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Identifying the Removal Efficiencies of As^{3+} in Wastewater by Functionalized Nanocellulose

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Nanocellulose (NC) gains significant attention as a promising candidate in water purification and environmental remediation studies due to its superior chemical and physical properties. The present study explored the capacity of removing the hypertoxic As^{3+} in wastewater, with the use of NC after functionalization, namely sulfonation, phosphorylation, and xanthation. Cellulose was extracted through an alkaline treatment followed by bleaching with NaOCl from *Panicum maximum,* which is an invasive plant in Sri Lanka, selected as the cellulose source. Acid hydrolysis on extracted cellulose with 50% sulfuric acid, 85% phosphoric acid, and 21.9 % hydrochloric acid results in sulfonated, phosphorylated, and non-functionalized NC respectively. Xanthation on non-functionalized NC with NaOH and CS_2 results xanthated NC. Functionalized NC was separately fabricated on each filter paper with 50 mg loading and allowed to filter the As^{3+}containing water through it. The As^{3+} concentrations in the medium were determined by the colour intensity of formed I_2 with the reduction of IO_3^-, which corresponds to the oxidation of As^{3+} into As^{5+} in an acidic medium, with the aid of UV-Vis spectroscopy. Among the functionalized NC, the sulfonated NC has shown the highest removal efficiencies in 200 ppm, 150 ppm, and 100 ppm As^{3+} concentrations with removal percentages of 46.8,38.4, and 50.1. Further advancement of this work can reach the development of bio-degradable and affordable columns for As^{3+} removal. Dynamic Light Scattering results of sulfonated, phosphorylated, and non-functionalized NC were 295.7 nm, 271.4 nm, and 320.9 nm respectively, indicating that the particle sizes were in the nanoscale range.

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