RESEARCH ACTIVITY of Dott.ssa *ANEESA PADINJAKKARA* performed at the Institute for Polymers Composites and Biomaterials (IPCB-CNR) during the period 20 of October-3 of November 2016, in the frame of Short Term Mobility program.

Development of high performance bio-nanocomposite through the homogenize dispersion of nanocellulose derived from hemp in the epoxy based polymer blend system.

ANEESA PADINJAKKARA
International and inter University Centre for NanoScience and Nanotechnology, Mahatma Gandhi University, Kottayam, India – 686560.

Nanocellulose was isolated from hemp fibre through an economically viable method to develop Hybrid nano-composites. The extracted nanocellulose was used for the fabrication of composites with epoxy resin and liquid rubber. Quality of the chemically treated hemp fibre and extracted nanocellulose have ensured by means of several chemico-physical characterization techniques such as ATR, TGA, SEM, and TEM.

For the exraction of nanocellulose, the raw hemp biomass was firstly treated with alkali solution to remove the hemicellulose. ATR and TGA analysis evidenced the success of the procedure, so as scanning electron microscopy (SEM) showed the development of porous structure due to the removal of hemicellulose. This treatment allowed both the solubilization of emicellulose, thus assuring its following removal and a partial elimination of lignin. The bleaching was conducted on alkali treated fiber in order to purify cellulose by removing the remaining fraction of lignin. The bleaching solution degraded the lignin, so two consecutive bleaching treatment executed for the extraction of pure cellulose. The white color of bleached fiber itself proved the purification procedure and SEM, ATR and TGA results strengthen that.

The morphological investigation of the raw and chemically treated fibres provided a clear information about the changes occurring on the fiber surface during various chemical treatments. After alkali treatment, an interconnected porous structure developed in the fiber through elimination of hemicellulose. The bleaching treatment completely removed the lignin. After each treatment, the fibre surface became more rough compared to the smooth surface of raw fibre due to the removal of impurties from cellulose.

At the higher magnification SEM images, the network of nanofibres could be observed in the bleached fiber and acid hydrolyzed fibers. After the alkali treatment and bleaching the peaks corresponding to hemicellulose and lignin of raw biomass disappered in ATR, whereas TGA analysis showed a slight thermal stabilization due to the presence of crystalline cellulose. Tranmission electron microscopy (TEM) images showed a good dispersion of nanocellulose. From SEM analysis, it was found that the average diameter of nanofibres were about 20 nm.

Hybrid nano-composites were prepared through the incorporation of nanocellulose into epoxy resin and epoxy-liquid rubber system. The processing parameters have optimized. The properties of obtained nanocomposites were evaluated using different characterization techniques and evidenced that nanofibers could really improve the mechanical performance of the composites, enhancing the interfacial adhesion between liquid rubber and epoxy resin.