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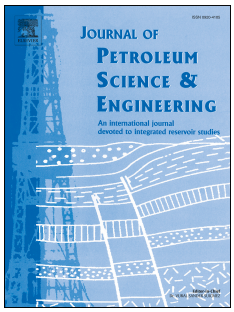

A comprehensive study of the impact of wax compositions on the wax appearance temperature (WAT) of some Iranian crude oils: An experimental investigation

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A comprehensive study of the impact of wax compositions on the wax appearance temperature (WAT) of some Iranian crude oils: an experimental investigation

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Abstract

In this study, the effect of the molecular and structural wax properties of five oil samples from reservoirs in southwest Iran on the wax appearance temperature (WAT), shape, and morphology of wax crystals was investigated. After determining the WAT by cross-polarized microscopy (CPM) and viscometer, the wax was subjected to Fourier transform infrared (FTIR) spectroscopy analysis to determine the intermolecular bonds and structure of the molecules. The results show that there is a close relationship between the shape and size of the wax particle and the intensity and types of peaks in the FTIR spectrum of the wax. Paraffinic wax samples had rounded crystals of varying sizes, while polar/naphthenic compounds formed needle-shaped crystals. In the wax structure of some crude-oil samples, although normal alkanes are the main component of the wax, polar and naphthenic structures, albeit small, can also exist. The experiments showed that polar compounds also existed in the naphthenic wax sample, although the paraffin wax sample contained no polar/naphthenic compounds. The presence of asphaltene in crude oil and in polar/naphthenic wax samples affected the WAT and the crystalline form. As the amount of asphaltene increased, the interaction between the polar/naphthenic wax and asphaltene molecules increased; consequently, the WAT also increased. Energy-dispersive spectroscopy (EDS) analysis showed that as the wax sample loses its hydrocarbon nature, its carbon content decreases, and changes in the SNO elements in the wax structure occur, the WAT proportionally increases. Scanning electron microscopy (SEM) images of wax samples showed that semi-microcrystalline samples were composed of rounded and compacted grains; however, paraffinic waxes consisted of a network of large tubular crystals similar in shape to rice grains. The presence of polar/naphthenic compounds in the wax structure changed the shape and density of particles, as shown in SEM images. The dispersion, mean size, and shape of the wax particles, both under the polarized light microscope and under SEM, depend on the molecular/bonding structure of the wax, the elemental composition, and the amount of asphaltene.