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A Review

Initiatives for Environmental Protection in Technological Processes of Cement Production. A Case Study: Holcim S.A.

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Abstract

The technological processes of cement production involve a significant consumption of thermal and electrical energy, but also emissions of dust and greenhouse gases. This sector of industry is responsible for 8% of global carbon emissions, more than all trucks in the world. The latest technologies in the field of cement production, which use a lower percentage of clinker, have reduced emissions, despite the cement worldwide demand increases. In this context, this research addresses a topical issue in the field of cement production, aiming at the analysis and synthesis of technological processes in cement production. The Holcim company (Romania), analyzed by us, is the first producer of cement, concrete and aggregates which implemented in Romania the concept of ecological concrete production. The results of our study can serve as a pattern for sustainable practices in the cement production sector.

Keywords: cement, technological processes, polluting emissions, sustainable development.

1. Introduction

The activities carried out by people to meet their daily needs inevitably have effects on the environment. These effects can be harmful to the natural environment, effects that involve social costs that are borne in varying proportions by different sectors of society, affecting their activity in the future [3]. Increasing the volume of greenhouse gases and, consequently, increasing the temperature of the environment are two factors of paramount importance in affecting life forms on planet Earth [1, 4]. Cement production is one of the major technological processes consuming heat, so fossil fuels for its production.

Decarbonation of limestone, one of the important processes in the technological flow, produces a significant volume of CO_2 that is released into the atmosphere [7].

In the cement industry, manufacturing processes also involve significant energy consumption, but also emissions of dust and greenhouse gases.

Both the combustion of fuels used in the production process and the clinker formation process involve CO_2 - greenhouse gas emissions. According to specialized studies, a ton of cement generates at least half a ton of CO_2.

It is even more than the pollution that a car produces over a distance of over 2 thousand kilometers, and a single concrete mixer can transport up to 13 tons of cement. Hundreds and even thousands of tons of concrete can enter the construction of an ordinary office building.

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In 2015, CO_2 emissions from the clinker manufacturing process contributed about 4% of total global emissions, and emissions from fuel combustion in the cement production process reached about the same level, so that, in total, they accounted for about 8% of global CO_2 emissions [6].

Forecasts estimate that cement production will increase by up to 23% by 2050, so the adoption of more environmentally friendly technologies is imperative.

Rehabilitation and modernization of cement production systems could significantly contribute to reducing greenhouse gas emissions. In this context, the analysis and synthesis of technological processes for cement production could provide a correct assessment of the level of emissions in this sector of activity and would allow the development of clear, timely and effective strategies for the adoption of the best technologies for environmental protection.

The purpose of this study is to analyze the technological process of cement production, at the level of the company Holcim (Romania) SA.

The company profile

In order to fulfill the proposed goal, we analyzed the technological process of cement production, at the level of the company Holcim (Romania) SA. The applied research methodology includes a bibliographic study on the importance of the cement production sector, the current situation of cement production and marketing worldwide and in Romania as well as aspects related to the impact of the cement industry on the environment. In order to analyze the technological process of cement production, at the level of the company Holcim (Romania) SA, we had several meetings with representatives of the company during which we received all the information necessary to carry out this study [2]. Holcim Romania is part of the Holcim Group [9] and currently owns two cement plants in Câmpulung and Aleşd, a network of 18 ecological concrete stations, two special binder stations and five aggregate stations (Fig. 1).

Figure 1. The location of different work points of Holcim in Romania [8]

The analyzed location is located on the territory of Tetchea and Astileu communes, south of the Lugas - Cris accumulation and has as activity profile the manufacture of cement, material and energetic recovery of waste by co-processing in the manufacture of cement, as well as limestone extraction at Quarry Subpiatra and extraction de marna la Cariera Hotar. The total area is: 513,000 sqm. The cement production achieved in 2019 is 1277294 tons [8, 9]. Cement factory located in Chistag village, str. Viilorului, no. 2, Astileu commune, Bihor county.

3. Consideration concering environmental problms connected with technological processes

In order to carry out the activity of cement production, material and energetic recovery of waste by co-processing in the manufacture of cement includes [2, 9]:

- furnace for the manufacture of cement clinker;
- waste co-processing installations by feeding the cold head and the hot head of the furnace;
- flue gas decoration installation and pneumatic transport of dust;
- installation for the recovery of thermal energy from flue gases with electricity production;
- hall prehomogenization of raw materials;
- hall for grinding cement clinker and additives;
- cement sealing and shipping installations;
- warehouses for raw materials, finished products, waste collected, thermal power plants, maintenance workshops, mechano-electric, laboratories, administrative pavilion.

The general technological flow that applies to the manufacture of cement consists in the following main phases [2, 9]: extraction and preparation of raw materials, transport and homogenization of raw materials, flour preparation, clinker production and storage, cement production, cement storage, bagging and delivery.

Holcim is the first producer of cement, concrete and aggregates to implement in Romania the concept of ecological concrete station. The implementation of the best available techniques in the cement industry in Holcim's cement plants ensures permanent emission control through the continuous monitoring system for clinker kilns, process automation, periodic installation and replacement of modern dust filters, investment in reduction installations. non-catalytic selective NOx emissions and in low NOx burners, conservation of natural resources by partial substitution of traditional fuels and raw materials with some alternatives from waste (co-processing of waste in the cement manufacturing process). New composite cements developed and marketed in recent years have a higher percentage of mineral additives. They contribute to the reduction of greenhouse gas emissions and energy consumption, thus conserving natural resources [2, 9].

Holcim Romania offers environmental services to waste generators by co-processing them, transforming them into alternative fuels and raw materials for the cement manufacturing process. The environmental services are offered in partnership with the company Ecovalor, which ensures the direct connection with the waste generators, specialized consultancy, as well as the collection, the transport [9].

Since starting its activity in Romania, Holcim Romania has invested over 27 million euros in projects to protect the environment. The main environmental investments made were [2, 9]:

• high-performance dust filters for the main production installations: clinker furnaces, clinker coolers, raw material and cement mills;

• high-performance dust filters for auxiliary installations: silos, slag dryers, crushers;

• improvement of the wastewater treatment system by installing a modern domestic wastewater treatment plant and arranging the sludge platform from the pre-treatment plant;

• equipment for continuous monitoring of emissions at the baskets of clinker furnaces;

• purchase of low NOx burners;

• career rehabilitation;

• opening a new clay quarry in Câmpulung, in order to reduce SO2 emissions

• closure and rehabilitation of the industrial waste dump belonging to the Cement Aleşd factory;

• closing the raw material storage platforms at Ciment Aleşd and Ciment Câmpulung in order to reduce fugitive emissions from the premises;

• rehabilitation of the clinker transport installation and the dust removal system at Cement Aleşd;

• retaining walls for fuel oil tanks at Cement Aleşd;

• high energy efficiency separator and state-of-the-art filter at Cement Aleşd;

• environmental projects included in the Muscel Project (for the modernization of the clinker manufacturing line at Cement Câmpulung) such as filters with bags for dusting technological flow: transport of raw materials, flour mill, transport of oven flour, barbecue cooler and transport, clinker storage and SNCR 2].

The efficient use of natural resources is an important objective of Holcim (Romania) SA and is achieved by co-processing waste in cement plants, reducing the clinker factor (clinker / cement ratio used in the manufacturing process), increasing energy efficiency, use intensive, in the process of preparation of raw materials, of previously stored materials in the form of waste from the exploitation of limestone quarries [2]. Since 2004, a system for the selective collection of internally generated waste has been introduced in all Holcim Romania locations, in order to optimize their management and improve the possibilities for recycling and energy recovery of waste. Specific training and education and

motivation campaigns for their employees in order to implement proper waste management take place periodically [2, 9].

4. Conclusions

The Holcim Group is one of the most important companies in the industry producing cement and aggregates (crushed stone, sand and gravel), as well as concrete, asphalt and related services, worldwide. The ash resulting from the combustion process is removed by the local sanitation company. Holcim is the first producer of cement, concrete and aggregates to implement in Romania the concept of ecological concrete station. The implementation of the best available techniques in the cement industry in Holcim's cement plants ensures permanent emission control through the continuous monitoring system for clinker kilns, process automation, periodic installation and replacement of modern dust filters, investment in reduction installations. non-catalytic selective NOx emissions and in low NOx burners, conservation of natural resources by partial substitution of traditional fuels and raw materials with some alternatives from waste (co-processing of waste in the cement manufacturing process). Holcim Romania offers environmental services to waste generators by co-processing them, transforming them into alternative fuels and raw materials for the cement manufacturing process. The environmental services are offered in partnership with the company Ecovalor, which ensures the direct connection with the waste generators, specialized consultancy, as well as the collection, the transport. The results obtained following the analysis of the technological processes of cement production at the level of the Aleșd Cement Factory (Holcim Romania) can be a model of sustainable practices for the cement production sector.

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