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ENVIRONMENTAL IMPACT ASSESSMENT FOR PROMOTING CLEANER PRODUCTION: QUALITATIVE PROCESS ANALYSIS IN CEMENT PLANTS

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ABSTRACT

The concept of cleaner production is known as a technological preventative process. The process of cleaner production analyzes every process, every information that is relevant, as well as every procedure and decision that are taken based on other processes. This concept has been proposed by the Indonesian government in every strategic industry, including the cement industry. Environmental Impact Assessment (EIA) applications in Indonesia is believed to be able to enhance promoting a cleaner production. This study analyzes specific qualitative data on the cement industry as an initial illustration in the implementation of EIA to support the achievement of environmentally friendly industries. Regarded as some of the most essential environmental protection processes, EIA and Cleaner Production ought to be optimally strengthened. One of the assessments in EIA can be used with life cycle analysis (LCA). LCA focuses on the environmental facets and possible effects on the environment, such as the utilization of resources and the outcome of releases on the environment. It is carried out in every part of the life cycle of products, starting from the process to acquire the raw material, production, utilization, end-of-life treatment, recycling, to final disposal.

KEYWORDS: Environmental Impact Assessment, Promoting cleaner production, Cement Production

INTRODUCTION

Cement production does not only produces the expected product, but also has the potential to generate byproducts (Teh, Wiedmann, *et al*., 2017). To prevent or minimize the negative side effects of the cement industry, it is necessary to implement clean production. Cleaner production is a preventive and integrated environmental management strategy that needs to be applied continuously in the production process and product life cycle with the aim of reducing risks to humans and the environment (Berriel *et al.,* 2018; Hens *et al.,* 2018). Clean production is implemented using environmental impact assessment (EIA). To discover the impacts, every process that occurs in the cement industry has to be observed (Çankaya and Pekey, 2018; Jacquemin, *et al*., 2012). This study forms the basis for determining an analysis of environmental impacts by evaluating the existing cement production process in Indonesia. Based on the existing conditions, it is expected to provide alternative strategies to reduce the emissions from the production process.

PRODUCTION PROCESS EVALUATION (SCOPE OF THE STUDY)

In this study, an evaluation of the production process was carried out at PT Solusi Bangun

Indonesia Tbk. Cilacap, which was originally named PT Semen Nusantara. PT Solusi Bangun Indonesia (PT SBI) has a production process that can be seen in the following figure (Figure 1).

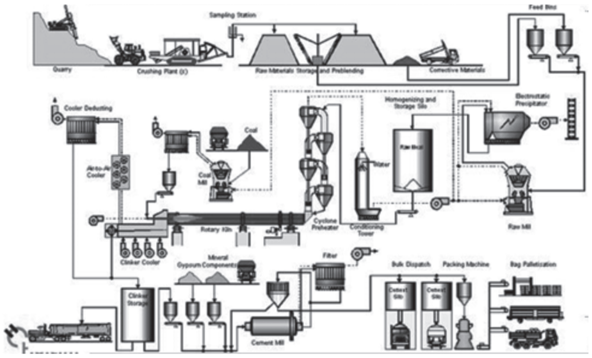

Fig. 1. Cement Production Process
Source: PT SBI (PT Solusi Bangun Indonesia Tbk. Cilacap)

DATA ANALYSIS

Mining

There are several stages in the mining process carried out by PT SBI, namely drilling, blasting, dredging, and material collection. Another raw material for making cement, clay, is taken from the mine of PT SBI in Jeruklegi, which is brought to the factory by truck. Silica sand and iron sand as other raw materials are purchased from third parties, while silica sand is obtained from two places, Tuban and Banjar. The mass balance of the limestone and clay mining process can be seen in Fig. 2 and 3.

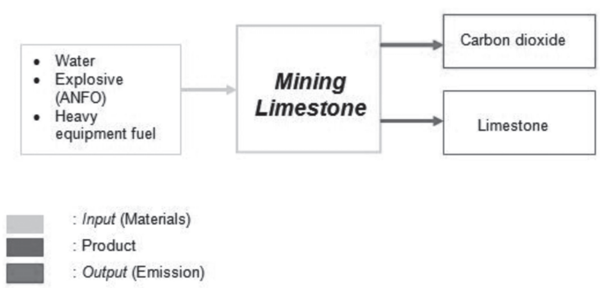

Fig. 2. Material Balance Diagram of Limestone Mining

Pre-Blending

The raw materials to be produced are previously analyzed for the levels of each element to match the levels of cement in the laboratory. After the composition of each raw material is determined by the laboratory, the results of the composition of the raw materials are given to Control Center Room (CCR) for the production execution process.

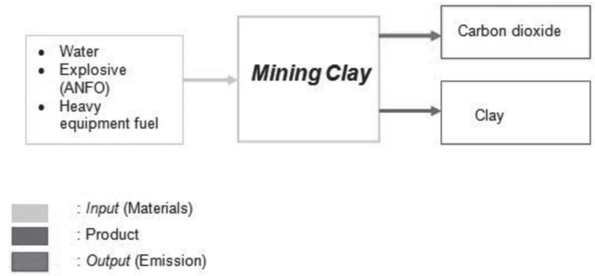

Fig. 3. Material Balance Diagram of Clay Mining Unit

Raw Mill

The hot air utilized to dry raw flour comes from the excess hot air from the suspension preheater and the clinker cooler. A raw mill has a sand filter that is useful to filter the output of the raw mill. If the size of the mixed sand does not meet the filter criteria, it will continue to be ground, heated, and filtered until the mixed sand is completely suitable. The product of the raw mill, called raw meal, which is fine raw flour, is carried by hot air flow towards cyclones. Approximately 90% of raw mill material after milled will be separated from the hot air, while the rest 10% of the product carried by the hot air flow will be captured by electrostatic precipitator. Clean gas will come out through an electrostatic precipitator stack, while the captured dust is collected inside a dust bin. The produced raw meal will be put in blending silos as a temporary storage before the next process. The mass balance of raw mill and coal mill can be seen in Figure 4 and 5.

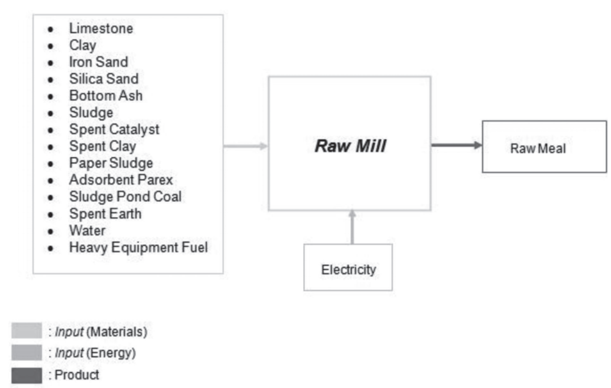

Fig. 4. Material Balance Diagram of Raw Mill Unit

Preheating

After that, the raw meal will be heated using hot air until it is processed in a rotary kiln, which is called preheating process. For preheating, there are four

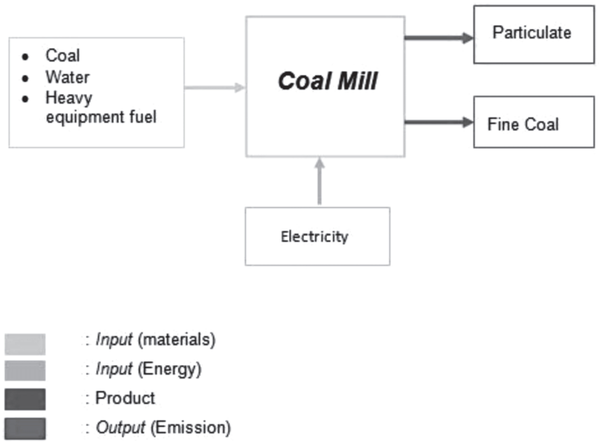

Fig. 5. Material Balance Diagram of Coal Mill Unit

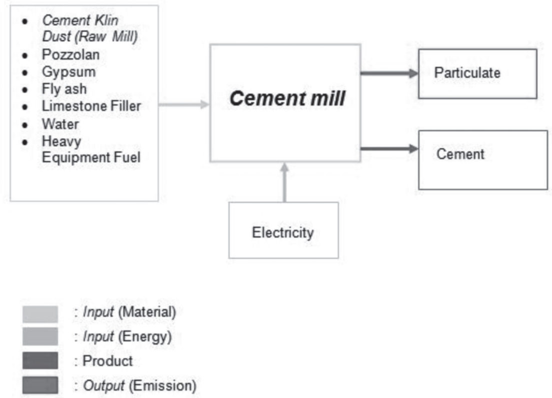

Fig. 7. Material Balance Diagram Cement Mill Unit

cyclones and one calciner in one production flow. The preheater has two parts, namely in-line calciner (ILC) and separate line calciner (SLC).

Kiln and Cooler

After being preheated in the suspension preheater, kiln feed will enter the kiln. The type of kiln used is a rotary kiln that functions to burn kiln feed into semi-finished cement called clinker (Georgiopoulou and Lyberatos, 2018; Moretti and Caro, 2017). The temperature of the rotary kiln is 1300-1450 ^{o}C. It is produced by burning coal in the burner, while the heat for preheating is from IDO (industrial diesel oil). The primary air for combustion comes from IDO (industrial diesel oil) fuel oil. The required materials and used energy, products, and emissions from the process of clinker production and cement mill can be seen in Figure 6 and 7.

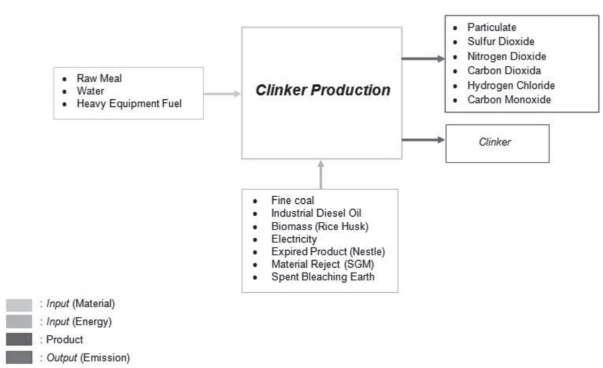

Fig. 6. Material Balance Diagram Clinker Production

Finish Mill (Cement Mill)

Gypsum as well as addictive substances are weighed beforehand using a conveyor belt along with the clinker. They are moved to the cement mill (finish mill) as the final mill. The final mill is intended to obtain cement with a specified degree of fineness. Cement produced using the final mill has a degree of fineness between 300 -320 m2/kg. Fine material from cyclone is brought by water slide to the cement silo. Meanwhile, the air will be sucked into the filter bag. The collected dust is brought by the screw conveyor through the water slide to cement silos. The capacity of each cement silo is 19,000 tons.

Packing

The cement bagging stage starts from the cement silos. After reaching 40 kg and 50 kg, the bag ends will be closed automatically and the filled bag will come out through the discharge conveyor. If the weight of the cement is less or more than the specified weight, the cement will be removed through the reject bin, transported by the screw conveyor, and returned by a bucket elevator to be put in the feed bin.

DISCUSSION

Cleaner production in the cement industry is implemented using the Life Cycle Assessment (LCA)

In several previous studies, environmental impact assessment assessments were conducted to achieve cleaner production using the life cycle assessment (LCA) method (Ali, *et al.*, 2016; Georgiopoulou and Lyberatos, 2018; Iswara *et al.*, 2020; Tucker *et al.*, 2018). Regarded as some of the most essential environmental protection processes, EIA and Cleaner Production ought to be optimally strengthened. They have many characteristics, such as principles, objectives, and procedures, as well as formal/legal links that are almost the same, which cause them to be correlated or integrated in practice. It may result in a noteworthy strengthening of these two processes (Salvador *et al*., 2000). The LCA is included to find out the ingredients, products, and residues generated from each production process (Standard, 2000; The International Standards Organisation, 2006). Therefore, for further research, there needs to be an LCA analysis in the cement industry in Indonesia to achieve the concept of cleaner production.

CONCLUSION

Environmental impact assessment can use the life cycle assessment analysis method to determine the quantity and quality of environmental impacts that occur in the cement industry. This analysis forms the basis of reference in the LCA study for subsequent studies.

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