ABSTRACT

CO_2 emission is significantly affecting climate change. The rising concentration of CO_2 in the atmosphere has led to global warming and other environmental issues. CO_2 sequestration using Chemical looping combustion or CLC technology is an effective strategy to mitigate the detrimental effects of CO_2 on the environment. Ferrochrome slag in the steel industry consists of transition metal oxides that can be an attractive and inexpensive oxygen carrier for chemical-looping combustion. The present work explores the possibility of oxidation of ferrochrome slag, pure Fe turning and their mixtures using CO_2 as the oxygen carrier in CLC process. The controlled TG experiments were performed using Ferrochrome slag, pure Fe turning and their mixture in varying wt. ratio (1:1, 1:2 and 2:1) at three different temperatures, i.e. 800 °C, 900 °C and 1000 °C (isothermal and dynamic temperature program) in presence of 40 %CO_2 and 60 % Ar gas mixture. The oxidized samples are investigated using a combination of SEM-EDS and XRD to analyze the phases and its composition. In addition, thermodynamic calculations are performed using to aid the understanding of the oxidation mechanism. The results show that Fe turning and Ferrochrome slag mixtures gain significant mass due to Fe_3O_4 spinel formation. In addition, the oxidized slag-Fe samples also constitute $MgAl_2O_4$ spinel with Fe and Cr solubility. The oxidation kinetics is found to increase with temperature and Fe content in the mixtures. The study effectively demonstrates that CO_2 can be utilized for oxidation of slag-Fe turning mixtures. The result is very promising to utilizing slag-Fe turning mixture as O_2 carrier in a CLC process. Besides, CO_2 gas can also be effectively utilized for oxidation in a CLC reactor.

Keywords: Chemical looping combustion, Ferrochrome slag, CO_2 sequestration, Thermogravimetric analysis, CO2 capture, Fe-turning.