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Energy Analysis and Integration of the H_2 Production from Biomass Fast Pyrolysis and in Line Sorption Enhanced Steam Reforming

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Abstract : H_2 production from fast biomass pyrolysis and line Steam Reforming (SR) has been extensively studied in the last years. However, Sorption Enhanced Steam Reforming (SESR) is gaining attention as an alternative to the conventional SR since it allows obtaining higher H_2 yields and a purity near 100 % in the product stream. In this work, both alternatives were compared through an energy analysis. The processes were modeled with PRO II v.2021 software. First, general energy balances were carried out in order to identify the total energy requirements in a wide range of operating conditions. At H_2 yield optimum conditions for both processes (steam to biomass ratio of 2 and temperature of 600 ºC), the total energy requirement for the SR alternative is 936 kJ/kgH_2, whereas for the SESR alternative is 1134 kJ/kgH_2. Then, the energy needs were grouped into operation stages, aiming at identifying the energy sinks and sources of the processes. It was determined that the SESR alternative is more energy intensive due to the need for a calcination stage for regenerating the sorbent. Finally, a configuration of the SESR alternative with energy integration was developed in order to compensate for the energy demand.

Keywords : Biomass valorization, CO_2 capture, Energy analysis, H_2 production
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