CEMENT, CCS AND CO_2 UPTAKE, INCLUDING AN UPDATE ON THE EU LEILAC PROJECT

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Portland cement manufacture is responsible for around 7% of anthropogenic CO_2 emissions, a percentage which is rising. The majority of direct emissions come from the calcination of limestone to form calcium oxide and calcium silicates, the main constituent of Portland cement. However, after cement is hydrated to make concrete, it can react with carbon dioxide in the air to re-form calcium carbonate, completing a cycle. This carbonation mechanism can be measured and the rate at which the global inventory of concrete absorbs CO_2 can be estimated – the results of such an exercise will be shown in this presentation.

That said, concrete carbonation only counterbalances a small fraction of emissions from concrete production, the majority of which come from cement manufacture. Incremental improvements in composition and efficiency are not sufficient to reduce CO_2 emissions by the extent necessary to hit a 1.5–2 °C temperature rise target – CCS is the only practical technology to achieve this ambition. The technological options for the cement-CCS will be presented. Three options – calcium looping, an oxy-fueled kiln, and direct capture – will be described and discussed in depth, including discussion of the effects of various highly integrated processes on the strength and other properties of the cement produced; for calcium looping and oxyfueled kilns, it will be shown that there are negligible effects on the quality of the cement produced.

Direct Capture will be presented and discussed in detail, as part of a recently funded project in the process of producing results. This process is being developed as part of Leilac (Low Emissions Intensity Lime and Cement), a EU Horizon 2020 research and innovation project. This €21m project has received €12m from the EU (H2020 No 654465), with the balance provided by the consortium partners. It runs for five years from 2016 to 2020 and the project team includes industrial, technology and research & development partners. The objective is to pilot a breakthrough carbon capture technology that can capture the process emissions from the calcination of limestone, without imposing a significant energy or capital penalty. The pilot plant will be hosted by Heidelberg Cement at Lixhe in Belgium. Imperial College is carrying out research on the kinetics of calcination under the conditions of interest, suitability of product for destination industries, defining reference technologies for modelling and modelling of the radiative heat transfer in the reactor. Here, we shall present an overview of the project and the current status.