ABSTRACT

As stringent environmental control mandates are introduced and enforced, the traditional disposal routes of land application, land-filling, and incineration for processed biosolids will come under increasing pressure and may no longer be viable and cost-effective disposal outlets for sanitary engineers to capitalize on.

This Master thesis research investigates the technical viability of incorporating dehydrated biosolids and sewage sludge ashes into concrete raw material mixtures to produce pre-cast bricks that can be utilized in general-purpose outdoor building of non-load bearing structures. Furthermore, the cost-cutting benefits of producing such sludge-amended bricks are quantified.

The approach was to experiment with the addition of various sludge quantities to concrete mixtures – (making use of both sun-dried biosolids and sewage sludge ashes) - and then to evaluate and analyze the corresponding physical properties of the concrete mix paste and of the produced concrete bricks – mainly those properties affecting structural integrity. Results showed that there is a general inverse relationship between the amount of dried sludge or ashes added and the compressive strength development of the cured blocks. However, the addition of as much as 10% of biosolids' ashes to the raw ingredients of a concrete mix did not affect the general physical properties of concrete (i.e. the workability of the concrete mix and the compressive strength, water absorption, and density of the cured bricks). On the other hand, the addition of an equal quantity of sun-dried biosolids decreased the compressive strength of the cured concrete by about 20% - which can be attributed to the presence of the organic materials in the dried biosolids. Moreover, results showed that there is no significant change in the relative strengths of the tested concrete blocks when sludge is used in small quantities (i.e. 10% ashes or a combination of 2.5% dried biosolids and 7.5% ashes) as sand replacements in the concrete mixture.

For concrete bricks' manufacturers that utilize sand as a raw material ingredient in their production process, the incorporation of 10% sewage sludge ashes into concrete mixtures as a partial replacement for sand can achieve the highest possible monetary savings.