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Thermogravimetric monitoring of visbreaking unit in oil refineries

Statement of the Problem: In order to improve the fuel oil production, engineers need new resources to control the cracking reaction in visbreaking plants. Given the crude oil variability and the chemical complexity of vacuum residue, the optimization of distillates production without compromising fueloil stability is a challenge. As an alternative (or complement) to current situation, thermogravimetric analysis (TGA) provides fast and valuable information about composition of streams entering and leaving visbreaker unit in oil refineries. Methodology & Theoretical Orientation: Over a period of 6 months, the visbreaking unit of La Rábida-CEPSA Refinery (Huelva, Spain) was monitored by analyzing samples of visbreaking feed (VF) and residue (VR) both chemically and thermally. Findings: Thermogravimetric curves can be deconvoluted, allowing thermal-based composition of visbreaking streams to be elucidated by using lumps: four for visbreaking feed and seven for visbreaking residue obtained after thermal cracking. In both cases, some lumps explains volatilization of light substances (viz. naphtha or gasoil) under 350 °C, and some lumps explains cracking of heavy molecules (viz. resins or asphaltenes) at higher temperatures. On this basis can be defined new indices, based on the thermal behavior of samples, that monitor the VF stability and facilitates adjustment of furnace temperature (cracking severity). Conclusion & Significance: Thermogravimetric analysis of visbreaking streams is an alternative to present chemical analysis in order to optimize thermal cracking. Reduces analysis time and provides valuable information to the process engineers in order to maximize middle distillates production and to produce stable fuel oil.

Recent Publications

1. Barneto, A.G.; Ariza, J.; Barrón, (2015) A. Thermogravimetric Monitoring of Crude Oil and its Cuts in an Oil Refinery, Energy and Fuels 29 (3): 2250–2260.
2. Barneto, A.G.; Ariza, J. (2016) Thermogravimetric description of visbreaker streams in an oil refinery. Thermochimica Acta 642:1–9.
3. Joshi, J.B, Pandit, A.B., Kataria, K.L., Kulkarni, R.P., Sawarkar, A.N., Tandon, D., Ram, Y., Kumar, M.M. (2008) Petroleum Residue Upgradation via Visbreaking: A Review, Ind. Eng. Chem. Res., 47: 8960–8988
4. J.G. Speight, Heavy and extra-heavy oil upgrading technologies. (2013) Elsevier. Waltham, MA, USA.
5. E. Alvarez, G. Marroquín, F. Trejo, G. Centeno, J. Ancheyta, J. Díaz, Pyrolysis kinetics of atmospheric residue and its SARA fractions, (2011) Fuel 90: 3602–3607.

Biography

A. García Barneto and J. Ariza Carmona are experts on the field of thermal analysis applied to organic materials. They have developed their careers applying thermogravimetric analysis to optimize industrial processes. To this end, they have used autocatalytic models based on Prout-Tompkins equation to deconvolute thermogravimetric curves. In recent times they have applied this approach to the crude oil industry in CEPSA's refineries. A. González Delgado is a plant manager in La-Rábida CEPSA refinery (Huelva-Spain), being responsible of fuel production.

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