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Application of SVM for Investigation of Factors Affecting Compressive Strength and Consistency of Geopolymer Concretes

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ABSTRACT

A solution for synthesizing environmentally friendly concrete is to reduce the conventional Portland cement (OPC) content and utilize activated pozzolanic binders. Geopolymers are a sort of mineral polymers, so that their chemical composition resembles zeolites and their microscopic structure is not crystalline, but rather amorphous. In this study, it is attempted to address the behavior of synthetic geopolymers through the investigation of their base materials, e.g. blast furnace slag, metakaolin, fly ash, and other curing agents such as potassium hydroxide or sodium hydroxide solutions. It is tried to study the behavior of geopolymer concrete (GPC) at different contents of curing agents and base materials using the literature review and, eventually, make an SVM model to find out whether the results of compressive strength and consistency of GPCs can be estimated using support vector machine or not. The research results suggest that it is possible to estimate the compressive strength and consistency of GPCs using SVM. Also, there is a significant relationship between molarity and compressive strength of concrete at different ages, molarity and consistency of concrete, ratio of sodium hydroxide to sodium silicate, compressive strength and liquid limit (LL) of concrete.

Keywords: SVM, compressive strength, geopolymer concretes, metakaolin, fly ash

1. INTRODUCTION

Geopolymers have been considered as the latest tsunami among concrete modifiers; so that curing agents along with base materials such as metakaolin, slag and fly ash can be a good substitution for cement to produce concrete. It can be argued that the quality of concrete mostly relies upon its activators and base material. According to the literature review, the research on GPC has boomed considerably since 2016, so that geopolymers can be now considered as a base material in constructions [1-2]. Many researchers performed numerical and experimental tests on geopolymers; for example, Dao et al. (2019) estimated the compressive strength of geopolymers using numerical methods, e.g., neural networks and genetic algorithms, with the aim of finding an optimum mix design [3]. Chidambaram (2018) investigated the geopolymer curing temperature during hardening and its impact on the compressive strength of GPC. In this research, the concentration of sodium hydroxide was considered variable (74%, 76%, 78%, 80% and 82%) In this research, the curing temperature was also variable and the behavior of concrete was evaluated [4]. The study showed that increasing the curing temperature to 90 °C and 12M sodium hydroxide can provide better results compared to other alternatives [3]. Suppiah (2019) studied the uniaxial behavior of geopolymer under static loading for oil well cements. Yadollahi et al (2015) estimated the compressive strength of GPCs using neural networks method. In this study, it is found that parameters such as silica modulus, Na2O content, w/b ratios and curing dramatically affect the behavior of geopolymers and their variation may change the compressive and tensile strength of GPC. In this study, the compressive strength of different GPCs is estimated using artificial neural networks (ANN) [5]. Zivica (2014) examined the high strength geopolymers based on geopolymer materials. The results can be applied for metahalloysite-based geopolymer properties. In this study, a compressive strength of 300 MPa is obtained for a low water to metahalloysite ratio (0.08). This substance used along with sodium hydroxide and sodium silicate may affect the strength properties of