Presentation KU Leuven SOLVOMET Group:

Laboratory of Metallurgical Chemistry & Industrial Service Centre

P.T. Jones & K. Binnemans

August 2, 2022

SOLVOMET Group

Laboratory of Metallurgical Chemistry [LAB] / Industrial Service Centre [ISC]

SOLVOMET Industrial Service Centre

SOLVOMET's vision is that metallurgical chemistry expertise allows to develop more efficient, eco-friendly hydrometallurgical and solvometallurgical processes to provide the critical metals that are needed for the transition to a climate-neutral society.

SOLVOMET 2.0 / June 2022 (Beguinage, Leuven)

[#circularhydrometallurgy] [#metallurgicalchemistry] - www.solvomet.eu

KU LEUVEN SOLVOMET GROUP

SIM2

SOLVOMET's mission is (1) to perform excellent research in metallurgical chemistry and to educate and train young researchers in this domain [LAB] and (2) to support its Industrial Service Centre partners in the conceptual and practical development of more sustainable (circular, low-energy input) hydrometallurgical (and solvometallurgical) processes, which are subsequently tested using state-of-the-art lab-scale and mini-pilot-scale experimental facilities [ISC].

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Background info on Prof. Koen Binnemans & SOLVOMET Group

- **Full professor** at the Department of Chemistry, specialised in circular hydrometallurgy and solvometallurgy
- Core expertise in **critical metals and solvent extraction** (SX)
- Author of more than 560 papers, **H-index = 81**, > 29,000 citations
- **Former ERC Advanced Grant holder** (SOLCRIMET: Solvometallurgy for critical metals)
- **ERC Proof of Concept holder** (SOLVOLi: Solvometallurgy for battery-grade refining of lithium)
- Co-founder **SOLVOMET Industrial Service Centre** for Hydro/solvometallurgy
- Steercom Member KU Leuven Institute for Sustainable Metals and Minerals (**SIM² KU Leuven**)
- Former Steercom Member European Rare Earth Competency Network (**ERECON**)
- Elected member **Royal Flemish Academy of Belgium for Science and the Arts** (KVAB)
- For research domains "hydrometallurgy" & "solvent extraction", according to Google Scholar (data retrieved 2021-07-06), the "**world's most cited author**".

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SOLVOMET's take on the future of hydrometallurgy

Genuine breakthroughs in hydrometallurgy will not come from the use of neoteric solvents like ionic liquids or deep-eutectic solvents, but rather from a **deep understanding of hydro-processes at a molecular level**. Hydrometallurgy needs to evolve to low-energy-input **circular hydrometallurgy.**

(Prof. Koen Binnemans, August 2021)

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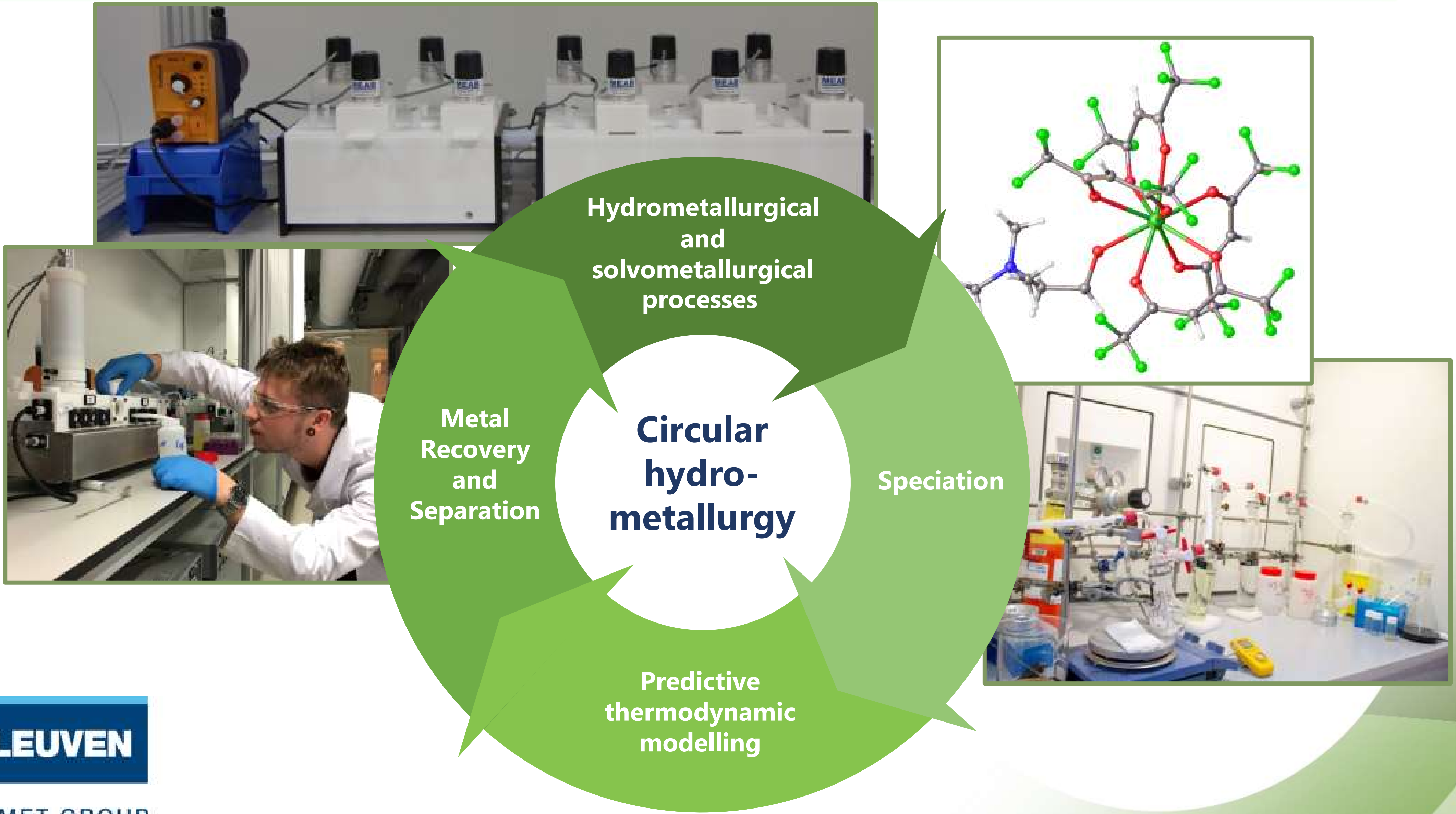
SOLVOMET Group Research domains



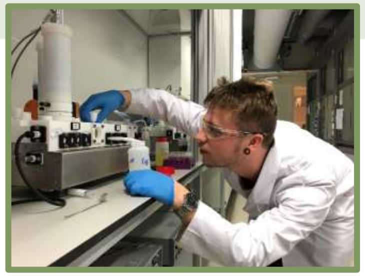
SOLVOMET Group: LAB
Fundamental research/curiosity & hypothesis driven

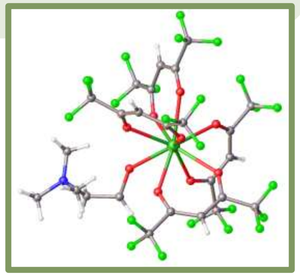
Research topics

- ✓ Speciation studies in concentrated, multicomponent electrolytes
- ✓ Development of methods for quantitative analysis of metals in complex matrices
- ✓ Advanced separation processes for hydrometallurgy
- ✓ Thermochemistry of hydrometallurgical reactions
- ✓ Thermodynamic and kinetic modelling of multiphase, multicomponent metallurgical systems
- ✓ Synthesis of new extractants and new synthesis methods for extractants
- ✓ Electrocoordination chemistry

Research philosophy

- ✓ Fundamental research
- ✓ Curiosity-driven and hypothesis-driven research
- ✓ Low TRL
- ✓ Bottom-up
- ✓ Development of new methods and tools
- ✓ Academia-oriented
- ✓ Answering research questions
- ✓ Insight and understanding at a molecular level





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SOLVOMET Group: Industrial Service Centre (ISC)
Industry-driven & result-oriented research

Research topics (interlinked)

- ✓ Development of (near-circular, low-energy-input) hydrometallurgical & solvometallurgical flowsheets
- ✓ Validation of hydrometallurgical processes on mini-pilot scale
- ✓ Thermodynamic modelling of hydrometallurgical processes
- ✓ Advanced leaching processes
- ✓ Hydrometallurgical applications of solvent extraction and ion exchange
- ✓ Chemical & mineralogical characterisation ores, concentrates & industrial process residues
- ✓ Forensic hydrometallurgy

Research philosophy

- ✓ Applied research
- ✓ Medium to high TRL
- ✓ Top-down (EU calls and bilateral projects with industry)
- ✓ Development of new processes
- ✓ Industry-driven
- ✓ Solving industrial problems
- ✓ Insight and understanding at a molecular level

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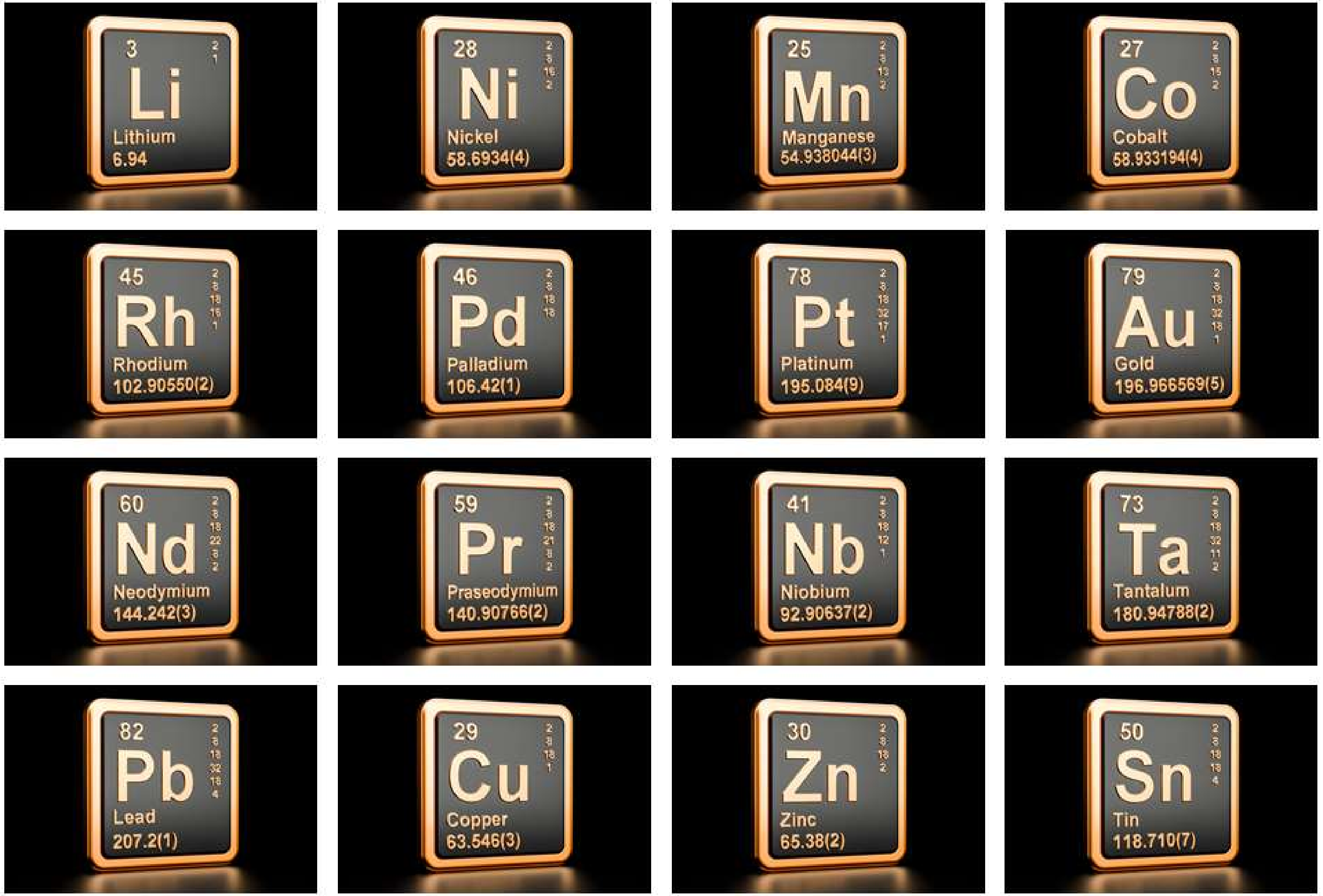
SOLVOMET ISC's key metals of interest



SOLVOMET Industrial Service Centre: Mini-pilot plant facilities for leaching

High pressure reactor

- Effective capacity of 800 mL
- Made from stainless steel with PTFE liner
- Max. pressure = 200 bar
- Max. T = 230 °C with PTFE liner (and 300 °C without)

Multiple reactor system

- 6 reactors (V_{max} = 40 mL) with internal stirring
- Individual T & p control
- Max. p = 200 bar
- Max. T = 300 °C, heating rates up to 15 °C/min

Batch leaching reactors

- Two jacketed reactors (1 & 5 L)
- pH and T control
- Digital overhead stirrer
- Filtration system included

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SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent Solvent Extraction (SX) - Mixer-settlers

3 SX mixer-settler set-ups

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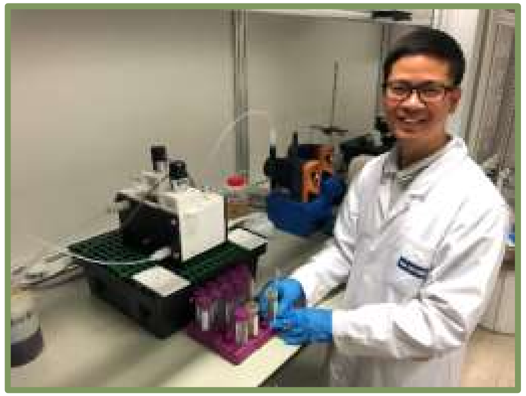
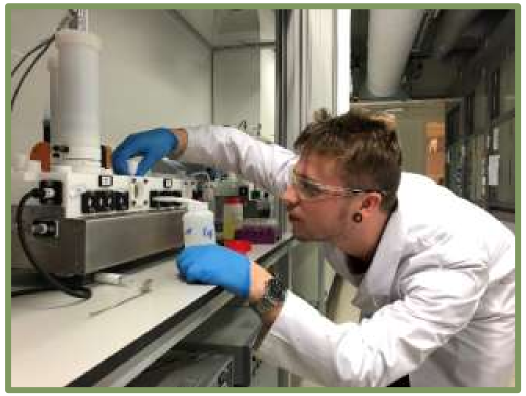
SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent Solvent Extraction (SX) - Mixer-settlers

Characteristics	SX Kinetics	MEAB	Rousselet Robatel
			
Temperature	Only room temperature	Only room temperature	Heatable (water or oil)
Operability	Robust, easy to operate. Easy to assemble.	Robust, easy to operate.	Robust. Easy to assemble. The operation requires more attention. Mainly for research.
Visibility	Transparent	Opaque	Opaque but with a window in the settling chamber
Capacity	Mixer: 0.270 L, Settler: 1.050 L	Mixer: 0.12 L, Settler: 0.48 L	Mixer 0.035 L, Settler 0.143 L
Flows (depends on settling velocity)	Max flow: 10 L/h*	Max flow: 10 L/h	Max flow: 2-4 L/h

*the limitation is for the pump, not the mixer-settler

SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent Solvent Extraction (SX) - Mixer-settlers

	Process	Equipment	Collaboration
PLATIRUS project	**Pt, Pd and Rh recovery from spent autocatalysts**	**MEAB MS**	Johnson Matthey, vito
Bilateral project with industry	**Cu recovery from high-grade Chrysocolla**	**1 L Hitec Zang leaching reactor and Rousselet MS**	Shell
Fundamental research	Li and Mg separation using binary extractants	Rousselet MS	
	Nd and Dy separation using ionic liquids	MEAB MS	
	Fe, Pb and Zn separation from DES	Rousselet MS	
	Y and Eu separation using non-aqueous solvent extraction	Rousselet MS	

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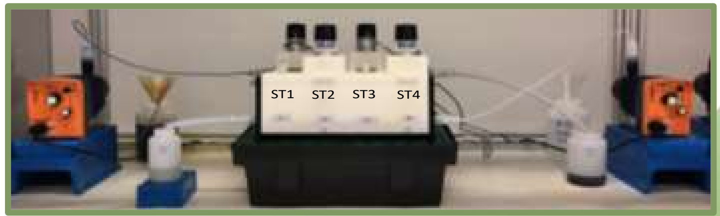

SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent SX – (Agitated column SX)

Kühni-type agitated column

For processes with low mass transfer, average residence time and high number of stages.

- Jacketed column made from glass with internals made from PEEK
- Max active volume: 0.9 L
- Active height: 1.2 m
- Total Flow: 5-25 L/h (both phases)

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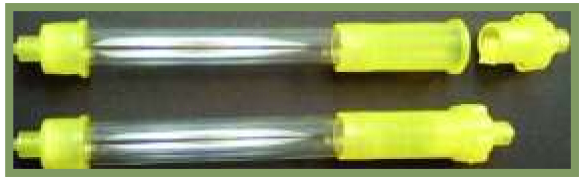
SOLVOMET Industrial Service Centre: Lab facilities for Ion exchange work (lab-scale column IX set-up)

Econo-chromatography columns

- Low-pressure (<1 bar) or gravity flow separations
- Used in various dimensions (*e.g*. 0.7 x 30 cm)



CF-2 Fraction collector

- Equipped with drop sensor
- Capacity of 174 tubes
- Coupled with a peristaltic

Ismatec IPC Peristaltic pump

- High-precision 8-channel dispenser
- Flow rates 0.002 – 44 ml/min

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SOLVOMET Industrial Service Centre:
Key analytical facilities & services

TXRF

WDXRF

XRD

ICP-OES

ICP-MS (Multi Quadruple)

SOLVOMET Industrial Service Centre: Key analytical facilities & services

UV-VIS-NIR

FT-IR/Raman

NMR

Raman microscopy

Publications deriving from bilateral projects with industry – on (solvo)leaching

Journal of Sustainable Metallurgy
https://doi.org/10.1007/s40831-020-00294-3

RESEARCH ARTICLE

Ammoniacal Solvoleaching of Copper from High-Grade Chrysocolla

Lukas Gijsemans[1] · Joris Roosen[1] · Sofía Riaño[1] · Peter Tom Jones[2] · Koen Binnemans[1]

Received: 22 June 2020 / Accepted: 14 September 2020

Abstract
The copper silicate ore chrysocolla forms a large potential copper resource, which has not yet been fully exploited, due to difficulties associated with its beneficiation by flotation and metallurgical processing. Direct acid leaching of chrysocolla causes silica gel formation. Therefore, in this work, the feasibility of solvometallurgical methods to leach copper from high-grade chrysocolla while avoiding issues with silica gel formation was assessed. Ammoniacal solvoleaching was performed with a solvent comprising the chelating extractant LIX 984 N or the acidic extractant Versatic acid 10 in an aliphatic diluent (ShellSol D70 or GTL Fluid G70), combined with a small volume of aqueous ammonia. In the three-phase system, aqueous ammonia dissolves copper from milled and sieved chrysocolla, while copper is simultaneously extracted to the organic phase, releasing ammonia that can be reused for further extraction. The best results were obtained with LIX 984 N as extractant: using a 50 vol% LIX 984 N solution, about 75% of copper could be extracted after 60 min of leaching at 25 °C. The stripping of copper from the pregnant leach solution was optimized. Quantitative stripping of copper was achieved with 1.89 M sulfuric acid and the final aqueous solution of copper sulfate had a concentration of 33 g L^{-1}. Experiments in a leaching reactor (1 L) and small battery of mixer-settlers (3 stages, 35 and 143 mL effective volume in the mixer and the settler, respectively, per stage) were successfully conducted and allowed to recover copper with a purity of 99.9%. A conceptual flow sheet has been developed.

Journal of Sustainable Metallurgy
https://doi.org/10.1007/s40831-020-00305-3

RESEARCH ARTICLE

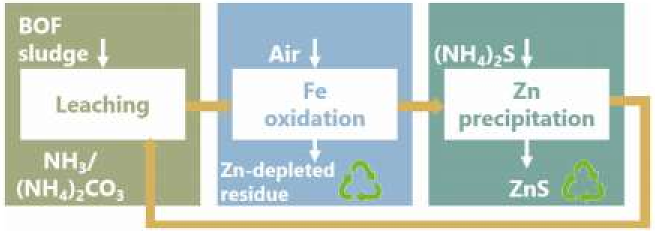
Selective Removal of Zinc from BOF Sludge by Leaching with Mixtures of Ammonia and Ammonium Carbonate

Nerea Rodriguez Rodriguez[1] · Lukas Gijsemans[1] · Jakob Bussé[1] · Joris Roosen[1] · Mehmet Ali Recai Önal[1] · Victoria Masaguer Torres[2] · Álvaro Manjón Fernández[2] · Peter Tom Jones[3] · Koen Binnemans[1]

Received: 18 July 2020 / Accepted: 13 October 2020

Abstract
The zinc content of basic oxygen furnace (BOF) sludges is too high for direct recycling into the blast furnace via the sinter plant, as excessive zinc concentrations are detrimental for the refractory lining of the blast furnace. However, by partial and selective removal of zinc from the BOF sludge, the residual sludge can be used as a secondary iron resource in the blast furnace. In this paper, BOF sludge was leached with aqueous ammonia, aqueous solutions of ammonium salts (chloride, carbonate, and sulfate), and aqueous mixtures of ammonia and ammonium salt. The mixtures of ammonia and ammonium salt could leach more zinc with respect to either the aqueous ammonia or the aqueous ammonium salt solution. The ammonia–ammonium carbonate (AAC) mixture was selected as the most suitable lixiviant due to the high zinc leaching efficiency in combination with a high selectivity towards iron; furthermore, this combination does not introduce unwanted chloride or sulfate impurities in the residue. The leaching process was optimized in terms of the liquid-to-solid ratio, total ammonia concentration, ammonium:ammonia molar ratio, temperature, and leaching time. The co-dissolved iron was precipitated as a hydroxide after oxidation of ferrous to ferric ions by an air stream, without co-precipitation of zinc, while the dissolved zinc could be easily recovered as zinc sulfide by precipitation with ammonium sulfide. The (almost) closed-loop process was successfully up-scaled from 10 mL to 1 L scale.

Graphical Abstract



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Publications deriving from bilateral projects with industry – on SX

SOLVOMET Industrial Service Centre

ACS Sustainable Chemistry & Engineering

pubs.acs.org/journal/ascecg

Research Article

Solvent Extraction of Gold(III) with Diethyl Carbonate

Stijn Raiguel, Lukas Gijsemans, Arne Van den Bossche, Bieke Onghena, and Koen Binnemans*

Cite This: ACS Sustainable Chem. Eng. 2020, 8, 13713–13723

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ABSTRACT: Diethyl carbonate (DEC) was evaluated as a green, renewable alternative to methyl isobutyl ketone and dibutyl carbitol for the recovery of gold from copper-rich sources, such as anode slimes, by solvent extraction from chloride solutions. DEC is a powerful extractant at high chloride concentrations and can be used to sequester and concentrate gold from large volumes of dilute aqueous solutions containing high concentrations of copper. Stripping can be performed using pure water. Different variables were investigated: DEC concentration, chloride concentration, chloride source, phase volume ratio, and equilibration time. The selectivity and phase disengagement times were studied, and possible mechanisms of extraction are discussed and evaluated. In addition, the stability of DEC against hydrolysis was measured.

KEYWORDS: anode slime, chloride hydrometallurgy, copper, precious metal refining, solvent extraction

Chemical Engineering Research and Design 161 (2020) 304–311

Contents lists available at ScienceDirect

Chemical Engineering Research and Design

journal homepage: www.elsevier.com/locate/cherd

ELSEVIER

IChemE

Selection criteria of diluents of tri-n-butyl phosphate for recovering neodymium(III) from nitrate solutions

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ARTICLE INFO

Article history:
Received 24 March 2020
Received in revised form 27 May 2020
Accepted 15 July 2020
Available online 24 July 2020

Keywords:
Diluents
Neutral extractant
Rare earths
TBP
Solvent extraction

ABSTRACT

The selection of a proper diluent should be based on several criteria such as the distribution ratio, phase disengagement time, cost, safety and environmental impact of the process. The effect of different diluents on the solvent extraction of Nd(III) by the neutral extractant tri-n-butylphosphate (TBP) from nitrate feed solutions was studied. The nature of the diluent had little effect on the extraction kinetics of Nd(III) by TBP above 2.5 min. In general, phase disengagement times were relatively shorter for aromatic diluents compared to aliphatic diluents. Conversely, extraction efficiencies were the highest for aliphatic diluents, slightly lower for mixed aliphatic-aromatic diluents and much lower for aromatic diluents. The poorer extraction efficiencies of aromatic diluents maybe due to the lower concentration of free extractant as a result of the stronger interactions of the diluent with water and/or of the diluent with the extractant. Under the experimental conditions, the differences in extraction between aliphatic and aromatic diluents decreased with increasing the salting-out effect of nitrate ions in the feed. At nitrate concentrations of 4.5 mol L^{-1} or more, the different diluents had a limited influence on the metal extraction with 1 mol L^{-1} TBP from feed solutions of 1 g L^{-1} Nd(III). Thus, under these conditions, the selection of the diluent can be preferably based on its cost, safety and biodegradability rather than on its physico-chemical properties.

Hydrometallurgy 177 (2018) 146–151

Contents lists available at ScienceDirect

Hydrometallurgy

journal homepage: www.elsevier.com/locate/hydromet

ELSEVIER

Effect of the diluent on the solvent extraction of neodymium(III) by bis(2-ethylhexyl)phosphoric acid (D2EHPA)

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ARTICLE INFO

Keywords:
D2EHPA
Diluents
Lanthanides
Rare earths
Solvent extraction

ABSTRACT

The effect of different types of diluents on the extraction of neodymium(III) from a chloride aqueous feed solution by the acidic extractant bis(2-ethylhexyl)phosphoric) acid (D2EHPA) was investigated. A total of 11 aliphatic, mixed aliphatic-aromatic and aromatic diluents were considered. D2EHPA was very well miscible with all diluents, even at 90% (v/v) of extractant. Aliphatic diluents gave the highest extraction efficiencies, while aromatic diluents did suppress the formation of emulsions or gels. Although a good separation of Dy(III) over Nd(III) was observed at 0.5 mol/L D2EHPA in all diluents, aromatic diluents were found to yield the highest separation factors. This study shows that the effect of the diluent on the extraction behaviour of Nd(III) is primarily determined by the aliphatic/aromatic content of the diluent. Diluents with the same concentration of aromatics show very similar behaviour. The choice of a diluent can be based on factors other than the extraction behaviour, for instance price and volatility.

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Some key achievements by SOLVOMET

Methanesulfonic acid: a sustainable acidic solvent

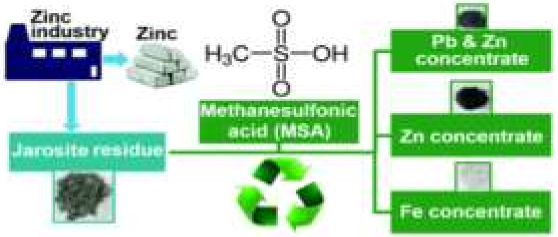
Recovery of rare earths from the green lamp phosphor $LaPO_4:Ce^{3+},Tb^{3+}$ (LAP) by dissolution in concentrated methanesulphonic acid

From the journal RSC Advances

Remaghic

Methanesulfonic acid: a sustainable acidic solvent for recovering metals from the jarosite residue of the zinc industry†

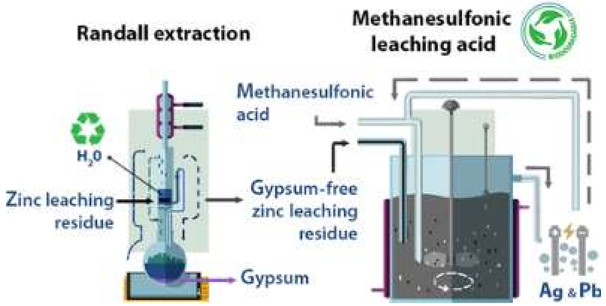
From the journal Green Chemistry



SOCRATES

Recovery of Lead and Silver from Zinc Leaching Residue Using Methanesulfonic Acid

From the journal ACS Sustainable Chemistry and Engineering



nyrstar

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Broad industrial network

Bilateral projects

- Umicore (materials for a better life)
- Aurubis Beerse
- Shell
- ArcelorMittal
- Toyota
- Michelin
- Lithium Americas
- ICL
- Nyrstar
- Meclex

Previous collaborations / Active collaborations within H2020/HE projects

- JM Johnson Matthey (Inspiring science, enhancing life)
- Treibacher Industrie AG
- Toyota
- LCM less common metals
- CLC Cobre Las Cruces, S.A.
- Metallo Aurubis Group
- MEAB
- Indaver
- Nyrstar
- Solvay (asking more from chemistry)
- Boliden
- Aluminium of Greece
- Umicore (materials for a better life)
- Finnish Minerals Group
- Larco
- Somincor (Sociedade Mineira de Neves-Corvo, S.A.)
- Euro Nickel Industries
- Campine (committed and competent)
- JGI Hydrometal
- Glencore

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SOLVOMET's academic network

Some key Projects

HE ENiCoN

HE HEPHAESTUS

Key Partners

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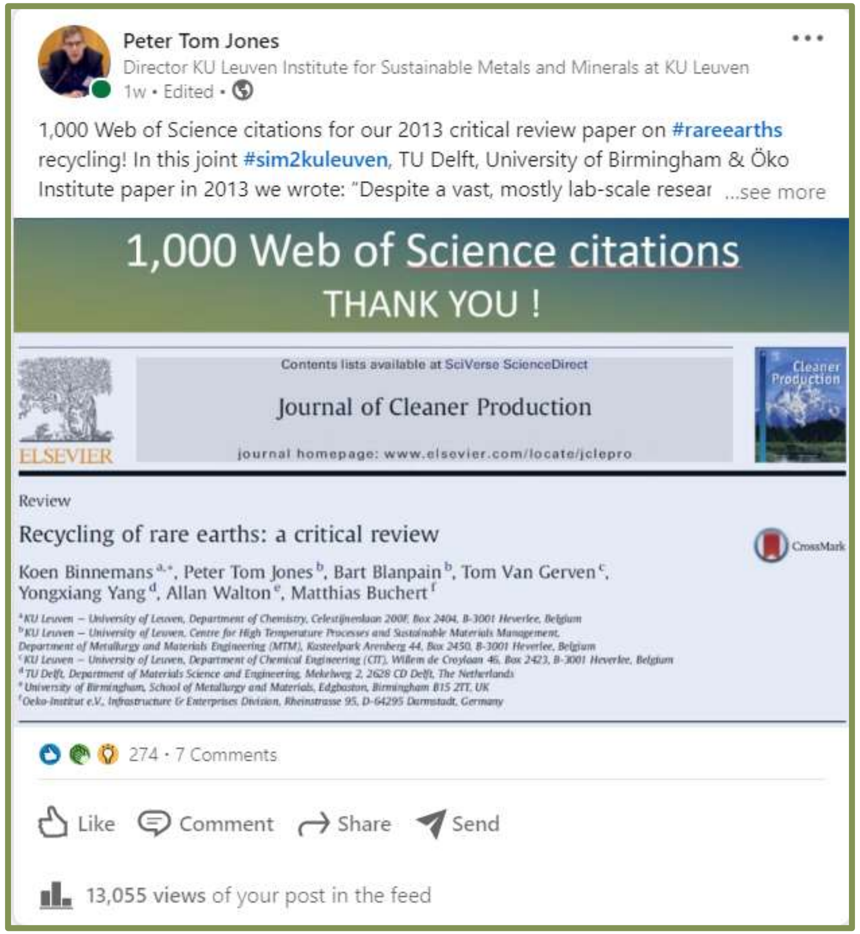
Scientific & societal impact



Peter Tom Jones
Director KU Leuven Institute for Sustainable Metals and Minerals at KU Leuven
1w • Edited •

1,000 Web of Science citations for our 2013 critical review paper on #rareearths recycling! In this joint #sim2kuleuven, TU Delft, University of Birmingham & Öko Institute paper in 2013 we wrote: "Despite a vast, mostly lab-scale resear ...see more

1,000 Web of Science citations
THANK YOU !

Contents lists available at SciVerse ScienceDirect
Journal of Cleaner Production
journal homepage: www.elsevier.com/locate/jclepro

Review

Recycling of rare earths: a critical review

Koen Binnemans[a,*], Peter Tom Jones[b], Bart Blanpain[b], Tom Van Gerven[c], Yongxiang Yang[d], Allan Walton[e], Matthias Buchert[f]

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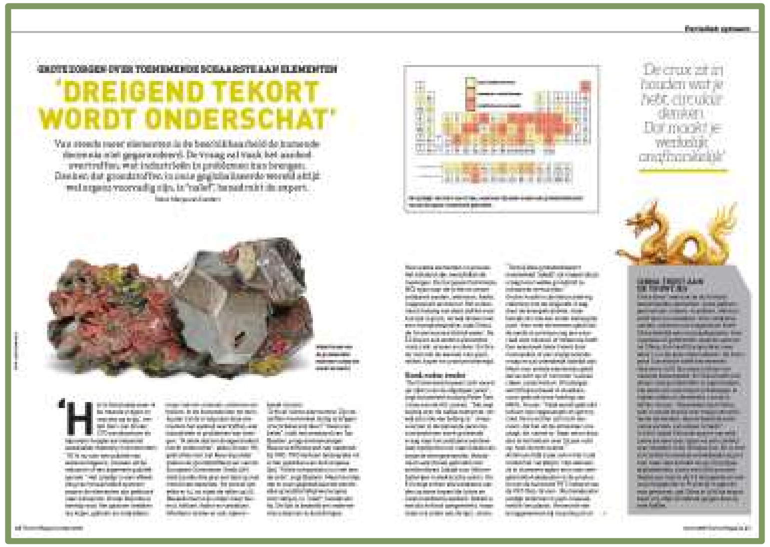

COMMENT

Rare-earth recycling needs market intervention

Koen Binnemans[1]✉, Paul McGuiness[2] and Peter Tom Jones[1]

Nd–Fe–B permanent magnets are essential for the transition to clean energy and mobility. Given the burgeoning demand for neodymium and other rare earths, we discuss the role of recycling and the need for government intervention in securing a sustainable rare-earth supply.

Exactly 200 years ago, in 1821, Michael Faraday demonstrated the first electric motor using a current-carrying wire, suspended vertically into mercury and rotating around a permanent magnet. In January 2021, Norway reported that two-thirds of car sales at the end of 2020 were battery electric vehicles (BEVs), meaning they are the first country in the world where BEV sales outstrip those of vehicles powered by fossil fuels. The vital component in Faraday's laboratory experiment and in the BEVs sold in Norway is the permanent magnet.

Faraday's magnet was a lodestone; today's BEVs are powered by neodymium-iron-boron magnets containing about 30 wt% of rare-earth elements (REEs). This group of metals is considered the most critical of raw materials by the European Commission because of its combination of economic importance and serious supply risk. With the prospect of millions of new BEVs, city scooters and electric bicycles on the road and of more electricity generation from direct-drive wind turbines, the availability of REEs represents a serious materials concern. In this Comment, we look at the status of primary production and recycling of the key REEs for Nd–Fe–B permanent magnets — neodymium, praseodymium, dysprosium and terbium — and discuss whether market intervention is required to get REE recycling up and running.

Permanent magnets and substitution

Nd–Fe–B permanent magnets are the largest single application for which REEs are used but not the only one. Catalysts, batteries, glasses and some metallurgical processes also use large quantities of REEs. Each application tends to demand one or more specific REE, because although REEs are chemically similar, their other properties — magnetic, optical, electronic — often limit a specific application to a choice of just one or two of these elements. In some instances, there is the possibility to replace the REE of the REE-containing component with a non-REE alternative, but in many cases there is no realistic option. Let us look at Nd–Fe–B permanent magnets. The basic composition involves about 30 wt% neodymium, which can be substituted, if necessary, by praseodymium (both of which are light REEs). If the magnets are required to operate above about 80 °C, then ~1 wt% dysprosium or terbium (both of which are much-less-abundant heavy REEs) must be substituted for some of the neodymium or praseodymium. The result is a family of permanent magnets that offers outstanding properties up to about 200 °C, which is sufficient for most automotive and wind-turbine applications. In the absence of available REEs, we would be forced to substitute Nd–Fe–B-based motors and generators with alternatives using much weaker magnets like ferrites or alnicos, which would be bulky and impractical. A dramatic drop in efficiency would be accompanied by a substantial size increase.

A dangerous reliance on imports

Since the early 2000s China has supplied more than 90% of the world's REE demand. However, China has only 37% of the world's total REE reserves, which means many REEs could be sourced from other parts of the world. In South Africa there are plans to restart REE production at the Steenkampskraal mine, which produced and exported a monazite concentrate during the 1950s and 1960s. The company Mkango is exploring for REEs in the Republic of Malawi. The Songwe Hill deposit has carbonatite-hosted REE mineralization and has seen previous explorations in the 1980s. The study that is currently ongoing includes a 10,900 m drilling programme and has received a £7 million investment. Meanwhile, contrary to popular belief, Europe also has extensive REE deposits. In fact, geological analyses have shown that Europe has a wide range of primary REE resources in Scandinavia and Greenland, which could easily meet domestic REE demands[1]. There are, of course, barriers, apart from economic ones: environmental impacts and local protests, in some cases radioactivity issues can throw a spanner in the works. As of today, there is still no operational REE mine in Europe.

Although Japan does not have any REE deposits or mines, it directly funds the Australian rare-earth company Lynas to process REE concentrates from Mount Weld in a separation plant in Malaysia. In doing so, Japan is trying to secure a sustainable REE supply for

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https://doi.org/10.1038/s41578-021-00308-w

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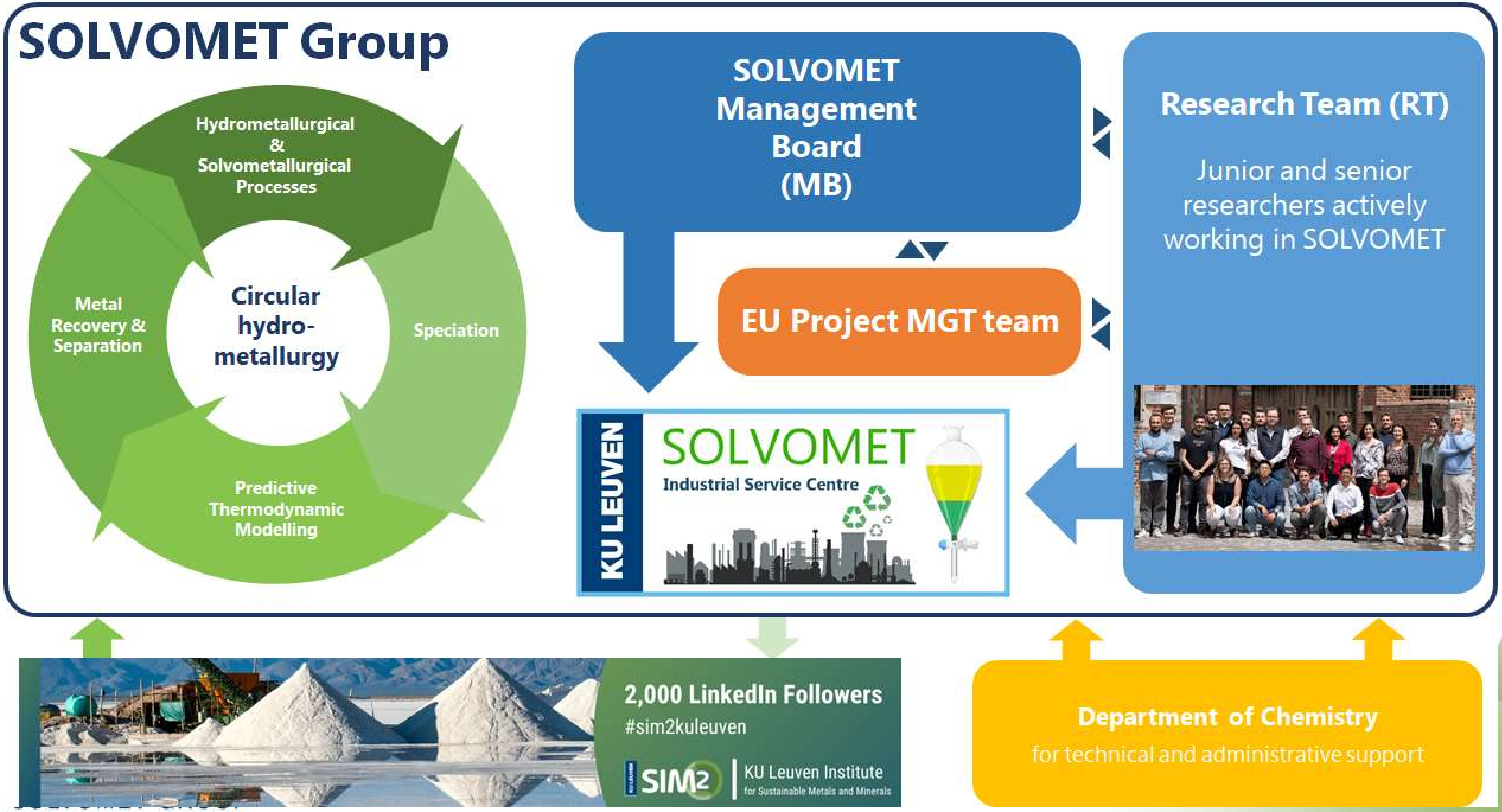
SOLVOMET GROUP

SOLVOMET Group Governance



SOLVOMET Industrial Service Centre: Project types

Services Agreement (short-term)

- **Project description**: 4-page document describing tasks, deliverables, milestones, budget, timing etc.
- **IP**: foreground IP transferred to company
- **Duration**: typically 6 to 12 months
- **Cost**: salaries of the involved researchers + 50% extra for working budget (chemicals, lab use, travel…)).
- **Publications:** not planned unless explicitly desired by company in terms of dissemination goals
- **Ideal for fast delivery of (confidential) results by experienced (permanent staff) research experts/managers, experienced postdocs, research associates & lab technicians**

Long-term framework agreement

- **Project description**: 4-page document research programme, budget
- **IP**: foreground IP transferred to company
- **Duration**: 2 to 5 years
- **Cost**: salaries of the involved researchers + 50% extra for working budget (chemicals, lab use, travel…)).
- **Publications:** not planned unless explicitly desired by company in terms of dissemination goals
- **Ideal for long-term, in-depth, research support provided by experienced (permanent staff) research experts/managers, experienced postdocs, research associates & lab technicians**

Industrial PhD project

- **Project description**: 4-page document with research programme, budget
- **IP**: foreground IP transferred to company
- **Duration**: 4 years
- **Cost**: ~95,000 euro/year [salary + 50% (overhead + working budget for chemicals, lab use, travel…)]
- **Publication clause:** Allowing to publish more generic parts of research while keeping the rest confidential
- **Equitable remuneration principle**: e.g. preferred partnership for follow-up projects
- **Ideal for first-class training of PhD researcher that can go and work for the company later**

KU LEUVEN
SOLVOMET GROUP

SOLVOMET is embedded in the KU Leuven Institute for Sustainable Metals and Minerals (SIM² KU Leuven)

KU LEUVEN SOLVOMET Industrial Service Centre

Research Line 1

Geological exploration and advanced resource characterisation

Research Line 2

Remanufacturing and demanufacturing

Research Line 3

Sustainable metallurgical processes

Research Line 4

Upcycling processes for primary and secondary resources

Research Line 5

Sustainability assessment and policy research

Research Line 6

Process intensification and digitalisation

SIM² KU Leuven's mission is to develop, organise and implement problem-driven, science-deep research and future-oriented education, contributing to the environmentally friendly production and recycling of metals, minerals and engineered materials, supporting the transition to a climate-friendly, circular-economy.

KU LEUVEN SOLVOMET GROUP

KU LEUVEN SIM2 KU Leuven Institute for Sustainable Metals and Minerals

https://chem.kuleuven.be/solvomet
https://solvomet.eu
https://kuleuven.sim2.be/

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