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Authors: Yuanjun Che, Ze Yang, Yingyun Qiao, Jinhong Zhang, Yuanyu Tian

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Study on pyrolysis characteristics and kinetics of vacuum residue and its eight group-fractions by TG−FTIR

Yuanjun Che, Ze Yang, Yingyun Qiao, Jinhong Zhang, Yuanyu Tian**

State Key Laboratory of Heavy Oil Processing, China University of Petroleum, Qingdao, 266580, China

Highlights:

- The reactivity of eight group-fractions can well reflect the reactivity of VR.
- Activation energy values from the various fractions reveal their nature
- The release of gaseous products for saturates, aromatics and VR is similar.

ABSTRACT

This study investigates the pyrolysis behaviors and kinetics of vacuum residue (VR) and its eight group-fractions using TG−FTIR. The weight loss properties of the fractions of VR suggest that each fraction has individual cracking pathways which are determined by the chemical nature of the constituents. The Friedman and Ozawa−Flynn−Wall (OFW) methods were used to calculate the reaction kinetic parameters of VR and its fractions, at heating rates of 10, 30, 50, and 100 ^{o}C/min. The activation energies of saturates and aromatics increased with the increase of conversion rates, whereas that for resins, asphaltenes and VR increased initially and then decreased. The on-line FTIR analysis of the gaseous products showed that the different structure of VR and its fractions leaded to the discrepancy of the release curves. Saturates and aromatics had significant release peaks at 530−750 ^{o}C, indicating they were the major contributors of methane, ethylene and light aromatics during the pyrolysis of VR within the temperature range of this study.

Keywords: Vacuum residue; Eight group-fraction; Pyrolysis behavior; Kinetics analysis; On-line FTIR analysis.

1. Indroduction