European Commission

Exchange of good practices on **metal by-products recovery**

Technology and policy challenges

Book of abstracts

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The International Conference 'Exchange of good practices on metal by-products recovery – technology and policy challenges' is an event organised by the Unit 'Resource Efficiency and Raw Materials', Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROWTH) of the European Commission with the funding support of the Partnership Instrument.

PDF copy of this Book of Abstracts and presentations available online in the website of the European Innovation Partnership (EIP) on Raw Materials.
https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en

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The European Union Strategy for Raw Materials

Minerals, metals and raw materials in general are essential for the functioning and progress of modern societies. Raw materials are the foundation on which our economy is built, and a sustainable supply of raw materials is essential for maintaining and improving our quality of life.

In response to the key role of raw materials and the current and future challenges in this field, the European Union has launched various actions in recent years. In 2008, the European Commission (EC) submitted the **'Raw Materials Initiative'**. This initiative, which defines a series of policies and integrated strategies that can help the sustainable supply of raw materials for the European economy, is based on three pillars. The first pillar aims to ensure for Europe a sustainable access to raw materials from third countries. The second seeks to promote the supply of raw materials within the Union. Finally, the third pillar covers the promotion of recycling and resource efficiency.

Everybody can see the growing use of increasingly sophisticated products and devices. Modern technologies and services usually depend on raw materials that are difficult to obtain either due to scarcity in nature, difficult extraction or geopolitical reasons. In response to this, and based on a detailed expert report, the EC published in 2010 the first **List of Critical Raw Materials (CRM) for the European Union**. CRM are those important for the value chain and with a particularly high risk of supply shortage. The last criticality assessment was carried out in 2013, when 20 raw materials were identified as critical. The next exercise is planned for 2016.

The EC proposed in 2012 the creation of a **European Innovation Partnership** (EIP) in the field of raw materials. Through this partnership and its **Strategic Implementation Plan** (SIP, adopted in 2013), there is now a much clearer idea of the research and innovation priorities in different sectors of raw materials, from prospecting to extraction, processing, recycling and substitution, including environmental, social or health aspects. The final objectives of the EIP are to reduce imports, promote production in Europe and exports, and put Europe at the forefront in each stage of the value chain by 2020.

Many measures promoted by the EC should be complemented by actions from Member States, industry, academics, researchers and civil society in general. In this regard, the EC launched in 2013 the first **Call for Commitments**. A commitment is a joint undertaking by several partners, who commit to carrying out activities that will contribute to achieving by 2020 the objectives set out in the SIP. At this moment, approximately 800 partners from very different sectors got together in 80 raw materials commitments, which cover the three-pillar structure of the EIP (technological and non-technological aspects, as well as international cooperation). The **second Call for Commitments** will open in end-2015, and new calls are planned for 2017 and 2019. All stakeholders are invited to participate.

Some of the actions proposed in the SIP are being implemented in the framework of the Programme **'Horizon 2020'** (H2020). The **raw materials part of H2020 is placed under the 'Societal Challenge 5** – Climate Action, Environment, Resource Efficiency and Raw Materials' (SC5) and has a budget of nearly EUR 600 million over the period 2014-2020. H2020 calls on raw materials aim to maximise the positive impacts of the EIP actions across the raw materials value chain and achieve its targets, including 10 innovative pilot actions, finding 3 substitutes for critical raw materials, creating innovation friendly regulatory framework, and developing a proactive international cooperation strategy. The 28 proposals (with around 400 participants) selected in the calls of SC5 and 'Waste Focus Area' for the first programming period (2014-2015) create a very promising basis for achieving the EIP objectives and targets. The new **work programme 2016-2017 of H2020** contains 16 raw materials topics under the SC5 with a budget of more than EUR 140 million, and several topics in other parts of H2020 directly contributing to the raw materials policy. In this period, the first large innovative pilot actions will be launched to demonstrate viability of cost-effective, environmentally sound and safe production of primary and secondary raw materials and unlocking a substantial volume of key raw materials within the EU.

Last but not least, a new main actor has recently arrived to the field of raw materials in Europe. A 'spin-off' of the EIP on Raw Materials under Horizon 2020, the **Knowledge and Innovation Community (KIC) on Raw Materials**, launched by the European Institute of Innovation & Technology (EIT) starts now to work at full speed. Addressing sustainable exploration, extraction, processing, recycling and substitution, the KIC will integrate all three sides of the 'knowledge triangle' – i.e. higher education, research and business – bringing together leading players from all these dimensions.

For further information on EU Raw Materials Policy, please consult: http://ec.europa.eu/growth/sectors/raw-materials/index_en.htm

The International Conference 'Exchange of good practices on metal by-products recovery – technology and policy challenges'

This conference aims at increasing the ability of the raw material industry to supply the economy with vital raw materials by exploiting a higher share of a potentially significant, but currently underexploited source of raw materials: the 'metal by-products'. Ore bodies of major metals such as copper or nickel usually contain metallic raw materials at low concentrations that accompany the major element. These **accompanying elements** or **'metal by-products' are often not properly recovered** during the mineral processing and metallurgical treatment of ores, so they finish diluted in major elements, in slags or wasted, not being properly valued.

Most significantly for the EU, many of these minor metals are scarce or have strategic economic importance, and usually they figure in the list of CRM for the EU. Many **by-product metals play a fundamental role on the competitiveness of the manufacturing sector and on innovations in high-tech sectors** such as renewable energy, telecommunications, information technology or defence industry. Recycling of secondary raw materials (e.g. mining and industrial waste and residues, scrap, complex end-of-life products) faces similar non-optimal recovery rates of strategic/high-value elements contained in low concentrations. The recent 'Study of By-Products of Copper, Lead, Zinc and Nickel', supported by the EC, confirmed the **opportunities** that can be reaped by **improving the metal by-products recovery rates** achieved in the raw material industry.

This conference tackles the technology challenges but also the policies and regulatory framework apt **to promote the recovery of metal by-products**. This aim is pursued by bringing together **leading stakeholders in the field** from industry, research and academia, as well as trade experts and relevant policy-makers. This event provides an excellent opportunity to share experiences, exchange good practices and present existing examples across the whole value chain. A specific session informing about the relevant raw material topics under H2020 aims to encourage multidisciplinary cooperation (at European and international levels) in research and innovation, and a round table will serve to wrap-up the main conclusions.

This volume collects the **abstracts of the presentations and posters received from world-class experts** and shows the latest developments on the recovery of metal by-products. Several abstracts illustrate how the challenges for the recovery of metal by-products are complex and diverse. Accordingly, the **ways to overcome those challenges have multiple origins and reproduce well the three-pillar structure of the EIP:** solutions can come from sustainable technological developments, but better-informed decision making by both policy–makers and companies is also essential. For that, strategies for improving the knowledge base and better understanding the markets can play an important role. Additionally, promotion of skills and multidisciplinary cooperation across the value chain, usually at international level, will be required.

This conference fits well within some of the major challenges for European and global societies for the next decades. For example: many metals recovered as by-products are key for the development of a digital economy and society, and mining, mineral processing and metallurgy can also play a major contribution to an improved resource efficiency and the achievement of a circular economy.

We hope you enjoy the conference.

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Entrepreneurship and SMEs (DG GROWTH)
European Commission

The Partnership Instrument, Introduction by the Service for Foreign Policy Instruments (FPI) of the European Commission

The Partnership Instrument (PI) is one of the funding instruments that enable the EU to take part in shaping global change and promote its core values. It is one of several instruments included in the EU's budget for 2014-2020 as a means of financing the Union's external action.

Projecting EU interests abroad

The PI finances activities in a number of areas of key interest to the Union. This funding supports the external dimension of EU internal policies – in areas such as competitiveness, research and innovation, as well as migration – and helps to address major global challenges such as energy security, climate change and environmental protection. As one of its main orientations, it contributes to the external projection of the Europe 2020 Strategy.

The PI also deals with specific aspects of the EU's economic diplomacy with a view to improving access to third-country markets by boosting trade, investment and business opportunities for European companies. It encourages public diplomacy, people-to-people contacts, academic and think tank cooperation and outreach activities.

Widening the scope of the EU's cooperation

The EU's interaction with many countries around the world focuses on development cooperation. The PI offers a different approach to established models of development cooperation by promoting policy cooperation with countries of strategic interest to the EU. In particular, it allows the EU to establish a wider political dialogue with emerging partners. It also supports the EU's relations with countries that are no longer eligible for bilateral development aid.

The Partnership Instrument and Raw Materials Initiative

By-products conference

FPI4 has supported under the impulse given by the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROWTH), a two-day event focused on the exchange of good practices between the EU and third countries on the recovery of metal by-products during raw materials processing. The event is structured in several sessions with oral presentations, a poster session and a round table session. It has a strong technical character, but policy challenges and international policy dialogues will be also covered.

EU-Canada Mineral Investment Facility

The general objective of this action is to support the Raw Materials Initiative objective of guaranteeing access to a secure and sustainable supply of raw materials for the EU industry. The feasibility study, which will encompass associated events and stakeholder dialogue, should analyse the current state-of-play of cooperation between the EU and Canada on the mining sector and related technology and services, and conclude how to better boost and structure this cooperation and whether this could be achieved through the establishment of a mineral investment facility (MIF) between the EU and Canada; examine all options within the context of the EU-Canada relationship in the field of raw materials; and make a proposal on the best design of the MIF.

Speaker abstracts

UCT PRAGUE

Li and Rb recovery from industrial by-products in the Czech Republic

Keywords
- lithium
- rubidium
- zinnwaldite
- extraction

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By-products from mineral processing of Sn-W ores and from production of feldspar raw materials, used in glass and ceramics industries contain high Li and Rb content in the form of the zinnwaldite mineral. Improved separation and extraction methods were developed and verified at the lab scale in order to obtain high-purity zinnwaldite concentrate from the by-products and to maximise Li and Rb extraction into solutions. Lithium carbonate was obtained from the leach liquors by carbonate precipitation and Rb was separated by selective precipitation of rubidium alum. A magnetic separation process was applied to recover calcium hydroxide from leach residues, which can be reused in sintering in order to minimise the consumption of additives.

Magnesium recovery from exhausted brine

Keywords
- brine disposal
- magnesium
- mineral recovery
- salt works
- reactive crystallisation

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Mg and MgCO3 are among the 20 EU critical raw materials. Interestingly, Mg can be found at very high concentration in brines generated as waste stream from salt works. Literature works have demonstrated the feasibility of Mg extraction from brines [1–3] by reactive precipitation, for the production of Mg(OH)2. Here we present an overview of the experimental campaigns carried out using exhausted brine from real salt works (Italy) to produce Mg(OH)2 with high purity and conversion. Lab – and pilot-scale batch and semi-continuous CSTR crystallisers were developed and tested, eventually leading to a continuous process by a quasi-PFR pilot reactor. Different alkaline solutions have been adopted in order to analyse their influence on the process, looking in particular at the product purity (affected by possible by-products co-precipitation) but also at the economic profitability. A late development focused on the development of a membrane crystalliser reactor using ionic exchange membranes (CrIEM) [4]. In the CrIEM the precipitation reaction occurs avoiding the direct contact between feed brine and alkaline solution, thus allowing in principle the use of any alkaline species, minimising the risk of by-products co-precipitation. In preliminary tests 99.5 % pure Mg(OH)2 was produced using cheap reactant, opening room for the development of a novel and economically profitable process.

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