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Thermo-Catalytic Reforming (TCR) of Lignocellulosic Biomass using Steel Slags (SS) as Catalyst

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Lignocellulosic biomass is known as a second generation biomass which means it is non-food competing, it is the most abundant renewable resource existing, and presently it's considered as a promising feedstock for the synthesis of green chemicals and biofuels for reducing transportation emissions and dependence on fossil fuels (Lichtenthaler and Peters, 2004). SS are by products of the steel industry, which are composed of various metal oxides promoting a catalytic effect on pyrolysis products improving their quality. It is a cheap and sustainable alternative to replace zeolites, the most common cracking catalysts. In this research, a TCR reactor and SS are used to transform lignocellulosic biomass into high quality bio-oils. TCR is a combination of intermediate pyrolysis followed by a second post reforming step. Intermediate pyrolysis heats biomass to moderate temperatures between 400–500°C in the absence of oxygen, with a short vapour residence

time (seconds) and moderate solid residence time (minutes) (Neumann et al, 2016). Post reforming is achieved at temperatures between 600-800°C with extended vapour and char residence times (Neumann et al, 2015). One characteristic of the process is that the final products (bio-oil, syngas and biochar) contains a higher energy density than the original feedstock having the advantage to be easily transported and stored (Mahmood et al, 2013). The introduction of SS in the TCR reactor increased the H₂ yield in 73.9% and consequently the HHV in 6.2% for the syngas. The bio-oil produced using SS suffered a reduction of 46.6, 55.1 and 65.7% in terms of viscosity, water content and acid number, respectively. Moreover, the HHV of the same bio-oil raised 12.7%. All these improvements make the pyrolysis oil more attractive and suitable to be used as a biofuel.

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