ERA-MIN 2

RESEARCH & INNOVATION PROGRAMME ON RAW MATERIALS TO FOSTER CIRCULAR ECONOMY

BIOMIMIC – Innovative biotechnological methods for effective mining of secondary material

BIOMIMIC

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ERA-MIN 2 Final Conference and Final Seminar of Call 2017 projects
18-19th November 2021

Co-funded by the Horizon 2020 programme of the European Union

Consortium

- 4. Recycling of End-of-Life products
  - Subtopics: 3.1: Increase resource efficiency in resource intensive production processes, 3.2: Increase resource efficiency through recycling of residues or remanufacturing, 4.3: Recovery of raw materials from End-of-life products, 5.1: New business models, 5.2: Improvement of methods or data for environmental impact assessment , 5.3: Social acceptance and trust/public perception of raw materials
- Project duration: 2018-05-01 to 2020-11-30
- Start TRL 3 – end TRL 5
- Total cost: 1 078 708 €, requested funding: 854 978 € / 100% project execution

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BIOMIMIC consortium

Research Organisations	RI.SE, Luleå University of Technology	Fraunhofer ISI	University of Limerick, Ollscoil Luimnigh	
Companies	fortum, mtc Miljöteknik och forskning, PURAC, Biosorbe	G.E.O.S. Ingenieur-Gesellschaft mbH		GEONARDO
Advisory Board	BOLIDEN		RUSAL	

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VINNOVA Sweden's Innovation Agency

Bundesministerium für Bildung und Forschung

epa Environmental Protection Agency

Geological Survey Suirbhéireacht Gheolaíochta Ireland | Éireann

Overview of the BIOMIMIC activites

Raw materials: Fly ash and acid mine drainage

Process

Biological sulfate reduction

↓

Lower sulfate emission to water

↓

Metal recovery

Process

Biosorption

↓

Leachate experiments – metal precipitation

↓

Increased biosorption on modified biosorbent material

Raw materials: Red mud

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Objectives

1. Recover Zn, Iron oxide and CRM targeting 90% recovery and 56% purity

2. Cost and energy effective bioprecipitation prototype (TRL 5)

3. Metal recovery from biosorption (TRL 5)

4. Stakeholders involvement and increased commercial reediness level

5. Economic and environmental benefits

6. Future collaboration and upscaling activities to commercial scale.

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Expected impacts

- Pushing the EU to the forefront of sustainable processing technologies
- Improving competitiveness through creation of added value and new jobs
- Creating value of raw materials currently landfilled enabling better efficiency of exploitation of raw materials' resources
- Increasing the range and yields of recovered raw materials (including water and energy consumption) leading to reduced environmental footprint.

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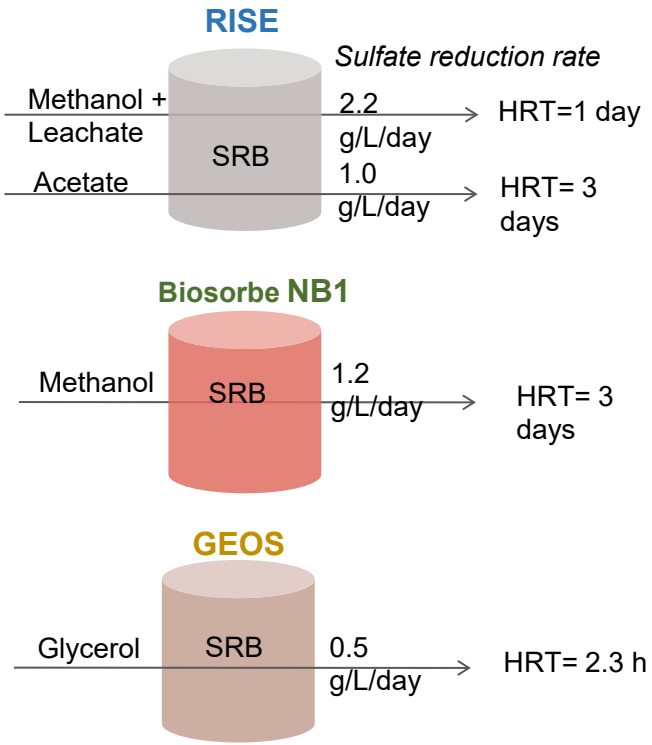
Final Results

Microbial consortia for sulfate reduction



SRB adaptation to utilize acetate

- 3 month adaptation period
- SRB to grow on and utilize acetate but still preferred methanol
- SRB process more robust on methanol than on acetate

Scaled up at pilot scale in Sweden and Germany

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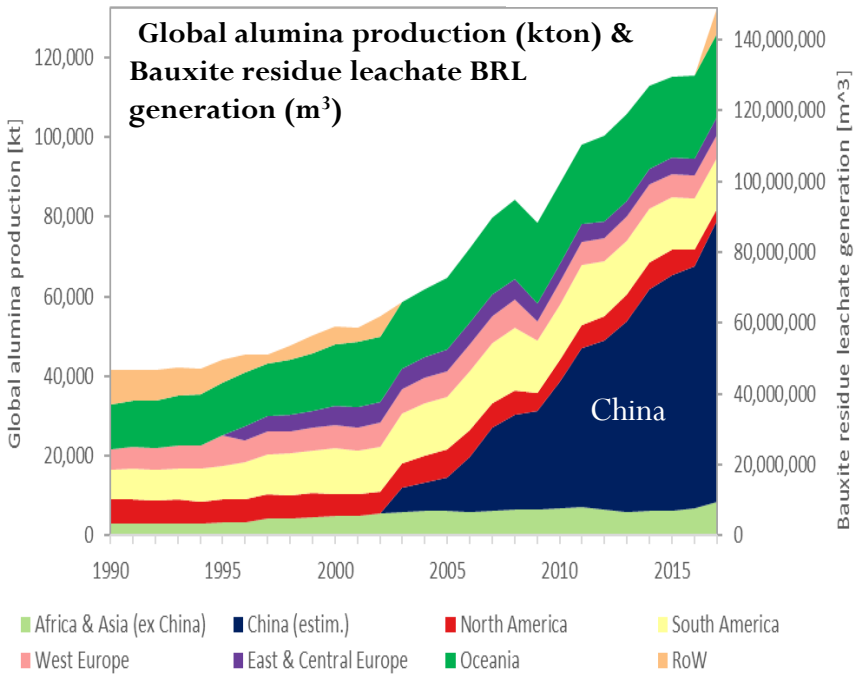
Potential contribution of BIOMIMIC bauxite residue leachate treatment with biosorption

1 ton Alumina**:** ~1.5 ton bauxite residue (BR)
1.5 ton BR**:** ~**1.1 ton** leachate (BRL)

	Concentrations in bauxite residue leachate [mg/L]	Theoretic potential globally 2017 [t]	BIOMIMIC contribution to EU supply [%]
Al	270	40 000	0.01%
Ga	**1.7**	**260**	**38%**
Mo	2.1	310	0.03%
V	**5.6**	**830**	**0.34%**

140 000 000 m^3 BRL



1) Murnane, J. *et al.* **2018**: Deliverable 2.1 EraMin Biomimic Project.

2) European Commission **2017**: Study on the review of the list of Critical Raw Materials

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a)

Parameter	Biosorbent Type		
	Biochar	**RM Biochar**	**KOH Hydrochar**
Surface Area ($m^2. g^{-1}$)	9.6	23.7	11.3
Pore volume ($cm^3. g^{-1}$)	413.4	666.3	0.55
pH_{pzc}	6.2	6.3	7.0
Max uptake mg. g^{-1}	4.15	16.45	12.3
Adsorption model	Langmuir	Langmuir	Langmuir
Uptake speed (mins)	60	60	60
Opt Uptake pH		4.0	3.8

b)

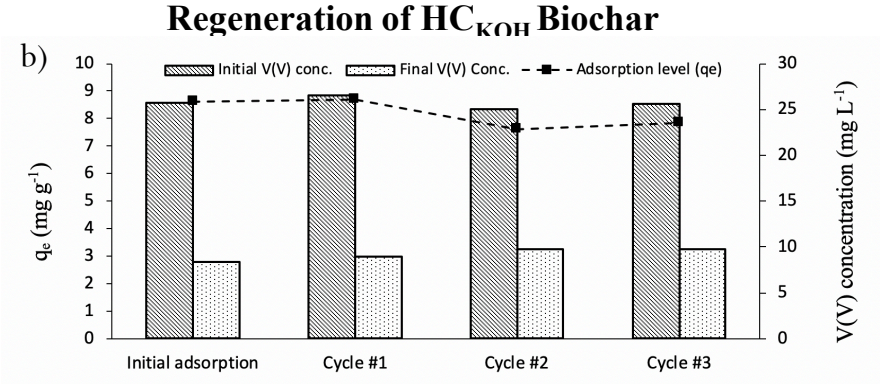

Fig7. a) Trials with various adsorbents ranging from Softwood Biochar, RM Wood Biochar and KOH Seaweed hydrochar as examples. b)Effect of regeneration of KOH modified hydrochar (HC_{KOH}) on V(V) adsorption level (q_e) and on final V(V) concentrations

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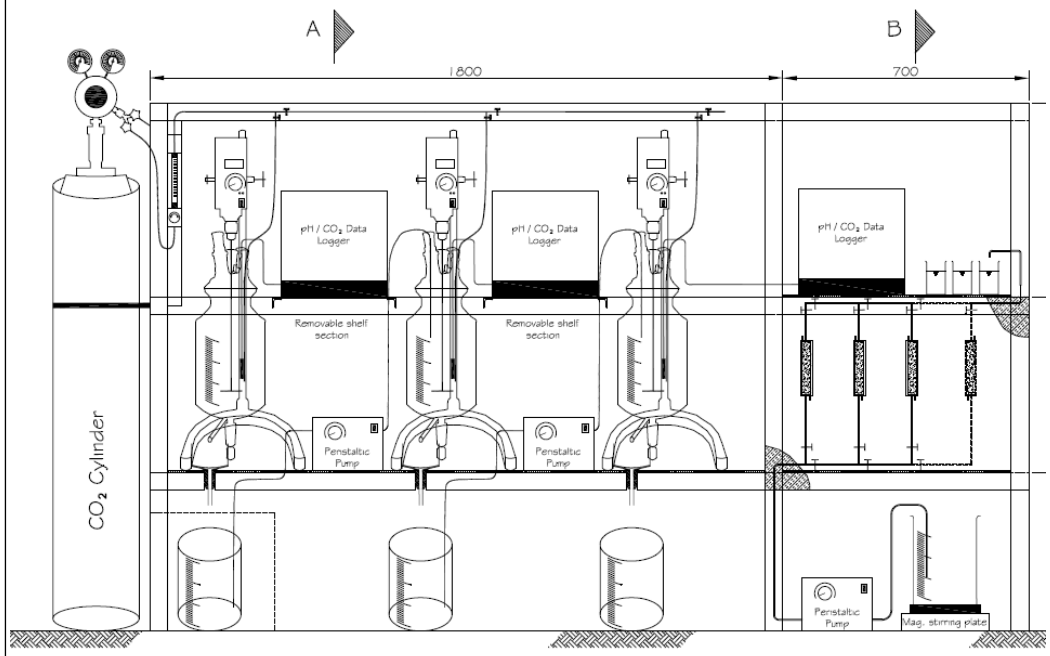

Fig 8. Continuous flow reactor (A) overall design concept and (B) during installation in the laboratory.

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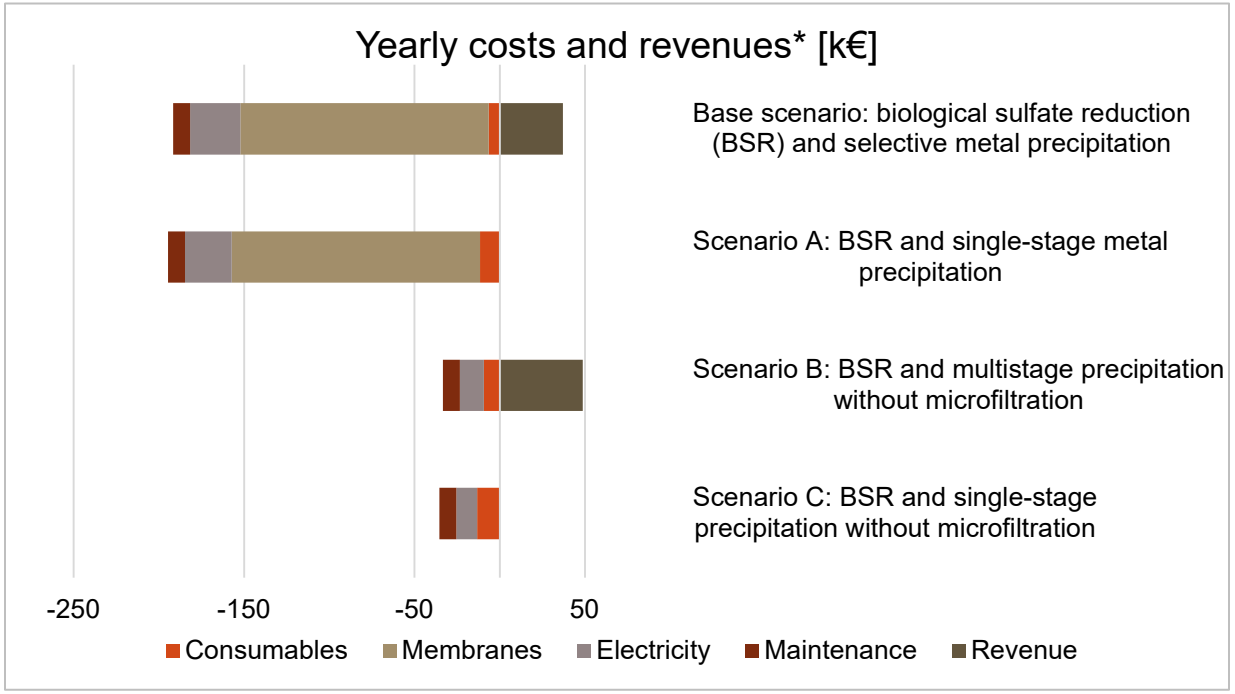
WP 5: Impact Assessment: Environmental and Economic Assessment: Municipal Solid Waste Ash Leachate

- **Economic performance**



* Some additional costs are not included in the analysis due to insufficient information at this stage of the processes. They are likely to negatively affect the economic performance of the processes.

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WP 5: Impact Assessment: Final conclusions

- **All developed processes successfully remove metal impurities from EU waste streams.**
- **Making the metal removal a legislative requirement is a key factor to get these processes into application.**
- **SRB processes and biosorption processes have to be improved regarding their environmental and economic performance in order to become a clearly environmentally superior and economically feasible alternative to mere chemical treatments.**
- **For SRB processes, increasing energy efficiency is the most important measure to improve environmental and economic performance, followed by increasing the efficiency of methanol and nutrient supply.**
- **For biosorption processes, biochar has a better environmental and economic performance than hydrochar, due to the necessary treatment of hydrochar with hydroxides.**

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Final Results

- Pilot demonstration of biological sulfate reduction in both Sweden and Germany successful (even with a partner alteration from Flocazur to MTC in Sweden)
- Pilot rig built for biosorption in Ireland – delayed due to Covid-19
- Objectives reached except TRL level of biosorption due to Covid-19

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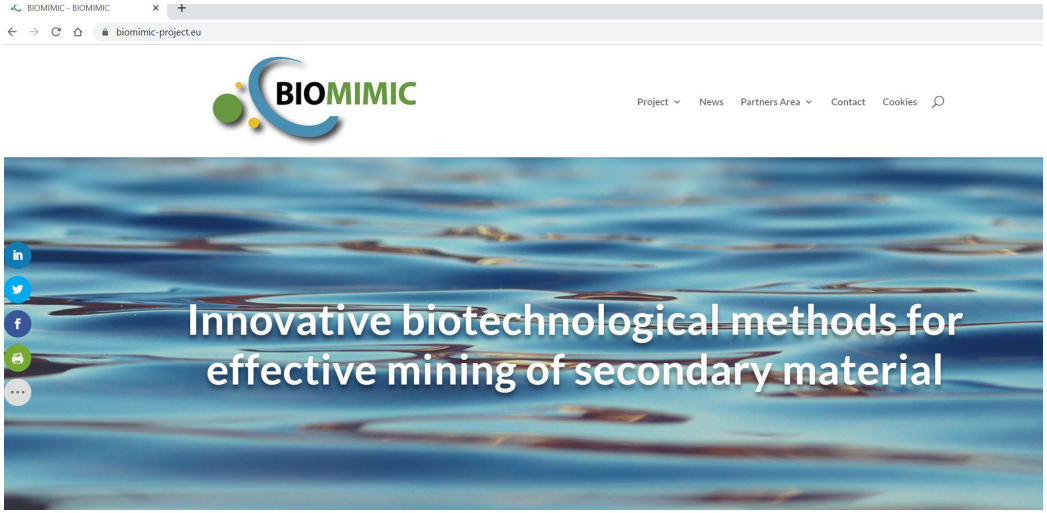
Communication and dissemination activites in selection

- 3 peer reviewed publications from University of Limerick
- Poster presentations and conference attendance
- Webpage: www.biomimic-project.eu and LinkedIN account
- Stakeholder meeting in Luleå and Freiberg



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