CO2 Capture by Cement Raw Meal - DTU Orbit (09/11/2017)

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The cement industry is one of the major sources of CO2 emissions and is likely to contribute to further increases in the near future. The carbonate looping process has the potential to capture CO2 emissions from the cement industry, in which raw meal for cement production could be used as the sorbent. Cyclic experiments were carried out in a TGA apparatus using industrial cement raw meal and synthetic raw meal as sorbents, with limestone as the reference. The results show that the CO2 capture capacities of the cement raw meal and the synthetic raw meal are comparable to those of pure limestone. The CO2
capture capacity of limestone in the raw meal is lower than for pure limestone. The difference in the CO2 capture capacity decreases with an increase in cycle number. The calcination conditions and composition are major factors that influence the CO2 capture capacity of limestone. At 850 °C in N2, the capacity of synthetic raw meal was similar to that of pure limestone, whereas at 950 °C in N2 and in a CO2-rich atmosphere there was a significant difference. The SEM and BET analyses indicate that sintering is the main reason for the lower capture capacity of the limestone in the raw meal. The main components of the raw
meal used along with the limestone have different effects on the CO2 capture capacity of the limestone. Al2O3 has the most negative effect, followed by Fe2O3, whereas SiO2 showed no effect. These interactions can be observed as a correlation between the measured surface area and the CO2 capture capacity. The XRD results indicated an increase in crystallite size and the formation of new phases due to the reaction between the main components of the raw meal and the limestone, which also has an effect on the CO2 capture capacity. The formation of dicalcium silicate was also observed by XRD analysis in the calcined
synthetic raw meal. The effect of calcination conditions and compositions on the CO2 capture capacity as a function of cycle number is described by a correlation equation. This equation is used to determine the decay constant (k) and residual CO2 capture capacity (Xr). This shows that raw meal could be used as a sorbent for the easy integration of the carbonate looping process into the cement pyro process for reducing CO2 emissions from the cement production process.

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