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MECHANICAL EFFECTS ON DIFFERENT SOLID TO LIQUID RATIO OF GEOPOLYMER FILLER IN EPOXY RESIN

ABSTRACT

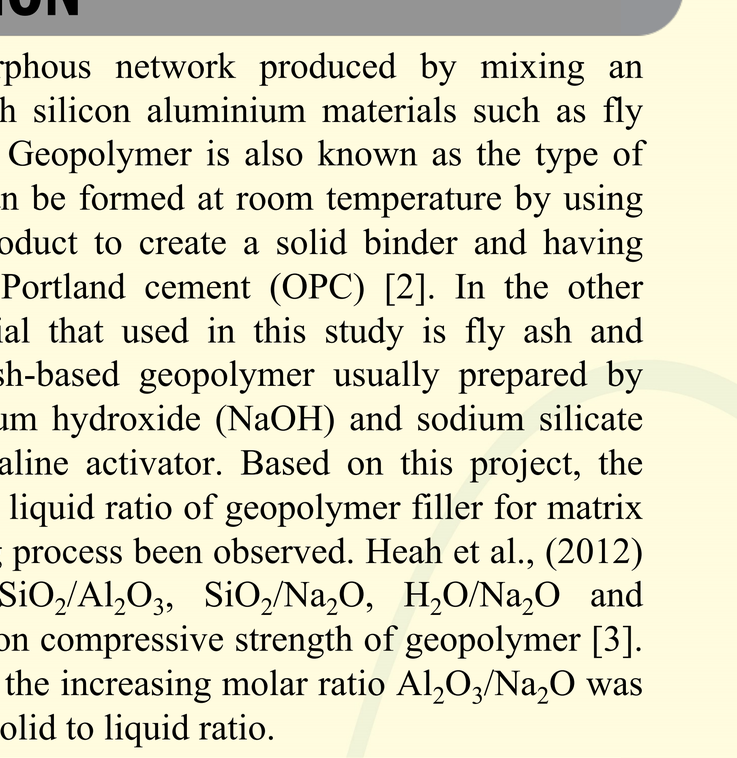
Nowadays, glass fiber reinforced epoxy has always been chosen in the industries such as aviation, oil and gas, and construction. However, the common problem that can be observed from solid to liquid ratio is the influence of curing time and compressive strength of geopolymer to have the best mechanical property. The mix design for geopolymers of solid to liquid ratio is essential in developing the geopolymer's mechanical strength. This research is to study the optimum value of solid to liquid ratio of fly ash-based geopolymer filler to produce the high strength epoxy filled fly ash-based geopolymer filler. A series of epoxy filled fly ash-based geopolymer materials with different solid to liquid ratio, which is prepared 0.5 to 2.5 solid to liquid ratio. Tensile strength and flexural strength of the epoxy-filled fly ash-based geopolymer materials is determined using Instron Universal Testing under tensile and flexural mode. It was found that both tensile and flexural strength for 2.0 solid to liquid ratio samples are increases from 0.5 solid to liquid ratio to 2.0 solid to liquid ratio of geopolymer content. However, both tensile and flexural properties of epoxy filled fly ash-based geopolymer suddenly decrease at a 2.5 solid to liquid ratio. The strength is increasing with the increasing solid to liquid ratio sample of geopolymer filler content. The results indicated that it could obtain the blending of geopolymer materials in an epoxy system in this study.

INTRODUCTION

- Geopolymer is an amorphous network produced by mixing an alkaline activator and rich silicon aluminium materials such as fly ash, kaolin, and slag [1]. Geopolymer is also known as the type of inorganic polymer that can be formed at room temperature by using industrial waste or by-product to create a solid binder and having performed and ordinary Portland cement (OPC) [2]. In the other hand, the primary material that used in this study is fly ash and alkaline activator. Fly ash-based geopolymer usually prepared by mixing fly ash with sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) acts as an alkaline activator. Based on this project, the effect of different solid to liquid ratio of geopolymer filler for matrix resin for filament winding process been observed. Heah et al., (2012) studied the effect of SiO_2/Al_2O_3, SiO_2/Na_2O, H_2O/Na_2O and Al_2O_3/Na_2O molar ratios on compressive strength of geopolymer [3]. The researcher found that the increasing molar ratio Al_2O_3/Na_2O was influenced by increasing solid to liquid ratio.

PROCESS DESCRIPTION

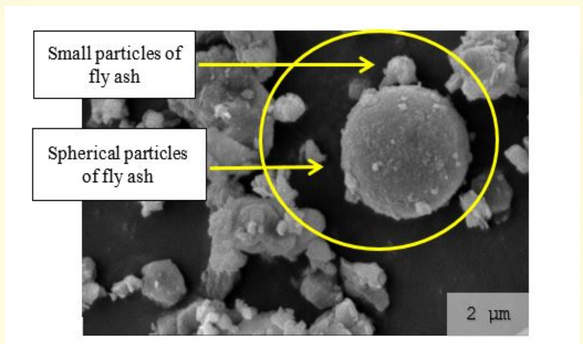
Epoxy geopolymer was prepared using a mechanical mixer according to the mix design of epoxy geopolymer resin formulation in Table 2. Firstly, epoxy resin was mixed with geopolymer filler materials for about 2 hours to make it wholly homogeneous and followed by curing agent/hardener for about 5 minutes [12]. Mixed epoxy geopolymer resin is poured into the rubber mould in shape for tensile and flexural testing before the resin is cured. The samples it then left in the rubber mould at the ambient temperature before taking out from the mould.



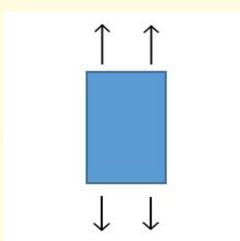
RESULTS

Table 3: Material composition of raw fly ash

Compound	Mass (wt. %)
SiO_2	55.90
Al_2O_3	27.80
Fe_2O_3	7.09
CaO	3.95
TiO_2	2.25
K_2O	1.55
SrO	0.37
SO_3	0.33
RuO_2	0.24
ZrO_2	0.13
V_2O_5	0.10
MnO	0.06
CuO	0.05



Tensile test result



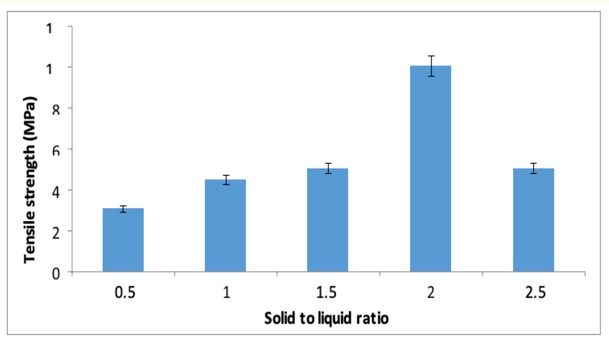


Fig. 4: Fly Ash Based Geopolymer at Different Solid to Liquid Ratio on Tensile Strength.

Flexural test result

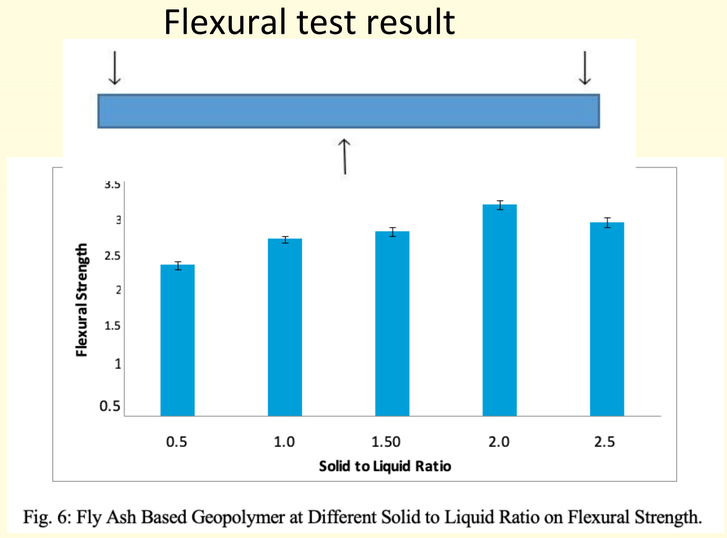


Fig. 6: Fly Ash Based Geopolymer at Different Solid to Liquid Ratio on Flexural Strength.

CONCLUSION

This research shows that epoxy filled with fly ash-based geopolymer was developed based on a different solid to liquid ratio of the geopolymer material. Flexural strength and tensile strength of epoxy filled with fly ash-based geopolymer 2.0 solid to liquid ratio give better properties than other solid to liquid ratios. The waste material-based geopolymer's useful properties have a more significant potential to be an ideal replacement matrix of composite with glass fiber in the filament winding technique.

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