HEMICELLULOSE HYDROTHERMAL EXTRACTION YIELD ESTIMATION FROM THERMAL DEGRADATION DATA

Alvaro Cabeza, G. Gallina, F. Sobrón and J. García-Serna
Department of Chemical Engineering and Environmental Technology, High Pressure Processes Group (hpp.uva.es), University of Valladolid, Valladolid, Spain
alvaro.cabeza.sanchez@gmail.com

Hemicellulose hydrothermal extraction is a well-known technology and there are many studies copping with it, which provide a huge amount of data about extraction yields. An extraction yield that depends on the studied sample. Additionally, there is not a way to estimate how much hemicellulose can be recovered from a new sample. On the other hand, biomass pyrolysis is another well-studied process and changes in the degradation behaviour between different samples were also observed. Thus, our assumption is that there should be a relation between these yield and thermal degradation changes. A relation that could be used to estimate the yield of a new sample from its thermogram. To do so, 10 different samples (walnut, linden, plane, elm, eucalyptus, cherry, cedar, catalpa, maple and almond) were treated in a cascade of five tubular reactors with hot pressurized water (160 ºC) for 20 min. A thermogravimetric analysis for the solid residue of each biomass was performed afterwards, fitting the data with a kinetic model. The model used in this work was obtained applying a transient mass balance for each biomass pseudo-compound (water, organic liquids, hemicellulose, cellulose and lignin) and solved by the Runge-Kutta's method with 8^{th} order of convergence. This model considers both, the biomass degradation into gas and charcoal and the vaporization of any liquid phase. The fitting was done by the Nelder & Mead's method, minimizing the average difference between the experimental and simulated data. The average deviation for all the fittings was 3.38%, low enough to ensure that the calculated kinetic parameters successfully reproduced the experimental behaviour. Analysing the calculated Arrhenius' pre-exponential factor evolution can be concluded that when the char production is lower than the gasification, the hemicellulose extraction yield will be also low, and vice versa. Additionally, it was observed that the bigger the char production is, the greater extraction is obtained. A conclusion that can be only reached when the sample has a cellulose content lower than 46%, which can be explained by a cellulose shield effect.

Acknowledgements
The authors acknowledge the Spanish Economy and Competitiveness Ministry, Project CTQ2015-64892-R (MINECO/FEDER). Alvaro Cabeza also wishes to acknowledge the Spanish Economy and Competitiveness Ministry for the scholarship/predoctoral contract FPU2013/01516.