Metal removal from wastewater sludge through electrochemical processes

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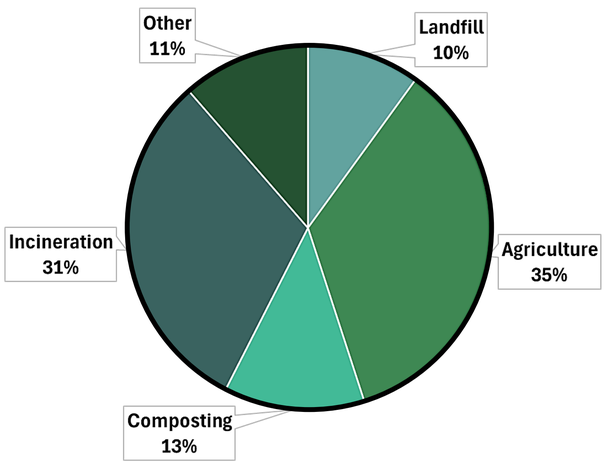
Did you know that metals can be removed from sludge through electrowinning?

Why?

EU-30 sludge disposal route distribution (2021)[1)]



Approximately **10M tonnes** of sludge are produced yearly by the **EU-30**

Germany alone produces **≈2M tonnes** of sludge

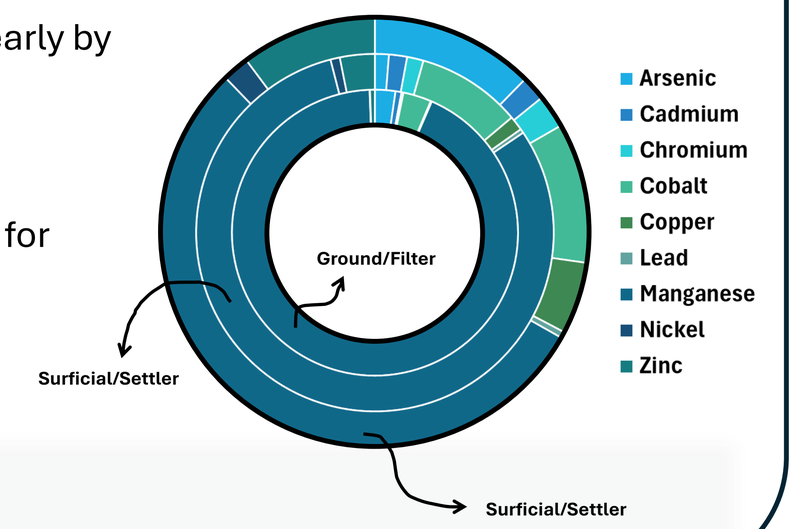
2.1M tonnes of sludge in the EU can still be valorised for agriculture

3% of the sludge dry matter is metals

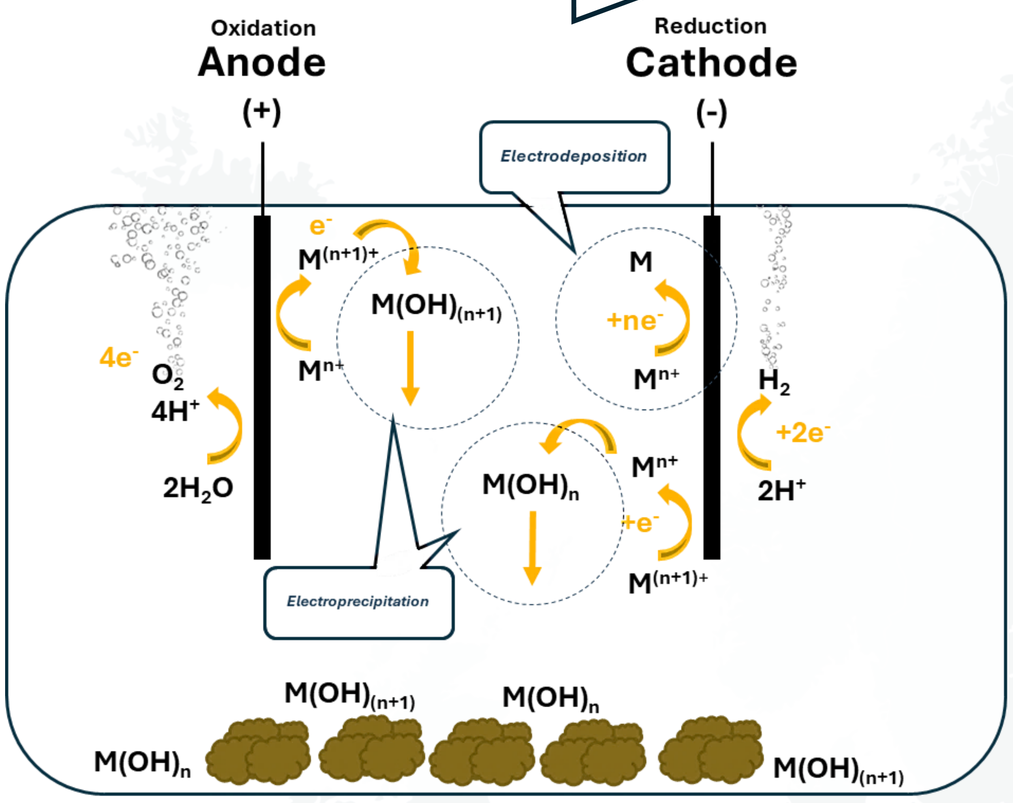
Recovery Potential:

300k tonnes of metals yearly only in EU-30

Heavy metal distribution in different sludges



How?



M: Metal atom / **n:** Number / **e⁻:** Electron / **OH:** Hydroxide

1st • Ionic reduction to zero-valence species

2nd • Ion depletion shifts the equilibrium

3rd • Dissolution of precipitated species

(Direct) Reduction M^{n+}

Fe^{3+} → Fe^{2+} → $Fe^{(0)}$

OR

$Fe(OH)_2\ (s) + 2e^- \rightarrow Fe\ (s) + 2OH^-$

Dissolution ↑ M^{n+} & ↓ M^{n+}

$Fe(OH)_2\ (s) \rightleftharpoons Fe^{2+}\ (aq) + 2OH^-$

↓

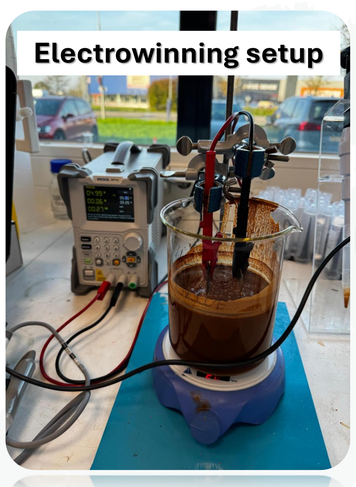
$Fe^{2+} + 2e^- \rightarrow Fe\ (s)$

Outcome

First Experiments with Sludge from Drinking Water

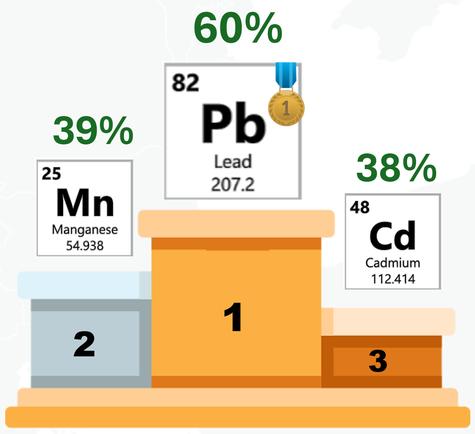
(**pH** 7 / **Conductivity** 3000 µS/cm / **Potential** 2V / **Current Density** 0.2 mA/cm²)

Reusable



Reduction of >30% on total metal content

216 J → 0,06 Wh



Higher removals

30 Zn Zinc 65.38 — 6%

33 As Arsenic 74.922 — 13%

27 Co Cobalt 58.933 | 24 Cr Chromium 51.996 | 28 Ni Nickel 58.693 | 29 Cu Copper 63.546 — 30%

Lower removals

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References:

1) Egle, L.; Marschinki, R.; Jones, A.; Yunta, F.; Schillaci, C.; Huygens, D. (2023). Feasibility study in support of future policy developments of the Sewage Sludge Directive (86/278/EEC). JRC Science for Policy Report.