NETWORKS OF INFRASTRUCTURE ZEROWASTE CLUSTER

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Introduction

Europe is highly dependent on the import of raw materials to supply its core industrial activities.[1] Several initiatives are therefore launched to increase resource efficiency and convert the current linear economic model into a circular approach. This requires a range of innovative technologies and infrastructures that are flexible to different resource types, availabilities and product compositions. One of the biggest hurdles for this innovation is, however, that it requires big and capital-intensive infrastructure. The European Institute of Technology (EIT) created the knowledge and innovation community EIT RawMaterials to tackle these challenges in the field of raw materials. EIT RawMaterials created virtual pools of state-of-the-art infrastructure within a certain domain of the raw materials value chain, *i.e.* networks of infrastructure (NoIs). The ZeroWaste cluster is a group of 9 of these NoIs and aims at providing and promoting services for unit processes in the ZeroWaste metallurgical toolbox.
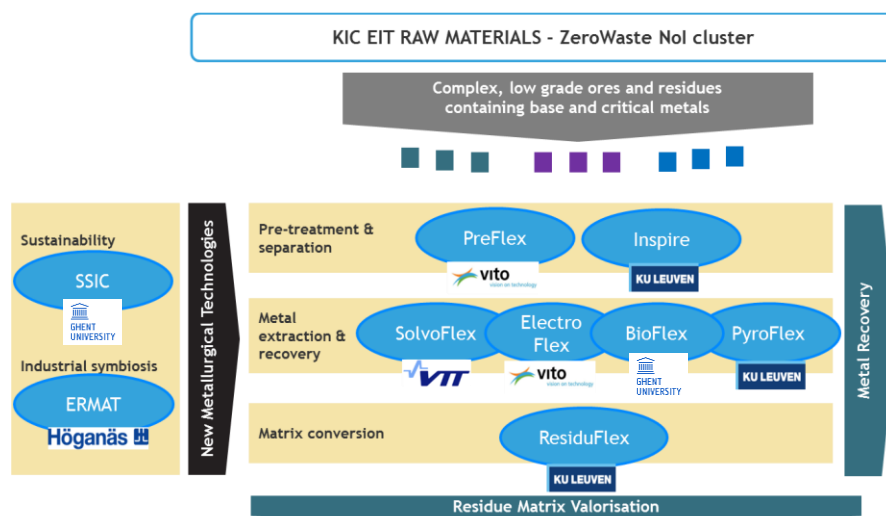

Figure 1: Structure of the ZeroWaste cluster

Figure 1 shows the structure of this ZeroWaste cluster which integrates infrastructure and expertise, such as solvo-, electro-, bio- and pyrometallurgy together with flow separation, pretreatment and residue valorisation, for treatment of metal containing complex, low grade ores and residues.

PreFlex

The overall economic viability of an extraction process in many cases critically depends on cost-effective pre-treatment and physical separation. In many cases the challenges posed by complex, low grade resources such as heterogeneity, entanglement, composition, complex mineralogy, small particle sizes, *etc.* go beyond the capacities and expertise of a single organisation and collaborative approaches are key to success. The Pre-Flex network aims to boost innovation in the raw materials sector through collaboration by establishing a Europe-wide network that hives the infrastructure and skills regarding 'Pre-treatment and physical separation'. Clients can benefit from a virtual lab which offers various equipment choices and the possibility to access equipment from laboratory to industrial scale. PreFlex can offer efficient solutions for clients through the right equipment choices for their specific needs in connection with the expertise offered by all PreFlex NoI partners.

INSPIRE

The Intensified Flow Separator Infrastructure and Expertise Network (INSPIRE) brings infrastructure & expertise together on innovative and breakthrough process intensification technologies for continuous separation of critical materials. These process intensification technologies strive to maximise the transfer of mass, momentum and heat and hence drastically increase separation efficiencies. The network aims at identifying the promising intensification technologies for the particular aim of separating and purifying metal ions, metal oxides and metal salts from liquid mixtures. The infrastructure consists of structured flow systems, possibly actuated with non-contact energy forms such as light, ultrasound, microwaves, *etc.* These systems are used for intensifying separation processes in the fields of crystallisation, precipitation, chromatographic separation, reactive extraction and membrane separation.

SolvoFlex

SolvoFlex (Solvometallurgy Infrastructure and Expertise Network) provides infrastructure in solvometallurgy through the Single Point of Contact and thereby accelerates the testing and deployment of solvometallurgical applications and services. SolvoFlex provides hydrometallurgical infrastructure and expertise for leaching (in situ, heap, dump, vat, reactor, pressure), precipitation, cementation, crystallisation, liquid-liquid extraction, ion exchange and solids separation. These technologies are increasingly more viable for metals recovery, as the grade of primary ores has decreased over the years and concentrations of metals in secondary raw materials are often highly variable with complex chemical structures suitable for the adjustable hydrometallurgical recovery methods.

ElectroFlex

ElectroFlex will unite and make available Europe's infrastructure and expertise on (bio)electrochemical metal recovery. ElectroFlex intends to boost innovation for valorising complex, low-grade ores and residues by bringing together infrastructure on electrochemical metal recovery and separation in Europe and offer it to potential customers in a comprehensive way. The ElectroFlex network will provide easy-access to equipment and expertise *via* a web-based tool and a Single Point of Contact, matching demand and offer. The infrastructure of the network includes equipment at lab and pilot scale and supporting modelling tools.

BioFlex

BioFlex aims to bring together partners with infrastructure and expertise in biometallurgy. Biometallurgy includes bioleaching of metals from ores and waste, biosorption of metals from liquid streams, bioprecipitation of metals and bio-electrochemistry of metals. There is a need for a one-stop-shop for infrastructure and expertise related to different types of metallurgy, including biometallurgy. The BioFlex network will create such a one-stop-shop for expertise and infrastructure of microbial culture collections, microbial and chemical characterisation techniques, lab- and pilot scale bioreactors and installations for biobased metal extraction.

PyroFlex

PyroFlex unites partners with strong expertise, unique equipment and infrastructure in high temperature extractive metallurgy that can deal with complex low grade residues, allowing the recovery/removal of valuable elements present in low concentrations, as well as to produce a clean slag by hot stage engineering and controlled solidification for subsequent valorisation. It has an overall aim to stimulate cooperation and development in pyrometallurgical processes, and to decrease the barriers for innovation in high temperature residue treatment. It aims to reach these objectives by building a network of pyrometallurgical expertise and infrastructure, primarily for lab scale equipment, providing proof of concept, complemented with thermodynamic calculations and process models. A system to provide services to outside customers will be developed and installed.

ResiduFlex

ResiduFlex unites partners with strong expertise and infrastructure in metallurgical residue valorisation/mineral matrix conversion, *i.e.* the major volumetric fraction, to (construction) materials by making a broad variety related technologies more easily accessible throughout Europe, and by offering a more diverse range of solutions compared to what partners may achieve separately (*e.g.* substitution of cement with by-products, carbonated products, inorganic (alkali activated) polymers, upgraded soil *etc.*). ResiduFlex has the overall aim to increase the number of residues that can be treated by proving the feasibility on the lab scale, detecting opportunities for upscaling, and by enhancing the recovered/generated value. It aims to reach its

objectives by building a network of expertise and infrastructure in residue treatment-valorisation which provides services to outside customers.

SSIC

The SSIC (Sustainability Support in decision making towards the design of products and services for the circular economy) provides information on the sustainability of material stocks, evidence on resource efficiency, analysis of critical raw material savings, guidance on innovation options for life cycle impact hotspots, sustainable up-scaling scenarios, socio-economic costs and benefits, job creation potential of new technologies, market potential, recyclability benefits of new waste valorisation options, *etc.* By clustering the available state-of-the-art technologies and these sustainability support systems, the SSIC helps the industry and research community in solution-driven optimisation.

Implementation plan

The ZeroWaste cluster will offer easy access to the infrastructure within all connected NoIs through a web based tool. The client can contact the NoIs through a query form which funnels the request towards the right NoI partners. An implemented SPoC (Single Point of Contact) for each network will assist the client in specific questions and direct the requests to the right partners. This approach allows fast and easy access to the infrastructure at NoI level.

The ZeroWaste cluster will be presented at the 5th International Slag Valorisation Symposium together with its NoI partners and EIT RawMaterials. This offers a chance to introduce and connect the ZeroWaste cluster and EIT RawMaterials to interested industrial and academic partners from the whole knowledge triangle. The roll-out of the first ZeroWaste cluster web tool, which will give access to the PreFlex infrastructure, will be at this event.

References

1. Eurostat. International trade in raw materials. http://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_raw_materials. Published 2014. Accessed February 21, 2017.