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Extension of the TBP curve of petroleum using the correlation DESTMOL

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Abstract

The properties of natural petroleum and petroleum products make use of the True Boiling Point (TBP) distillation analysis and it has been proved to be very useful for petroleum characterization and design and operation of refinery units. So, the TBP distillation analysis has contributed to the petroleum science and technology, to the classification of petroleum, to the development of petroleum property correlations and it has been used worldwide. However, when applied to heavy petroleum fractions, difficulties are often encountered. Through petroleum distillation curve (TBP), it is possible to evaluate the yields of the products that will be obtained in the refineries, as well as to establish operational strategies and process optimizations, as the cracking process. The TBP curve is very important for the oil industry and is used to understand the behavior of oil before distillation. For when the oil is subjected to a distillation tower on an industrial scale is already known about the percentage of distillate obtained working at a specific temperature. In the oil refining industry as the distillations follow: Atmospheric Distillation (distillation up to 673 K - ASTM D 2892) and vacuum distillation (distillation to 838K - ASTM D 5236). This work creates the possibility of extending the temperature range of distillation of oil to 973K. The goal of this work is extend the TBP by DESTMOL, the extension of the TBP curve oil reaching approximately 973 K exceeding the curves generated so far that reach only 838 K. The DESTMOL correlation applies pretty good showing continuity and asymptotic profile of the TBP curve. The results help to meet the waste oil and can thus use the waste for more noble ends. As the result of DESTMOL, we can better define the strategiesand operating conditions for oil processing, achieving better economic results in the use of heavy oil, due to its better characterization.

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1. Introduction

True Boiling Point (TBP) distillation is one of the most common experimental techniques for determination of petroleum properties. The methods for performing TBP distillation experiments are described by ASTM D2892 and by ASTM D5236. However, these methods are established for petroleum fractions that reach temperatures up to 838 K.

In this work, three petroleum residues were distilled in a falling film molecular distillation prototype and the data were used to obtain the extension of the TBP curve above temperatures of 838 K. It was possible to extend the TBP curve of these petroleum up to temperatures close to 973K with consistency and continuity in comparison to the standard curve.

The TBP distillation data were the most commonly available information regarding the volatile behavior of hydrocarbon mixtures. Specific cut fractions (part of the TBP range), used in the generation of petroleum products directly influence pricing of crude oils [1]. The other major use of these data is in deciding refinery processes needed to refine a given crude oil. TBP distillation can also be used as a method to isolate a specified fraction from a crude oil for testing [2].

Two conventional physical distillation procedures, specified by the American Society for Testing and Materials (ASTM), are needed for the determination of the boiling range distributions of crude oils. The first method, ASTM D2892 (American Society of Testing and Materials, 1999a) is suitable for the distillation of crude oil components boiling at temperatures lower than 673 K. The second method, ASTM D 5236(American Society of Testing and Materials, 1999b) performed at reduced pressures (0.1 Pa) to avoid thermal cracking, permits the distillation of crude components boiling at temperatures higher than 673 K. The maximum achievable atmospheric equivalent temperature (AET) with the method ASTM D 5236-95 is 838 K. Curve-fitting mathematical techniques are used to combine the data obtained by the two methods into a single continuous distillation curve [3].

Recently, the ability of the method to characterize heavy petroleum components with AET higher than 838 K, the maximum achievable temperature by conventional distillation, has been exploited. A correlation New DESTMOL has been developed (Equation 1) to extend TBP curve through molecular distillation process [4].

$$AET = -1x10^{-5}T_{MD}^{3} + 0.008xT_{MD}^{2} - 0.581xT_{MD} + 427 \quad (1)$$

where: AET = Atmospheric Equivalent Temperature,
T_{MD} = Operating Temperature of the Molecular Distillation Equipment.

The DESTMOL correlation, as it was called, allows conversion of the operating temperature of molecular distillation in equivalent atmospheric temperatures that are used in the conventional TBP curves. The extension of TBP curve from DESTMOL correlation reached values next to 973 K, with continuity and substantial coincidence with the curve obtained from ASTM points.