Benchtop NMR relaxometry for the follow-up of Cr(III) and Mn(II) removal by ion exchange resin.

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Water pollution by heavy metals has become a major public health and environmental concern [1]. The removal of these metals from water is often performed by ion exchange. However, Current techniques to study ion exchange efficiency are indirect and destructive. In this research, the paramagnetic properties of Cr(III) and Mn(II) are used to monitor their removal by an ion exchange resin. Indeed, the presence of paramagnetic ions affect the Nuclear Magnetic Resonance (NMR) relaxation times T_1 and T_2 of water protons which can be easily measured by benchtop NMR relaxometry [2-3].

In order to study ion exchange kinetics, a NMR tube was filled with a small amount of Dowex Marathon MSC resin and 350 µL of aqueous solutions containing the paramagnetic ion of interest before being shaken by a vortex mixer. The transverse relaxation time was measured at different time intervals which allowed the monitoring of the amount of loaded metal. The same experiment was repeated with different metal concentrations to provide the adsorption isotherms.

The equilibrium isotherm behavior of Cr(III) or Mn(II) are satisfactorily described by the Langmuir model with the maximum adsorption capacity of 21.8 mg g-1 and 58.1 mg g-1 for Cr(III) and Mn(II) respectively. Experimental kinetic data fit well with the pseudo-first and pseudo-second order model.

In the future, it will be interesting to carry out a so-called NMR column experiment in order to follow the loading of adsorbent in real-time through the measurement of the NMR signal of the resin.

References

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