PVA/Chitosan nanofiber membranes for Pb(II) and Cd(II) ions removal from wastewater

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The nanofibers membranes were fabricated by poly(vinyl alcohol)/chitosan (PVA/Chi) using an electro-spinning technique for selective and high adsorption of lead (Pb(II)) and cadmium (Cd(II)) ions based on the solution acidity. The PVA/Chi NFs membranes were characterized systematically using several instrumentations. In addition, several experimental parameters such as initial metal ions concentration, interaction time, adsorbent dosage, solution pH and the effects of competing ions on Pb(II) and Cd(II) adsorption were evaluated. The adsorption data were also clarified that the PVA/Chi NFs membranes exhibited high kinetic performances towards the both toxic ions at the optimum conditions. The adsorption data were manipulated using different kinetics models, and it was confirmed that only pseudo-second-order model obeyed the adsorption kinetics for Pb(II) and Cd(II) ions. Similarly, the equilibrium data were well fitted with the Langmuir adsorption isotherms model, and the maximum adsorption capacity was 266.12 and 148.79 mg/g for Pb(II) and Cd(II) ions, respectively. The Pb(II) and Cd(II) ions adsorptions were also measured to know the selectivity with simulated environmental solution, and the data were confirmed the high selectivity to Pb(II) and Cd(II) ions at the optimum condition and the nanofibers membrane shown the potentiality for possible use in efficient removal of the selected toxic ions from waste samples. Thus, the PVA/Chi NFs are considered to be effective and promising materials for Pb(II) and Cd(II) ions from wastewaters with high efficiency.

Issues -
- Contaminated drinking water: main cause of diseases in the third-world & development countries.
- 1.1 billion people do not have access to safe water (WHO, 2014).
- The importance of water disinfection and microbial control cannot be overstated.

Potential solution = nanofibrous filter media
- High surface to volume
- Low basis weight
- High permeability
- Small pore size
- Remove unwanted particles smaller than 0.3 μm

Electrospinning

Problems & solutions -
- Water loss and quality deterioration associated with aging distribution networks and the increasing cost to transport water.
- Increasing need for alternative water sources and wastewater reuse for water shortage problems.
- Urgent need for decentralized/point-of-use water treatment and reuse systems.

(A) Adsorption of Cd(II) and Pb(II) ions onto PVA/Chi NFs membrane (Conditions; 0.025 g adsorbent, 10mL of different solution concentrations of heavy-metal ions, contact time = 60 min.) and (B) Plot of Langmuir isotherm for the adsorption of Cd(II) on primary axis and Pb(II) ions onto PVA-Chi NFs membranes.

(A) Pseudo-First-order adsorption kinetics of Cd(II) and Pb(II) ions onto PVA/Chi NFs membranes and (B) Pseudo-second-order adsorption kinetics of Cd(II) and Pb(II) ions onto PVA/Chi NFs membranes.