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Cleaner Production tips for Bentonite Manufacturing Sector

GUJARAT CLEANER PRODUCTION CENTRE

ENVIS Centre on: Cleaner Production & Clean Technology

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The document is intended to provide guidance on prevention and elimination of dusting related issues in the Indian Bentonite Manufacturing Industries including case examples of bentonites manufacturing industries of Gujarat, India.

Title: Cleaner Production tips for Bentonite Manufacturing Sector

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About us

Gujarat Cleaner Production Centre (GCPC) was established by Department of Industries and Mines, Government of Gujarat in the year 1998, with technical support of United Nations Industrial Development Organization (UNIDO). GCPC acts as an environmental advisor of GIDC, Government of Gujarat to solve environmental problems faced by SMEs at GIDC industrial estates.

GCPC is regular member of RECP net – The Global Network on Resource Efficient and Cleaner Production of UNIDO and CTCN – Climate Technology Centre and Network, a working arm of UNFCCC - The United Nations Framework Convention on Climate Change.

GCPC is acting as an Environmental Information System (ENVIS) Centre for Ministry of Environment, Forest and Climate Change, Government of India since 2005, with objective to disseminate and promote the theme of 'cleaner production and clean technology' and other environmental practices across industries, students, academicians, researchers to create sustainable industrial development in the state of Gujarat.

GCPC provides guidance to industries in implementing cleaner production, conducting cleaner production orientation programmes, training and dissemination programmes and conducting cleaner production assessment projects to achieve sustainable industrial development in the state.

GCPC has played an active role in framing Gujarat Industrial Policy 2009 and 2015 and many financial assistance schemes, pertaining to Cleaner Production and Clean Technology in the state of Gujarat.

GCPC has so far conducted more than 200 orientation programmes in various academic institutions and industries associations. The centre has successfully completed more than 100 Cleaner Production Demonstration Projects in various industrial sectors such as Textile, Dairy, Pulp & Paper, Chemical, Petrochemical, Pharmaceutical, Fish Processing, Ceramic etc.

Foreword

Cleaner Production plays a major role in achieving sustainable industrial development as it is the continuous application of an integrated preventive environmental strategy applied to processes, products and services. It embodies the more efficient use of natural resource and thereby minimizes waste and pollution as well as risks to human health and environment. Cleaner Production concept tackles pollution problems at their source rather than at the end of the production process; in other words it avoids the 'end-of-pipe' approach.

Cleaner Production requires changing attitudes, adopting responsible environmental management and evaluating technology options. Cleaner Production can be an efficient way to operate processes, manufacture products and provide services. It cuts the cost of wastes and emissions, reduces the liabilities associated with adverse environmental and health effects, and can create new markets.

The objective behind the preparation of this document is to provide guidance to the industries to tackle dusting related issues which in Bentonite Manufacturing Industries to create sustainable industrial development.

Environmental Information System (ENVIS) provides a single knowledge sharing platform. GCPC disseminates the concept of Cleaner Production and Clean Technology to industries, students and academicians through ENVIS, supported by Ministry of Environment, Forest and Climate Change, Government of India.

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Introduction

India has long been recognized as a nation well endowed in natural minerals resources. India is ranked 4th amongst the mineral producer countries, behind China, United States and Russia, on the basis of volume of production. It is an extremely important sector and contributes significantly to our Gross Domestic Product (GDP). Mining sector is one of the core sectors that drive growth in an economy. Not only it contribute to GDP, it also acts as a catalyst for the growth of other core industries like power, steel, cement, etc. which in turn are critical for the overall development of the economy.

The Indian bentonite industry is expected to perform better in the coming years because of emerging demand for oil clarification. Bentonite is among the exportable mineral commodities in India.

Bentonite is a highly colloidal clay mineral which gets its name from the place where its presence and usages were first discovered – Fort Benton, America. The multiple properties of bentonite namely hydration, swelling, water absorption, viscosity, thixotropy make it a multi-application product for diverse industries. Primarily two varieties of bentonite are available – sodium bentonite (high swelling, gelling and thermal durability) and calcium bentonite (more commonly available worldwide but with less swelling). Bentonite is of a great commercial importance processing inherent bleaching properties hence, it is known as bleaching clay. It is mainly used in foundry, chemical, rubber, pesticide, ceramic industries.

In India, Bhavnagar and Kachchh districts of Gujarat and Barmer district of Rajasthan are the major producers of bentonite. The mineral called Bentonite found in Kachchh region of India is of igneous origin and it is regarded as one of the world's best deposits because of its high swelling property. The total resources of bentonite in the country as per United Nations Framework Clasification (UNFC) of Mineral Reserves / Resources as per April, 2010 are about 568 million tonnes out of which 25 million tonnes are categorized as reserves. Bulk of resources i.e., 424 million tonnes (76%) are in Rajasthan, 134 million tonnes (24%) in Gujarat and remaining in Tamil Nadu, Jharkhand and Jammu & Kashmir. About 9 million tonnes resources are placed under drilling fluid grade, 55 million tonnes under foundry grade and 19 million tonnes resources are placed under poor/blendable grades, respectively. Substantial quantity (485 million tonnes of 85%) of total resources is placed under 'unclassified' and 'unknown' categories.

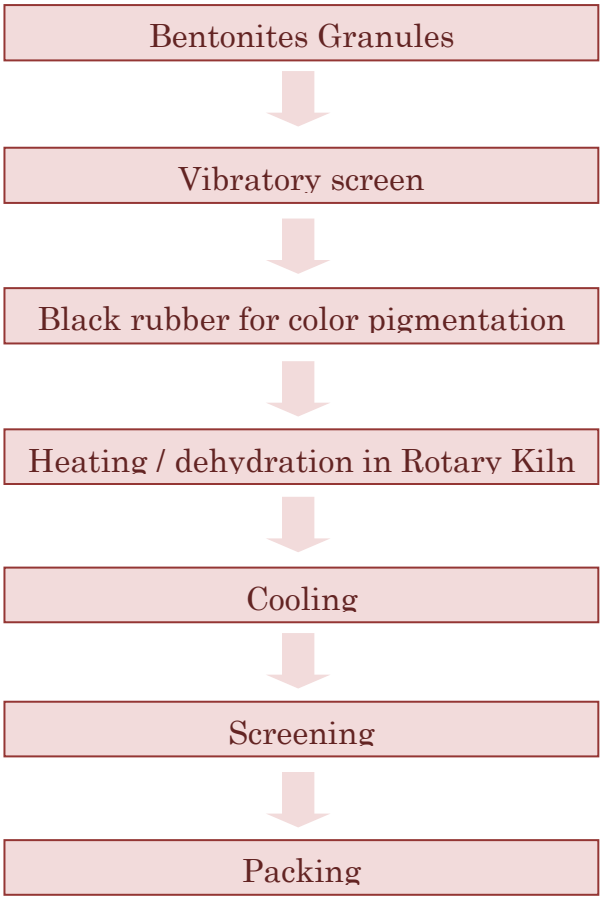
Mining and Processing

Bentonite is exploited mainly from manual mines. The bentonite processing involves drying, grinding, sizing and at times use of additive for exchange. Bentonite processed generally by simple milling techniques that involve removal of water and volatile matter like carbon, dioxide, if present, and grinding in to the appropriate sizes. Small amounts of chemicals like soda ash are added sometimes before grinding to control the properties of bentonite. Raw bentonite when delivered to the processing plant contains 25 to 40% moisture. It is, therefore dried in dryers and the dried clay is ground in roll and hammer mills or other pulverisers and screened. Most of the bentonite is ground to approximately 90% finer than 200 mesh.

Uses and Specifications

Bentonite has high swelling properties along with good viscosity and liquid limit. These properties are highly valued in most of the industrial applications. Sodium bentonite is well suited as a binder in the preparation of pellets and in foundry and as oil-well drilling mud. Bentonite also acts as a suspending agent in oil-well drilling fluids. Bentonite exhibits good green strength along with high hot and dry strength which helps in preventing moulds from breaking or cracking during the pouring or cooling process in the foundry industry.

Bentonites Manufacturing Process



Issues associated with bentonite manufacturing

- Dust emissions occurs during:

i. unloading of raw materials
ii. vibratory screen operation
iii. inlet point of rotary kiln
iv. rotary kiln operation
v. movement of raw material within the plant
vi. packaging of materials
vii. loading of materials into trucks

This emission leads to breathing problems, asthma, lung cancer, premature deaths, heat attacks, strokes etc.

Case Studies

Bentonites Manufacturing Units located in Bhavnagar, Gujarat (India)

Unit-1

Snapshots:

Dust Emission during Bentonites Manufacturing Process

Emission due to unorganized material placed on the floor dust

During transfer of material into hopper through bucket elevator

During coal feeding as a fuel in Rotary Kiln

During transfer of material from one operation to other operation

Existing workplace storage area

Unit-2

Snapshots:

Dust Emission in Bentonites Manufacturing Process, Bhavnagar


Vibrating Screener
Vibrating Screener
Bucket Alivater
Over Head Bentonite Granules Tank
Rotary Cooling Drum


Chimney
Oil Tank
Dust Collector
Rotary Furnace

Cleaner Production tips to reduce dust emissions during

i. unloading of raw material

- Ramp shall be constructed at the place of unloading from truck which shall be movable in nature to minimize dropping height to avoid dusting problems during unloading
- The enclosures for unloading should be flexible which covers height of dumpers discharge from the roof
- Raw material should be unloaded in silo and silo should be covered and should have air vent and dust collector mechanism to avoid dusting during raw material unloading
- Open Stock Piles should have windbreak walls or greenbelt on its three sides
- The capacity of silo should be enough to store the incoming raw materials in case of excess raw material. Storage area of raw materials should be covered
- To avoid fugitive emission the operation of the pay loaders should be slow down whenever wind speed is exceeded upto 50 Km/h
- Use dry dust collection methods such aas fabric filters to avoid dust emissions during unloading

ii. vibratory screen operation

- Provide enclosure to the hopper entrance
- Vibratory screen should be kept closed (covered) and provide air vent and dust collection mechanism to avoid dusting
- Inlet of vibratory screen should be widened and kept in position having minimum dropping height
- Increase area of screening by providing them more number of holes having same size screen to increase screening efficiency
- Modify vibratory screen hopper as per the requirement to prevent damages to the plates and to reduce spillages of crushed granules

iii. inlet point of rotary kiln

- Speed of bucket conveyor should be maintained at optimum level to avoid dusting from bucket elevator to rotary kiln inlet
- Flexible covers must be installed at entry and exit of the conveyors

iv. rotary kiln operation

- Rotary kiln should be operated as per the designed criteria with optimum temperature and pressure
- Feed rate of the raw material in the rotary kiln should not be exceeded beyond the capacity of rotary kiln
- Feed rate and air to fuel ratio should be maintained to avoid back fire

v. movement of material within the plant

- Reduce spillages from screen hopper to conveyer belt by providing box type arrangements
- Belt conveyors should be closed preferably
- Raw material pit should be covered to avoid dusting during lifting through bucket elevator
- To minimize he drop height the free falling transfer points from the conveyor to stockpiles should have flexible curtains to minimize the drop height

vi. packaging of materials

- to create dust free environment within the premises adequate ventilation should be provided for packaging section

vii. loading of materials into trucks

- trucks carrying finished material bags must be covered with tarpaulin

Measures need to be taken in storage areas

- Storage area should be reserved
- Bentonites granules should be preferably stored in silo
- Pathways should be provided properly with entry and exit points
- The stock pile should be preferably be covered under shed for new plants
- Accumulated dust should be removed or swiped out on regular basis
- Production area and storage area should be separated with brick lining wall
- If material is stored in the silo then the silo vent should provide a bag filter system to minimize air borne fines
- Suitable storage silos of adequate capacity should be constructed for collection and storage of the mineral powder, to prevent fugitive emissions during the falling of material from conveyer belts and during material handling
- Provide proper dust collection system to avoid dust emission in storage areas

Measures need to be taken in flooring areas

- Construction of roads should be proper for proper transportation of materials without any type of leakage
- Proper flooring area should be provided within the premises to avoid spill or leakage within the premises
- The paved areas should be maintained and repaired periodically
- Set up a maintenance program on regular basis to maintain equipments
- Keep a register where the results of the inspections and measurements of every installation are described
- Provide staff training conducting training programmes on regular basis for the staff working in the premises on “good housekeeping” measures with objective to create better workplace environment within the premises
- The ground within the premises should be cleaned on regular basis

Measures need to be taken during processing of bentonites

- Manual segregation of small and large stones during loading
- Provide optimum inclination of crusher discharge chute for smoothing the fall of material during conveyer belt
- Segregate small and large stones mechanically during its loading at mines and separate hoopers
- Segregate small size of stones after unloading and feeding in primary crusher
- Modify collection belt conveyer of crusher discharge
- Modify vibratory screen hopper to prevent damages to the plates and to reduce spillage of crushed granules
- Modify screen plant circular hole to hexagon shaped hole to increase efficiency and to avoid blinding of holes during screening operation
- Reduce thickness of screening plate to reduce power consumption of the screen
- Use separate screening to separate dust from grit, to avoid carrying of stones along with the grit
- Use elevate screen for reducing power consumption and to reduce maintenance charges of material handling system

Measures need to be taken to control dust emissions

- Stack attached to the kiln should be provided with dust collection system such as cyclone, bag filters, dust collection chamber etc.
- Dust collected during manufacturing and operation of Air Pollution Control System should be stored in bags
- Any open structure for the passage of conveyors should be sealed with flexible seal
- Wherever feasible, free falling transfer points from conveyor to stockpiles should be fitted with flexible curtains or to be enclosed with chutes designed to minimize the drop height
- Scattered piles gathered in beneath belt conveyors, and around the enclosures must be cleared on regular basis
- Housekeeping standards should be maintained within the premises; any piles of materials accumulated in the plant should be cleaned up on regular basis

Tips for Operation of Rotary Kiln efficiently

- Raw material feeding should be there as per the loading capacity of the rotary kiln. Optimum feeding ratio should be maintained for proper kiln operation
- For complete combustion of every 1kg of fuel oil (furnace oil); 14kg of air is required. So, it is advised to install oxygen sensor monitoring oxygen to create proper combustion
- Optimize burner flame shape and temperature. Periodic testing is required for adjustments and calibration of burner flame to increase Kiln efficiency
- Install waste heat recovery system to utilize the excess heat in other relevant applications within the premises
- Heat from flue gas can be used in pre-heater for primary heating in rotary kiln

Features of coal combustion

- On every 1kg of coal it requires 7 to 8 kg of air; depending upon the carbon, hydrogen, nitrogen, oxygen and sulphur content for complete combustion. The air which is required is known as theoretical or stoichiometric air.

  For any reason the air supplied is inadequate, the combustion will be incomplete which result in improper generation of heat due to unburned carbon particles which forms carbon monoxide instead of carbon dioxide. Complete combustion could not take place unless excessive air is supplied.

Tips for proper selection of fuel in rotary kiln

- Use cleaner fuels (e.g. Natural Gas) if it is available
- In case of inefficient natural gas as a fuel, use coal having good quality standards with higher calorific value, having lower moisture and sulphur content
- Avoid mixing of coal in powder form with main fuel, which may cause dust emission in huge quantity
- Use furnace oil or Diesel Oil of high quality standards specified under the Indian Standards Specifications
- The normal sulphur content for the residual fuel oil (furnace oil) is in proportionate of around 2 to 4 % respectively. The sulphur leads to risk of corrosion as it froms sulphuric acid during and after the combustion
- Excessive ash in the liquid fuels can cause deposition of fouling in the combustion equipment and the ash has a erosive effect on the burner tips, it

causes damage to the refractory at high temperatures and gives rise to high temperature corrosion and fouling of equipments

- For complete air combustion on every 1kg of fuel oil 14.1kg of air is required. In practical application mixing of air and fuel oil is not perfect than the certain amount of excess air is required to complete combustion and one should ensure release of heat in the fuel oil. Improper amount of air leads to incomplete combustion and smoke. So it has been designed an optimum excess air level for each type of fuel.

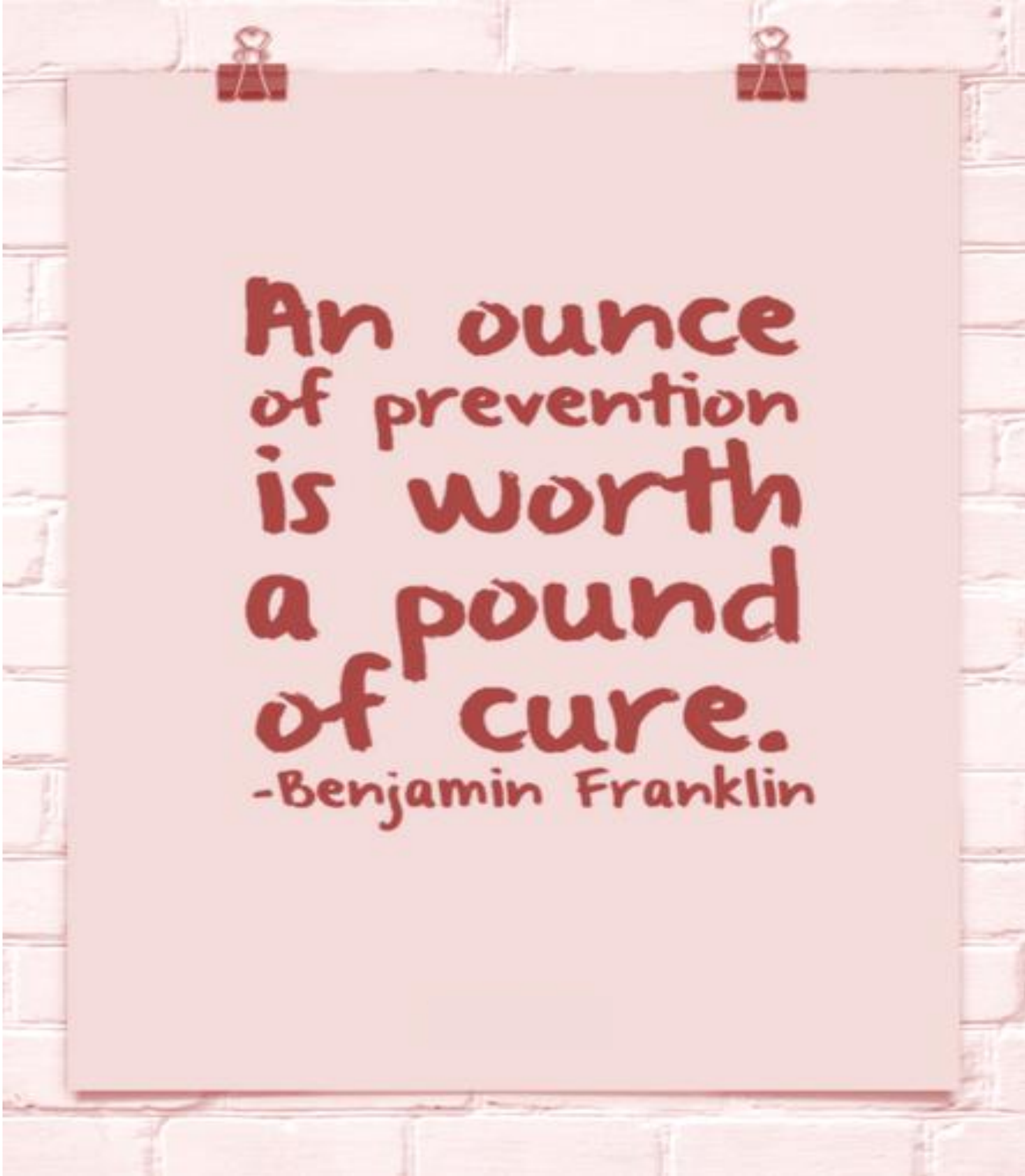
Energy saving opportunities in rotary kiln

- Install variable frequency drive (VFD) to vary load on positive displacement compressor
- Use VFDs for large variable loads
- Check voltage condition of motors
- Balance three phase power supply
- Stag start-up times for equipments having large starting currents to minimize load peaking
- Improve power factor (PF) ratio installing power capacitors to reduce KVA demand charges and avoid losses within the plant
- Provide protective insulation cover on outer surface of rotary kiln to prevent heat losses

Suggestions for Environmental Monitoring

- The effectiveness of prevention cum control measures provided for controlling fugitive emissions from any source can be said to be satisfactory, provided the SPM concentration, measures at 10 meter distance (from the enclosure wall housing the emission source or from the edge of the stockpiles / pavement area) in downwind direction should not exceed 2000 µg/M3 and 5000 µg/M3. In case where SPM concentration exceeds the prescribed limit, necessary and corrective measures need to be taken for improving the controls.

  The measurement shall be carried out by High Volume / Respirable type samplers a per standard method prescribed by Central Pollution Control Board (CPCB) and Bureau of Indian Standards (BIS) , covering at least 4 hours duration (240 minutes) during normal working hours with normal production rate of the operation / source being monitored on quarterly basis.



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