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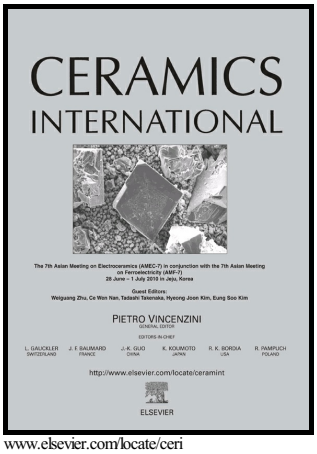
Mandeep Kaur, Jaspal Singh, Manpreet Kaur



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Synthesis of Fly ash based Geopolymer Mortar considering different concentrations and combinations of Alkaline Activator Solution

Mandeep Kaur*, Jaspal Singh and Manpreet Kaur

Department of Civil Engineering, Punjab Agricultural University, Ludhiana

*E-mail: mkmeenu86@gmail.com

Abstract

Geopolymerisation is a process that can transform alumina and silica rich waste materials into valuable binding materials, having excellent mechanical properties. The present experimental study shed a light on the variation in compressive strength of fly ash based geopolymer mortar by varying the molarity of sodium hydroxide as 12M, 14M, 16M and accompanying by sodium silicate (Na_2SIO_3) in 2:1 (Na_2SIO_3/ NaOH) with same molarities. All the geopolymer mixes were oven cured at 80°C for 24 hours and after that kept at room temperature up to the time of testing. The compressive strength was checked subsequently at the ages of 3, 7, 14 and 28 days. The experimental results reveal that the addition of sodium silicate enhances the strength development in geopolymer mortar. The ultimate compressive strength of 40.42 MPa was obtained by incorporating sodium silicate along with 16 M concentrated sodium hydroxide. Furthermore, increasing trend of the compressive strength was found with increasing molar concentration of sodium hydroxide and curing period.

Keywords: Geopolymer mortar, sodium hydroxide, sodium silicate, compressive strength

1. Introduction

Cement is most popularly used as a binder material in concrete. At present, the production of cement is increasing significantly to cope with demand of construction industries. The cement manufacturing industry has a large contribution to rising level of carbon dioxide emissions in the environment [1]. Therefore, it is the time requirement to develop an eco-friendly and economic binder material that can totally replace cement as a binder in mortar and concrete. In context of this, materials prepared by geopolymerisation process can be effectively used as binders, instead of cement binder in mortar and concrete. Geopolymerisation is a process that can transform alumina and silica rich waste materials into valuable building/binding materials, having the same properties as of cement based construction materials [2].The term "geopolymer" was first investigated by a French Professor Davidovits in 1978 to represent a broad range of materials which are members of the inorganic polymers family.

The mortar prepared with geopolymerisation process is known as geopolymer mortar. Geopolymer mortar is developed by alkali activating alumina and silica rich waste materials such as fly ash, rice husk ash, GGBS etc. with high alkaline solution that results in three-dimensional polymeric chain and ring structure consisting of Si-O-Al-O bonds. This 3D molecular chain results in conversion of the waste material into binding material [3]. According to the survey, the total fly ash (waste material from electricity generated thermal plant) production in the world is about 780 million tons per year out of which 220 million tons of fly ash is produced in India, whereas utilization of this waste material is only about 17–20 % [4]. The utilization of fly ash as source material in geopolymer mortar and concrete not only helps in the reduction of disposing problem of fly ash but also eliminates the adverse impact causes to the environment during cement production by totally replacing cement as a binding material in mortar and concrete.

Fly ash based geopolymer mortar is prepared by activating fly ash with alkaline solutions. Sodium and potassium based alkaline activators are most commonly used as alkaline activators. From the previous studies it has been proved that Class F fly ash is a good source for geopolymer mortar and sodium based alkaline activators are more efficient than potassium based activators for the activation of the fly ash [5].

The present study provides the experimental data on the variation in compressive strength of fly ash based geopolymer mortar with the incorporation of sodium silicate along with different molarities of sodium hydroxide.