

Terpolymers as flow improvers for Mexican crude oils

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Reducing the viscosity in the heavy crude is of vital importance in the coil industry. Heavy crude production increases day by day, a liable technology to lower crude oil's viscosity becomes urgent. The flow properties of crude oil play a great role in its production, storage, transport, and refining. Therefore, it is important to minimize the viscosity on the heavy crude oil. The crude oils being very viscous on extraction have to go through some processing e. g. gas plasticization, thermal cracking or blending with lighter distillate fractions (gasoline, kerosene), to enable them to be transported by pipeline [1]. Several options are available including chemical additives such as flow improvers, reducer viscosity, PPDs, etc. All the chemical additives are very selective, that is, not all additives are sufficiently effective for every crude oil. Some heavy Mexican Crude Oils are characterized by high viscosity, high content of asphaltenes, low quantity of paraffin components, appreciable amounts of sulfur [2]. This work describes the preparation and evaluation of flow improver additives for Mexican Crude oils. A heavy Mexican crude oil was provided for evaluating the reduction of viscosity. The physical characteristics of crude oil are provided in Table 1.

Table 1
Physical characterization of crude oil.

Specification	Heavy crude oil	Method
API density	15.82	ASTM D-287
Water (vol %)	0.1	ASTM D-4006-07
Kinematic viscosity at 25°C (mm ² s ⁻¹)	2989.5	ASTM D-445
Asphaltene (wt%)	19.92	ASTM D-2007

The rheological behavior of dilute solutions of different terpolymers was investigated over a wide range of temperatures (20-120 °C) under shear rate (0.1-300 s⁻¹). The investigation focuses on the effect of the three comonomer content, on their molecular weight, of the terpolymer, on the viscosity temperature relationship of Mexican crude oil (MCO).

Random terpolymers with various molar ratios of styrene, vinyl acetate and n-butyl acrylate were synthesized by free radical polymerization in water under nitrogen atmosphere. The terpolymers

synthesized were analysed using ¹H e ¹³C NMR spectroscopy. The molecular weight and polydispersity of the polymers were determined by size exclusion chromatography (SEC). The crude oil untreated and treated with solution of terpolymers exhibit non-Newtonian behavior. A conclusion could be that the molecular weight of terpolymers play a role fundamental on the performance as viscosity reducers on heavy crude oil. Figure 1 shows representative plots of shear rate versus viscosity for 1000 ppm of terpolymer solution at 20 °C on heavy crude oil. The crude oil untreated and crude oil with polymer solution are clearly non-Newtonian "pseudoplastic liquids" and the flow behavior cannot be explained by simple Newtonian. The decrease in viscosity with increasing shear rate is more evident at low temperatures because of the larger polymer molecular orientation resulting from larger shear forces acting on the polymer and the crude oil under these conditions. As mentioned in the literature, additive treated crude oil could be transported with minimum energy consumption [3].

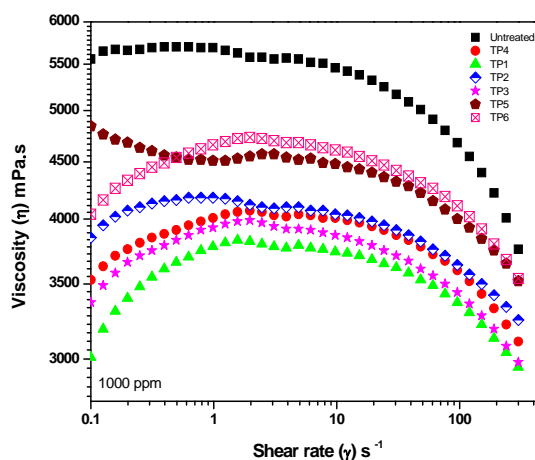


Fig. 1. Viscosity versus shear rate for heavy crude oil untreated and treated with 1000 ppm of terpolymer solution at 20°C.

References

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- [3] Erceg K. A. et al. (2008) Fuel 87, 2943-2950.