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Nanofluid-Based Emulsion Liquid Membrane for Selective Extraction and Separation of Dysprosium

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Abstract : Dysprosium is a rare earth element which is essential for many growing high-technology applications. Dysprosium along with neodymium plays a significant role in different applications such as metal halide lamps, permanent magnets, and nuclear reactor control rods preparation. The purification and separation of rare earth elements are challenging because of their similar chemical and physical properties. Among the various methods, membrane processes provide many advantages over the conventional separation processes such as ion exchange and solvent extraction. In this work, selective extraction and separation of dysprosium from aqueous solutions containing an equimolar mixture of dysprosium and neodymium by emulsion liquid membrane (ELM) was investigated. The organic membrane phase of the ELM was a nanofluid consisting of multiwalled carbon nanotubes (MWCNT), Span80 as surfactant, Cyanex 272 as carrier, kerosene as base fluid, and nitric acid solution as internal aqueous phase. Factors affecting separation of dysprosium such as carrier concentration, MWCNT concentration, feed phase pH and stripping phase concentration were analyzed using Taguchi method. Optimal experimental condition was obtained using analysis of variance (ANOVA) after 10 min extraction. Based on the results, using MWCNT nanofluid in ELM process leads to increase the extraction due to higher stability of membrane and mass transfer enhancement and separation factor of 6 for dysprosium over neodymium can be achieved under the optimum conditions. Additionally, demulsification process was successfully performed and the membrane phase reused effectively in the optimum condition.

Keywords : emulsion liquid membrane, MWCNT nanofluid, separation, Taguchi method
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