**Gasification of lignocellulosic biomass in a fluidized bed reactor: Catalyst treatment for tar removal and hydrodynamics modelling.**

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**Highlights**

* Study of the main parameters for the gasification process.
* Use of a green catalyst for the problematic tar removal.
* Usage of Computational fluids dynamics (CFD) to model reactors hydrodynamics.

**1. Introduction**

In order to minimize the use of conventional fuels, various renewable technologies and alternative energy sources have been studied during past decades, such the gasification of lignocellulosic biomass. Gasification is a thermochemical process of conversion at high temperature (>700°C) of organic matters into synthesis gas such as monoxide of carbon (CO), dihydrogen (H2), methane (CH4) and dioxide of carbon (CO2).However, predicting the behavior of biomass and its products under this particular thermochemical process, especially in a fluidized bed reactor, is not a simple task. Fluidized bed reactors represent a notable advantage for this process because of the fact that the biomass particles interact with inert materials inside the reactor and remain in a fluidized or suspended region, which provides better results in terms of mass and heat transfer. The composition of these products may vary due to the effect of numerous parameters in the gasification process including reactor temperature, residence time of gases, particle size of solids, type of oxidant, oxidant/feed ratio, nature of biomass and type of catalyst used. The latest one is a critical parameter due to the presence of undesirable products in the gasification process known as tar. Tar removal is an important problematic in biomass gasification. Different catalyst such as nickel-based, calcined rocks, alkali metals and others have been tested in order to reduce tar from final products. The use of a green catalyst like biomass biochar is an alternative solution to this problematic, being very effective in tar removal (up to 99% conversion) and considered a sustainable option (El-rub, 2008). Highly accurate techniques to model hydrodynamics, such as Computational Fluid Dynamics (CFD), are used to study gas-solid interactions, reaction kinetics like homogeneous and heterogeneous reactions and reactor hydrodynamics as the parameters used for the latter have proven to influence the final products obtained.

**2. Methods**

The experimental setup is a fluidized bed reactor in quartz (Fig.1). The biomass is feed at the center of the reactor by a stainless steel tube connected from the top of the reactor. Gases get out from the top to a cyclone in order to collect solids particles trained by the gases. The reactor temperature varies from 500-1000 °C. Nitrogen (N2), air and dioxide of carbon (CO2) were used as carrier gas for gasification reaction. Tar produced was condensed at -13°C temperature and then analyzed in a GC/FID and GC/MS. Product gases are collected in a sample bag and then analyzed in a micro GC/TCD and a GC/FID-TCD according to the system configuration (discontinuous or continuous). For hydrodynamics modelling, a CFD Euler-Lagrange code is used to study the behavior of reactor taking in account the hydrodynamics phenomena.



**Figure 1.** Fluidized bed reactor dimensions.

**3. Results and discussion**

The variation of the each operation parameter influence the results of the final composition gases and tar. Gasification oxidant have a strong influence in the results because it favors the main gasification and tar reactions (dry reforming, water gas-shift, etc.). Temperature influencing the thermal cracking and production of light tar and gases. In the case of hydrodynamics parameters, the fluidization velocity strongly influences the behavior of gas and solids inside the reactor. The use of biochar as bed material for gasification reaction showed a high conversion of tars.

**4. Conclusions**

This work presents an experimental study of the influence of different reactor parameters such as biomass particle size, vapor residence time, reactor temperature, oxidant/biomass ratio, product composition. Tar removal is study using a green and sustainable catalyst (biochar) to show the strong performance of biochar against commercials catalyst. In order to optimize the hydrodynamic of the fluidized bed of biochar, a numerical model has been developed. Additionally, this would help study the shrinkage effects of biomass particles in the process, a phenomenon often neglected in literature.

**References**

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