Pet.Sci.(2013)10:134-138
DOI 10.1007/s12182-013-0260-y

Study of asphaltene deposition from Tahe crude oil

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Abstract: Borehole blockage caused by asphaltene deposition is a problem in crude oil production in the Tahe Oilfield, Xinjiang, China. This study has investigated the influences of crude oil compositions, temperature and pressure on asphaltene deposition. The asphaltene deposition trend of crude oil was studied by saturates, aromatics, resins and asphaltenes (SARA) method, and the turbidity method was applied for the first time to determine the onset of asphaltene flocculation. The results showed that the asphaltene deposition trend of crude oil by the turbidity method was in accordance with that by the SARA method. The asphaltene solubility in crude oil decreased with decreasing temperature and the amount of asphaltene deposits of T739 crude oil (from well T739, Tahe Oilfield) had a maximum value at 60 °C. From the PVT results, the bubble point pressure of TH10403CX crude oil (from well TH10403CX, Tahe Oilfield) at different temperatures can be obtained and the depth at which the maximum asphaltene flocculation would occur in boreholes can be calculated. The crude oil PVT results showed that at 50 , 90 and 130 °C, the bubble point pressure of TH10403CX crude oil was 25.2, 26.4 and 27.0 MPa, respectively. The depth of injecting asphaltene deposition inhibitors for TH10403CX was determined to be 2,700 m.

Key words: Onset of asphaltene flocculation, turbidity method, crude oil composition, temperature, bubble point pressure, borehole

1 Introduction

Crude oil is a stable colloidal system and asphaltene can dissolve in it under oil reservoir conditions, while in the oil production process, the stable state of crude oil will be disrupted due to changes in external conditions, resulting in deposition of asphaltenes. This is a severe problem in crude oil exploitation, and can cause substantial increase in production costs and affect the oil production due to frequent treatment and removal of asphaltenes. Reducing asphaltene deposits to a minimum level is a common goal for many oil companies (Akbarzadeh et al, 2004; Newberry and Barker, 1985; Akbar and Saleh, 1989), so it is of great importance to find out the reasons why asphaltene deposits in boreholes. Asphaltenes and resins in crude oil comprise its dispersed phase, while the remaining soluble fractions make up the continuous phase. Asphaltene deposition is closely related to the instability of the complex colloidal system, which is easily affected by temperature, pressure and crude oil composition, and any variation of these external conditions can lead to asphaltene deposition. Asphaltene flocculation is most likely to be the first step of asphaltene deposition (Leontaritis and Mansoori, 1987). In order to prevent or decrease asphaltene deposition, it is necessary to determine the flocculation onset and the possibility of asphaltene deposition.

The influence of crude oil composition on asphaltene deposition can be studied by adding *n*-alkanes to crude oil to reduce its stability and then determine the onset of asphaltene flocculation, when the ratio of *n*-alkanes to crude oil is used as a parameter for the stability of the colloidal system (Luo et al, 2007). Generally, the more stable the crude oil, the larger the amount of *n*-alkanes needed for flocculation. The methods for experimentally determining the onset of asphaltene flocculation include the interfacial tension method, filter drop spreading method (Carnahan et al, 1999), viscosity method (Li et al, 1997), spectrophotometry (Bartholdy and Andersen, 2000) and the electrical conductivity method (Li et al, 1998). Each of these methods has its merits and demerits, but until now, there has been no generally-accepted method for evaluating the onset of asphaltene flocculation (Zhao and Yan, 2003). The viscosity method is unsuitable for thin oil, while spectrophotometry can have a large measurement error due to crude oil color. The electrical conductivity method requires high precision high-sensitivity measurements, and is of low sensitivity for a crude oil with low asphaltenes

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Received March 18, 2012