A Practical Alginate-based Synthetic Differentially Permeable Membrane for Metal Ions Separation

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The problem of heavy metal pollution has escalated to that of a serious social-environmental crisis. Calcium alginate, a natural polymer in brown algae, was investigated regarding its absorption of metal ions. Further analysis has been done in terms of its feasibility of differentiating and retrieving metal ions in sewage. Two parameters: concentration of CaCl2 solution and sodium alginate solution, were varied to produce different alginate layers, allowing for different properties. From the investigation, it was suggested that there was a negative relationship between the permeability and the absorptivity towards lead(II) and cadmium(II) ions. With calcium ion concentration increased from 0.400 M to 1.00 M in fixed alginate concentration (0.800%), the absorptivity increases by 63.6%, while the permeability has decreased by 125%. It was found that the optimal concentration for maximum separation between Pb(II) and Cd(II) ions was reached at the combination of 0.400 M calcium ion, and 0.800% alginate. A difference of 19.7%, between the permeability of Pb(II) ions, and Cd(II) ions was recorded. The ratio between Pb(II) ions and Cd(II) ions that had permeated the membrane was found to be around 2.18:1, hence proving the use of alginate as a differentially permeable membrane for permeating different metal ions in wastewater successful. Based on the findings, a model was made utilizing micro:bit sensors and Python programming as means for automation. Using invented system, the membrane was able to differentiate 1:1 Pb2+/ Cd2+ solution into a 9:1 Pb2+/ Cd2+ solution and a 1:6 Pb2+/ Cd2+ solution, with filtration rates of 2970 mmol m^-2 h^-1 and 313 mmol m^-2 h^-1 respectively.

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