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Kinetic Study of the Pyrolysis of *Pinus Cooperi* and *Quercus Sideroxyla* for the H_2 Production Combined with CO_2 Capture

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ABSTRACT

Pyrolysis of forestry residues is currently of great interest because bio-oil compounds are produced and these can be employed for the hydrogen production from steam reforming. The objective of the present research was to perform a kinetic study and to determine the optimum reaction conditions for the pyrolysis of the Mexican species *Pinus cooperi* and *Quercus sideroxyla* to achieve the greatest amount of volatile matter (condensable and non-condensable). Furthermore, a thermodynamic analysis was made to evaluate its possible application towards the steam reforming of the volatile matter combined with CO_2 absorption (AERS). Samples of forest biomass were crushed and sieved to particle sizes between 300 to 710 µm and evaluated in a pyrolytic reactor under a N_2 flowrate of 50, 100 and 150 ml/min, at heating rates of 1, 5, 10, 15, 20 and 25 °C/min from room temperature to 700 °C. Results show that at a particle size of 300 microns, 100 ml/min and SV = 33000 h^{-1} and heating rate of 20 °C/min, allowed to obtain the greatest amount of volatile matter in both species. Proximate analysis (wt%) for *Pinus cooperi* resulted in 3.01% moisture, 78.01% volatile matter, 12.35% fixed carbon, 0.42% ash and 6564 J/g of calorific value, while for *Quercus sideroxyla* specie was 2.39% moisture, 78.69% volatile matter, 18.24% fixed carbon, 0.45% ash and a 7322 J/g of calorific value. Kinetic study of the pyrolysis shown an activation energy of Ea = 201.24 kJ/mol for *Pinus cooperi* and 141.97 kJ/mol for *Quercus sideroxyla*, respectively with an apparent reaction order of 1 for both species. Finally, through the thermodynamic analysis, it was found that the obtained volatile species showed a high potential for the production of hydrogen under the steam reforming combined with CO_2 absorption reaction scheme (AESR).

Keywords: hydrogen production; biomass pyrolysis; kinetic study