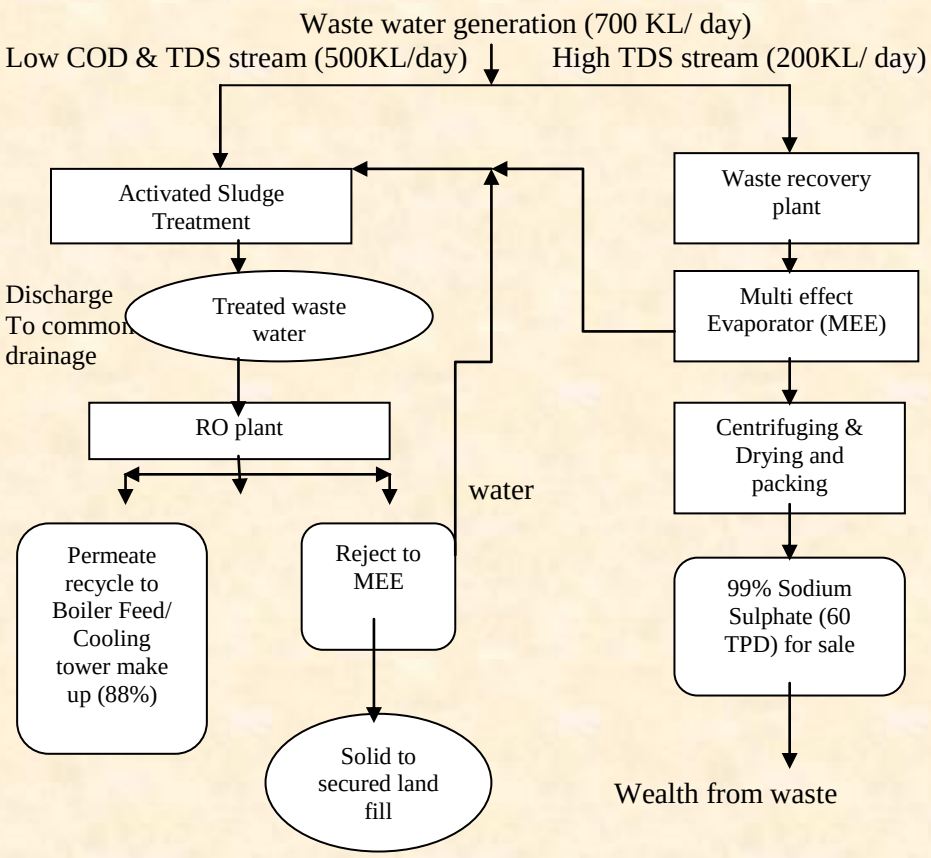


Benefits	Before	After
Economic	• Company paid charges to NCT (Narmada Clean Technology) for final treatment of waste water with high TDS (Total Dissolved Solid).	• Revenue generation from waste stream in year 2012-13 around Rs.608 Lac.
Environmental	• Generation of very high amount of waste water and discharged to NCT around 1500 KL/Day	• Reduction in the waste water generation and discharge quantity average 500 KL/Day.
	• High COD (Chemical Oxygen Demand) and TDS load and decrease the efficiency of ETP (Effluent Treatment Plant). • Solid waste with high TDS comes from MEE (Multiple Effect Evaporator), disposed off to the secure landfill.	• Reduction in the TDS load and COD having 100 ppm to 150 ppm. Increase the efficiency of ETP. • Recovery of 99% pure sodium sulphate from high TDS liquid Waste Stream.
Social	• Negligence of workers on useful resources going as waste	• Workers skills to conserve resources have improved the EMS of the company.

Intervening Technology/ Technique	**Recycling of entire Treated Waste Water with low TDS and low COD through Reverse Osmosis in the Process and Conserve Natural Resource and become Zero Liquid Discharge (ZLD) unit.**

About the industry	M/s. Atul Limited (Aromatics Division) is the largest manufacturer of p-Cresol in the world, located at Ankleshwar, Gujarat. Aromatics Division is also the largest producer of p-Anisic Aldehyde and p-Anisyl Alcohol in the world and also the leading manufacturer of Manganese Sulphate and Sodium Sulphite.
Implemented Techniques/ Technology	**Before** • After the tertiary treatment of waste water with low TDS and low COD, it was discharged to the Final Effluent Treatment Plant (FETP) (NCT) at Ankleshwar for final treatment. It increases the environment load on NCT for further treatment. **After** • DCS (Distributed Control System) based RO plant having 700 m3/day capacity has been installed. • It is a three stage RO plant designed at max discharge pressure of 42 bars to achieve the max water recovery as permeate. • Treated Waste Water coming from ETP tertiary treatment is again pre-treated in RO plant with defined chemicals to remove hardness, oil/grease if any, and suspended solid in traces to meet the desired norms of RO feed water. Pre-treatment process is very critical for the membrane life and water recovery. • Pre-treated water is then passed though a Dual Media Filter (DMF) followed by Ultra Filtration system (UF). After UF, water is fed through RO system in multi stages and clear water having very low TDS is recovered as permeate for recycling in the process. • Rejected water having high TDS is sent to a multi-effect evaporator system for removal of solids through Centrifuge. Solid coming out from Reject stream is non-toxic & non-hazardous and used in secured land fill. • Average recovery of water as permeate presently established is in the range of 85-88%. The operation is being stabilized and optimized to enhance the recovery to > 90% in RO. Total Water Recovery from RO and MEE put together is presently about 99%. • Permeate water having TDS as low as 25 ppm is used as boiler feed water and makeup water in cooling tower. The RO plant has been successfully commissioned resulting in complete stoppage of Waste Water discharge in the common pipe line and achieving Zero-liquid discharge (ZLD) objective.

Waste water treatment methodology: complete recovery & recycle of water



Benefits	Before	After
Economic	• Company paid amount to NCT (Narmada Clean Technology) for final treatment of waste water with low TDS (Total Dissolved Solid) and COD (Chemical Oxygen Demand).	• Achieved Zero liquid discharge concept and recycle the entire water in to process as well as utility.
Environmental	• High Water Consumption • High waste water discharge quantity.	• Reduction in the water consumption from 24 KL/Day/MT to 6 KL/Day/MT of product.
Social	• Negligence of workers on useful resources going as waste	• Workers skills to conserve resources have improved the EMS of the company.

Intervening technique / technology	**Co-processing of Pharmaceutical Waste in Cement Kiln.**
About the industry	M/s. Lupin Ltd. is located at Ankleshwar, Gujarat. The Company is engaged in manufacturing of cephalosporin (API) with FDA approval to manufacture complex oral and injectable cephalosporin.
Implemented technology / technique	**Before** • Lupin Ltd was generating 200T of liquid process waste having calorific value of around 5000 Kcal / kg. Lupin used to send the same to the Incinerators outside by paying cost for incineration. **After** • Co-processing of Incinerable waste is an alternate fuel and it is environment friendly especially in the cement kiln due to operation above 1700^0C temperature where waste will get decomposed full and no residue left.. • Ambuja Cement Limited has received the final approval from the Central Pollution Control Board, New Delhi to accept liquid waste at their Kodinar Plant.
Benefits	
Economical	• Regular co-processing of waste -2500 MT/year. Saving of cost of disposal by incineration–250 lac/year.
Environmental	• Reduction in the use of non-renewable fossil fuels viz: Coal 3800MT/year. • Recovery of energy from the alternative fuel material. • Elimination of the disposal of the waste in the land fill or incineration. • Cement industries used to burn coal as fuel which has substantial impact on natural resources and co – processing of incinerable waste, cement industry substantially save the coal usage. • Alternate fuel is substantially reduced the air pollution.

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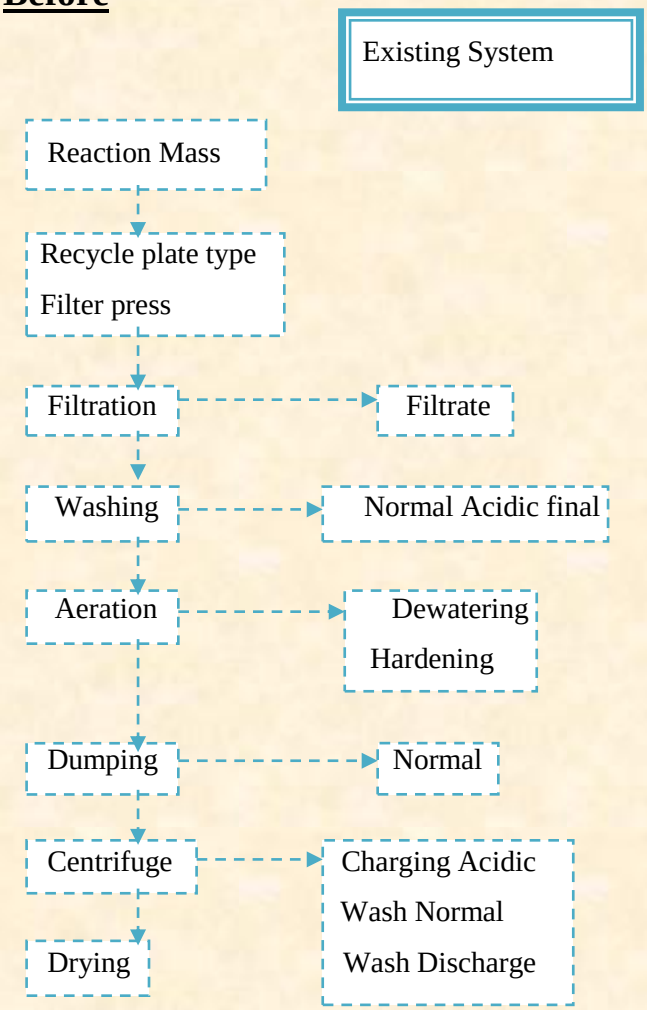
Intervening Technology/ Technique	Modification in the Filtration Technology

About the industry	M/s. Devarsons Industries Private Limited located at Odhav, Gujarat. Company engaged in manufacturing of powder solvent Dyes, liquid solvent dyes, vat dyes, acid dyes, food dyes etc.
Implemented Techniques/ Technology	**Before**  Losses in the Conventional Drying methods which are calculated as follows: - Blow down losses because of high TDS water (Approx losses - 10%) - Boiler efficiency (Approx losses - 10%) - Steam transportation losses (Approx losses - 5%) - Hot air generation by steam through Radiator losses (Approx losses - 10%) - Steam evaporation loss due to manual system (Approx losses - 5%)

After

Filtration System

- By adopting new filtration technology, the power consumption has been reduced efficiently. As power consumption is mainly due to the centrifugation of the product which will be avoided by adopting new technology. The reduction in power consumption is 30%.
- On completion of reaction, filtration and washing are the prime stages for the good quality product.
- In recessed type press, the dewatering process was carried out by compressed air at 0.2 kg of Pressure. The same process is totally avoided in the newly mixed pack membrane press as it removes water from wet cake hydraulically at 8 kg Pressure.
- The process of centrifugation will be avoided because of reduction in water by almost 16% in the wet cake.

Benefits	After CP	Before CP
Economical	• Power: 803 kWh • Labour: 14 nos. • Water :43 kL	• Power: 560 kWh • Labour: 5 nos. • Water :38 kL

	PNG: 480 Scm	• PNG: 348 Scm
Environmental	• Sludge Generation is more which is more problematic for environment and also cause disposable problem.	• Reduction in sludge quantity and found less moisture in sludge.

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Intervening Technology/ Technique	**Increasing Chiller's Set Point, reduces running hrs of EO Bullet Scrubber Pump, Provision of VFD in Chiller's Secondary Pump at Manufacturing Process.**

About the industry	M/s. Galaxy Surfactants Limited located at Taloja, Tarapur (Maharashtra) and Jhagadia (Gujarat) and a depot outlet at Delhi, India. The Company is engaged in manufacturing and marketing surfactants and specialty chemicals for the personal and home Care Industry.	
Implemented Techniques/ Technology	**Before** 1. Earlier the Chiller set point was 7^0C. 2. Earlier the running hrs of EO bullet scrubber pump was 1013 hr. 3. Earlier chiller secondary pump was running on DOL (Department of Labor) starter. **After** 1. Chiller set point has been increased to 10^0C. 2. The running hrs of EO bullet scrubber pump is reduce to 902. 3. Provision of VFD (Variable Frequency Drive) in chiller secondary pump.	
Benefits	**Before CP**	**After CP**
Economical	**1.**Running hrs =1013 **2.**Total Hours of Run =24 **2.1** Energy Consumed (kWh) =48 **3.** Power taken Pump (kWh) =7 **3.1** Energy Consumed (kWh)=168	**1.1** Running Hrs = 902 **1.2** Energy Savings = 1.78 kWh **2.1** Energy saving = 1.41 kWh **2.2** Total time of run=7.08 hrs. **2.3** Energy Consumed (kWh)=14.17 **3.** Power Taken (kWh) with VFD=3.38 **3.1** Energy Consumed (kWh) = 81 **3.2** Savings per day (kWh)=86.88

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Intervening Technology/ Technique	**Printer Toner Cartridge Re-manufacturing (Recycling)**

About the industry	M/s. GRC (Gujarat Refilling Centre) is one of the largest and fastest growing remanufacturing high quality printer toner cartridges company, located at Vadodara in Gujarat, India.
Implemented Techniques/ Technology	Remanufactured cartridges are essentially reused cartridges. It was empty cartridges that have been collected, inspected, cleaned and rebuilt. The process by differs by manufacturer and materials used with varying results in quality and page yields. Remanufactured cartridges have quality control standards, lab-tested components to ensure consistent OEM (Original equipment manufacturer) equivalent performance. **Toner Re- Manufacturing Process** 1. Incoming raw material • All incoming cartridges are thoroughly inspected for irregularities before dismantling. 2. Sorting and gradation • All empty cartridges are sorted and graded as per OEM Brands. 3. Dismantling • All incoming cartridges are dismantled to drums, toner, blades, PCRs, magnetic rollers, etc which are verified before it reach the production floor. 4. Disassembling and Clean • Empty cartridges are carefully disassembled and cleaned. Through automation, it precisely splits the toner hopper with custom splitting equipment and the hopper for the sealing phase. 5. Toner Filling • Toner hoppers are filled with premium toners, which are technically matched to the OPCs (drum) for optimal yields and printer performance. 6. Assembly • Factory-trained technicians assemble all cartridges with OEM grade compatible components (up to 75 % new components are used in each cartridge.) The assemble process includes the installation of a pre-qualified drum, wiper blade, doctor blade, PCR and magnetic roller. 7. 100 % Post Testing • Each Cartridge is tested for standard print tests to ensure their performance and quality. 8. Quality Control • Each step in manufacturing process is monitored by dedicated quality control experts. Each step in production process undergoes regular and spot inspections 9. Packaging • All cartridges receive a final inspection to ensure for quality standards.

Benefits

Economical

CP option	Remanufacturing of cartridge
Investment	Rs: 38,00,000
Annual Operating Cost	Rs: 6,00,000
Annual Saving	Rs: 2.5 Lac Approx
Payback Period	5 Years

Life Cycle Stage	Emission Per New cartridge (gCO_2)	Emission during remanufacturing (gCO_2)
Components (Inc. End of Life)	2136	223
Component Packaging	286	65
Cartridge Packaging	980	380
Components Shipping	203	19
Distribution	33	451
Energy Use	761	451
Total	**4399**	**1802**

Environmental

- Reduction in carbon emissions.
- Remanufactured cartridges reduces landfill waste.

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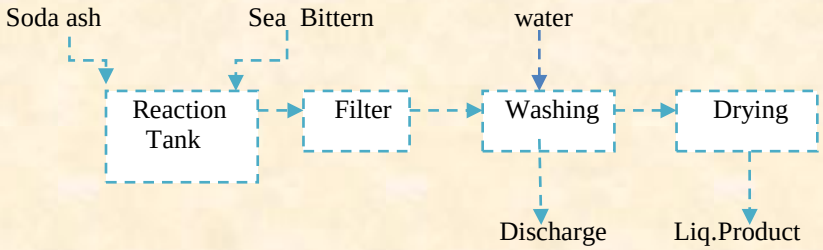
Intervening Technology/ Technique	**Novel Process for Manufacturing of Magnesium Carbonate**

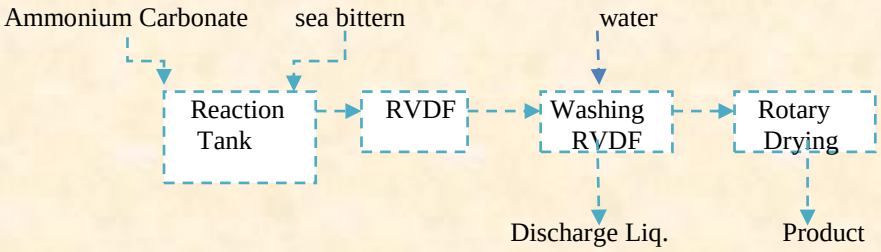
About the industry	M/s. Hariom Fine Chem is a chemical manufacturing company based at Bhavnagar, Gujarat, India. The company is engaged in manufacturing and exporting Light Magnesium Carbonate.
Implemented Techniques/ Technology	**Before**



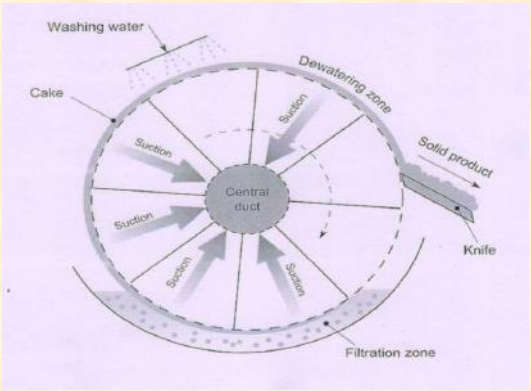
$$MgCl_2 + (NH_4)2CO_3 \rightarrow MgCO_3 + 2NH_4Cl$$
$$95.1 + 96 \qquad 84.3 + 106.8$$

- Magnesium Carbonate was manufactured by reaction of sea bittern ($MgCl_2$) with Soda Ash (Na_2CO_3) in reaction tank. Practically 1.3 MT of soda ash was consumed to produce 1 MT of magnesium carbonate. Market price of soda ash around Rs. 24000 was consumed to produce 1 MT of magnesium carbonate.
- Magnesium Carbonate was filtered and washed by the Filter press. The cake was discharged from filter press and sun dried in open space. Here, the wash water required in very large quantity and around 6 labours required in each shift to unload filter press and take material from the plant to open space for drying. Labour charge was around Rs. 1200/ MT of magnesium carbonate.
- Material was kept in ground for 5-6 days in summer and 9-10 days in winter for drying. Labour charge for sun drying was around Rs. 800/ MT of magnesium carbonate. After drying the cake was pulverized up to certain mesh size and then packed for dispatched.
- 10-15% of free moisture content was there in sun dried material, so it has to be further dried in tray dryers. 4 labours per shift required for load and unload the tray dryer. Labour charge was around Rs. 800/ MT of magnesium carbonate.

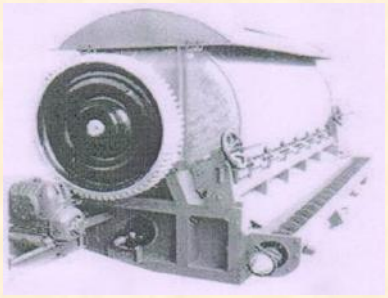
After



- Magnesium Carbonate is manufactured by reaction of sea bittern ($MgCl_2$) with ammonium carbonate in reaction tank. Magnesium carbonate is filtered and washed by the Rotary Vacuum Drum Filter (RVDF). It consist of a drum rotating in a tub where liquid to be filtered. High solids and liquids that would blind or block other forms of filter. The liquid to be filtered is sent to the tub below drum. The drum rotates through the liquid and vacuum sucks liquid and solid on the drum. Liquid portion is sucked by the vacuum in the filter media to internal portion of the drum and pumped away filtrate. The solids adhere outside of the drum is passes to the knife where, it is cutting and discharging to conveyer. The same process is continued further.



- RVDF is continuous and automatic operation, so operating cost is low around Rs. 200/ MT of magnesium carbonate. One operator per shift can handle it. The variation in rotating speed of the drum can be use to control cake thickness.



	• Now, the cake is discharge to RVDF and dried in Rotary Drum Dryer is basically conduction dryer. Wet feed film in liquid or paste form is applied to rotating metal cylinder where heating medium (steam) is supplied. Material film dries to the final moisture level and is scrap off to screw conveyor by blades at other end. • Material obtained is in small granular form, so it is easy to pulverize it. Uniform drying due to uniform application of film, consisting quality obtained. Very high thermal efficiency due to that less energy per kg of product required. One operator per shift is required to handle equipment and operating cost is around Rs. 200/ MT of magnesium carbonate.	
Benefits	**Before CP**	**After CP**
Economical	• Due to high price of soda ash raw material cost becomes high. • Around 6 labours were required per shift and operating cost was Rs. 1200/ MT for Filter Press. • Labour charge for sun drying to tray dryer was Rs. 800/ MT.	• Due to low price of ammonium carbonate raw material cost becomes low. • Only one operator required per shift can handle the equipment and operating cost is around Rs. 200/ MT for RVDF. • Labour charge for sun drying to Rotary drum dryer is Rs. 200/ MT.

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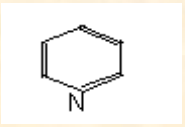
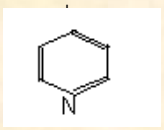
Intervening Technology/ Technique	**Modification in the Manufacturing Process of Hydroxy Sulfo Propyl Pyridinium Betaine.**

About the industry	M/s. Parth Chem & Technologies is a major Manufacturer, Exporter and Supplier of Electroplating Intermediates & Pharmaceuticals Intermediates located at Vatva, Ahmedabad in Gujarat. Company engaged in manufacturing of Hydroxy Sulfo Propyl Pyridinium Betaine, Sodium Propyne Sulfonate, Propargyl Chloride, Sodium Allyl Sulfonate etc.
Implemented Techniques/ Technology	**<u>Before</u>** **Hydroxy Sulfo Propyl Pyridinium Betaine** Water, Pyridine and 3-Chloro-2-Hydroxypropane Sulphonic Acid are taken into Reaction Vessel. During stirring, it is slowly heated. Keep this stage for 14 hrs to reach the temperature 100°C - 105°C to complete the reaction. Than cool it to the room temperature, treat with carbon and filter. Clear filtrate was evaporated in open pan at 105 ^{0}C - 130 ^{0}C by steam heating in jacket to get pasty mass; it will take minimum 25 hrs time. Followed by cooling, centrifuging, drying, milling and packing.



2-Hydroxy 3-Chloropropane Sulphonic Acid Sodium Salt + Pyridine



OH + NaCl
|
CH_2--- CH-CH_2SO_3
Sodium Chloride
Hydroxy Sulphopropyl Pyridinium Betaine

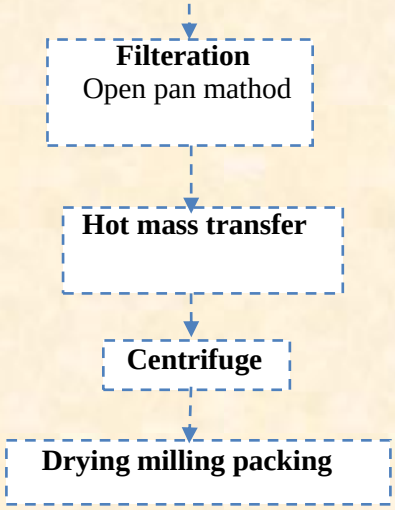
Before C.P.

Mixing
Solid Raw Material Charged
Liquid Raw Material charged

↓

Reaction
In normal condition

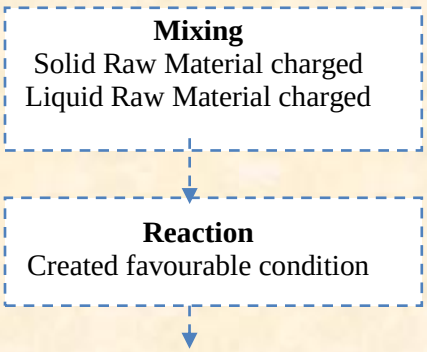
↓



After

- Required quantity of Water and Sodium 3-Chloro-2-Hydroxypropane Sulphonic Acid are taken in to Reaction vessel. Pyridine is charge during stirring (10 % extra in first batch) by vacuum. Reaction mass is then heated at lower temperature of 70°C - 100 °C maximum.
- In this process the reaction completes within 6 hrs instead of 14 hrs at 102°C - 105 °C. The content is cooled to room temperature and filtered through sparkler filter pump in closed system. The clear filtrate is taken in to vacuum evaporator by gravity under low pressure.
- In this process heating is done externally by steam and distillate about 812 kg. Than it is collecting at 60°C -100°C temperature under vacuum pressure of 650-690 mm within 10-12 hrs instead of 25 hrs at 105°C-130°C. 812 kg of distillate is successively reused for next batch. The hot residue from the closed evaporator is taken out by Gravity in to trays, followed by cooling, centrifuging, drying, milling and packing. There is reduction in time cycle, energy, water consumption and new method is in environmental friendly manner.

After C.P.



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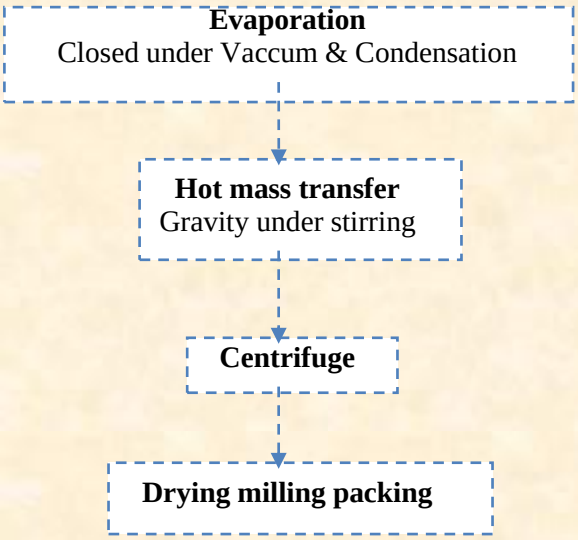
<tr><td></td><td colspan="2"> 
</td></tr>
<tr><td>Benefits</td><td>Before CP</td><td>After CP</td></tr>
<tr><td>Environmental</td><td>Water and Energy consumption was more.</td><td>Water Saving : 812 kg per tonne of Product
Electricity Saving : 206 kW per tonne of product</td></tr>
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Intervening Technology/ Technique	**Technological Innovations in the Manufacturing Process of Profenofos Technical.**

About the industry	M/s. PI Industries Ltd (PIL), the Corporate office is located in Gurgaon, Haryana with the R&D unit at Udaipur, and the manufacturing sites at Panoli near Ankleshwar (Gujarat State), and Jammu (J&K state).	
Implemented Techniques/ Technology	**Before** • In the original manufacturing process, the reactions in step-II were carried out using an organic solvent (Acetone) and potassium carbonate. The molar yield of this step was only 85%. • The reactions in step-III were carried out with anhydrous sodium hydrosulfide (NaHS) in moisture free isopropanol as solvent. • The reactions in step-IV was carried out in the solvent medium of MIBK (Methyl Iso Butyl Ketone).The purity of Profenofos technical obtained by this process was only 89%. **After** • In the new innovative process, in reaction step – II, the organic solvent was replaced with water and Potassium carbonate, which is costly, was also replaced with 47% caustic lye. The resulting yield increased to 94%. • The reactions in step – III Anhydrous sodium hydrosulphide (NaHS) was replaced with Aq. 30% NaHS solution which is a by- product of another major product at PI Industries. • The reaction in step – IV was carried out in a purely aqueous medium, thereby greatly minimizing the use of the costly MIBK solvent. The new process also results in an average increase in yield of greater than 8% and increased purity of Profenofos technical to 94%. • The aqueous layer containing sodium bromide was also re-utilized to generate bromine, which is an input in step-I of the process.	
Benefits	**Before**	**After**
Economical	• All the solvents such as Acetone, MIBK, and Potassium Carbonate and Anhydrous sodium hydrosulphide were responsible for high COD load in the waste water hence difficult to treat. It reduced yield and purity of final product.	• Potassium Carbonate was replaced by cheaper 47% caustic lye. 100% reduction in the COD load in waste water. • Use of **water** in place of **acetone** and **MIBK.** • 30% Use of aqueous NaHS in place of anhydrous sodium hydrosulphide. • Use of 90% industrial ethanol in the

		place of costly anhydrous isopropanol. Increased yield to 89% to 94%. • Cost saving of Rs. 35,42,75,000 per annum, based on an annual production of 2000 MT.
Environmental	• Acetone, Isopropanol and MIBK were used in the various manufacturing steps of Profenofos which was responsible for high COD built up in the waste water.	• Two solvents, namely acetone and MIBK, were completely replaced by water. • The third solvent - anhydrous Isopropanol - was replaced by 90% industrial ethanol.
	• Unrecovered sodium hydrosulphide increased the TSS in the waste water.	• Anhydrous sodium hydrosulphide (NaHS) was replaced with 30% aqueous NaHS, which is a process by-product from the manufacture of another major product at PI.
	• Aqueous layer of waste water with halogen compound such as bromine which was responsible for poisonous in fluid form and bromine vapour is destructive for the human skin, eyes and respiration tract.	• The aqueous layer containing sodium bromide was also re-utilized to generate bromine, which is an input in step-I of the process.
	• Increase the waste water and solid waste generation without any cleaner production options such as Reduce/ Recovery/ Reuse/ Recycle.	• Reduction in Waste water and solid waste through the CP concept.

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Intervening Technology/ Technique	**Technological Innovations in the Manufacturing Process of Phorate Technical.**

About the industry	M/s. PI Industries Ltd (PI) the Corporate office is located in Gurgaon (Haryana), with the R&D set up at Udaipur, and the manufacturing sites at Panoli near Ankleshwar (Gujarat State), and Jammu (J&K state).
Implemented Techniques/ Technology	**Before** • In the original manufacturing process, the reaction in step-II was carried out with aqueous 37% formalin solution and ethyl mercaptan. The un-reacted formalin goes to the effluent and increases the effluent load with high COD/TDS/TSS. **After** • In the new innovative process, the reaction in step-II is carried out with Para formaldehyde and Ethyl mercaptan in minimum quantity of water (recycled from the aqueous layer of the previous batch). The de-polymerisation of Para formaldehyde takes place in-situ to generate formalin for the reaction with ethyl mercaptan and DETA (Diethylenetriamine). • After the reaction, two layers are formed and separated. The aqueous layer containing un-reacted Formalin and DETA is recycled for use in the subsequent batch. • The organic layer containing 8-10% un-reacted DETA is neutralized with caustic lye to generate an aqueous solution of Sodium DETA, which can be used in the manufacturing process for another PI product called Ethion. • After washing and subsequent drying, the organic layer gives Phorate of 95% purity.

Benefits	**Before**	**After**
Economical	• Increased raw material consumption due to inefficient recovery of un-reacted raw material from the effluent.	• Recycle and re-use of the formalin and DETA which minimize the fresh raw material consumption.
	• Un-reacted DETA remained in the effluent.	• The aqueous solution of Sodium DETA, generated by neutralizing the un-reacted DETA in the organic layer, can be used in the manufacturing process for another PI product called Ethion. This prevents the wastage of DETA as a raw material.

	• Aqueous Formalin solution was used in excess amount and therefore, unreacted formalin directly sent to the effluent treatment plant for further treatment of the effluent without any recovery/reuse/recycle.	• New process replaces with the 37% aqueous Formalin solution with solid para formaldehyde. Smaller quantity is required than formalin. • It is also easier to handle small quantities of solid para formaldehyde rather than large quantities of aqueous formalin solution. • The new process resulted in an overall **cost saving of Rs. 10, 53, 12,500 per annum.**
Environmental	• Increase the pollution load on waste water treatment plant due to un-reacted formalin and DETA remains in the effluent. It reduces the yield and purity of final products.	• 90% reduction in the generation of toxic effluent, through in-process recycling of waste streams.

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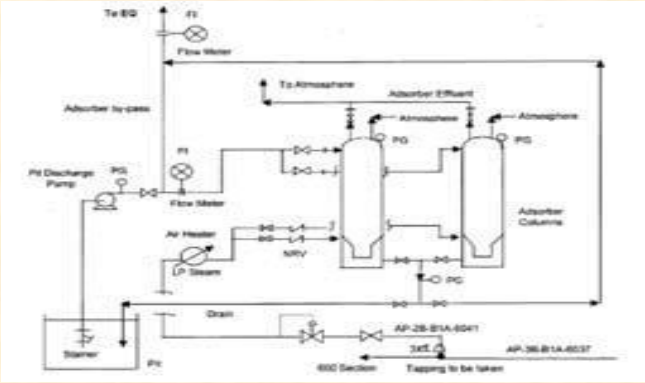
Intervening Technology/ Technique	**Removal of Fluoride from the Wastewater**

About the industry	M/s. Reliance Industries Limited (VMD) is the pioneering Petrochemical unit in India. RIL-VMD is Asia's only producer of ACN (Acrylonitrile) and India's only producer PBR (Poly butadiene rubber) located in Vadodara, Gujarat.
Implemented Techniques/ Technology	**Before** The concentration of fluoride generated in the wastewater of PBR plant was around 40-50 ppm, whereas the discharge norms for fluoride is 1.5 mg/L. Although the final discharge norms were meeting, still the high concentration of fluoride concentration in the final effluent was a cause of concern while providing the end of pipe treatment. **After** • Root cause analysis is carried out in order to check if the generation of fluoride could be eliminated by any means. But this is not possible as the process itself generates such high concentrations of fluoride. Therefore it is thought to provide an ISBL (Inside battery limit) treatment by segregating the fluoride stream. • Activated Alumina has been considered the best technology for fluoride removal from aqueous solutions. It is currently use to treat PBR-II wastewater stream. Adsorptive process is simple requiring a flow rate across the media with a contact time. • Remediation and municipal fluoride removal systems normally require regeneration to make them cost effective. Regeneration is accomplishes by a simple process whereby a dilute caustic solution is use to strip the adsorb fluoride and other dissolve contaminants off of the surface of the media. The caustic step is followed by rinsing and then the recondition with sulfuric acid. As some of the alumina can be dissolving during regeneration it is recommend planning for periodic media "top-up". **Schematic diagram for removal of Fluoride** 

	De-fluoridation Unit-PBR –II plant 
Benefits	
Economical	• A cost effective process is developed for reduction of fluoride (to <10 ppm) using spent (waste) alumina.
Environmental	• Decrease in the toxicity levels earlier created due the presence of higher concentrations of fluoride. • The benefits from this modification to the treatment scheme helps in reducing the Fluoride levels from 30 ppm to less than 5 ppm.

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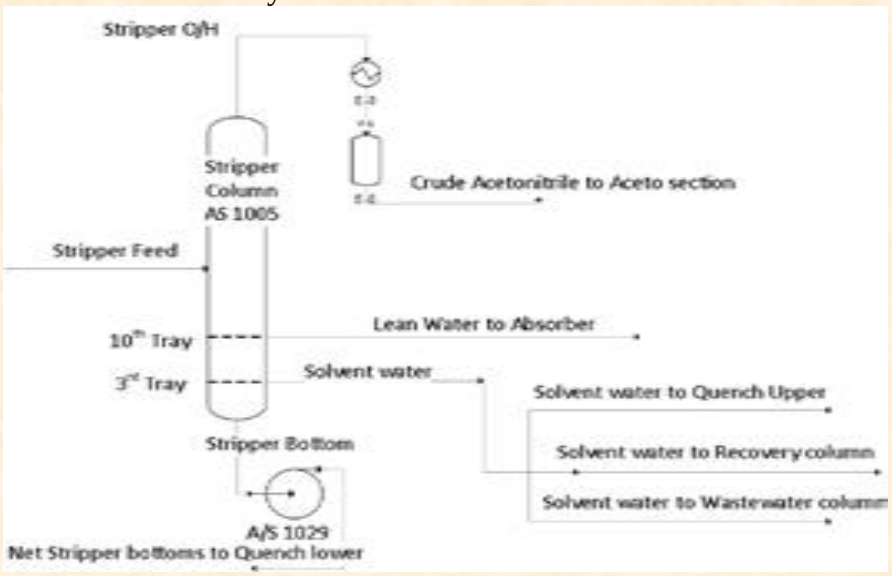
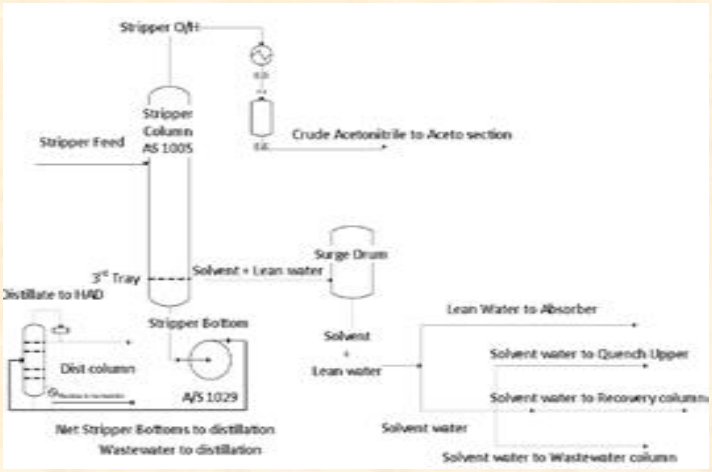
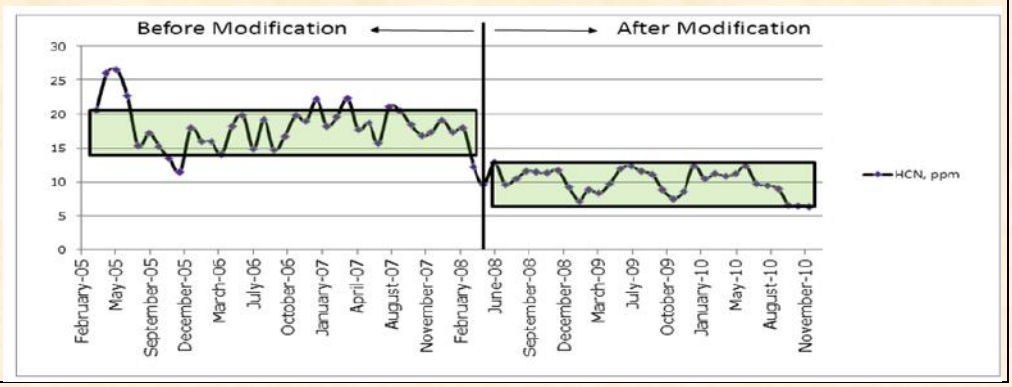
Intervening Technology/ Technique	**Tackling The Pollutant at Source, Reliance Industries Ltd -Vadodara**

About the industry	M/s. Reliance Vadodara Manufacturing Division (RIL-VMD) located in Gujarat. It is the pioneering Petrochemical unit in India. RIL-VMD is Asia's only producer of ACN (Acrylonitrile) and India's only producer PBR (Poly butadiene rubber).
Implemented Techniques/ Technology	**Before** • Reduction in HCN emission from process stack (AOG vent) at ACN plant. Acrylonitrile production involves the chemical catalytic reaction of propylene and ammonia vapors with oxygen. Reaction occurs in a Fluidized Catalytic Bed Reactor and was Exothermic in nature. Acetonitrile and Hydrogen Cyanide are major by-products of this process. • Hydrogen Cyanide (HCN) was removed from the system as additional product in gaseous phase. However HCN has a tendency to travel with water that was also generated by process chemistry. The water which was separated out after Acetonitrile Stripping operation, was recycled as solvent in the Acrylonitrile. • Absorber column as "Lean water". The basic purpose of the absorber column was to absorb gaseous produce Acrylonitrile in water and facilitate removal of inert such as Nitrogen as Absorber off Gas (AOG). This column operates at lower temperature and pressure as a result of which, trace amount of this HCN was separated out of water and appears in the Off Gas Vent amounting to a concentration of about 30 mg/Nm3 of the total gas flow. In this gas it was observed by GPCB that there was high concentration of Ammonia being released for which the industry was issued notice of direction. 

	After • In order to bring down the HCN concentration in AOG, a unique scheme is implements in-house which are aided by use of Process Engineering Tools such as ASPEN based Simulation. As shown in the schematic below, earlier Lean water is separate out from the stripper column from the 10th tray from the bottom, because of which HCN concentration in this stream is substantial. • With the intention to reduce HCN concentration in AOG, stripper column withdrawal of solvent and lean water is modifies. Now lean and solvent water are both withdrawn from the 1st tray of the stripper column, reducing HCN concentration in lean water by 50%. 
Benefits	
Economical	• ACN emissions to atmosphere also reduced by 51.840 MT/annum that have increased revenue by Rs.26.43 lacs. Total revenue increased by Rs.27 lacs.
Environmental	• This project caused 50% reduction of cyanide emissions from Absorber off Gas vent to atmosphere amounting to about 4 MT/year. **Graphical representation of HCN concentration before and after modification** 

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Intervening technology / technique	**Reduction in the "Edge Cutter" Waste by Adjustment of "Deckle Guard".**
About the Industry where implemented	M/s. Vaibhav Paper Boards Private Limited is located at Vapi, Gujarat. The Company is engaged in manufacturing of kraft paper.
Implemented technology / technique	**Before** • When the paper is passed through the wire section for dewatering, total width of wire section was more than required width of the paper, thus, "Deckle Guard" was adjusted to 5.5 inch width from both ends of the wire. • Due to this adjustment, when the paper was cut through the "Edge Cutter" for getting the desired width (106 inches or 269.24 cm), there was a generation of wet broke which was required to be reprocessed through the drum thickener via Couch Pit. This reprocessing increases production cost and resource consumption. **After**  • Industry after evaluation, readjusted the "Deckle Guard" by reducing the width from 5.5 inches to 3 inches at both the ends of wire section. • The waste from the "Edge Cutter" is reducing about 2.5%-3%. Which in turn reduced the reprocessing cost i.e., about 9 Rs./kg. • With no capital cost investment the industry saves Rs. 5,10,300 per annum in the reprocessing of broke.

Benefits	Before	After
Economic	• High cost of production due to reprocessing cost of the material	• Reduction in production cost due to optimization of reprocessing
Environmental	• Additional resource consumption leads to excess emission & chemical usage	• Reduction in emissions and chemical usage by reducing reprocessing of material
Social	• Workers are not aware of resource conservation	• Workers skill for resource conservation improved

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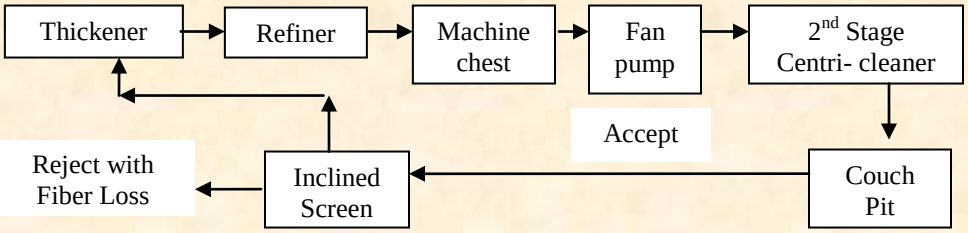
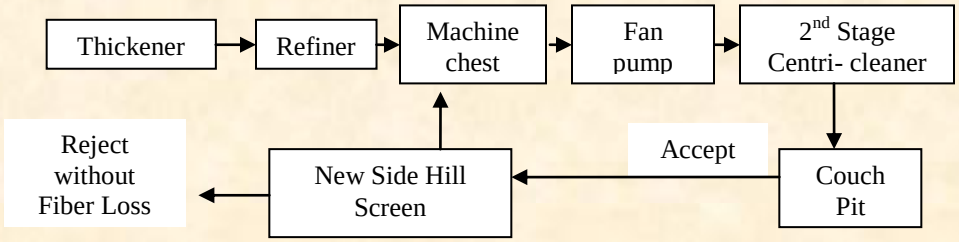
Intervening technology / technique	**Process Modification - Recovery of Fibre from Couch Pit and 2nd Stage Centri – Cleaner.**
About the Industry where implemented	M/s. Vaibhav Paper Boards Private Limited is located at Vapi, Gujarat. The Company is engaged in manufacturing of kraft paper.
Implemented technology / technique	**Before** • During Kraft paper manufacturing process, output of 2nd Stage Centri-cleaner collected in Couch pit was reprocessed after screening through inclined screen and sent to the thickener. • The inclined screen was found to be non-efficient and there was a loss of about 5% (based on 70 TPD production) fiber with the rejects.  **After** • Additional sidehill screen is placed in process, after the couch pit, to reduce continuous recirculation of pulp with direct supply to mixing (machine) chest after screening and fiber recovery with by-passing thickener and refiner. • This modification in process helps in recovery of about 5% (Base on 70 TPD Production) fiber. • Total capital cost invested by industry is Rs. 1, 70,000 with total saving of Rs.14, 17,500 per annum giving a simple payback in 2 months. 

Benefits	Before	After
Economical	• Increase in TSS load at ETP thus affected water quality with increased quantity of solid waste generation and loss of valuable fiber.	• Reductions in TSS load at ETP which in turn increases the quality of recirculating water with recovery of valuable fiber which can be reuses in the process.
Environmental	• Increased the load of TSS on ETP as well as increased solid waste quantity for disposal.	• Reduction in TSS loads on ETP with reduction in solid waste generation for disposal.
social	• Negligence of workers on useful resources going as waste	• Workers skills to conserve resources have been improving.

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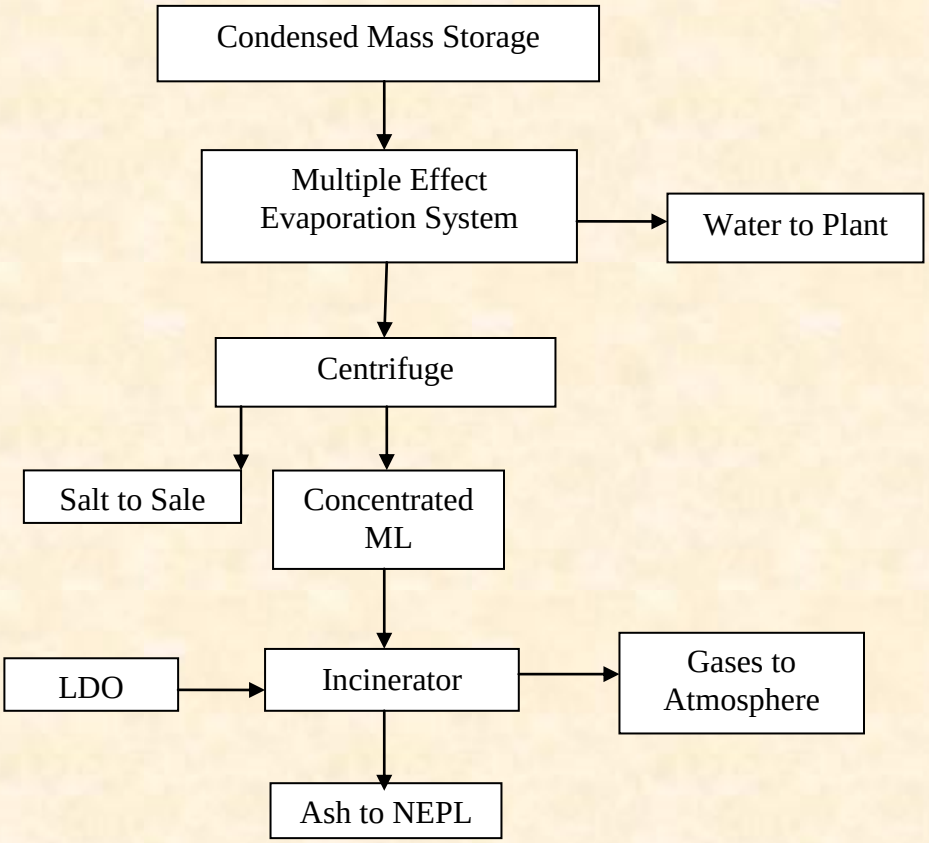
Intervening Technology/ Technique	**Installation of Additional Multi-Effective Evaporator to Recover Water and Salt**

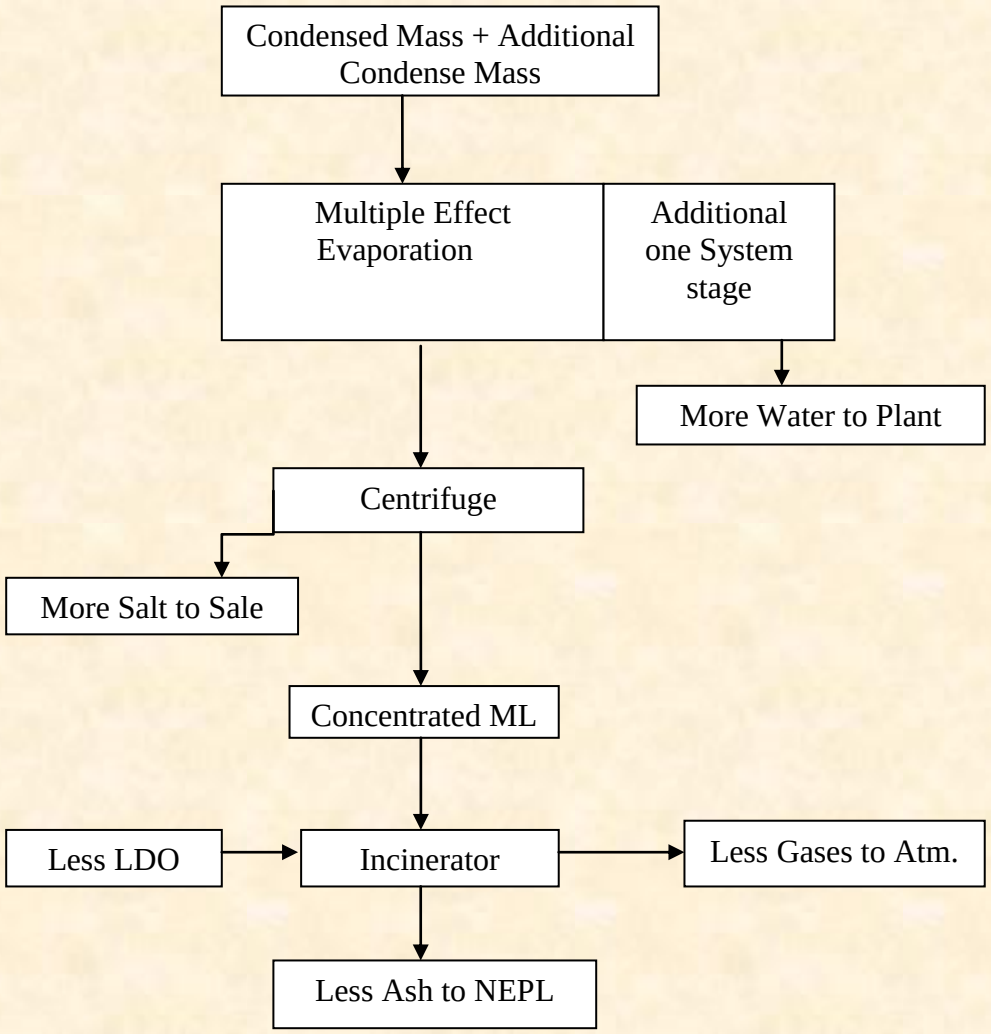
About the industry	M/s. Aksharchem Ltd is located at kadi, Chhatral road, Mahesana, Gujarat. Company engaged in manufacturing of the Vinyl Sulphone.
Implemented Techniques/ Technology	**Before** The material was taken to Multiple Effect Evaporation system and water was separated from the condensed mass as distilled water and salt was removed as Na_2SO_4-$10H_2O$ through centrifuging the material. The salt was known as Glauber salt. The filtrate of centrifuge was taken to incinerator for complete combustion of organic impurities and for the recovery of ash.



The part of condensed mass was solar evaporated and solar evaporated mass is incinerated which requires LDO for complete combustion. Thus, the fuel consumption goes up resulting in high cost of LDO. To avoid high cost of fuel and to avoid unnecessary decomposition of sodium salt in incinerator, the unit wished to improve the existing system by installing an additional stage in the existing Multiple Evaporation system.

After

In order to increase the plant capacity, additional stages in MEE has been added. Due to this more recovery of water and salt has been achieved. The remaining organic material will be burnt in Incenerator. The company intends to improve the capacity of Multiple Effect Evaporation system by addition of 1 No. additional stage which comprises of calendria / Preheater / Vapour separator / Pumps / Thermo compressor / electrical and pipings etc. The capacity of the plant will increase from 4800 ltr/day (58000 kg/day) to 74000 ltr/day (87000 kg/day). For the additional quantity of 2400 ltr. /day (29000 kg/day) company intends to upgrade the existing system of the Multiple Effect Evaporation system which will result in increase in the quantity of water available for process / cooling towers etc. to the tune of 70,000 ltr/day and at the same time it will generate more Sodium sulphate which can be sold to the existing Dyes manufacturers and thus, the load on Incinerator will be reduced in terms of fuel consumption.



Benefits

Economical

Sr. No.	Particulars savings	Units	Existing savings/ consumption per day	Implemented savings/ consumption per day	Net savings/ consumption
1	Water recovery	kg/day	42480	63280	20800
2	Recovery of Glauber salt	kg/day	7000	10500	3500
3	LDO consumption	kg/day	1174	802	372
4	Consumption of stream	kg/day	16160	15800	-15800
5	Power consumption	kw/day	548	360	-360
6	Ash generation	kg/day	2463	1483	980

Sr. No.	Particulars	Rate in Rs./ unit	Savings/ Consumption	Net savings/ Expenditure per day in Rs.
1	Water in Kg.	0.025	20800	520
2	Recovery of Glauber salt in kg.	1.5	3500	5250
3	LDO savings in kg.	46	372	17112
4	Stream in kg	0.8	-15800	-12640
5	Power in Kwh	6	-360	-2160
6	Ash disposal in kg.	0.7	980	686
7	Net savings per day in Rs.			8768
8	Per annum savings at 330 working days in Rs. Lac			28.93
9	Estimated cost of modification			45
10	**Payback period in years**			**1.6 Yrs**

Environmental

- Company do not have to evaporate water in solar ponds which occupies lot of space and to face problem in rainy season.
- Less fuel consumption in incineration and less ash generation.
- By water recovering process company save that much amount of water which generally pumps from natural resources. Recovered water is as good as distilled water which can be used in the process.

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Intervening Technology/ Technique	**Ammonical Nitrogen Recovery from Waste water**

About the Industry	M/s. Amsal Chem located at the Industrial Estate Ankleshwar, Gujarat. It manufactures the Active Pharmaceutical Ingredients Nutraceuticals Intermediate of Omeprazole.
Implemented Techniques/ Technology	**Before** The waste water containing ammonical nitrogen in the I. Such waste water has pH less than 7, that was acidic in nature. Caustic soda solution (48-50%) was added to waste water to make it alkaline and bring the pH to +11. That released free ammonia into the water. The ammonia was stripped from waste water by contacting it with large amount of air so that the effluent reaches the desired level of ammonical nitrogen content. The stripping air containing ammonia was contacted with dilute sulphuric acid to give a solution of ammonium sulphate as crystals. **After** At present treating influent in their convectional E.T. plant with biomass. After adopting new technology of ammonium nitrogen stripping they will recover ammonium sulphate and then effluent will require reduction of treatment in E.T. plant with biomass for further reduction.
Benefits	• The solution of ammonium sulphate can be used as a fertilizer for crop production. • Reduction in the cost of nutrients for Biological treatment as the solution acts as a nutrient for biomass development. • Achieved the discharge norms stipulated by GPCB.

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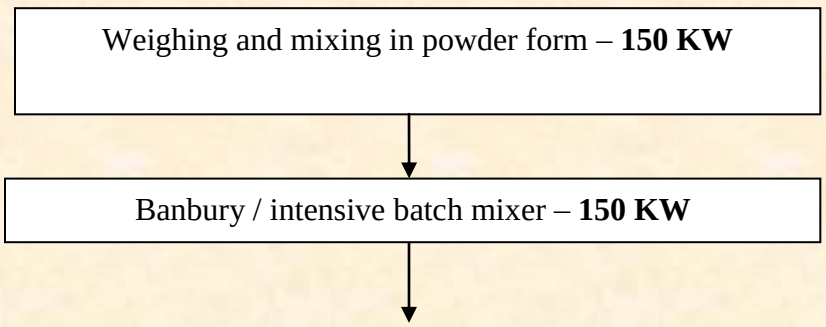
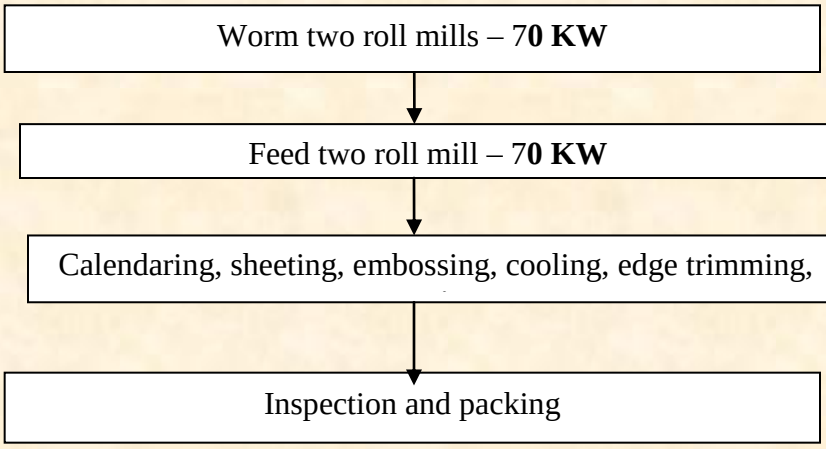
Intervening Technology/ Technique	**Replacing DC Motors by VFD motors**

About the industry	M/s. Om Vinyls Pvt. Ltd. Located at Valsad, Gujarat. Company is engaged in manufacturing of PVC films & sheeting and PVC leathercloth (Calendered, Coated & Foamed)
Implemented Techniques/ Technology	**Before** The PVC Calendaring line was mainly used to produce PVC films and Sheeting, either embossed or plain, either opaque or transparent, either very soft or rigid for uniform thickness and quality. The process starts with the weighing of ingredients (DC motors used) as per given formulation such as PVC Suspension grade Resin, Plasticizers like D.O.P., Chlorinated Paraffin Wax Filler / Extenders like Calcium Carbonate (Stearic Acid Coated) Hear Stabilizers Ba-CD complex or organotingmercaptides (Butytin, Octyltnemercaptide) or Calcium Zinc Stearates, Organic / inorganic Pigments, Lubricant like Stearic Acid Oxidized Polythylene Wax etc. processing aids, epoxidised oil and blending the above in the high-speed mixer. This "Dry Blend" was weighted & loaded in to the plastificator or integral batch mixer (also called Banbury). The powder with the influence of shear between the (WigWig) conveyor with metal detector to pull out if any metal particles or an impurity from the feeding material and calendar consists of four large sized and sturdy rolls of exceptional surface finish. The rolls of calendar are heated by Thermic fluid at pressure of 3 kg/Sq. to attain temperature at around 200° C. The plastic mass was forced to pass between these rolls. The gap between those was adjusted to obtain the required thickness. The emerging film is strip from the last Roll of the Calendar and was made to pass between a metal engromed roll called Embossing roll and water cooled rubber roll. **After** New technology implemented VFD (Variable Frequency drive) motors to replacing by DC motors. It will replace by Four motors. **Flow diagram of PVC** 



Note: In Figure, weighing and mixing, Banbury / intensive batch mixer, warm two roll mills, feed two roll mill here DC motors was used which is replaced by VFD motors.

VFD provides following Advantages:

- Energy savings
- Low motor starting current
- Simple installation
- High power factor
- Lower KVA
- Lower maintenance costs, as lower operating speeds result in longer life for bearings and motors.

Benefits

Economical

	Average
Production, tones/month	1060.19
Units consumed/month	362316.67
Units consumed/tonne of product	342.10

Motor Capacity	**Current Technology units consumed/hr**	**After Implementation CP, units consumed/hr**	**Net saving of Units/hr**
KW-150	225	191.25	33.75
KW-150	225	191.25	33.75
KW-70	105	89.25	15.75

KW-70	105	89.25	15.75

Assuming that the plant works for 24 hrs. For 25days a month, Total units saved per month, is (33.75+15.75)*2*24*25 = 59400

Average units consumed after implementing CP = 362318.67-59400 = 302918.67 units

After implementing CP, the average units consumed per tonne of product produced
= 302918.67 / 1060.19
=285.72

So, It can be concluded that the units consumed per tonne of product would reduce from 342.10 to 285.72 after replacing the current DC motors (150KW and 70 KW – 2 no. Each) by variable frequency drives.

Note: There may be 5-10% variation in the amounts as the values assumed for calculating the units consumed are for highest efficiency.

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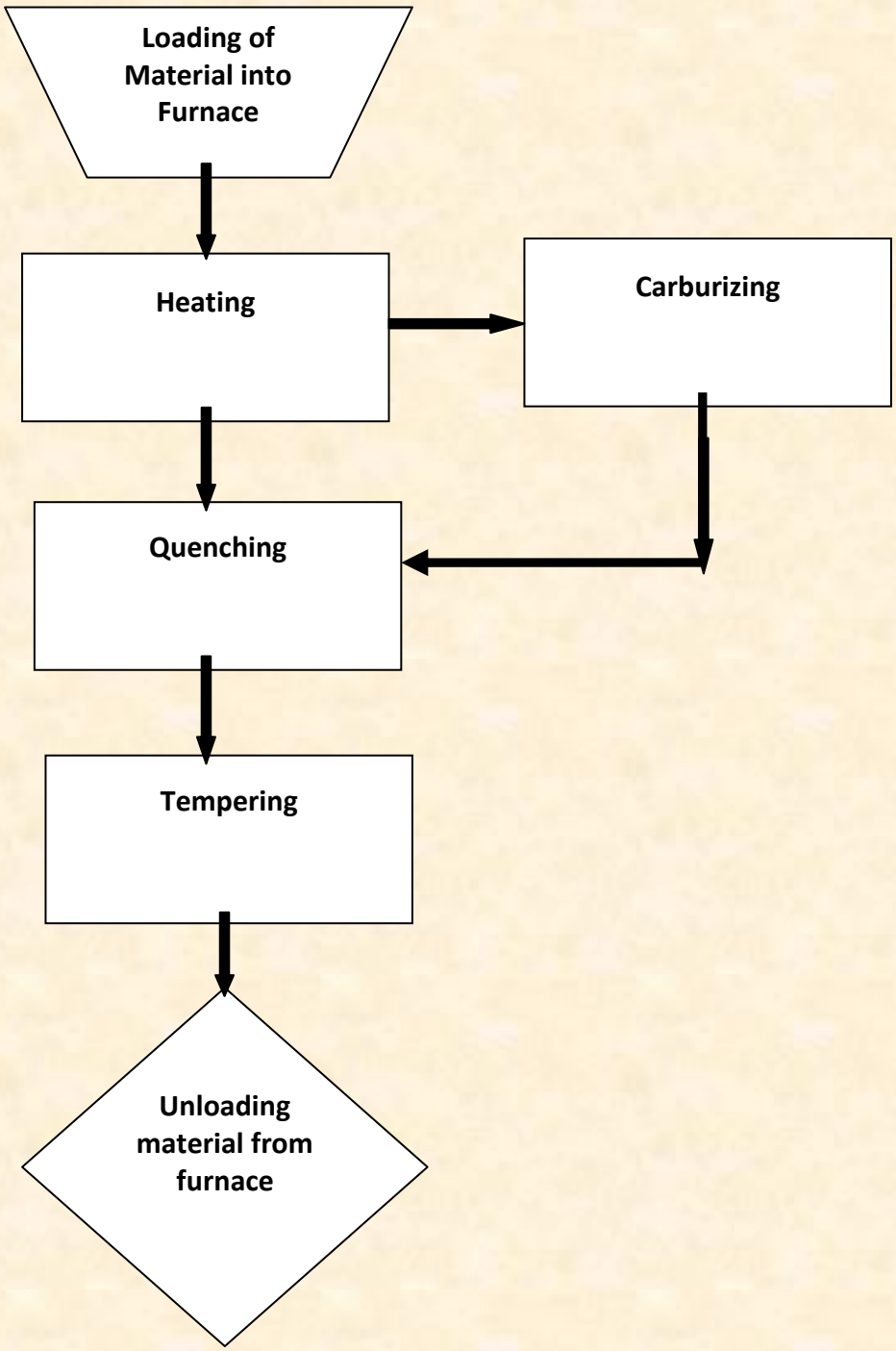
Intervening Technology/ Technique	**Oil replaced with Nitrogen in Gas Quenching Process.**

About the industry	M/s. R. K. Feed equipments located at GIDC, Halol. It is a Design Engineering company dedicated to serve Pelleting Industry; be it animal feed pellet viz., cattle feed, poultry feed, fish feed, aqua feed, wood pellet, bio-mass pellet, saw dust pellet etc. our main products are Dies, Press Roll shell, hammer mill beaters and other spares. These equipments are used in the various pellet mill plants.
	Before Quenching was an accelerated method of bringing a metal back to room temperature, from very high temperature (1000°-1150° C) through which the material was cooled causing significant change in the micro structure. Quenching can be performed with oil, fresh water, salt water and special purpose polymers. **After** • In the vacuum heat treatment furnace, oil is replaced by nitrogen (Gas Quenching) for quenching which is available in the atmospheric air and is considering as the greenest technology available. • Gas Quenching is an environmentally friendly quenching medium, and it produces cleaner products, eliminating the need for washing the parts after quenching and disposal of liquid quenching fluids. In addition, gas Quenching provides more uniform cooling and less distortion compared to liquid quenching, thus reducing post quenching machining. Safety and environmental considerations make gas quenching an attractive alternative to liquid quenching. The advantages of gas quenching includes cleaner product, minimum distortion, and elimination of environmental problems associated with liquid quenching.

Process Diagram of proposed Project



Project cost: INR 57230000/- (one time investment)

Benefits	Before CP	After CP
Economical	• Transportation cost • Service tax • Cost of running for the furnace is high.	• 10% of the total saving as there is no transportation cost. • 12.36% saving from service tax. • Cost of running the furnace has decreased up to 35-40%. 60-65% savings on the new heat treatment.
Environmental	• Oil used for the quenching process which produces more CO_2. • Conventional oil was used in process.	• Oil is not use for the quenching process therefore no CO_2 emission takes place. • Oil is replaced against nitrogen; it will result into less consumption, less pollution and green environment.

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Intervening Technology/ Technique	**Modernization and Up gradation of Effluent Treatment Plant**

About the industry	M/s. Ramdev Chemical Industries located at the Ankleshwar, Gujarat, India. Company engaged in manufacturing of Copper Phthalocyanine crude and copper Phthalocyanine pigments like Beta Blue, Alfa Blue, and Activated CPC Blue.	
Implemented Techniques/ Technology	**Before** Ramdev Chemical Unit generates sustainable quantity of effluent, and the quality of which in most of the cases was unsuitable for further use. It causes environmental problems, if disposed of without proper treatment. At present, due to the increasing resource constraints and the environmental requirements, these Chemical units need to adopt a sustainable approach, and wastes should be viewed as an unutilized resource. Water and Chemicals should be recovered. **After** Advance treatment like Multi Effect Evaporator (MEE) helps in reducing the pollution and also provides a better scope for the recovery and recycling of Water and Chemicals. Company proposes to put up a New Project for Modernization an Up Gradation of Existing Effluent Treatment Plant with Suitable and Advanced Waste Water Recycling System with suitable Machinery.	
Benefits	**Before CP**	**After CP**
Economical	• Water and salt were not recovered from the waste stream for reusing.	• MEE system reasonably good for the reuse in pigment operation. Water and Salt can reduce recurring cost of treatment system.
	• ME systems permeates salt water but rejects other contaminants from effluent stream.	• The brine when reused in plant requires less addition of salt.
Environmental	• Salts not recovered. • Effluent not treated.	• Recovering the salts reducing the problems related to disposal of TDS effluent streams. • Recycling and reuse of the treated effluent and salt directly conserve natural resources and a step towards sustainable development.

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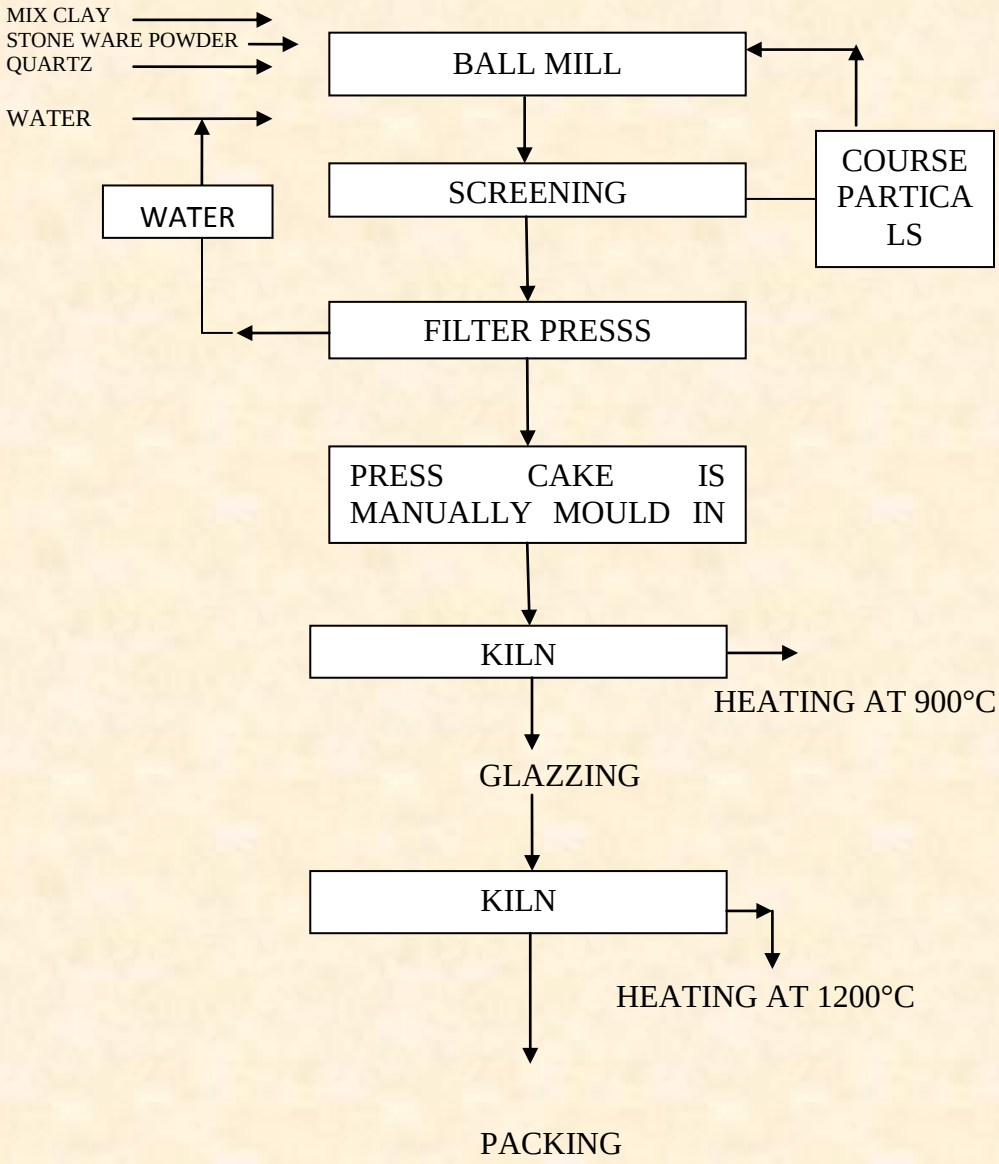
Intervening Technology/ Technique	**Use of Lightweight Refractory Material called "Ultralite" as Thermal Insulation for Rotary Kiln in Ceramic Industry**

About the Industry	M/s. Ravi Ceramic located at Naroda, Ahmedabad.
Implemented Techniques/ Technology	**Before**



<table>
<tr><td></td><td><u>After</u>

The industry is using PNG fired kiln and car trolley is being pushed in the kiln to gain the strength and glossiness. The car being use is made of full HFK Bricks. The specific heat of HFK Bricks is higher than the unique light weight refractory material called ‘Ultralite’ that has excellent thermal insulation properties. Its thermal characteristic is now proving itself to save significant energy and costs associated with the overall kiln operation.</td></tr>
<tr><td>Benefits</td><td></td></tr>
<tr><td>Economical</td><td>
<table>
<tr><td>Daily PNG consumption</td><td>650.00</td></tr>
<tr><td>Cost of PNG</td><td>32.50</td></tr>
<tr><td>Saving on PNG</td><td>12%</td></tr>
<tr><td>Cost of saving per day
(900*12%*21.30)</td><td>2535.00</td></tr>
<tr><td>No. of working days in years</td><td>300</td></tr>
<tr><td>Annual saving in Rs.;</td><td>760500.00</td></tr>
<tr><td>Rate of return (Payback period)
(730382*690120)*12</td><td>9 Months</td></tr>
</table>
</td></tr>
</table>

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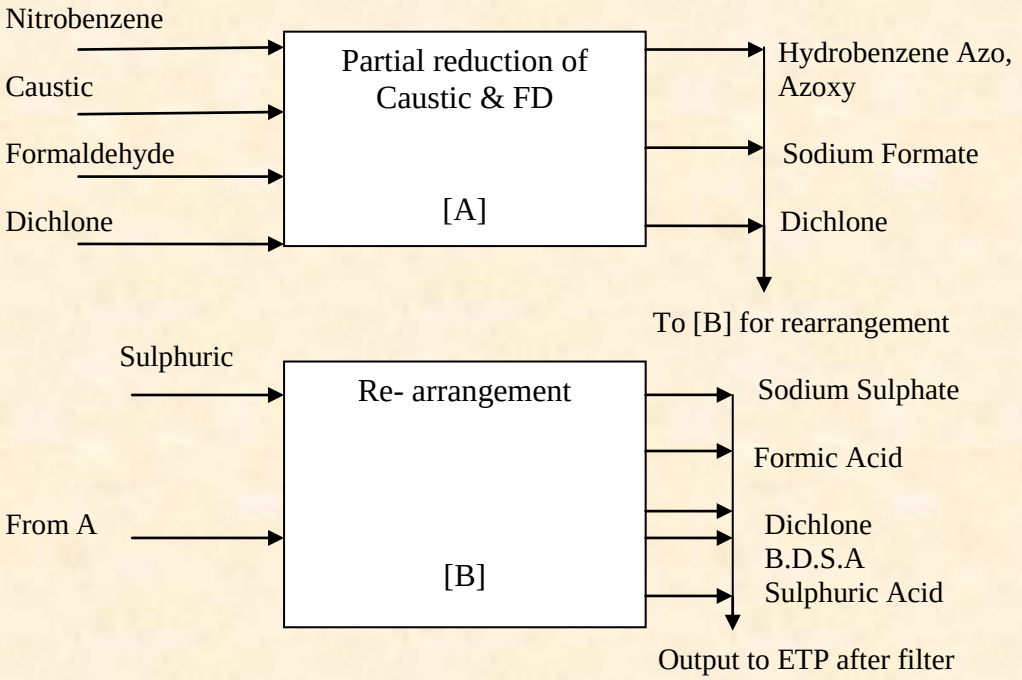
Intervening Technology/ Technique	**Partial Reduction replaced with Hydrogenation Method**

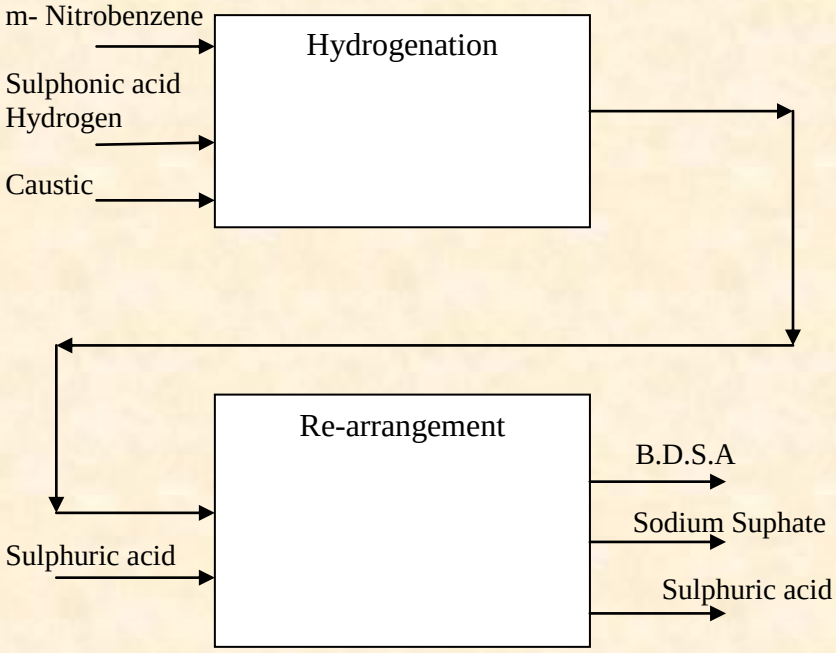
About the Industry	M/s. Sahyog enterprise located at the GIDC Vatva, Gujarat. Company engaged in manufacturing of the dyes intermediate.
Implemented Techniques/ Technology	**Before** Raw material Requirement: 1. **m- Nitrobenzene Sulphonic acid:** 2000 kg 2. **Caustic:** 1200 kg 3. **Dichlone Catalyst:** 20 kg 4. **Formaldehyde:** 2500 kg 5. **Sulphuric acid:** 3000 kg • m-Nitrobenzene sulphonic acid was reduced by caustic and formaldehyde in a MS reducer. Caustic and formaldehyde reacted together and produce Hydrogen. Requirement of Caustic and formaldehyde was about 25% excess than theoretical requirement. Dichlone used as catalyst convert the Hydrogen to nascent Hydrogen. Reaction of hydrogen was on surface of reactor. Sodium formate formed during reaction has salting effect on Hydrazo. This process proceeds slowly via intermediate product Azo, Azoxy and Hydrobenzene of nitrobenzene. • Hydrobenzene of nitrobenzene was rearranged for BDSA by Benzidine Rearrangement. Reaction mass was in slurry. This reaction takes almost 48 Hrs For completion. The alkaline slurry was difficult to cool. 

After

Raw material requirement

1. **m- Nitrobenzene Sulphonic acid:** 1700 kg
2. **Hydrogen gas:** 550Nm^3
3. **Nitrogen gas:** 50Nm^3
4. **Caustic:** 150 kg
5. **Sulphuric acid:** 1500 kg

- In new technology, Hydrogenation method is uses for manufacturing BDSA. The company is using Induction Hydrogenerator which is having high mass transfer .
- m- Nitrobenzene Sulphonic acid is reduce in alkaline media in presence of catalyst under pressure to produce hydrazo. Selective Mild catalyst requires for the reduction. Reduction leads to formation of Metanilic acid. MS reducer is replaces with the SS Hydrogenerator.



Total investment for new process in Rs. 690000.

Benefits	**Before CP**		**After CP**	
Economical	Reaction time Hrs	72	Reaction time Hrs	8
	HP connected	15	HP connected	25
	Approx Unit	700	Approx Unit	250

- Reaction time is reduces by 60 hrs & 450 kw saving per MT of product. Saving in raw material per MT of

		Product: 1. M-Nitrobenzene: 300 kg. 2. Caustic: 1050 kg 3. Formaldehyde: 2500 kg. 4. Diclone: 20 kg.
	• Intermediate Formation of Azo, Azoxy.	• There is no Intermediate formation, directly Hydrazo is produce. Savings of National Resources.
	• Caustic requirement was high. Re- Arrangement reaction was carried out at high temperature. • Raw material quantity was high.	• Caustic requirement is low. Sulphuric acid is also save here. The Re- arrangement reaction is carrying out at low temperature. Installing a chilling plant of 50TR. About 70Hp power which uses during chilling is save by 4Hr. saving in power about 225units per MT of product. • Savings in Raw material. • Saving in energy consumption 675kW per MT.
Environmental	• Formaldehyde was used which result in that formic acid increases, COD by 30000mg/l. • Sodium sulphate contributes to high TDS about 100000mg/l.	• Formaldehyde is not used so, formic acid is not forms due to which COD reduces by 30000mg / lit. • Effluent quality improves. • Water requirement per MT of water is reduced by 5000lit. • TDS reduced by more than 100000mg/lit.

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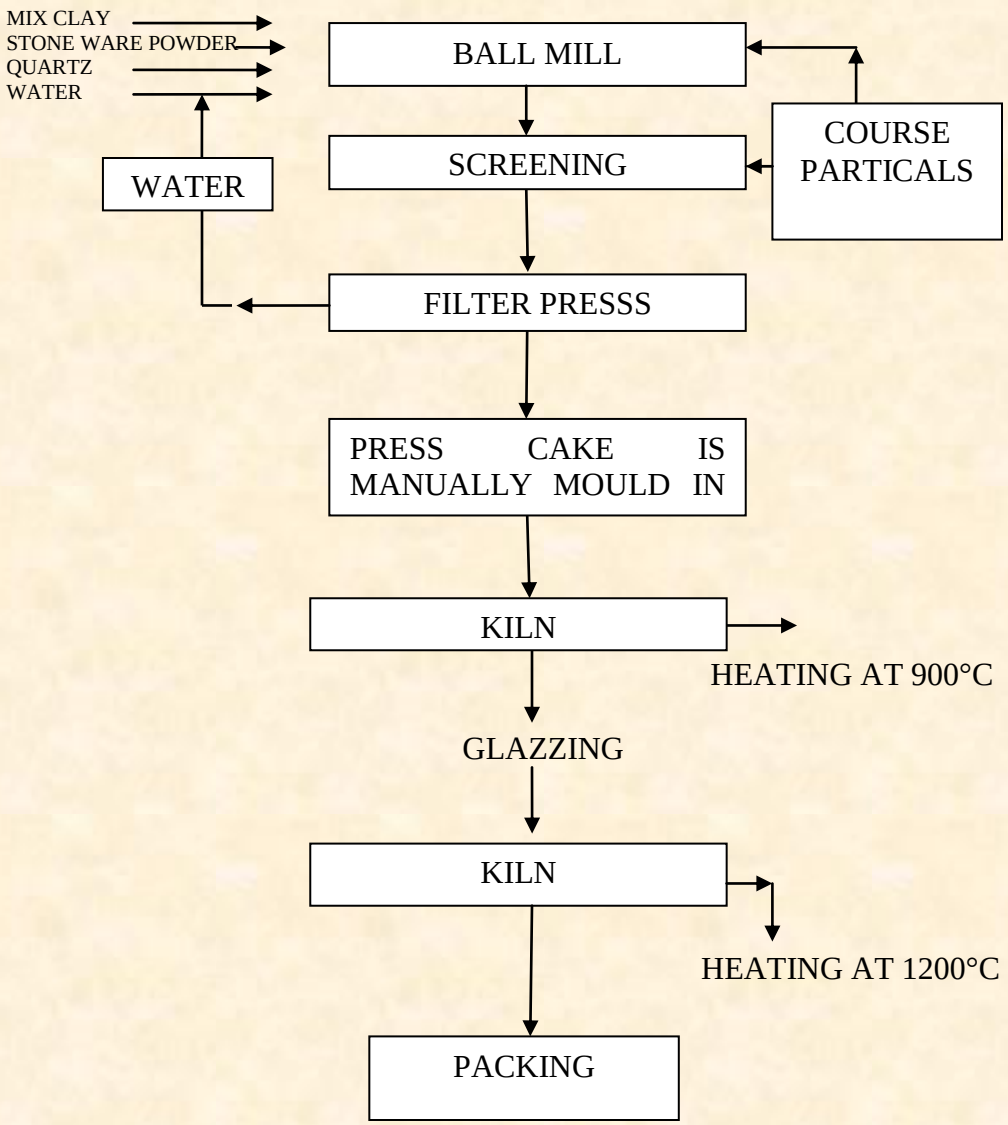
Intervening Technology/ Technique	**Use of Lightweight Refractory material called "Ultralite" as Thermal Insulation for Rotary Kiln in Ceramic Industry**

About the Industry	M/s. Sanya insulator located at Ahmedabad, Gujarat.
Implemented Techniques/ Technology	**Before**



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<tr><td>Benefits</td><td></td></tr>
<tr><td>Economical</td><td>
<table>
<tr><td>Average daily PNG consumption</td><td>750 MQ</td></tr>
<tr><td>Cost of PNG per MQ</td><td>32.50</td></tr>
<tr><td>Savings on PNG</td><td>12%</td></tr>
<tr><td>Cost of saving per day
(750*12%*32.5)</td><td>2925.00</td></tr>
<tr><td>No. of working days in year</td><td>300</td></tr>
<tr><td>Annual saving in Rs.</td><td>877500.00</td></tr>
<tr><td>Rate of return (Payback)</td><td>7 months</td></tr>
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Gujarat Cleaner Production Centre

(Established by Industries & Mines Department, GoG)

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