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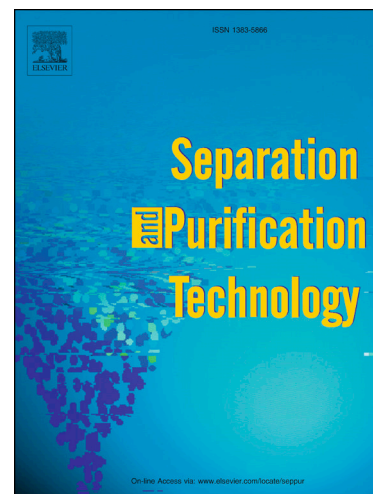
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Chelating extraction of vanadium(V) from low pH sulfuric acid solution by Mextral 973H

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Abstract:

In the current study, a novel chelating extractant Mextral 973H was employed to selectively extract V(V) from a low pH sulfuric acid solution containing high concentration of Fe (III). The extraction of V(V) is strongly dependent on solution pH, and the separation coefficient ($\beta_{(V/Fe)}$) between V(V) and Fe(III) can be greater than 720 when the solution pH < 0.5. A cation exchange between -H and VO_2^+ was proposed as the main extraction mechanism at pH < 1.5, while at pH > 1.5, a solvating reaction between the extractant and metal-oxo cluster anions took place. The effects of solution pH, acid medium types, contacting time and temperatures on the extraction and separation of V have been discussed. FT-IR and ¹HNMR were applied to confirm the extraction mechanism and also the degradation behavior of Mextral 973H in some extreme conditions. The loaded vanadium was effectively stripped using a diluted 0.2M Na₂CO₃ solution and a total stripping extent of 97% was achieved. The extraction process by Mextral 973H was finally simulated using Aspen Plus simulator comparing to traditional process, the results obtained were in good recovery efficiency and with the advantage of acid and alkali saving.

Keywords: Vanadium; Solvent extraction; Sulfuric acid; Mextral 973H; Separation; Aspen Plus

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1. Introduction

Vanadium (V), as the 22nd most abundant element in the Earth's crust, has indispensable applications in the fields of steel and iron, aerospace, catalysts, machine tools, vanadium redox battery, medicine and nuclear reactor components [1-4]. Almost all the vanadium in nature exists in complex minerals such as carnotite, roscoelite, vanadinite, mottramite and patronite [5]. China has the most abundant vanadium-bearing mineral reserves [6]. Among them, vanadium-titanium magnetite and black shale are the main vanadium resource apart from various secondary sources like spent catalysts, fly ashes, crude oil etc [7-11]. In general, vanadium-titanium magnetite ores may be oxidized and enriched into vanadium slag during the steelmaking process in oxygen blowing converter [12], and the vanadium iron spinel was formed as the main composition of the vanadium slag mixed with other phases like fayalite and titanomagnetite [13]. Vanadium in the stone coal exists in the crystal lattice of the aluminosilicate minerals and replaces Al(III)

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