

Paper Number: 5287

## **The industrial approach to metal recycling - opportunities and challenges to close the loop for technology metals**

Hagelueken, C.

Entwicklungsfonds Seltene Metalle & Umicore, Hanau/Germany, christian.hagelueken@eu.umicore.com

---

The secured supply of non-ferrous metals, especially precious and special metals - essential for high-tech applications - is increasingly considered critical for the European economy. End of life products such as electronics and cars are an important "urban mine" for these metals which can be exploited through comprehensive recycling. E.g., annual sales of mobile phones and computers alone account for 4% of world mine production of gold and silver and even make 20% for palladium and cobalt.

However, for this purpose the existing recycling approaches designed for flows of mass materials are insufficient. It is important to develop instead highly effective process chains that also gain high yields with "technology metals" present only in traces. In technical perspective, many metals can be recycled with high yields, using state-of-the-art recycling plants. The challenge though lies in ensuring the collection of scrap and in the capacity and technical capabilities optimized for each product type through the different stages of the recycling chain. A highly efficient metallurgical recycling process is not sufficient as long as collection rates are poor and high losses occur in dismantling and pre-processing. The latter plays a key role, since the complex and heterogeneous products have to be "decomposed" and treated in such a way that the output fractions generated can reach the most appropriate final metallurgical processes needed to produce pure metals for a new lifecycle. Heterogeneity and complexity of products as well as their design and types of material interconnections used impact the optimal process set-up and determine the limits of recycling. Considerable improvement potentials exists both in product design for recycling/disassembly as well in selecting the most suitable processing option. In this context, legislative frame conditions, business models and other kinds of recycling incentives are crucial to ensure that high quality recycling processes are used along the chain. The recently announced circular economy strategy of the European Union can become an important trigger for improvements in this aspect.

Although the "urban mine" is an often used useful analogy to geological deposits, crucial differences exist with respect to heterogeneity, logistical requirements and economic drivers which need to be understood and considered. Overall, considerable efforts of all players are required to achieve a real closed loop system for metals. Interdisciplinary approaches will play a key role here, and in order to be successful both, the material and the product perspectives, must be taken into account.

### *References:*

- [1] Hagelueken C (2014) Recycling of (critical) metals, In; Gunn G (ed) Critical Metals Handbook, Wiley, 41-69
- [2] Hagelueken C and Meskers C (2010) Complex Lifecycles of precious and special metals, In: Graedel T, Van der Voet E (eds) Linkages of Sustainability, MIT Press, 163-197

