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POUR POINT DEPRESSANT STUDIES ON WESTERN ONSHORE CRUDE OIL

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Abstract: Paraffin deposition causes major issues during production, transportation and storage of petroleum crude oil. To mitigate wax deposition issues, chemical additives are extensively used which are collectively known as Pour Point depressants (PPDs)/ flow improvers. Pour point depressants (PPDs) are high molecular weight polymers which co-crystallise with the wax and inhibit its growth. In this work, pour point behaviour of three different PPDs were rigorously studied on crude oil collected from Western onshore field. The results were promising up to certain concentrations of different PPDs samples.

Keywords: - *Pour point depressant (PPD), Wax appearance temperature (WAT), Pour point, Paraffin deposition, Crude oil*.

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I INTRODUCTION

Crude oil contains wax which solidifies at low temperature precisely below its cloud point. Such oils are encountered throughout the world and have been produced for several decades in India, particularly in Assam, Gujarat, Andhra Pradesh, and Rajasthan. These fluids contain substantial amount of wax (normally ≥ 5wt %); which complicates crude oil recovery, processing and transportation. Wax may be categorised into two distinct types: macro-crystalline wax which is composed of primarily low molecular weight n-alkanes (C16-C40) and generally crystallises as needles or platelets and micro-crystalline wax which contains a large proportion of high molecular weight iso-alkanes and cyclo-alkanes.

When waxy crude oil is cooled below the WAT (wax appearance temperature), wax precipitates from the oil, leading to technical challenges. It may cause formation damage, reduce separators efficiency. It will also cause the reduction of the effective diameter of the pipeline or complete blockage under severe conditions. For a better alleviation of this wax, chemical additives such as pour point depressant are used. It will lower down the pour point, Improve oil flow ability and hence making possible the transportation of crude oil below their WAT. The objective of the present work is to evaluate the flow behaviour of Western onshore crude oil when mixed with PPD (DA, DB & DC), a perspective to reduce flow problems in this area.

II EXPERIMENTAL PROCEDURE

A. Characterisation of Crude oil

Physico-chemical parameter of Crude oil such as Water content, Demulsification, Density, Specific gravity, API gravity, Pour point and Distillation were studied as per standard procedures prior to Pour point studies.

B. Pour point measurement

Three industrial pour point depressant DA, DB, and DC of unknown concentrations were taken for study. PPDs solutions of 100, 200, 300, 400 and 500 ppm concentrations were prepared for each PPD. 50ml of oil sample was taken and heated in a water bath up to the dosing temperature 65°C. PPD solutions DA, DB and DC were added to the crude oil samples with their respective dosing. At 65°C, the oil was transferred to the pour point tube up to the level mark. A cork with a thermometer fixed on it, was used to tightly close the tube. The sample was allowed to rest at ambient temperature until it reached 45°C (closest value to its initial pour point). The tube was then kept in the pour point apparatus (cooling bath). After every 3°C, the tube was taken out of the bath to check the flow. The temperature at which it ceased to flow for a minimum time of 5 seconds was noted as the cease to flow temperature of the equivalent concentration. Therefore, the equivalent pour point was noted as the no flow temperature plus (+) 3°C.

Figure 1 Pour point determination

III RESULTS AND DISCUSSIONS

A. Crude oil parameters

The density, specific gravity and API gravity values helps to deduce that the sample is a heavy crude oil having API gravity of 27.66. Asphaltene content and wax content of crude oil were 8.66 % and 4.66 % respectively. The pour point of crude is 42°C, which is a very high temperature giving us reasons to find the required PPD. The analysis of Crude oil is given in Table – 1.

TABLE 1 PHYSICO-CHEMICAL CHARACTERISTICS OF CRUDE SAMPLE

S.N	Parameters	Observed values
1	Density (g/cc at 15 °C)	0.8890
2	Specific gravity	0.8892
3	API gravity (°API)	27.66
4	Pour point (°C)	42
5	Water content	Traces
6	Wax content (wt %)	4.66
7	Asphaltene content (wt %)	8.66
8	IBP (initial boiling point) (°C)	120

A. Pour point measurement

Table – 2 represents the results of pour point measurements obtained from the treatment of the crude sample with the three different PPDs at 100,200,300,400,500 ppm concentrations.

TABLE 2 EFFECT OF POUR POINT DEPRESSANTS ON CRUDE OIL

dditive Code	oncentration of PPD (ppm)	our point of blank oil (°C)	our point of treated (°C)	epression ΔT(°C)
DA	100	42	39	3
	200	42	36	6
	300	42	36	6
	400	42	33	9
	500	42	33	9
DB	100	42	42	0
	200	42	39	3
	300	42	36	6
	400	42	33	9
	500	42	33	9
DC	100	42	39	3
	200	42	33	9
	300	42	33	9
	400	42	33	9
	500	42	33	9

The pour point data given in table shows that on treatment with 100 to 500 ppm dose of DA, the pour point constantly decreases from 42 to 33°C. So, on increasing the dose, the pour point further decreases with a maximum effect at 400 ppm. In case of DB, there is decrease in pour point after addition of 200ppm dose. It is showing that small doses of DB are inactive on the oil sample. In addition, maximum depression of 9 °C was obtained at 400 and 500 ppm doses. Therefore, 400 ppm dose is the appropriate concentration of DB for an efficient and economical treatment. With DC, there is a sharp decrease of pour point at 200 ppm, the performance is at its best. At doses above 200 ppm, the depression remains constant till 500 ppm; no further reduction in pour point occurs. Therefore, 200 ppm of DC is the concentration gives better results.

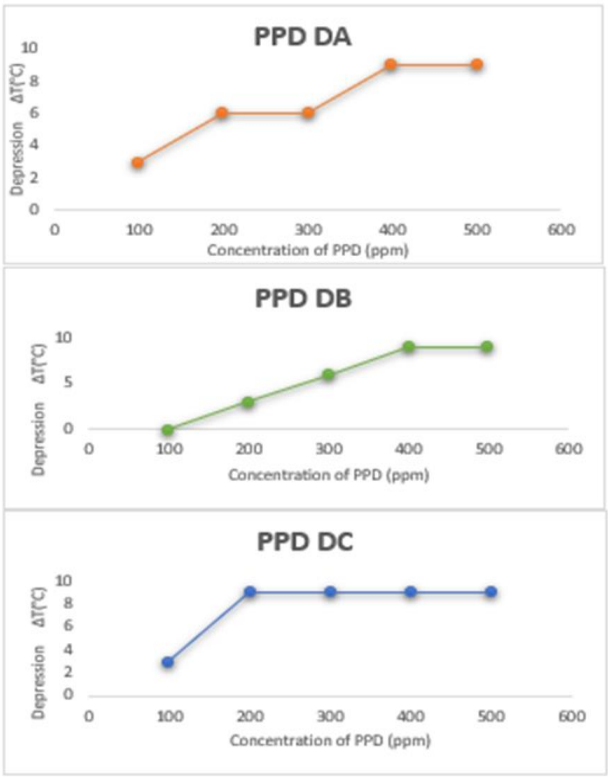

Figure 2 Graphical representation of Pour point depression ΔT (°C) Vs Conc. Of PPD (ppm) for DA, DB & DC

IV CONCLUSIONS

In the course of studying pour point depressant effect on western onshore crude oil, crude oil sample was evaluated to study the impact of three different PPDs. The analysis describes the wax crystallization process, the different action mechanism of PPDs, along with some of the chemicals used as pour point depressant.

The following conclusions can be drained from the present investigation:

- The sample studied is a heavy crude rich in Asphaltene, which plays a significant role on the flow properties of crude oils.
- Pour point of the crude have decreased with the addition of all the three different PPDs, at all the concentration (with 100ppm DB as an exception).

- The best performance is obtained by PPD DC, which sharply reduced pour point of the sample at a concentration of only 200ppm; so it can be considered as an effective and economically viable solution for flow problem in the field.

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