Thermophysical Properties Measurement of the Pyrolysis Oil Components

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Pyrolysis oil is considered as an alternative energy resource for fossil fuels. However, the pyrolysis oil must be upgraded before it can be used as fuel. The upgrading and subsequent downstream processes in the biorefineries require accurate thermodynamic models of the compounds formed during pyrolysis. These models rely on the accurate data of the thermophysical properties of the pyrolysis oils components. Our literature review of the thermodynamic data revealed a large gap on experimental data of the thermophysical properties such as vapour pressure, enthalpy of vaporization, and enthalpy of combustion. For that purposes, a new Knudsen effusion apparatus was built in our laboratory and tested by measuring the vapour pressures of the reference organic compounds such as benzoic acid and anthracene in the temperature ranges 299-317 K and 340-360 K, respectively. A commercial bomb calorimeter Parr-6200 was tested for measuring the enthalpy of combustion of anthracene. Benzoic acid was used to determine the energy equivalent of the calorimeter and to test precision and accuracy of the equipment. From the value of the standard specific energy of combustion, the standard molar enthalpy of combustion and the standard molar enthalpy of formation in the liquid state can be derived. The first relevant compound identified in the pyrolysis oil that measured in this work is 5-(Hydroxymethyl)furfural. It is one of the major components found in the pyrolysis of cellulose and also very important intermediate compound for the production of the biofuel dimethylfuran (DMF), as well as for the production of other molecule such as levulinic acid. In this work, the vapor pressures and enthalpy of vaporization of 5-(Hydroxymethyl)furfural are presented. The ongoing measurements on vapor pressures and enthalpy of combustion of the major compounds existing in pyrolysis oil are expected to get underway in the future.