

Optimization of adhesion strength and microstructure properties by using response surface methodology in enhancing the rice husk ash-based geopolymer composite coating

ABSTRACT

As a result of their significant importance and applications in vast areas, including oil and gas, building construction, offshore structures, ships, and bridges, coating materials are regularly exposed to harsh environments which leads to coating delamination. Therefore, optimum interfacial bonding between coating and substrate, and the reason behind excellent adhesion strength is of utmost importance. However, the majority of studies on polymer coatings have used a one-factor-at-a-time (OFAT) approach. The main objective of this study was to implement statistical analysis in optimizing the factors to provide the optimum adhesion strength and to study the microstructure of a rice husk ash (RHA)-based geopolymer composite coating (GCC). Response surface methodology was used to design experiments and perform analyses. RHA/alkali activated (AA) ratio and curing temperature were chosen as factors. Adhesion tests were carried out using an Elcometer and a scanning electron microscope was used to observe the microstructure. Results showed that an optimum adhesion strength of 4.7 MPa could be achieved with the combination of RHA/AA ratio of 0.25 and curing temperature at 75 °C. The microstructure analysis revealed that coating with high adhesion strength had good interfacial bonding with the substrate. This coating had good wetting ability in which the coating penetrated the valleys of the profiles, thus wetting the entire substrate surface. A large portion of dense gel matrix also contributed to the high adhesion strength. Conversely, a large quantity of unreacted or partially reacted particles may result in low adhesion strength.

Keyword: Geopolymer; Coating; Optimization; Polymer; Adhesion