Heat Integration of the Water-Gas Shift Reaction System for Carbon Sequestration Ready IGCC Process with Chemical Looping

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Integrated gasification combined cycle (IGCC) technology has been considered as an important alternative for efficient power systems that can reduce fuel consumption and CO_2 emissions. One of the technological schemes combines water-gas shift reaction and chemical-looping combustion as post gasification techniques in order to produce sequestration-ready CO_2 and potentially reduce the size of the gas turbine. However, these schemes have not been energetically integrated and process synthesis techniques can be applied to obtain an optimal flowsheet. This work studies the heat exchange network synthesis (HENS) for the water-gas shift reaction train employing a set of alternative designs provided by Aspen energy analyzer (AEA) and combined in a process superstructure that was simulated in Aspen Plus (AP). This approach allows a rigorous evaluation of the alternative designs and their combinations avoiding all the AEA simplifications (linearized models of heat exchangers). A CAPE-OPEN compliant capability which makes use of a MINLP algorithm for sequential modular simulators was employed to obtain a heat exchange network that provided a cost of energy that was 27% lower than the base case. Highly influential parameters for the pos gasification technologies (i.e. CO/steam ratio, gasifier temperature and pressure) were calculated to obtain the minimum cost of energy while chemical looping parameters (oxidation and reduction temperature) were ensured to be satisfied.

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