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Study and Analysis of Occupational & Health Diseases in Cement Industries

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ABSTRACT

Safe workplace in cement industries plays vital role to prevent occupational health diseases and increasing productivity. In 21st century, millions of people are suffering and several killed due to occupational diseases. Such diseases are arises due to inhalation of dust particles or exposure of dangerous fumes and gases. Exposure of Noise beyond permissible limit also creates headache, nausea, increase in blood pressure and long term exposure may cause of noise induced hearing Loss. In cement industries, most health problems are chronic cough, phlegm production, impairment of lung function, chest tightness, skin irritation, conjunctivitis, stomach ache, headache, fatigue, carcinoma of larynx, colon also effected due exposure of such hazardous agent. Cause of such diseases are unavailability or poor condition of dust collection system, Poor housekeeping, Non availability of personal protective equipment's (PPE's), use of defective personal protective equipment's (PPE's) or not using personal protective equipment's (PPE's) due to unawareness, so workers do not adequately protect themselves through personal protective device.

Keywords: Environmental Hazard, Occupational Diseases, Environmental & Social Impacts, and Safety Control Measure.

Objective:

To increase productivity & Improve OHSE performance there is need to minimise OHSE Risk as low as reasonable practicable which leads to:

- Identifying OHSE hazard & controlling Risk at work place
- Reducing work injury & cost arises due to injury like medical expenses, injured employees wages, Replacement of labour cost, Poor reputation of organisation & legal expenses etc.
- To protect plant personnel and private citizens.
- To prevent or minimize damage of property or the environment.
- Prevention of Accidental emissions from stacks.
- Preventing Occupational diseases
- Increasing moral of employees, stakeholders and other associates
- Provide measurable systems for verifying OHS performance & finding opportunities for improvement.
- Maintain better relation with stakeholder & enhancing organisation reputation.
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INTRODUCTION

Cement industries play vital role for development of countries. The production process for cement industries consists of drying, grinding and mixing limestone and additives like iron and bauxite ore into a powder known as "raw meal".

The main raw material used in cement industry are limestone (CaCO3), sandstone (SiO2), clay, bauxite (N2O3) and gypsum (Ca2SO4.2H2O) and involves the release of various particulates, dust, gases and heavy

metals. The raw meal is then heated and burned in a pre-heater and kiln and then cooled in an air cooling system to form a semi- finished product, known as a clinker. Clinker (95%) is cooled by air and subsequently ground with gypsum (5%) to form Ordinary Portland Cement (OPC).The manufacturing units of a cement factory such as a raw mill, Preheated, kiln, coal mill, cement mill, storage silo & packing section are point sources of pollution emission. Basically, three types of air pollutants are released into the air during cement manufacturing which includes particulate matter (PM), nitrogen oxides (NOX) and sulfur dioxide (SO2).Portland cement is caustic, so it can cause chemical burns, the powder can cause irritation or with severe exposure, this may cause lung cancer and can contain some hazardous components such as crystalline silica and hexavalent chromium. Environmental concerns are the high energy consumption required to mine, manufacture, and transport the cement and the related air pollution including the release of greenhouse gasses (e.g., carbon dioxide), dioxin, NOx, SO2, and particulates. The cement sector is the third largest industrial source of pollution, emitting more than 500,000 tons per year of sulfur dioxide, nitrogen oxide, and carbon monoxide. Chronic exposures in cement industries, workers suffer from impairment of respiratory system function, lungs cancer, Headache, fatigue, stomach, and colon. It also effects oral cavity & eye, the commonly reported symptoms concerned with the oral cavity of cement industries workers are inflammation of gums, calculus and pockets formation, dental caries and non-carious tooth surface loss. These conditions are consistently associated with concentration and time of exposure, Personal hygiene & behavior, Personnel tolerance level, susceptibility, State of matter, & regular use of appropriate personal protective equipment. Route of exposure is inhalation (breathing in), absorption through the skin or eye & ingestion. In experimental animals those who were fed with cement dust for 42 days found that body weight reduction, osteonecrosis, thinning of cortex, and reduction of epiphyseal cartilage. Portland cement consists essentially of compounds of lime (calcium oxide, CaO) mixed with silica (silicon dioxide, SiO 2) and alumina (aluminium oxide, Al 2O 3) and other impurities. The lime is obtained from a calcareous (lime-containing) raw material, and the other oxides are derived from an argillaceous (clayey) material.

Characterisation, Composition & Types

Characterization:

Cement may be defined as, calcined mixtures of clay and limestone, usually mixed with water, sand, gravel, etc., to form concrete that is used as a building material for civil work. It may also be defined as a powdery substance used for binds or unites.

Compositions:

Portland cement consists essentially of compounds of calcium oxide (CaO) (61% - 67%), silicon oxide (SiO2) (19% - 23%), Aluminium tri oxide (AL2O3), (3-6%), ferric oxide (Fe2O3) (2% - 6%), magnesium oxide (MgO) (1% - 2%) 5 and also selenium , thallium and other impurities.

Types:

Basically, cement is two types, natural and artificial cement. The artificial cement is also called Portland cement. Portland cement is further classified into Portland blast furnace cement (PBFSC), Sulphate Resisting Portland Cement, Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC), Rapid Hardening Portland Cement, Oil Well Cement, Clinker Cement, White cement.

Apart from these, some of the other types of cement that are available in India can be classified as Low heat cement, High early strength cement, hydrophobic cement, High aluminum cement, Masonry cement.

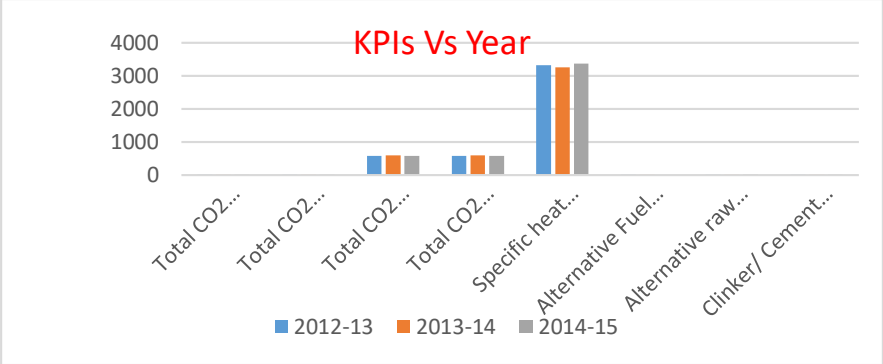
IMPACTS

Generated Pollutant Data as per Cement Sustainability Initiative (CSI)

Key Performance Indicators as Per CSI (Europe)

Data (reported 2011 unless otherwise specified)

Sl. No.	KPI	Range	Companies Reported
i	Specific NOx emissions (g/ton clinker)	844 - 1,915	14 reporting members
ii	Specific SOx emissions (g/ton clinker)	77 - 1,247	14 reporting members
ii	Specific Dust emissions (g/ton clinker)	58 - 613	14 reporting members



Environment Impact

Generated pollutants during different process stage in cement industries always effect to the environment. It mixes in air, water, and land and polluted them. Such pollutants enter our body through inhalation, skin absorption & ingestion and effect to our health. Major pollutants are NOx, SO2 & CO.

These include emissions of airborne pollution in the form of dust, gasses and fumes during quarrying, material handling and crushing like activity. Noise and vibration also generate during machinery and equipment operation and another operational process during cement manufacturing, that effect to the environment and human being.

Inhalation of SO2 causes Irritation of throat, nose etc and causes death when in high concentration. It also creates respiratory and cardiovascular disease. SO2 is also a primary contributor to acid deposition or acid rain.

Same as inhalation of CO2 causes asphyxiation or breathlessness. High concentration of CO2 may cause death also. Carbon monoxide (CO) also reduces oxygen delivery to the body's organs and tissues, as well as adverse effects on the cardiovascular and central nervous systems. CO also contributes to the formation of smog (ground-level ozone), which can cause respiratory problems

Nitrogen oxide (NOx) can cause or contribute to a variety of health problems and adverse environmental impacts, such as ground-level ozone, acid rain, global warming, water quality deterioration, and visual impairment. Affected populations include children, people with lung diseases such as asthma, and exposure to these conditions can cause damage to lung tissue for people who work or exercise outside.

Climate

Cement manufacture contributes greenhouse gasses both, directly through the production of carbon dioxide when calcium carbonate is heated, producing lime and carbon dioxide and indirectly through the use of energy, particularly if the energy is sourced from fossil fuels. The cement industry produces about 5% of global man-made CO2 emissions, of which 50% is from the chemical process, and 40% from burning fuel. The amount of CO2 emitted by the cement industry is nearly 900kg of CO2 for every 1000kg of cement produced.

Fuels and raw materials

A cement plant consumes 3–6GJ of fuel per ton of clinker production, depending on the raw materials and the process used. Most cement kilns today use coal and petroleum coke as primary fuels and, to a lesser extent, natural gas and fuel oil. Selected waste and by-products with recoverable calorific value can be used as fuels in a cement kiln, replacing a portion of conventional fossil fuels, like coal, if they meet strict specifications. Selected waste and by-products containing useful minerals such as calcium, silica, alumina and iron can be used as raw materials in the kiln, replacing raw materials such as clay, shale, and limestone. Because some materials have both useful mineral content and recoverable calorific value, the distinction between alternative fuels and raw materials is not always clear. For example, sewage sludge has a low but significant calorific value and burns to give ash-containing minerals useful in the clinker matrix.

Local impacts

At all Local Level, Producing cement has significant positive and negative impacts. On the Positive side, the cement industry creates employment and business opportunities for people. This play vital role in the economic development of the country. Negative impacts include disturbance to the landscape and disruption to local biodiversity from quarrying limestone (the raw material for cement) like activity and effect to a living thing.

Effects of Cement dust & generated pollutants

Long Term exposure of cement dust can develop lungs cancer, pneumoconiosis, respiratory system damage, skin irritation, dermatitis, skin burn, conjunctivitis, headache, fatigue, eye injury as well as stomach and colon problem.

According to studies reported with respect to the oral cavity, the mostly reported diseases in workers are inflammation of gums (gingivitis), dental caries, calculus and pockets formation, loss of surface area of teeth and also periodontal diseases. This depends on the duration of exposure to dust.

Eye also affected when cement dust particles enter in the eye. Pollutants generated from cement manufacturing industries also effect to structure, Tree & animals. Apart from this Noise generated from cement industries and exposure beyond permissible limit also effect to our hearing system.

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Environmental control

Environmental control Comprises improvement in general ventilation system thereby diluting the

Dangerous dust, gasses, and fumes to such concentration level so as to maintain the permissible limits prescribed for the relevant contaminants. Total Enclosures of the hazardous process with exhaust system by using the principle of segregation may be used as an effective control method. This is called engineering control method. Enclose to conveyor like the system is the best method to control dust emission that emits during raw material handling and spread in working atmosphere. This help to protect the environment and preventing occupational diseases.

All filters, Lines, and connectors shall be designed to prevent leakage of particulate or contamination. Regular monitoring must be done to identifying such leakage and taking corrective action at the same time to prevent dust emission in the atmosphere.

Noise is also a source of pollution that effect to people to create a headache, Nausea, develop hypertension and long-term exposure may cause of noise-induced hearing loss. Noise may be reduced to use enclosure, Barriers and functional sound absorber.

Electrostatic Precipitator (ESP), Bughouse Filters, Monitoring equipment like device also used in cement industries for dust control.

ESP control devices ionize contaminated air flowing between the electrodes. The charged particles (contaminants) travel to the oppositely charged plates. The particles on the plates are removed. These particles can be dry dust or liquid droplets (liquid droplets are more efficient). The particles that are removed from the plates are knocked off to the bottom of the ESP. ESPs have high efficiency and low-pressure drops.

These devices are used after the roller mill and after the cement kiln in the production of cement to reduce emissions of particulate matter such as cement kiln dust. Often spray towers are used before the ESP in order to moisten the particulates, increasing ESP efficiency. The figure is given in 1.

In Baghouse Filters, polluted air is filtered through the bags. The bags are closed at the bottom and are exposed to a clean air chamber at the top. The bags are cleaned by short bursts of pressured air. The bags contracts and snaps which release the particulate layer.

Bughouses are used in cement production at the top of material storage silos and gas separators. They help prevent any particulate matter escape the process. Anything collected in the bag filters is simply released back into the process to be used in the cement-making. The figure is given in 2. Generation of Electrical Power to use waste flue gasses that contain CO2 is also good method to protect the environment and prevent occupational health diseases. Power is generated through waste Heat recovery boiler (WHRB) to use waste flue gasses.

Apart from this water sprinkling system, enclose to the conveyor belt to prevent dust emission, Sweeping m/c like equipment also used for controlling dust. Power is also generated to use waste flue gasses that contain CO2 with the help of WHRB.

CONCLUSION

The effect of dust, Fumes & gasses that generated in cement industries may cause of occupational & Health diseases due to inhalation, ingestion & direct contact with the skin of these agents. Such dangerous agent also effects to the eye and another living thing. Noise generated from machinery, equipment and other operation of cement manufacturing may cause to hearing loss due to exposure beyond permissible limit. Apart from dust, fumes and gases and other hazard associated with cement industries like Mechanical (Entanglement, Contact, Sharp edge etc.), Electrical (Electrocution, Shock, fire), Fall hazard, Vehicle movement, Physical (Heat, poor illumination), Chemical hazard, Fire hazard (Naked flame, Hot material) etc. The risk may minimize to control hazard at the workplace to take adequate control measure. Safe workplace minimizes Numbers of injury and increases the productivity of the organization.

RECOMMENDATIONS

Recognize the hazard and eliminate it or Control at source through dust collecting system or other engineering control method. Water sprinkling & ensuring good housekeeping on regular basis is also best method to controlling dust and preventing occupational health diseases.

Maintain dust control systems on regular basis for keeping them in good working order. Conduct air monitoring to measure worker exposures and ensure that controls are providing adequate protection for workers.

Cement industry workers should wear suitable personnel protective equipment like high-efficiency particulate arresting or high-efficiency particulate air (HEPA) mask, safety goggles and mandatory get pre-employment and medical surveillance on periodically. Use safety gloves also for preventing dermatitis like disease. Displayed post warning signs inside factory & Provide training to workers and staff's for creating awareness and taking suitable safety control measure. Report all occupational Health disease to OHS centre & Govt. authority. This will help to reducing the risk of Occupational hazards of cement dust in the cement industry workers.

- All disease that created inside plant due to cement dust, fumes and gases, Noise must be investigated and preventing measure must be taken to avoid similar future diseases.
- Use Enclosure, absorber and barrier like devices for reducing noise level and use Ear plug and goggle like PPE's is a techniques to protect ear and eye from such diseases.
- Risk must be identified in every process and operational activity and take adequate control measure for minimising its level as low as reasonable practicable (ALARP) to prevent occupational health diseases and Protect to environment.

Hazard is controlled to eliminate hazard or Isolate Hazard or Engineering control measure or Administrative control measure or to use Personnel protective equipment. This method is known as hierarchy of hazard control measure. To use of PPE's last consideration of hierarchy of hazard control, when risk is not minimise up to tolerable level to Take rest control method.

Tables

PERMISSIBLE LEVELS OF CERTAIN HAZARDOUS SUBSTANCE IN WORK ENVIRONMENT

Substances	**Time weighted Average concentration (TWA) in ppm (8 hours)**	**Short Term exposure Limit (STEL) in ppm (15 minutes)**
Carbon monoxide	50	400
Sulphur dioxide	2	5
Nitrogen dioxide	3	5
Ozone	0.1	0.3

Note: This Value is taken from Second schedule of The Factories Act 1948 (India)

AMBIENT AIR QUALITY STANDARD IN RESPECT OF NOISE

Noise Regulation (Regulation & Control) Rule-2000 (India).

Category of Area/ Zone	Day Time Limits in dB (A) Leq*	Night Time Limits in dB (A) Leq*
Industrial Area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Note: Day time means 6:00 AM to 10:00 PM and Night Time means 10:00 PM to 6:00 AM

Illustrations (Figures)

Fig. 1 (Source)

Fig. 2 (Source)

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