

CREATION AND DEVELOPMENT OF TECHNOLOGIES FOR PRODUCING RARE-EARTH METALS «GIREDMET» FOR USE IN VARIOUS INDUSTRIAL AREAS

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Abstract:

Currently, Russian industry is consistently developing the entire technological chain for rare earth elements (REE): from mining and extraction to metal production and their integration into high-tech manufacturing.

Sazhin Giredmet JSC is a leading Russian research and design institute specializing in developing new materials based on rare earth metals (REM), their compounds, alloys, high-purity substances, and semiconductor materials.

Technologies and Production of Rare Metals (RM) and Rare Earth Elements (REE). Metal-Thermal Reduction.

• Calciothermic technologies for producing REE

Calciothermic reduction technology is used to produce high-purity rare earth metals (REMs) by reducing their fluorides with metallic calcium at high temperatures. A low-tonnage production unit for metallic Pr, Nd, Ce, Dy, and Tb is in operation.



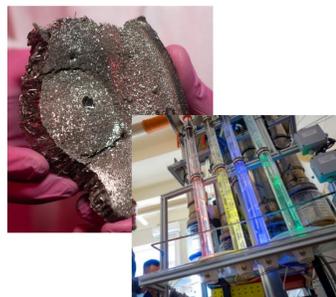
• Lanthanothermic technologies for producing REE



Lanthanothermy technology is used to produce medium-heavy rare earth metals (Sm, Eu, Yb) through the reduction of their oxides with metallic lanthanum and distillation in a single-step process

• Lithiothermic technologies for producing rare earth metals

The technology involves the chlorination of rare earth metal (REM) oxides followed by the lithiothermic reduction of the resulting chlorides with metallic lithium, enabling the production of high-purity Nd, Pr, Dy, and Sc."



• Magnesiothermic technologies for producing RM



Magnesiothermic technology is used to produce powders of refractory metals (Ta, Zr) by reducing their chlorides with metallic magnesium.

• Al-Ca technologies for producing RM and REE

Aluminothermic-calciothermic technology leverages aluminum's high exothermicity and calcium's strong reducing power to produce refractory metals (e.g., Nb, Ta) and their compounds.



Production Technologies for RM and REE Compounds (Hydrometallurgy: Solvent Extraction, Sorption)



Giredmet conducts research on the extraction and separation of light and medium-heavy rare earth elements (REE) from concentrates using diverse extractants. The institute has developed a technology and established an experimental section for extracting and purifying cerium from REE concentrates, leveraging electrochemical and extraction methods. Additionally, a hydrometallurgical technology for processing "black mass" (a mixture of spent lithium-ion batteries) has been developed and implemented on a laboratory scale, enabling the extraction and purification of non-ferrous metals and lithium from associated impurities.

Advanced Oxide-Fluoride Electrolysis for High-Purity REMs

Electrolytic production of rare earth metals (REMs) is carried out from oxide-fluoride melts. The advantages include the ability to obtain high-purity metals (up to 99.9%) as molten ingots and the industrial scalability of the technology. At Giredmet, new electrolyzers are being developed and melt compositions optimized to produce Nd, Ce, and other REMs with improved energy efficiency and equipment durability.



Vacuum Alloy Production: Next-Stage VIM & VAR Technologies



At Giredmet, new vacuum induction melting (VIM) and vacuum arc remelting (VAR) equipment are being developed to process rare earth metals into high-performance alloys. This next-stage technology enables the production of ultra-pure, homogeneous special-purpose alloys (magnetic, superhard, corrosion-resistant) with controlled microstructure and minimal impurities.

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Laboratory Names:
 Laboratory 1 — Laboratory of Metallurgical Processes
 Laboratory 2 — Laboratory of Synthesis Technology for Halide Salts of Rare and Rare-Earth Elements
 Laboratory 3 — Laboratory of High-Purity Substance Production Technology
 Laboratory 4 — Laboratory of Production Technology for Rare and Rare-Earth Metals, Powders, and Alloys



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