Centre - Eau Terre Environnement

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Feasibility study of pilot scale mineral carbonation in real industrial conditions: Parameters and results

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I- Introduction

I-1- Context

- Since the beginning of the industrial revolution in 1750, the greenhouse effect is amplified by the release of large amounts of greenhouse gases (GHG) into the atmosphere (MDDEP 2002).
- CO_2 is the most emitted GHG (GIEC 2007).
- Mineral carbonation is a technology for carbon dioxide capture firstly proposed by Seifritz, W. (1990).

I-1- Objectives

- Implantation of an economical and efficient process for direct aqueous mineral carbonation using widespread magnesium rich mining residues.

I-2- Originalities

- Use of real industrial conditions: Cement plant flue gas + open pit drainage water
- Use of widespread and cheap raw materials without mining requirement
- Ambient temperature and moderate pressure operating conditions
- Carbonates precipitation out of reactor and production of pure by-product

II- Materials and methods

II-1- Raw material caracterization and preparation

- Raw material = 43.4 % of MgO
- Magnetic fraction removal using physical separation methods.
- Grinding = fine particules
- Hydroxyl groups removal by thermal treatment at 650°C~30min

- Raw material is mostly composed of Lizardite

raw material granulometry

Sample ID	Mean size (µm)	Median size (µm)
Sample (A)	65.1 ± 19.1	24.9 ± 8.9
Sample (B)	35 ± 2.0	16 ± 1.0

II-2- Experimental procedure

- Industrial flue gas composition: CO_2; 19-23% , H_2O; 8-10% + traces of other gas

Flue gas cooling

Gas compression

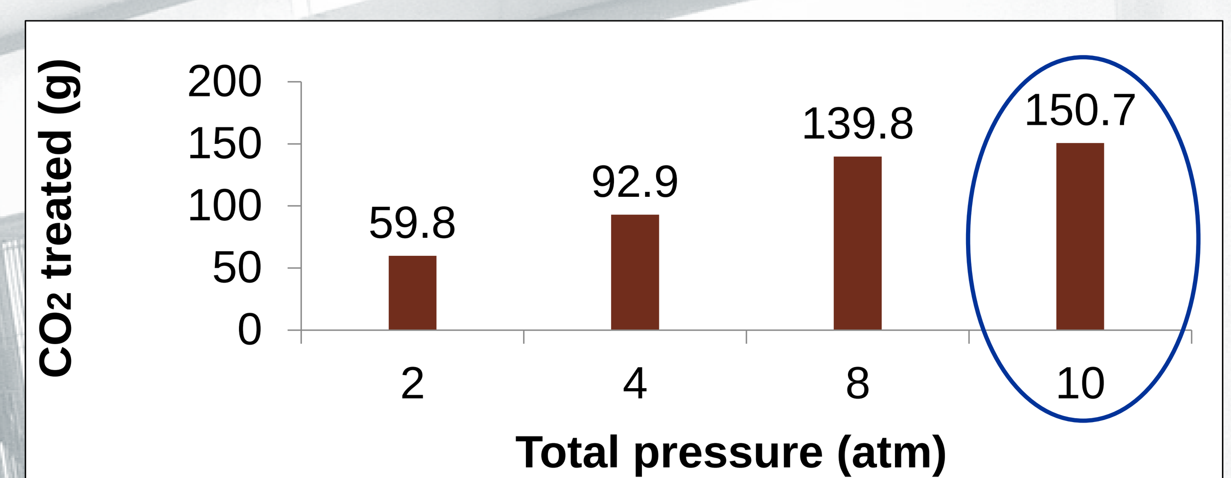
Pulp & Gas in a stirred reactor

Pulp filtration

Carbonates precipitation

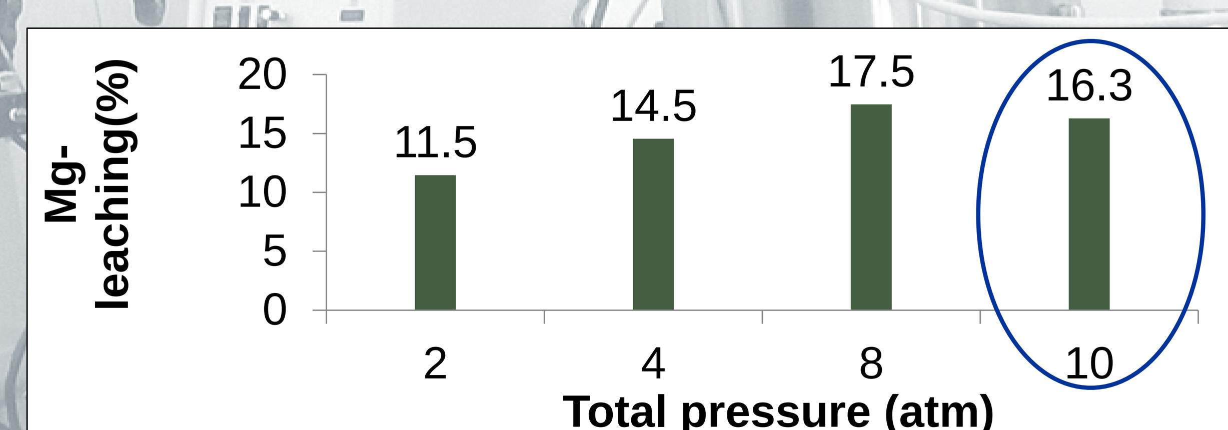
- Solid/Liquid ratio = 15%
- 6 successives batchs of gas
- Retention times: Gas: 15 min; Liquid: 30 min; Solid: 90 min

III- Results



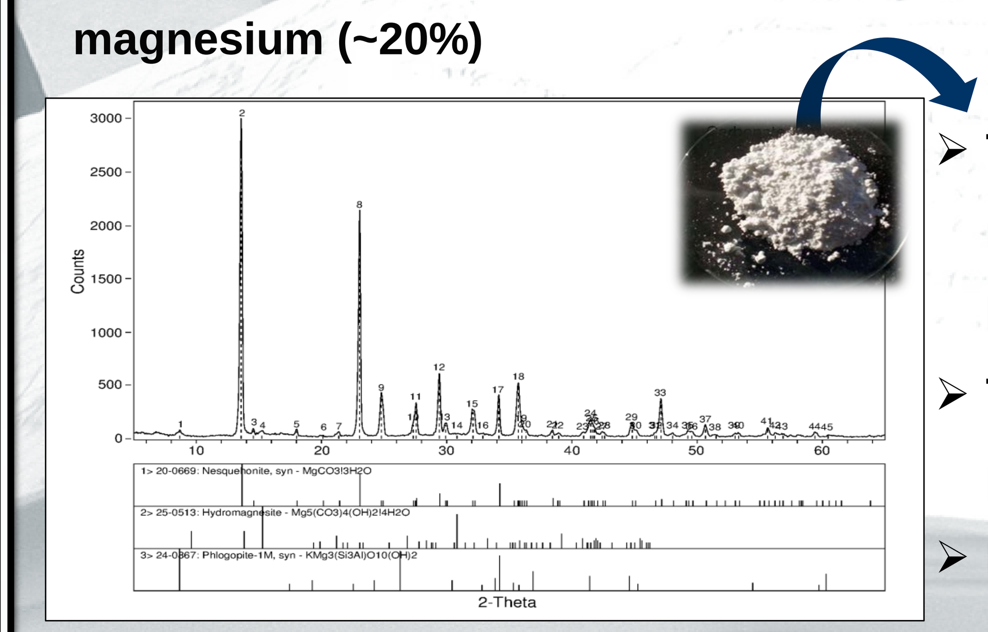
Cumulative mass of CO_2 treated using Sample (A)

- At a total pressure of 10 atm, the mass of CO_2 captured is around 150g
- It corresponds to ~66% of CO_2 initially introduced into the reactor



Cumulative rate of leached magnesium using Sample (A)

- At a total pressure of 10 atm, 16,3% of magnesium is leached from the solid feedstock
- Grinding of raw material into finer particles (average size ~ 35µm) improves the CO_2 capture's potential (74,4% of CO_2 is treated) and the rate of leached magnesium (~20%)



Mineral composition of the precipitated by- products

- The precipitated by-products is majoritarily composed of Nesquehonite.
- The Mg^{2+} content in the precipitate is above 94%.
- It reflect the high purity of the carbonates produced.

IV- Conclusion

- Mining residues CO_2 sequestration potential has been proved at different studied pressures.
- Magnesium leaching is improved by grinding the raw material into fine particles (average size ~35 µm)
- Precipitated carbonates showed a high purity due to the precipitation out of reactor and have a high potential sale value.
- Results optimization and the economical aspects of this process are under studies

V- References

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VI-Acknowledgements