



**KU LEUVEN**

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Industrial Service Centre



# Presentation KU Leuven SOLVOMET Group:

*Laboratory of Metallurgical Chemistry & Industrial Service Centre*

*P.T. Jones & K. Binnemans*

September 27, 2022



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](http://www.solvomet.eu)



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].

# 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)
- **Former 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 (**SIM<sup>2</sup> 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 2022-09-07), the “**world’s most cited author**”.



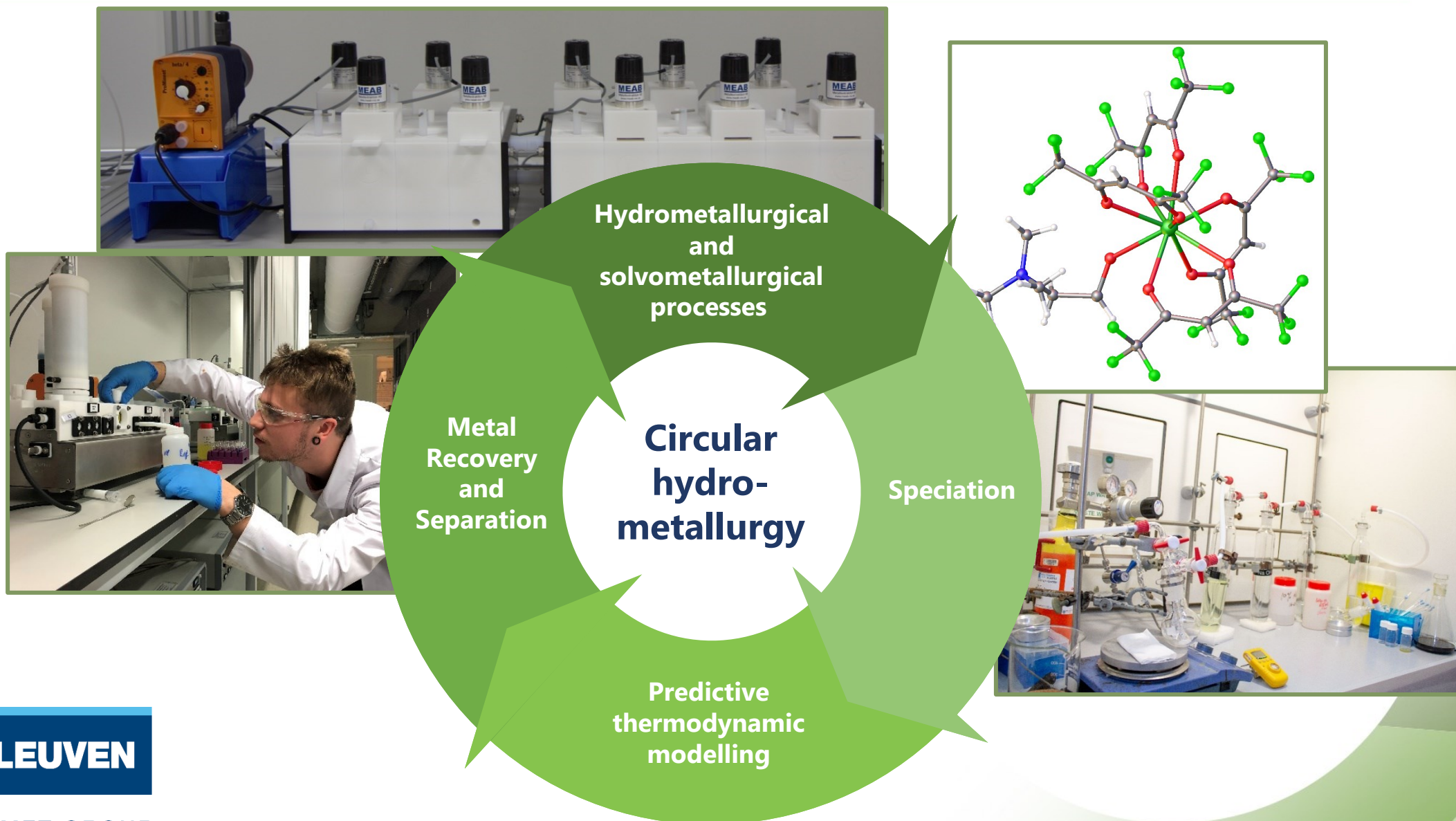




Genuine breakthroughs in hydrometallurgy will not come from the use of neoteric solvents like ionic liquids or deep-eutectic solvents, but rather from a **deep understanding of hydro-processes at a molecular level**. Hydrometallurgy needs to evolve to low-energy-input **circular hydrometallurgy**.

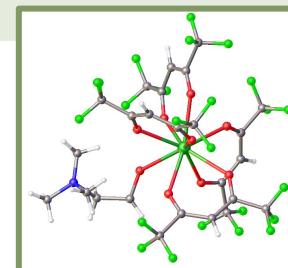
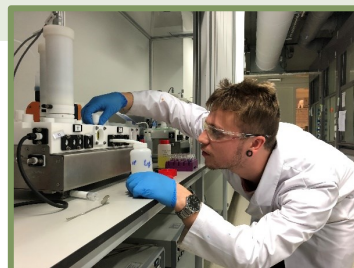
(Prof. Koen Binnemans, August 2021)

# SOLVOMET Group Research domains



### 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

### 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

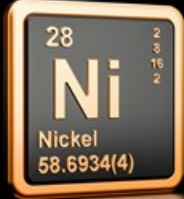

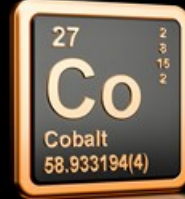
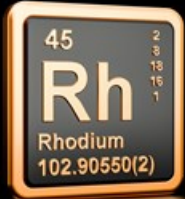
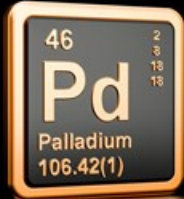
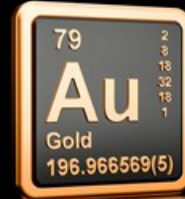
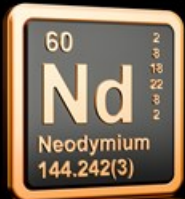
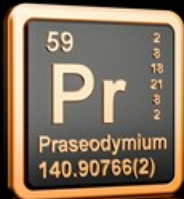
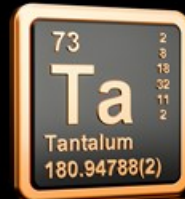
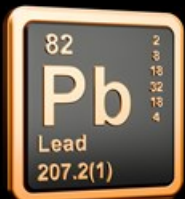
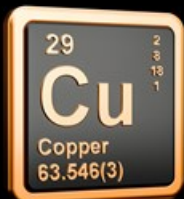
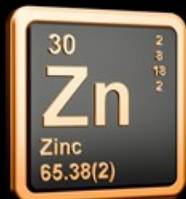
### Research philosophy

- ✓ 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





# SOLVOMET ISC's key metals of interest

 <p>3 <b>Li</b> Lithium 6.94</p>	 <p>28 <b>Ni</b> Nickel 58.6934(4)</p>	 <p>25 <b>Mn</b> Manganese 54.938044(3)</p>	 <p>27 <b>Co</b> Cobalt 58.933194(4)</p>
 <p>45 <b>Rh</b> Rhodium 102.90550(2)</p>	 <p>46 <b>Pd</b> Palladium 106.42(1)</p>	 <p>78 <b>Pt</b> Platinum 195.084(9)</p>	 <p>79 <b>Au</b> Gold 196.966569(5)</p>
 <p>60 <b>Nd</b> Neodymium 144.242(3)</p>	 <p>59 <b>Pr</b> Praseodymium 140.90766(2)</p>	 <p>41 <b>Nb</b> Niobium 92.90637(2)</p>	 <p>73 <b>Ta</b> Tantalum 180.94788(2)</p>
 <p>82 <b>Pb</b> Lead 207.2(1)</p>	 <p>29 <b>Cu</b> Copper 63.546(3)</p>	 <p>30 <b>Zn</b> Zinc 65.38(2)</p>	 <p>50 <b>Sn</b> Tin 118.710(7)</p>



# 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

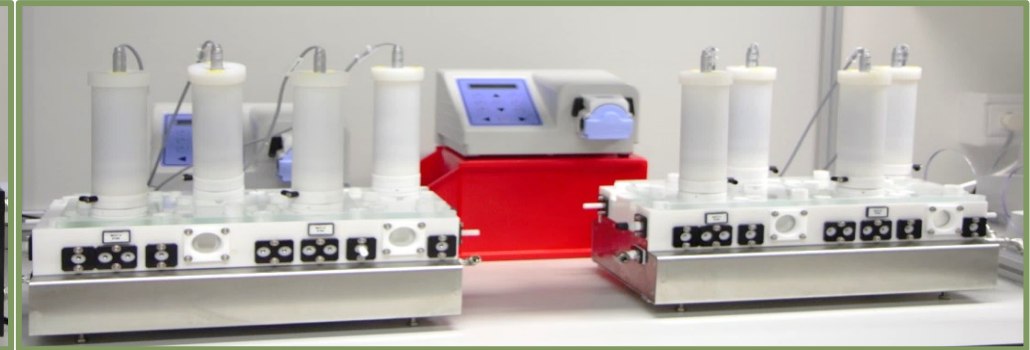


### Batch leaching reactors

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



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



3 SX mixer-settler set-ups

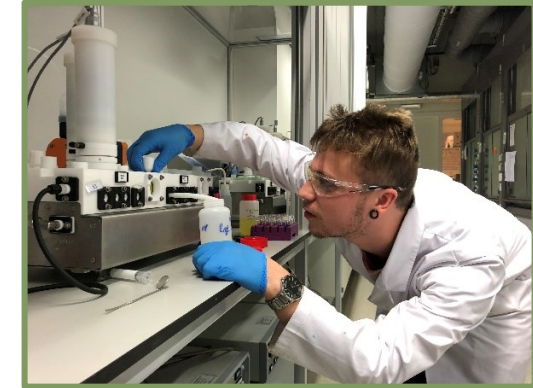
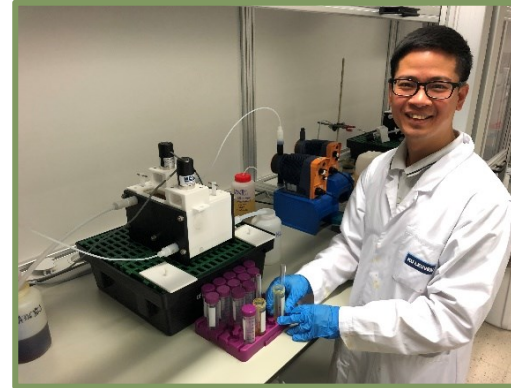
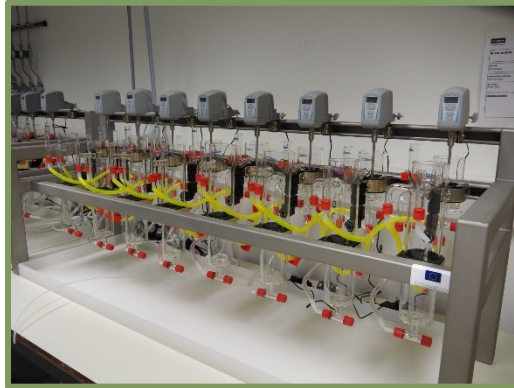




# SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent Solvent Extraction (SX) - Mixer-settlers



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

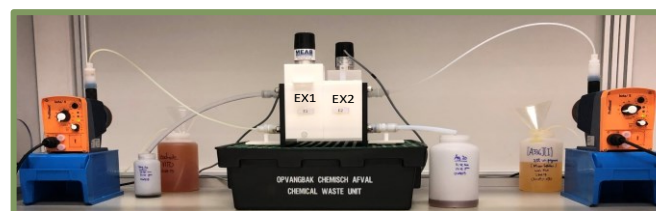




# SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent Solvent Extraction (SX) - Mixer-settlers



	Process	Equipment	Collaboration
PLATIRUS project	Pt, Pd and Rh recovery from spent autocatalysts	MEAB MS	JM Johnson Matthey Inspiring science, enhancing life 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	

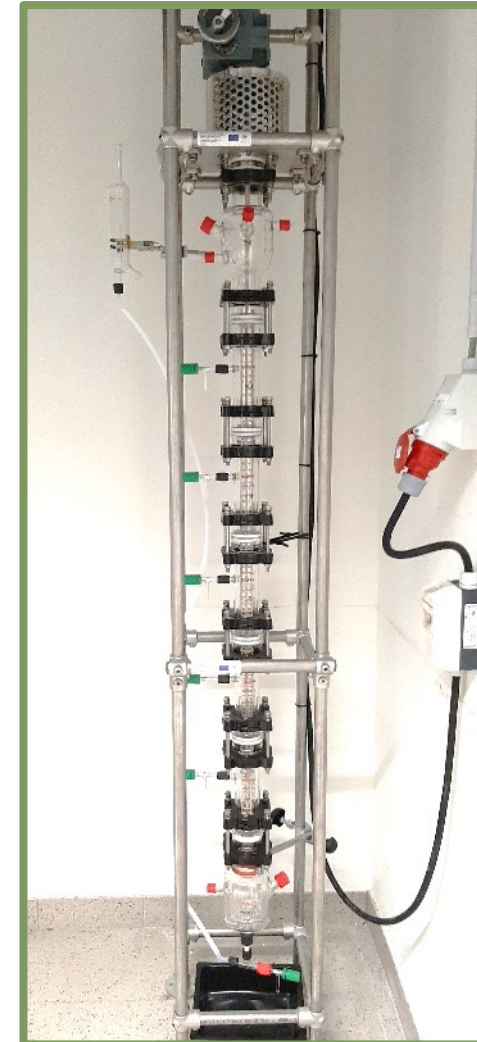


# SOLVOMET Industrial Service Centre: Mini-pilot facilities for continuous, countercurrent SX – (Agitated column SX)

## 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)



# 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





# SOLVOMET Industrial Service Centre: Key analytical facilities & services

**TXRF**



**WDXRF**



**XRD**



**ICP-OES**



**ICP-MS (Multi Quadrupole)**

# 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 Solvleaching of Copper from High-Grade Chrysocolla

Lukas Gijsemans<sup>1</sup> · Joris Roosen<sup>1</sup> · Sofia Riaño<sup>1</sup> · Peter Tom Jones<sup>2</sup> · Koen Binnemans<sup>1</sup>

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#### 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 solvleaching 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<sup>-1</sup>. 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

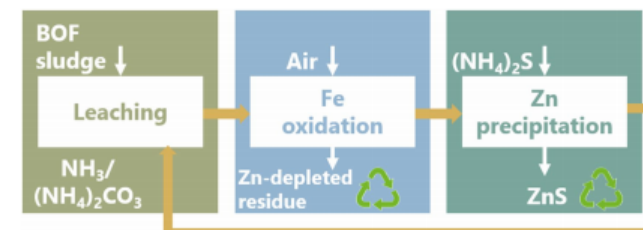
Nerea Rodriguez Rodriguez<sup>1</sup> · Lukas Gijsemans<sup>1</sup> · Jakob Bussé<sup>1</sup> · Joris Roosen<sup>1</sup> · Mehmet Ali Recai Önal<sup>1</sup> · Victoria Masaguer Torres<sup>2</sup> · Álvaro Manjón Fernández<sup>2</sup> · Peter Tom Jones<sup>2</sup> · Koen Binnemans<sup>1</sup>

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#### 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





# Publications deriving from bilateral projects with industry – on SX

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\*

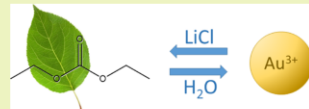
Cite This: *ACS Sustainable Chem. Eng.* 2020, 8, 13713–13723

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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



Hydrometallurgy 177 (2018) 146–151

Contents lists available at ScienceDirect

**Hydrometallurgy**

journal homepage: [www.elsevier.com/locate/hydromet](http://www.elsevier.com/locate/hydromet)

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

Nagaphani Kumar Batchu, Koen Binnemans\*

KU Leuven, Department of Chemistry, Celestijnenlaan 200 F, bus 2404, B-3001 Heverlee, Belgium

Check for updates

**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.

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](http://www.elsevier.com/locate/cherd)

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

Mercedes Regadio\*, Nagaphani Kumar Batchu, Koen Binnemans

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**ARTICLE INFO**

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**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 may be 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<sup>-1</sup> or more, the different diluents had a limited influence on the metal extraction with 1 mol L<sup>-1</sup> TBP from feed solutions of 1 g L<sup>-1</sup> 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.

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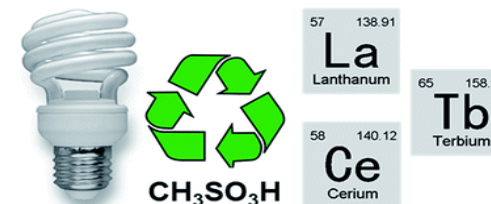
# Some key achievements by SOLVOMET

## Methanesulfonic acid: a sustainable acidic solvent

Recovery of rare earths from the green lamp phosphor  $\text{LaPO}_4:\text{Ce}^{3+}, \text{Tb}^{3+}$  (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

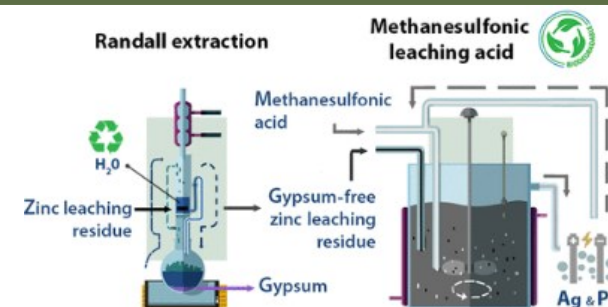


Zero Waste  
CRATES  
EU MSCA-ETN

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



From the journal  
ACS Sustainable  
Chemistry and  
Engineering



nyrstar

# Broad industrial network

## Bilateral projects

## Previous collaborations / Active collaborations within H2020/HE projects



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# SOLVOMET's academic network

## Some key European Projects



## Key Partners



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COMMENT

# Rare-earth recycling needs market intervention

Koen Binnemans<sup>1</sup>, Paul McGuinness<sup>2</sup> and Peter Tom Jones<sup>3</sup>

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 Mingo 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<sup>1</sup>. There are, of course, barriers, apart from economic ones: environmental impacts and local protests, in some cases radioactive 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

<sup>1</sup>SCORCOMET group, KU Leuven, Leuven, Belgium.

<sup>2</sup>Institute of Metals and Technology, Ljubljana, Slovenia.

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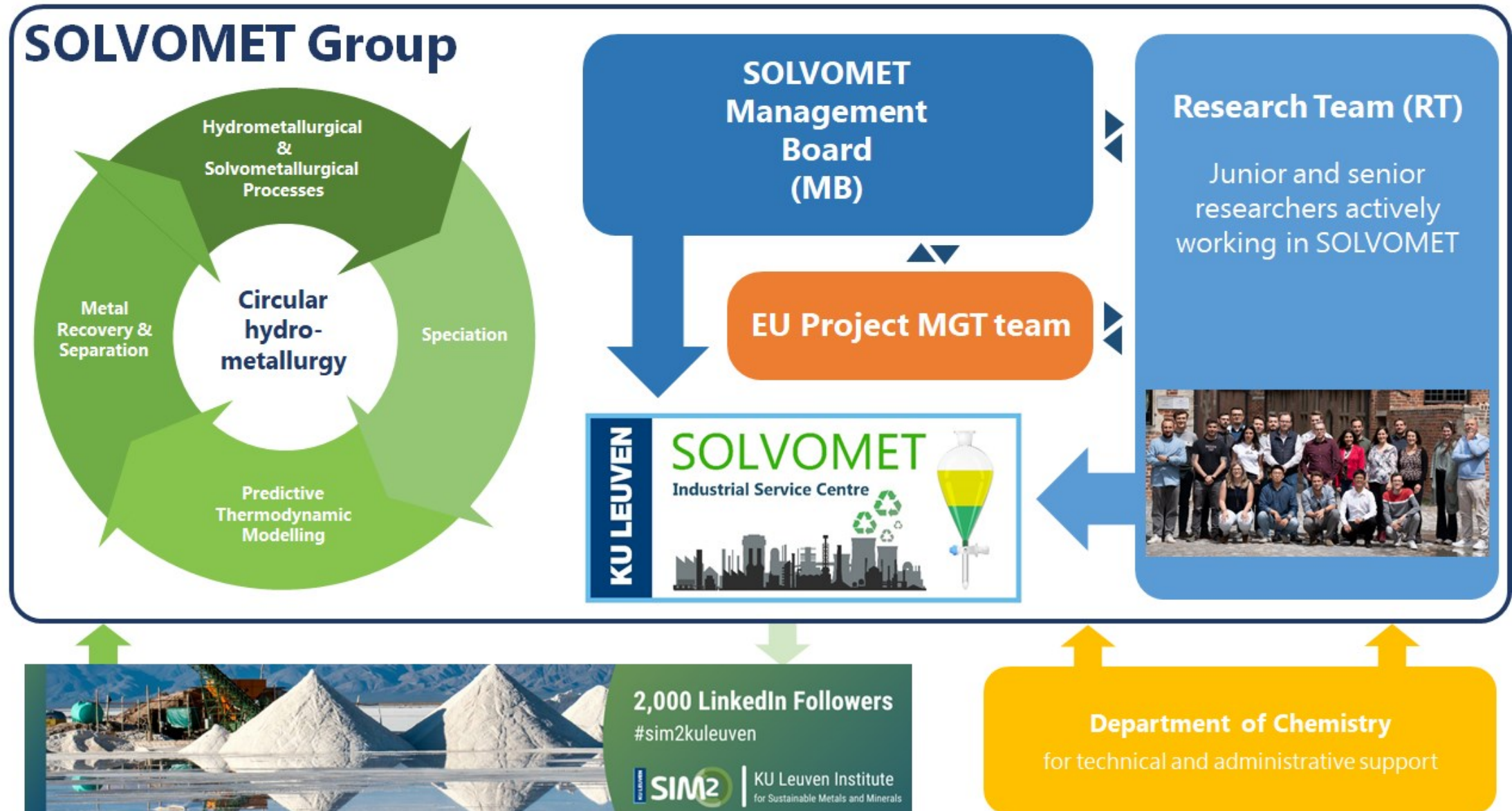
https://doi.org/10.1038/

s41578-021-00308-w

NATURE REVIEWS | MATERIALS



# 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**

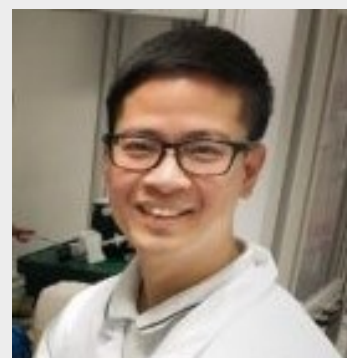
# Our permanent staff Research Managers (SOLVOMET ISC projects)

Dr. Ir. Peter Tom Jones	Dr. Clio Deferm	Dr. Lieven Machiels	Dr. Thomas Abo Atia
Industrial Research Fund (IOF) Valorisation Manager	OZK-Research Manager	OZK-Research Manager	Senior Research Manager (pending completion of procedure)
Sustainable Metallurgy	Metallurgical Chemistry	Battery raw materials/recycling & valorisation of residues	Circular Hydrometallurgy
<a href="#">[LinkedIn Profile]</a>	<a href="#">[LinkedIn Profile]</a>	<a href="#">[LinkedIn Profile]</a>	<a href="#">[LinkedIn Profile]</a>



# Our permanent staff Research Experts (SOLVOMET ISC projects)

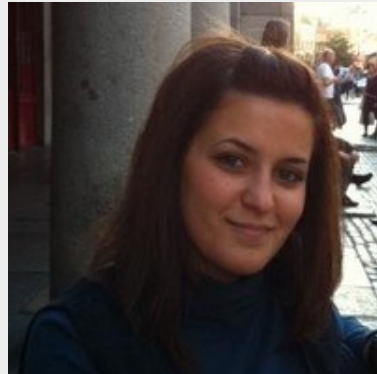
Dr. Ir. Sofía Riaño	Dr. Viet Tu Nguyen	Dr. Rayco Lommelen	
OZK-Research Expert	OZK-Research Expert	Senior Research Expert (pending completion of procedure)	
Upscaling of Solvent Extraction	Aqueous and non-aqueous solvent extraction process development	Hydrometallurgical thermodynamic modelling	
<a href="#">LinkedIn Profile</a>	<a href="#">LinkedIn Profile</a>	<a href="#">LinkedIn Profile</a>	





# Our permanent staff Lab Technicians and Research Associates (SOLVOMET ISC projects)

Jakob Bussé	Alexandra Alexandri		
Research Associate (ATP) (pending completion of procedure)	Lab Technician (ATP)		
Metallurgical Chemist	ICP-OES/MS Lab Technician		



# Our permanent staff Project Managers & Software developers (SOLVOMET ISC EU projects)

Giorgian Dinu	Lucian Onisei	Rabab Nasser	Elisabeth De Decker
ATP	ATP	ATP	ATP
Software developer & project manager	Software developer & project manager	Project manager & event organiser	Financial-administrative manager SOLVOMET Group
[LinkedIn profile]	[LinkedIn profile]	[LinkedIn profile]	[LinkedIn profile]



# Meet our other SOLVOMET colleagues

## Postdoctoral fellows:

Dr. [Jong-Won Choi](#)

Dr. [Brecht Dewulf](#)

Dr. [Pieter Geysens](#)

Dr. [Sharron \(Xiaohua\) Li](#)

Dr. [Stijn Raiguel](#)

Dr. [Panagiotis Xanthopoulos](#)

## Researchers:

[Carlos Arias Quintero](#)

## PhD students:

[Robin Aerts](#)

[Meryem Ozge Arman](#)

[Vincent Cool](#)

[Nor Kamariah](#)

[Filip Kolesar](#)

[Dominic Maertens](#)

[Nand Peeters](#)

[Willem Vereycken](#)

[Hongshan Zhu](#)



# SOLVOMET is embedded in the KU Leuven Institute for Sustainable Metals and Minerals (SIM<sup>2</sup> KU Leuven)



## 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

SIM<sup>2</sup> 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.



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Industrial Service Centre



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**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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