UNIVERSITI TEKNOLOGI MARA

PREPARATION AND CHARACTERIZATION OF MICRO BEARING FROM EPOXY FILLED UHMWPE POLYMER COMPOSITE

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ABSTRACT

Significance modification of polymer composite to the conventional ways involving metal, ceramic and polymer alone gave effective solution to obtain the desired properties especially on the application related to alternative bearing surfaces. The limitations on the bearing materials which are relatively too hard, that can cause high wear rate or relatively too soft, which can cause potting and failure in repeated cycle. Thus, this research project focuses on the objectives of improvising the limitations of the existing physical and tribological properties of existing application by the introduction of a new micro bearing concept of polymer composite. The usage of Ultra High Molecular Weight Polyethylene (UHMWPE) as the particulate filler into the epoxy resin where the density and low wear rate of UHMWPE and high physical encapsulation of epoxy matrix are exploited for the micro bearing concept. The presence of acetone as diluent on the formation of the layer can be supported by the theory of particulate fillers in suspensions according to Modified Mooney-Einstein's Theory of Viscosity. In short, micro-bearing concept, which can be called as solid lubricant, is a type of material that can provide the lubrication or minimizing the abrasion without the usage of lubricating agent such as wax, grease or oil. For the study of the formation of micro bearing layer, relatable testings in term of surface topography and morphology were conducted by varying the acetone ratio of 1:1/4, 1:1/3, 1:1/2 and 1:1 to the high viscosity resin. For the study on the physical and tribological properties of the micro bearing concept, the selected acetone ratio from the previous study will be used as the control parameter while varying filler loadings percentage of 1%, 3%, 5%, 7% and 10%, accordingly. The surface topography and morphology were tested using Alicona Infinite Focus and Polarised Optical Microscope to determine the surface profile measurement. Based on the results observed, EpUPE3 (epoxy and UHMWPE with acetone ratio of 1:1/2) showed better surface distribution and morphology with relatively low value of surface roughness (Ra) which is 1.41 µm and low pseuodocolour value of surface height which is around 6.76-6.77 cm compared to other formulation ratio. While for the tribological and physical properties, the respective tests involved are wear abrasion test, viscosity test, hardness test, density test, FTIR test and water absorption test. Based on the results obtained, there were increment up to 41.7% for viscosity value. For the wear test, the results showed decrease in the wear rate up to 72.0%. For the hardness test, the results indicate increment in the hardness value up to 94% compared to UHMWPE alone. For the density test, the results showed decrease in the density value up to 3.8%. The relation between physical to mechanical properties had been achieved whereas the density plays the important role that altered the distribution of micro-bearing UHMWPE to be deposited on the surface which influenced the tribological behavior of the polymer composite. The characterization in term of physical and mechanical properties for polymer composites were analyzed in term of the polymer rheology which involve the filler-filler interaction and filler-matrix interaction. The outcomes of this study can be used as a parameter to for future works improve the bearing surfaces material involving polymer composite in solid lubricant applications due to the simple fabrication process and yield balanced in the bearing properties.

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