Synthesize and application of the oil-soluble viscosity reducer in heavy oil

Guo Jixiang[a], Wang Heyi[a] , Zhang Zhihong[b] ,Huang Yun[b], Chao Kai[a]

[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. Synthesize of the Oil-soluble Viscosity Reducer

According to the characteristics of high-viscous oil of Tahe, we synthesized the polybasic copoymer oil-soluble viscosity reducer of heavy oil was by using orthogonal method. This synthetic viscosity reducer has better effect than commercial viscosity reducer. The viscosity reduction rate is up to 95.47% at 50 °C. Infrared spectra (IR) and interfacial tensions of heavy oil with or without viscosity reducer were investigated to explain the viscosity reduction mechanism: when viscosity reducer is added, molecules of viscosity reducer are inserted into molecules of crude oil, and that will destroy original structure of crude oil and make their ability of forming hydrogen bonds by hydrogen bonds or carboxy groups weak, so viscosity of crude oil is reduced.

2. Influence of oil-soluble viscosity reducer on oil-water interfacial tension

Adding viscosity reducer to 10% model oil of crude oil(viscosity reducer is 1% of model oil mass fraction), stirring evenly, putting the above-mentioned mixture as oil phase and formation water as aqueous phase. At 25 °C, considering the impact on oil-water interfacial tension with or without viscosity reducer, the results are shown in Fig. 1.

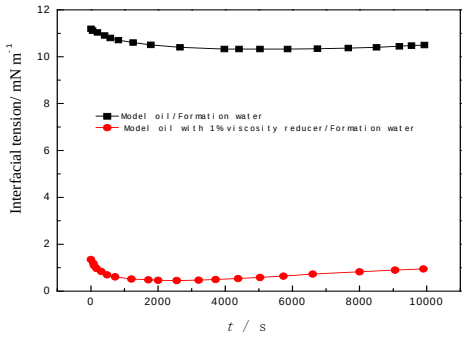

Fig.1 Impact of viscosity reducer on interfacial tension between TK1074 crude model oil and formation water.

As can be seen from Fig. 1, by adding viscosity reducer, interfacial tension between crude model oil and formation water system reduces significantly, this shows that viscosity reducer has a high interfacial activity and can cause interfacial tension between oil and water to reduceing. Viscosity reducer can spread from oil phase to oil-water interface; it could replace macromolecular active substances of oil-water interface so new interfacial film can be formed and interfacial tension is reduced.

3. Field test of the oil-soluble viscosity reducer

The field test of the developed oil-soluble viscosity reducer has been carried out for two months in well TH12510 (machine pumping well) and TH 12210 (flowing well) of the second oil production plant of Tahe. Results are as follows: (1) well TH12510, during the test, the doped light oil ratio was down-regulated from 0.83 to 0.49 respectively. In normal circumstances, the relative savings rate of light oil each day was 44.5% after adding viscosity reducer per day, the average relative savings rate of light oil each day was 21.00%, the maximum of absolute amount of savings each day was 6.1 t/d, the average absolute amount of savings was 4.5 t/d. (2) well TH12210, during the test, the doped light oil ratio was down-regulated from 1.42 to 0.99 after adding viscosity reducer. In normal circumstances , the relative amount of savings each day was up to 30.42%, the maximum of absolute amount of savings each day was 12.3 t/d, the average absolute amount of savings was 8.99t/d.

References

[1] Larry Lines,Hossen Agharrran , P.F.Daley,et al. Collaborative methods in enhanced cold heavy oil production. The Leadline Edge2008(8):1152-1156

[2] Amy Hinkle, M. Batzle. Heavy oils : A worldwide overview. The Leadline Edge. 2006(6):743-749..

[3] Chang Y X and Zhang X J. Viscosity reduction mechanism of oil-soluble viscosity reducer of heavy oil. Oil-Gasfield Surface Engineering. 2006. 25 (4) :8-9 (in Chinese)

[4] Chen Q F, Wang D X and Liu R B. Advances In Oil-Soluble Viscosity-Reducers For Viscous Crude Oil. Oil drilling & Production Technology. 2004. 26 (2) :45-51 (in Chinese)

[5] Zhou C, Wu C J, Ren S S, et al.Outline Heavy Oil Viscosity Methods. Inner Mongolia Petrochemical Industry. 2007. (4):128-129 (in Chinese)

[6] Zhang F Y and Li J B. Advances in oil-soluble viscosity reducers for viscous crude oil. Special Oil & Gas Reservoirs. 2006.13(20) :1-5 (in Chinese)

[7] Zhang F L, Liu Q C, Liu B L, et al. Development and application of experimental techniques of heavy oil. Beijing: Petroleum Industry Press. 2007. (in Chinese)