Carbonation and deactivation kinetics of a mixed calcium oxide-copper oxide sorbent/oxygen carrier for post-combustion carbon dioxide capture

Patrice Perreault, Gregory-S. Patience

PII: S1385-8947(16)31060-9
DOI: http://dx.doi.org/10.1016/j.cej.2016.07.114
Reference: CEJ 15563

To appear in: *Chemical Engineering Journal*

Received Date: 18 April 2016
Revised Date: 29 July 2016
Accepted Date: 30 July 2016

Please cite this article as: P. Perreault, Gregory-S. Patience, Carbonation and deactivation kinetics of a mixed calcium oxide-copper oxide sorbent/oxygen carrier for post-combustion carbon dioxide capture, *Chemical Engineering Journal* (2016), doi: http://dx.doi.org/10.1016/j.cej.2016.07.114

Carbonation and deactivation kinetics of a mixed calcium oxide-copper oxide sorbent/oxygen carrier for post-combustion carbon dioxide capture

Patrice Perreault[a,*], Gregory-S. Patience[a]

[a] *Polytechnique Montréal, Department of Chemical Engineering, C.P. 6079, Succ. Centre-Ville, Montréal QC, Canada*

Abstract

Removing carbon dioxide from industrial effluents via solid carbonate sorbents is a potential greenhouse gas mitigation strategy that can also produce hydrogen from the effluent in water gas shift reactors downstream. However, to regenerate the calcium oxide (from the carbonate) requires high temperature that is provided via an oxidation step. To avoid costly oxycombustion to regenerate the $CaCO_3$, it is possible to use the heat generated during the reduction of copper oxide and manganese oxides as chemical looping agents. Unfortunately, sorbents sinter thereby and consequently the surface area drops in the regeneration step. A mixed CuO-CaO sorbent with 10 % calcium aluminate binder lost 84 % of its initial BET surface area during the first 100 min on stream. Homogeneous calcium-copper-cement oxide sorbent deactivate to the 0.5 order with respect to the remaining surface area and a decay constant equal to 2.86 min^{-1}. An empirical equilibrium power law model characterizes the carbonation rate from 425 °C to 665 °C with 10 % to 20 % CO_2 in a 45 mm fixed bed. The apparent

*Corresponding author
Email address: patrice.perreault@polymtl.ca (Patrice Perreault)