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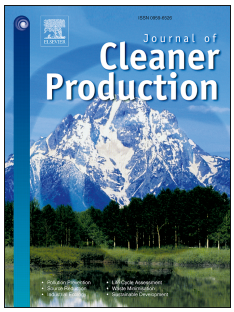

Sustainable Resource Opportunity for Cane Molasses: Use of Cane Molasses as a Grinding Aid in the Production of Portland Cement

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Sustainable Resource Opportunity for Cane Molasses: Use of Cane Molasses as a Grinding Aid in the Production of Portland Cement

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Abstract: Current methods used in China have failed to recycle cane molasses in an environmentally friendly way. Meanwhile, it is an urgent concern to find a cheap alternative to the present Portland cement grinding aids. However, the available literature has several limitations in properly evaluating the feasibility of using cane molasses as a Portland cement grinding aid. Therefore, the mixture of calcium sulphate and cement clinker is interground along with it, and mixture properties such as grindability, setting time, compressive strength, water absorption, compatibility with water reducing admixture, and hydration characteristics are systematically discussed and the mechanisms of these property variations are clarified. Besides, the economic, logistical, and environmental viability are also considered. The results show that cane molasses affects the cement grindability, setting time, compressive strength, water absorption, compatibility, hydration characteristics and microstructure, and these effects are related to its content. Moderate cane molasses delays the cement setting, but it is beneficial to the improvements of compressive strength, compatibility and microstructure. However, in addition to the fact that compressive strength is lowered, compatibility becomes poor, the later hydration is postponed and the microstructure gets loose, the scale of setting delay is also lessened when excessive cane molasses is used. The results also indicate it is logistically and economically feasible, also environmentally friendly that it is recycled as a cement grinding aid. These results are crucial to its sustainable and effective uses as well as the reuse of the waste containing similar matters. Additionally, this study also helps realize the sustainable production of cement, and also to contribute to the efforts at sustainable construction.

Key words: Cane molasses; Portland cement; Grinding aid; Physical performances; Hydration characteristic

1 Introduction

The significance of sugar is related to its potential energy contribution and its capacity to sweeten, as well it has been one of the most important components of the human diet since it is produced in 121 countries. In 2011, sugar worldwide yield a total of 0.16 billion tons. China is one of the world's major producers of sugar and about 12 million tons of sugar was processed in 2011. Average 16 million tons of it is expected to be produced every year for the next five years. Molasses is a by-product of sugar industry. About 0.3 ton of it will be discharged while 1 ton of sugar is processed. It is estimated that approximately 0.24 billion tons of molasses will be accumulatively discharged in this period. In many developed countries, molasses is widely used as raw materials to produce animal feed (Broderick and Radloff, 2004). Most of it also has been used as concrete water reducing and retarding admixtures (Jumadurdiyev et al., 2005). However, it has been mainly utilized as a raw material for the fabrication of ethyl alcohol and as a growth medium for yeast production, very little is recycled for use by livestock in China. Unfortunately, wastewater is usually discharged in these processes (Ingaramo et al., 2009). There are many organic substances in the wastewater, and their concentrations are high. Besides, it also contains a large amount of dark brown pigment. It is difficult to be disposed of and is directly discharged outside without reasonable treatment on account of poor environmental supervision and wastewater treatment technology (Liu et al., 2009). As a result, the serious environmental problems have been resulted from this practice. The finding of a more proper method of recycling of molasses is certainly a boon for the sugar industry as well as for the Chinese environmental protection administration. It will not only give the Chinese sugar industry more financial benefits, but also alleviate many of its potential environmental liabilities.

On the other hand, cement is one of the most important and indispensable building materials. However, cement