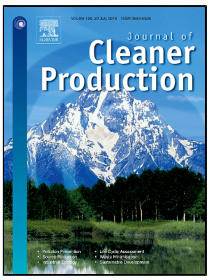
Accepted Manuscript



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PII:	S0959-6526(18)31498-7
DOI:	10.1016/j.jclepro.2018.05.158
Reference:	JCLP 13015
To appear in:	*Journal of Cleaner Production*
Received Date:	21 January 2018
Accepted Date:	20 May 2018

Please cite this article as: Muhammad Zahid, Nasir Shafiq, M.Hasnain Isa, Lluis Gil, Statistical modeling and mix design optimization of fly ash based engineered geopolymer composite using response surface methodology, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.05.158

Statistical modeling and mix design optimization of fly ash based engineered geopolymer composite using response surface methodology

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Abstract

Fly ash-based geopolymer binders have been identified as one of the alternatives to the Ordinary Portland Cement (OPC), which qualify the criteria of green construction material. In the process of enhancement of the properties of geopolymer; engineered geopolymer composite (EGC) is a recent development that is classified as the high-performance fiber reinforced geopolymer matrix. The philosophy of the development of EGC is to achieve high compressive strength and ductility. In this paper, statistical models are developed to predict the mechanical and post-cracking properties of EGC using Response Surface Methodology (RSM). In this regard, effects of three principal variables; molarity of sodium hydroxide, sodium silicate to sodium hydroxide ratio, and curing temperature on the properties of fresh and hardened EGC (setting time, compressive strength, elastic modulus, flexural strength, flexural toughness, ductility index, tensile strength, tensile first crack strength and tensile strain capacity) were investigated. All models are found significant because, and the difference between predicted R^2 and adjustable R^2 was found less than 0.2. The optimized mixture proportion was assessed using multi-objective optimization technique as discussed in the RSM literature. Finally, an experimental program was performed to validate the optimized mixture proportion. The predicted and experimental results were found in a close agreement because the variation between the predicted and the experimental results was obtained less than 5%. The proposed method can be performed for any objective value of the EGC property with desirability almost equal to one, improving the yield, the reliability of the product and the processes.

Keywords:

Geopolymer, Engineered Geopolymer Cement, NaOH molarity, Na_2SiO_3/NaOH Ratio, curing temperature, Response Surface Methodology (RSM), Optimization