Effects of Different Acids on Solvent Extraction of REEs from Coal Ash

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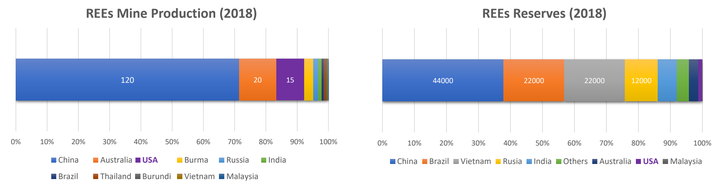
Rare Earth Elements

- Critical Elements in High-Tech, Defense, Clean Energy

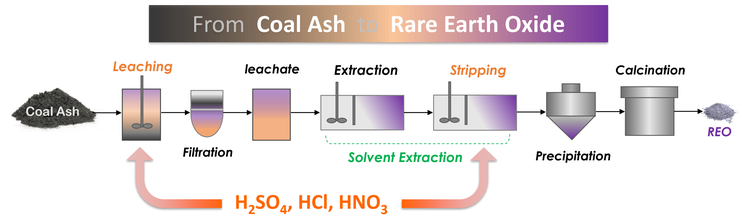
- Global Reserves and Mine Production (1000 tons, source: USGS)

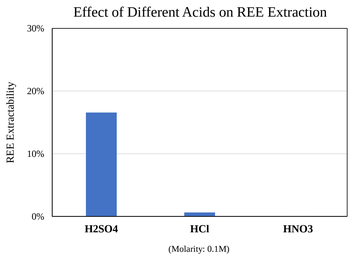


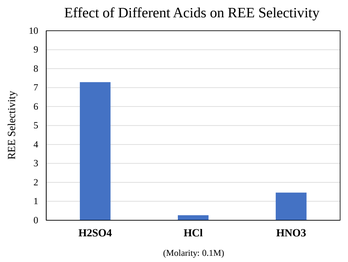
USA: 9% of World REE Production - Imbalance - USA: 1% of World REE Reserves

- USA: Net Import Reliance of REE Compounds and Metals=100%

Effect of Different Acids



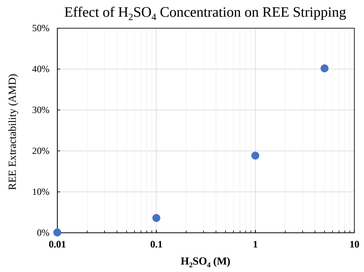


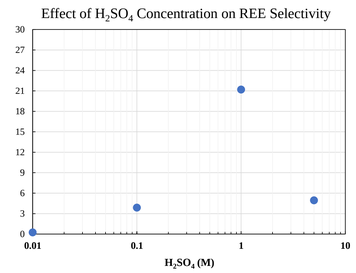


✓ Suitable Acid for REE Extraction from Coal Ash: H_2SO_4

REEs from AMD

- Validation with Other Coal-Based Resources: Acid Mine Drainage (AMD)



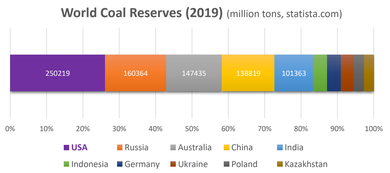


Acid Conc. → REE-Strip

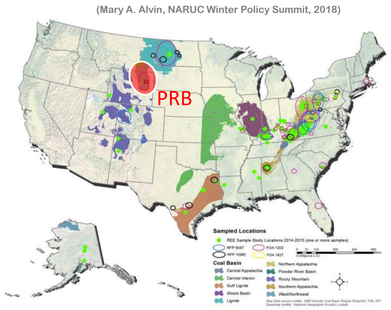
- ✓ Highest REE Selectivity: **~1M H_2SO_4** in the strip
- ✓ High acid concentration (5M): Increase MM extraction → Decrease REE selectivity

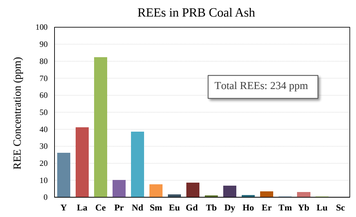
REEs in Coal Ash

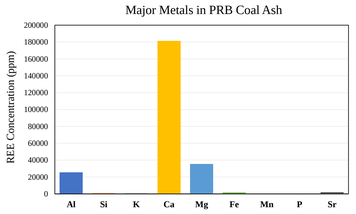
- USA: world's largest coal reserves (26%)
- Avg. REEs in Coal: 62 ppm
- REEs in Coal Ash: ~300 ppm



(Mary A. Alvin, NARUC Winter Policy Summit, 2018)

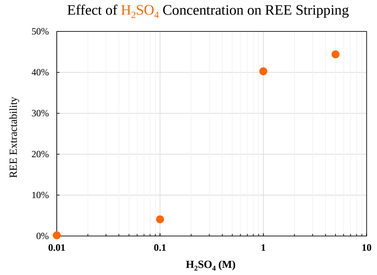






- Coal Ash Used in This Study: Power River Basin (PRB) Coal Ash
- Total REEs: 234 ppm

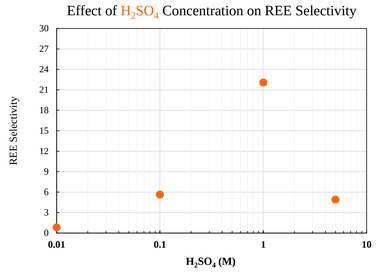
Effect of Acid Concentration



$$REE\ Extractability = \frac{C_{TREE\ in\ S}}{C_{TREE\ in\ L}}$$

(**TREE**: Total REEs, **L**: Leachate, **S**: Strip)

- ✓ **Increase** in acid concentration → **Increase** in REE-stripping from organic phase



$$REE\ Selectivity = \frac{C_{TREE\ in\ A}}{C_{MM\ in\ A}} \Big/ \frac{C_{TREE\ in\ O}}{C_{MM\ in\ O}}$$

(**A**: Aqueous Phase, **O**: Organic Phase, **MM**: Major Metals)

- ✓ Highest REE Selectivity: **~1M H_2SO_4** in the strip

Conclusion

- ✓ H_2SO_4 has shown much higher REE extractability and REE selectivity from coal ash than HCl and HNO_3.
- ✓ The highest REE selectivity over major metals was obtained at 1M H_2SO_4 in the stripping solution.
- ✓ The same REE extraction behaviors were observed with other coal-related resource (AMD).

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