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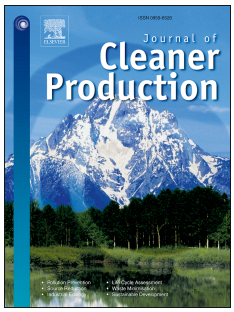

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Analysis of Material Flow and Consumption in Cement Production Process

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Highlights:

- The material flow route for a cement plant was obtained.
- Three mass balances for three cement production stages were established.
- Each ton of products requires 2.48, 4.69, and 3.41 t of materials in three stages.
- Waste gas recycling rate in clinker production is higher than in other stages.
- Recycling waste gas discharged from raw and cement mills should be the focus.

ABSTRACT:

Cement production, which is highly dependent on the availability of natural resources, will face severe resource constraints in the future. This is especially true for the cement industry in China. Thus, the industry is focusing on reducing the consumption of natural resources at both the manufacturing and operational stages. The aim of this article is to improve the management of resources used in the cement production process and mitigate their environmental effects. First, material flow routes for the cement manufacturing process are established, after which three mass balances are built during the three production stages using actual plant data received from an existing cement manufacturing facility. Finally, the material efficiency of the units and stages as well as the waste recycle rates during these stages is calculated. The results show that approximately 2.48 t, 4.69 t, and 3.41 t of materials are required to produce a ton of the product in raw material preparation, clinker production, and cement grinding stages, and their waste rates are 63.31%, 74.12%, and 78.89%, respectively. The recycling rate of wastes during clinker production is remarkably higher than those during other manufacturing stages, wherein waste gases are directly discharged into the atmosphere. The material efficiency values for a raw mill, pyro-processing tower, rotary kiln, clink cooler, and cement mill are determined to be 36.69%, 34.24%, 39.24%, 29.76%, and 25.88%, respectively, whereas the waste recycling rates for these units are found to be 16.33%, 81.98%, 100.00%, 99.53%, and 0.00% respectively. These results will provide researchers with knowledge regarding the effectiveness and efficient use of natural resources in the cement sector. These important findings can also be used to influence the development of national and industrial policies in relation to the goal of achieving sustainable development in the cement industry.

Keywords: material flow; material efficiency; mass balance; cement production; China

1. Introduction

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