CCSP Deliverable D547
Turku 2016

Ron Zevenhoven
Martin Slotte

Selection of dry gas/solid ($Mg(OH)_2$) or wet aqueous ($MgSO_4$) carbonation of lime kiln gas CO_2

FP4 report

CLIC Innovation Oy
ETELÄRANTA 10
P.O. BOX 10
FI-00131 HELSINKI
FINLAND
www.clicinnovation.fi

CLIC Innovation Oy
Carbon Capture and Storage Program (CCSP)
Deliverable D547

Ron Zevenhoven, Martin Slotte
Åbo Akademi University, Turku

Selection of dry gas/solid ($Mg(OH)_2$) or wet aqueous ($MgSO_4$) carbonation of lime kiln gas CO_2

FP4 report

Report Title: Selection of dry gas/solid ($Mg(OH)_2$) or wet aqueous ($MgSO_4$) carbonation of lime kiln gas CO_2

Delayed report for FP4 (scheduled for September 2014)

Key words: mineral carbonation, silicate raw materials, lime kiln application

Abstract:

Aiming at a large-scale application of magnesium (Mg) silicate rock mineral carbonation at an industrial-scale lime kiln in Finland (presumably at Parainen) implies the choice of a process route. For this, two routes developed at ÅA can be considered: both operate directly on flue gas (no separate CO_2 capture) and involve solid/solid extraction of Mg from serpentinite rock, but differ in the carbonation step. The ”original” ÅA route implies carbonation of $Mg(OH)_2$ in a pressurised fluidised bed (PFB) reactor, giving recoverable heat and $MgCO_3$ as product, while the ”alternative” ÅA route implies carbonation of $MgSO_4$ in an aqueous solution, giving hydromagnesite $4MgCO_3 \cdot Mg(OH)_2$ and nesquehonite $MgCO_3 \cdot 3H_2O$ as products. The latter won't give heat that can be recovered for further use but offers the great benefit of a simpler process.

Awaiting Tekes' funding decision, parallel work commenced in cooperation with ICES/A*Star in Singapore, under Tekes/A*Star project cooperation *Novel low energy routes to activate minerals for large-scale carbonation for useful products (NEACAP) (2010-2014)* with a natural gas-fired power plant as the application of this CCS technology.

As one outcome, a study titled *A comparison of CO_2 mineral sequestration processes involving a dry or wet carbonation step* was produced for the ECOS'2015 conference in, Pau (France) June 29 – July 3, 2015. The (already peer-reviewed) manuscript was during autumn 2015 slightly reworked for ENERGY and was recently accepted for publication.

In this paper four case studies are compared from an energy (heat and power) use point of view, being an industrial scale lime kiln and a natural gas-fired power plant, with either the ”original” (dry carbonation) or ”alternative” (wet carbonation) ÅA route, all without a CO_2 capture step, as the applied CCS technology.

The content of this paper covers the goal and objectives of Deliverable D547. (Unfortunately IPR limits sharing of results from the NEACAP project to publications in the open literature.)

The full paper can be found, as *doi:10.1016/j.energy.2016.05.066*
at: http://www.sciencedirect.com/science/article/pii/S0360544216306831

Turku, June 2016