Abstraction

Ion exchange technology is currently the best way to remove nitrate from drinking water. A commercial resin was tested to examine the effectiveness of adsorption for nitrate removal; the resin is Amberlite IRA 400, since it is considered the most promising owing to its chemical stability and ability to control surface chemistry. KNO₃ solution (22.15 mg L⁻¹) was used in batch adsorption experiments. Adsorbent dosages were varied from 0.875 to 5 g L⁻¹. An increase in adsorbent dosage increased the percent removal of nitrate. The retention was initially very fast and maximum retention was observed within 30 min of agitation. Two simplified kinetic models were considered to investigate the ion exchange mechanisms, i.e. the liquid film diffusion and the intra-particle diffusion models, and it was shown that the former controlled the beginning of the process while the latter predominated at the end of the process.

Keywords: Adsorption; Ion-exchange resins; Kinetic models; Nitrate removal

1. Introduction

The nitrate in groundwater used for drinking in rural areas is becoming an important problem due to its harmful effects. Among several techniques available for the removal of nitrate, such as ion exchange, biological denitrification, chemical reduction and electrodialysis, the ion exchange process seems to be the most suitable for small water suppliers contaminated by nitrate because of its simplicity, effectiveness and relatively low cost [1, 2]. Adsorption on resin is considered as the most promising method owing to its chemical stability and ability to control surface chemistry [3], Amberlite IRA 400 contains an amine group, which is particularly reactive and able to retain anions [4, 5]; these strong base anion exchangers have a significantly stronger affinity for nitrates [6].

To understand the dynamic interactions of nitrate with resins and to predict their fate with time, knowledge concerning the kinetics of these processes is important [7]. A number of models have been suggested in the literature for simulation of the adsorption experimental data.

Various mechanisms and steps in ion-exchange phenomena can control the kinetics. Four major rate-limiting steps are generally cited [8,9]: (1) mass transfer