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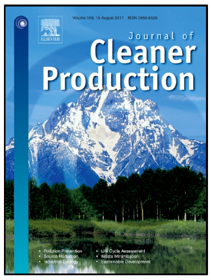

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1. Introduction

The current increasing trend of global warming is highly alarming due to its adverse effects on climate including rise in atmospheric temperature, melting of glaciers, rise in sea levels, change in rainfall patterns, vanishing of animal populations etc. Global warming is attributed to the increasing concentrations of greenhouse gases in atmosphere, among which carbon dioxide (CO_2) emission is the highest, accounting for nearly 75%. Out of all the global anthropogenic CO_2 emissions, more than 40% emission is from fossil fuel fired power plants. Huge amount of research is going on globally, to address the issue of CO_2 emissions associated with the conventional combustion technologies, either by adopting carbon capture and storage (CCS) techniques or by developing alternative cleaner combustion technologies. However, the energy penalty associated with the integration of conventional power plants with the available CCS technologies such as pre, post, oxy fuel combustion is quite high. Thus, the plausible solution options could be either to find out alternate combustion technologies catering to CO_2 sequestration or to switch over to the production of cleaner non-carbonaceous fuels such as hydrogen (H_2) to meet the energy demand.

The research on these options led to the emergence of chemical looping processes (CLPs), firstly with chemical looping combustion (CLC) followed by chemical looping reforming (CLR) (Adanez et al., 2012; Moghtaderi, 2011). Unlike the conventional combustion and reforming processes, in these looping processes, metal oxides are used as oxygen carriers (OCs) to oxidise the fuel and there exists no direct contact between fuel and air. The product gases are kept separate from the rest of the flue gases, thereby eliminating the tedious and cost intensive step of CO_2 separation from flue gas mixture. Considering the CO_2 emission from other sources, it is noted that the transport sector is contributing to over 21% of global emission which is highly significant (Kheshgi et al., 2012). In this scenario, H_2 seems to be the most promising alternative non-carbonaceous cleaner fuel to address the issue of CO_2 emission. H_2 can be used as high-efficiency energy carrier for transportation, heating, as well as for power generation. Moreover, the demand from industrial sector for the production of H_2 is