Publicacions

Fluidized-bed co-gasification of residual biomass/poor coals blends for fuel gas production

Pan, Y. G.; Velo, E.; Roca, X.; Manyà, J. J.; Puigjaner, L. (2000)

Revista: *Fuel*, 79: 1317–1326.

Abstract

Experimental involving the co-gasification of residual biomass/poor coal blends and gasification of individual feedstocks used in the blends were performed in a bench scale, continuous fluidized-bed working at atmospheric pressure. Two types of blends were prepared, mixing pine chips (from Valcabadillo, Spain) with black coal, a low-grade coal from Escatrón, Spain, and Sabero coal, a refuse coal from Sabero, Spain, in the ratio range of 0/100–100/0. Experimental tests were carried out using as a gasification agent mixtures of air and steam with dew points of 74–85ºC at gasification temperatures of 890–910ºC and superficial gas velocities of 0.7–1.4 m/s. Feasibility studies were very positive, showing that blending effectively improved the performance of fluidized-bed co-gasification of the low-grade coal, and the possibility of converting the refuse coal to a low–Btu fuel gas. This study indicates that a blend ratio with no less than 20% pine chips for the low-grade coal and 40% pine chips for the refuse coal are the most appropriate. The dry product gas low heating value augments with increasing blend ratio from 3700 to 4560 kJ/N m^3 for pine chips/low-grade coal, and from 4000 to 4750 kJ/N m^3 for pine chips/refuse coal. Dry product gas yield rises with the increases of the blend ratio from 1.80 to 3.20 N m^3/kg (pine chips/low-grade coal), and from 0.75 to 1.75 N m^3/kg (pine chips/refuse coal), respectively. About 50% co-gasification process overall thermal efficiency can be achieved for the two types of blend.

Kinetics of Biomass Pyrolysis: A Reformulated Three-Independent-Reactions Model

Manyà, J. J.; Velo, E.; Puigjaner, L. (2002)

Revista: *Industrial and Engineering Chemistry Research* (submitted).

Abstract

The thermal decomposition of sugarcane bagasse and waste-wood samples are studied using thermogravimetric analysis. Assuming the addition of three independent parallel decompositions, these corresponding to three pseudo-components linked to the hemicellulose, cellulose and lignin, the weight loss associated to the pyrolysis process is simulated. Firstly, an irreversible first-order reaction model is assumed for each pseudo-component. Results show that the model-simulated curves do not fit well to the experimental data. Consequently, a further kinetic study is carried out for the pure lignin (Kraft Alkali Lignin), which demonstrates that the pyrolysis of lignin is better described by a third-order reaction kinetic. The reformulation of the lignin kinetic model, and its subsequent implementation in the summative model (for the third pseudo-component), has allowed to reach an excellent agreement between simulated and experimental data.

Pyrolysis of sugarcane bagasse: kinetic study at high heating rates

Manyà, J. J.; Gómez, C.; Velo, E.; Puigjaner, L. (2002)

To be presented at the 9th Mediterranean Congress on Chemical Engineering, in Barcelona (Spain), November 25–29, 2002.

Abstract

The main kinetic studies about biomass pyrolysis, based on the thermal decomposition of pure cellulose, have been focused toward two general lines: schemes of competitive and consecutive reactions and mechanisms of global decomposition. The competitive outlines (parallel reactions to get the different fractions of pyrolysis products) have not been able to be validated by thermogravimetry (TGA) or under conditions assuring kinetic control, and they involve a high number of parameters. The mechanisms of global decomposition (by means of an irreversible, single step, and first order reaction) have only been validated under dynamic regime at slow heating rates. However, experimental runs at high heating rates can't be carried out by thermogravimetry. Furthermore, the heat transfer limitations question the validity of the kinetic parameters obtained directly from the experimental results.

The specific aim of this work is to evaluate (at high heating rates, isothermal regime and with an additional parametric adjustment) the predictive capacity of a global decomposition summative model developed at the UPC. This model is defined for three biomass pseudo-components.

Experimental procedure

In this way, an experimental study is carried out using an own-designed micro-reactor (42 mm I.D., and 150 mm long.), and 100 mg samples of untreated and treated (washed with water at

80ºC to eliminate the soluble inorganic matter) sugarcane bagasse. The pyrolysis experiments have been carried out at the temperature range between 275 and 600ºC, and for three residence times (3, 6, and 8 minutes). For each sample, the weight loss is determined as a function of time. The temperature inside the sample holder (real measurement of the sample temperature) is monitored. Once the experimental results are analyzed from a qualitative point of view, and the absence of mass and heat transfer limitations is guaranteed, under isothermal regime, and in absence of secondary solid-vapor reactions; the predictive capacity of two kinetic models has been compared: the competitive kinetic scheme of Miller and Bellan, and the UPC's global weight loss model.

Kinetic study under isothermal conditions

For the application of the global weight loss summative model to the experimental data obtained in the micro-reactor, the kinetic parameters (initially obtained from TGA experiments carried out at 20 K/min) have been adjusted.

Figure 1 shows the evolution of the char yield for the washed sugarcane bagasse vs. temperature (for a residence time of 3 minutes). The char yield evolution simulated by means of the two models under evaluation, have been compared with the experimental data. A better behavior for the UPC's global weight loss model is shown in Figure 1.

This global model has shown to be efficient when reproducing isothermal experiments. Being simpler and using a smaller number of kinetic parameters, our model has been able to reproduce the experimental results carried out in the micro-reactor.

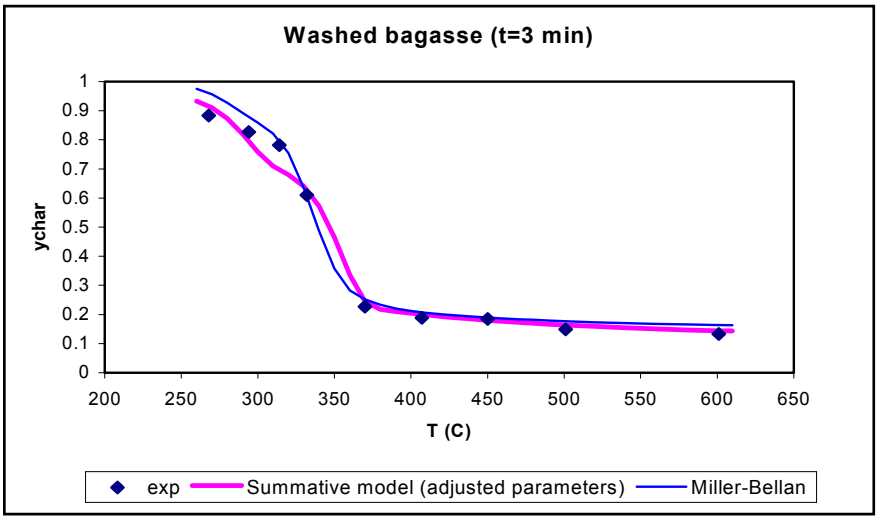

Figure 1. Evolution of the char yield for a washed sugarcane bagasse