World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:06, 2016

Use of Sewage Sludge Ash as Partial Cement Replacement in the Production of Mortars

Authors : Domagoj Nakic, Drazen Vouk, Nina Stirmer, Mario Siljeg, Ana Baricevic

Abstract : Wastewater treatment processes generate significant quantities of sewage sludge that need to be adequately treated and disposed. In many EU countries, the problem of adequate disposal of sewage sludge has not been solved, nor is determined by the unique rules, instructions or guidelines. Disposal of sewage sludge is important not only in terms of satisfying the regulations, but the aspect of choosing the optimal wastewater and sludge treatment technology. Among the solutions that seem reasonable, recycling of sewage sludge and its byproducts reaches the top recommendation. Within the framework of sustainable development, recycling of sludge almost completely closes the cycle of wastewater treatment in which only negligible amounts of waste that requires landfilling are being generated. In many EU countries, significant amounts of sewage sludge are incinerated, resulting in a new byproduct in the form of ash. Sewage sludge ash is three to five times less in volume compared to stabilized and dehydrated sludge, but it also requires further management. The combustion process also destroys hazardous organic components in the sludge and minimizes unpleasant odors. The basic objective of the presented research is to explore the possibilities of recycling of the sewage sludge ash as a supplementary cementitious material. This is because of the main oxides present in the sewage sludge ash (SiO2, Al2O3 and Cao, which is similar to cement), so it can be considered as latent hydraulic and pozzolanic material. Physical and chemical characteristics of ashes, generated by sludge collected from different wastewater treatment plants, and incinerated in laboratory conditions at different temperatures, are investigated since it is a prerequisite of its subsequent recycling and the eventual use in other industries. Research was carried out by replacing up to 20% of cement by mass in cement mortar mixes with different obtained ashes and examining characteristics of created mixes in fresh and hardened condition. The mixtures with the highest ash content (20%) showed an average drop in workability of about 15% which is attributed to the increased water requirements when ash was used. Although some mixes containing added ash showed compressive and flexural strengths equivalent to those of reference mixes, generally slight decrease in strength was observed. However, it is important to point out that the compressive strengths always remained above 85% compared to the reference mix, while flexural strengths remained above 75%. Ecological impact of innovative construction products containing sewage sludge ash was determined by analyzing leaching concentrations of heavy metals. Results demonstrate that sewage sludge ash can satisfy technical and environmental criteria for use in cementitious materials which represents a new recycling application for an increasingly important waste material that is normally landfilled. Particular emphasis is placed on linking the composition of generated ashes depending on its origin and applied treatment processes (stage of wastewater treatment, sludge treatment technology, incineration temperature) with the characteristics of the final products. Acknowledgement: This work has been fully supported by Croatian Science Foundation under the project '7927 - Reuse of sewage sludge in concrete industry – from infrastructure to innovative construction products'.

Keywords : cement mortar, recycling, sewage sludge ash, sludge disposal
Conference Title : ICW 2016 : International Conference on Wastewater
Conference Location : Paris, France
Conference Dates : June 20-21, 2016