Seminar of Professor Sabu THOMAS

MGU, Mahatma Gandhi University,
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Nanostructured Polysaccharides Materials for Water Purification

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The design and synthesis of nano-architected cellulose and chitin can act as efficient materials for water purification. The talk aims to study and compare the performance of a polyvinylidene fluoride (PVDF) electrospun membrane, unmodified cellulose nanofiber (CNF) based PVDF membrane, and Meldrum's acid (2,2-dimethyl-1,3-dioxane-4,6-dione) modified CNF-based PVDF membranes against the Fe_2O_3 nanoparticle filtration and crystal violet (CV) dye adsorption. Herein, we introduced a facile method to produce a unique green adsorbent material from cellulose nanofibers (CNFs) via a nonsolvent assisted procedure using Meldrum's acid as an esterification agent to enhance the adsorption toward positively charged crystal violet dyes. Most of the surface modifications of cellulose nanofibers have been done using toxic organic solvents like pyridine, dimethyl acetate, (2,2,6,6-tetramethylpiperidin-1-yl)oxyl (TEMPO), etc. So far, this is the first report on the surface modification of cellulose nanofibers via a nonsolvent assisted procedure. Both CNF-based PVDF membranes were prepared by successive coating of modified and unmodified CNFs on to the surface of a PVDF electrospun membrane. All the demonstrated membranes showed high filtration capacity against the Fe_2O_3 nanoparticles. With the 10 mg/L of crystal violet (CV) aqueous solution, CV adsorption of PVDF electrospun membrane, and unmodified CNF-based PVDF membrane was around 1.368 and 2.948 mg/g of the membrane respectively, whereas it was 3.984 mg/g of the membrane by Meldrum's acid CNF-based PVDF membrane. The demonstrated Meldrum's acid modified CNF-based PVDF membrane was proven to be the efficient media that can concurrently eliminate the Fe_2O_3 nanoparticles and CV dyes from the water. The investigation into the surface chemistries of cellulose nanofibers beyond the adoption of toxic solvents can enhance the economic usefulness of the process and also yield a new eco-friendly adsorbent material that is agreeable to adsorbing various toxic pollutants.

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