

Snack 6: Mining and Reprocessing Critical Minerals in Industrial Waste Streams

Overview

The world is transitioning from a carbon economy into a metal economy to sustain the need to harness, store and transport sustainable energy from the place of generation to end-users. The UK currently relies on the import of critical technology metals and rare earth minerals, predominantly from China, to manufacture facilitating devices across the sector. Critically, presently the UK lacks the infrastructure to process, recover and repurpose those critical elements. Instead, we rely on exporting waste streams to Asia and Europe for further processing. For this reason, the MOD has been stockpiling waste equipment containing critical minerals to retain a national stockpile of strategic resources. But storage at scale is also costly and not sustainable. The major challenge facing Defence is the lack of rapid triage, characterisation and valorising of individual wastes for selective storage or disposal, lack of knowledge in recycling of critical elements and design-to-recycle strategies.

Context

Centre for Sustainable Material Processing (CSMP) at the University of Leicester, comprising three investigators, has a wealth of combined experience in reprocessing critical elements from various sustainable technologies, including, but not limited to, processing superalloys for the aviation industry (Rolls-Royce), removing surface critical elements/radioactive components from crucibles (Rolls-royce, JM and others), critical minerals from X-ray protective garments (SFXray), valuable gold from WEEE wastes (DESCYCLE) and short-loop recycling battery wastes (Ecoshred, JLR, Nissan). More examples, including design-to-recycle ideas, could be found in recent reviews (RSC Sustainability, 2024, 2, 320-347; RSC Sustainability, 2025, 3, 2455-2471).

Recognising the need for rapid triage of the content of critical elements within Defence waste stream valorisation, the team at Leicester has discussed their development of a value-predicting software which determines if a particular waste stream is worth keeping/processing at all. This software performs a retro-economic analysis, weighing up the cost to process (material-specific) and the economic value (or strategic value in the case of Defence) of the recoverable metals, to provide a near-instant determination of the profitability of processing or storage for economic/strategic reasons.

Key Discussion Points

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Actionable Insights

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Summary

