E-waste valorization by recovering valuable metals with microorganisms

HERAKLION2019

7th International Conference on Sustainable Solid Waste Management

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A biotechnological process

***For** electronic waste managers and related companies,*

***that allows to** recover metals from obsolete electronic devices with greater value than the price obtained for the waste,*

***not as** the conventional processes that need to be centralized with large volumes, high energy consumption and environmental impact.*

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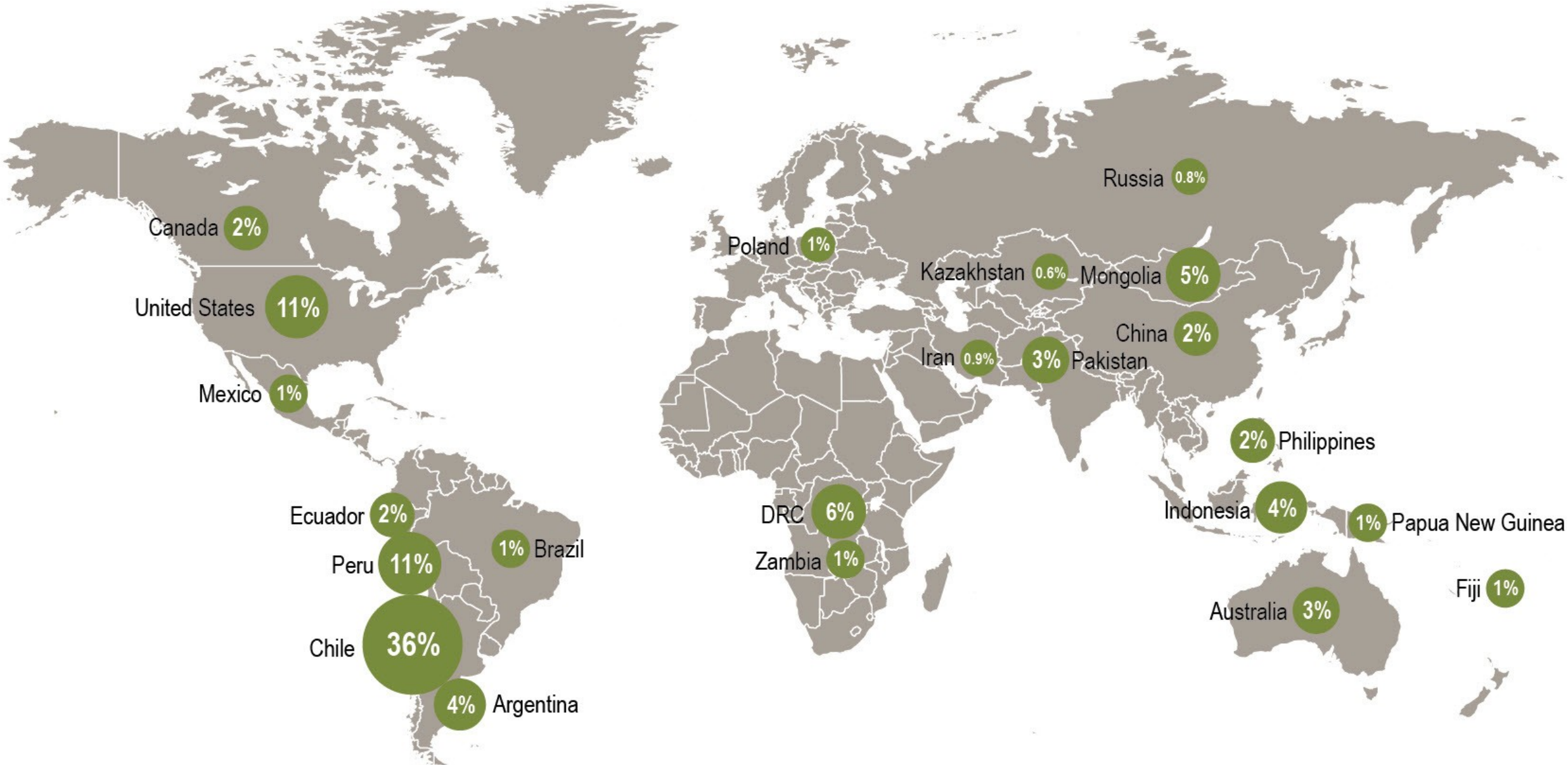
THE PROBLEM


Canada 2%
United States 11%
Mexico 1%
Ecuador 2%
Peru 11%
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Kazakhstan 0.6%
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Fiji 1%
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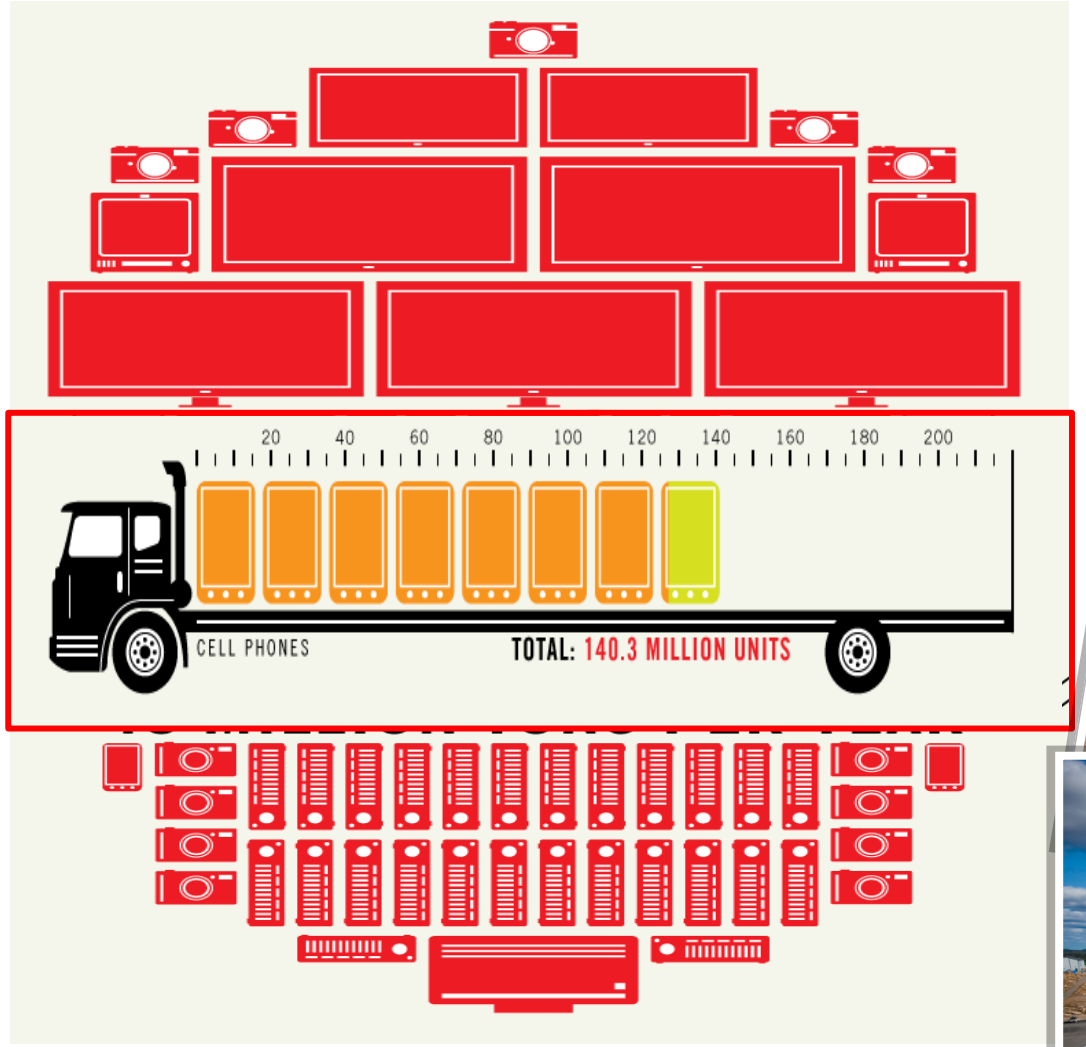
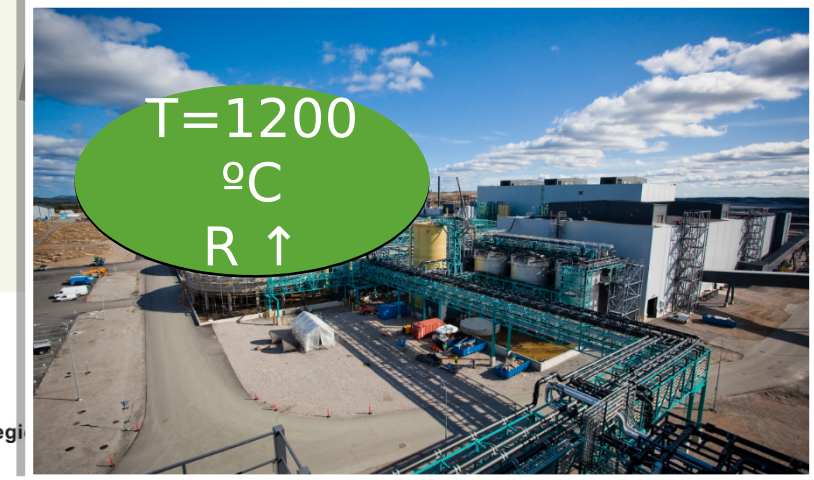
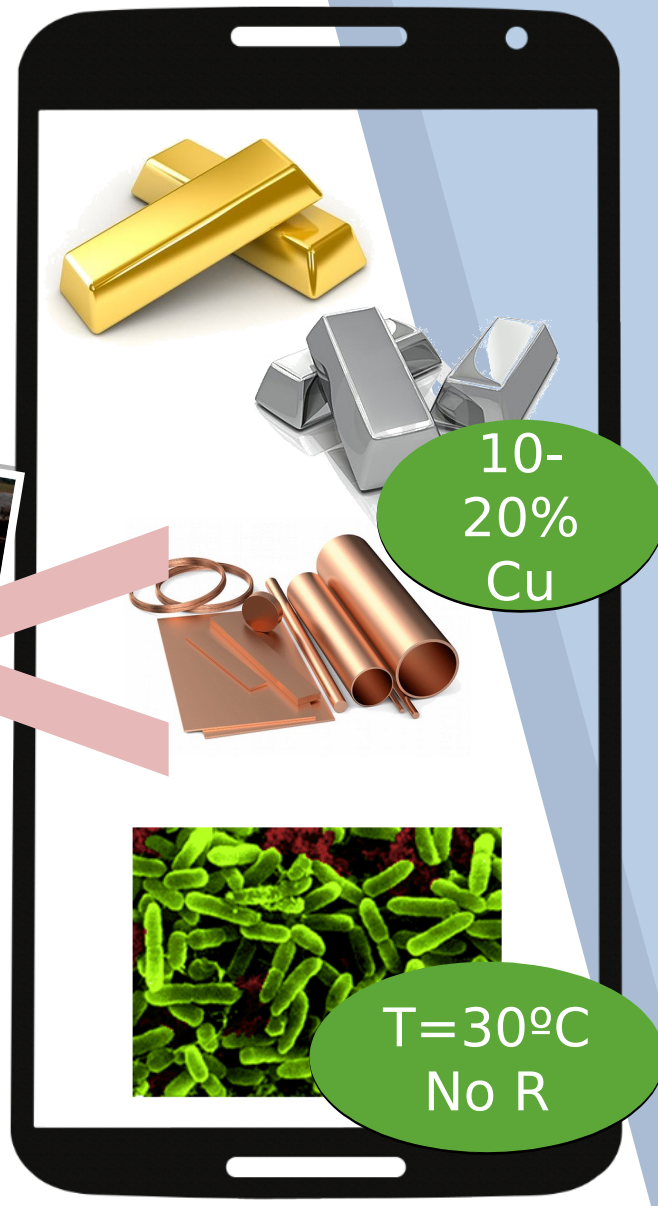
THE SOLUTION







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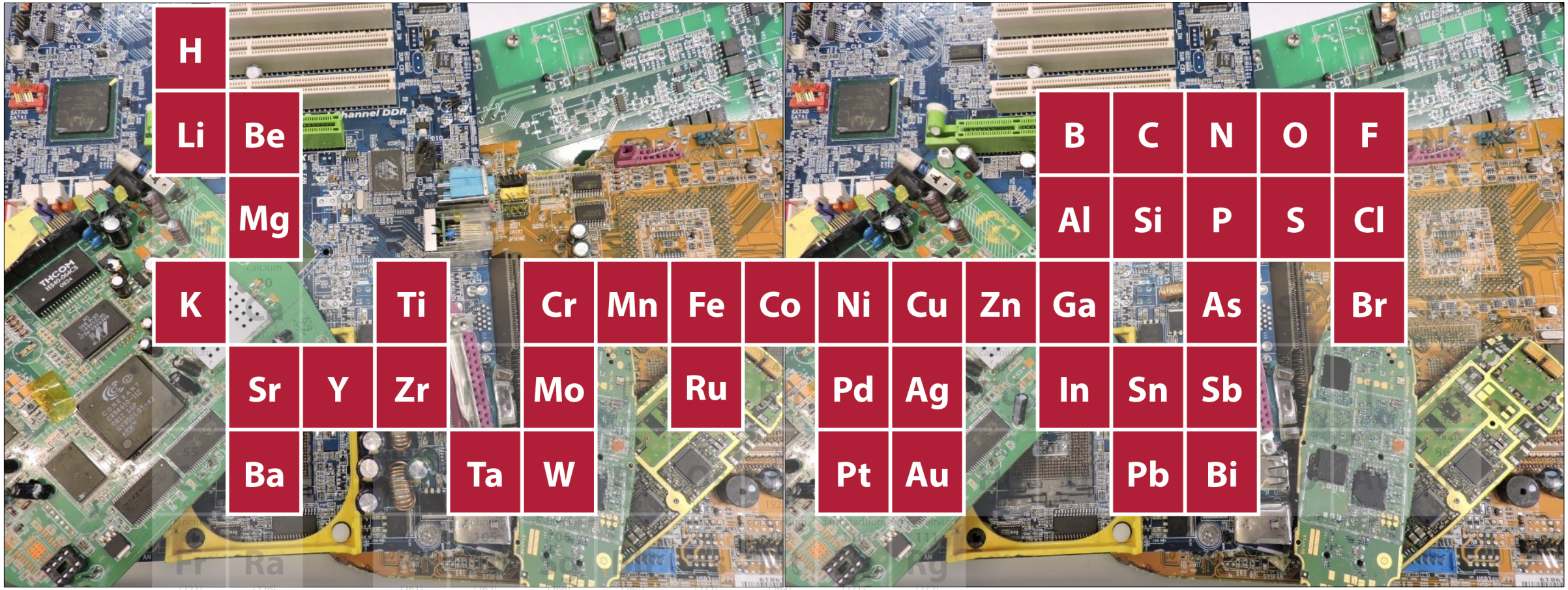
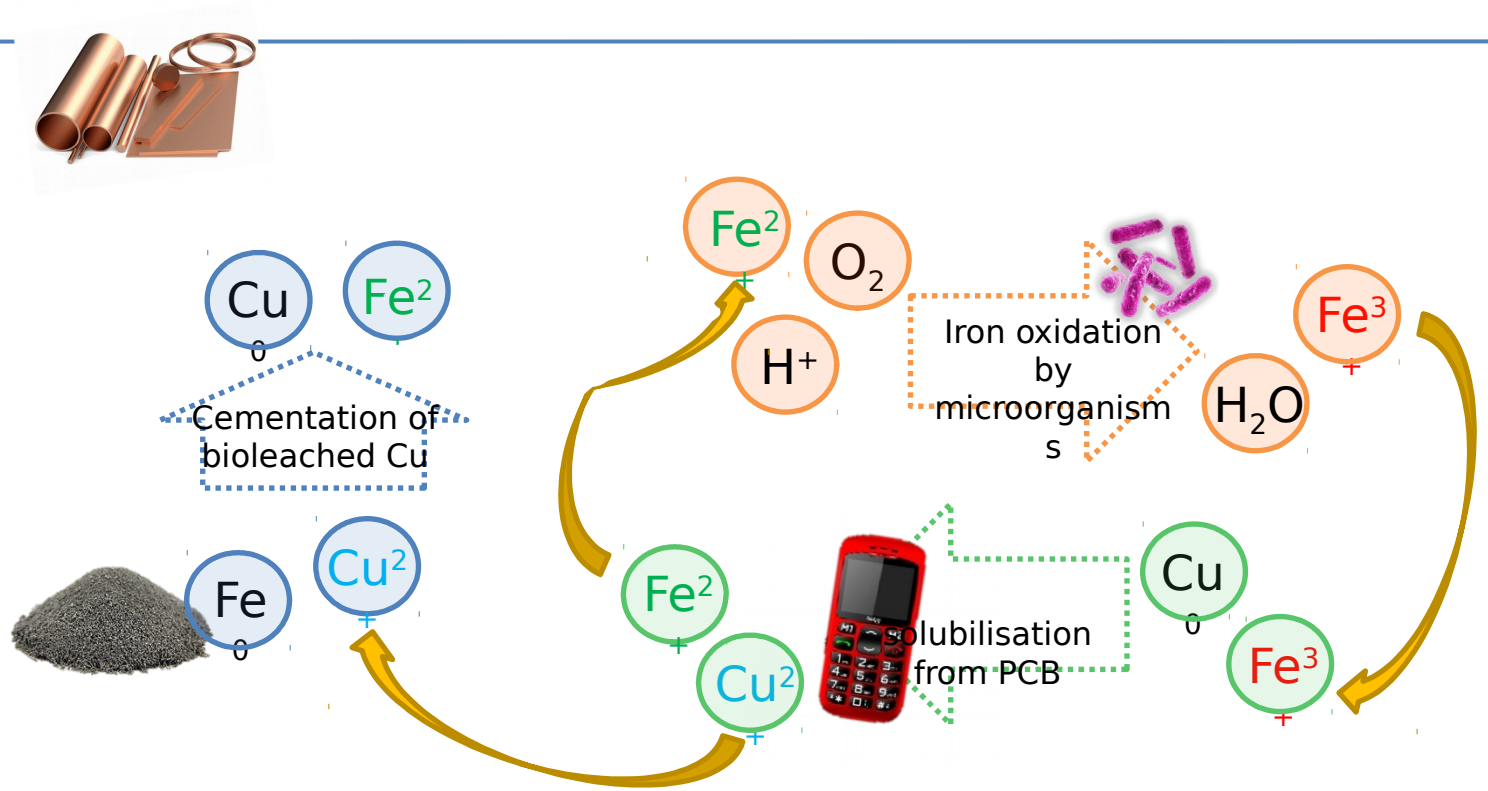
Mobile phone composition

Source: UNEP, 2012

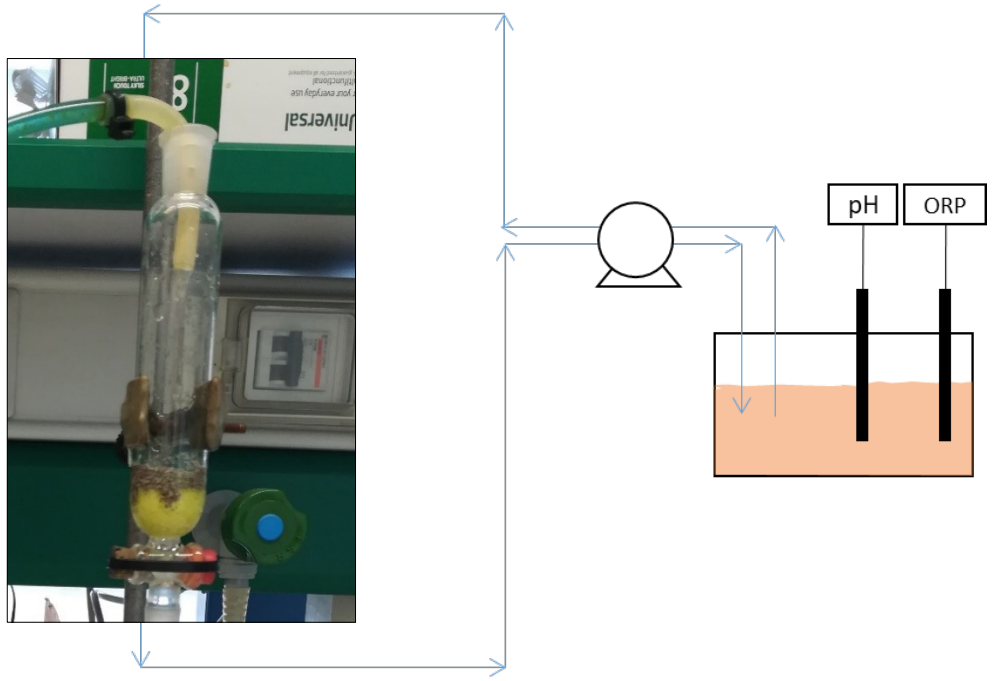


Bioleaching



Investigation of electronic waste bioleaching

Flask → Lab scale → Pilot plant



Bioleaching process

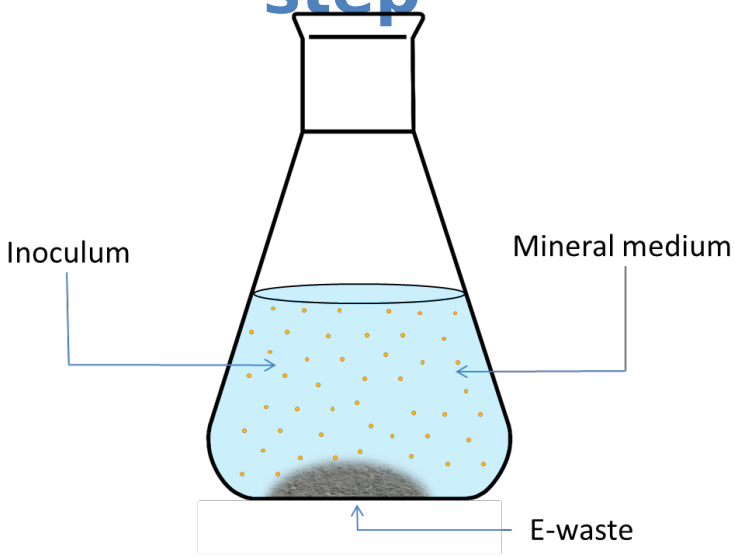
Biological reaction

$$4\,Fe^{2+} + 4\,H^{+} + O_2 \xrightarrow[\text{ferrooxidans}]{\text{Ac.}} 4\,Fe^{3+} + 2\,H_2O$$

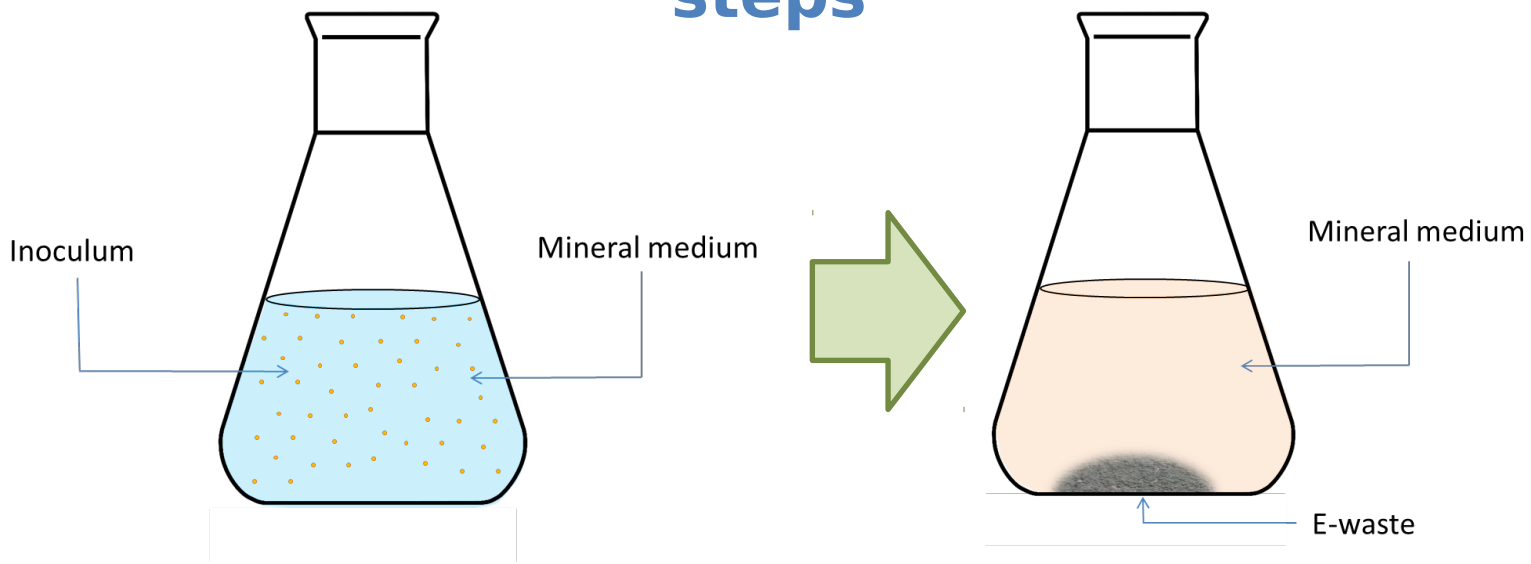
Chemical reaction

$$Cu + 2\,Fe^{3+} \rightarrow Cu^{2+} + 2\,Fe^{2+}$$

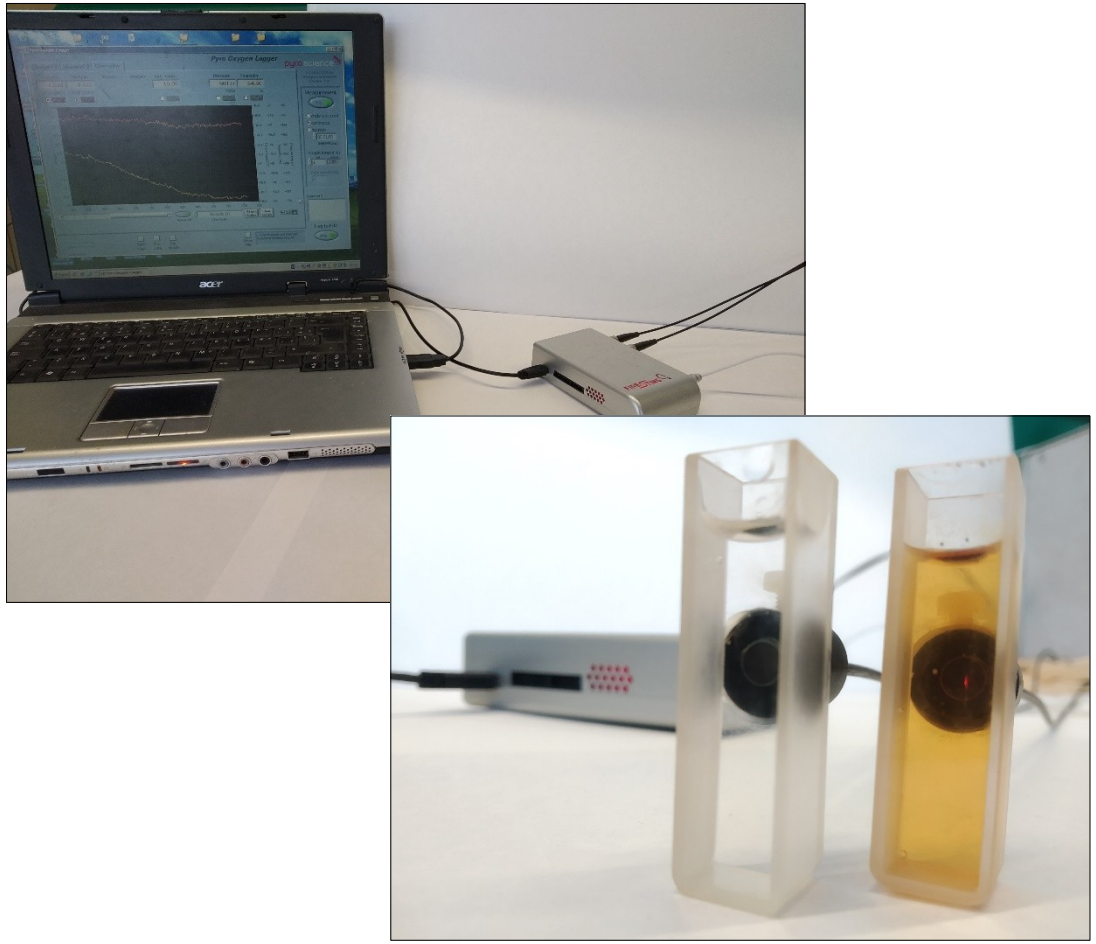
1 step

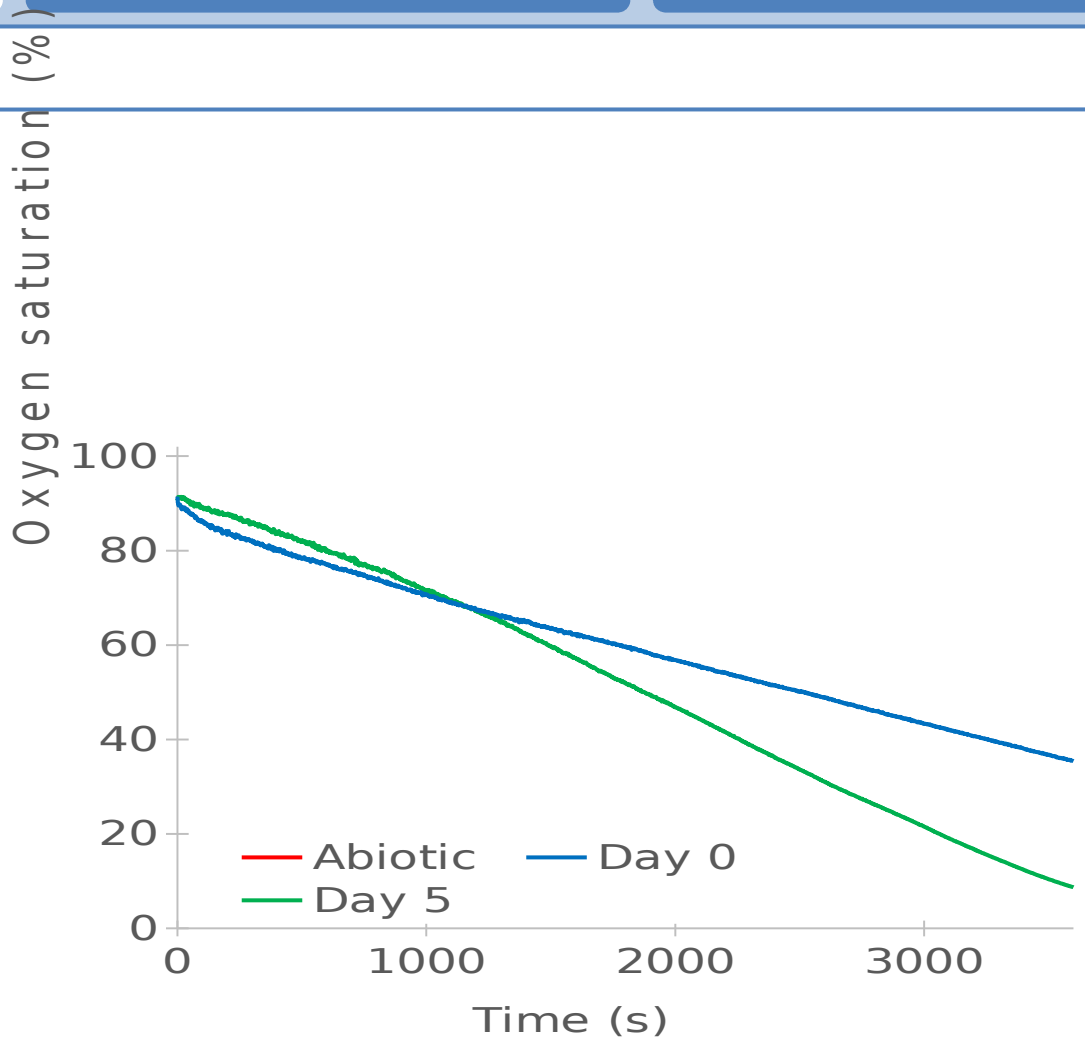


2 steps



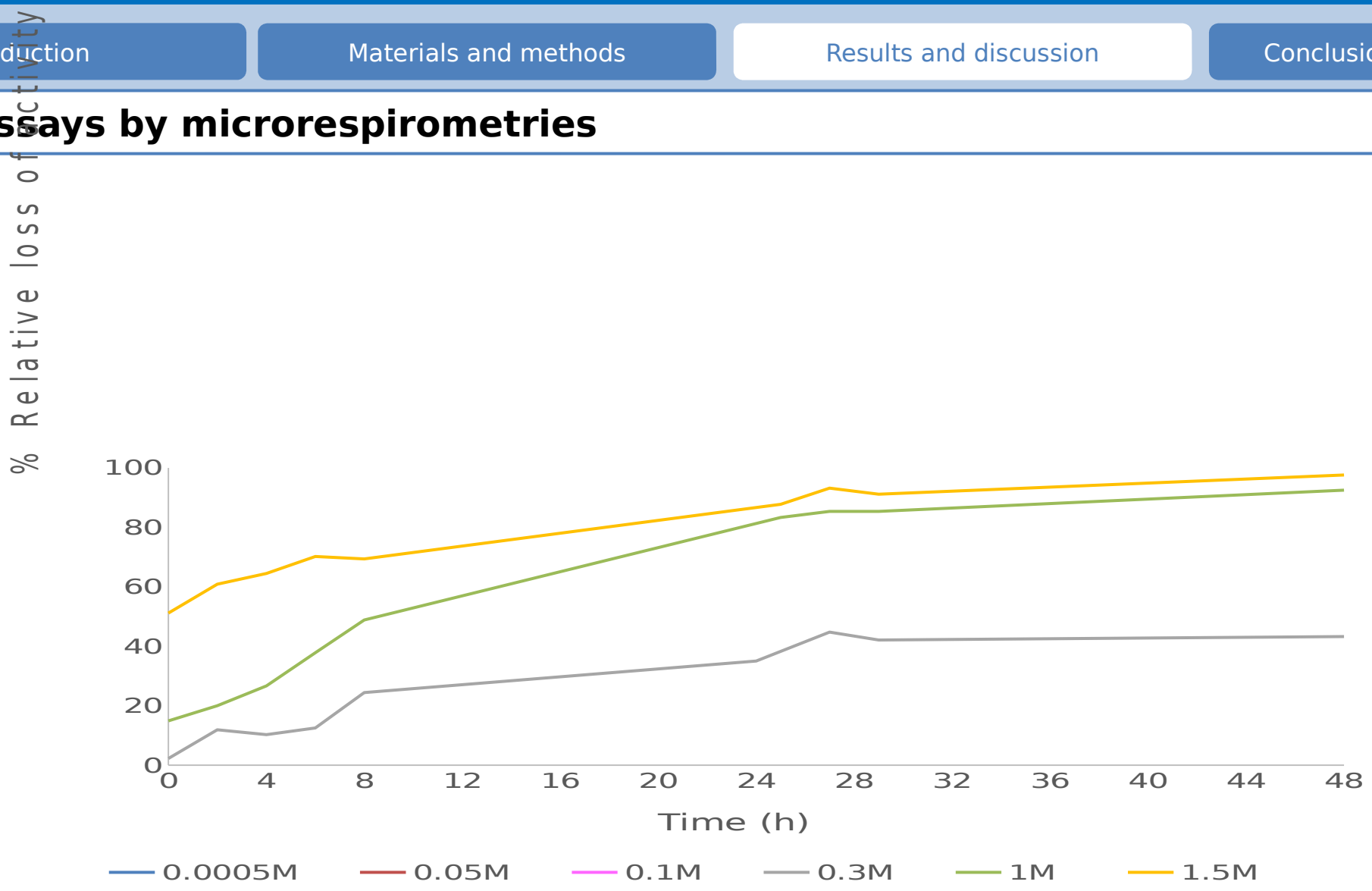
Toxicity tests





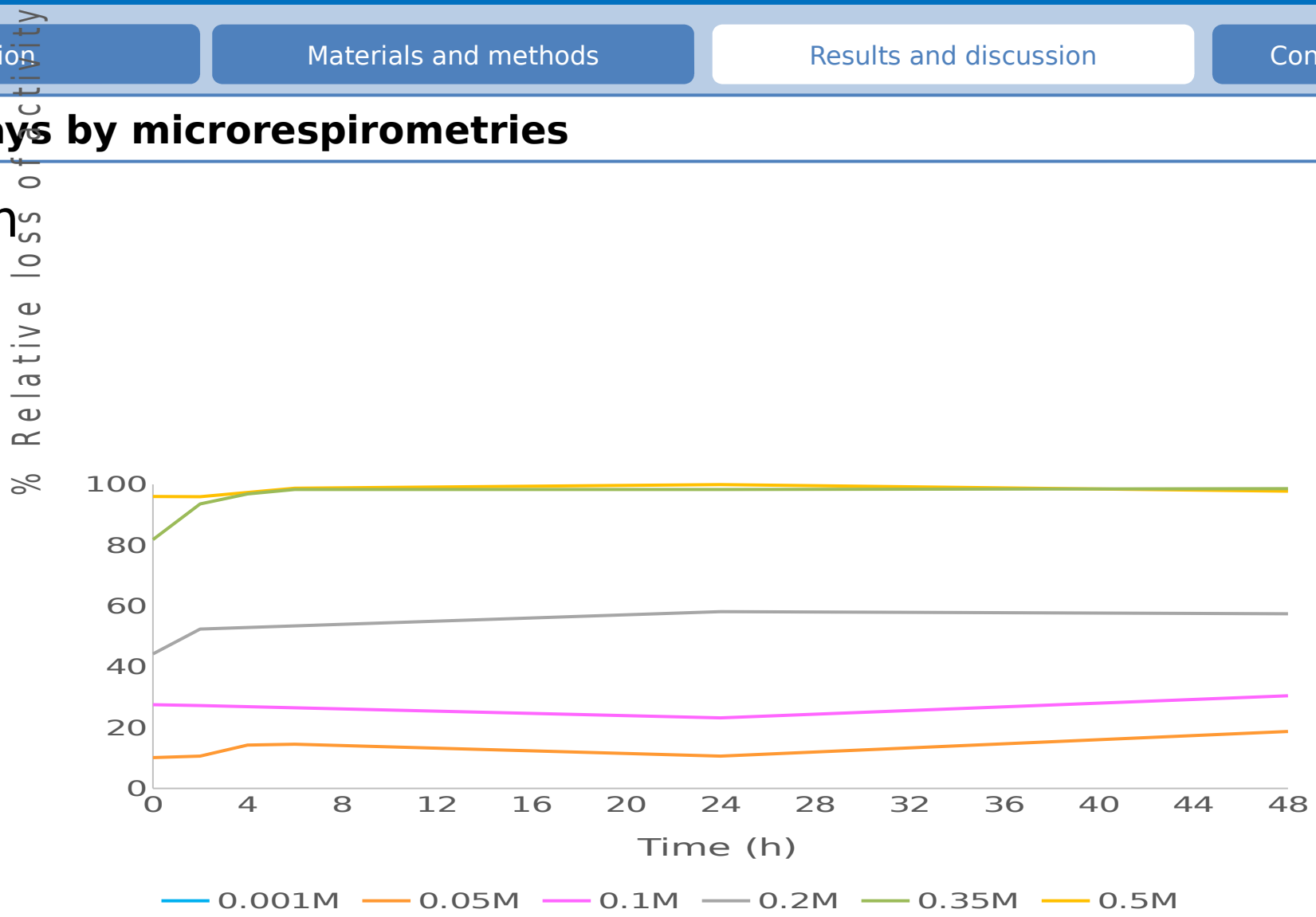
Toxicity assays by microrespirometries

Nickel



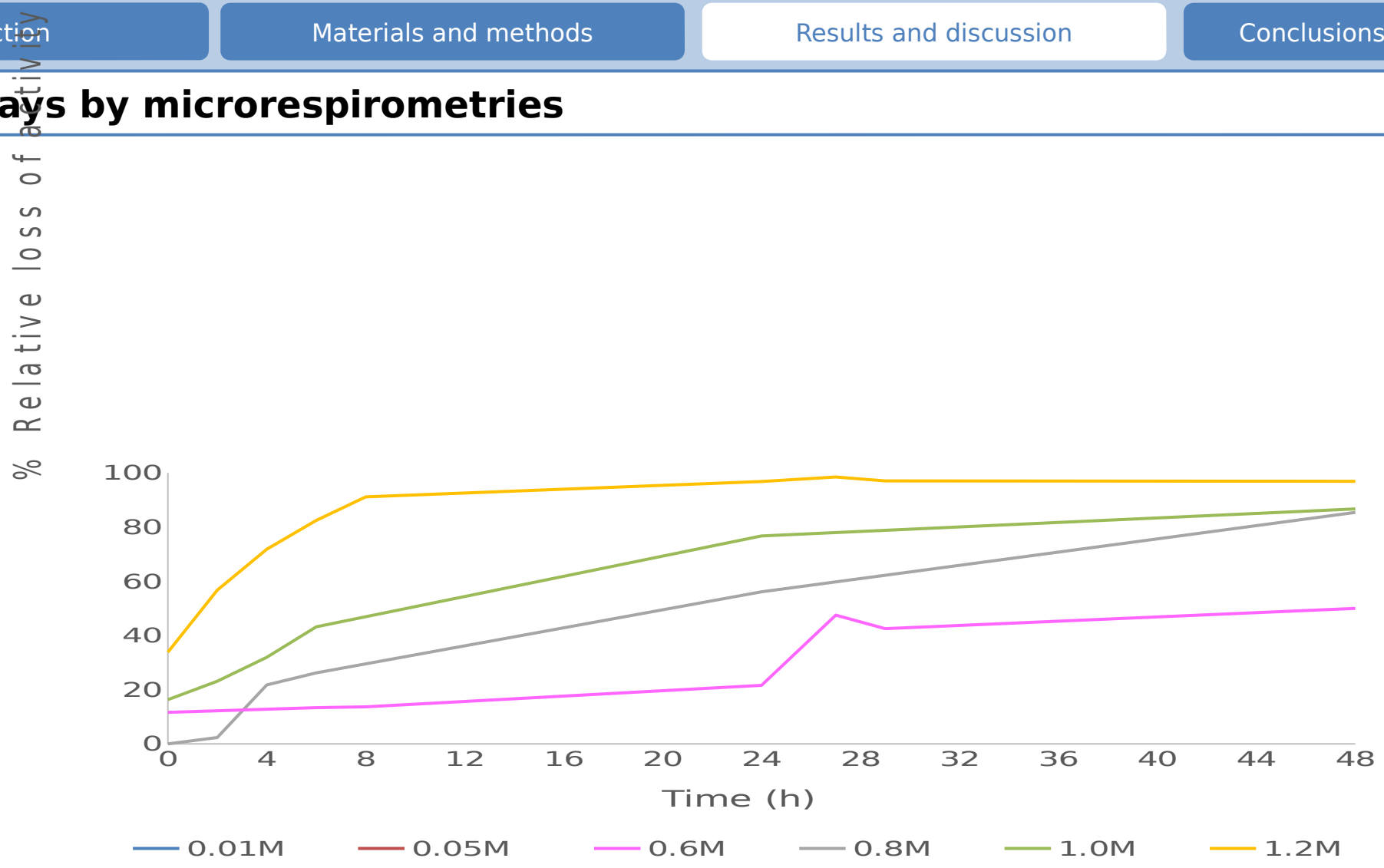
Toxicity assays by microrespirometries

Aluminium



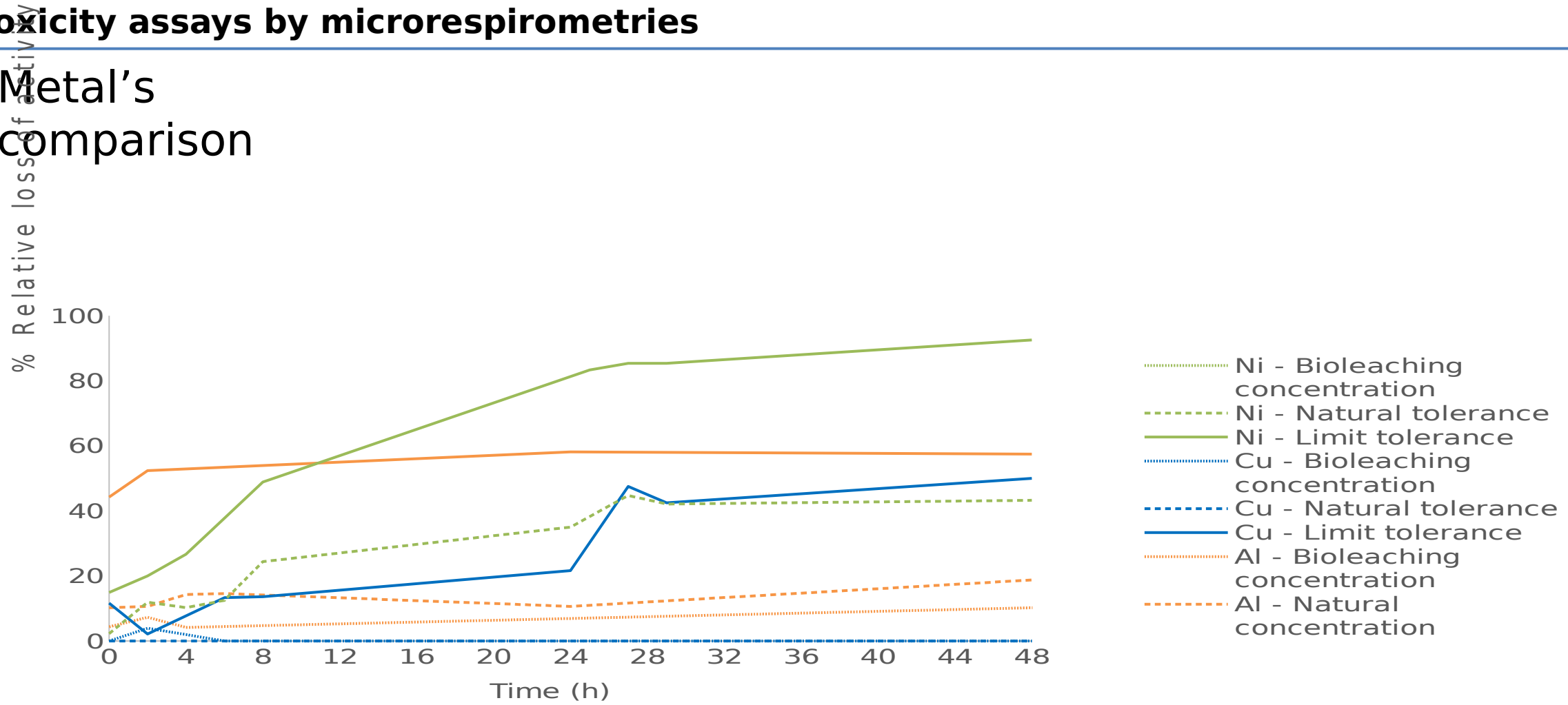
Toxicity assays by microrespirometries

Copper



Toxicity assays by microrespirometries

Metal's comparison



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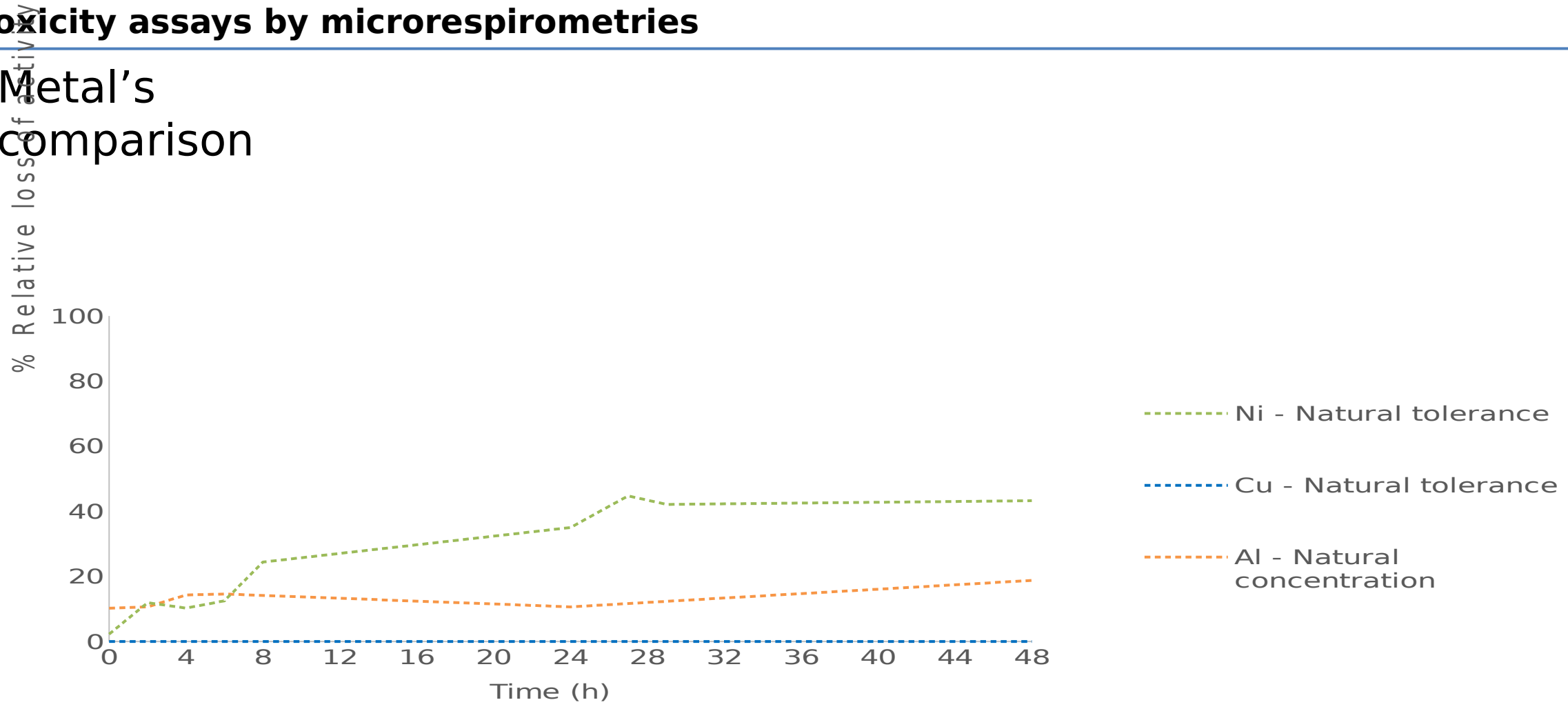

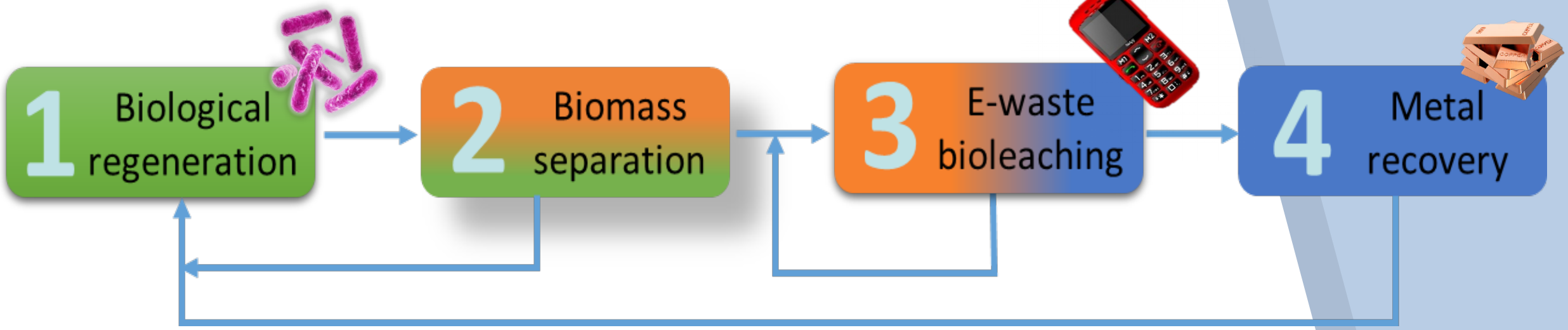

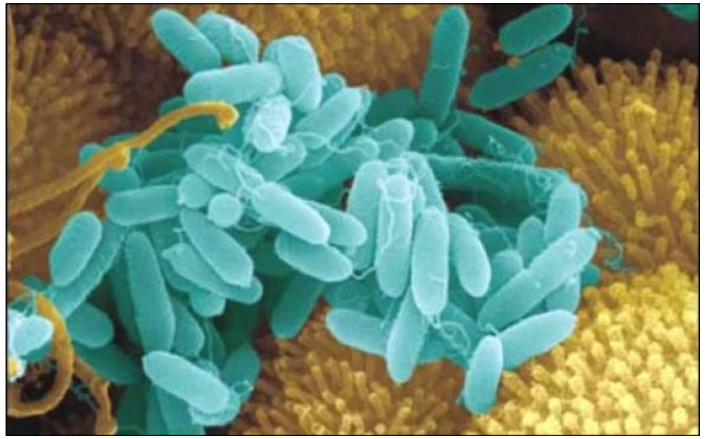

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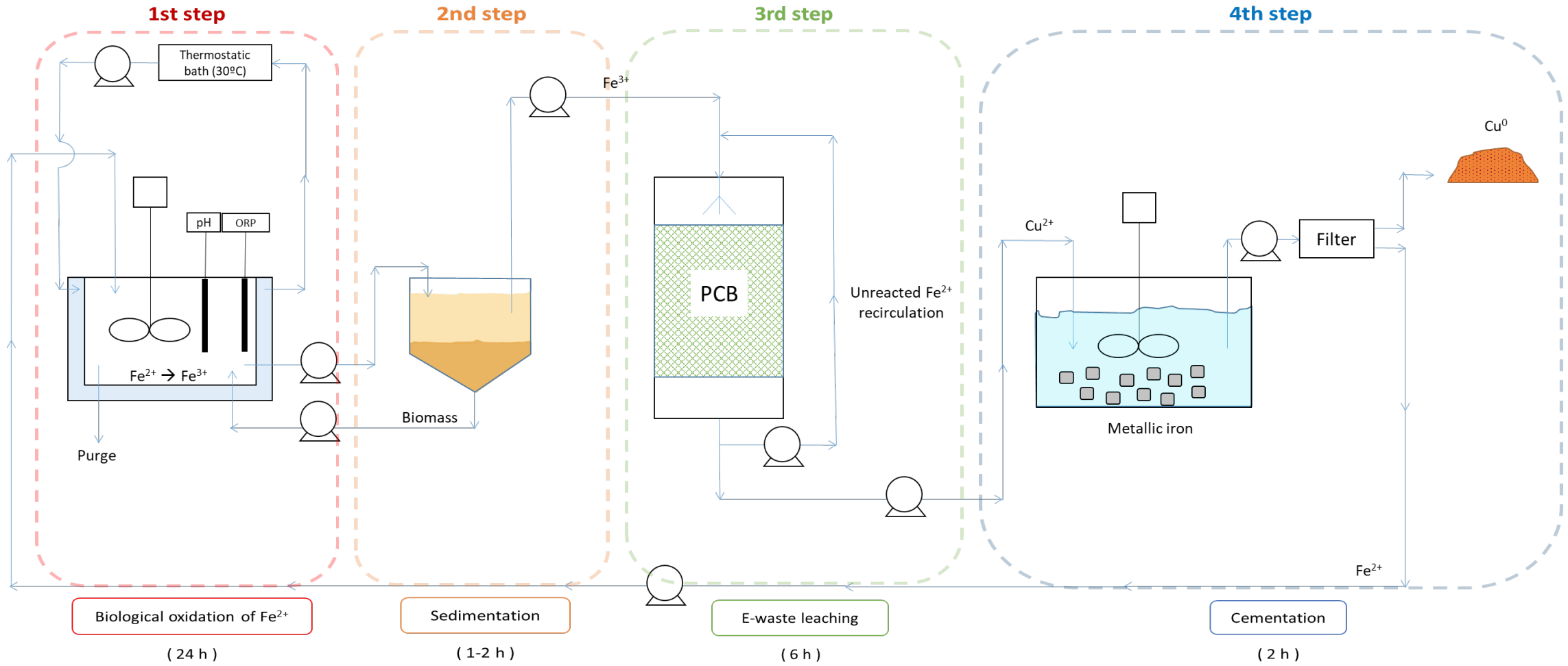
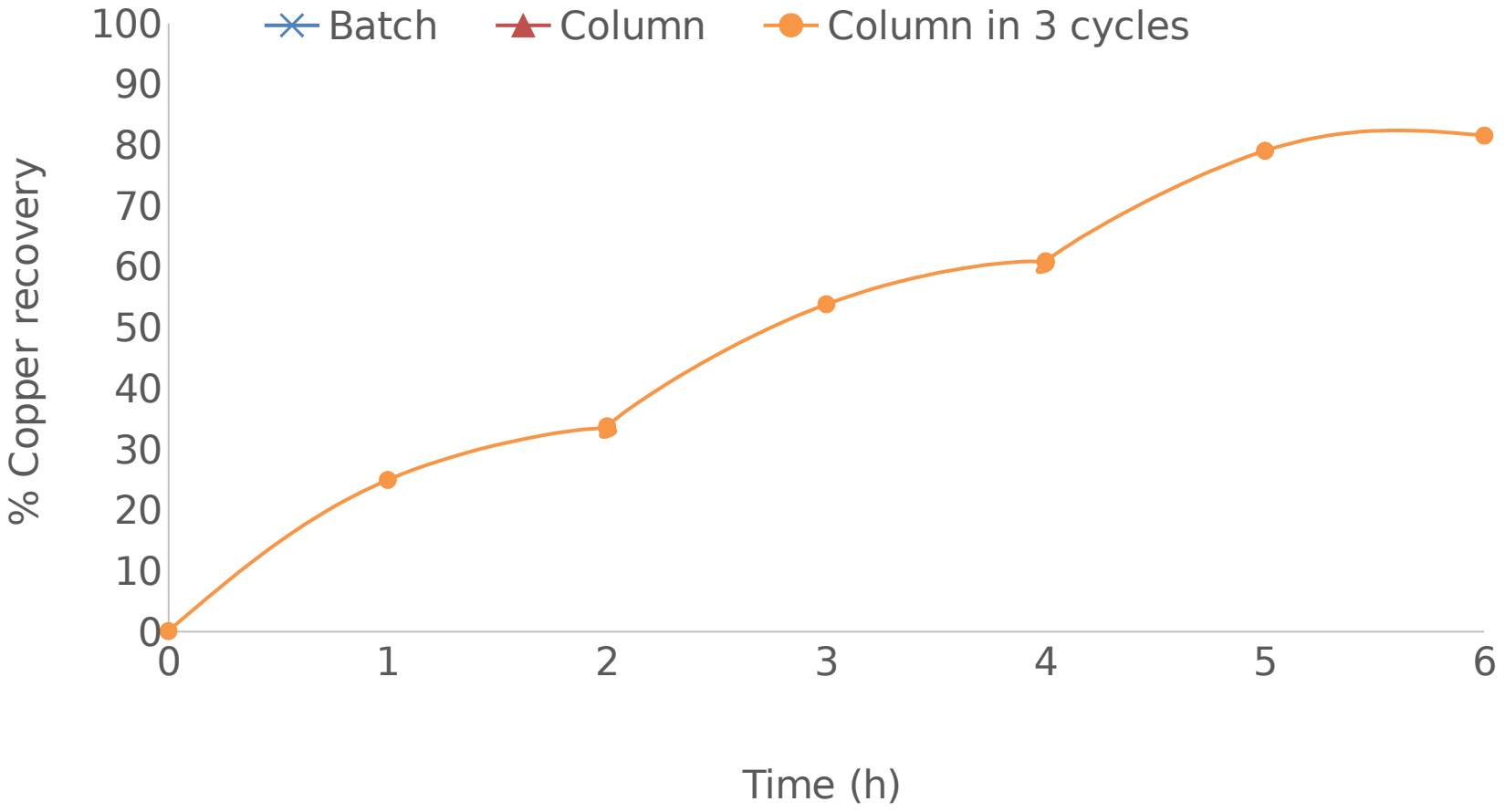
Bioleaching pilot plant



Copper recovery in batch and column reactors



Bioleaching of electronic waste

- **Bioleaching** process to recover copper from the electronic scrap is **effective**, verifying the proof of concept.
- **Column reactor** improve the metal extraction efficiency.
- **Automatic** and **continuous** operation makes possible to recover **85%** in less than **6 hours**.
- **Ni**, **Al** and **Cu** affect biological activity, depending on the concentration as well as the time contact.

Aknowledgments

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG

The University of Resources. Since 1765.

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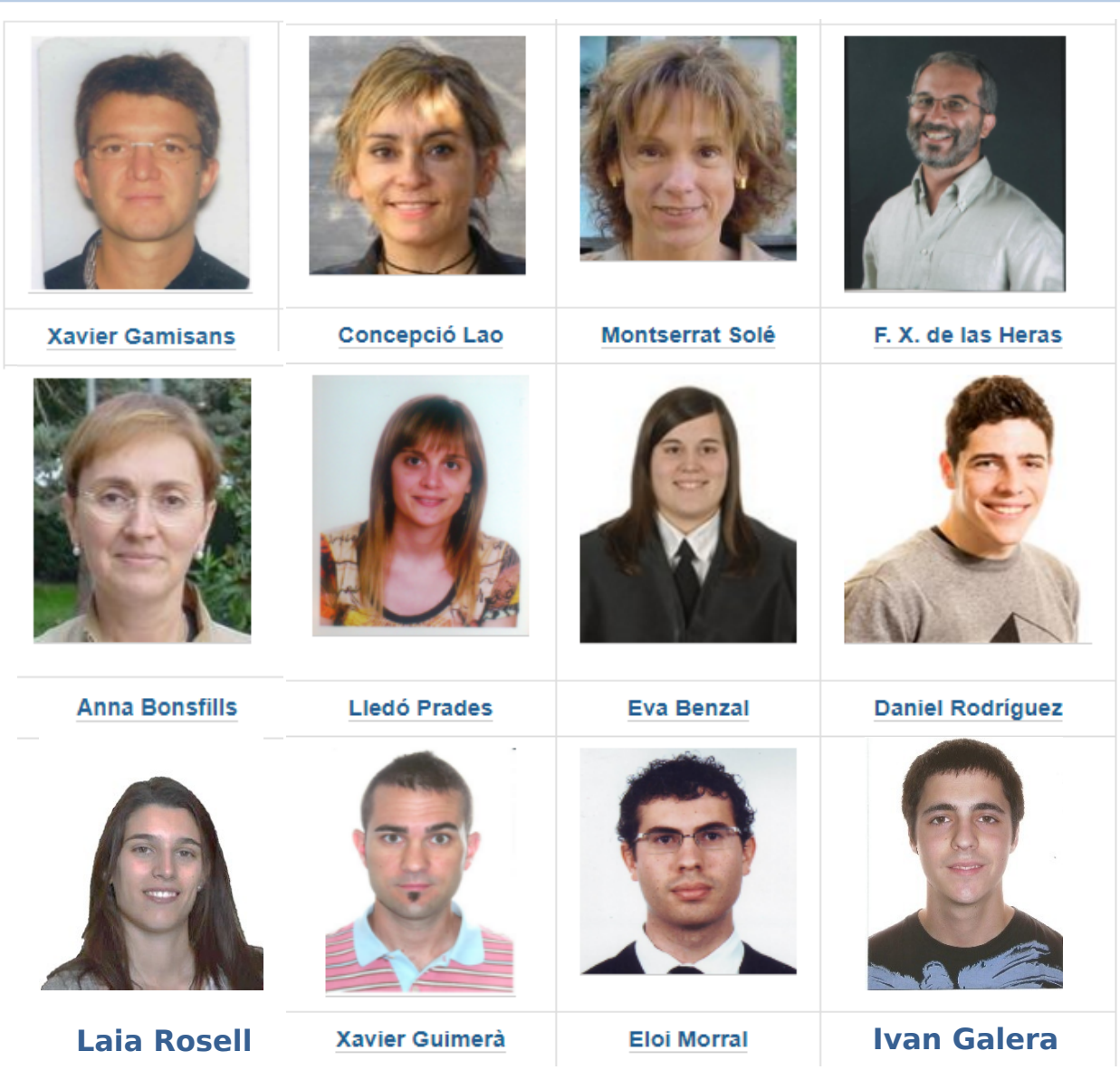

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