

Determination of thermal properties of cuts and residues streams obtained in the molecular distillation process

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In Brazil, the discovered oil reserves (conventional and unconventional) by the year 2008 are about 20,9 billion barrels. Regarding to the unconventional oil, Brazil has an approximate reserve from three to four billion barrels of heavy oil and two billion barrels of ultra-heavy oil. This fact has stimulated the new separation processes research which will suite for a heavy petroleum processing alternative. This separation technique promotes a significant gain in the product quality operating at high vacuum. [1].

The molecular distillation or short path distillation as it's known, is a non-conventional process of separation indicated for separation of homogeneous liquid mixtures which contains heat-sensitive substances of high molecular weight (typically above 180g/mol) and low volatility.

In this process, the mixture is fed to a distiller that has an evaporator equipped with an internal capacitor. This evaporator operates under high vacuum and provides the necessary heat for some parts of fed molecules volatilize. The volatile molecules that migrate to the condenser, turn into solution and are removed from the equipment. Thus, this process creates two effluent streams that are withdrawn from the process. One consists in material which is not volatilized, called the residue, and another formed by molecules that are volatilized during the process, called the cuts [2].

The molecular distiller used in this study was manufactured by UIC GmbH, model KDL 5. (Fig 1).

The molecular distillation process allow to obtain fractions and residues of oil in the range of 500 ° C to 700 ° C, which extends the characterization of oil, especially the ultra-heavy. Within the characterization of oil, it is very important to determine some thermal properties such as specific heat, enthalpy and thermal conductivity. These properties can be measured using the Differential Scanning Calorimetry (DSC) technique, with great sensitivity and precision.

The technique of Differential Scanning Calorimetry (DSC) recorded on a continuous basis the apparent heat capacity or specific heat of any macromolecule according to temperature, through thermograms. This is characterized by a peak of heat absorption corresponding to a transition process or thermally induced, which, according to the second principle of thermodynamics (considering the case in equilibrium), is a procedure endothermic. [3].



Fig. 1: Molecular distiller (LOPCA / FEQ / UNICAMP).

An Oil with °API less than to 25 was obtained by atmospheric and vacuum distillation (100 and 2 mmHg) according to ASTM D2892, resulting in the residue 400°C +, which was the feed of the molecular distillation process. The molecular distillation generates cuts and residues in the range of temperature of 500°C to 700°C, which were analyzed using the Differential Scanning Calorimeter, DSC model 823e, in the range of temperature from 80 to 350°C. The temperature limit is intended to prevent the oil degradation, either undesired craking or polymerization.

The analysis of enthalpy variations, specific heat and thermal conductivity with temperature have been evaluated and confirmed, as expected, an increase in enthalpy and specific heat in heavy fractions with increasing temperature in the studied range, and a decrease in conductivity heat.

The thermal properties of the material are a contribution for the literature as new experimental data and are of great importance in the computational modelling of molecular distillation processes.

References

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