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

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Abstract

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 at*, 2016). Post reforming is achieved at temperatures between 600-800°C with extended vapour and char residence times (Neumann *et at*, 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 at*, 2013).

The introduction of SS in the TCR reactor increased the H_2 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.

Image

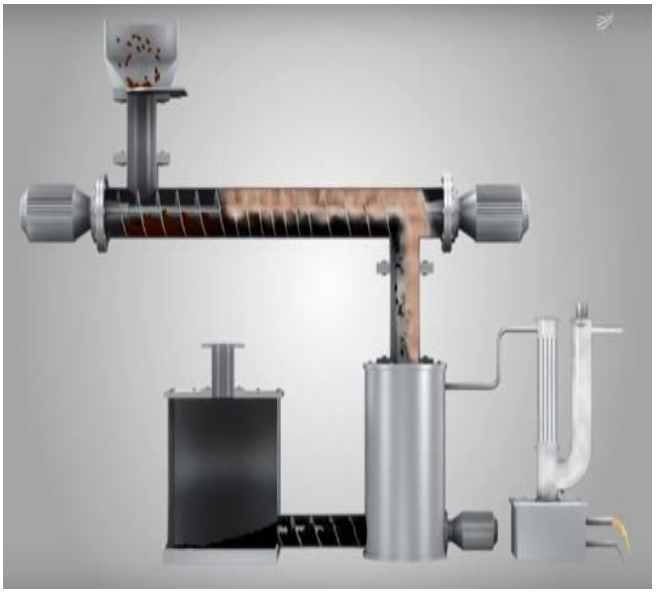


Fig 1. TCR technology

Recent Publications

1. **J. Santos**, M. Ouadi, H. Jahangiri, A. Hornung (2019) Integrated intermediate catalytic pyrolysis ofwheat husk. Food and Bioproducts Processing 1 1 4: 23–30.
2. M. Ouadi, N. Jaeger, C. Greenhalf, **J. Santos**, R. Conti, A. Hornung (2017) Thermo-Catalytic Reforming of municipal solid waste. Waste Management 68: 198-206.
3. F. Pinto, J. Gominho, R. André, D. Gonçalves, M. Miranda, F. Varela, D. Neves, **J. Santos**, A. Lourenço, H. Pereira (2017) Effect of rice husk torrefaction on syngas production and quality. Energy & Fuels 31: 5183-5192.
4. F. Pinto, R. André, M. Miranda, D. Neves, F. Varela, **J. Santos** (2016) Effect of gasification agent on co-gasification of rice production wastes mixture. Fuel 180: 407-416.
5. F. Pinto, M. Miranda, R. N. André, **J. Santos**, D. Neves, F. Varela (2015) Effect of biomass type blended with rice production wastes in syngas produced by co-gasification. Materials and Technologies for Energy Efficiency 1: 7-11.



Biography

Joao is a PhD student at the University of Birmingham developing his project with Fraunhofer UMSICHT institute. He concluded his masters at University of Science and Technology of Lisbon being the best student of his course. After his masters he has worked in two research institutes connected to the biomass and biofuels production. He has given his contribute in 7 papers (1 as main author) and he had the privilege to participate in 2 conferences as a speaker.

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