UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF ELECTROSPUN COMPOSITE POLYMER FIBER AS SORBENTS FOR OIL SPILL MITIGATION

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ABSTRACT

Research on polymers has grown exponentially in the purpose of oil spill removal from the water surface. It is very important to take immediate action to remove the oil from the water surface to reduce worldwide oil pollution. Materials with high porosity and mostly, superhydrophobic and oleophilic natures are the best candidates for this purpose. In this research, the Electrospinning method was used to synthesize the polystyrene (PS), polysulfone (PSF), and polyvinylidene fluoride (PVDF) which produced solvent-free fibers for the application of oil-spill removal. Different concentrations of solvents were used to produce electrospun fibers using N, N-Dimethylformamide (DMF). Moreover, DMF/THF and DMF/TCE solvent mixtures were used for PS and PSF respectively to identify the best solvent for fabrication and to minimise the dissolving time of the polymers. Viscosity and conductivity were measured for all the electrospun solutions to find the appropriate viscosity and conductivity for producing fibers. Composite polymer fibers were produced using PS/PSF and PS/PVDF polymer blending. For producing the composite polymer fibers only DMF was used to reduce the possibility of chemical degradation inside the polymer blending. A comprehensive physiochemical, thermal, mechanical, and sorption characterisation of the different polymer blend was undertaken, to examine the effect of blend ratio on the fibers mat. To characterize the electrospun polymer fibers scanning electron microscope (SEM) was used to identify the surface morphology, Contact angle (CA) measurement was applied to justify the hydrophobicity, the soaking method was used to measure the porosity of the fibers, Fourier Transform Infrared (FT-IR) was applied for identifying the appropriate functional group for oil sorption and Thermogravimetric Analysis (TGA) and differential scanning calorimeter (DSC) were used to measure the glass transition temperature for the polymer blending to identify the quality of the electrospun solution. Furthermore, the tensile strength measurement was used to measure the mechanical strength of all the composite polymer fibers films. ImageJ analysis of the SEM results was used to measure the fibers' diameter and void spaces. The microstructural properties of the films showed up fundamentally subject to the general mix proportion. DSC uncovered that great collaboration/miscibility existed between the two polymers. Rigidity qualities showed that an unmixed PS fibers film had a poor elasticity, however, the worth expanded over one order of significant degree with the expansion of PVDF in the polymer matrix, credited to the development of inter-fibers bonds. Then again, the expansion of PSF with PS showed poor elasticity. On the other hand, the oil sorption limit diminished with expanding PVDF expansion. Regulating the mix proportion could in this manner give a harmony between the ideal sorption limit and the mechanical way of behaving of resultant films. In light of the CA results, just a single sample, 24wt % concentrations of polystyrene (PS-5) film showed a superhydrophobic value above 150°. ASTM F726-12 standard and low viscous motor oil and crude oil were utilized for the oil sorption test. Sorption limit is an intricate connection among fibers and fibers film attributes, yet the composite polymer fibers building procedure detailed here offers an easy and effective strategy. 5wt% PVDF and through upgrading micro/nanoscale interactions between the two polymers inside the composite polymer matrix. Moreover, the oil sorption results were compared for all the polymer samples to identify the best polymer concentration, concentration ratio for mixed polymer fibers, and solvent that can adsorb oil the most. Finally, the overall research outcomes where the best polymer for oil sorption was polystyrene (PS) with concentrations of 24wt % (PS-5) provided the highest oil absorption efficiency of 20.99 g/g, and the appropriate polymer matrix was produced from PS/PVDF blending with the ratio of 24:5, where the oil sorption efficiency was 19.39 g/g.

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