Gas-Liquid precipitation for the recovery of lithium from a Lithium-Ion Battery Leachate

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1. Introduction

Lithium-ion battery waste and recycling needs

- Lithium-ion battery waste is growing by 20 per cent per year and could exceed 136,000 tones by 2036.
- 1,2 million of EOL EV batteries to recycle annually by 2030.
- Rising to 14 million per year by 2040.
- Challenges of improper disposal : environmental contamination , health risks, resource wastage, fire hazards, regulatory issues and economic impact.

McKinsey & Company (March 13,2023) Battery recycling takes the driver's seat https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-recycling-takes-the-drivers-seat#
Mark Peplow (November 19,2023) Lithium-ion battery recycling goes large, Chemical & Engineering news https://cen.acs.org/environment/recycling/Lithium-ion-battery-recycling-goes/101/i38

1. Introduction

Advantages and outlook of battery recycling

- Recycling lithium-ion batteries could reduce the ne
- Recycled materials lowers the cell construction C
- Battery recycling is a profitable and rapidly growin environmental responsibilities and shortage of raw
- EOL EV batteries are not expected to become a si 2040.

	NMC 811	NCA	LFP	USD/kg
Lithium	5 kg	6 kg	6 kg	14,59
Cobalt	5 kg	2 kg	0 kg	27,83
Nickel	39 kg	43 kg	0 kg	21,41
Manganese	5 kg	0 kg	0 kg	
Graphite	45 kg	44 kg	66 kg	
Aluminium	30 kg	30 kg	44kg	
Copper	20 kg	20 kg	26 kg	
Steel	2 kg	20 kg	26 kg	
Iron	0	0 kg	41kg	

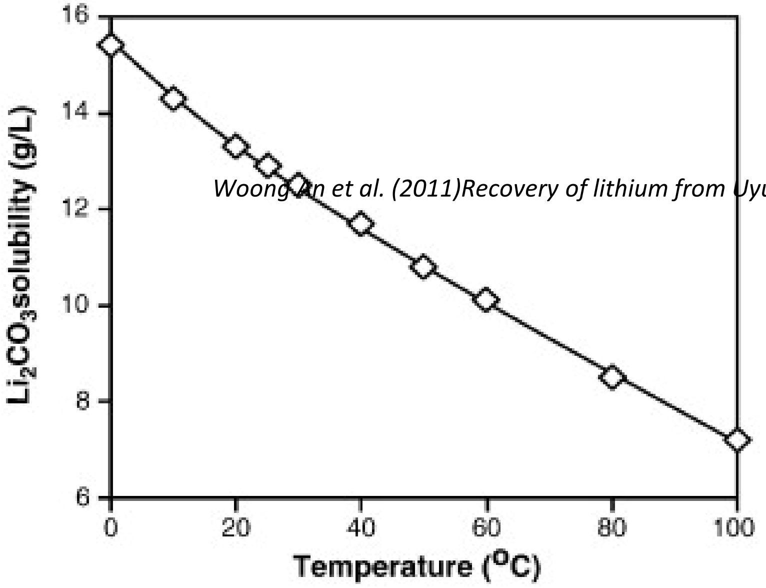
https://www.dailymetalprice.com/lithium.html

2. Precipitation using Na_2CO_3

Objectives :

1. Obtain lithium carbonate using Na_2CO_3
2. Analyse the quality of the product focusing on the morphology, lithium recovery yield and purity levels.

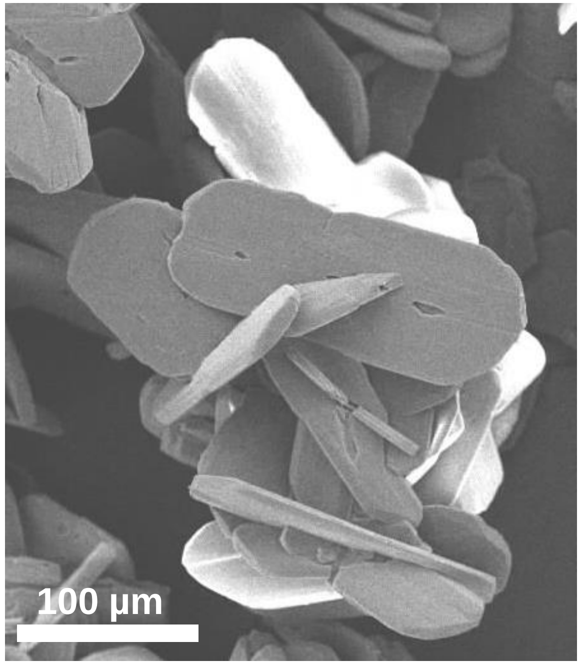
Exp.	**T** [°C]	**V_T** [ml]	**Agitation** [rpm]	**T** [min]	**pH**	**Li^+** [g/L]
1	80	500	500	60	10 ≈11	5
2						10
3						20



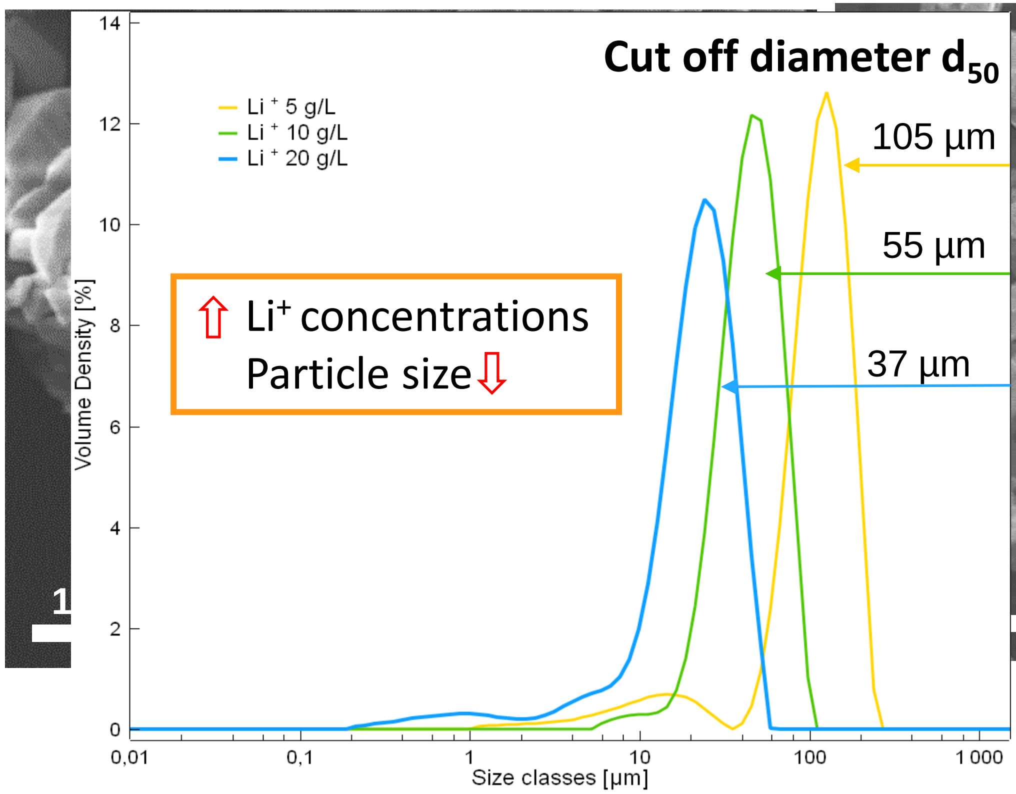
Woong An et al. (2011)Recovery of lithium from Uyuni salar brine, Hydrometallu

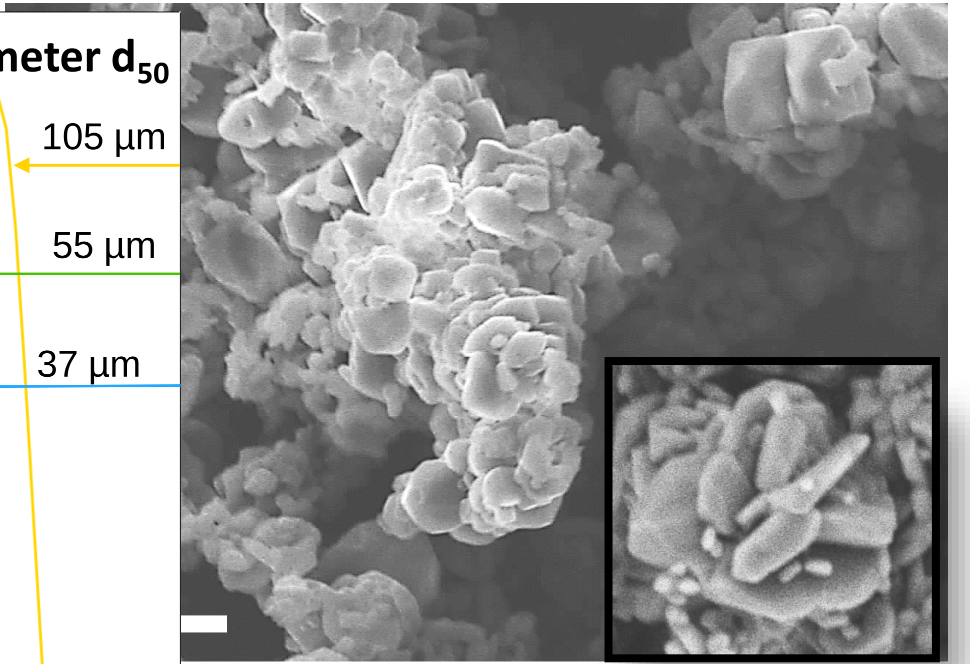
2. Precipitation using Na_2CO_3

Morphological characterization



Li+ 5 g/L

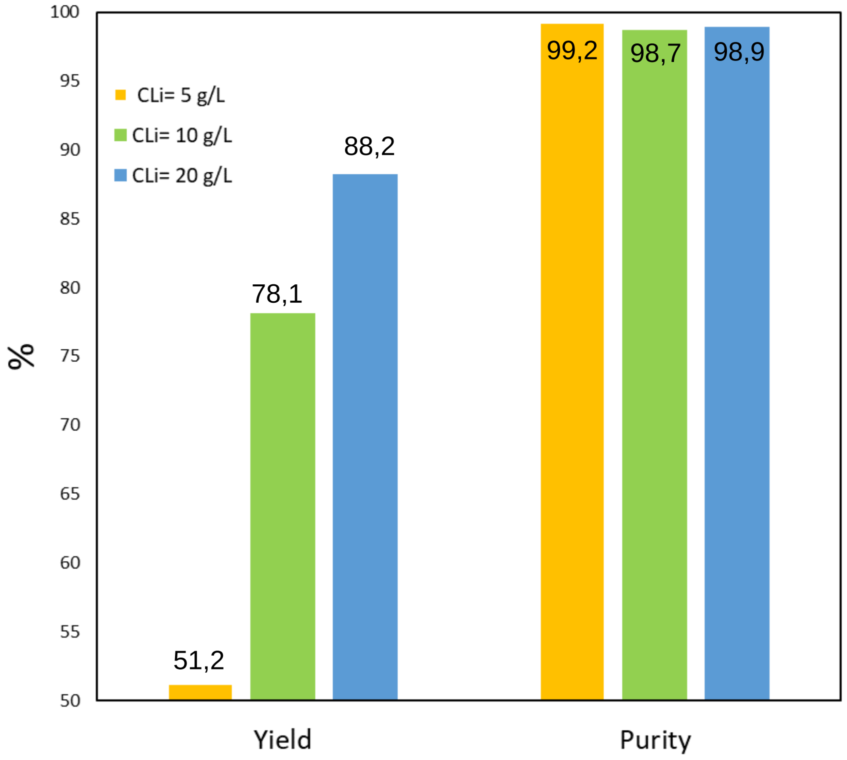


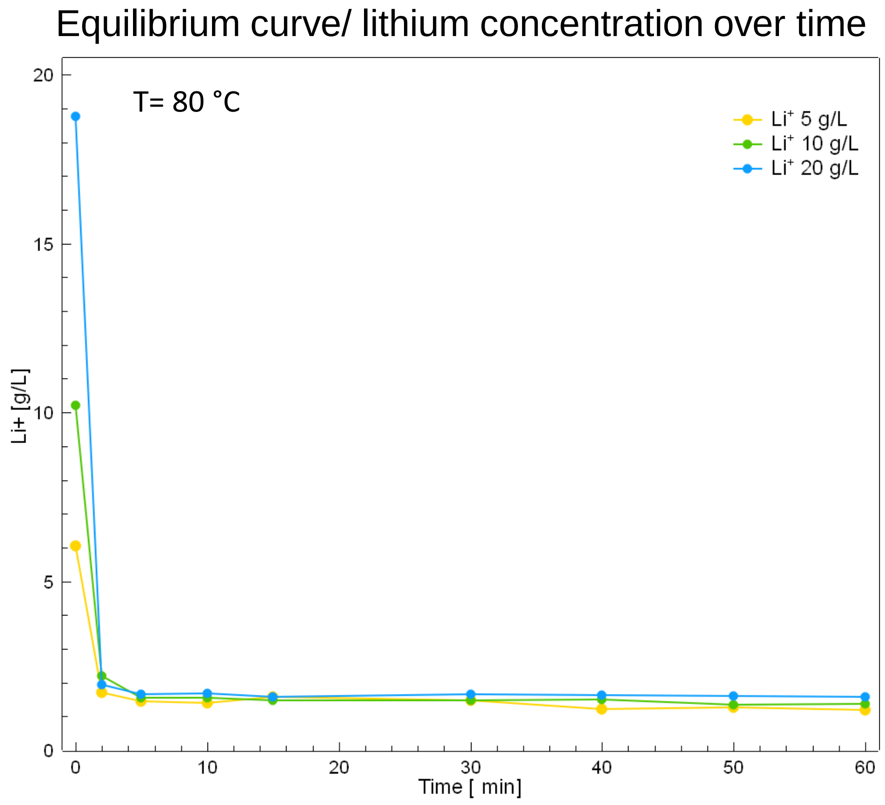


Li+ 20 g/L

2. Precipitation using Na_2CO_3

Lithium recovery yield

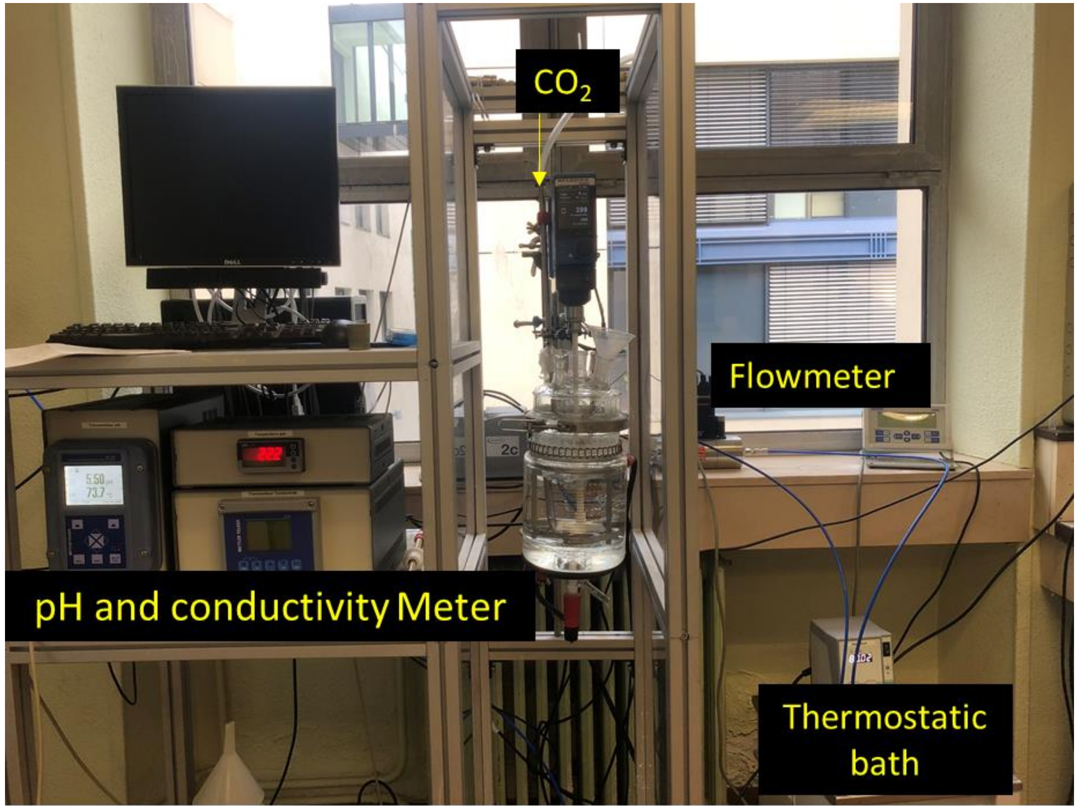




3. Precipitation using CO_2 (Gas-Liquid precipitation)

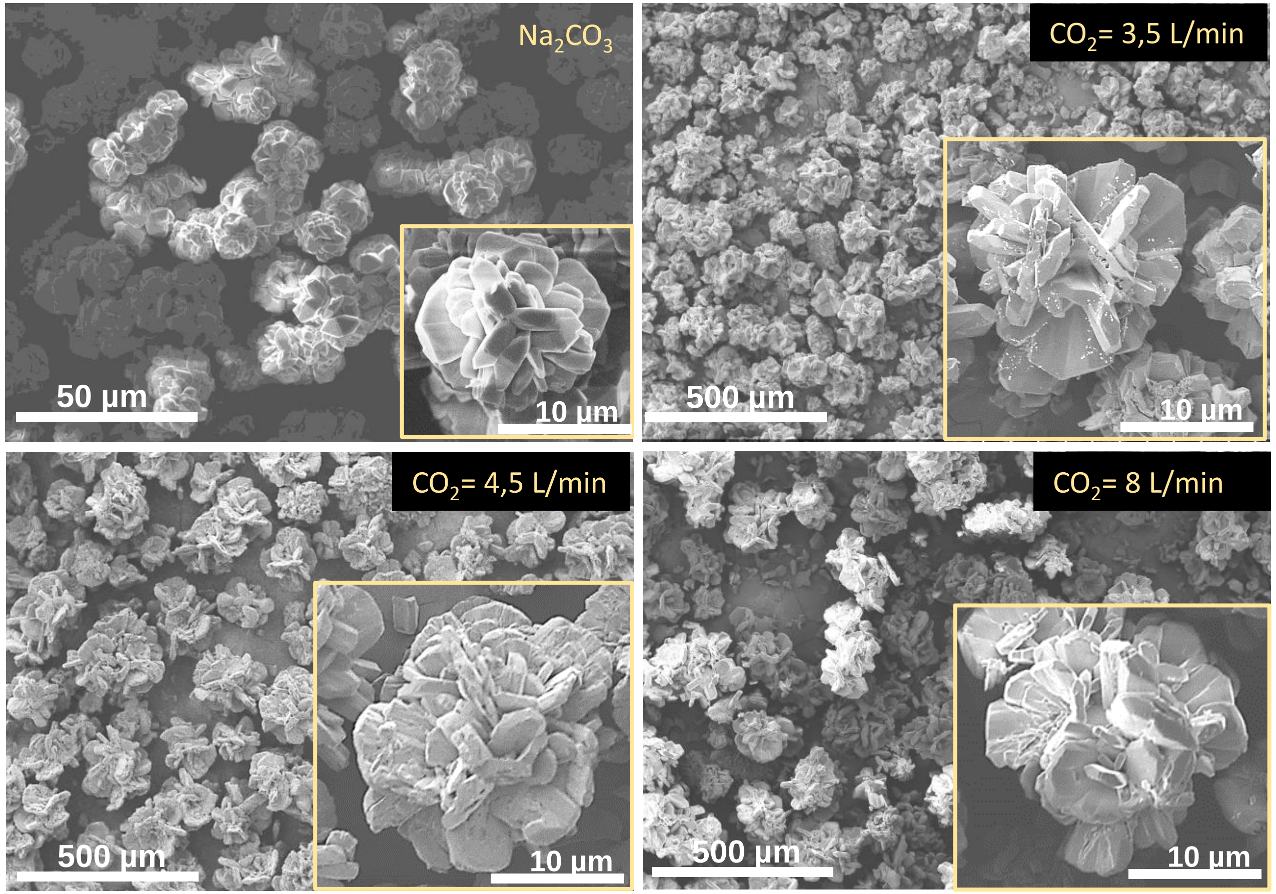
1. Obtain lithium carbonate throu
2. Analyse product quality in term lithium recovery yield and puri
3. Compare results with the Na_2C method.

Exp.	Li^+ [g/L]	T [°C]	V_T [ml]	Agitation [rpm]
1	10	80	2000	400
2				
3				

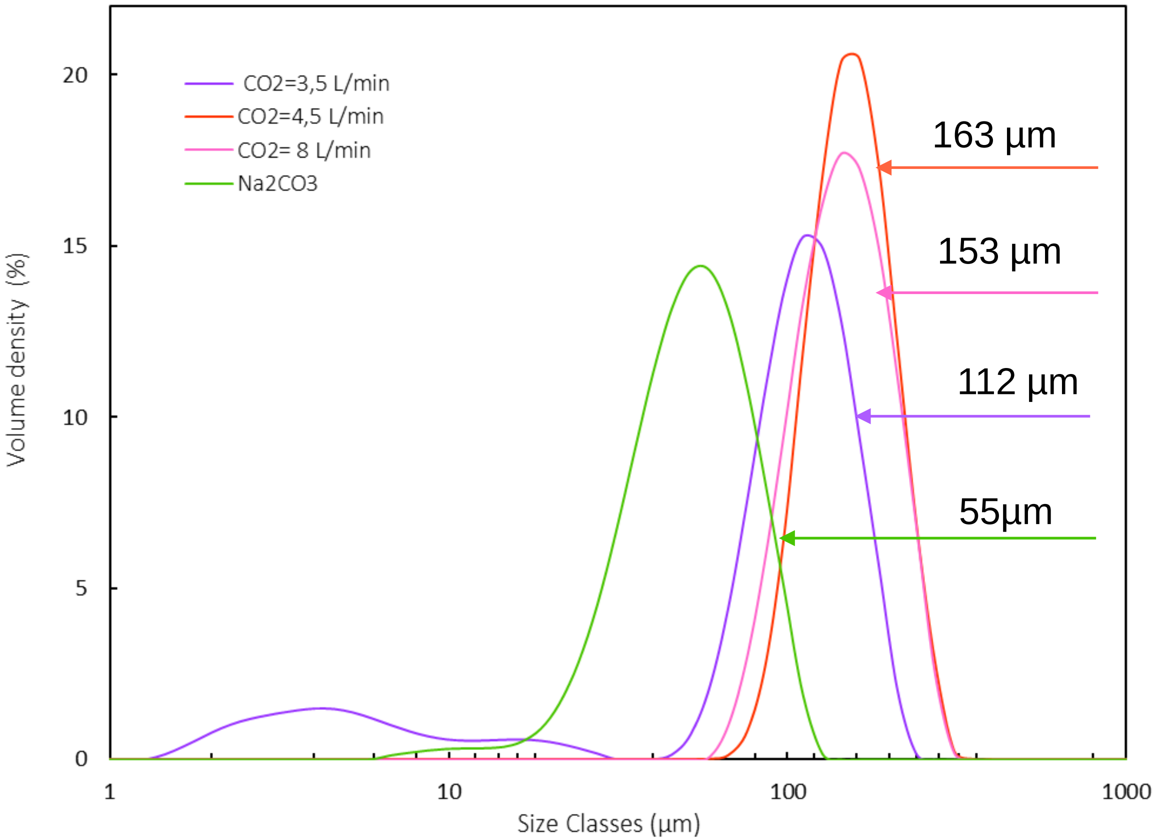


3. Precipitation using CO_2 (Gas-Liquid precipitation)

Morphological characterization

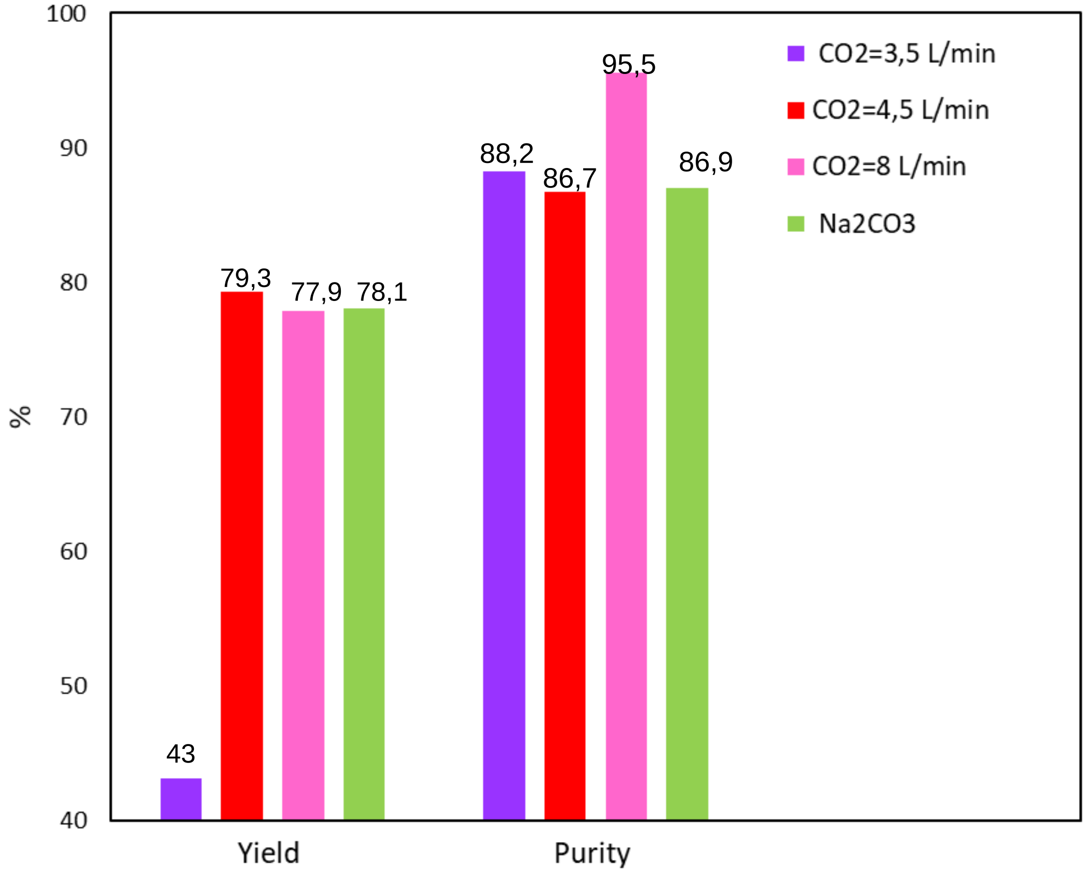


Cut off diameter d_{50}



3. Precipitation using CO_2 (Gas-Liquid precipitation)

Lithium recovery yield and purity



Hot washing

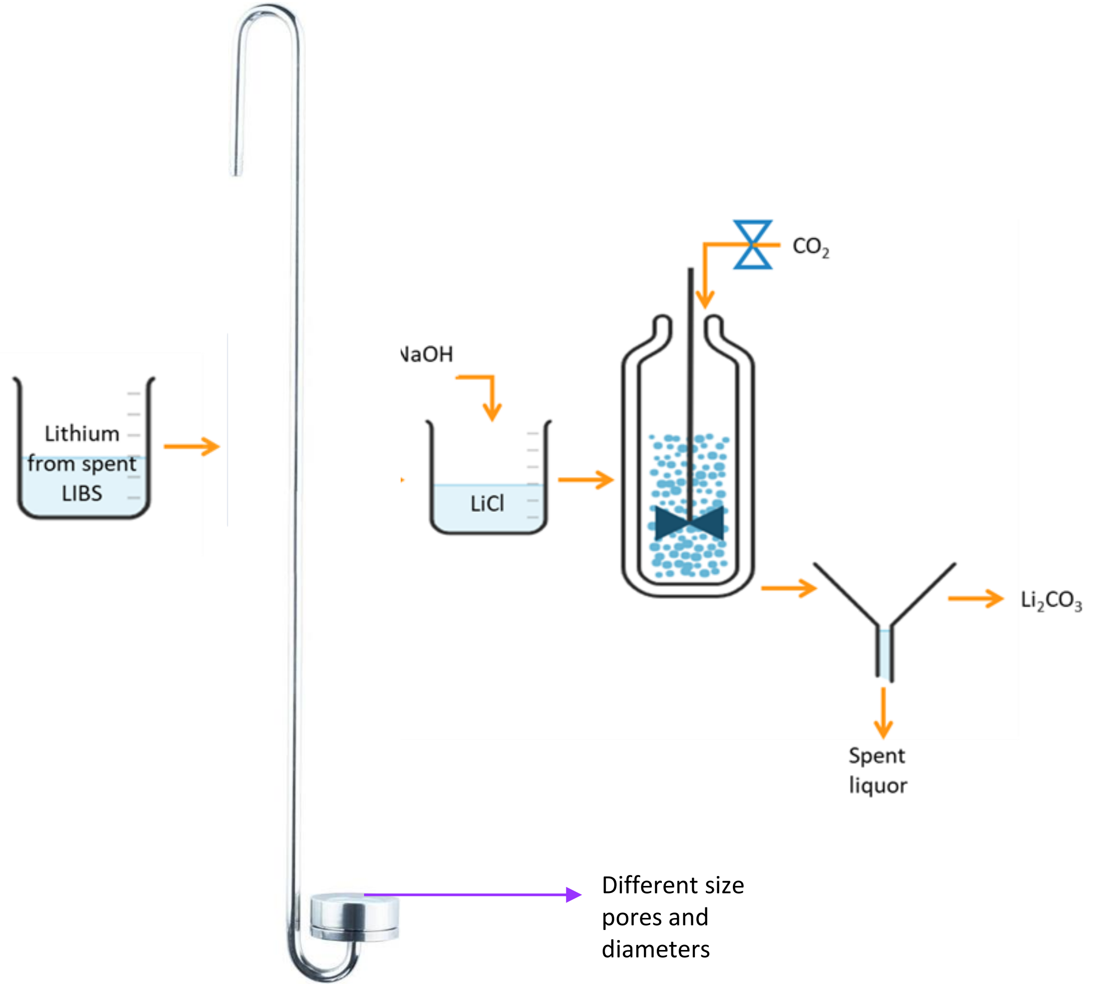
99,89 %
99,48 %
99,71 %
98,70%

4. Summary

	Li_2CO_3 precipitation using CO_2	Li_2CO_3 precipitation using Na_2CO_3
Purity and recovery	Higher purity and recovery under optimal conditions	Standard purity and recovery
Crystals morphology	Larger spherulites	Smaller spherulites
Reaction speed	Slower	Faster
Operational conditions	Requires careful pH and temperature control	Less stringent control needed
Material costs	Lower, utilizes CO_2, however it requires a basic solution to increase pH.	Higher, requires Na_2CO_3
Safety and handling	Involves CO_2 storage and handling risks	Easier to handle and store Na_2CO_3
Technology requirements	Specialized equipment to increase superficial area to improve reaction efficiency	Standard Set-Up
Environmental impact	More sustainable, supports carbon neutrality	Less environmentally friendly

5. Further work

- Continue testing techniques to increase the initial lithium concentration.
- Identify the optimal operational conditions, focusing on temperature and flow rate.
- Experiment with different CO_2 injectors to asses their impact on product quality.
- Additionally, investigate whether the injectors influence flow rate and pH control.



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