Chemical Looping for Pre-combustion CO₂ Capture – Performance and Cost Analysis

Hari C. Mantripragada* and Edward S. Rubin

Department of Engineering and Public Policy, BH129, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA 15213.

Abstract

The objective of this paper is to compare the two technologies – chemical looping combustion (CLC) for inherent CO₂-capture, and Calcium looping-based (CaL) CO₂-capture – when applied to a coal-based IGCC power plant, in terms of system efficiency, overall plant efficiency, CO₂-capture percentage and cost. It was found that a CLC-based CO₂ capture system is more efficient than a CaL-based CO₂ capture system. However, both the chemical looping processes lead to higher efficiencies than a conventional solvent-based pre-combustion CO₂ capture. The capital cost and cost of electricity of the CLC-based CO₂-capture power plant were also found to be lower than a conventional pre-combustion CO₂-capture for an IGCC power plant.

© 2013 The Authors. Published by Elsevier Ltd.
Selection and/or peer-review under responsibility of GHGT

Keywords: Chemical looping; calcium looping; pre-combustion CO₂ capture; techno-economic analysis

1. Introduction

CO₂ capture using the chemical looping concept, which involves circulation of solids between two reactors, is being widely proposed as a more efficient and cost-effective way than the currently commercial capture technologies [1, 2]. Broadly, two different methods have been proposed for separation of CO₂ from gaseous mixtures in different applications – chemical looping combustion (CLC), and a calcium-looping cycle (CaL) for CO₂ separation.