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 [ZnCl4](2-)complex. This transition has a spontaneous Gibbs free energy of-14.68 kJ/mol. While the two-stage countercurrent 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 rare earth finishes.

Keywords **Author Keywords:** lanthanum chloride; solvent extraction; zinc; N235; McCabe-Thiele

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