Development of Superhydrophobic/Oleophilic Fabric using Modified Nanotitania for Oil-water Separation

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Abstract

In recent years, the increasing environmental issues arising from oil spills and industrial wastewater discharge have emphasized the need for finding efficient and sustainable solution for oil water separation. This research paper investigates the fabrication of an advanced superhydrophobic coating on cotton fabric surfaces to improve the process of oil-water separation. The coating is developed through the synergistic utilization of stearic acid and titania sol via the dip coating method. By varying the molar ratio of various constituents, three-sol solution of titanium dioxide (TiO_2) were prepared using sol-gel technique. The Titania sol exhibited an average particle size of 39.35 nm and zeta potential value of 25.96 mV which shows good stability of sol solution. The Scanning Electron Microscopy (SEM) analysis was employed to examine the surface roughness and morphology of the superhydrophobic coating. The composition of the modified sol was characterized by Fourier Transform Infra-Red (FTIR), revealing peaks corresponding to Ti-O-Ti and Ti-O-Si bonds at wave numbers of 665.3 cm^{-1} and 894.5 cm^{-1} respectively. The coated fabrics displayed hydrophobic characteristics with low surface free energy values and demonstrated significant superhydrophobicity, with the maximum water contact angle (WCA) recorded at 158.5° and the minimum contact angle hysteresis at 5°. Mixtures such as Toluene-water, Cooking Oil-water and Chloroform-water were successfully separated by coated fabrics, with separation efficiencies of up to 97.5%. This study provides a promising solution for ecofriendly and effective oil water separation systems and as well as contribution to the advancement in materials for environmental applications.

Keywords: Superhydrophobic, Titania, Stearic Acid, Sol-Gel method, Oil-Water separation.