International Journal of Greenhouse Gas Control 50 (2016) 271–304

Contents lists available at ScienceDirect

International Journal of Greenhouse Gas Control

journal homepage: www.elsevier.com/locate/ijggc

Review

Review and research needs of Ca-Looping systems modelling for post-combustion CO_2 capture applications

Isabel Martínez[a,*], Gemma Grasa[b], Jarno Parkkinen[c], Tero Tynjälä[c], Timo Hyppänen[c], Ramón Murillo[b], Matteo C. Romano[a]

[a] Politecnico di Milano, Department of Energy, Via Lambruschini 4, 20156 Milano, Italy
[b] Spanish Research Council (CSIC), Instituto de Carboquímica, Miguel Luesma Castán 4, 50018 Zaragoza, Spain
[c] Lappeenranta University of Technology, LUT Energy, P.O. Box 20, 53851 Lappeenranta, Finland

ARTICLE INFO

Article history:
Received 16 December 2015
Received in revised form 18 March 2016
Accepted 1 April 2016
Available online 1 June 2016

Keywords:
CO_2 capture
Calcium looping
Carbonation
Calcination
Modelling
Economics

ABSTRACT

Ca-Looping technology has experienced a substantial development in the technical readiness level in the last years, especially in its application as post-combustion CO_2 capture technology in power plants. Experimental results from MW-scale power plants worldwide have confirmed post-combustion Ca-Looping process using interconnected circulating fluidised bed reactors as a promising technology for CO_2 capture. Among the different fields of research having contributed to this breakthrough, modelling activity aiming at assessing sorbent properties, interpreting results from experimental reactors or assessing technology scale-up through large-scale reactors and process integration have played a crucial role.

This paper aims at reviewing and discussing findings obtained by different research groups worldwide about post-combustion Ca-Looping process modelling. Assumptions made with respect to sorbent performance, reactor operating conditions and process integration between different components are crucial when evaluating the performance of the Ca-Looping process as a post-combustion technology for CO_2 capture. With the aim of understanding the importance of these assumptions, this paper covers particle reaction and reactor models for carbonation and calcination steps, assessing the impact of the conditions used for their determination into their reactivity predictions, as well as process modelling works that assess performance obtained when integrating a Ca-Looping process into a power plant. Indications on the research needs detected among the reviewed works have also been highlighted in this work to contribute to the advancement of the knowledge on the Ca-Looping technology.

Contents

* Corresponding author.
E-mail address: isabel.martinez@polimi.it (I. Martínez).

http://dx.doi.org/10.1016/j.ijggc.2016.04.002
1750-5836/