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جامعة المرقب

العدد الثاني والعشرون

يناير 2023م

ضوابط النشر:

يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :

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-ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .

-يرفق بالبحث تزكية لغوية وفق أنموذج معد .

-تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .

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-يخضع البحث في النشر لأولويات المجلة وسياستها .

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Air Pollution From The Cement Industry in AlKhums City:A Case Study in LEBDA Cement Plant

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Abstract: The cement industry is a strategic industry because it is directly related to construction and reconstruction. Cement is used as a hydraulic bonding material from mortar or concrete components. Cement factories are usually established near the quarries of the clay and limestone in order to reduce the cost of transporting raw materials. Contaminants produced by cement plants differ in terms of components and quantity, depending on the different operating processes from one plant to another, hygiene procedures and other factors. This study scrutinizes the environmental impact due to cement production process in Libya. A case study of Lebda Cement Plant revealed that the production adopted the dry process, which includes supply of raw materials, clinker burning and grinding process..This study investigates the quantities of emissions from the cement industry, including the quantities of gases out of the chimneys and also the amounts of dust. This study also discusses the noise generated by the cement industry from its stages and its impact on workers.

One of the most important sources of particulate emissions grinding and transport of raw materials, run the rotary kiln and cool the clinker and grinding, transport and packaging of products. The rotary kiln is one of the most important sources of particulate matter (dust), which causes the furnace to spin and flow speed combustion gases cause a large amount of dust. Dust in the rotary kiln causes a few problems such as the accumulations and loops in the cyclones, the feeder of the rotary kiln and the calcinations zone may cause the furnace to stop working for several days and alkaline evaporation consumes a large amount of energy. Noise is produced by crushing and milling of raw materials, and filling processes. This study found that the amounts of dust exceeded national and international standards allowed, as well as a clear increase in the proportions and quantity of gases emitted from the chimneys, it was also found that the noise intensity in the cement manufacturing stages according to the working period affects the workers so they should not exceed the allowed time according to the noise intensity. These emissions are not only deteriorating air quality but also degrading human health. Emissions have local and global environment impact resulting in global warming, ozone depletion, acid rain, biodiversity loss, reduced crop productivity etc.

Key Words: Cement Manufacturing,, Lebda Plant, Air Pollution, Dust, Noise.

1. INTRODUCTION

The cement industry contributes significantly to the imbalances of the environment; in particular air quality. The key environmental emissions are nitrogen oxides (NOx), sulphur dioxide (SO_2) and grey dust. Industrial plant smokestacks from cement and construction companies are some of the biggest contributors to poor air quality, especially in urban developments. As of 2007, the cement industry alone was reported to produce 5% of total greenhouse gasses in the atmosphere. The principal aim in pollution control in the cement industry is to minimize the increase in ambient particulate levels by reducing the mass load emitted from the stacks, from fugitive emissions, and from other sources.

2. Cement Manufacturing Process.

The main component of cement is clinker, which is produced from raw materials, such as limestone and clay. Limestone supplies $CaCO_3$ for the cement production. Silica, alumina, and iron are considered to be other raw materials. The limestone used for cement manufacturing contains 75-90 % of $CaCO_3$ and remainder is $MgCO_3$ and impurities. Raw material is extracted through mining and quarrying which follows drilling, blasting, excavating, handling, loading, hauling, crushing, screening, stockpiling, and storing. A specific composition of the raw materials are crushed and then milled into a raw meal for the quality and uniformity of cement. This raw meal is blended in blending silos and is then heated in the pre-heating system. This process dissociates carbonate to calcium oxide and carbon dioxide. It can be accomplished by any of three processes: the dry process, the wet process, or the semidry process. In a dry cement manufacturing process, dry raw mix contains less than 20% moisture by mass. However, in a wet process water is added to the raw mix to form slurry and then is transported to the kiln. Raw meal or blended raw materials are fed into the upper end of the pre-heater tower and then passed through the end of the rotary Kiln. A rotary kiln is a tube with a diameter up to about 6 m. which is installed at a horizontal angle of 3^o–4^o and rotates slowly with about one to four RPM. The Kiln rotates and the ground raw material moves down toward the flame. As the temperature increases, the sequence of chemical and physical changes starts with reaction taking place between calcium oxide and other elements. This reaction will produce calcium silicates and aluminates at about 1500^oC. The flame can be produced by fuel materials such as coal, petroleum coke, or by natural gas, oil, biomass, industrial waste and recycled materials. A series of chemical reactions will take place and the raw material will be melted and fused together to form a clinker. The clinker is discharged as red-hot at approximately 1500^oC from the end of the kiln, which is passed through coolers, where the excess heat is recovered. Most commonly cooling of the clinker can be performed in a grate cooler, a tube (rotary) cooler, or a planetary cooler. It recovers up to 30% of kiln system heat and route it back to the pre-heater units. In the final step, clinker is ground together with additives (e.g., fly ash, blast furnace slag, pozzolana, gypsum, and anhydrite) in a cement mill to control the properties of the cement. Combinations of milling techniques including ball mills, roller mills, or roller presses are often applied to ground

clinker with additives in cement mill. The finished cement is being transferred via bucket elevators and conveyors to silo for storage. Figure 1 illustrates the steps of cement manufacturing.

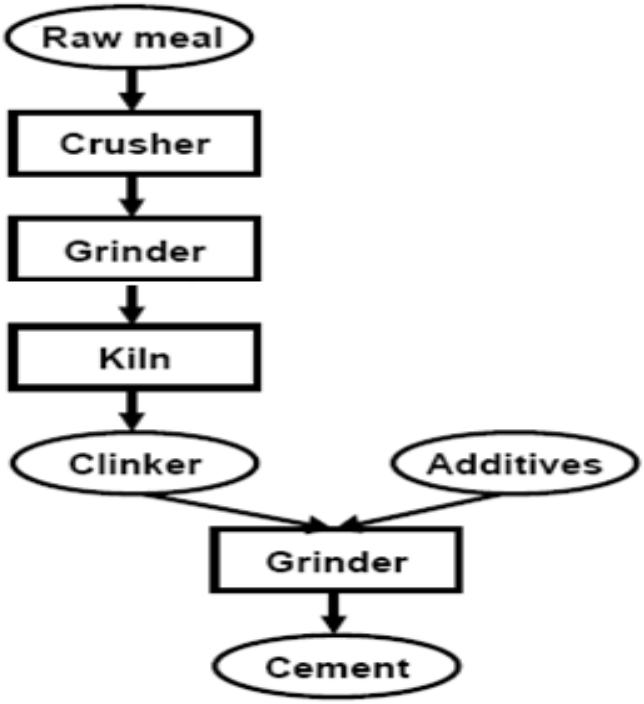

Figure 1: Cement Manufacturing Process

2.1 Emissions From Cement Manufacturing

The most significant environment health and safety issue of cement manufacturing is emission. Cement industry is potential anthropogenic source of air pollution. It has estimated that cement production originates about 5% of global manmade CO_2 emissions. The typical gaseous emissions to air from cement production include NOx, SOx, CO, CO_2, H_2S, VOCs, dioxins, furans and particulate matters. These major pollutants can be classified in two categories- gaseous and particulates. Fuel combustion process is the source of gaseous emissions which include oxides of nitrogen, oxides of sulfur, oxides of carbon and volatile organic compounds and hydrogen sulfide. Quarrying, drilling, blasting, hauling, Cement mill, fuel preparation, packaging, road cleaning and stacks are sources of particulate matter in the form of dust and carbon particle. Table 1 shows the major sources of the main Emissions of the cement manufacturing. There are many other sources of emissions from cement manufacturing, such as emissions from transportation equipment used in the mining and transporting raw and finished material, fuel used for electricity production for operating other process in cement manufacturing. Types of fuel used in cement industries for few selected countries.

Table 1: Major sources of the main Emissions of the cement manufacturing

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Source	Emissions
Cracking, grinding and handling of raw materials.	Solid particles.
Rotary kiln operation and cooling clinker.	Solid particles, CO, NOx, SOx, Hydrocarbons, Aldehydes, ketones, Dust.
Grinding, handling and packaging products.	Solid particles.

3. MATERIALS AND METHODS

3.1 Area of Study

Lebda cement plant is located in the market area of Souq AlKhamees/Al Khums and 27 km from the center of Al-Khums city. The plant produces ordinary Portland cement according to Libyan standards. The factory consists of one production line with a design capacity of one million tons annually.

3.2. Data of Emission Sources

The amount of dust coming out of the flue, the analysis of the emitted gases and the noise values from the Lebda cement plant as found in this paper were obtained.

4. RESULTS AND DISCUSSIONS.

4.1 Gases Emitted From Chimneys.

The gases emitted from the smokestacks of the cement plant are in the form of dense white clouds. Dust is the main element causing these clouds. These very soft soils contain chlorides, sulphates, alkali and lime. They are dangerous in terms of health and environment. These products are called BY PASS, This is due to the pollution of the air inside the cement factories and the environment surrounding the factory. The dust caused by the cement industry, which is called " BY PASS ", is one of the most dangerous sources of pollution of the environment. Because of the accuracy of the granules of this dust, The Banner can be carried easily, and publish it on large areas of the surrounding areas and cement plants when people inhaled lead to respiratory and lung diseases, Cement dust can contaminate drinking water by spreading and leaking dust to the sea, rivers and waterways.The dust caused by the cement industry leads to a decrease in the length of tree growth, number of leaves, weight and area, where dust settles on the foliage, destroys gaps and obstructs the gas exchange process, forming a soft layer which causes the leaves to fall off and dry the plants. Actually graduated from production, in addition to low productivity of plants and soil. The device used to measure the amount of dust through the chimneys is shown in Figure 2.

The concentrations of dust released through the plant chimneys As shown in the table 2, such concentrations exceed the national and international permitted standards by 50-100

mg/m3, in addition to the dust from the furnaces and grinding of the raw materials. Transient emission sources and misuse practices that lead to dust release in the laboratory environment and surrounding environment. The value of dust emitted through the flue is indicated in the table 2.

Table 2: Dust emitted through chimneys.

Position	Value (mg/m^3)
Preheater Chimney	100
Raw Mill Chimney	169
Gravel Filter Chimney	728
Cement Mill Chimney	66

The quantity and proportions of gases are measured using the gas analyzer through the preheating chimney and the chimney filter as shown in Tables 3 and 4 respectively.

Table 3: Measurement of gases emitted through the preheater chimney

Gas	SO_2 ppm	NO_X ppm	CO_2 %	CO ppm	O_2 %
Value	0.4	0	0.7	350	20.1

Table 4: Measurement of gases emitted through the gravel filter chimney

Gas	SO_2 ppm	NO_X ppm	CO_2 %	CO Ppm	O_2 %
Value	0	0	0	0	19.9

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Figure 2**:** The device used to measure the amount of dust through the chimneys.

4.2Noise.

Noise emissions occur throughout the whole cement manufacturing process from preparing and processing raw materials, from the clinker burning and cement production process, from material storage as well as from the dispatch and shipping of the final products.

The device used to measure noise intensity is shown in Figure 3.The heavy machinery and large fans used in various parts of the cement manufacturing process can give rise to noise and/or vibration emissions, particularly from:

- chutes and hoppers;
- any operations involving fracture, crushing, milling and screening of raw material, fuels, clinker and cement;
- exhaust fans;
- blowers;
- duct vibration.

Plants are required to comply with reduction standards in compliance with national legislation, and noise surveys are being conducted and evaluated. Natural noise barriers, such as office buildings, walls, trees or bushes are used in the cement industry to reduce noise emissions. Table 4 shows the intensity of noise at some cement plant sites.

Table 4: Measurement of noise intensity at some cement plant sites.

Position	Noise intensity (dB)
Cracking of raw materials	74 – 110
Raw Mill	67 – 93
Preheater	77 – 105
Rotary Kiln	87 – 104
Cement Mills	90 – 108

Figure 3: The device used to measure noise intensity**.**

5. CONCLUSIONS

From the present study, the following conclusions are obtained:

1. Cement industry plays an important role in air pollution.
2. The amounts of dust exceeded national and international standards allowed, as well as a clear increase in the proportions and quantity of gases emitted from the chimneys.

3. The noise intensity in the cement manufacturing stages according to the working period affects the workers so they should not exceed the allowed time according to the noise intensity.
4. Emissions from cement industries based on their process which require replacement of old strategies to new emerging strategies/technologies but not with degradation of environment.

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