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Topic of Research: Fatigue and Erosive Wear Analysis of Biodegradable Nano Composite

## Finding

The present investigation deals with the development of new biofiber-epoxy nano composite. Plant nano fibrils-based composites reinforced with a different weight percentage of palm-epoxy, sugarcane-epoxy, maize-epoxy, and hybrid of these fibers were fabricated by stir casting technique. The raw plant fibers are obtained from the leaf, stem or fruit of the plant. The fibrillation of plant fiber is carried out by using a series of processes. The raw plant fibers first undergo drying in the sun than chopping and lastly sieving. These fibers are further dried in the hot air oven. The Extraction process follows the alkali treatment, autoclave steam explosion, bleaching treatment and acid treatment. After acid hydrolysis the fibrils undergo sonication to obtain the lignin and hemicellulose free cellulose. The phase identification, surface morphology and chemical composition of nano fibers were examined by X-ray diffraction (XRD), Scanning electron microscope (SEM), Energy Dispersive Spectroscopy (EDS) and Fourier Transform Infra-red Spectroscopy (FTIR), respectively. SEM image neat epoxy composite show that no inclusion, particle and nano fibrils. SEM of reinforcing material show that uniform nano dimension bundles of crystals which are depicted in the images. It is evident that the lignin and hemicellulose were removed through bleaching and the fiber bundles were separated into individual cellulose microfibers. EDS of reinforcing material show that maximum carbon percentage in nanofibers is found in maize husk fiber (60.79%) and maximum oxygen percentage in sugarcane bagasse nanofiber fiber (47.46%). XRD analysis of plant fiber at different chemical stages show that obtaining the Nano cellulose constituents of the fibers by each treatment, it is observed that the degree of the crystalline material and the percentages of crystallinity index are affected. The crystallinity index reveals that the increase in the case of Nano cellulose fiber with respect to untreated fibers is due to the extermination of lignin and hemicellulose. The major utilization of FTIR spectroscopy is to determine the

various functional groups and some structural characteristics of substances and materials. These materials have oxygen-containing groups, which are mainly composed of alkaline, aromatic, ketones, ester, and alcohols. Tensile test result of all the fabricated composite at different weight fraction show that at 5%, maize husk and palm leaf bio-composites give similar values at 69 and 68 MPa since their carbon percentage was high, whereas, for bagasse, it is slightly lower at 66 MPa. In hybrid composition in 6,9 and 12%, shows relatively low tensile strength as compared to its successors with reinforcement. Impact test show that the strengths of the bio-composites with different weight percentages of nanofibers. At 5% lower impact strength for sugarcane bagasse due to weak mechanical bonds between coarse cellulose of bagasse and epoxy matrix. It is observed that in hybrid nanofibril composites of the three plants, as there is an increase in the percentage of reinforcement, the impact strength is also rises. Hardness test show that Maize husk hardness is higher than other fibers in both 5% and 10%. The highest value of 91 is reported for the hybrid with 12% inclusions. Flexural test show that strength improves as the percentage of reinforcement increases. In hybrid composition, strength is higher than the conventional composite. The maize husk and bagasse bio composites are 87 MPa, whereas it is slightly higher at palm leaf 91 MPa. The influence of fiber loading on flexural strength of conventional and bio composites is also evaluated using SEM micrographs of the fractured samples. Water absorption test show that weight percentage and the combination of all the three Nano fibrils display enhanced water absorption for the hybrid composite. Solid particle erosion wear test show that Cumulative Mass Loss (CML) of all the fabricated bio composites are calculated. It is seen that the mass loss decreases with increases of percentage of Nano fibril reinforcement. The eroded surfaces of the conventional and hybrid biocomposites were studied using scanning electron microscope (SEM). The fatigue behaviour of neat epoxy matrix and CNFs reinforced conventional and hybrid biocomposites is evaluated using Tension Tension Fatigue Test at 25, 50 and 75 % stress level. Coefficient of variance and S-N curves for studied the behavior of all the composites.

**Keywords:** Nanofibril, Hybrid composite, Extraction, Characterization, Fatigue,Wear.