ABSTRACT

The work done in this study was devoted to the development of a procedure to produce bricks from water treatment plant sludge incorporated with silica fume and/or rice husk ash as a modern way for sludge reuse. The main objectives are to increase the value of the water treatment plant sludge and to provide a sustainable and profitable disposal alternative for it.

A large quantity of sludge is generated each year from water treatment plants in Egypt. Disposing of the water treatment plant sludge to the nearest watercourse is the common practice in Egypt, which accumulatively rise the aluminum concentrations in water and consequently in human bodies. The aluminum's contributory influence has been linked to occurrence of Alzheimer's disease. Landfill disposal of the sludge is impractical because of the high cost of transportation and it depletes the capacity of the landfill. Recovering and reusing of the coagulants (alum), at the drinking and sewage treatment plants, may reduce both raw material and disposal costs if the needed technology is available. However, this recovered alum, if reused as a coagulant, has a trihalomethane formation potential during chlorination stage of water treatment, because of the additional quantity of algae that contained in the reused sludge. The trihalomethanes are suspected carcinogens. Among all that options, the use of sludge, incorporated with other wastes, in manufacturing of constructional elements is considered to be the most economic and environmentally sound option. This trend also provides an environmentally sound manner to reuse some of the agricultural and industrial wastes, such as rice husk ash (RHA) and silica fume (SF). Due to the similar mineralogical composition of clay and water treatment plant sludge, this study focused on the use of sludge in clay-brick making. The study investigated the complete substitution of brick clay by sludge incorporated with silica fume and/or rice husk ash.

The sludge, silica fume (SF), and rice husk ash (RHA) was initially submitted to characterization tests, such as XRF and XRD, to determine its, chemical composition, mineralogical composition, and thermal behavior.

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The study investigated the complete substitution of brick clay by water treatment plant sludge incorporated with silica fume (SF) with ratios 25, 50, and 75 % by weight. At the second stage, the incorporation of sludge with rice husk ash (RHA) with ratios 25, 50, and 75 % by weight was then investigated. In the last stage of the experimental program, the incorporation of water treatment plant sludge with both silica fume and rice husk ash was investigated. As in the last two stages, three different series of sludge to silica fume (SF) to rice husk ash (RHA) proportions were tried, which were (25: 50: 25 %), (50: 25: 25 %), and (25: 25: 50 %), respectively. Lab scale specimens were pressurized in molds and then fired at 900, 1000, 1100, and 1200 ^{o}C in a laboratory furnace. The physical and mechanical properties of the produced brick types were then evaluated according to E.S.S and compared to that of previously prepared 100 % clay control-brick and two of the commercial brick types available in the Egyptian market.

A main conclusion was then provided to use the water treatment plant sludge, silica fume, and rice husk ash in brick manufacturing. By operating at the temperatures commonly practiced in the brick factories and based on the experimental program executed in this research, and limited on both the tested materials and the testing procedures employed, 50 to 75 % was the optimum sludge addition to produce brick from water treatment plant sludge incorporated with silica fume (SF) and/or rice husk ash (RHA).

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