A Quarterly Loss Prevention Digest

Seventh Edition

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IN-SIGHT

Lead Article:

Loss Prevention in Cement Industries

bharti AXA

redefining general insurance

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CEO & MD

Bharti AXA General Insurance Company Limited

Message from CEO and MD

We have now successfully completed 4 Fantastic Years of service to the general insurance industry in India and with your confidence and support; we have continued to grow in many spheres this year as in the past. Our growth story has won us a few more awards and recognition in June 2012 – i.e. the **'Commercial Lines Growth Leadership Award'** and the **'Best Product Innovation Award'** at the **India Insurance Awards 2012**. During this period we also won an award for the **'Best Employer Brand'** conferred on us by BFSI and our Chief Risk Officer Parag Deodhar was awarded the **'Top 100 CISO Awards for 2012'**.

These accolades besides bringing out our commitment to the society further inspire us to raise the bar of our own performance and expand our roadmap of growth and service to the society. As we now work towards scaling up on all aspects of our business, we solicit your continued support and assure you of our best services at all times as we move forward in realising our vision of becoming the **Preferred General Insurance Company in India by 2014.**

Subrahmanyam B.

Sr. VP & Head, Health and Commercial Lines

Bharti AXA General Insurance Company Limited

From the Editor's Desk

The focus of our inaugural and subsequent five issues till date were on loss prevention aspects related to the SME segment. Commencing from this issue, we are moving our focus to loss prevention aspects concerning big and large industries. While large quantities of data pertaining to safety and loss prevention that concern many large industries is available in a wide variety of literature, standards and code of practise we rarely find these requirements being consolidated as a single document on an industry specific basis. Our attempt in the forthcoming issues would be to consolidate the hazards and loss prevention measures on an industry specific basis that would be useful to those responsible for managing safety and loss prevention.

In this issue we focus on the hazards and loss control measures that need to be adopted in cement manufacturing industries. Cement industry is of great significance to our economy and has been one of the main beneficiaries of the infrastructure boom that is taking place. This boom is expected to continue and this industry is bound to benefit from the robust demand that will be made by this sector mainly coming in from private housing (53%) followed by government infrastructural spends.

Hope the information provided here will be useful to the readers and I wish you all a very happy and informative reading experience!

1.0. Lead Article: Loss Prevention in Cement Industries

1.0 Introduction

Cement manufacturing is a vital industrial activity in India. India is the 2nd largest cement producer in the world. This segment comprises 125 large cement plants (capacity of 148.28 mn tonnes) and more than 300 mini cement plants (capacity of 11.10mn tonnes). Growth in domestic demand for cement would continue to remain strong as government & private sectors continue to focus on infrastructural & housing development. Industry players would continue to increase their annual cement output in the coming years and India's cement production is slated to grow at a CAGR of 12% between 2012-13 and 2013-14 to reach 303 mn metric tonnes. A large number of overseas players are expected to enter this segment due to governmental regulations which permit 100% foreign direct investment in this sector. According to Cement Manufacturing Association, the industry would be targeting to achieve a capacity of 550 MT by 2020.

2.0 General Process

Cement is produced by pulverising clinker, produced by calcination of a mixture of calcareous and argillaceous material at 1450^0 C.

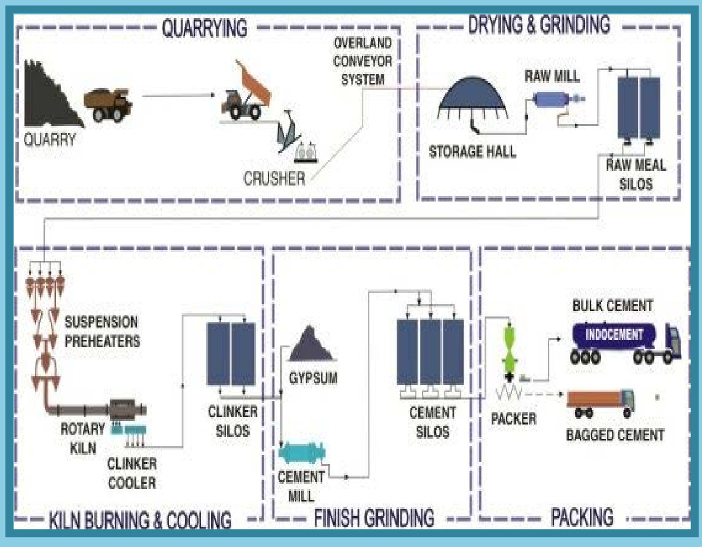
Calcareous Material (Providing lime- CaO): Lime stone, Chalk, Marble, Lime sand, Shell deposits, Lime sludge, etc. **Argillaceous Material (SiO_2, Al_2O_3, Fe_2O_3 etc.):** Clay, Shale, Phyllite Clay, Slate, glass.

2.1. Material Requirements

Material	Comments
Coal	On an avg. 0.2–0.25 tonnes of coal are consumed per kg of clinker production. Given the low CV and high ash content of Indian coal, this constitutes 35-40% of production cost.
Electricity	On an avg. 130 units of electricity are consumed per tonne of cement production. Increasingly captive power plant is being set up to meet energy demands of the cement plant.
Limestone	Forms the largest bulk input in cement manufacture (about 1.6 tonnes of limestone for every 1 ton of cement manufactured. It therefore becomes an important parameter in locating a cement plant.

2.2 Process Details

This involves the following activities:



- **Quarrying:** This involves mining of limestone. It is primarily crushing and transporting to factory through conveyors or road.

- **Drying & Grinding:** The crushed rock obtained from quarries is taken to a mix bed plant where the raw material components are pre-homogenised, dried and ground. Raw materials generally contain moisture; hence they are dried before or during the grinding process. Heat for this is supplied by waste gases from the rotary kiln (~3500C) or clinker cooler. For grinding, large cement plants use **high speed roller mills** or **bowl type grinding mills** and in smaller plants, **tube mills filled with iron balls** are used.

- **Kiln Burning & Cooling:** Raw mix is transported hydraulically to air separators. Here separation of particles into coarse & fine takes place. Coarse material is returned to the grinding mill and fine particles (raw mix) are blended in homogenising silos. Homogenisation takes places when air stream entering from the bottom, whirls up the raw mix fed from above. Raw mix is heated up to $800^{0}C$ by kiln waste gases in a multi-stage cyclone pre-heater before in enters kiln. The pre-calciner in lower part of the pre-heater almost entirely calcinates the raw mix, heating it up to $800^{0}C$ after which it passes into the kiln. The raw mix entering the kiln passes through various reaction zones due to rotation of the inclined kiln.

  The various reaction zones are: the inlet or preheating zone, the calcinating zone where the raw mix gets split up at a temperature between $1050^{0}C$–$1150^{0}C$ and then the burning zone where lime reacts with clay and sand at a temperature between $1250^{0}C$–$1450^{0}C$ resulting in partial melting and formation of granular clinker. The length of each zone depends on the composition of raw material, type of rotary kiln and cooling system employed. The clinker formed in the kiln then drops into the clinker cooler where it gets cooled down to a temperature between $120^{0}C$ to $200^{0}C$. From here clinker is shifted to an intermediate storage silo through conveyors.

- **Finish Grinding:** Clinker granules from the storage silos are conveyed to the cement mill where it is ground with additives like gypsum to make cement. Grinding is most frequently carried out in tube mills through rolling grinding elements (balls) which by impact and friction reduce grinding stock to powder. Ground cement is then transferred to silos for storage through conveyors

- **Packing**: Packing and loading station with bagging and weighing devices is used in bagging, packing and transfer of bagged cement to a truck for despatch. Now-a-days, cement is mostly packed in paper bags. Bulk transfer of un-bagged cement is in vogue.

Note: Basically there are 3 types of cement manufacturing processes - wet process, semi-dry process, and dry process. In all 3 processes, limestone is the principal raw material. The 1st step after quarrying is primary and secondary crushing. Thereafter, in the wet process, raw material is blended with water to produce slurry which is pumped directly into the cold end of the kiln. Here the slurrying process helps to homogenize material. In the dry process, raw materials are fed to the kiln in a dry state and homogenization takes place with the help of an air stream. The semi-dry process involves mixing smaller amounts of water with the raw material which is then exposed to exit gases from the kiln prior to entering the kiln chamber. In all other respects, the processes are essentially alike. Wet process is the most energy intensive among the three processes, since water used needs to be evaporated from the slurry mixture.

3.0. Hazards in Cement Industry

Cement industry hazards arise due to the nature of processes that are carried out and the type of raw materials being used. Besides property damage resulting from fires and explosions, accidents that cause injuries and deaths, as well as short term and long term health injuries including cancer are the other hazards that are associated with this industry. A preview of these is given below in the sections that follow.

3.1. Fire & Explosion Hazards

Fire & explosion hazards can take place in cement industry either due to the type of processes employed or the combustible nature of certain materials used in cement production. Factors which give rise to this hazard are:

3.1.1. Usage of Coal

Since coal is a fossil fuel, coal storages can easily get ignited. The risk of fire spread from a burning coal heap further increases the fire risk. It is hence recommended that coal storages be located at least 50m way from important plant buildings and other combustible storages in open. Other safety recommendations regarding coal storages are:

- Storage site and layout should be such that all parts of the stack are easily accessible to mobile appliances for quenching a fire in case of fire emergency.
- Storage site should have good drainage facilities to ensure that water does not get accumulated near the storage piles.
- Coal storage should be carried out on a clean and hard, flat surface devoid of all vegetative material or having any hot surface in the vicinity.

3.1. 1. 1. Spontaneous Combustion of Coal

Amongst the various causes that result in coal fires; spontaneous combustion assumes significance on account of the fact that a large number of losses occur due to this reason. Spontaneous Combustion of coal is caused by adsorption of oxygen at the outer & inner surface of coal which results in its oxidation. Oxidation is an exothermic reaction which causes temperature of the coal stack to rise gradually and when it exceeds approximately 80°C ignites the coal stack and sets it on fire. Spontaneous combustion of coal depends on many factors and critical among these is the type, age and composition of coal besides factors such as how it is stored, and how it is used. Factors that help control spontaneous combustion are:

- **Roll packing:** This controls spontaneous combustion by excluding oxygen and also helps in increasing the storage capacity in a given area by about 30%. Coal heaps should be levelled and consolidated at every 0.3-0.5 meters height using dozers/rollers, etc; while building up the stack height.
- **Stack Layout:** Coal should be stored in such a way that the normal direction of wind is along the length of the stack to prevent movement of air through the coal pile.
- **Stock Handling:** Follow the 'first in, first out' rule of using stock as this reduces the chances for hot spots by helping to preclude heat build-up for portions of stock which may remain undisturbed for a long time.

3.1.1.2. Coal dust explosions

Coal Pulverisers grind bulk coal, which is then fed as fuel to heat the kiln for calcining raw materials into clinker. Pulverisers therefore are one such equipment with a potential for a fire / explosion hazard. Hazard control measures that need to be adopted in this area are provision of CO_2 flooding systems for coal pulverisers and use of dust proof electrical fittings in areas where coal dust is likely to be present.

3.1.1.3 Fire in Coal carrying circuits

The combustible nature of crushed coal poses a fire hazard in the conveying system as frictional resistance between the idlers/rollers can generate sparks, which on coming into contact with crushed coal can create fire. A well defined preventive maintenance program that includes regular lubrication of conveyors and rollers are factors that help in mitigating this hazard. Provision of motion-sensing switches that detect slipping/jammed belt or interlocking of conveyor drives to switch them off when the belt stops/slows down to more than 20% of normal speed are other measures that would enhance fire safety. Usage of conveyor belts made of fire retardant material is also recommended.

3.2. Bag Filters

Fire/explosion hazards in bag filters can arise due to any of the factors listed below. These are:

- Spontaneous combustion
- Dust explosion
- Static electricity
- High temperature of materials passing through filters

Bag filters used for coal mill ranks the highest among fire risks in cement plants and hence require higher levels of fire protection than the rest. Such protection is usually provided through spot protection of this equipment with automatic CO_2 gas discharge systems.

3.3. Electrostatic Precipitators

Build-up of explosive mixtures like finely dispersed coal dust in air or CO (Carbon Monoxide) and air can result in an explosion hazard in Electrostatic Precipitators (ESPs). Hence special care is required in these locations to prevent such a build-up. Monitoring the concentration of this explosive gas (CO) in ESPs helps in mitigating this hazard. Inspection of explosion venting devices and periodical maintenance of instruments measuring explosive gas concentrations are a must do exercise for safety of such equipments.

3.4 Captive Power Plant

Some of the fire hazards associated with Captive Power Plants include fire in power house buildings due to ignition of lube oil and those in the boiler area due to fire at burner fronts arising from usage of fuel oils like - furnace oil or diesel and cable gallery fires. A detailed analysis of these hazards and the recommended control measures for their mitigation will be dealt with in one of our subsequent issues and as such are not explained here in great detail.

3.5 Electrical Equipment & Cabling

Cement plants are energy intensive industries & have a large number of heavy duty electrical equipment used for distribution, control & electric power utilization. Large quantities of insulation oil used in equipments like switchgears, transformers and capacitors are combustible in nature and pose a major fire hazard. Fire hazard also arises from large scale electrical cabling carried out between various substations and equipments. Each of these substations has a cable vault/cable gallery adjoining it. Various modifications & capacity enhancements taking place in a cement plant, over a period of time require laying & relaying of cables resulting in layouts getting affected and give rise to a number of joints which downgrade fire safety. Since most of these substations are unmanned, it increases the fire risk.

3.6 Empty Bag Storage

Storage of empty bags (mostly paper) amounts to fire hazard due to the combustible nature of the material being stored. Fire spread through doors and wall openings of empty bag storage go-down to other adjoining areas of the plant like cement bagging sections can further increase the loss potential of such fires.

3.7. Storage and Handling of Explosives

Most cement plants own limestone quarries that are located close to the cement plant or at a close proximity. Limestone quarrying involves use of explosives. Hence it is vital that these explosives are stored and handled in a safe manner to avoid unexpected explosions. Explosives should be stored only in approved sites in an approved manner and all such storages should fully comply with the required legislative requirements including approval from the Chief Controller of Explosives, Nagpur.

4.0. Health and Injury Hazards

Dusty environments likely to be present in cement plants can expose one to various health hazards owing to exposure to fume, gas and dust. Of these, cement dust is the most critical one. It can cause lung function impairment, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis & carcinoma of lungs, stomach and colon. Studies show that cement dust can enter into systemic circulation and reach various body organs: heart, liver, spleen, bone, muscles and hair which at times can affect their micro-structure and physiological performance. The first line of defence against these hazards are engineering controls such as bag filters, ESPs or Local Exhaust Ventilation (LEV) systems that capture dust at critical dust generation points like coal mills, raw mills, cement mills and cement bagging sections. These have now become mandatory due to strict enforcement of pollution control norms and hence their effective upkeep would ensure a better and healthy work environment. Noise induced hearing loss is another health risk to which employees in a cement plant are exposed to. Exhaust fans and grinding mills are the main sources of noise & vibrations in a cement plant, hence the use of silencers for fans, provision of room enclosures for mill operators and construction of noise barriers are techniques to reduce exposure to this hazard. In addition, control measures would include well ventilated work areas and use of appropriate Personal Protective Equipment (PPEs) like dust respirators, ear plugs and safety goggles appropriate to the exposed hazard.

5.0. Fire Detection and Protection

5.1. Fire Detection

Since most of the sub-stations and cable galleries are unmanned, it is vital to provide automatic fire detection system in these areas to facilitate an early detection of fire. Smoke detectors happen to be the most commonly used fire detection devices in these areas. While such type of detectors are very effective in clean locations such as IT/sever rooms, process control rooms, administrative offices, and stores building they are found to be not very useful in dusty locations of a cement plant since we have observed that on many occasions these have been bypassed or are not working. Since linear heat sensing cables don't require maintenance and are not affected by dusty environments usually present in a cement plant, we recommend the use of these detectors for detecting fires in cable galleries, cable tunnels or cable cellars of a cement plant.

5.2. Fire Protection

Fire protection measures required in a cement plant can be categorized into:

- Passive Fire Protection Systems, and
- Active Fire Protection Systems.

5.2.1. Passive Fire Protection

Passive fire protection systems help in the prevention of fire spread, thereby reduce losses that can occur due to fire. These strategies are very critical in a cement plant and some of the important practices in this regard are:

- **Fire Compartmentation:** Transformers and equipment installed outdoor, having an individual/aggregate oil content of 2300 litres or more shall be located in a suitably fenced and locked enclosure separated on all sides by at least 6m from any building including the Substation with an oil soak pit. If the transformers are within 6m proximity of buildings, door/window openings, even if this is a Substation, it should be protected by single fireproof doors and 6 mm thick-wired glasses in steel frames respectively.
- **Baffle walls:** Segregated baffle walls need to be provided between transformers/ other oil filled equipments where adequate spatial segregation commensurate with the quantity of oil in the equipment is not available. The recommended spatial separation that is necessary for a given quantity of oil in the equipment is as below:

Oil capacity of individual transformers	Clear separating Distance
More than 2300 litres but less than 5000 litres	6m
5000 to 10000 litres	8 m
10000 to 20000 litres	10 m
20000 to 30000 litres	12.5 m
More than 30000 litres	15 m

- **Sealing of cable pass openings:** Openings around cable entries in walls and floors of buildings/substations should be properly bricked up, plastered and also sealed with intumescent material to prevent the spread of fire through cables from one area to another through cables.

- **Fire retardant coatings on cables:** Coating of cables with fire retardant paints for a length of at least 1 meter on either side of its entry and exit into a substation/ building helps in further retarding fire spread through cables. In addition, cables that pass through fire prone / hot areas (like those close to kiln) and cables of fire pumps when laid in the same cable trench along with other cables should also be coated with fire retardant paints to improve fire safety
- **Other measures:** Filling indoor cable trenches with clean dry sand/ pebbles and/ or covering them with non-combustible slabs as well as providing fire break walls at every 50 metre length of outdoor cable trenches are other measures that help to improve fire safety.

5.2.2. Active Fire Protection

Active fire protection devices help in fighting and putting out a fire. Towards this, various manual and automatic systems are employed. These include hydrants, sprinklers, water spray systems and gas based systems. For a cement plant, a well laid out hydrant system in line with TAC (Tariff Advisory Committee) regulations should form the basic fixed fire protection system covering the entire plant including fire vulnerable areas such as coal storages, main stores (where machinery spares and consumables are stored), and storage areas for flammable liquids such as diesel. In addition, automatic fixed fire protection systems also need to be provided based on factors like value concentration, criticality of equipment and proximity to process areas. Some of the protection systems employed in cement plants are:

- Automatic gas discharge Systems (CO2 Protection System): Coal Mills/ Pulverisers, Bag Filters
- High Velocity Water Spray Systems: For High capacity transformers including main incoming transformers, generator transformers (in case there is a CPP)
- Medium Velocity Water Spray System: Coal carrying circuits, cable galleries
- Automatic Sprinkler Systems: Empty bag storage area, Main stores building

Our ten loss prevention commandments for cement industries are given in the page that follows

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Ten Loss Prevention Commandments for Cement Industries

1. **Storage and Handling of Explosives:** Explosives should be stored only in approved sites in full compliance of all required statutory & safety legislations. Storing together explosives and capsules are to be avoided and only authorised persons should be permitted to handle transportation and triggering activities connected with its use.

2. **Coal Storage**: Coal storages should have good drainage facilities and besides being located about 50m away from important buildings and other combustible storages in open, should be easily accessible from all sides for fire fighting. Coal storage should also be carried out on a clean, hard & flat surface devoid of all vegetative material or having any hot surface in the vicinity. Control factors that help mitigate the hazards of spontaneous combustion such as roll packing, following 'first in first out' stock policy, temperature monitoring and wetting of coal to avoid temperature build-up are measures that need to be adopted.

3. **Coal grinding and conveying:** Hazard control measures that need to be adopted regarding coal grinding and conveying are provision of CO_2 flooding systems for coal pulverisers and use of dust proof electrical fittings in these and other areas where coal dust is likely to be present. For coal conveyors a well defined preventive maintenance program that includes regular lubrication of conveyors & rollers and provision of motion-sensing switches that detect slipping or jammed belt with interlocking of conveyor drives to switch them off when the belt stops or slows down to more than 20% of normal speed are measures that enhance fire safety. Usage of conveyor belts made of fire retardant material is recommended.

4. **Bag Filters & Electrostatic Precipitators:** Since these equipment pose high fire and explosion risks additional safety measures such as provision of automatic CO_2 flooding system for bag filters of coal mills and monitoring of CO concentration in ESPs together with regular inspection and maintenance of explosion venting and CO gas concentration measuring devices are necessary.

5. **Health Hazards:** Dusty environments likely to be present in a cement plant can expose one to different types of health hazards and the first line of defence against these are well maintained engineering controls such as bag filters, ESPs or Local Exhaust Ventilation

(LEV) systems that capture dust at critical dust generation points like coal mills, raw mills, cement mills and cement bagging sections which need to be well maintained.

6. **Noise Control**: Exhaust fans and grinding mills are the main sources of noise and vibrations in cement plants. Control of noise emissions may include the use of silencers for fans, room enclosures for mill operators, noise barriers, and, where noise cannot be reduced to acceptable levels, PPEs such as ear plugs and ear muffs should be used.

7. **Fire detection:** Provision of linear heat sensing cables for detecting fires in cable galleries/ tunnels/ cellars are recommended as these devices perform better in a dusty atmosphere that is likely to be present in a cement industry than smoke detectors and also require little maintenance.

8. **Passive fire protection**: Large numbers of high capacity transformers, extensive cabling and unmanned substations require that passive fire protection measures such as fire compartmentation, provision of baffle walls, sealing of cable pass openings and coating of cables with fire retardant paints be carried out to control and manage the fire risk arising out of the usage of such equipments.

9. **Hydrant Protection**: A well laid out hydrant system in line with TAC (Tariff Advisory Committee) regulations covering the entire plant including fire vulnerable areas such as coal storages, main stores, tank farms should form the basic fixed fire protection system of a cement plant.

10. **Special fixed fire protection systems:** Based on factors such as equipment criticality, value concentration, and inherent fire hazards automatic fixed fire protection systems such as sprinklers and water spray/ gas systems would need to be considered for locations such as empty bag storage area, main stores, transformers, cable galleries, coal pulverisers/ bag filters.

2.0. SAFETY QUIZ

1. **Boiling liquid expanding vapour explosion is an example of a physical explosion**
   a. True
   b. False

2. **Breather valves installed in storage tanks:**
   a. Eliminate explosive atmosphere in the vapour space of the tank
   b. Act as emergency venting during fire
   c. Protect tank against overpressure/ vacuum
   d. All the above

3. **The System for protecting storage tanks from radiation effects from the adjacent tank on fire is:**
   a. High velocity water spray system
   b. Sprinkler system
   c. Medium velocity water spray system
   d. Water mist system

4. **If you are in moving vehicle when an earthquake strikes**
   a. Speed up and drive on
   b. Pull off the road, park, stay inside the car

5. **Lightning is not a fire hazard**
   a. Right
   b. Wrong

6. **A safe forklift must have**
   a. Seatbelts
   b. Fire Extinguisher
   c. Backup alarm
   d. All of the above

7. **Good housekeeping on the job can prevent fires by:**
   a. Removing potential fuel
   b. Keeping access-ways clear
   c. Making trash cans lighter
   d. None of the above

8. **Storage of compressed gas cylinders must be:**
   a. In upright positions
   b. In a dry area
   c. In a well ventilated area
   d. All of the above

9. **If fire fighting foams are used for liquids that are water miscible, they must be __________foam. Water miscible liquid has the capability of destroying foam blanket of other types of foam, leading to re-ignition:**
   a. Fluorinated protein
   b. Alcohol resistant
   c. Hazmat
   d. Aqueous film forming

10. Combustible liquids that are absorbed into fibrous materials like corrugated packing, cloth/ thermal insulation are more easily ignited than the liquid alone. The fibres of the substrate into which the liquid is absorbed provide a large surface area coated by a thin film of liquid. Fibrous materials tend to be poor conductor of heat. So ignition is more easily attained.

    This statement is:

    a. True
    b. False

Answers:

1	2	3	4	5	6	7	8	9	10
a	d	c	b	b	d	a	d	b	a

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3.0. Loss lessons: Dust Explosion at ESP in a Cement Plant in Rajasthan

Date & Time of Loss: 22nd June, 1996 – 08:25 Hrs

Occupancy: Cement Plant

Probable Cause of Loss : As per standard literature (Datasheet of Industrial Risk Insurers, USA and Factory Mutual Research Corporation, USA) fire & explosions can occur in ESPs (electrostatic precipitators) when combustibles like coal dusts are present over an extended period of time or during upsets. The excess oxygen required for fire/explosion can come through openings in duct work/precipitator forming combustible mixtures which can explode. These explosion/ fires are normally difficult to detect & extinguish. In this case it is believed that the disturbance in the coal feeding system led to accumulation of coal dust in the ESP and subsequently caused a dust explosion which was triggered by electric sparks of precipitator electrodes.

Reported Loss: INR 80 lakhs

Premise: Dry type cement mill having 2 production lines with adequate separation between them.

Incident: Some disturbance was noticed in the coal feeding system in the kiln of unit no.1 at around 7am while cement production was going on in full swing. Possible technical measures were taken to rectify the system without disturbing production. Around 08:25am there was a loud bang in the ESP, which ripped open the casing and flame started leaping out of the opened portions. Fire was extinguished with the help of local fire brigade after a couple of hours of fire fighting.

Loss Prevention Recommendations:

- ❑ Tripping of ESP should be coupled with oxygen analyses in a manner to give alarm whenever oxygen concentration crosses 1% and the system will trip at 2% concentration of oxygen.
- ❑ ESP should be provided with explosion relief panels in accordance with NFPA standard no. 68.
- ❑ ESP should be provided with temperature sensing devices in the discharge hopper with alarm at the control room

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Response Invite:

We invite your feedback on the contents and coverage we provide in our e-newsletter as also articles of interest on safety and loss prevention including fire loss case histories with loss lessons for publication over here. You may send us your feedback and articles at risk.engineering@bharti-axagi.co.in .

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