Properties of Tahe crude oil and influence of separation components on crude oil viscosity

Guo Jixiang[a], Wang Heyi[a] , Lin Meiqin[a] ,Chen Chaogang[b] and Deng Hongjun[b]
[a] *Enhanced Oil Recovery Research Center, China University of Petroleum, Beijing 102249, China*
[b] *Northwest Oilfield Branch Engineering and Technology Institute of Sinopec, Urumchi 830011, Xinjiang*
(corresponding author: guojx002@163.com)*

1. Properties of Tahe Crude oil

Xinjiang Tahe oil-field produces from an Ordovician reservoir at depth from 5500 m to 7000 m and temperatures from 128 to 140 °C. Salinity of formation waters is high (23,000 to 200,000 mg / L), The oils have a high freezing point (from 24 to 59 °C), density ranging from 0.9327 to 1.0780 g/cm^3, viscosity from 300 mPa s to 325 0000 mPa s at 50°C, and wax amount from 1.47% to 15.6%.

To determine the major factors impacting oil viscosity, the properties of Tahe heavy oil and its fractions (saturate, aromatic, resin and asphaltene) were measured using IR, scanning electron microscopy, energy spectrum analysis (EDX), elemental analysis, ICP techniques. As expected, the viscosity of the crude oils decrease with the increasing of the temperature. Moreover, the viscosities of crude oils exhibit different levels of temperature-sensitive and different temperatures of turning-point. The contents of asphaltene (18 to 30%) and resin (18 to 36%) of the Tahe crudes oil are higher than other oil fields. Tahe crude oils have high levels of sulfur, chlorine, oxygen, nitrogen and metals (Ca, Al, Fe, Cu, Mg, Na, Ni, V, Pb). The transition metal ions and organic heterocyclic elements form stable complexes which have a high capacity of molecular aggregation. It is the high stability of these aggregates that causes the high viscosity.

2. Influence of separating components on the viscosity of heavy oil

Taha crude AD11 was separated into oil fractions (saturate, aromatic, resin, asphaltene). Solutions at a 25% mass fraction of each fraction solution were prepared using toluene as the solvent. Viscosity of these solutions were determined at temperature of 10 to 70°C and viscosity changes of each component with the shear rate at the temperature of 45°C.

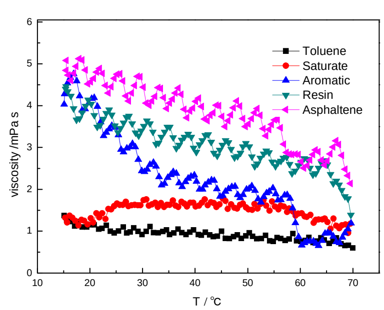

Fig.1 Influence of temperature on viscosity of AD11 separation components

Fig.1 shows that the viscosity of asphaltene, resin and aromatic decreases with increasing temperature. The viscosity of saturate and toluene is almost temperature independent; the viscosity of saturate is higher than that of toluene. In the same concentration of the fraction, the impacts of each component on viscosity are: asphaltene>resin>aromatic>saturate. Asphaltene has the greatest impact on viscosity.

3. Asphaltene scanning electron microscope and EDX

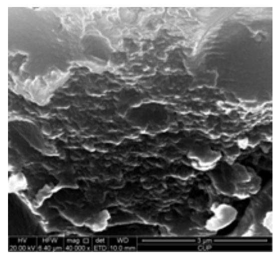

Fig.2 SEM of asphaltene(40000 times)

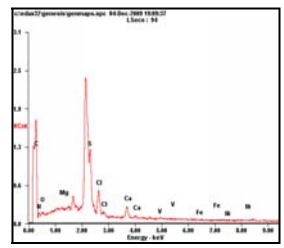

Fig.3 Energy spectrum of AD11 asphaltene

Fig.2 shows that asphaltene aggregations were two-dimensional layered structures. Between the layered structures are the layered molecular aggregates. Influences of asphaltene on viscosity of heavy oil, rheology, colloidal state, molecular weight and other physical parameters depend on chemical compositions and molecular aggregations of asphaltene.

Fig.3 shows that asphaltene's compositions were determined by using of the EDX method. The mass fraction of each element in asphaltene is as following: C 75.67%, N 4.37%, S 9.12%, O 2.50%, Cl 4.34%, Ca 2.74%, Fe 0.28%, Mg 0.31%, V 0.41%, Ni 0.26%.

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