Separation of cobalt and lithium by supported liquid membrane

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Membranes for the separation and concentration of metal ions have received considerable attention throughout the past three decades due to certain specific characteristics such as operational simplicity, energy and selectivity advantages, lower solvent inventory factor and low cost operation factors [1]. Additionally, membrane separation processes have various applications in different fields such as separation of metal values from industrial wastes, analytical applications, and biomedical applications as well as in wastewater treatment [2-3]. Carrier-mediated transport through SLM is currently recognized as a potentially valuable technology for selective separation, concentration of toxic and valuable metal ions. In this investigation the feasibility for separation of cobalt and lithium by both flat sheet liquid membrane (FSSLM) and hollow fiber liquid membrane (HFSLM) for separation of Co(II) and Li(I) has been investigated and compared.

The microporous hydrophobic PVDF film, supplied by Durapore® Membrane Filters, was used as the solid support for the FSSLM study. The hollow fiber module Liqui-Cel® Minimodule® contactor (1.25 in. × 9 in.), supplied by Celgard, was used as the solid support for the HFSLM study. The Cyanex 272 was treated as extractant and mobile carrier in both SLM studies. Sulfuric acid was used as a stripping agent. In both the separation processes effect of different parameters such as pH of the feed solution, Cyanex 272 concentrations, metal ion concentration in feed phase, strip acid concentration on Co(II) flux $J_{Co(II)}$ and Li(I) flux $J_{Li(I)}$ for both the metals have been investigated and compared. The separation factors for both the processes have been calculated and presented in the Table 1.

Table 1. Comparison of separation factors for supported liquid membranes

pH	β FS SLM	β HF SLM	[Cya 272]	β FS SLM	β HF SLM	[Co]	β FS SLM	β HF SLM	H_2SO_4 Conc.	β FS SLM	β HF SLM
4.00	24.3	1.0	30	21.2	1.5	2.5	235.5	24.9	1	53.3	4.8
4.50	40.8	2.3	50	23.7	1.8	5.0	197.8	21.8	5	141.3	7.3
5.00	95.0	6.6	75	36.1	2.5	7.5	195.7	20.4	10	146.8	8.5
5.50	138.1	11.1	100	58.1	4.7	10.0	179.0	18.2	25	179.0	9.6
6.00	179.0	17.5	500	158.6	17.5	30.0	65.1	4.5	50	179.0	14.0
6.50	164.8	15.4	750	179.0	18.2	50.0	41.1	3.5	75	179.0	18.2
6.75	164.8	14.7	1000	91.0	15.7	100.0	20.5	3.0	100	179.0	18.2

β = Separation factor, Cya 272= Cyanex 272, All concentration are in mol/m^3

Our investigation indicates that separation of cobalt/lithium and enrichment of cobalt to required purity can be achieved along with their inherent advantages and disadvantages by controlling some important process parameters.

References

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