EX-SITU MINERAL CARBONATION: RESOURCES, PROCESS AND ENVIRONMENTAL ASSESSMENTS (CARMEX PROJECT)

Françoise Bodénan, Florent Bourgeois, Charlotte Petiot, Thierry Augé, Benjamin Bonfils, Carine Julcour-Lebigue, François Guyot, Joachim Tremosa, Aïssa Boukary, Arnault Lassin, et al.

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F. BODENAN[1,*], F. BOURGEOIS[2], C. PETIOT[3], T. AUGE[1], A. B. BONFILS[2], C JULCOUR[2], F. GUYOT[4], J. TREMOSA[1], BOUKARY[4], A. LASSIN[1], P. CHIQUET[5]

[1] BRGM, Orléans, France.

[2] LGC, Toulouse, France.

[3] Bio-IS, Paris, France.

[4] IPGP, Paris, France.

[5] TOTAL, Pau, France.

*Corresponding author: f.bodenan, tel: 33 (0)2.38.64.34.41, fax 30.62.

Abstract

This article presents the main results of the French Carmex project (2009-2012) aimed at determining the industrial feasibility of ex-situ mineral carbonation (IPCC, 2005) from the standpoints of resource availability, through optimization of the accelerated carbonation process to an analysis of the entire sector's life cycle.

Through building a GIS it has been possible to identify potentially favourable areas for developing the sector on a worldwide scale. A first treatment targeted on large amounts of (already crushed) ultramafic rock waste near thermal power plants has enabled us to determine the bottle-necks, notably concerning the volumes that are actually accessible, and to identify relevant selection criteria (1). The case of South Africa and, to a lesser extent, that of New Caledonia in connection with its insularity, are discussed. Indeed, New Caledonia's insularity and its accessible abundance of suitable rocks and industrial waste (i.e. rich in MgO, CaO, if not Fe(II)O) would appear to be perfect for the application of mineral carbonation to store the extensive industrial emissions of CO_2 derived from pyrometallurgical processing of nickel.

A detailed study of direct aqueous mineral carbonation in the presence of organic ligands (3) was studied in detail as part of a thesis (2), but detailed analysis of the coupled dissolution and precipitation mechanisms has led this option being discarded (4). Very promising yields (70-90% conversion) under limited P and T conditions, on the other hand, have been obtained by integrating an appropriate physical process.

Comparative environmental assessments of three scenarios for a coal-fired power station – without CO_2 capture, with CO_2 capture and geological storage, and with CO_2 capture and ex-situ mineral carbonation – show mixed results with pollution gains or transfers depending on the process and the studied impact indicators. The analysis shows that the viability of this CO_2 storage option is mainly at the level of the mineral carbonation process and the optimization of its operating conditions.

References: (1) BRGM public report RP-58296-FR (2011) in French; (2) Krevor et Lackner (2009) Energy Procedia; (3) Bonfils B. (2012); (4) Bonfils et al. (2012) IJGGC

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