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SALT SETTLING TENDENCY IN PARAFFINIC CRUDE FROM SIND PROVINCE

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Abstract

Local crude from Sind Province is of paraffinic nature and therefore, tends to solidify above ambient temperatures in winter (18° to 20°C). Associated formation water containing high salts encapsulates in crude thus increasing average crude oil salt content. High salts in crude oil pose fouling problem in refineries. A study was carried out to overcome this problem. It has been established that if the crude oil is stored at 70°C in storage tanks then water encapsulation problem would be rectified in 6 to 8 hours time and salt content in crude oil would reduce from 70 PTB to less than 5 PTB. This tendency is further enhanced if demulsifiers are used in ppm level.

Introduction

Inorganic salts in crude oil are mainly chlorides and sulphates of sodium, potassium, mangesium and calcium metals. (Ohio Geol. Surv., 1952; U.S. Bur. Mines., 1953., HDIP, 1988). Salt content in crude oil is considered to be undesirable due to its deposition on heat transfer surfaces in Crude Distillation Units (CDU). Some of these salts also liberate inorganic acids, thus creating corrosion problems in costly equipment. Salts are generally removed through a de-salting process by electrical precipitation before feeding to CDU. If it is not done, fouling in heat exchangers of CDU is developed through settling of inorganic salts, predominantly on last heat exchanger before furnace, where crude oil temperature ranges between 110° to 155°C. Secondary fouling by organic compounds is catalytically generated on inorganic layer. Thus pressure differential (Δ P) across heat exchanger increases and heat transfer efficiency of exchanger reduces simultaneously due to lower thermal conductivity of inorganic salts and organic deposition on heat transfer tubes of heat exchanger (Eyles *et al*, 1976).

Crude oil discovered in Sind Province is paraffinic in nature and it tends to solidify in the range of 18° to 24°C (HDIP, 1988). Thus in the winter months due to production water encapsulation, the salt content in crude may increase to a level of 2000 lbs/1000 bbl (PTB) as against specification of 5 PTB.

In order to examine the settling tendency of salt in crude oil, a study was carried out in the Hydrocarbon Development Institute of Pakistan (HDIP) so that a practical solution of salt reduction could be achieved. The study included experiments on reduction of salt in crude at various temperatures, with and without use of commercially available demulsifiers. It was concluded from this study that if crude oil was kept in storage tanks at about 70°C for a period of 3 to 4 hours, the salt content reduces from 8—10 PTB to 3 PTB level.

These conditions were also simulated in a 2 litre vessel in laboratory and salt reduction tendency was examined. This experiment showed that 70 PTB crude could achieve 5 PTB level in 7 hours. However, if 5—10 ppm of commercial demulsifier is added, the same 5 PTB level would be achieved in 4 hours only. The temperature is the main criteria for reduction of salt content but the salt reduction process is improved through the use of demulsifier.

Experimentation

Salt content of crude oil was experimentally determined both on oil field storage tanks and in 2 litre laboratory experimental vessel.

At the oil field, after the established oil/water separation procedure, crude is stored in storage tanks where the remaining small amount of water is separated. In these tanks salt reduction tendency of crude was examined against time.

The study was carried out in Precision Salt Analyzer Model 74700 (Forney *et al*, 1963). The method is based on determination of conductivity of a solution of crude oil in a polar solvent when subjected to an alternating electrical stress between two stainless steel plates. In the beginning of this study instrument was standardised by using mixture of calcium

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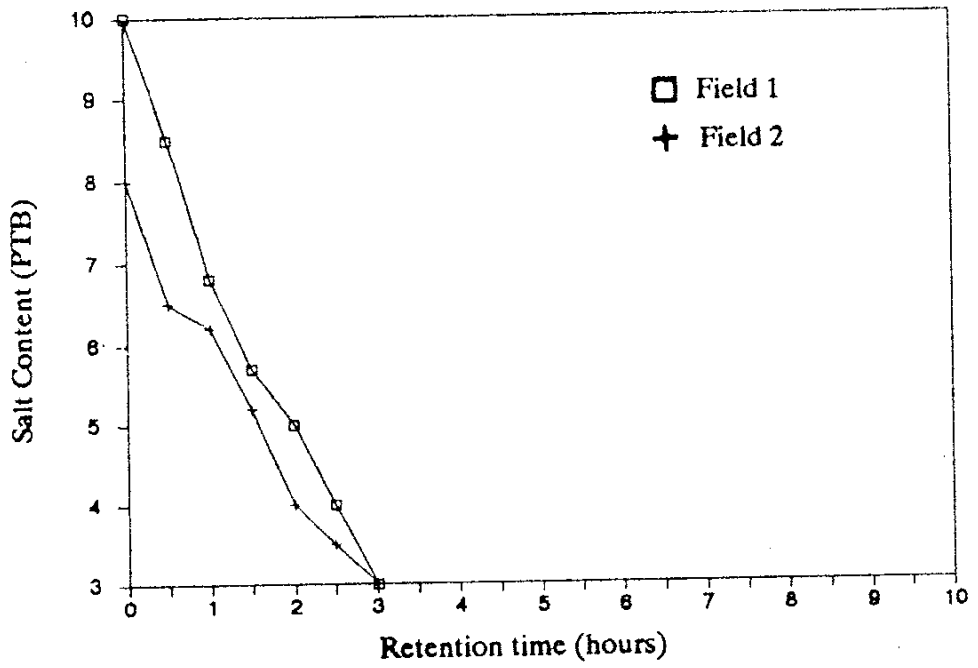

Figure 1. Salt reduction tendency in paraffinic crude oil at field storage tanks.

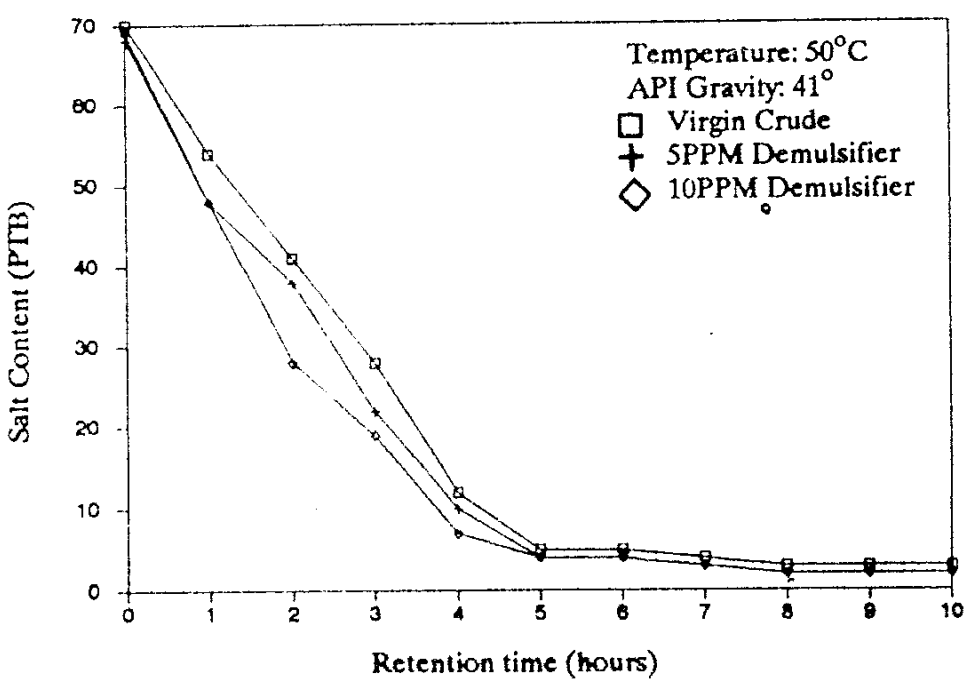

Figure 2. Salt reduction tendency in paraffinic crude at 50°C.

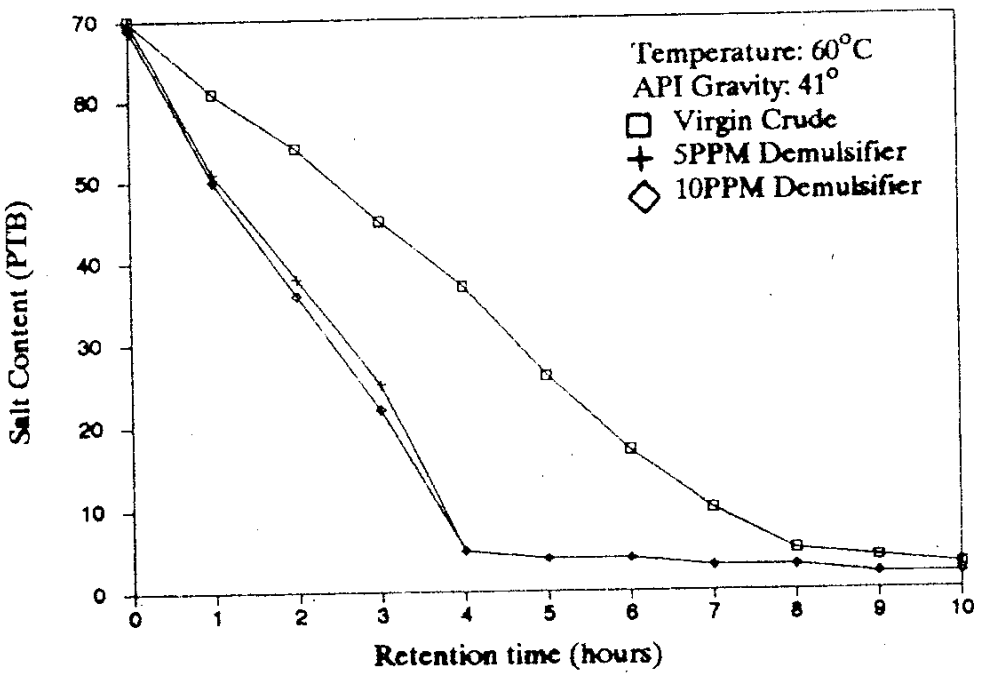

Figure 3. Salt reduction tendency in paraffinic crude at 60°C.

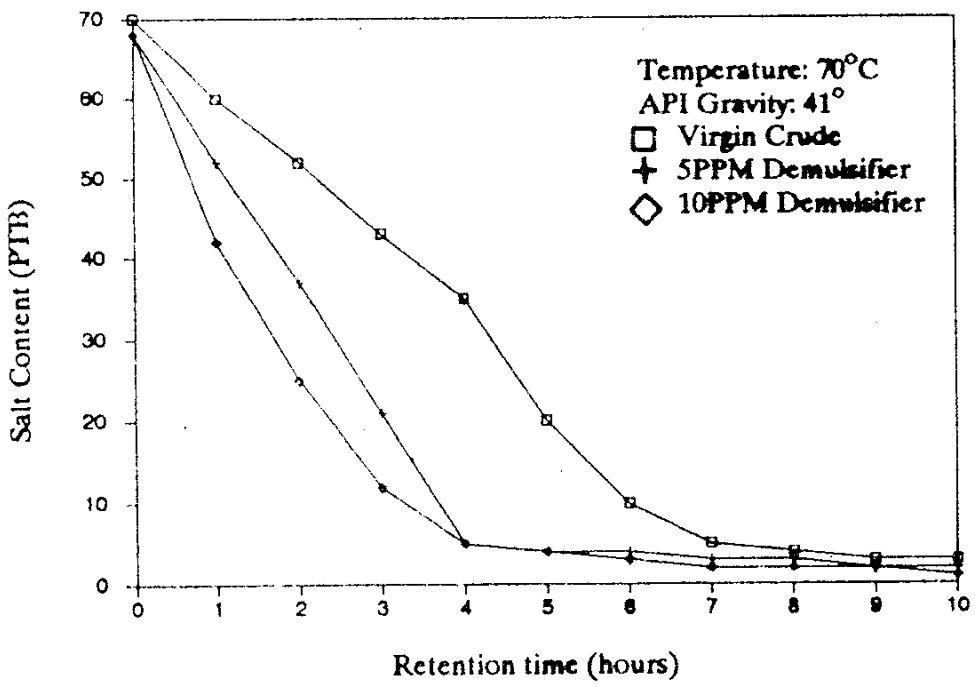

Figure 4. Salt reduction tendency in paraffinic crude at 70°C.

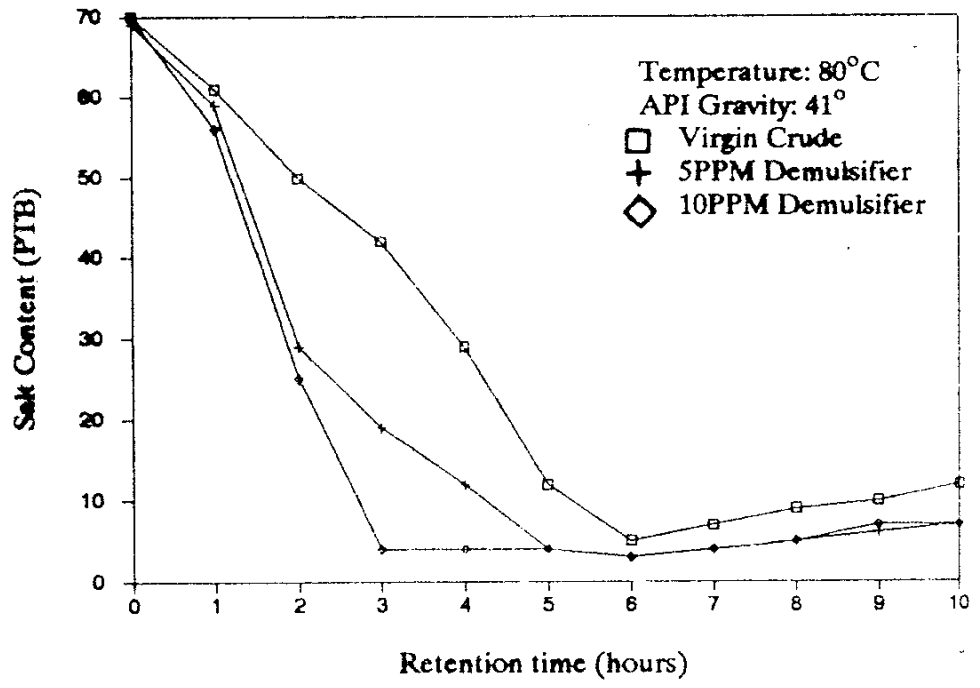

Figure 5. Salt reduction tendency in paraffinic crude at 80°C.

chloride, magnesium chloride and soldium chloride. Refined neutral oil of 100 Saybolt Universal Second (SUS) Viscosity at 100°F and free of additives was used for calibration. Various standard curves of salt concentration versus current in milliampre were plotted.

The waxy crude oil of 40° to 44° API gravity & paraffinic nature from different oil fields of Sind Province were studied using ASTM method D-3230. Mixed alcohol solvent was prepared. Crude oil sample was dissolved in Xylene in a glass stoppered cylinder and alcohol solution was added in it. After vigorous shaking, mixture was allowed to stand for five minutes and sample was taken out of this mixture for analysis on Model 74700 Precision Salt Analyzer (ASTM).

Discussion

Salt-bearing formation is normally produced along with crude oil. Its separation from crude oil depends on many factors such as specific gravity of crude, reservoir temperature and type of crude. Most of the Sind crude oils have API Gravity in the range of 40° to 44° or above. Thus the differential of gravity with water is enough for ease of water separation. The crude reservoir temperature is also fairly high *i.e.* about 85° to 90°C. However, due to parafinic nature of crude, water encapsulation in wax takes place. Wax congealing could be reduced through use of pour point depressant. In our experiments, a more straight-forward and less expensive approach was taken. Salt reduction tendency in crude with the passage of time at various temperatures was used and the optimum temperature was determiend at which most salt water would settle. The results are shown in Figures 1 to 5.

As may be seen from Figure 1 that retention of 8—10 PTB crude in storage tanks for 3 hours reduces salt content level to 3 PTB which is acceptable at refineries.

In laboratory, the experiment was conducted on varying temperatures of 50°, 60°, 70° and 80°C (Figures 2 to 5). The 70 PTB crude was kept in laboratory storage vessel at these temperatures. Virgin crude (without demulsifier) was able to reduce salt of required specifications in 10 hours at 50°C. However, with the addition of demulsifier in 5 to 10 ppm level, 4 to 5 hours were sufficient to achieve the desirable results. The best result of water/salt settling was achieved at 70°C when 7 hours time was required for virgin crude to achieve 5 PTB level, whereas with demulsifier only 4 hours were sufficient.

At 80°C, it was observed that salt content after achieving a lower level of 5 PTB started increasing probably due to emulsion formation of oil with water.

It was observed that it takes twice as much time for salt reduction process in the laboratory vessel as compared to storage tanks. This difference is probably due to hydrostatic pressure in storage tanks having oil/water column of 4 to 6 metres as comapred to only 0.3 metre in the laboratory vessel.

Conclusion

For paraffinic Sind crudes, maximum salt water settling is achieved if crude oil is allowed to settle for a few hours at 70°C. Additions of 5 to 10 ppm demulsifier would further enhance the settling process.

References

ASTM, Standard Test Method No. D-3230.

Eyles, M.K., W.L. Wagner and S.N. Sarwar, Unpublished reprot on Heat Exchanger Fouling Mechanism: BP Research Centre, Sunbury on Thames.

HDIP, 1988, Unpublished report on local crudes.

———, Unpublished report on Sind Crude and Production Water.

Forney, W.E., A.F. Gulbrandsen and R.E. Borup, 1963, Conductometric determination of Salt in crude oil, *in* proceedings American Petroleum Institute, v. 43 (III), p. 267—271.

Ohiv Div. Geol. Survey, 1952, Rept. Invests, n. 11, p. 1.

Rall and Wright, 1953, US. Bur. Mines, Rept. Invest. 4974.