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Novel Diglycolamide Extractant?s Performance in Liquid-Liquid Separations for Pilot Scale Application

August 2022

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Idaho National Laboratory

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Novel Diglycolamide Extractant's Performance in Liquid-Liquid Separations for Pilot Scale Application

Enhanced Separations of Critical Materials
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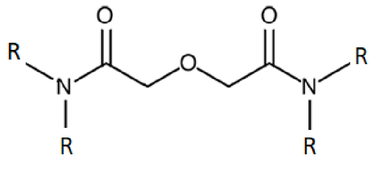
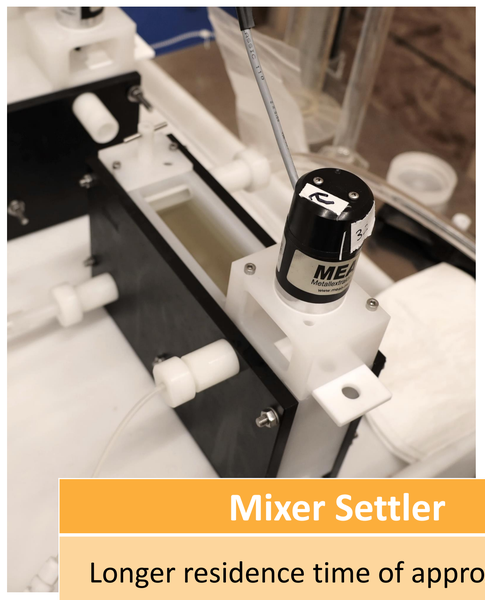
Background

- Modified diglycolamide (DGA) extractants show high affinity for light lanthanides and improved separation factors compared to phosphonic acids used commercially.
- Previous studies with DGAs included flowsheet design and implementation into solvent extraction equipment but with low extractant concentration. Modifications on the alkyl chains of previous DGA extractants led to a competitive product for light rare earth separation with a higher extractant concentration.
- The scope of this project is to test an optimized DGA extractant for application in pilot scale solvent extraction equipment.



Equipment Testing



Mixer Settler
Longer residence time of approx. 3 min
Larger hold up volume: 600 mL
Separation of phases caused by gravity

Centrifugal Contactor
Residence time on the order of seconds
Minimal holdup volume: 200 mL
Phase separation aided by centrifugal force

Previous dispersion studies led to variable and subjective values. Phase disengagement compatibility with solvent extraction equipment was therefore determined experimentally.

Phase Carryover

- Caused by entrainment or slow disengagement. Typically, <1% carryover is acceptable for operating conditions.
- Conditions: O/A= 1, Aqueous feed $[H^+]$= 3 M
  - Mixer Settler: 0.2% aqueous carryover
  - Centrifugal Contactor: 0.1% aqueous carryover
- Extractant dispersion performance was fair, so centrifugal contactors may be a more ideal equipment type due to added separation forces.

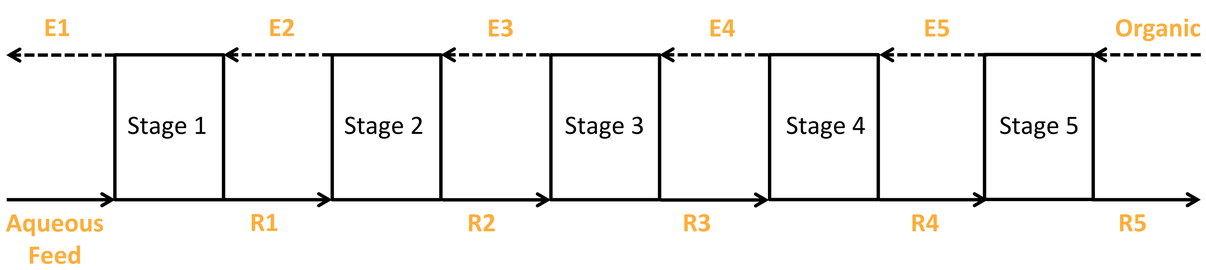
Selective Scrubbing

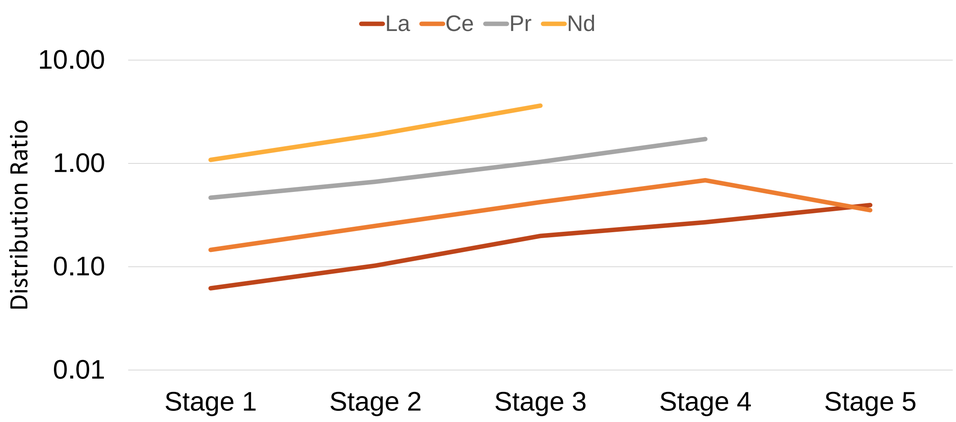
- Single stage scrubbing tests with loaded organic and simulated strip product feed were performed to demonstrate the exchange of co-extracted La and Ce with heavier lanthanides.
- An associated bench scale, acid dependency test with the same parameters showed an increase in Pr and Nd extraction but a decrease in La and Ce scrubbing with an increase in acid concentration.

	Mixer Settler	Centrifugal Contactor
% lost of La+Ce	32%	61%
% gain of heavies	131%	43%

Counter Current Batch Contacts

- Matrices of batch shakeouts simulate steady state results of a five-stage extraction cascade and a five-stage scrub cascade.
- Distribution ratios were extracted and implemented into flowsheet modeling to calculate optimal number of stages.





Future Work

- Implementation into a cascade of 30 mixer-settlers to test flowsheet model and verify pilot scale performance
- Consider life cycle of extractant and any consequent modifications necessary to maintain integrity for large scale application
- Collaborate with other industries to demonstrate the modified DGA's extraction capabilities

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