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Purification of lanthanum chloride solution through tertiary amine extraction: thermodynamic and graded assessment

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Abstract

Purification of lanthanum chloride from high-load zinc contaminants remains a major challenge in producing grade 5N lanthanum oxides. This study investigates the process of matrix-driven solvent extraction using tertiary amine N235 to treat a 1.41 M rare earth oxides (REO) industrial lanthanum chloride feed containing 3000 mg/L zinc. Thermodynamic modelling with Medusa Hydra and Langmuir isotherms revealed that the high chloride activity (> 4 M) of the matrix induced significant changes in coordination towards the extractable $[\text{ZnCl}_4]^{2-}$ complex. This transition has a

spontaneous Gibbs free energy of -14.68 kJ/mol. While the two-stage counter-current flow sheet meets the industry target of less than 50 mg/L zinc, the five-stage configuration achieves a four-log reduction to 0.23 mg/L, effectively achieving 99.999% purity. This reagent's lean approach, using water-induced stripping, offers a sustainable and mathematically validated framework for ultra-high purity rare earth finishes. © 2028, Institute of Metallurgy and Ore Beneficiation JSC. All rights reserved.

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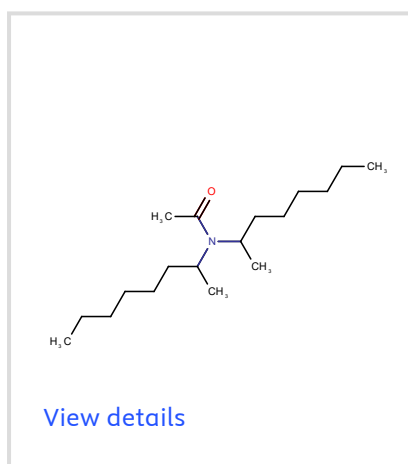
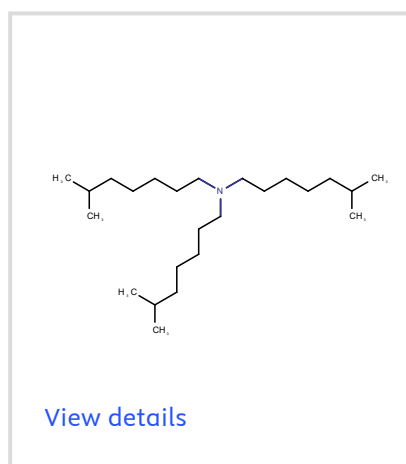
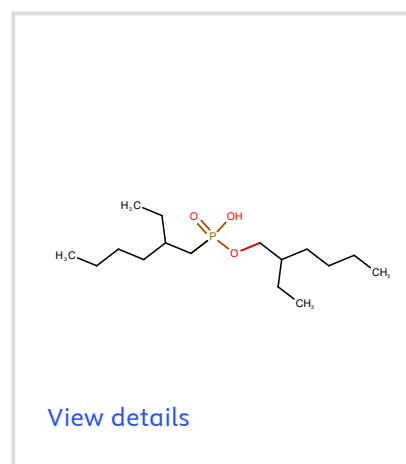
lanthanum chloride; McCabe-Thiele; N235; solvent extraction; zinc

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