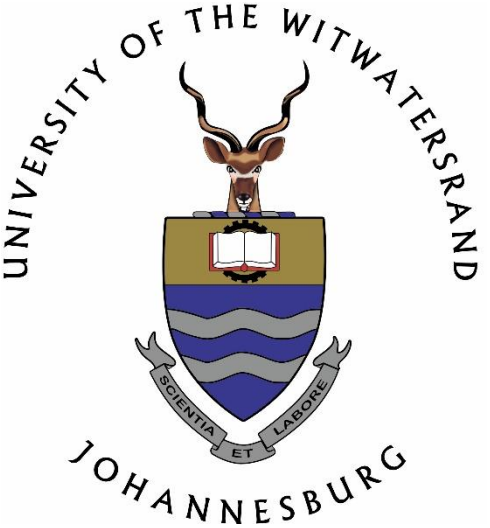

Department of Mechanical, Industrial and Aeronautical Engineering
MSc (Mechanical Engineering)

Electrospun Nano-mat Strengthened Aramid Fibre Hybrid Composites: Improved Mechanical Properties by Continuous Nanofibres

A Research Thesis by:

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Abstract

Aramid fibre reinforced epoxy composites were hybridised by the addition of electrospun PAN (polyacrylonitrile) and ECNF (electrospun carbon nanofibre) doped PAN nanomats. One of the major concerns in polymer composites is the effect of the interlaminar properties on the overall mechanical properties of the composite. Electrospun carbon nanofibres were used as doping agents within PAN nanofibres, and coated in between aramid epoxy laminates to improve the interlaminar properties. PAN nanomats and ECNF doped PAN nanomats were created by the use electrospinning on the surface of aramid fibre sheets. Multiscale hybrid aramid reinforced composites were then fabricated. Mechanical characterization was carried out to determine the effect of PAN and CNF doped PAN nanofibre mats on aramid fibre reinforced epoxy. It was found that PAN reinforced nanomats had improved the mechanical properties and more specifically, when doped by ECNFs, the volume fraction of ECNFs played a vital role. An addition of 1% vol. CNF doped 0.1% vol. PAN reinforcement within a 30% vol. aramid fibre composite (control composite), improved the tensile strength and elastic modulus by 17.3% and 730% respectively. The 0.5% vol. PAN reinforced AFC (aramid fibre composite) specimens revealed a major increase in the flexural strength by 9.67% and 12.1%, when doped by both 0.5% vol. ECNFs and 1% vol. ECNFs respectively. The 0.5% vol. CNF doped reinforcement increased the impact energy by over 40%, for both the 0.1% vol. and 0.2 % vol. PAN reinforced aramid hybrid specimens. The 0.5% vol. CNF doped 0.5% vol. PAN had increased by 30% when compared to a non-doped sample. Morphological studies indicated interlaminar shearing between plies was affected by CNF agglomerations. This was discovered when determining the impact properties of the multiscale doped hybrid composites. Electrospun nanofibres however, assisted in improving the interlaminar regions within aramid epoxy by mechanical locking within the epoxy, and creating an adhesive bond using Van der Waals forces and electrostatic charges between nanofibre and macro fibre. Hybridising aramid epoxy with the use of nanofibres assisted in improving various mechanical properties. Impact degradation was one disadvantage of hybridising using CNF doped PAN nanofibre reinforcements.