Materials Processing Institute

CREATING A CIRCULAR ECONOMY IN STEEL

A speech given at the UKRI Interdisciplinary Centre for Circular Metals, Brunel University

Tuesday 14 December 2021

Materials Processing Institute

Introduction

Thank you for inviting me to launch this session on the industrial perspective for the circular economy, where I will focus on the steel industry.

The Materials Processing Institute is the UK's national centre for innovation in steel and metals and are currently delivering a £22m programme of innovation for the sector, funding by the UK government, focussing on decarbonisation and digital technologies, alongside the circular economy.

Steel is already a widely recycled metal, with almost all steel produced using at least 20% recycled content and some steel using 100% recycled content. Steel is infinitely recyclable, in that it can be remelted and reformed time and again without losing its properties. Steel is also generally upcycled, in that in each round of recycling the steel that is produced has greater performance properties than the steel from which it was made.

Here I will explore some of these issues and identify opportunities for improving the circularity of steel, in particularly I will look at the link between the **applications** to which steel is put, the products into which steel is made and the **processes** used to manufacture steel.

Applications

Starting first with the applications, we can see that the emerging economy of both the green and digital revolutions, creates new opportunities and requirements for the application of steel, for new energy technologies, high speed transport, electric vehicles and associated infrastructure.

Circularity in steel is usually conceived as the recovery and remelting of steel at the end of its useful life, but reuse has generally been neglected. There are examples, particularly in the construction area, where steel products have been reused, but they are not widespread.

To fully benefit from reuse requires changes in standards and the business model for steel producers and traders. It also requires a different approach to monitoring in-service performance. The properties of a piece of steel will change over time and a thorough understanding of this on the level of the actual material will be required to unlock the potential for steel reuse. New instrumentation and monitoring technologies will be required, alongside advanced digital technologies, such as digital twins.

Products

As we strive for more demanding applications, new steel alloys are constantly being developed that improve light weighting in automotive and aerospace, corrosion resistance for offshore wind, abrasion resistance for construction machinery, or structural strength for high rise buildings. The inherent adaptability of steel as a material leads to a continuous pipeline of new alloy developments.

We need to give grater consideration to how these new steels are recycled at their end of life. For instance, the rise of niobium steel in construction applications is only now resulting in their returning back into the metals supply chain. There remain unanswered questions about how such steels perform during melting and the impact on slag and fume compositions.

Will our ability to continually upcycle steel be maintained as we strive for ever more exotic alloys, or do we risk creating chemistry 'dead-ends' where products cannot be reprocessed?

Conclusion

During this talk I have focussed on the issues in creating a circular economy around steel itself, but steel processing also consumes vast quantities of metals, minerals and ceramics and generates wastes in the form of slags and other by-products. To take a wholistic view of a circular economy in steel requires attention in these areas to, but to do so would take up more than my allowed five minutes!

Thank you for listening and I would happy to pick up any questions in the discussion.

Materials Processing Institute

Chris McDonald is the Chief Executive Officer of the Materials Processing Institute. The Institute carries out industrial research and innovation in advanced materials, industrial decarbonisation, digital technologies and the circular economy supporting the materials, processing and energy sectors for over 75 years. Chris led the divestment and return to independent, not-for-profit ownership of the Institute in 2014.

Chris's background is in industrial research and manufacturing, where he has worked internationally. A graduate of Cambridge University, Chris is a Fellow the Institute of Chemical Engineers and of the Institute of Materials, Minerals and Mining. He sits on industrial advisory boards at a number of universities, including Oxford and Sheffield.

Chris has an interest in innovation management and industry dynamics and in addition to leading the Institute, he provides expert opinion and consultancy support to companies, institutes, Governments and public bodies in innovation and technology strategy and management. He also advises on the technical due diligence aspects of mergers and acquisitions.

Chris is prominent in the development of public policy, around innovation, steel, SMEs, where he works to support growth and inward investment. Chris is the policy chair for Innovation and Enterprise for the Federation of Small Businesses, a member of the CBI Regional Council and Shadow Monetary Policy Committee for the North East, the Chair of the UK Metals Council and a member of the Steel Advisory Board for UK Steel (EEF).

Chris is often called to commentate in the media on innovation leadership and the steel industry.

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Chris McDonald
Chief Executive Officer
Materials Processing Institute

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The Materials Processing Institute is an independent, open access and not-for-profit technology and innovation centre working with industry, government and academia worldwide. Support ranges from small scale, site based investigations, through to long term collaborative research programmes.

The Materials Processing Institute is expert in advanced materials, industrial decarbonisation, digital technologies and the circular economy, specialising in challenging processes, particularly those involving high specification materials, high temperatures and difficult operating conditions.

The Institute has over 75 years' experience as a leading UK technology provider. Extensive materials processing knowledge is supported by state-of-the-art facilities with a broad range of equipment, from laboratories through to demonstration, scale-up and production plant.

Scientists and engineers work with industry and apply their expertise to develop and implement robust solutions to research and development and improvements for products and processes.

Expertise is spread across a wide range of disciplines, including:

- Materials Characterisation, Research and Development
- Simulation and Design
- Monitoring, Measurement and Control in Hostile Environments
- Process Development and Upscaling
- Specialist Melting and Steel / Alloy Production
- Engineering / Asset Management
- Materials Handling
- Minerals and Ores

Research and project management teams deliver support across a wide range of industrial and manufacturing sectors including:

- Metals and Metals Manufacture
- Chemicals and Process
- Nuclear
- Oil & Gas
- Energy
- Aerospace and Defence
- Mining and Quarrying

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