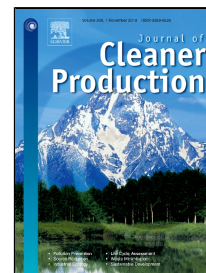


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Sustainable Utilization of Deinking Paper Mill Sludge for the Manufacture of Building Bricks

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ABSTRACT

Building bricks were produced by utilizing deinking paper mill sludge (DPMS) and alluvial soil by varying percentage of sludge at different firing temperatures. Different mix proportions were prepared with 0%, 5%, 10%, 15%, 20%, 25% and 30% of DPMS incorporation in alluvial soil by weight. Three firing temperatures of 900°C, 950°C and 1000°C were investigated to simulate the typical condition of kiln. The density, firing shrinkage, water absorption, efflorescence, apparent porosity, compressive strength and thermal conductivity of the bricks were determined. The XRD and microstructural analysis of brick specimens were also studied. The optimum firing temperature was 950°C. The thermal conductivity decreases with increase in percentage of deinking paper mill sludge. It was found that 15% deinking paper mill sludge gives optimum strength at firing temperature of 950°C. Developed bricks satisfy the requirements of class 10 of Bureau of Indian Standards (BIS), in terms of efflorescence, compressive strength and water absorption. Thermal conductivity results show that the developed brick was thermally more insulated than the conventional bricks and can be used as alternative to conventional bricks. This will address the issue of waste management through cleaner production and show the ways towards sustainable, economical and energy efficient construction.

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KEYWORDS: Deinking paper mill sludge; alluvial soil; insulating brick; burnt clay brick; green materials; sustainable material

1.0 INTRODUCTION

Pulp and paper industry is one of the most polluting industries. India produces about 13 million tons paper, paper board and news print per annum accounting to 3.18% of the total world production (408 million tons per annum) as per data of 2015 [1]. Paper industries generate about 40 to 50 kg of dry sludge for every tonne of paper production. It consists of primary (70%) and secondary (biological) sludge (30%) [2-4]. The amount of deinking paper mill sludge (DPMS) on a dry mass basis generates in the range of 170-600 kg for production of one tonne news print to tissue paper [2,5]. This leads to solid waste accumulation causing environmental concerns due to its disposal by landfilling [6,7].

Several attempts were made in past to utilize paper sludge for various applications such as hydraulic binders, cementitious products, polymer reinforcement and fibreboards due to presence of gehlenite, tricalcium aluminate, belite, metakaolinite and mayenite in paper sludge [8-10]. An excellent source of calcite and kaolin can be used as a pozzolanic addition in manufacturing of cement [11, 12]. The pozzolanic reactivity of sludge is as good as of natural metakaolin. However, presence of CaO and MgO in sludge causes volume instability, which limits its use up to 10% partial replacement of cementitious binder. In addition, paper sludge in cement mortar/ concrete reduces its flow properties owing to absorption of

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