REMOVAL OF BORON FROM GEOTHERMAL WATER BY ELECTRODIALYSIS (ED) METHOD-EFFECT OF pH

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Geothermal waters may contain high concentration of boron and other toxic elements such as As and F. In geothermal waters boron presents as undissociated boric acid, H₃BO₃ and borate ion, B(OH)₄⁻ depending on pH. Thermal waters are generally used as irrigation water in agricultural fields. Some amount of boron in the irrigation water is required for some metabolic activities of plants, such as cellular multiplication, the metabolism of nucleic acids and the metabolism of sugars. However, if boron concentration in irrigation water is only slightly higher than the tolerable limit value for the plant, this will negatively affect the plant growth and signs of boron toxicity will be observed. Regular use of irrigation water with more than 1 mg/L of boron is harmful for most of the plants [1]. The objective of this study is to investigate the boron removal from geothermal water by ED method using batch-mode operation. Electrodialytic separation of boron was studied as a function of pH. For our experiments, a TS-l-10 model electrodialysis equipment (product of Tokuyama, Japan) modified with rotameters was employed. This equipment contains a stack with ten pairs of Neosepta® CMX (cation exchange) and AMX (anion exchange) membranes with the area of 1 dm². This equipment has three pumps having capacities of max. 1.8 L/min. A rectifier is provided to supply a DC power at a constant voltage (max. 18 V) or constant current (max. 3 A). Three solution tanks (each 1 L) are used for holding the dilute, the concentrated, and the electrode rinse solutions. The electrodes are platinum plated titanium (anode) and stainless steel (cathode). Figure 1 shows the plots of the boron removal from geothermal water vs. time as a function of pH. It was observed that pH is an important parameter on boron removal from geothermal water. Dissociation of boric acid becomes much easier at a higher pH. The increase in pH of geothermal water led to an increase in the amount of B(OH)₄⁻ ions in geothermal water and thus a certain increase in the transport of boron was obtained.

Figure 1. Removal of boron versus time as a function of pH (a: pH= 7.50; b: pH=10.5)

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Reference