European Bank
for Reconstruction and Development

Sub-sectoral Environmental and Social Guidelines: Cement Production

PROCESS DESCRIPTION

Cement production facilities are often located in rural areas and close to quarries, where the raw materials required are present, for example, limestone and shale. This guideline deals with the EHS issues associated with cement production facilities and not with quarrying activities (see EBRD guideline on Quarrying activities).

The limestone or chalk (calcium and silica containing raw materials) are crushed and mixed in varying proportions according to the required quality of the final product. Typically, there are four processes:

- dry process - the raw materials are ground and dried to form a flowable powder. This material is then fed into a pre heater or pre-calciner kiln;
- semi-dry process – dry raw material is combined with water to create pellets which are fed into a grate pre-heater before the kiln;
- semi wet process – created from a slurry that is de watered. The resulting filter cake is formed into pellets and fed into a grate pre heater or directly to a filter cake dryer;
- wet process – pumpable slurry is created from the raw materials and is fed directly into a kiln or to a slurry drier and then a kiln.

The mixture is then heated or "sintered" using a high temperature to produce the basic cement formulation, "clinker". At this stage gypsum (calcium sulphate) is added, before the mixture is crushed again. Various additives are incorporated into the mixture depending upon the end use. The clinker is ground up with gypsum and other additives to produce cement.

EU BREF – Cement Kiln Emission Limits	BAT - AEL[1] mg/Nm³
Dust (from kiln firing process)	<10-20
NOx emissions:	
Preheater Kiln	<200-450
Long Rotary Kiln	400-800
SOx (expressed as SO_2)	<50-<400
Hydrogen Chloride (HCl)	<10
Hydrogen Fluoride (HF)	<1

IFC – Cement Kiln Emission Limits	Guideline values[2] mg/Nm³
Dust from kiln firing	50
NOx	600
SOx (expressed as SO_2)	400
Hydrogen Chloride (HCl)	10
Hydrogen Fluoride (HF)	1

KEY ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Air Emissions

Emissions to air may come from manufacturing activities, such as grinding, or kiln operation from the fuel and additives used. The key releases are oxides of nitrogen, dust, SOx mercury, cadmium and carbon monoxide. In

[1] BAT-AEL – EU BREF (2009) Best Available Technique – Associated Emission Level. Based on daily average.

[2] IFC E,H & S Guidelines – Cement and Lime Manufacture. Guideline Emission Limits Based on daily average.

addition, there are sulphur dioxide and carbon dioxide releases. Of particular importance are particles of less than 10 microns (PM10) in size which are extremely harmful to the lungs, resulting in diseases such as silicosis and other respiratory problems.

Dust emissions also arise as a result of transport of raw materials to the site, from stockpiles of raw materials, from hoppers and raw material transfer, various crushing plant, pipe-work and from vents and furnaces. The dust is typically alkaline in nature with small quantities of trace metals also present giving rise to environmental and health impacts. Other pollutants, such as chlorinated compounds may also be present if the kiln is being used for simultaneous waste incineration. The extent and severity of dust problems will vary with the extent of dust control measures, meteorological conditions and the location of the production site and neighbouring sensitive areas.

Alternative Fuels/Waste incineration

Alternative fuels to reduce the use of fossil fuels and reduced gaseous emissions. It is common practice for cement kilns to be used for incineration of waste, for example, waste tyres and substitute liquid fuels made up of spent solvents. Under certain conditions of temperature and in the presence of chlorinated compounds, there is potential for dioxins and furans to be formed which air pollutants. The types of waste and the associated storage and handling arrangements will also influence the potential environmental impacts. Typically, waste incineration is highly regulated because it will incur its own emissions which might require permitting, however it can reduce energy costs.

Energy consumption

The cement industry is energy intensive due to the high temperatures that are required to achieve the chemical reactions 'calcination' necessary to create clinker. Energy sources include natural gas petroleum coke (petcoke), coal or fuel oil . In any combustion process green house gas emissions will be created.

Manual Handling and Repetitive Work

Manual handling, lifting and carrying heavy or awkwardly shaped objects, such as bags, and repetitive work activities can result in injuries and loss time incidents.

Burns and heat stress

Kilns working at high temperatures can increase the temperature of the working environment which can lead to heat stress for those working in the vicinity. Contact burns can result from contact with hot equipment especially during maintenance activities. In addition, there can be contact burns from alkali materials that are used in the process and mix with moisture.

Slips, Trips and Falls

These often occur on the same level and are primarily caused by uneven surfaces, inappropriate footwear, lighting, weather conditions, trailing cables and pipe work especially during unblocking, maintenance and cleaning activities.

OTHER ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Solid Waste

Solid waste is created in the manufacturing process. This typically comes in the form of non hazardous wastes, such as, cement or cement kiln dust. The majority of this can be reused in the process. In addition, depending on raw materials there can also be spoil rocks which are removed from the raw materials. There may also be waste ash from the incineration of waste which requires disposal that may require a permit.

Water consumption

Water is typically used for raw material preparation, cooling, dust suppression and vehicle cleaning. This can either be from the mains or from local abstraction. Where local abstraction occurs a permit or consent which controls volumes of water removed is likely to be required.

Wastewater

The cement production process does not generate significant quantities of liquid waste Wastewaters are created in the wet grinding and washing activities. Slurry from dampening activities may generate a waste slurry and could require a slurry treatment plant. Also vehicle washings and site run off occur that contain suspended solids and associated metals. This water can have a high pH.

Packaging

The bagging of the final cement product uses large quantities of packaging. Companies operating with the European Union (either as a manufacturer or as a supplier into European Union countries) will be subject to the European Union Packaging and Packaging Waste Directive (94/62/EC), which aims to reduce the amount of packaging that is being introduced into waste streams.

Polychlorinated Biphenyls (PCBs) and Asbestos

PCBs are a group of substances which are good electrical insulators. Typically, PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear, transformers and fluorescent light starters.

Asbestos has been used on a large scale for many years as a fire proofing and insulation material and may be encountered in a wide range of forms including asbestos cement boards, as fire retardant gaskets in pipework and as fire retardant insulation around boilers and furnaces.

Particular attention should be given to buildings constructed before the 1980's.

Noise

Noise induced hearing loss can occur from working in noisy areas, for example, around grinders and conveyor systems.

Confined Spaces

Storage silos are dangerous confined spaces and entry to them must be strictly controlled and avoided wherever possible.

Machinery

All equipment should have safety guarding and workers should be issued with appropriate personal protective equipment to protect against unavoidable sharp items and edges. Particular

attention should be paid to conveyors, kilns and packaging machinery.

Respiratory Disease

Dust created in the process from moving raw materials, crushing and grinding within the process can be inhaled and cause respiratory disease.

Collision

This often takes the form of people being hit my moving, flying or falling objects.

Hazardous substances

Additives to the cement process can be harmful and toxic if incorrectly stored, used and disposed of. This includes alkaline materials, such as, lime. Contact with such substances can cause skin disorders and respiratory disease.

Explosion

Raw materials are often stored in silos. A silo rupture can result from over pressurisation in the tank.

KEY SOCIAL, LABOUR AND COMMUNITY RISK/LIABILITY ISSUES

Dust

Public/environmental health and nuisance issues associated with dust and vented fumes can arise from production activities and may have a significant effect on neighbouring locations. This may be important if there are neighbouring residential and industry in the area.

Transport

As cement is produced in large volumes and often not close to the customer, transport of products by either road or rail can be a significant issue. This might lead to road noise and traffic congestion, along with heavy vehicles using rural roads and increase in Road Traffic Accidents.

FINANCIAL IMPLICATIONS

Many countries are signatories to the Kyoto Protocol and have adopted targets for the reduction of CO_2 emissions. Where Governments have set up carbon emission reduction programmes industrial processes have been required to reduce their CO_2 emissions through the setting of targets. This can result in a need for substantial investment in new/clean technologies to achieve the emission targets. These targets may be reflected in environmental permits.

- Transfer from a wet process to a dry process could require capital investment.
- Incineration of waste to provide energy could result in capital investment and additional permitting requirements.
- Where large quantities of energy are used then this can result in high operating costs to the business.
- Injuries may lead to increased payroll costs to replace skilled workers and lost production time.
- Capital investment may be required to comply with new environmental, health and safety requirements.

- Fines, penalties and third party claims may be incurred for non-compliance with environment, health and safety regulations.
- Where the Cement Operator does not run an associated quarrying operation to provide raw materials to the process, cost of raw materials could fluctuate depending on the market.
- The introduction of alternative technologies and materials such as Recycled Asphalt Product (RAP) could result in a reduction in product demand.

IMPROVEMENTS

Environmental Improvements

- Implementation of an Environment, Health & Safety Management System
- Regular inspection should be carried out of all bulk containment on site to prevent leakage and product loss;
- Provision of secondary spill containment for bulk storage tanks and silos;
- Good housekeeping should be maintained at all times in all areas;
- Install and maintain dust filters to control dust levels;
- Enclose conveyors and storage areas to reduce dust;
- Maintain on site abatement equipment and treatment plant;
- Heat recovery to minimise fuel energy requirements.
- Provision and use of energy efficient equipment and an energy management system
- Reuse collected cement and cement kiln dust in the process;
- Select low sulphur fuels;
- Investigate the use of alternative fuels (waste materials);
- Use low nitrogen oxide burners to reduce nitrogen oxide releases;
- Ensure that processes work at optimum levels to ensure energy use is kept to a minimum and optimise combustion operations;
- If a wet process is used consider transfer to a dry process;
- Insulate pipe work and kilns to retain heat;
- Install wet scrubber systems to reduce particulate emissions;
- Install dedicated drainage systems for collection and settling or removal of contaminated or silt laden waters from the site;
- Carry out appropriate construction and maintenance of site roadways to minimise dust generation (for example, by spraying or paving roadways) and ensure that driving practices support this, for example, sheeting vehicles;
- Electrostatic precipitators or fabric filters to reduce point source particulates

Health and Safety Improvements

- Provision of personal protective equipment (PPE) that is fit for the task to prevent injury and maintain hygiene standards. Staff should be trained in the correct selection, use and maintenance of PPE;
- Train workers in correct use of machinery and safety devices;
- Redesign manual processes to avoid heavy lifting/repetitive activities;
- Install mechanical lifting aids where possible and rotate work tasks to reduce repetitive activities;
- Implement a permit to work system for working in confined spaces and for hot work.
- Separation of people from moving equipment:
    - Ensure that the process layout reduces opportunities for process activities to cross paths;
    - Installation of safeguards on moving parts of conveyor belts to reduce risk of entrapment of employees;
    - Install walkways to separate people from vehicle movements to reduce risk of collision;
- To reduce the risk of noise exposure isolate noisy equipment and rotate tasks to minimise time spent in a noisy area over an eight hour period and provide personal protective equipment where people have to enter noisy areas;
- Route cables and pipe work under walkways to prevent slips, trips and falls;
- Construct walkways of non slip materials;
- Provide a good standard of lighting;
- Install automatic cleaning systems to reduce the risk of burns;
- Install automatic alarms and shut off systems;
- Regulate exposure times to reduce heat exposure times and to prevent dehydration;
- Enclose conveyor systems to reduce noise and dust levels.
- Consider the need for public consultation and the development of stakeholder engagement plans

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

During the initial site visit, the issues will vary according to the specific processes being adopted and depending on the level of environment, health and safety management already introduced. While visiting the site it is important to discuss and review the following:

- Note whether the plant discharges to a local watercourse or the municipal wastewater treatment works;
- Check if the kiln is used for waste incineration;
- Check the condition of storage facilities for bulk raw materials;

- Discuss procedures to check the source of raw materials and/or materials for waste incineration;
- Note the noise and dust levels at the site to determine whether abatement equipment is in use or might be required;
- What is the standard of "housekeeping" on site? Do areas look clean and tidy? Look for evidence of any recent spills or releases of raw materials/product. ;
- Are staff wearing Personal Protective Equipment?
- Check signage around the site:
    - Does it convey the health and safety risks?
    - Are fire exits and/or evacuation routes clearly marked?
    - Are there demarcated routes for pedestrians and vehicles?
- Is fire fighting and first aid equipment available? When was the last drill?
- Check the age and condition of equipment, look for signs of wear and tear, degradation, leaks and breaks;
- Check that solid waste storage and disposal (storage equipment) is in a good condition;
- Check that waste storage areas are clear of debris and that skips are covered to prevent waste escaping, for example, check that waste containers have lids or are stored in an area with a roof;
- Have the premises been inspected recently by the regulatory authorities for health, hygiene and environment? What were their findings?
- Check for automatic safeguards on machinery to prevent accidental injury;
- Check that wages and working hours are consistent with the average for the sector and national standards;
- Does the organisation have insurance in place to cover the recall of contaminated products? Have there been any recent product recall incidents?
- Check for visible dust emissions
- For quarry operations - any residential areas
- Have there been any recent incidents on site such as fatalities, fires/explosions, spills? Is insurance in place to cover such incidents?
- Does the business plan have line items for Environment, Health and Safety improvements?
- Check the conditions and duration of validity for all permits.
- Check that labour standards, contracting and remuneration are in line with national law and are consistent with the average for the sector.
- Check that hours, including overtime, are recorded and staff should receive written details of hours worked and payment received.
- Is there a management review/demonstrating senior management involvement in

environment, health, safety and hygiene management.

- Has the company received inspections from the local labour inspectorate or other regulators in the previous three years? Have these resulted in any penalties, fines, major recommendation or corrective action plans?
- Does the organisation have a grievance mechanism which allows employees to raise workplace concerns?
- Are employees free to form, or join, a worker's organisation of their choosing?
- Take note/ask questions relating to any activities that address the improvements listed in the improvements section of this document.

ACTION PLANS

Dependent on the individual business, select appropriate improvements from the list above to include in the action plan. As a minimum, any business should be required to have the following in place:

- Operational procedures to manage environmental, health and safety and labour risks;
- Monitoring programmes (particularly energy efficiency programmes);
- Improvement objectives, targets and project plans;
- Training for personnel;
- Regular inspections, checks and audits with records to demonstrate achievement of the required level of performance against legal requirements and improvement action;
- Emergency plans for environment, health and safety accidents or hygiene non-compliance.
- Introduce appropriate stakeholder engagement plans.

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REFERENCES AND ADDITIONAL SOURCES

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