European Commission

Science for Environment Policy

A circular economy for earth metals in industrial waste: the politics of vanadium

A successful circular economy for valuable metals needs more than just effective recycling technologies, as a new study shows. The research, which explored the governance of recovering vanadium from steel-industry waste, revealed that industry stakeholders feel the prospect of financial gain, or reduced costs, through recovery is too distant at present. This perception could hinder a circular economy for critical materials from industrial residue, the study warns.

Vanadium is one of 27 critical raw materials considered highly important to the EU's economic growth but which has high risk associated with its supply[1]. One of its main forthcoming uses is in new battery technologies, particularly energy-storage solutions for managing intermittent supplies of renewable electricity. It, therefore, has an important role to play in decarbonising the economy. Vanadium is also environmentally hazardous and subject to pollution controls.

The raw material is mostly mined in China, Russia and South Africa; the majority of this is used to make steel. Major research interest is underway to identify technological methods for recovering residual vanadium from steel-industry waste, or steel slag.

These recovery methods are close to moving out of the laboratory and being tested in practice, but little research has explored the non-technical issues surrounding a circular economy for this material. This study, therefore, investigated governance issues for vanadium recovery, using a steel works in the north of the UK as a case study. The researchers say their study provides a guide for policymakers on issues relating to resource recovery more widely — such concerns are likely to become more significant as stocks of economically important resources dwindle in future.

The research team interviewed 24 stakeholders, including industry representatives, UK regulators and policymakers, and European Commission circular economy officials. The interviewees were questioned about the potential for recovering vanadium from steel slag, and the role of policy influences and stakeholder relations. The researchers also analysed relevant legislation in detail.

A number of issues emerged from these talks. For instance, a recovery technique which is financially viable under current regulations could not be identified. One technique crushes the slag and adds acid, but this process could create pollution, such as dust and leachate, which could breach the steel works' permit under the Integrated Pollution Prevention and Control (IPPC) Directive (superseded by the Industrial Emissions Directive (IED) since the time of study). The permit sets a limit for emissions from the plant.

Another potential technique adds waste organic matter (containing bacteria and fungi) to crushed slag. The organic matter also helps contain dust. However, the steel company would need a license to take organic matter as a waste stream. Furthermore, this method would entail mixing two waste streams, which would comprise a new substance with unknown properties and environmental risks. Mixing is generally discouraged by the Waste Framework Directive although is permitted in exceptional cases where the adverse impacts of the waste management on human health and the environment are not increased, and the mixing operation conforms to best available techniques). A future new amendment to the WFD — Article 28(3) — will place a stronger emphasis on the recovery of critical raw materials.

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1. http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

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Furthermore, both of these recovery techniques would alter the physical-chemical properties of the slag and render it unusable for use as an aggregate, for which it can otherwise be used.

In addition, to trial new approaches to steel-slag management, the company would have to revise their Environmental Permit; this is seen as a major task and deters innovation. In the UK, an Environmental Permit specifies a firm's precise requirements and actions, including waste-management practices, as permitted by various pieces of legislation, including the IPPC and Waste Framework Directive[2].

The researchers argue that the liability for restoration and remediation of slag could be an incentive to recover vanadium and other elements to provide additional income to offset the costs of remediation. However, at the case study site, the ownership of the slag is passed to another company, which use it as road construction material. Therefore, although the steel works retains environmental liability for the slag under the Waste Framework Directive, they would not own any metals recovered.

However, the steel industry takes a precautious approach to managing slag, preferring to avoid the potential risk of environmental and reputational damage from pollution, than to explore ways of recovering value unless, or until, the financial benefits of recovery become clear.

The study concludes that a greater understanding of the intertwined relationship between stakeholder attitudes and regulation can help ensure that industrial waste plays a stronger role in safeguarding resource supply in the context of a circular economy whilst preserving environmental standards.

2. A future new amendment to the Waste Framework Directive - Article 28(3) - will place a stronger emphasis on the recovery of critical raw materials.