Egyptian Environmental Affairs Agency (EEAA)

Egyptian Pollution Abatement Project (EPAP)

Inspection Manual

Cement Industry

December 2002

Cement Industry
Inspection Handbook

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1. Introduction

The Egyptian Pollution Abatement Project (EPAP) sponsored by FINIDA has assigned Finish and Egyptian consultants for the task of developing sector-specific inspection and monitoring guidelines..

A General Inspection Manual, GIM, has been developed covering inspection aspects common to all sectors. The manual :

- Discusses the strategy, objectives and tasks of the inspectorate management
- Identifies the team leader responsibilities and tasks
- Presents a methodology for performing all types of inspection. Tasks during the various phases of planning, performing field inspection, report preparation and follow-up are discussed. Several checklists are included

Sector specific inspection manuals have been developed for the following industries

- Textile industry
- Pulp and paper industry
- Food industry
  - Grain milling industry
  - Dairy industry
  - Carbonated beverages industry
  - Confectionery industry
  - Fruits and vegetables industry
- Metallurgical industry
- Fabricated metal industry
- Motor vehicle assembly

The developed manuals were tested through a number of training programs that targeted RBOs and EMUs. The inspectors involved in the training used these manuals to inspect a number of industrial facilities. Feedback from the concerned parties led to the improvement of these manuals and their continuous update.

1.1 Preface

As a continuation of the previous effort, manuals for the following industrial sectors are being developed

- Paint industry
- Detergent oil and soap industries
- Cement and ceramic industry
- Fertilizer industry

1.1.1 Project objectives

The project aims at the development of sector-specific guidelines for inspection to be used by inspectors. These manuals are meant to be simplified but without abstention of any information necessary to the targeted users. Flowcharts, tables and highlighted notes are used for easy representation of information.

1.1.2 Organization of the inspection manual

The inspection manual for the cement industry includes ten chapters. The first chapter represents an introduction to the whole project and to the specific sub-sector of the industry. Chapters two to five deal with the cement industry and its environmental impacts.

The description of the industry in chapter 2 includes the inputs and outputs, a description of the different production lines with their specific inputs and outputs, a brief description of the service and auxiliary units that could be present at the industrial establishment with their potential sources of pollution and the various emissions, effluents and solid wastes generated from the different processes.

Chapter three describes the environmental and health impacts of the various pollutants whereas chapter four gives a summary of the articles in the Egyptian environmental laws relevant to the cement industry. Chapter five gives examples of pollution abatement techniques and measures applicable to the cement industry.

The inspection procedures are described in chapters 6 to 10 starting with a brief description of the inspection process in chapter 6 then the planning aspects that should be considered at the inspectorate level are explained in chapter 7. The different tasks at the inspectors level specific to the cement industry, will be described in chapters 8 to 10. The tasks before field inspection are presented in chapter 8 whereas the inspection tasks for actually performing the field visit are defined in chapter 9. Chapter 10 is concerned with the conclusion of the field visit including inspection report writing, supporting the enforcement case and following-up the compliance status of the facility.

1.2 Introduction to the cement industry

Cement industry is considered one of the important industry in Egypt. This industry is related to the building, construction and infrastructure industries. In the last ten years, there has been a great breakthrough in this industry :

- Cement manufacturing is being performed by dry process instead of wet process
- Awareness of the harmful impact of this industry on environment and health and trying to find out the solution

- The plants are being distributed in different locations in Egypt instead of being concentrated in Helwan and Alexandria

Table (1) shows the daily production of clinker according to design capacity

Table (1) Daily Production of Clinker According to Design Capacity

Clinker daily production of design capacity		Grey			White			
		Dry		Wet	Dry		Wet	
		No: of Kilns	Daily Prod.	Daily Prod.	No: of Kilns	Daily Prod.	No: of Kilns	Daily Prod.
1	Toura Portland cement	3	10000	2000				
2	Helwan Portland cement	2	8400	2000	1	750	2	300
3	Alexandria of cement	1	3300	2000				
4	National cement	2	8400	2000				
5	Assuit cement	3	12000					
6	Amria cement	2	8000					
7	Suez cement	3	14000					
8	Egyptian cement	4	16800					
9	Cement of Beni Sweif	1	3500					
10	Cement of Sinai	1	4000		1	1400		
11	Misr Beni Sweif of cement	1	4200					
12	Misr for cement Quina	1	4200					

2. Description of the Industry

Cement manufacturing is considered one of the strategic industries because it is directly related to building and construction. Cement is used as a hydraulic binding material, most often applied as a component of mortar or concrete.
Cement plants are usually sited near limestone, clay quarries in order to minimize raw material hauling costs.

Cement manufacturing plants vary widely in volume and composition of pollutants discharged. Differences arise from process variations, in-plant practices, housekeeping and other factors.

Two types of processes are available, nominally termed "wet" or "dry". In the wet process, raw materials are ground, mixed with water and the slurry fed to the kiln. With the dry process raw materials are dried before or during grinding. Dry ground materials are fed to the kiln.

Service and ancillary units provide water and energy requirements as well as maintenance, storage, packaging, testing and analysis needs.

2.1 Raw materials, products and utilities.

The principal raw materials are limestone, silica sand, clay, shale, oxides of chalk. Silica , aluminum and iron are added in the forms of sand, clay, bauxite, shale (medium size particles of sedimentary layer, like clay , with low water content), iron ore.
Gypsum is added at the final stage of the process in cement mills.
Chemicals are also used in the lab for quality control and analysis.
Oils and lubricants are used for machinery maintenance.
Natural gas and mazot may be used to generate combustion gases used in the kiln. Most kilns are equipped to fire more than one type of fuel.
There are five types of Portland cement. Table (2) presents these types

Table (2) Types of portland cement

Type	Description
1- Regular Portland cements	Are the usual products for general construction. There are other types of this cement, such as white, which contains less ferric oxide, oil-well cement, quick-setting cement, and others for special uses.
2- Moderate heat of hardening and sulfate resisting Portland cements	Are for use where moderate heat of hydration is required or for general concrete construction exposed to moderate sulfate action.
3- High early strength (HES) cements	Are made from raw materials with a lime to silica ratio higher than that of regular cement

	and are ground finer than this type. They contains a higher proportion of tricalcium silicate than regular Portland cements. Finer grinding causes quicker hardening and a faster evolution of heat. Roads constructed from HES can be put into service.
4- Low heat Portland cements	Contain a lower percentage of tricalcium sulfate and tricalcium aluminate, thus lowering the heat evolution. Consequently, the percentage of tetracalcium ferro-aluminate is increased because of addition of ferric oxides to reduce the amount of tri calcium aluminate
5- Sulfate resisting Portland cements	Contain a lower percentage of tricalcium aluminate. By their composition or processing, they can resist sulfate better than the other four types. This type is used when high sulfate resistance is required.

The difference between the gray and white cement are presented in table (3)

Table (3) The difference between the gray and white cement

	Gray cement	White cement
Raw materials	Lime stone, clay, sand gypsum, iron oxide	Pure lime stone, kaolin, pure sand, gypsum
Chemical composition		
SiO_2	21-23	24-26
Al_2O_3	7-9	5-6
Fe_2O_3	3-4	-
CaO	64-65	66-67
Application	Foundation	Plastering works and tile manufacturing

Note: Defining the inputs and outputs helps predict the expected pollutants.

2.2 Production lines

Table 4 presents the various production lines and service units that could be present in a facility producing cement.

Note: Knowledge of the processes involved in each production line and units allows the prediction of pollution hazards and expected violations and helps determine possibilities for implementing cleaner technology.

Table (4) Production lines and service units in cement industry

Production Lines	Service Units
Wet process production line. Dry process production line. Semi-dry production line	Boilers Water treatment unit Cooling towers Air compressors Laboratory Mechanical & electrical workshops Garage Storage facilities. Wastewater Treatment Plant Paper sacks plant Restaurant and Housing complex

Cement is manufactured in five kiln types: wet process, dry process, preheater, precalciner and semi dry process kilns. The same raw materials are used in wet and dry process kilns, however, the moisture content and processing techniques differ, as does the kiln design. The commonly processes used in Egypt are the dry and wet processes. Semi dry process are commonly used in India and China.

2.2.1 Wet Process production line

The wet process is being displaced by the dry process because of saving in energy, accurate control and mixing of the raw mixture.

Figure (1) presents the main operations in this process, the inputs to the units and the pollution sources. These operations are:

Crushing, proportioning and Mixing of raw materials The raw materials lime stone, silica, clay, shale and oxides of chalk are crushed, screened and transported to be stored as piles in open area or covered storage.

Grinding Raw materials are transported to slurry mills to be mixed with water to form a slurry. The raw material is ground continuously until its mean fineness has reached the desired value. The slurry is transported to silos making the mixture homogeneous and allowing the final adjustment in composition to be made. Periodical samples are taken to ensure that the mixture composition is identical to the required specifications.
Slurry is transported to a slurry basin where rotating arms make the mixture homogeneous.

Kiln, cooler

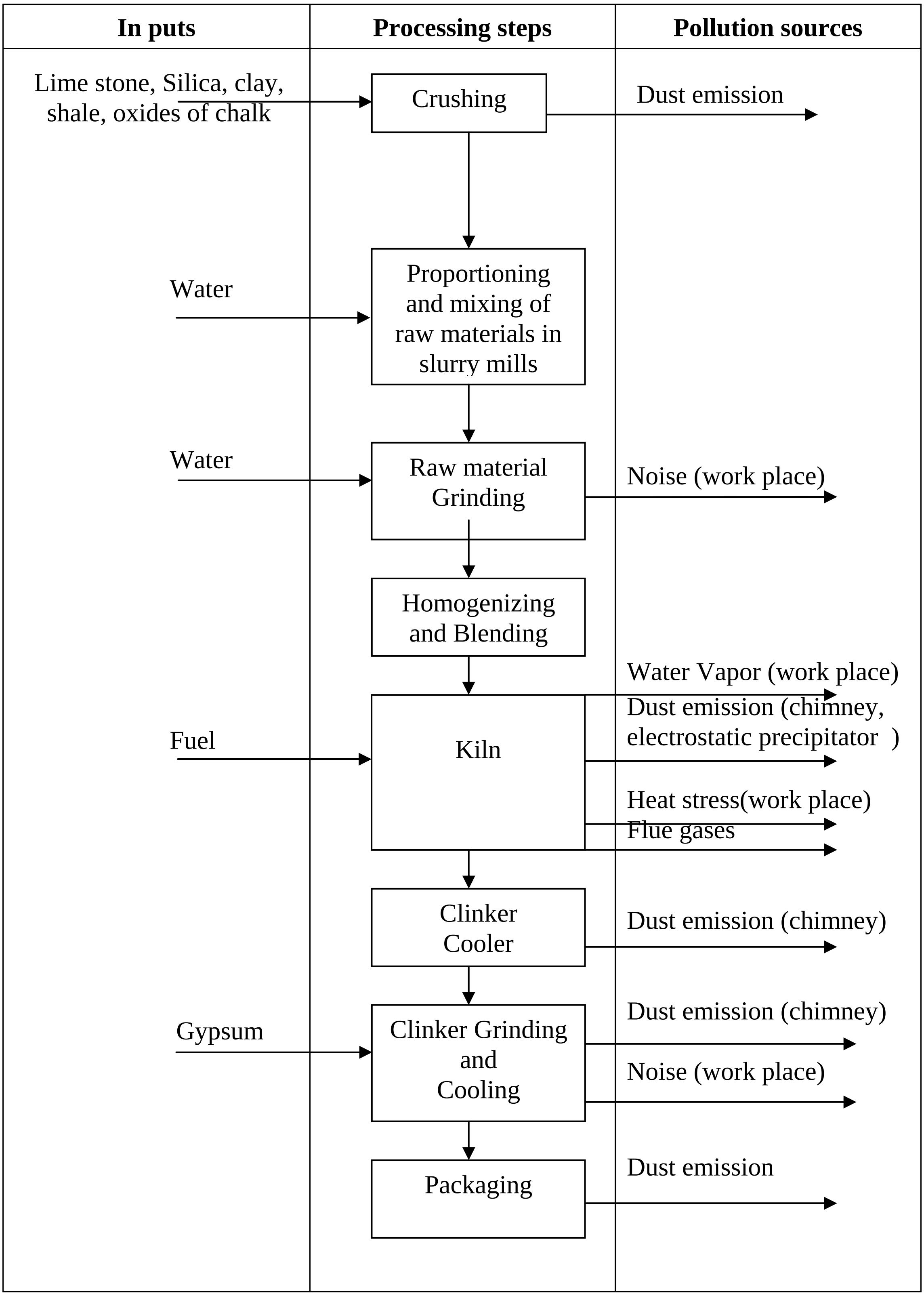
The slurry is withdrawn from the bottom of the basin, to be fed into the inlet of the rotary kiln. The kiln is a long cylindrical shaped oven, internally lined with refractory bricks. It rotates slowly on an axis slightly inclined from the horizontal. The slight axis inclination allows the kiln contents to drop forward as the kiln rotates. High temperature combustion gas produced at the lower end of the kiln flows upward, counter current to solid material moving down the kiln.

The hot clinker at 1400° C is cooled by air cooler to 60-200° C.

Finish Grinding and Packaging

The clinker is transported to a cement ball mill where Gypsum is added then grinding takes place. Cement is packed in paper/plastic bags. Fig (2) shows the ball mill used in cement industry

Figure (1) Production line for Wet Cement and Related Pollution sources



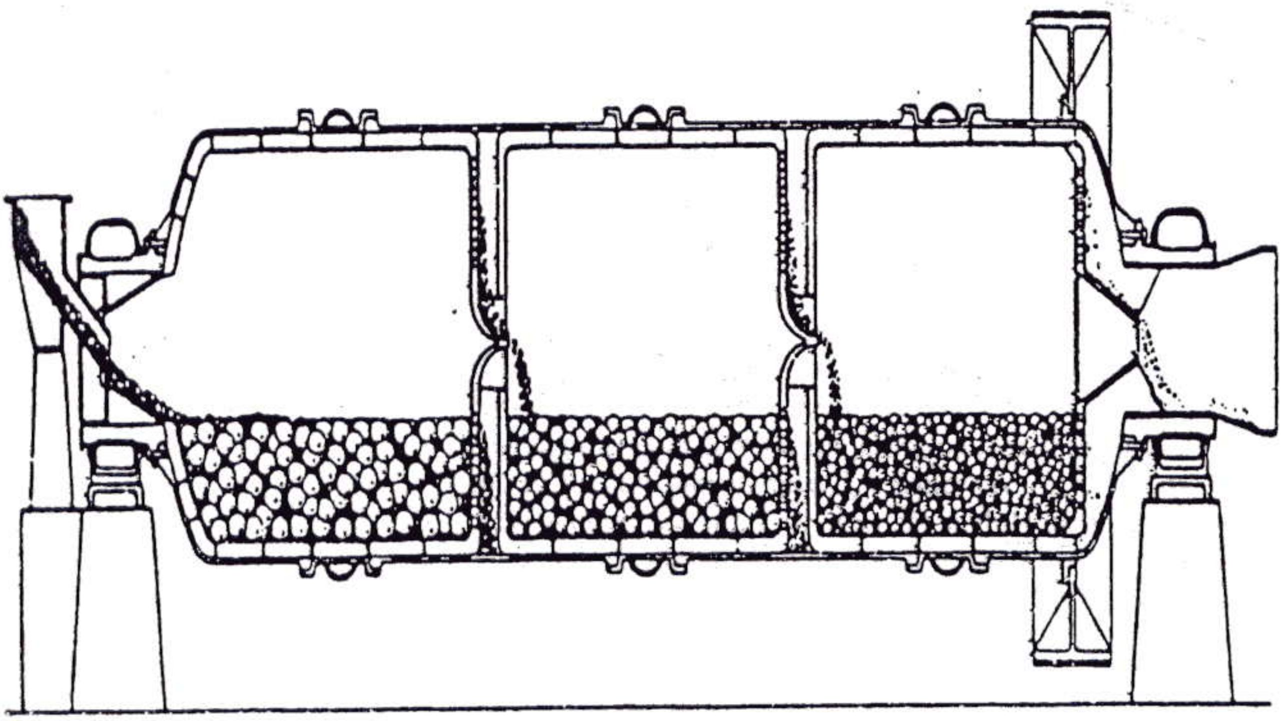


Fig.(2) Three-compartment tube mill

Note: Find out:

- What happens to the flue gases emitted from the kiln and contains a percentage of soft dust
- What happens to the rejected paper /plastic sacks

Notice :

Noise is generated from crushers, screens and grinders (mills)

2.2.2 Dry Process production unit:

Figure (3) presents the dry and semi dry cement manufacturing processes. Figure (4) presents the processing steps for the dry process production and its potential pollution sources. The processes involved are:

Crushing, proportioning and Mixing of raw materials	The raw materials lime stone, silica, clay, shale and oxides of chalk are crushed, screened and transported to be stored as piles in open area and covered storage.
Grinding	Raw materials are fed into a rotary dryer, where they are dried by hot air or the flue gases generated from the kiln. The dried raw material is grinded in raw materials mill and transported to a pre-blending silo to be homogenized by compressed air. The raw material out-put from the pre-blending silo is transported to the storage silo.
Kiln, Cooler	Homognized raw material is withdrawn from the bottom of the silo, then fed to the pre-heater tower before feeding the rotary kiln . Heat is provided by burning fuel oil (mazot)or natural gas. Additional heat is provided by preheated air from cooling the clinker. High temperature combustion gas produced at the lower end of the kiln flows upward, counter current to solids moving down the kiln. The kilns are slightly inclined, so that materials fed at the upper end travel slowly to the lower firing end, taking from 1 to 3 hours. Combustion gases preheat the raw materials at the entrance of the kiln to 900° C, and provide the heat necessary for the decomposition of calcium carbonate. The absence of water in this process allows the use of shorter kilns as compared to the wet process. Waste heat boilers are sometimes used to conserve heat and are particularly economical for dry process cement, since the waste gases from the kiln are hotter than those from the wet process. The by-pass kiln dust particulates are separated from exhaust gases by using electrostatic precipitator. Because the lining of the kiln has to withstand sever abrasion and chemical attack at the high temperatures in the clinkering zone, the choice of a refractory lining is difficult. For this reason high alumina and high magnesia bricks are widely used. The final product formed consists of hard granular masses from 3 to 20 mm in size called clinker. The clinker is discharged

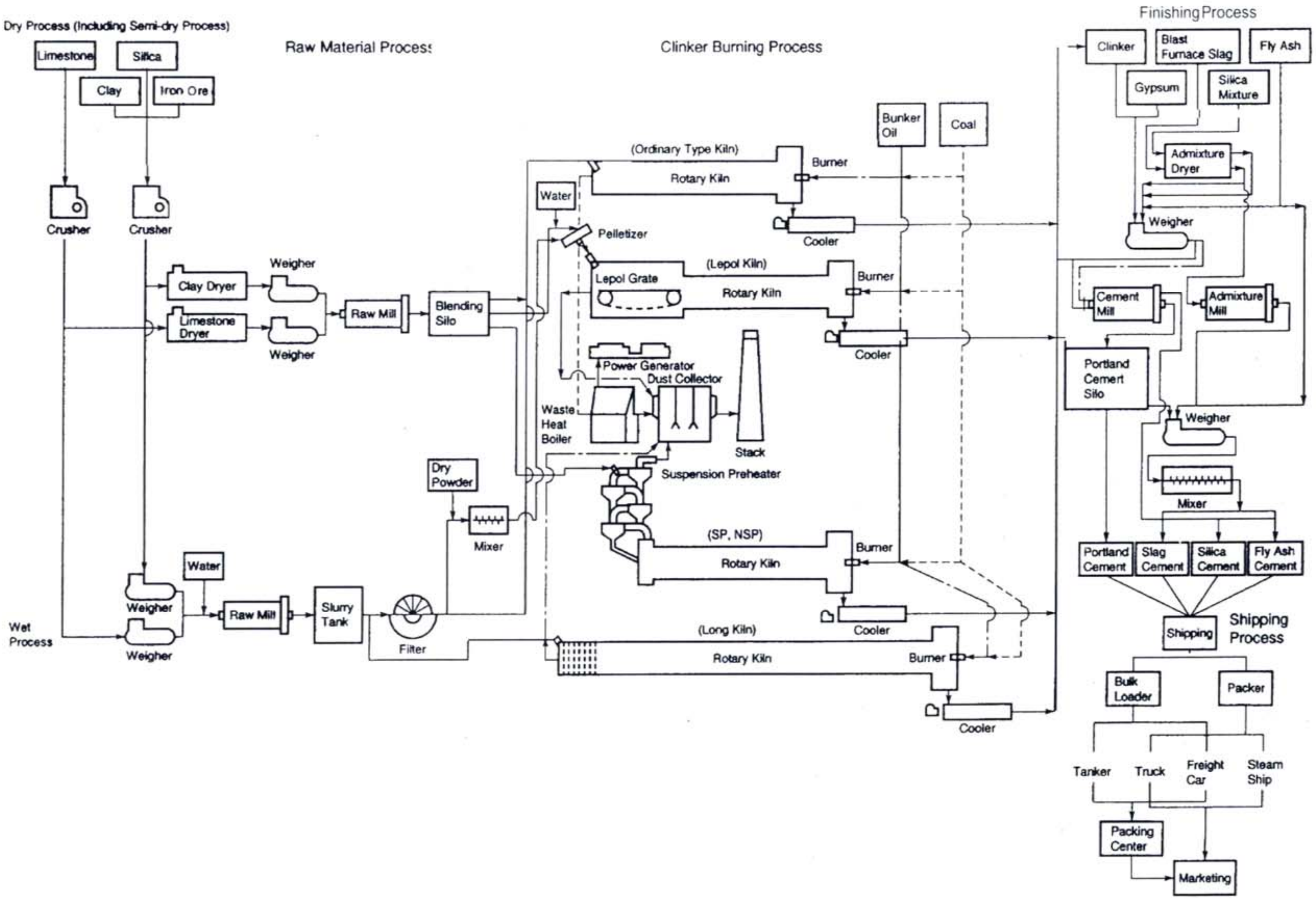
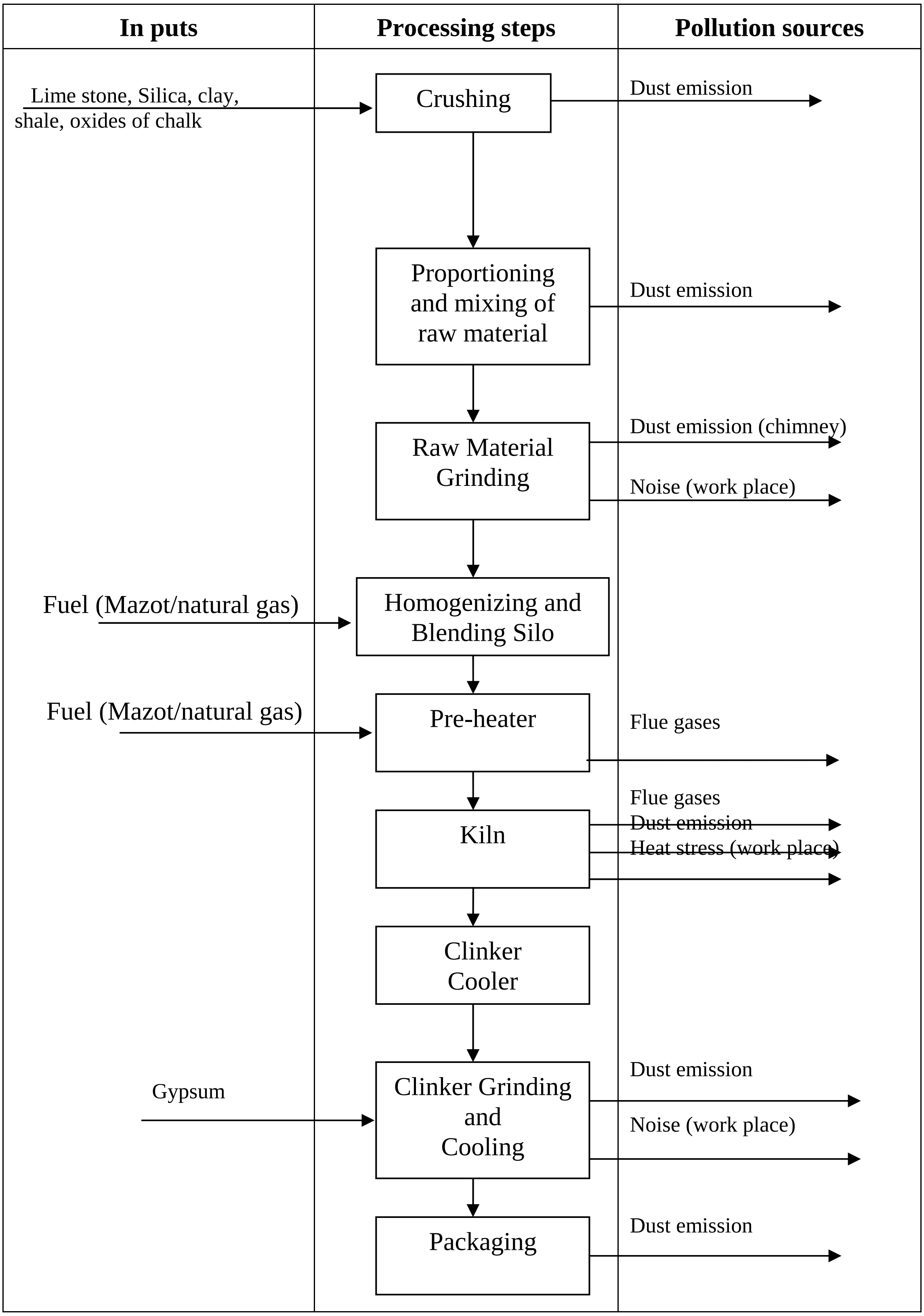


Fig (3) Dry and semi-dry cement manufacturing processes

Figure (4) Production line for dry Cement and Related Pollution Sources



from the rotating kiln into the air quenching coolers which quickly bring its temperature down to approximately 100 to 200°C. These coolers simultaneously preheat the combustion air. Figure (5) illustrates the 3 zones in the kiln.
There are 3 types of coolers used for clinker cooling, rotary cooler, planetary cooler and grate cooler.
Grate cooler is the most common cooler used in the dry process. Fig (6) shows the grate cooler

Some of the problems that arise due to dust formation in the kiln are :

- The formation of build-ups and rings in the cyclones, kiln inlet and calcining zone that could lead to complete blocking and stopping the kiln for several days
- Alkali vaporization consumes a large amount of energy

Finish Grinding and Packaging The clinker is transported to tube cement ball mill where Gypsum is added. Cement is packed in paper/plastic bags.

Note: Find out:

- What happens to the flue gases emitted from the kiln and contains a percentage of soft dust
- What happen to the rejected paper /plastic bags

Notice :

Check for noise from grinding and crushing

2.2.3 Semi-Dry Process production unit:

The semi-dry process is a special example of the dry process and uses a Lepol kiln or shaft kiln. In either kiln, the raw material ground in the dry process is shaped into pellets with diameter of 10 to 15 mm, so that about 13% of water is added.

In the case of the Lepol kiln, the pellets are dried and preheated once by the movable grate preheater and fed into the kiln. This system applies for the first time in the cement industry a concept of separating the raw material preheating process, which used to be effected in the kiln, and preheating by a separate device with high thermal efficiency.

In the shaft kiln, silica, clay, fuel is added in the pelletizing process. All process of drying, sintering and cooling are effected in the vertical movable bed. This concept had been conducted before the rotary kiln was spread and, recently, the shaft kiln with a continuous discharging function installed at the furnace bottom is mainly uses in India and China. This kiln's advantage is heat economy but it also has disadvantages since the poking work in the furnace has to be repeated to retain a stable combustion state and nonuniformity of quality cannot be avoided.

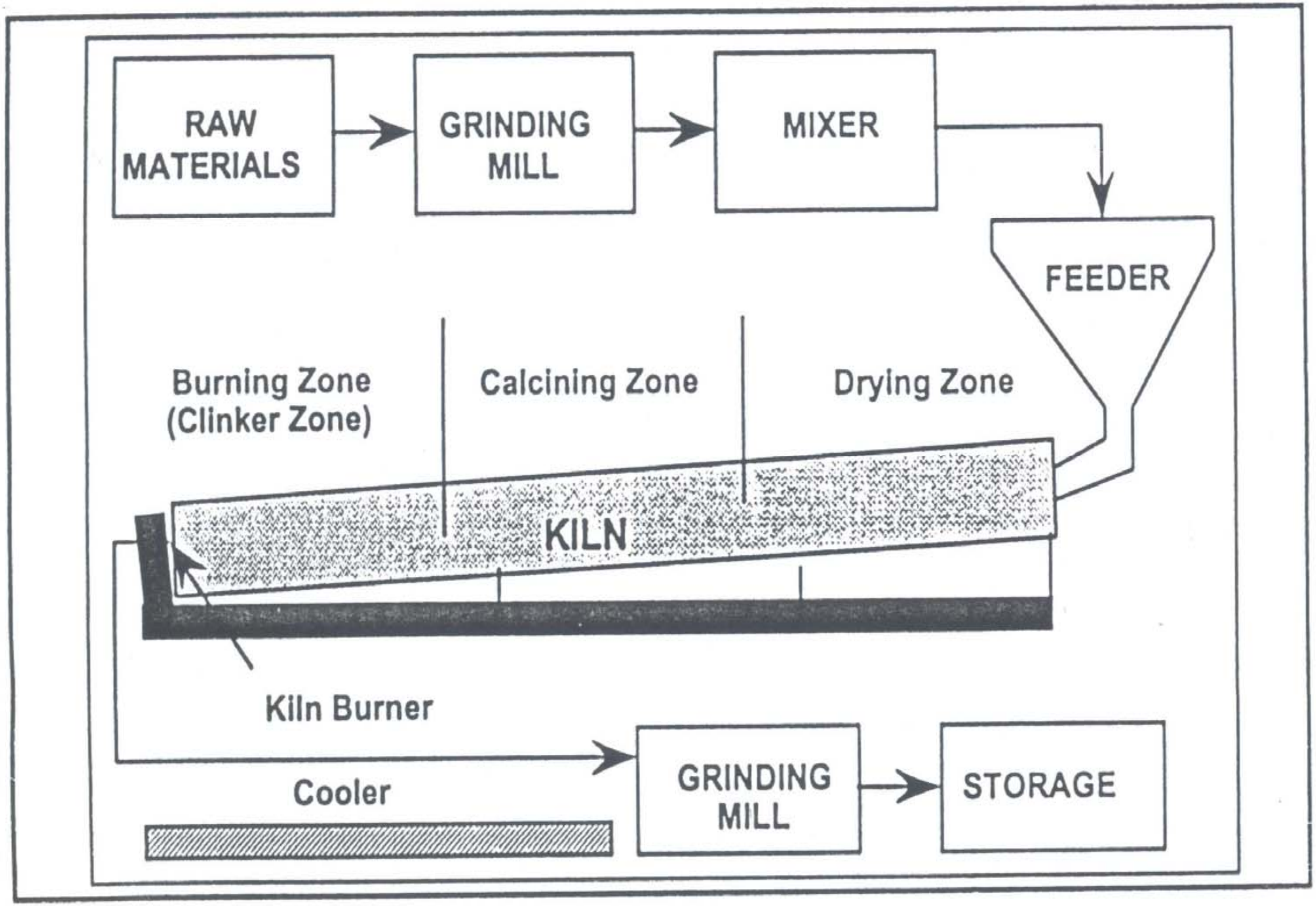


Fig (5) Three zones in the kiln

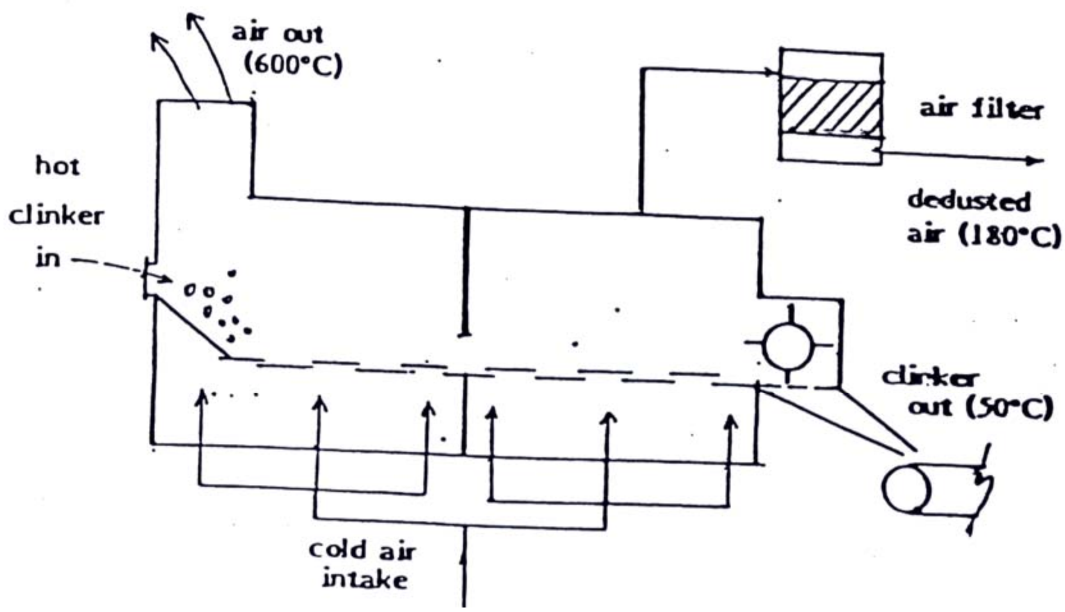


Fig (6) Grate cooler

2.3 Service units: description and potential pollution sources

Medium and large size plants will have some/all of the following service and auxiliary units. These units can be pollution sources and therefore should be inspected and monitored. Figure (7) shows the various units with their corresponding raw materials and potential pollution sources.

2.3.1 Boilers

Boilers are used to produce steam for electric power generation

Boiler grade water must be low in TDS to minimize scale formation. Therefore soft water is used as feed to the boilers.
Conventional steam-producing thermal power plants generate electricity through a series of energy conversion stages. Fuel is burned in boilers to convert water to high-pressure steam, which is then used to drive the turbine to generate electricity.
The gaseous emissions generated by boilers are typical of those from combustion processes. The exhaust gases from burning fuel oil (Mazot) or gas oil (solar) contain primarily particulates (including heavy metals if they are present in significant concentrations in the fuel), sulfur and nitrogen oxides (SOx and NOx) and unburned hydrocarbon
The concentration of these pollutants in the exhaust gases is a function of firing configuration (nozzle design, chimney height), operating practices and fuel composition.
Gas-fired boilers generally produce negligible quantities of particulates and pollutants.
Wastewater is generated as blowdown purged from boilers to keep the concentration of dissolved salts at a level that prevents salt precipitation and consequently scale formation. The blowdown will be high in TDS.
In the case of power plants, water is used for cooling the turbines and is also generated as steam condensate. The amount of wastewater generated depends on whether cooling is performed in open or closed cycle and on the recycling of steam condensate. Contamination may arise from lubricating and fuel oil
More information about boilers can be found in the inspection manual for energy generating plant (EPAP, 2002)

2.3.2 Cooling Towers

Cooling water is used extensively in industry. During the cooling process, water heats up and can only be reused if cooled. Cooling towers provide the means for recycling water and thus minimizing its consumption. The cooling effect is performed through partial evaporation. This causes an increase in the concentration of dissolved salts which is controlled by purifying some water (blowdown). The blowdown will be high in TDS.

Process cooling is the major use for water in dry process cement manufacture (drying equipment and air compressor operation, and cooling of kiln bearings, mill bearings, burner pipes, etc.). Therefore, dry process water effluents should not normally be contaminated unless poor water management is practiced. Slurry water used to feed raw materials into the kiln for the wet process evaporates (dissipates in the air as vapor).

2.3.3 Air Compressors

Air compressors are used in cement industry for raw material pneumatic transporting. Compressors consume a considerable quantities of lube oils for lubricating and cooling purposes, in addition to electricity. The major environmental impacts are noise affecting workers and spent oils.

2.3.4 Laboratories

Laboratories have an important role in the cement industry, as they are responsible for:

- Testing raw materials, chemicals, water, wastewater
- Quality control of the products and comparing the findings with the standard specifications for raw materials and final products
- The measured parameters are physical properties, chemical composition
- Chemicals used for testing could be hazardous. Proper handling and storage are required for compliance with environmental law.

2.3.5 Workshops and Garage

Large facilities have electrical and mechanical workshops for maintenance and repair purposes. Pollution source could be due to:

- Noise
- Rinse water contaminated with lube oil
- Scrap metal

Pollution in the garage area will depend upon the services offered. The presence of a gasoline or diesel station implies fuel storage in underground or over the ground tanks that require leak and spill control plans.
Replacing lube oil implies discharge of spent oil to the sewer lines or selling it to recycling plants.

2.3.6 Storage Facilities

The specifications for the storage facilities depend on the stored material.

- Chemicals are used as additives for the process, for treatment processes.
- These chemicals require special handling, storage and management procedure as required by law.
- Fuel is used for the boilers, for the cars and delivery trucks. It is stored in underground or over ground tanks. The types of fuel usually used are fuel oil (Mazot), gas oil (solar), natural gas and gasoline.
- Scrap metal

2.3.7 Wastewater Treatment Plants

A cement facility discharges wastewater high in Total dissolved solid (TDS), Total suspended solid (TSS), alkalinity, potassium salts and sulfates. The potential pollution sources are:

- Sludge which represents a solid waste problem
- Treated water, which could represent a water pollution problem if containing pollutants that exceed the limits set by relevant environmental laws.

2.3.8 Restaurants, Washrooms and Housing Complex

These facilities will generate domestic wastewater as well as domestic solid waste.

2.3.9 Paper Sacks Plant

This plant produce sacks from kraft paper for cement packaging. This facility will generate solid waste of rejected paper.

Figure (7) Service Units and Their Related Pollution Sources

Inputs	Service Units	Pollution
Fuel + air Water	Boilers Steam	Boiler Blow Down (TDS) Flue Gases
Hot Water	Cooling Towers	Cooling Tower Blowdown (TDS)
Lube oil	Compressors	Spent Oil Noise
Chemicals	Laboratory	Wastewater Hazardous Materials (handling)
Lube Oil Floor and equipment rinse water Cleaning Chemicals	Electrical & Mechanical Workshops	Oily Rinse Water Solid Wastes
Fuel Oil Rinse Water	Garage	Oily rinse water Solid wastes
Raw materials Fuel Chemicals Scrap metal	Storage	Spills Raw material rejects Hazardous material
Wastewater	Wastewater Treatment Units	Treated water Sludge
Water	Restaurant and restrooms	Sanitary Wastewater
Kraft paper	Sacks Plant	Noise Solid waste (rejected paper)

2.4 Emissions, Effluents and Solid Wastes

Table (5) summarize the major polluting processes, their outputs and the polluting parameters.

2.4.1 Air Emissions

Carbon dioxide emissions

There are two different sources of CO_2 during cement production

- Combustion of fossil fuels
- Chemical process of calcining limestone into lime in the cement kiln

The most significant way to reduce CO_2 emissions is improving the energy efficiency of the cement kiln operation. Switching to lower CO_2 fuels such as natural gas can also reduce emissions. Another strategy, which addresses the CO_2 emissions from calcining limestone, is to use waste lime from other industries in the kiln.

Particulate emissions

- Raw materials grinding and handling
- Kiln operations and clinker cooling
- Product grinding, handling and packaging

The source of pollution and their emissions are presented in table (6)

Table (6) Pollution sources and Related emissions

Source	Polluting parameters
Raw materials crushing, grinding and handling	Particulates (dust)
Kiln operation and clinker cooling	Particulates (dust), CO, SO_x, NO_x, hydrocarbons, aldehydes and ketones By-pass dust
Product grinding, handling and packaging	Particulates (dust)

A major source of particulate matter (or dust) at most cement plants is the kiln. Kiln rotation and high velocity flow of combustion gases entrain large quantities of dust .

Table (7) present a total suspended solid measures for a plant at Helwan

Typical Kiln dust constituents compositions of the Egyptian cement industry are shown in table (8).

Flue gases are resulting from fuel consumption used to generate steam for electric power generation. The violating parameters would be: particulate matters, sulfur oxides, nitrogen oxides and carbon monoxide.

Table (5) Wet and dry Processes Pollutants

Major Polluting source	Process Inputs	Process Outputs	Pollution Parameters	Impact
Wet process				
Crushing	Lime stone, silica, clay, shale, gypsum	Crushed raw materials	Dust from raw material	Air pollution
Proportioning and mixing of raw materials & Grinding	Water	Slurry	Noise	Workplace
Homogenizing and blending				
Kiln and Clinker cooler	Fuel Raw meal	Clinker	Water vapor	Workplace
			Filter kiln dust	Air Pollution
			Temp	Workplace
Finish grinding	Clinker Gypsum	Cement	Dust	Air Pollution
			Noise	Workplace
Packaging machine	Cement		Solid waste	
			Cement Dust	Air Pollution
Dry process				
Crushing	Lime stone, silica, clay, shale, gypsum	Crushed raw materials	Dust from raw material	Air Pollution
Proportioning and mixing of raw materials	Crushed raw materials		Dust from raw material	Air Pollution
Grinding	Raw material	Raw meal	Noise	Workplace
			Dust	Workplace
Homogenizing and blending				
Kiln	Fuel Rae meal	Clinker	By-pass kiln dust	Air Pollution
			Temp	Workplace
Clinker cooler	Hot clinker	Clinker		Air pollution
Finish grinding	Clinker Gypsum	Cement	Dust	Air Pollution
			Noise	Workplace
Packaging machine	Cement		Solid waste	Air pollution
Kiln's chimney	Exhaust gases + particulate	Exhaust gases + particulate	Particulate	Air pollution

Table (7) A total suspended solid measures for a plant at Helwan

Survey zone	TSP (mg/m^3) air
Raw mills and preheaters of dry line	21
Cement mills and kiln of the wet line	61

Table (8) Typical kiln dust constituents compositions of the Egyptian cement industry

Constituents	Composition (%)
SiO_2	12-15
Al_2O_3	3-5
Fe_2O_3	2-3
CaO	38-42
MgO	2-3
K_2O	2-4
SO_3	5-7
Cl	4-6
Free lime	13-16

2.4.2 Effluents

Highest levels of water pollution occur when water is allowed to contact collected kiln dusts. Three most significant sources where this contact may occur are:

- The leaching operation (most important) which removes soluble alkalie and recovers solid insoluble portions for reuse, and discharges overflow (leachate) as waste
- Disposal of entire wet dust slurry with no recovery or reuse (slurry is fed to a pond, solid settles and overflow is discharged)
- Aqueous effluents from wet scrubbers are used to wash dusts from kiln gas emissions.

The other sources of pollution in the cement industry are

- Blow down from cooling towers and boilers (high in: TDS and TSS).
- Spent lube oil from garage and workshops if discharged to sewer will give oily wastewater (O&G).
- Domestic wastewater

The expecting polluting parameters are TDS, TSS and heavy metal

2.4.3 Solid waste

Kiln dust, raw materials, clinker and other substances are frequently stored in piles on plant property. Unless sheltered, rainfall may percolate through these piles, dissolve (or leach) soluble matter and carry them with the surface run-off water. From 2000 ton/day clinker 50 ton/day dust is produced. Water polluted in this manner can migrate through the sub-surface layers beneath the material storage piles and contaminate ground water source.

Dust also arises from crushing, mixing, grinding and final grinding before packaging
Other sources of solid wastes are rejected plastic and paper Sacks from packaging process and from the workshops and garage. The wastewater treatment plant also generates sludge.

By-pass kiln dust
This dust is entrained with flue gases in rotary kiln. Part of by-pass cement kiln dust is withdrawn with flue gases through chimney. Appreciable amount is fed to electrostatic precipitator, in which high voltage charges the dust particles. Dust is then collected at the electrode and precipitated. The disposal of cement dust whether inside or outside the company limits causes an air pollution problem due to wind effects. Granulation of cement dust by water reduces this problem.
When the company uses the wet production line, part of by-pass cement kiln dust can be recycled back to the wet production line.

2.4.4 Workplace

Noise	Noise arises from grinding, crushing, sacks plant and packaging operations. Noise may reach 100-110 dB
Heat Stress	The workers are exposed to heat from kilns.

3. Environmental and health impacts of pollutants.

3.1 Impact of air emissions

Particulate matters Recent epidemiological evidence suggests that much of the health damage caused by exposure to particulates is associated with particulate matters smaller than 10µm (PM_{10}). These particles penetrate most deeply into the lungs, causing a large spectrum of illnesses (e.g. asthma attack, cough, and bronchitis). Emissions of particulates include ash, soot and carbon compounds, which are often the result of incomplete combustion. Acid condensate, sulphates and nitrates as well as lead, cadmium, and other metals can also be detected.

Sulfur Oxides Air pollution by sulfur oxides is a major environmental problem. This compound is harmful to plant and animal life, as well as many building materials. Another problem of great concern is acid rain, which is caused by the dissolution of sulfur oxides in atmospheric water droplets to form acidic solutions that can be very damaging when distributed in the form of rain. Acid rain is corrosive to metals, limestone, and other materials.

Nitrogen Oxides Oxides of nitrogen (NO_x) include six known gaseous compounds: nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), nitrogen sesquioxide (N_2O_3), nitrogen tetroxide (N_2O_4), and nitrogen pentoxide (N_2O_5). The two oxides of nitrogen of primary concern in air pollution are nitric oxide (NO) and nitrogen dioxide (NO_2), the only two oxides of nitrogen that are emitted in significant quantities in the atmosphere. Being heavier than air, nitrogen dioxide (NO_2) is readily soluble in water, forming nitric acid and either

nitrous acid or nitric oxide, as indicated in the following equations:

$$2\ NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$$

(Nitrous acid)

$$3\ NO_2 + H_2O \longrightarrow 2\ HNO_3 + NO$$

(Nitric oxide)

Both nitric and nitrous acid will dissolve in the rain or combine with ammonia (NH_3) in the atmosphere to form ammonium nitrate (NH_4NO_3). In this instance, the NO_2 will produce a plant nutrient. A good absorber of energy in the ultraviolet range, NO_2 consequently plays a major role in the production of secondary air contaminants such as ozone (O_3).

Nitric oxide (NO) is emitted to the atmosphere in much larger quantities than NO_2. It is formed in high-temperature combustion processes when atmospheric oxygen and nitrogen combine according to the following reaction:

$N_2 + O_2 \longrightarrow 2\,NO$

Effects of nitrogen oxides on human health

Nitric oxide (NO) is a relatively inert gas and only moderately toxic. Although NO, like CO, can combine with hemoglobin to reduce the oxygen-carrying capacity of the blood, NO concentrations are generally less than 1.22 mg/m^3 (1 ppm) in the ambient air, and are thus not considered health hazards. However, NO is readily oxidized to NO_2, which does have biological significance.

$NO + ½\,O_2 \longrightarrow NO_2$

NO_2 irritates the alveoli of the lungs.

Carbon dioxide Combustion of fossil fuels to produce electricity and heat contribute to the green house effect caused by the formation of carbon dioxide. The greenhouse phenomenon occurs when heat radiation from earth is absorbed by the gases causing a surface temperature increase.

Dust Occupational exposure to cement dust, presents health problems due to its abrasive, hygroscopic and alkaline properties, as well as its content of trace elements, particularly hexavalent chromium, cobalt and nickel. Exposure to air borne cement dust is a hazard in the cement manufacturing plants. Cement workers suffer from upper respiratory tract irritation and eczema, because of the high dust levels in the working areas.

Silicon dioxide There is sufficient evidence for the carcinogenicity of inhaled crystalline silica in the form of quartz. The action of crystalline silica on the lungs results in the production of a diffuse fibrosis in which the parenchyma and the lymphatic system are involved. This fibrosis is, to a certain extent progressive, and may continue to increase for several years after exposure is terminated.. The most common physical sign of silicosis is a limitation of expansion of the chest. There may be a dry cough.

Tricalcium silicate Acute inhalation may cause irritation, wheezing and coughing. Chronic inhalation has been associated with chest tightness, coughing, restrictive lung disease and emphysema.

Prolonged dermal contact with wet cement may cause

	severe second or third degree burns, most commonly on the hand, feet, knees or legs. Bronchitis and emphysema have been reported after many years of exposure to cement manufacturing.
Aluminum oxide	Dry powder may cause marked inflammation or corrosion of the skin & mucous membranes. Industrial exposure to high concentrations of Aluminum containing airborne dusts has resulted in a number of cases of occupational pneumoconiosis. Workers chronically exposed to aluminum containing dusts or fumes have developed severe pulmonary reactions including fibrosis, emphysema and pneumothorax.
Ferric oxide	Workers exposed to iron oxide fume and silica may develop a mixed dust pneumoconiosis.
Kaolin Clay	Occupationally inhaled kaolin produced chronic pulmonary fibrosis sites of action: lung parenchyma, lymph nodes and hilus.
Bentonite clay	The powder may contain large amounts of free silica which can produce pneumoconiosis with chronic inhalation. Chronic inhalation exposure to similar clays, such as fuller's earth, has been shown to cause pneumoconiosis without pathological changes of silicosis. Symptoms usually appear after many years of exposure. Direct eye exposure resulted in severe anterior segment uveitis and retrocorneal abscess in a dental assistant.
Calcium sulfate (Gypsum)	Gypsum dust has an irritant action on mucous membranes of the respiratory tract & eyes & there have been reports of conjunctivitis, chronic rhinitis, laryngitis, pharyngitis, impaired sense of smell & taste, bleeding from the nose, & reactions of tracheal & bronchial membranes in exposed workers.

3.2 Environmental Impact of Effluent

If kiln dustreaches the plant sewer system, a slurry is produced. The slurry may clog the sewer system.

Spent lube oils from garage and workshops could be a cause for concern if discharged into the sewer system, because they tend to coat surfaces causing maintenance problems. Also, if they discharged to surface waters, they can interfere with the aquatic life in these surface waters and create unsightly floating matter and films.

3.3 Environmental Impact of Solid Wastes

Dust arises from crushing, mixing, grinding in addition to by-pass kiln dust collected from electrostatic precipitator in the final grinding stage before packaging. It is worth noting that disposal in dumping area outside the factory of by-pass kiln dust requires addition of fixing agents otherwise dust emissions to air will take place with all its health impacts on surrounding population. The other sources of solid waste are rejected paper and plastic sacks that are collected and sold.

3.4 Environmental Impact on Workplace

In cement factories, noise is generated from grinding and crushing. Constant noise causes an increase in blood pressure and may affect the nervous system. Moreover, it can reduce a person's attention and concentration and cause hearing loss as a result of long period of exposure.

4. Egyptian laws and regulations

There are a number of laws and regulations that address the different environmental violations. The following are the laws applicable to the cement industry.

4.1 Concerning air emissions

Article 40 of Law 4/1994, article 42 of the executive regulations and annex 6 deal with gaseous emissions from combustion of fuel. The statutes relevant to the fuel combustion are:

- The use of fuel oil (mazot) and other heavy oil products, as well crude oil shall be prohibited in dwelling zones.
- The sulfur percentage in fuel used in urban zones and near the dwelling zones shall not exceed 1.5%.
- The design of the burner and fire-house shall allow for complete mixing of fuel with the required amount of air, and for the uniform temperature distribution that ensure complete combustion and minimize gas emissions caused by incomplete combustion..
- Gases containing carbon dioxide shall be emitted through chimneys rising sufficiently high in order that these gases become lighter before reaching the ground surface, or using fuel that contains high proportions of sulfur in power generating stations, as well as in industry and other regions lying away from inhabited urban areas, providing that atmospheric factors and adequate distances to prevent these gases from reaching the dwelling and agricultural zones and regions, as well as the water courses shall be observed.
- Chimneys from which a total emission of wastes reaches 7000 – 15000 kg/hr, shall have heights ranging between 18 – 36 meters.
- Chimneys from which a total emission of gaseous wastes reaches more than 15000 kg/hour, shall have heights exceeding at least two and a half times the height of surrounding buildings, including the building served by the chimney.
- The permissible limits of emissions from sources of fuel combustion in boilers are given in table (9).(ministerial decree no. 495,2001)
- The permissible limits of emissions from Kilns are regulated according to the limits shown in table (10)

Table (9). Maximum limits of emissions from Boilers of fuel combustion

Pollution	Maximum limit, mg/m^3 of exhaust
Sulfur Dioxide.	3400
Carbon Monoxide.	250
Volatized ashes in urban regions.	250
Volatized ashes in remote regions.	500
Smoke.	50

Table (10) Maximum limits of emissions from kilns of fuel combustion

Pollution	Maximum limit, mg/m^3 of exhaust	
	Existing	**New**
Sulfur Dioxide.	4000	2500
Carbon Monoxide.	4000	2500
Ashes in urban regions.	250	250
Ashes in remote regions.	500	500
Smoke.	250	250

Annex 6 of law 4/1994 states that the emission of total particulate at concentrations higher than the permissible limit is considered an air pollution. Tables 11,12 present the permissible limits for dust in ambient air and workplace respectively.

Table (11) Total particulate matter

Kind of activity	Maximum limit for emissions mg/m^3 in exhaust
Cement industry	500 existing
	200 new

Table (12) Limits for nuisance causing dusts

Limits for total dusts	10 mg/m^3
Limits for inhalable dusts	5 mg/m^3

4.2 Concerning Effluents

Limits for pollutants in wastewater vary depending on the type of receiving water body. The parameters that should be monitored and/or inspected are TSS, TDS

Table (13) presents the permissible limits for discharges to the different recipients (sea, Nile, canals, agricultural drains, public sewer) according to the different relevant laws.

Spent lube oil has a negative impact on water and soil and therefore its disposal should be monitored/inspected. A record should be kept for this purpose.

4.3 Concerning Solid Waste

A number of laws address solid waste management. The following laws apply to solid waste and sludge from the WWTP:

- Law 38/1967 which addresses public cleanliness, regulates the collection and disposal of solid wastes from houses, public places, commercial and industrial establishments.

Table (13) Egyptian Environmental Legal Requirements for Industrial Wastewater

Parameter (mg/1 unless otherwise noted)	Law 4/94: Discharge Coastal Environment	Law 93/62 Discharge to Sewer System (as modified by Decree 44/2000)	Law 48/82: Discharge into:			
			Underground Reservoir & Nile Branches/Canals	Nile (Main Stream)	Drains	
pH (Grease)	6-9	6-9.5	6-9	6-9	80	100
Oil & Grease	15	<100	5	5	6-9	6-9
Temperature (deg.)	10C>avg. temp of receiving body	<43	35	35	10	10
Total Suspended Solids	60	<800	30	30	35	35
Settable Solids	—	<10	—	20	50	50
Total Dissolved Solids	2000	—	800	1200	—	—

- Ministry of Housing, Utilities and Urban Communities (MHUUC) decree No. 134 of 1968, which provides guidelines from domestic and industrial sources, including specifications for collection, transportation, composting, incineration and land disposal.
- Law 31/1976, which amended law 38/1967
- Law 43/1979, the Law of Local administration, which provided that city councils are responsible for "physical and social infrastructure", effectively delegating responsibility for infrastructure functions.
- Law 4/1994 regulates incineration of solid waste

4.4 Concerning Work Environment

Violations of work environment could be encountered:

- In the boiler house: gas emissions, regulated by article 43 of Law 4/1994, article 45 of the executive regulations and annex 8.
- Wherever heating is performed: temperature and humidity are regulated by article 44 of Law 4/1994, article 46 of the executive regulations and annex 9.
- Near heavy machinery: noise is regulated by article 42 of Law 4/1994, article 44 of the executive regulations and table 1, annex 7.
- Ventilation is regulated by article 45 of Law 4/1994 and article 47 of the executive regulations.
- Smoking is regulated by article 46 of Law 4/1994 and article 48 of the executive regulations, and Law 52/1981.
- Work environment conditions are addressed in Law 137/1981 for Labor, Minister of Housing Decree 380/1983, Minister of Industry Decree 380/1982

The limits for the relevant pollutants are presented in Table 14:

Table (14) Permissible limits as time average and for short periods

Material	Limits			
	Time average		Exposure limits for short periods	
	ppm	mg/m^3	ppm	mg/m^3
Carbon dioxide	5000	9000	15000	27000
Carbon monoxide	50	55	400	440
Sulfur dioxide	2	5	5	10

4.5 Concerning Hazardous Material and Waste

Law 4/1994 introduced the control of hazardous materials and wastes. The hazardous chemicals used in the lab and the fuel for the boilers, fall under the provisions of Law 4/1994. Articles 29 and 33 of the law makes it mandatory for those who produce or handle dangerous materials in gaseous, liquid or solid form, to take precautions to ensure that no environmental damage shall occur. Articles 25, 31 and 32 of the executive regulations (decree 338/1995) specify the necessary precautions for handling hazardous materials. Storing of fuel for the boilers is covered by the Law 4 as hazardous material.

4.6 The Environmental Register

Article 22 of Law 4/1994 states that the owner of the establishment shall keep a register showing the impact of the establishment activity on the environment. Article 17 and Annex 3 of the executive regulations specify the type of data recorded in the register.

5. Pollution abatement measures

This section deals with pollution abatement in the three media air, water and soil. Three types of interventions will be considered:

- In-plant modifications, which are changes that are performed in the plant to reduce pollutant concentrations in streams through recovery of materials, segregation and/or integration of streams, reducing the flow rate of the wastewater streams that need further treatment to reduce the hold-up of the required WWTP.
- In-Process modifications, which are changes performed on the process such as the introduction of newer technology, substitution of a hazardous raw material, performing process optimization and control.
- End-of-pipe (EoP) measures, which involve treatment of the pollutant or its separation for further disposal. Whereas in-plant and in-process modifications usually have an economic return on investment, end-of-pipe measures will be performed for the sole purpose of compliance with the laws without economic

Egyptian Environmental Laws do not require water and energy conservation measures. These measures have been considered in this manual since resource depletion and hence conservation is a worldwide-recognized environmental issue that could be implemented in Egypt in the near future. Water conservation measures can lead to higher concentrations of pollutants in the effluent streams. Both energy and water conservation measures will provide both financial and economic benefits.

The term Cleaner Production (CP) refers to the same concepts of pollution reduction through in-process, in-plant and resource conservation, in contradistinction to end-of-pipe treatment. In many cases, the adoption of CP can eliminate the need for (EoP) treatment.

The following CP and EoP measures have been identified for the cement industry.

5.1 Air pollution

Flue gases

Particulate matter in flue (exhaust) gases are due to ash and heavy metal content of the fuel, low combustion temperature, low excess oxygen level, high flow rate of flue gases. *Sulfur dioxide* is due to the sulfur content of the fuel. *Nitrogen oxides* are formed when maximum combustion temperature and high excess oxygen. *Carbon monoxide* is formed when incomplete combustion occurs at low air to fuel ratio.

The following measures can be adopted to minimize air pollution from flue (exhaust) gases:

- Replace Mazot by solar or natural gas. Mazot is high in sulfur content.
- Regulate the fuel to air ratio for an optimum excess air that ensures complete combustion of carbon monoxide to dioxide.
- Keep the combustion temperature at a moderate value to minimize particulate matter and nitrogen oxides.

Dust

Kiln operation is the major source of dust and gaseous pollutants due to poor quality of raw material. Larger dust particles can be removed by cyclones or other mechanical devices. Small dust particules can be removed by bag filters, electrostatic precipitators, or wet scrubbers. Figures 8,9 show the baghouse filter and electrostatic precipitators respectively.

Dust-Source Reduction

One approach to pollution prevention in the cement industry is to minimize the production of cement kiln dust. There are three primary means to decrease the amount of dust generated by the kiln. Dust can be minimized by reducing gas turbulence in the kiln and avoiding excessive flow velocities. In wet process the use of chains near the cool end of the kiln can also minimize dust by trapping the dust before it is released in the kiln exhaust. Most wet process kilns are already equipped with such cool-end chain sections.

Dust-Recycling and Reuse

Cement kiln dust generated from the baghouse dust collectors can be reused both on-site and off-site. Direct return of dust to the kiln is a common recycling practice. The dust may be returned to the hot end, to the middle of the kiln, or to the feed material. However, cement kiln dust can only be reused if contaminant concentrations fall within specified limits, because clinker quality can be affected by the presence of certain constituents. Alkali metals, such as lithium, sodium and potassium are of primary concern. The raw materials used to produce clinker and the kiln fuel influence the chemical composition of the dust generated and thus may affect recycling rates.

Cement kiln dust can be utilized beneficially in a variety of ways. It can be used as adsorbent, as a neutralizing agent for acidic wastewater stream; as a soil stabilizer; and as an ingredient in various agricultural and construction products.

The best practices for air pollution control are summarized in table (15). The main techniques used are described below.

Table (15) Best Practices in Air Pollution Control

Air Pollution Control	
Capture of kiln dust	▪ Electrostatic precipitator ▪ Baghouse filter ▪ Cyclone ▪ Nodulizer system
Capture of dust from clinker cooler	▪ Granular bed filter ▪ Electrostatic precipitator ▪ Baghouse filter
Control dust from other operations	▪ Cover or enclose conveyors, crushers, material transfer points, storage areas ▪ Install mechanical dust collectors and/or baghouse filters where needed ▪ Pave plant road ▪ Vacuum sweepers for plant roads ▪ Sprinklers for plant roads and storage piles ▪ Latex stabilizing sprays for storage piles

Electrostatic precipitator (ESPs) : Electrostatic precipitators use high voltage to charge particles in a gas stream. The electrically charged particles are attracted to an oppositely charged plate where they are collected.

Baghouse filter: Baghouse or fabric filtration relies upon a finely woven fabric to separate particles from the air stream as the air passes through the fabric. The design of a baghouse is generally dependent upon the air-to-cloth ratio.

The overall costs of the two systems are similar. The choice of system will depend on flue gas characteristics and local considerations.

Both ESPs and baghouses can achieve high levels of particulate removal from the kiln gas stream, but good operation and maintenance are essential for achieving design specifications. Two significant types of control problem can occur:

a) Complete failure (or automatic shutoff) of systems related to plant shutdown and start-up power failures, leading to the emission of very high levels of particulates for short periods of time

b) A gradual decrease in the removal efficiency of the system over time because of poor maintenance or improper operation.

Wet scrubbing: Wet scrubbing uses water particles to capture particulate matter in the gas stream. The efficiency of a wet scrubber is generally dependent upon the pressure drop.

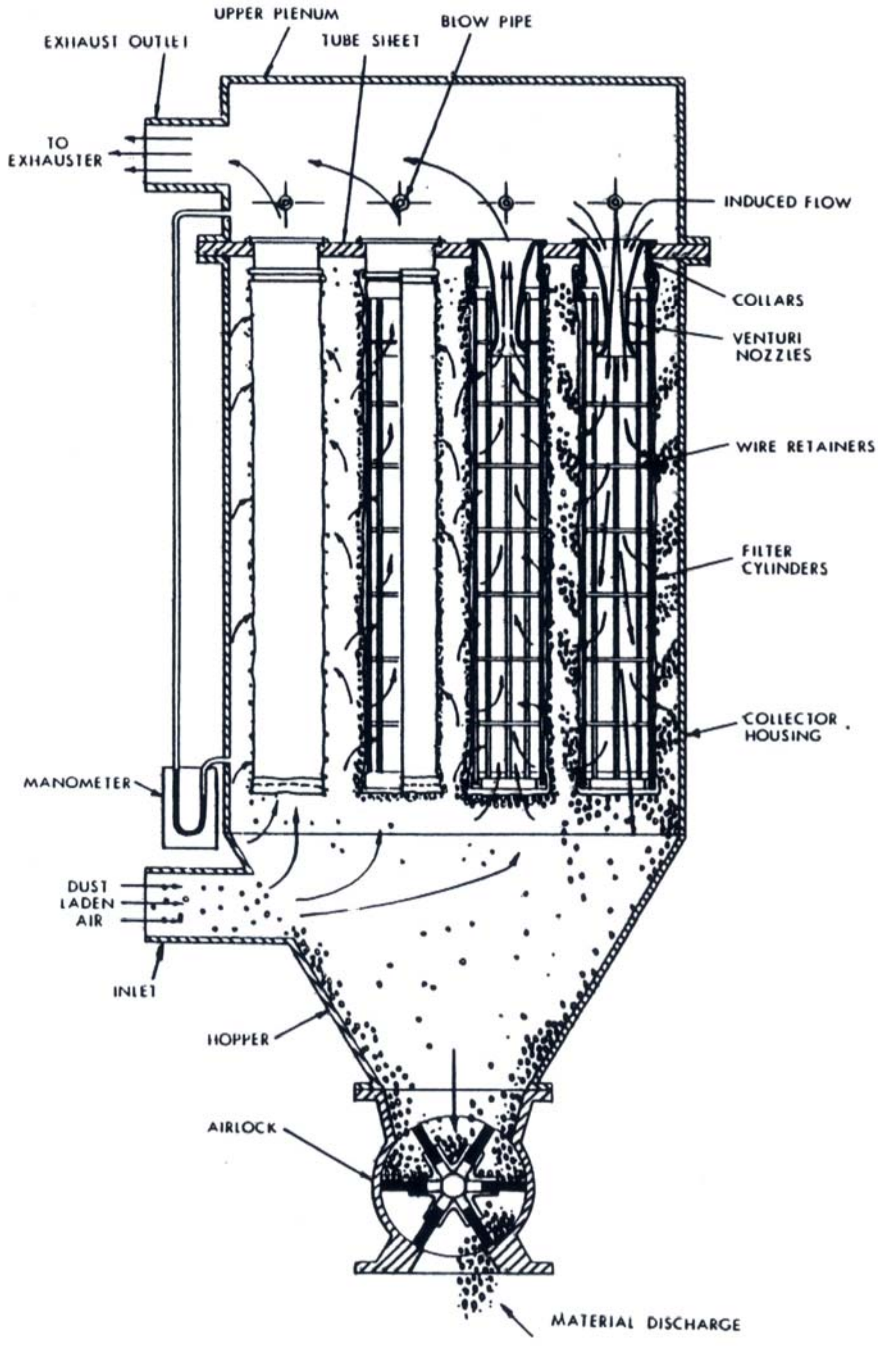


Fig (8) Baghouse Filter

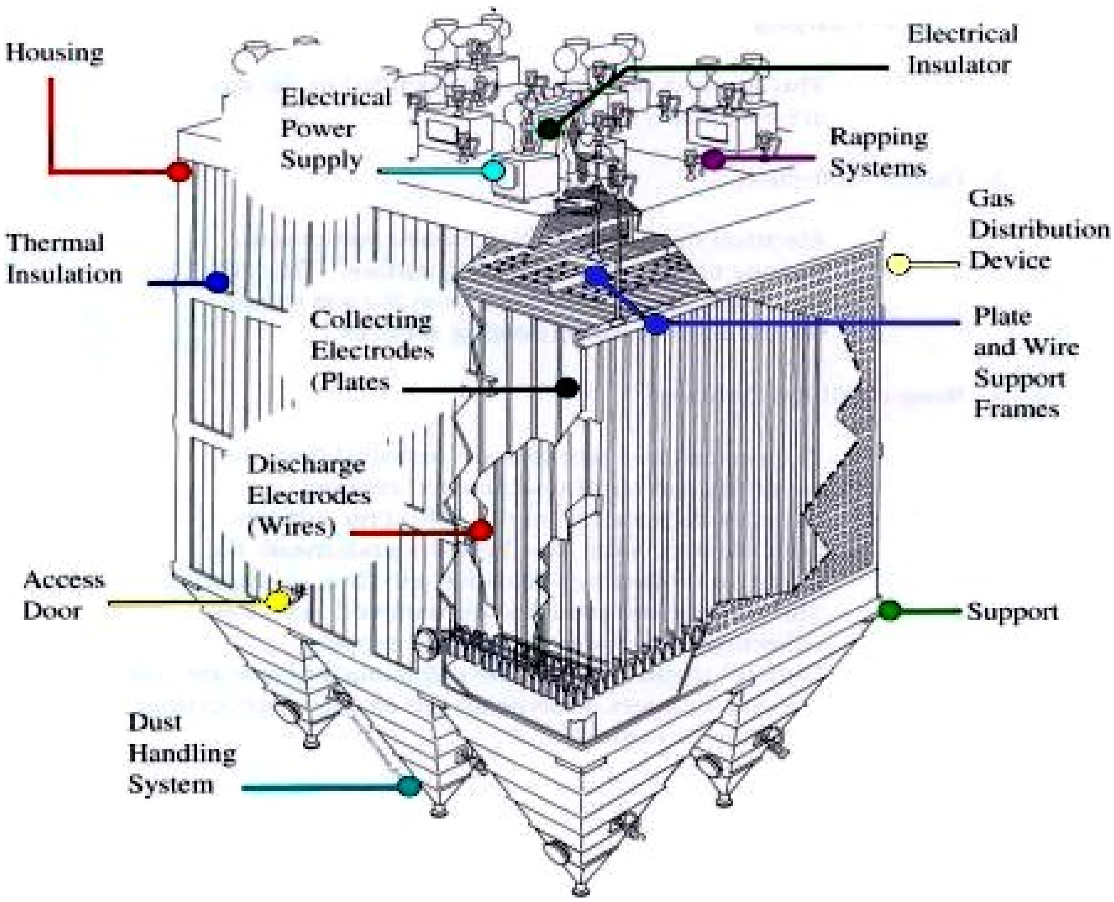


Fig (9) Electrostatic Precipitator

5.2 Water pollution abatement measures

In-plant modifications

The cement manufacturing process also generates wastewater from the cooling of process equipment and from the recovery of cement kiln dust through wet scrubbing of kiln stack emissions. The pollutants contained in raw wastewater are principally dissolved solids (potassium and sodium hydroxide, chlorides, and sulfates), suspended solids (calcium carbonate), and wasteheat. The main control and treatment methods for wastewater involve recycling and reusing wastewater. The devices employed include cooling towers or ponds, settling ponds, containment ponds, and clarifiers. Cooling towers or ponds are used to reduce the temperature of water used in cooling process equipment. Settling ponds are used to reduce the concentration of suspended solids. Containment ponds are used to dispose of waste kiln dust. Clarifiers are used to separate solids.

- Recycling wet process waste water to the kiln
- Cooling towers and ponds
- Runoff control from waste or raw material piles by diking
- Infiltration control from waste or raw material piles by lining
- Integration and segregation of sewer lines to minimize treatment needs and ensure compliance with the environmental laws, can be an option for many factories. In some cases where there are several discharge points from the factory, mixing of the streams could lead to compliance. In other cases where treatment is imperative some streams could be segregated and discharged without violation. The remaining streams will require a smaller treatment unit.

End-of-pipe treatment

Because of the typically high TSS and TDS in the cement industry waste-streams, end-of-pipe treatment is frequently required

5.3 Abatement measures for solid waste pollution

Plastic/Paper bags

Rejected plastic/Paper bags are collected and sold.

Sludge

Effluent treatment processes generate solids, that should be dried and dumped in waste disposal sites.

5.4 Water and Energy Conservation

Water and sewer service costs have been rising, and these increases can cut into profits. Using water more efficiently can help counter these increases.

Water Conservation

- Install water meters and monitor water use
- Use automatic shut-off nozzles and mark hand-operated valves so that open, close and directed-flow positions are easily identified.
- Recycle cooling water through cooling towers.
- Minimize spills on the floor minimizes floor washing.
- Repair leaks.
- Handle solid waste dry.
- Recycle steam condensate whenever economically viable.

Heat energy conservation measures

- Waste heat boilers are used to conserve heat and are particularly economical for dry process cement.
- In order to obtain greater heat economy, part of the water is removed from wet process slurry. Techniques used employ slurry filters and Dorr thickeners.
- Insulation of steam lines.
- Installation of steam traps.
- Repair or replace steam valves.
- Maximize boiler efficiency.
- Install pressure regulators on steam lines.

Table (16) presents the various energy conservation techniques.

Power energy conservation

- Improve power factor
- Optimum of grinding media in mills

Table (16) The energy conservation technique in the cement industry

	Raw material process	Clinker burning process	Finish process
First step	1) selection of raw material 2) management of fineness 3) management of optimum grinding media	1) prevention of stop due to failure 2) selection of fuel 3) prevention of leak	1) management of fineness 2) management of optimum grinding media
Second step	1) use of industrial waste material (fly ash) 2) replacement of fan rotor 3) improving of temperature and pressure control system 4) improving of mixing and homogenizing system	1) recovery of preheater exhaust gas 2) recovery of cooler exhaust gas (drying of raw material and generation of electricity) 3) replacement of dust collector from multi-cyclone to E.P	1) installation of closed circuit (dynamic separator) 2) installation of feed control system
Third step	1) From wet to dry process 2) From ball and tube mills to roller mill	1) from wet process to dry process 2) conversion of fuel 3) use of industrial waste (slag) 4) from planetary and under coolers to grate cooler	

6. Industrial inspection

The inspection of the cement industry will follow the procedures described in the General Inspection Manual (GIM, EPAP 2002). This chapter presents a summary of the inspection process regarding the purpose and scope of various types of inspection, and the proposed inspection procedure for the Cement Industry.

The overall purpose of inspections is to enforce environmental laws. Table 17 lists the various types of inspections and the objectives that have to be fulfilled for each type.

Table (17) The different types of inspections and their objectives

Inspection type	**Objectives**
Site Inspection	
1. Comprehensive	Evaluate compliance status regarding all aspects of Law 4
2. Specific	Evaluate compliance status regarding some aspects of Law 4 Review special conditions set by EEAA in EIA studies. Investigate complaints
3. Follow-up	Check environmental register and implementation of compliance measures
Inspection campaign	
1. Geographic	Check pollution sources to specific receiving media
2. Sector specific	Check aspects relevant to specific sector

As evident from the above table, comprehensive inspection deals with all aspects of environmental laws and therefore is considered in this manual. Other inspection types can be tailored accordingly.

Developing an inspection strategy and quarterly and/or monthly plans are the responsibility of the inspectorate management. Developing site-specific inspection plans for carrying out the scope of work that fulfills inspection objectives is the responsibility of the inspection team. Planning for inspections is presented in more detail in the General Inspection Manual, GIM (EPAP-2002).

7. Inspection Planning at the Inspectorate Level

The responsibilities of the inspectorate management regarding the specific inspection are to state clearly, in writing, the type of inspection and related objectives as well as the time schedule necessary to carry out inspection. The inspectorate management is also responsible for providing preliminary information about the facility, inspection tools, and logistics.

7.1 Activities Characteristic to the Cement Industry

Taking the comprehensive inspection as an example, the objectives stated in Table 17 dictate the activities required for covering all aspects of compliance with environmental laws and regulations. The required personnel, equipment and logistics are determined accordingly.

The inspectorate management should have a clear idea about how to proceed with inspection of this type of facilities. The main problem in this industry are:

- The dust generated from grinding, crushing, kiln flue gases and by-pass cement dust from electrostatic precipitator
- The solid waste generated from packaging (paper/plastic sacks) and piles of dust.

7.2 Providing Information about the Facility

Chapters (2-7) present the technical aspects regarding the cement industry, its pollution sources and relevant environmental laws. Information regarding compliance history related to other inspecting parties (irrigation inspectors, occupational health inspectors, etc.) can be helpful in anticipating potential violations and preparing necessary equipment

7.3 Providing Resources

The required personnel, tools and equipment depend on the size of the facility to be inspected. The inspection team leaders, in coordination with the inspectorate management, are responsible for assessing the inspection needs. The number of inspectors required depends on the size of the facility and the planned activities.

Usually the team members are split and assigned different tasks during the field visit to allow the required activities to be performed in parallel. Each task is rotated among the inspectors to diversify their experience.

8. Preparation for Field Inspection (Inspection Team)

As presented in the General Inspection Manual, GIM (EPAP-2002), tasks necessary for preparation for field inspection, are:

- Gathering information about the specific facility to be inspected
- Preparing of the inspection plan
- Preparing the checklists

This manual presents the case of a comprehensive multi-media site-inspection of a large cement facility since it represents the highest level of inspection complexity. Tasks for carrying out less complicated inspections can be easily deduced.

8.1 Gathering and Reviewing Information

The inspection team should review the general information prepared for the cement industry (chapters 2-5) and then check - if possible - what production lines and service units are present at the targeted facility. In addition to the required information listed in Annex (a) of the General Inspection Manual, GIM (EPAP-2002), it is important at this stage to determine the following:

- The type of receiving body for the industrial wastewater and review relevant Egyptian laws (Chapter 4).
- The scope of inspection and related activities based on the type and objectives of inspection required by the inspectorate management.
- The potential pollution hazards as addressed in section 2.4, and accordingly, define measurement and analyses needs.

Note to inspector:

- *Some facilities dilute its polluted wastewater with water before discharging to sewer. Degree 44/2000 explicitly prohibits this behavior.*

8.2 Preparation of the Inspection Plan

An example of an inspection plan is included in Annex (b) of the General Inspection Manual (EPAP-2002). The plan should take into account the following:

- For large cement facilities, the inspection team could be divided into smaller groups. Each group will be responsible for inspecting a number of production lines and service units.
- At the beginning of the field visit, the inspection team should check the environmental register for completeness using the checklist provided in Annex (g) of the General Inspection Manual, GIM (EPAP-2002).
- The results of the analyses included in the environmental register should be checked at the end of the field visit (if suspicion arises about them) and copies of these results should be obtained.

Notes to inspector:

- *When the final effluent is expected to be in violation of environmental laws, sampling should be planned.*
- *Make sure that the polluting production lines are in operation since some factory management resort to halting the polluting lines during the inspection.*

8.3 Preparation of the Required Checklists

The checklist for the cement industry is presented in Annex 1 of this manual. The checklist has been prepared in such a way that it starts with general information about the facility and its operation. Separate checklists are then filled for each production line/service unit independently for relevant environmental aspects and media. The inspection team will compile the checklists relevant to existing production lines and service units in the targeted facility.

The development of the checklists goes through the following steps:

- Draw the block flow diagrams for the production lines with their pollution sources as presented in figures 1 and 4.
- Identify the areas of possible non-compliance and the parameters that need checking. For example, noise should be checked near the compressors and paper sacks plant. Temperature and humidity where steam leaks occur and near the kilns.
- Identify what to observe, ask and/or estimate that can convey information about pollutants. For example :
  - the type of detergent or antiseptic determines the contaminant in the wash streams,
  - Oily effluents from production lines or oily cooling water indicates the contamination of the plant effluent with oil

Note to inspector:

*Law 4 does not specify standards for effluent from production lines but only for final disposal points. However, effluent quality from production lines is an important indicator of the final discharge quality***.**

8.4 Legal aspects

As evident from chapter 2, a large cement facility is expected to be in violation of several environmental laws, specifically with respect to air if no abatement is applied. The inspection team should be prepared for legally establishing such a violation.

> *Note to inspector:*
>
> *It is the responsibility of the inspector to assess the seriousness of the violation upon which the enforcement action will be based. His information about the nature and cause of the violation must be well documented and the evidence sound. The case could be contested in court and the inspector will be asked to defend his technical judgement.*

9. Performing the field inspection

9.1 Starting the field visit

The General Inspection Manual, GIM (EPAP, 2002) describes the procedures involved for entering an industrial facility. The inspector's attitude and behavior are very important from the start and will dictate the factory's personnel response to the inspection tasks.

> *Note to inspector:*
>
> - *It is better at this stage not to ask direct questions on cement dust emission. Interviewing the workers on-site in an indirect manner can give better results.*
> - *Check the results of dust analyses, time and place of sampling. If suspicious,make your own analyses.*
> - *Get a sketch of the factory layout with sewer lines and final disposal points.*

9.2 Proceeding with the field visit

Information gathered during the facility tour is dependent on interviews of facility personnel and visual observation. Annex (D) in the Guidelines for Inspection Team (EPAP, 2002) presents some useful interviewing techniques.
Using the facility layout, start by checking the final disposal points and the various plants and/or service units connected to each point. This will determine where and how to take the effluent samples. Visual observations about the condition of the sewer manholes should be recorded. In some facilities the discharge to the receiving body is performed through a bayyara (cesspit), septic tanks or holding tanks. If the holding tank is not properly lined, contamination of the underground water could occur.

> *Note to inspectors:*
>
> *Cesspits, septic tanks and holding tanks are a form of pre-treatment that generates settled sludge. Check:*
>
> - *The presence of accumulated sludge and related hygienic conditions*
> - *The disposal of the sludge*

Inspection of the production lines should start with the feeding of raw materials and end with the product packaging and storage.

Production Lines

Wet Process production line	- Check for noise from grinding and crushing ? - What happen to the solid waste produced? - Check for heat stress from the kiln? - Check for the wastewater characteristics from the unit (color, clarification ,..etc) - Check for humidity in the workplace ? - Are there analyses for dust in workplace ? - Check the disposal of by-pass kiln dust - Check if the conveyor used for material transportation after grinding are covered - Check the disposal of by-pass kiln dust - Check the using of equipment to control dust emission - Check the emission from chimney
Dry Process production line	- Check for noise from grinding and crushing - What happen to solid waste produced ? - Check for the heat stress from the kiln ? - Check for the ventilation system in the workplace ? - Check for dust emission in workplace ? - Check the disposal of by-pass kiln dust - Check if the conveyor used for material transportation after grinding are covered - Check the disposal of by-pass kiln dust - Check the using of equipment to control dust emission - Check the emission from chimney
For all lines	- Check for losses during packaging. - Check for noise near packaging - How is solid waste managed? - Check for noise in paper sacks plant - Check for noise near the turbines

Service Units

Water treatment units	- If chemicals and coagulants are used, such as lime, alum and ferric sulfate, inorganic sludge will be generated. Check the amount and method of disposal. - In case of ion-exchange units and reverse osmosis the effluent wastewater will be high in dissolved solids.
Boilers	- Check the height of the chimney in relation to surrounding buildings. - Perform flue gas analysis if mazot is used as fuel or if suspicious about results of analysis presented by facility management in the opening meeting. - Check for fuel storage regulations and spill prevention.
Cooling towers	- The amount of blowdown from the cooling towers is about 10-15% of the make-up water and is low in BOD and high in TDS.
Garage, and Workshops	- Check for noise and take measurements if necessary. - Check solid waste handling and disposal practices. - Check for spent lube oil disposal method. Ask for receipt if resold.
Storage facilities	- Check storage of hazardous materials and fuel as per Law 4. - Check spill prevention and containment measures for storage of liquids.
WWTP	- Check for sludge accumulation and disposal. - Analyze the treated wastewater.

Effluent analysis

Receiving body	- The nature of the receiving body determines the applicable laws. - Check if effluent discharge is to public sewer, canals and Nile branches, agricultural drains, sea or main River Nile. - Accordingly, define applicable laws, relevant parameters and their limits.
Sampling	- A composite sample must be taken from each final disposal point over the duration of the shift or a grab sample at peak discharge. Each sample will be analyzed independently. - According to legal procedures in Egypt, the effluent sample is spilt and one of them is sealed and kept untouched.

9.3 Ending the field visit

When violations are detected a legal report is prepared stating information pertaining to sampling location and time. Violations of work environment regulations should also state location and time of measurements. Other visual violations such as solid waste accumulation, hazardous material and waste handling and storage, and material spills should be photographed and documented. It is preferable that the facility management signs the field-inspection report but this is not a necessary procedure.
A closing meeting with the facility management can be held to discuss findings and observations.

> *Note to inspector:*
> - *The less certain the team leader is about a specific violation the more reason not to discuss it at the closing meeting.*

10. Conclusion of the Field Inspection

The activities performed during the site inspection are essential for preparation of the inspection report, for assessing the seriousness of the violations, for pursuing a criminal or civil suit against the facility, for presenting the legal case and making it stand in court without being contested, and for further follow-up of the compliance status of the facility.

10.1 Preparing the inspection report

An example of an inspection report is included in Annex (F) of the Guidelines for Inspection Team (EPAP, 2002). The inspection report presents the findings, conclusions, recommendations and supporting information in an organized manner. It provides the inspectorate management with the basis for proposing enforcement measures and follow-up activities.

10.2 Supporting the enforcement case

Many issues may be raised and disputed in typical enforcement actions. Enforcement officials should always be prepared to:

- Prove that a violation has occurred. The inspector must provide information that can be used as evidence in a court of law.
- Establish that the procedures were fairly followed.
- Demonstrate the environmental and health effect of the violating parameter.

> *Note to inspectorate management:*
> - *Although the inspector is not required to suggest pollution abatement measures, the inspectorate management should be able to demonstrate that a remedy for the violation is available.*

10.3 Following-up compliance status of violating facility

After performing the comprehensive inspection and detecting the violations the inspectorate management should:

- Decide on the sanctions and send the legal report to the judicial authority.
- Plan routine follow-up inspections. This type of inspection focuses on the violating source and its related pollution abatement measure. Self-monitoring results are reviewed during the visit.
- Follow-up the enforcement case (legal department)

Annex (1)

Inspection Checklist for Cement Production Facility

Annex (1- A)

Basic Data Sheet

(To be fed to the database of the inspection units)

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Date of visit:…………………………………. Visit number:………………………….

Facility name:……………………………………

Commercial name:……………………………………………………………………….

Licensed Activity:………………………………... Days off:………………………

Legal status:…………………………………………………………………………….

Address of facility

Area of facility:………………………………… Governorate:………………………….

City:…………………………………………… Zone:……………………………….

Phone no. :………………………………… Fax no.:……………………………….

………………………………... ………………………………….

Year of operation :……………………………….. Postal code:……………………………

The Facility Representative:…………………………………………………………..

Environmental management representative:………………………………………………….

Chairman/Owner:………………………………………………………………………………

Address of Administration

e-mail:……………………………………………..

Phone no. :………………………………… Fax no.:……………………………….

………………………………... ………………………………….

The industrial sector:………………………………………………………

No. of male employees: …………………… No. of female employees:…………………

Do they work in production …………………………….

Total no. of employees: ………………………….

Number of shifts/day:…………………………shifts/day

Duration of shift:……………………….…hrs/shift

Environmental register:………………………….. Hazardous waste register:…………….

EIA:…………………………………………….. Self monitoring:……………………….

Nature of Surrounding Environment

Industrial ❑ Coastal ❑ Coastal/ Residential ❑

Industrial/ Residential ❑ Residential ❑ Agricultural ❑

Agricultural/ Industrial ❑ Agricultural/ Residential ❑ Desert ❑

<u>Power Consumption</u>

Electricity ❑ Fuel ❑

Electric power: ……………...kWh/(day-month-year)

Type of fuel	Fuel consumption	
Mazot	………………………	Ton/(day-month-year)
Solar	………………………	Ton/(day-month-year)
Natural gas	………………………	Ton/(day-month-year)
Butagas	………………………	Ton/(day-month-year)
Other ….	………………………	Ton/(day-month-year)

The GPS (Global Positioning System) reading for Gaseous Emissions

1- LAT(Latitude):..……. LONG(Longitude):…….
2- LAT(Latitude):……… LONG(Longitude):…….
3- LAT(Latitude):……… LONG(Longitude):…….

Production

Product	**Quantity/ (day-month-year)**
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………
……………………………………………	……………………………………………

Water Supply

Artesian well ❑ Municipal water ❑ Treated water ❑ Nile water ❑

Canal water ❑ Other………….. ❑

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Water Consumption

Amount of water consumed in operation (day-month-year):

Process ……..m^3/ Boilers…………………..m^3/

Domestic usage………....m^3/ Cooling………………....m^3/

Other…….. …………….m^3 /

Total amount of water consumed (day-month-year)……… …………..m^3/

Type of waste water:
Industrial ❑ Domestic ❑ Mixed ❑

Wastewater Treatment:
Treated ❑ Untreated ❑

Type of Treatment:
Septic tanks ❑ pH adjustment ❑ Biological treatment ❑
Chemical treatment ❑ Tertiary treatment ❑

Amount of treated water/ (day-month-year)……………..m^3 /
Amount of waste water/(day-month-year)……………………….m^3 /

Final wastewater receiving body:
Nile ❑ Lakes (fresh water) ❑ Drain ❑
Groundwater ❑ Public sewer system ❑ Canals❑
Agricultural Land ❑ Desert Land ❑ Other………………………❑

The Global Positioning System(GPS) reading for final disposal
1-LAT(Latitude):……. LONG(Longitude):…….
2-LAT(Latitude):……. LONG(Longitude):…….

Engineering Drawings for the Facility
Gaseous emissions map Yes ❑ No ❑

Sewer map: Domestic ❑
Industrial ❑
Mixed ❑
Factory Layout ❑
Production process flow diagram ❑

Raw material consumption

No.	Trade name	Scientific name	CAS no.	UN no.	Physical state	Type of container	Amount	Classification	
								Hazardous	Non-Hazardous

Inspection Team Member:

Team member	**Position**

Date: Inspector signature:

Annex (1- B)

Inspection Checklist for Production Lines and Service Units

Checklist for Cooling Towers

1.General	
1.1 Number and capacity of cooling towers	-- -- --
1.2 Cooling tower make-up rate Note : Blow down = 10-15% of make-up	Rate -- Blowdown --
3. Status of the Effluent	
3.1 Cooling water are used	☐ Open Cycle ☐ Closed Cycle
Note : If performed in open cycle it will dilute the final effluent	

Checklist for Wastewater Treatment

1. General	
1.1 What is the capacity of WWTP	--
1.2 Specify the units included in WWTP :	
Screens	☐ Found ☐ Not found
Pumping station	☐ Found ☐ Not found
Equalization tank	☐ Found ☐ Not found
Mixing tank	☐ Found ☐ Not found
Flocculation tank	☐ Found ☐ Not found
Clarifier	☐ Found ☐ Not found
Sludge thickening tank	☐ Found ☐ Not found
Sludge drying	☐ Found ☐ Not found
Others	--
1.3 List any chemical and their quantity used for wastewater treatment	-- -- -- -- --
2. Status of Effluent	
2.1 Are there analyses for the effluent <u>If not</u> Make your own	☐ Yes ☐ No
2.2 Are the results of the analysis included in the environmental register	☐ Yes ☐ No
3. Status of Solid Waste	
3.1 Determine the sludge disposal method	--
If a third party is involved in disposal, get documents for proof	☐ Found ☐ Not found <u>Comment</u> -- --

Checklist for Garage

1. General	
1.2 Is there any detergent or solvent used for washing equipment parts, trucks, floor,….etc?	☐ Yes ☐ No
1.3 What is the amount of oil and grease used per day?	--
1.4 What is the amount of spent lube oil generated per day?	--
1.5 How does the facility dispose of the spent oil?	--
2. Status of the Effluent	
2.1 What is the amount of wastewater generated?	--
2.2 Do you observe any oil / foams / solid matter in the inspection manhole?	☐ Yes ☐ No

Checklist for Workshops

1. Status for the Effluent	
1.1 What is the amount of wastewater genertaed?	--
1.2 What is your visual observation for the inspection manhole of the workshop?	--
2. Status of solid waste	
2.1 What is the amount of solid waste generated?	--
2.2 How does the facility get rid of the solid waste generated?	--
3. Status Of the Work Environment	
3.1 Are there any noise in work place If yes 3.2 Are there any measurements for noise 3.3 Check the exposure time If not Perform measurements	☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ---

Check list for Laboratories

1. General	
1.1 What is the amount of wastewater generated?	--
1.2 List the chemicals and materials used in the laboratories	-- -- --
2. Status of the work Environment	
2.1 Are there any odor/ gases/ noise in the work environment	☐ Yes ☐ No --
3. Handling of Hazardous Material	
3.1 Inspect storage and handling of hazardous material. Is it in compliance with the requirements of law 4/1994	☐ Yes ☐ No
3.2 Are there any first aid measures in place?	☐ Yes ☐ No

Checklist for Boilers and Water Treatment Units

1. General	
1.1 Boiler number and capacity	------------------------------------ ------------------------------------ ------------------------------------ ------------------------------------
1.2 Type of fuel used for boilers In case of using mazot for boilers Is it a dwelling zone Note :	☐ Mazot ☐ Solar ☐ Natural gas ☐ Yes ☐ No
Note : The use of mazot as fuel in the dwelling zone is Prohibited by law.	
1.3 What is the method used for water treatment	☐ Lime method ☐ Ion exchange ☐ Reverse osmosis
2. Status of Air Pollution	
2.1 What is the height of the chimney	--
Note : the height of the chimney must be 2.5 times the height of adjacent buildings.	
2.2 If mazot is used in non dwelling regions, or smoke is detected	Are there analyses of the flue gases for sulfur dioxide, carbon monoxide, and particulate matter ☐ Yes ☐ No <u>If Yes</u> Are they enclosed in the environmental register ☐ Yes ☐ No <u>If No</u> Ask for preparation of these records and their inclusion in the environmental register
Note : Perform analysis, if necessary	
3. Status of Effluent	
3.1 What is the blow down rate from the boilers	------------------------------------ m^3/d
3.2 What is the back wash rates for the water units	------------------------------------ m^3/d
3.3 Steam condensate is	☐ Recycled to the boiler ☐ Discharged to sewer

4. Status of Solid Waste	
4.1 If the lime method is used, sludge is generated. What is the amount of sludge produced per day	-------------------------------------
4.2 What is the sludge disposal method	-------------------------------------
5. Storage and Handling of Hazardous Material	
5.1 Check the storage of chemicals used in the treatment process(hydrazine). Is it in compliance with law 4 ?	☐ Yes ☐ No
5.2 Is there any fuel leaks from fuel tanks	☐ Yes ☐ No
5.3 Is there any fire extinguishing devices and equipment	☐ Yes ☐ No
5.4 Is there a spill prevention plan	☐ Yes ☐ No
5.5 Do you notice anything that can provoke a fire? Such as the presence of a pump underneath the fuel tank (the start-up of the engine can produce a spark)	☐ Yes ☐ No Comment -- -- --
6. Status of Work Environment	
6.1 Check the noise next to the boilers	---
6.2 Check the heat stress next to the boilers	---
6.3 Are there any existed measurements? Are they included in the environmental register?	Yes ❑ No ❑ Yes ❑ No ❑

Checklist for Cement (Dry Process) Production Line

1. General	
1.1 The housekeeping status Floor condition Piling of solid waste	 -- --
1.2 Make sure the all units of the production line are operated	--
1.3 Type of operation	☐ Batch ☐ Continuous
1.4 Amount of raw material processed per day and per shift	-- -- --
2. Status of the Work Environment	
2.1 Are there noise in the workplace	☐ Yes ☐ No
2.2 What are the source of noise	☐ grinding ☐ crushing ☐ others Comment -- --
2.3 How long does the employee exposed to noise ?	-- --
2.4 Does the worker wear the hearing protection tools?	-- --
2.5 Does the facility have noise measurements	-- --
2.6 Do you feel with heat stress and humidity from the kiln?	☐ Yes ☐ No
2.7 Does the facility have heat stress and humidity measurements	☐ Yes ☐ No
2.8 Is there a ventilation system in place ? **<u>If Yes</u>** Is the ventilation system operating?	☐ Yes ☐ No ☐ Yes ☐ No
Note : If suspicious, measure noise and/or heat	
3. Status of Effluents (Wastewater)	
3.1 Are there any wastewater produced from the dry process ?	-- --
3.2 What is the amount ?	--

4. Status of Ambient Air	
4.1 Are there an air pollution control	☐ Yes ☐ No
4.2 The control system used for	☐ kiln ☐ Clinker cooler ☐ Other operation
4.3 What are the system used to capture dust from kiln?	☐ Electrostatic precipitator ☐ Baghouse filter ☐ Other operation **Comment** -- --
4.3 What are the system used to capture dust from clinker cooler?	☐ Electrostatic precipitator ☐ Baghouse filter ☐ Granular bed filter ☐ Other operation **Comment** -- --
4.3 What are the system used to capture dust from other operation?	☐ Cover or enclose conveyors, crushers, storage area ☐ Install mechanical dust collectors and/or baghouse filter ☐ Others **Comment** -- --
5. Solid Waste	
5.1 What type of solid waste is produced	--------------------------------------- --------------------------------------- --
5.2 What are the amount of each type ?	--------------------------------------- --------------------------------------- --

Checklist for Cement (Wet Process) Production Line

1. General	
1.5 The housekeeping status Floor condition Piling of solid waste	 -- --
1.6 Make sure the all units of the production line are operated	--
1.3 Type of operation	☐ Batch ☐ Continuous
1.4 Amount of raw material processed per day and per shift	-- -- --
2. Status of the Work Environment	
2.1 Are there noise in the workplace	☐ Yes ☐ No
2.2 What are the source of noise	☐ grinding ☐ crushing ☐ others Comment -- --
2.3 How long does the employee exposed to noise ?	-- --
2.4 Does the worker wear the hearing protection tools?	-- --
2.5 Does the facility have noise measurements	-- --
2.6 Do you feel with heat stress and humidity from the kiln?	☐ Yes ☐ No
2.7 Does the facility have heat stress and humidity measurements	☐ Yes ☐ No
2.8 Is there a ventilation system in place ? **<u>If Yes</u>** Is the ventilation system operating?	☐ Yes ☐ No ☐ Yes ☐ No
Note : If suspicious, measure noise and/or heat	
3. Status of Effluents (Wastewater)	
3.1 What is the amount of wastewater produced from the wet process?	-- --
3.2 Is it dumped into the sewer or recycled to the kiln?	--

4. Solid Waste	
4.1 What type of solid waste is produced	-- -- ---
4.2 What are the amount of each type ?	-- -- ---

Checklist for Boilers and Water Treatment Units

1. General	
1.1 Number of boilers and capacity	-- --
1.2 What is the method used for water treatment?	❑ Lime ❑ Ion exchange ❑ Reverse osmosis
2. Status of Air Pollution	
2.1 What is the height of the stack of each boiler	Boiler (--)--------------------------- Boiler (--)--------------------------- Boiler (--)---------------------------
***Note**: the height of the stack must be 2.5 times the height of adjacent buildings.*	
2.2 Type of fuel used for boilers	❑ Mazout ❑ Solar ❑ Natural gas ❑ Other…….
2.3 In case of using mazot for boilers, is the surrounding area residential?	❑ Yes ❑ No
***Note**: The use of mazot as fuel in the residential area is Prohibited by law.*	
2.4 If mazot is used in non residential area, are there analysis of the flue gases for sulfur dioxide, carbon monoxide, and particulate matter	❑ Yes ❑ No
2.5 If Yes Check the compliance of the analysis readings in the register with your observations	-- -- --
***Note** : Whatever the fuel used ,if you notice any smoke, take a sample for analysis*	
3. Status of Work Environment	
3.1 Check the heat stress next to the boilers	---
3.2 Check the noise next to the boilers and duration of exposure	-- ---
3.3 Are they included in the environmental register?	❑ Yes ❑ No
***Note** : In case of suspicious perform your own measurements*	
4. Status of Effluent	
4.1 What is the blow down rate from the boilers?	--- m^3/d
4.2 What are the blow down and back wash rates for the treatment units?	--- m^3/d --- m^3/d
4.3 Steam condensate is	❑ Recycled to the boilers ❑ Discharged to sewer
5. Status of solid waste	
5.1 If lime method is used, sludge is generated, what is the amount of sludge produced per day?	--- ---
5.2 What is the sludge disposal method?	---
6. Status of Hazardous Material	
6.1 Check the storage method of chemicals used in the treatment process. Is it in compliance with law 4?	-- --- ❑ Yes ❑ No
6.2 Is there any fuel leaks from fuel tanks	❑ Yes ❑ No
6.3 Is there any fire extinguishing devices and fire fighting measures?	❑ Yes ❑ No
6.4 Is there a spill prevention plan?	❑ Yes ❑ No
6.5 Do you notice anything that can provoke a fire? Such as the presence of a pump underneath the fuel tank (the start-up of the engine can produce a spark)	❑ Yes ❑ No Comment --- ---

Checklist for Cooling Towers

1.General	
1.1 Number and capacity of cooling towers	--- --- ---
1.2 Cooling tower make-up rate Note : Blow-down = 10-15% of make-up	Rate --- Blow-down --
2. Status of Effluent	
2.1 Cooling water for the compressors is performed in	❑ Open Cycle ❑ Closed Cycle
Note : • *Cooling towers are used in an open cycle for cooling the effluent stream to the tempreture limit regulated by law 4/1994* • *If performed in open cycle it will dilute the final effluent*	
2.2 Record the amount of open cycle cooling	---

Checklist for Garage

1. General	
1.1 Are detergents or solvents used for washing equipment, trucks, floor,….etc?	❑ Yes ❑ No
1.2 What is the amount of oil and grease used per day?	--- ---
1.3 What is the amount of spent lube oil per day ?	---
1.4 How does the facility dispose the spent oil ?	---
2. Status of Effluent	
2.1 What is the amount of wastewater generated ?	---
2.2 Do you observe any oil / foams / solid matter in the inspection manhole?	❑ Yes ❑ No

Checklist for Laboratories

1. General	
1.1 What is the amount of eflluents generated per day?	---
1.2 Check the disposal method of eflluents	---
1.3 List the chemicals used in the laboratories	---
2. Status of Work Environment	
2.1 Are there any odor/ gases/ noise in the work environment? 2.2 Check the exposure time	❑ Yes ❑ No ---
3. Status of Hazardous Material	
3.1 Check storage of hazardous material. Is it in compliance with the requirements of law 4/1994?	❑ Yes ❑ No
3.2 Are there any first aid measures in place?	❑ Yes ❑ No

Inspection Checklist for Wastewater Treatment Plant

1. General	
1.1 What is the capacity of WWTP?	--
1.2 Specify the units included in WWTP : Pumping station Equalization tank Aeration tank Sedimentation tank Sludge thickening tank Sludge drying Others	 ❑ Found ❑ Not found ❑ Found ❑ Not found ❑ Found ❑ Not found ❑ Found ❑ Not found ❑ Found ❑ Not found ❑ Found ❑ Not found --
1.3 List any chemical and its quantity used for wastewater treatment (coagulants,…..)	-- --
2. Status of Effluent	
2.1 Are there analysis readings for the effluent? If not make your own	❑ Yes ❑ No
2.2 Are the analysis readings included in the environmental register?	❑ Yes ❑ No
3. Status of Solid Wastes	
3.1 Determine the sludge disposal	--
Note : *Sludge can be use in liquid or dry form in agricultural purposes,according to the Ministrial decree 214/97 issued by the Ministry of Housing*	
3.2 If a third party is involved in disposal, check the presence of contracts and receipts	❑ Found ❑ Not found Comment -- --

Inspection Checklist for Compressors

1. General	
1.1 Number of compressors	--------------------------
1.2 Type of compressors (air, ammonia or gases)	--------------------------
2. Status of Effluents	
2.1 Identify the type of the used lube oils.	--------------------------
2.2 Check the disposal method of used lube oils	--------------------------
2.3 Check the documents confirming selling of lube oils in the environmental register.	--------------------------
2.4 What is the amount of spent cooling water discharged from the compressors?	--------------------------
2.5 Identify the disposal point of this wastewater.	--------------------------
3. Status of Work Environment	
3.1 Do you notice high noise levels beside the compressors?	--------------------------
3.2 Are noise measurements in the environmental register consistent with observations? If suspicious perform your own measurements	❑ Yes ❑ No
3.3 Do you notice any ammonia leaks at the ammonia compressors?	❑ Yes ❑ No
3.4 Check the analysis results in the environmental register.	
Check the emergency procedures concerning the ammonia compressor.	

Checklist for Mechanical Workshops (Maintenance)

1. Status of Effluent	
1.1 What is the amount of wastewater generated?	--
1.2 What is your visual observation for the inspection manhole of the workshop?	--
2. Status of Solid Wastes	
2.1 What is the amount of solid waste generated and its type?	--
2.2 How does the facility get rid of the solid wastes generated?	--
3. Status of Work Environment	
3.1 Are there any noise in work place	❑ Yes ❑ No
If yes 3.2 Are there any measurements for noise 3.3 Check the exposure time	❑ Yes ❑ No --
If not Perform measurements	