Development of a sustainable battery recycling process with recirculation of process water

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Motivation

- Development of a "green" recycling process, robust and flexible for all cell chemistries
- Prevention of high salt loads in the recycling of lithium-ion batteries through leaching and precipitation

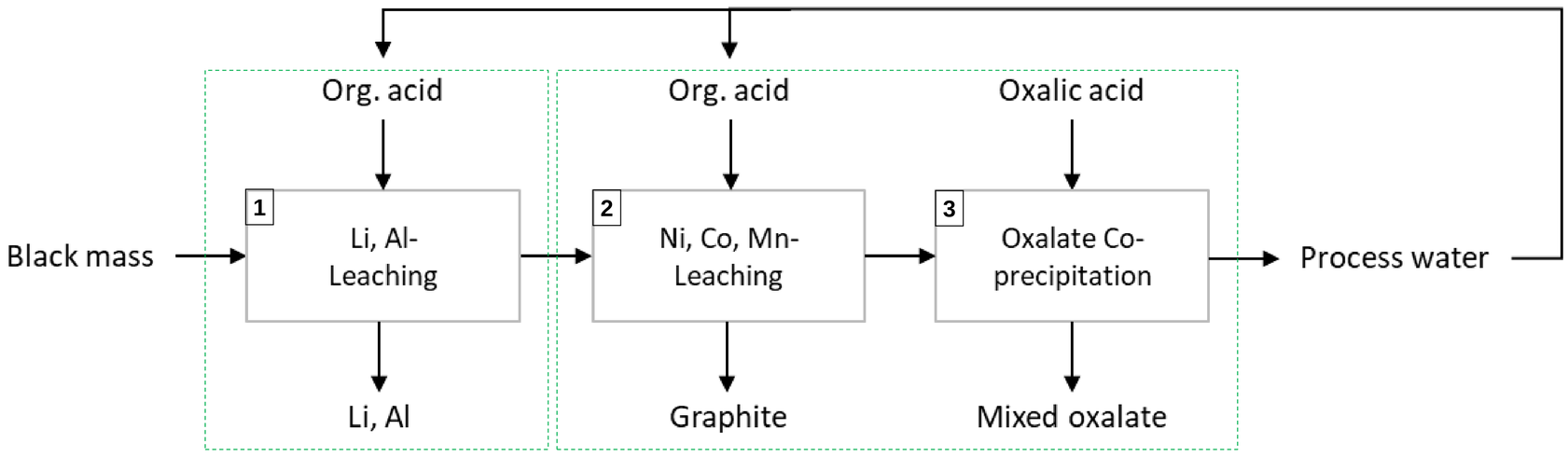
Research Targets

- Biodegradable leaching & precipitation agents
- No loss of valuable metal
- Low energy requirement
- Process water circulation / near zero waste
- Easy and safe process

Process

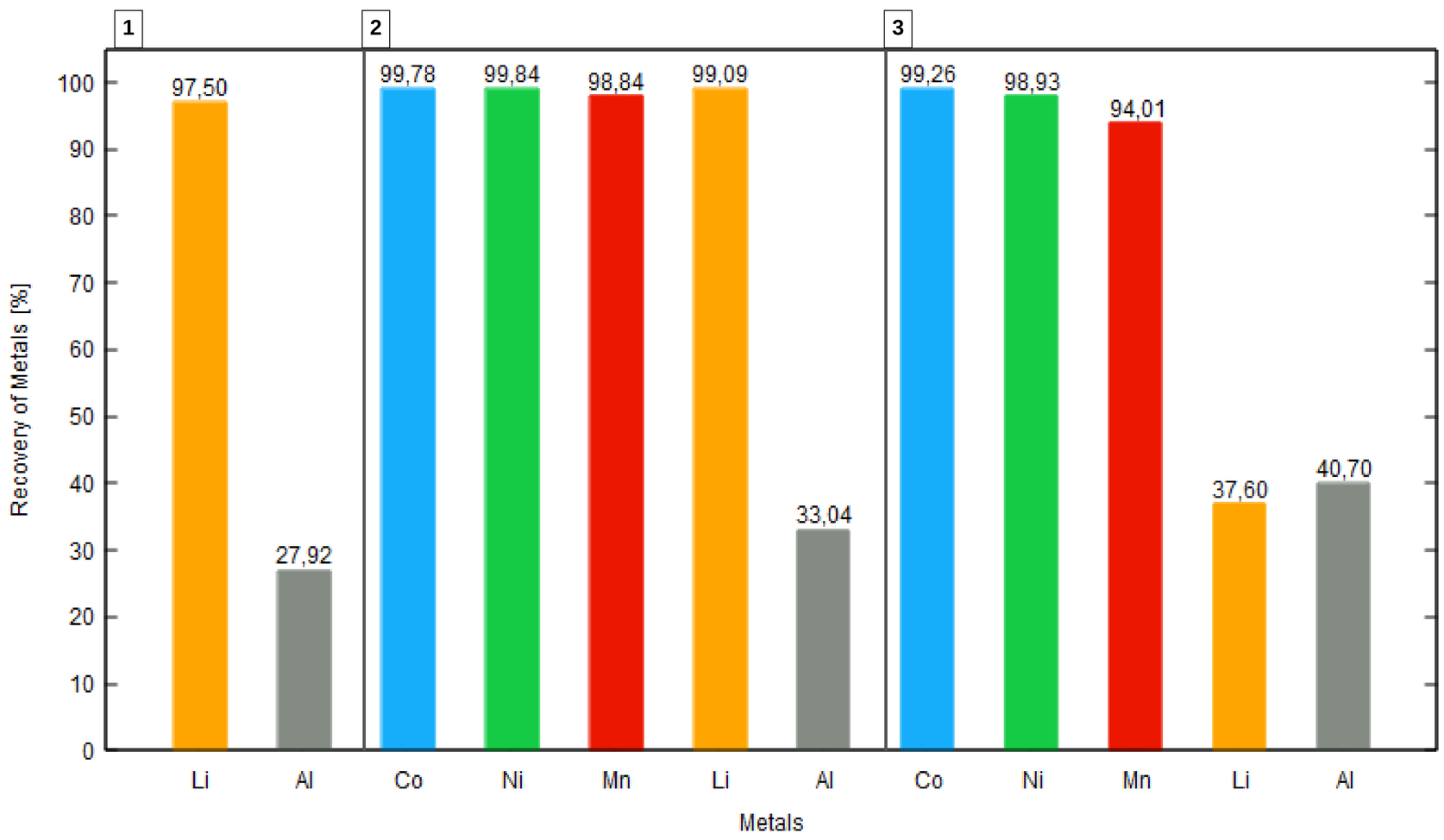
- Pyrolysed black mass
- Cell chemistry NMC111

Co	Ni	Mn	Li	Al	Cu	Fe
%	%	%	%	%	%	%
8.80	8.80	8.17	3.20	4.65	0.25	0.07



1. Lithium and Aluminium leaching
   - Using 0,6 M oxalic acid with the optimum parameters from [1], 500 ml scale, 60°C, S/L 50 g/L
   - 98,8% lithium and 100% aluminium yield according to Paper [1]
2. Valuable metals leaching
   - Using citric acid with the optimum parameters [2]
3. Mixed oxalate precipitation
   - Using oxalic acid with the optimum Mol ratios of oxalic acid to M^{2+} [2]

Previous results



- Process step 1 not yet linked to process steps 2 and 3

1
- Selective leaching was carried out successfully
- Aluminium separation only possible to a limited amount

2
- Successful leaching of valuable metals with organic acids
- Aluminium with similar yields to 1

3
- Precipitation of valuable metals successfully carried out
- Trials showed a significantly precipitation of Li and Al, implementation process step 1

Outlook

- Combining the process steps
- Investigation of the recirculation of the process water

Sources and own publications

[1] Rouquette L., et al; Complete and selective recovery of lithium from EV lithium-ion batteries: Modeling and optimization using oxalic acid as a leaching agent; Separation and Purification Technology Volume 320, 2023; DOI: 10.1016/j.seppur.2023.124143.

[2] Schmitz D., et al; Co-Precipitation of Metal Oxalates from Organic Leach Solution Derived from Spent Lithium-Ion Batteries (LIBs); Metals 14(1), S. 80, 2024; DOI: 10.3390/met14010080.

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