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Mercury Release and Speciation in Chemical Looping Gasification of Coal

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Abstract: The coal gasification process is used in the commercial production of syngas as a means toward the clean use of coal. Among the Carbon Capture technologies, Chemical Looping Gasification (CLG) has recently emerged as a promising option to facilitate CO_2 inherent separation at low cost, where two interconnected fluidized bed reactors are used, namely the fuel and air reactors. The oxygen carrier material transports oxygen from air to fuel reactor. In CLG, the oxygen in the oxygen carrier is used instead of the gasification medium in conventional gasification to provide the oxygen needed for gasification reaction to the fuel, through controlling the lattice oxygen/fuel ratio, the solid fuel is gasification, and the syngas with CO and H_2 as the main component is produced. Mercury is one of the main pollutants in the formation of coal gasification process with high volatility, high toxicity and corrosiveness will seriously jeopardize the safety of process equipment, study the generation and release mechanism of the removal of mercury is particularly important. This work is the first study on mercury release in Chemical Looping Gasification of coal. The mechanism of Hg release and the oxidative transformation mechanism of lattice oxygen and molecular oxygen in different reaction atmospheres (oxidation/reduction) on mercury in the process of chemical looping gasification were studied. The determination of mercury speciation (Hg^0/Hg^{2+}) in fuel and air reactors as well as the quantification of the amount of mercury released in each reactor were addressed. In a CLG system, mercury emissions to the atmosphere will decrease compared to conventional as only mercury released in the air reactor will reach the atmosphere. However, measures should be taken to reduce Hg^0 in the CO_2 stream before the purification and compression steps in order to avoid operational problems.

Keywords: Coal, CLG, Mercury, Speciation, Mechanism

Graphical abstract: