Evaluation of Waxy Crude Oil characteristics & its significance

[1]Krishna Patel,[2]Ashish Nagar
[1]Student, [2]Professor.
[1]Department of Chemistry,
[1]PIAS, Parul University, Vadodara, India

Abstract Crude oil plays a very important role in the energy security of the country. To resolve any issue of crude oil transportation, Demulsification, Asphaltene or Wax related problems crude oil analysis is the first and most important step. Crude oil characteristics gives us an idea about the problem to be faced by the operator and also indicates about the ways and means to resolve it. Any problem in the field can be managed by studying the crude oil parameters. Efforts were made to study the waxy crude oil of Western Onshore field. Crude oil characteristics, such as, Water content, Density, Pour-point, Distillation, Asphaltene content, Wax content, Viscosity, Saturates, Aromatic and Resins etc were studied in the laboratory of India's Premier Oil Company. Data obtained not only gives us the idea about the kind of oil i.e. Paraffinic /Asphaltic/Heavy/Light etc but also tells us about the future problems going to be encountered in the field.

Waxy/Heavy crude oils are usually produced in the form of water in-oil emulsion, so the initial water content in crude oil was measured using the Dean and Stark method. Water was then separated with the aid of a commercial demulsifier and heated to obtain pure heavy crude oil. Further, the density and pour point of the heavy crude oil were also determined using standard ASTM methods. Demulsified crude oil was further distilled upto 300˚C.Ashphaltene and wax percentage were determined from 210˚ residue obtained from distillation.

Crude oil analysis of two samples were carried out to also determine 1. Saturates 2. Aromatics 3. Resins 4. Asphaltene etc

Keywords: Density, Pour Point, Distillation, Viscosity, Saturates, Aromatics, Resins, Asphaltene, Wax.

I. Introduction

Petroleum plays a significant, even critical role in the modern industrial world. Petroleum products and petrochemicals affect almost every aspect of our civilization and of our lives as individuals, including the areas of transportation, food, clothing, shelter and recreation.

The word petroleum originates from the Latin word (Petra=Rock) and (oleum=Oil).

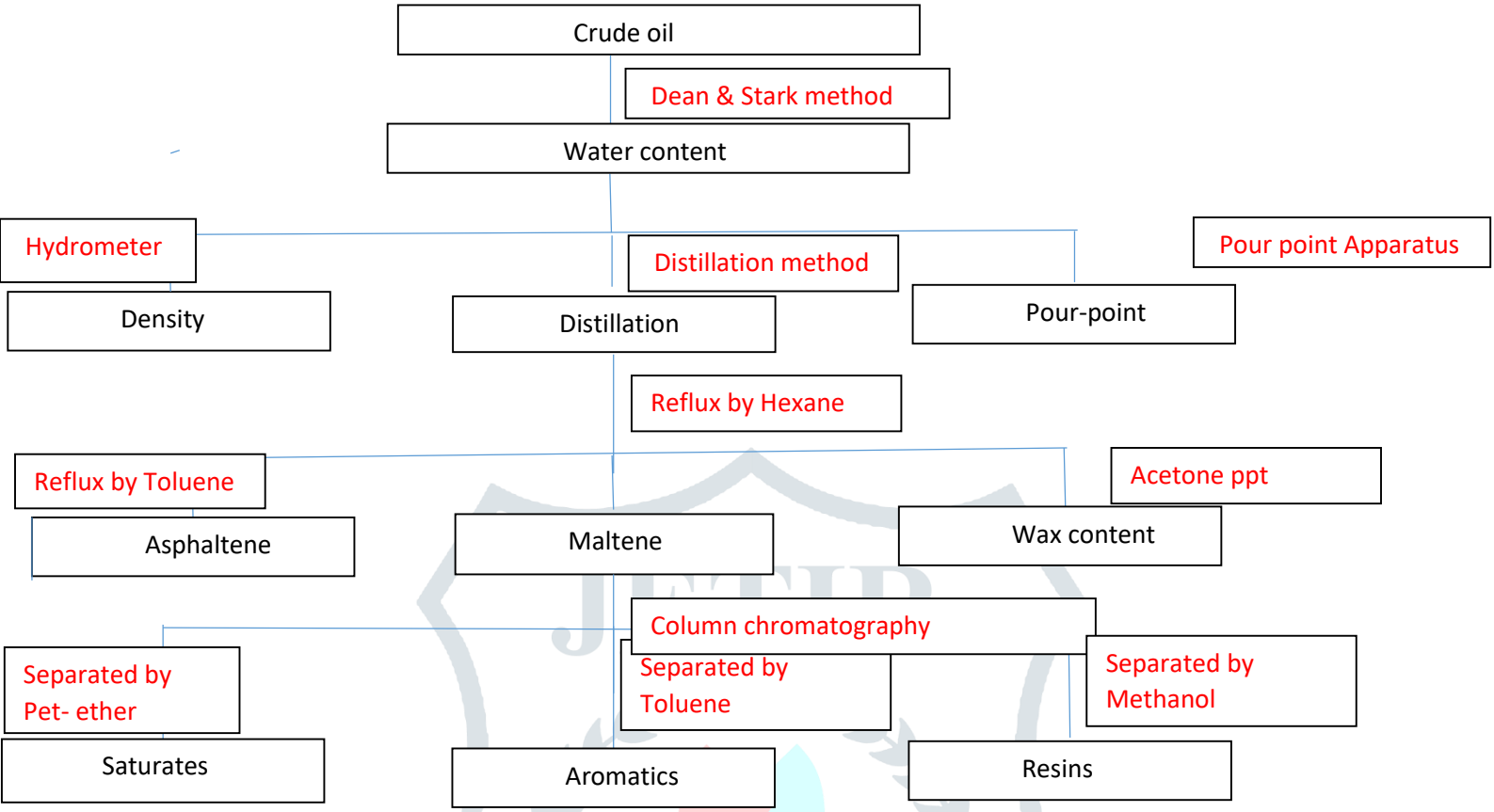
Crude oil is occurring by naturally, unrefined Petroleum product composed of hydrocarbon deposits and other organic materials. It is a non-renewable resource, which means that it can't be replaced by naturally at the rate we consume it and is therefore a limited resource.

There are four types of crude oil:

- Very light oils- these include: Jet fuel, Gasoline, Kerosene, Petroleum ether, petroleum naphtha.
- Light oils -These include grade 1 & 2 fuel oils, Diesel fuel oils and most domestic fuel oil.
- Medium oils -They generally have low volatility and a higher viscosity than the light oils.
- Heavy fuel oils - These include the heaviest grade 3, 4, 5 and 6 fuel oils along with heavy marine fuel.

II. Research methodology:

Flow diagram of Crude oil analysis



III. Material and Method

Testing methods of crude oils:

1. **Water content**: Small quantities of water lead to difficulties in processing and blocking the heat exchangers. Water content was determined by Dean & Stark Method.
2. **Density**: Density is defined as the ratio between mass and volume. Crude petroleum products lab determination of density by- Hydrometer Method.
3. **Specific gravity:** Specific gravity of material is defined as the ratio of a mass of given volume of the material at a temp to mass of equal volume of pure water at a temp.
4. **API Gravity:** API gravity scale is an arbitrary one which has the advantage of simplifying the construction of hydrometer.
5. **Pour point:** It is a temperature at which oil ceases to flow and is determined with a difference of 3˚C.Pour point is determined primarily to determine the flow characteristics of the crude oil.
6. **Distillation:** The method gives a rough and rapid idea about the distillation characteristics of the crude oil.
7. **Asphaltene content:** Asphalts are complex materials of relatively low value and can be produced from the heaviest portion of crudes.
8. **Wax content:** It's high content in the crude oil may affect the fluidity of the sample. The wax content can be determined by Acetone precipitation technique which involves separation of oily fraction of crude oil.
9. **Resin content:** A typical paving asphalt may contain 20% asphaltenes by dehydrogenation while asphaltenes can be converted to resins by hydrogenation.

10. **Viscosity:** Viscosity is an inverse measure of the ability of a substance to flow. Viscosity determined by Rheometer.

Fig.-1 Dean & Stark

	Uni	San
	% v	Trac
	% v	Trac
	kg/l	0.81
	-	0.81
	-	41.5
	˚C	33

Fig.-2 Hydrometer

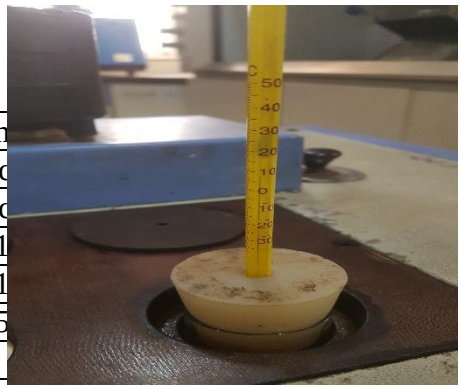


Fig.-3 Pour Point Apparatus

Fig.-4 Distillation Apparatus

Fig.-5Asphaltene content

Fig.-6 Wax content

Fig.-7Rheometer Apparatus

Experiments carried out have been depicted from Fig 1 - 7

IV. Procedure

Crude oil samples were evaluated by standard IP Methods.

V. Results

Table No.-1 General Analysis of Sample by Standard Methods:

Temperature, ˚C	Shear rate, Sec^{-1}	Viscosity, cP	Viscosity, cP
		Sample 1	Sample 2
51	10	3.2	3.96
48	10	3.4	5.31
45	10	4.2	6.14

42	10	4.7	5.73
39	10	6.1	4.37
36	10	6.9	9.73
33	10	12.2	12.28
30	10	73.2	48.24
27	10	424.1	320.4
24	10	817.3	926.9
21	10	1312.0	1810

Table No.-2 Viscosity Profile of Dehydrated Crude Oil:

Table No.-3 Distillation Profile:

	Sample 1	Sample 2
Wt. of 100 mL Crude oil, gms	78.62	78.99
Initial Boiling Point (IBP) ˚C	67	71

Temperature Range, from IBP to	Recovery % Volume (Cumulative)mL	Recovery % Volume (Cumulative)mL
	Sample 1	Sample 2
75	0.5	0.2
100	4.0	3.0
125	9.0	7.5
150	15.0	14.0
175	21.0	19.0
200	26.0	25.0
210	28.0	27.5
225	31.0	32.5
250	36.0	37.5
275	42.0	44.5
300	52.0	53.5

	Sample 1	Sample 1	Sample 2	Sample 2
	Up to 200 ˚C	Up to 300˚C	Up to 200 ˚C	Up to 300˚C
Residue, (%w/w)	72.58	46.63	69.97	45.19
Distillate recovery, (%w/w)	27.42	53.37	30.03	54.81

Table No.-4 Analytical Result:

		Sample 1	Sample 2
1.	Wax Content (% w/w) in whole oil	24.90	15.21

Table No.-5 SARA Composition Of 210˚C Residue by Column Chromatography:

		Sample 1	Sample 2
1	Saturate (%w/w)	69.53	79.89
2	Aromatic (%w/w)	16.52	15.07
3	Resin (%w/w)	13.65	4.08
4	Asphaltene **(**%w/w)	0.30	0.96

VI. Conclusion

1.High Pour Point and high Wax Content indicates both the samples to be waxy in nature.

2.During winter Crude Oil transportation will be a problem due to high wax content.
3.Detailed studies on flow improver/ Paraffin inhibitor must be carried out to find the suitable chemical. As the Wax crystal modifier/paraffine inhibitor may be required during winter.

VII. Acknowledgement

Authors would like to convey their sincere thanks to the management of Parul university for allowing to carry out research work.

Authors would like to convey their thanks to HOD for her constant encouragement.

Authors are also grateful to the principal of PIAS for his efforts and encouragement throughout the course of studies.

Authors would also like to convey their gratitude to the Premier oil company for allowing and providing necessary facilities to carry out this work.

VIII. References

1. IP 15, Petroleum product – Determination of pour point
2. D 96 Test Method for water and sediment in crude by centrifuge Method.
3. ASTM standard test method for specific gravity of crude petroleum by hydrometer, 05.01, D12998-85
4. ASTM standard test method for API gravity of crude petroleum by hydrometer,0.5.01, D287-92.
5. J.M. Hunt Petroleum Geochemistry and Geology
   W.H. Freeman and Company, New York, USA (1996)
6. D473 Test for Sediment in Crude Oils and Fuel Oils by the Extraction Method.
7. D1250 Guide for Petroleum Measurement Table[2]
8. ASTM standard test method for kinematic viscosity of transport and opaque liquids, 05.01, D445-88.
9. ASTM D7042 – 11a Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer.
10. ISO 3171:1988, Petroleum liquids – Manual sampling.

References

11. D 95 Test Method for water in petroleum products and Bituminous Materials by Distillation.
12. D 96 Test Method for water and sediment in crude by centrifuge Method.
13. ASTM standard test method for specific gravity of crude petroleum by hydrometer, 05.01, D12998-85
14. ASTM standard test method for API gravity of crude petroleum by hydrometer,
    0.5.01, D287-92.
15. J.M. Hunt Petroleum Geochemistry and Geology
    W.H. Freeman and Company, New York, USA (1996)
16. ASTM standard test method for pour point of petroleum 05.01, D97-98. ASTM standard test method for sediments and water in crude oils by centrifuge method, 05.02, D4007-81.
17. ASTM standard test method for kinematic viscosity of transport and opaque liquids, 05.01, D445-88.
18. ASTM D7042 – 11a Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer.
19. ISO 3171:1988, Petroleum liquids – Manual sampling.