INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Studies on Oil-Water Separation using Functionalized Magnetic Nanoparticle Dispersed Polymeric Membranes

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SHORT ABSTRACT

The motivation of the current research work is to develop a suitable method for the separation of oil from oily wastewater. A bio dispersant and a polymeric membrane were developed for the treatment of oily wastewater. The dispersant was developed by using a biopolymer as a bio-dispersant to stabilize crude oil. The polymeric membrane was developed using polyvinylidene fluoride (PVDF) and a lab-developed bioderived nanofiller, cellulose nanocrystal (CNC). Oligo lactic acid conjugate chitosan (OCH) were used as a bio-dispersant, an alternative to the synthetic chemical dispersant, which reduces the toxicity associated with chemical dispersants used in oil spill remediation. Results from the research indicate that by applying Xanthan gum (XG) and OCH, a considerably stable crude oil-in-water emulsion was obtained, which remains stable for more than 3 weeks, as confirmed by the optical microscopic image. XG was used to increase the viscosity of water, which helps in further stabilizing the oil droplets. Degradation of these stabilized emulsion droplets was also carried out by isolated bacteria *Pseudomonas aeruginosa* CoE-SusPol3. The degradation percentage obtained from gas chromatography (G.C.) analysis for the stabilized emulsion is 74.31%, whereas the unstabilized emulsion is 34.06%. The in-situ production of biosurfactants from the isolated bacteria also assisted the degradation process by decreasing the surface tension of the crude oil. This research work addressed in this thesis also discussed the use of CNC as a bionanofiller, an alternative to the inorganic filler in the membrane. CNC was modified to form magnetic CNC (FeCNC) by single-step co-precipitation method, and a thin film membrane was prepared by adding FeCNC into the PVDF matrix. Detailed characterization for morphology, wettability, porosity and performance analysis was carried out for the composite membranes. For comparison, PVDF membranes with CNC were also prepared, and its detailed characterization and performance analysis were carried out. Further, the application of a magnetic field during membrane formation gives a new dimension to understanding the magneto-responsive behaviour of FeCNCs for orientation at the surface of the membrane. More prominent finger-like structures were obtained for the PVDF/FeCNC membrane. This migration of FeCNCs to the surface improves the hydrophilic property of the membrane and thus results in superior antifouling properties. This current research helps in understanding the application of biomaterials for treating oily wastewater and how a bio-based material could be a potential and sustainable solution for treating oil spills instead of using harmful synthetic chemical dispersants. The reported findings also give an idea for the improvement of properties of the membrane by application of surface modification of the CNCs and how CNCs can be oriented at the surface of the membrane to improve the performance.