Improved metal recycling

A new technique that can predict where metal quality is lost in the recycling process could make recycling cost-effective and reduce the need for raw material inputs.

CSIRO, the University of Melbourne and Delft University of Technology, the Netherlands, have developed an approach to measure the sustainability of recycling and pinpoint where the inefficiencies occur in the metal recycling process, something that current life cycle assessment (LCA) methods cannot calculate.

Complete dismantling of products such as cars and computers – which contain several different metal types mixed with numerous organic materials – is economically unattractive for the recycling industry. Shredding of partly dismantled products, however, results in particles of mixed materials, causing imperfect separation, which cannot be handled by current metallurgical processes. The result is often low-quality, contaminated products.

A titanium ingot under heat. CSIRO Light Metals Flagship

According to CSIRO Minerals researcher Shahriar Amini, 'recycled light metals are particularly susceptible to contamination. Manufacturers often have to add high-purity raw material to dilute the contaminants and produce alloys of the required standards.'

To overcome the limitations of current LCA methods, Dr Amini has applied thermodynamic life-cycle analysis to light metal recycling. He says that by accurately predicting quality loss, product designers will be able to design for reduced contamination.

His team's analysis uses exergy – a measure of the maximum work potential of a material – to calculate recycling sustainability. A metal stream's loss in exergy due to contamination and dilution defines the resource efficiency of the recycling process.

'By using thermodynamic modelling to predict the behaviour of metal solutions and accurately defining smelting conditions, we have calculated exergy losses and assessed various dilution scenarios,' says Dr Amini.

'This allows us to recommend technical solutions to minimise exergy losses and help make recycling more economically viable, while improving resource efficiency.'

The team is now considering how their process can be extended to products beyond light metals.

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