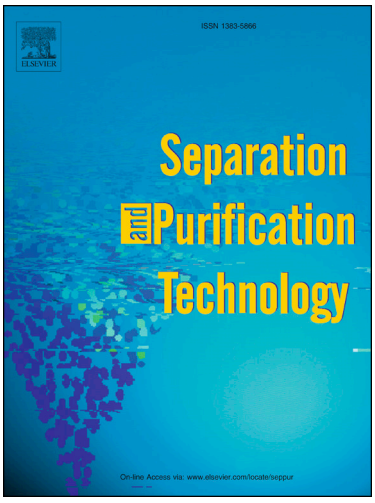

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Preparation of chloride-free potash fertilizers by electrodialysis metathesis

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Abstract: Traditional preparation processes of chloride-free potash fertilizers (KNO_3, K_2CO_3 and K_2SO_4) have certain limitations, such as complicated operation and existing potential pollution. In this work, electrodialysis metathesis (EDM) was used to prepare these fertilizers using KCl and acid radical salt (nitrate, carbonate and sulfate) as raw materials. Firstly, as current density increases from 10 to 25 mA/cm^2, energy consumption grows from 0.41 to 0.64 kW·h/kg KNO_3, while KNO_3 product purity improves from 92.36 to 95.91 wt. %. Secondly, different sulfate sources, such as $MgSO_4$, Na_2SO_4 and $(NH_4)_2SO_4$, were used to investigate the effects of cation species, showing that the orders of energy consumption and impurity cations in product are $E_{MgSO_4} > E_{Na_2SO_4} > E_{(NH_4)_2SO_4}$ and $W_{NH_4} > W_{Na} > W_{Mg}$, and $(NH_4)_2SO_4$ is regarded as the suitable sulfate source. Thirdly, $NaNO_3$, Na_2CO_3 and Na_2SO_4 were selected to investigate the effects of anion species. The order of average energy consumption is $\overline{E}_{K_2CO_3} > \overline{E}_{K_2SO_4} \approx \overline{E}_{KNO_3}$, while that of average current efficiency is $\overline{\eta}_{K_2SO_4} > \overline{\eta}_{K_2CO_3} > \overline{\eta}_{KNO_3}$. Besides, compared with other two fertilizers, generated KNO_3 product purity is comparatively higher. Finally, economic evaluation results showed that EDM has great potential applications in preparing chloride-free potash fertilizers, especially for KNO_3 and K_2CO_3.

Keywords: Chloride-free; Potassium; Electrodialysis; Metathesis; Fertilizer.

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