



Removal of nitrate from groundwater using the technology of electro dialysis and electrodeionization

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ABSTRACT

In this paper, the technical capabilities of a lab-scale electrodeionization (EDI) process and its basic technology electro dialysis (ED) process that used for removing NO_3^- from nitrate-contaminated groundwater were investigated. The EDI unit with three chambers (anode, diluted and cathode) was used; it utilized electricity to regenerate ion-exchange resins instead of chemicals. At first, the voltage-current (V-I) characteristic curves about the ED and EDI processes were studied, and then chose the optimum operating voltage which based on the curves. The effects of operational parameters (voltage, water flow rate and initial NO_3^- -N concentration) on nitrate removal rate and concentration effect of ED and different ion-exchange resins, the proportion of anion and cation resins and the voltage used for regeneration of EDI were investigated. The results of ED showed that NO_3^- -N concentration could be reduced from initial 50–300 mg/l to 1–6 mg/l, with the removal rate 99% and the conductivity could be reduced to less than 10 $\mu\text{s}/\text{cm}$. Under the conditions of equal (1–8 l/h) and unequal (1:1,2,3,4,5,6,7,8 l/h) water flow rate between concentrated and diluted water, the concentrated water could be reached to 2–5 times more than the initial water. The current efficiency and energy consumption was 17–34% and 0.–1.7 W·h/l, respectively. It was shown that ED was effective to NO_3^- removal and concentration. As to EDI process, the results showed that continuous electrodeionization could regenerate the resins effectively from simulated nitrate-contaminated water. Under the condition of 50 V as the regenerate voltage, after 90 h, the regeneration rate was as high as 60%. In addition, the NO_3^- -N concentration of the diluted water was reduced to 5 mg/l from initial 50 mg/l. As a fundamental technology of in-situ remediation for groundwater contamination, the process was proved to be feasible and provided foundation for further research.

Keywords: Nitrate contamination; Electro dialysis; Electrodeionization; Water reuse; Regeneration

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