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Reuse of ceramic sludge in the production of vitrified clay pipes

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ABSTRACT:

The use of various wastes in the manufacture of different ceramic products has proved to be beneficial from both economic and environmental points of view. In the present paper, the simultaneous reuse of ceramic sludge waste (from 0 to 6.2%) and cullet (from 0 to 10%) in the production of vitrified clay pipes has been investigated. Samples were pressed at 15 MPa, dried and subsequently fired at three different temperatures (1050, 1150 and 1250°C) and soaking times (1, 2 and 3 hours). A two-level factorial design was applied to study the effect of the various parameters on the properties of fired bodies. It was concluded that an economic recipe can be prepared involving the use of 6.2% sludge (dry basis) and 5% cullet with the balance clay + grog followed by firing the dried body at 1050°C for one hour only. The produced fired specimens yielded bending strength exceeding the minimum requirement for any size of soil embedded pipes and for 8" and larger concrete cradled pipes. The suggested composition makes use of an environmentally polluting waste (sludge) and broken glass waste (cullet) and involves firing for one single hour at a temperature about 200°C lower than commonly used.

Keywords: Ceramic Sludge, Cullet, Vitrified Clay Pipes, Standards, Factorial Design

1. Introduction

The use of various wastes in the manufacture of different ceramic products has proved to be beneficial from both economic and environmental points of view [1]. The nature of these wastes covers a wide scope of industrial and agricultural refuse which were the subject of extensive studies. In particular broken glass (cullet) has been the focus of many studies as it was used as a substitute for feldspar in the preparation of ceramic bricks [2], ceramic tiles [3], white-ware [4], sanitary ware [5], clay sewer pipes [6] and concrete works [7, 8]. On the other hand, fewer efforts were directed toward reusing the wastes produced from ceramic manufacturing plants in the production line of the same plant. Waste sludge, which is the sediment of washed down particles from ceramic manufacturing processes, constitutes approximately 2 weight% of the final products. This sludge which contains both coarse particles (feldspar, quartz, and ground fired defective products) and fine particles (clay minerals such as kaolinite and mica) is normally drained along the production line and disposed of as waste in landfills. (Fig. 1) Elimination of this muddy waste poses a serious problem due to the huge amount produced each year and

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