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## **Physico-chemical studies of Crude oil of Western Onshore Field**

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### **ABSTRACT**

Crude oil is a complex mixture of hydrocarbons with non-metallic elements such as sulphur, nitrogen, oxygen, and other elements that is found naturally in geological formations under the earth's surface. Crude oil comprises a variety of hydrocarbon molecules that fall into three categories: alkane, cycloalkane, and aromatic. Crude oil is distinguished by a number of chemical and physical features that play an essential role in the oil industry. These qualities are critical in making decisions in the exploration and production of crude oil. Characteristics like Density, Specific gravity, API gravity, Water content, Pour point, Distillation, Wax content, Asphaltene and SARA analysis, contribute value to the price of crude before it is transported to markets and refineries. Thus, controlling these parameters significantly saves damage to infrastructure like pipelines and refineries. As a result, the study of physical and chemical properties becomes crucial for the petroleum industry. This paper presents methods for determination of some important physico-chemical parameters of crude oil.

**Keywords**— Crude oil, Pour Point, Wax, Asphaltene

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### **I. INTRODUCTION**

Petroleum is a fossil fuel, which means it was formed through the decomposition of organic materials from animals and plants. It is made up of the remains of microscopic sea plants and animals that perished millions of years ago. Petroleum is primarily made up of gas and crude oil (liquid) which is defined as a complex mixture of hydrocarbons with non-metallic components such as sulphur, oxygen, and nitrogen, as well as metal traces (Vanadium, Nickel etc.). Crude oil is used in practically every aspect of human life. It must be transformed before it may be used. This transition depends on the chemical and physical properties of the substance. Their qualities are critical for engineers in several sectors during their manufacturing (upstream), transportation (midstream), and refinement (downstream). Furthermore, depending on the kind, depth, and location of the underground deposit as well as the geology of the area, these properties vary from one field to the next. Indeed, while crude oil's general elementary composition is largely constant, the chemical and physical structures of its parts vary greatly. The analytical examination of crude oil's physico-chemical characteristics is critical from this standpoint. Density, Specific gravity, API gravity, Water content, Pour point, Distillation, Wax content, Asphaltene and SARA analysis are important physico-chemical parameters of crude oil.

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### **II. PHYSICO-CHEMICAL PROPERTIES OF CRUDE OIL**

Crude oil is a mixture of comparatively volatile liquid hydrocarbons (compounds primarily made of hydrogen and carbon), with some nitrogen, sulphur, and oxygen thrown in for good measure. Those elements combine to generate a wide range of complicated molecular structures, some of which are difficult to identify.

#### *A Water Content*

During the production of crude oil, water and sediment are produced in an oilfield. Water and sediment are pollutants, which cause problems in transportation and refining, such as corrosion, and have an impact on crude oil and derivatives quality. They have the potential to poison the catalyst during processes.

Its study allows for the assessment of selling prices, production rates, and pipeline oil quality control. To evaluate the water content, Dean and Stark method is used.



Figure. 1 - Dean and Stark Method for determination of water content

#### B Density, Specific Gravity and API Gravity

Density is the ratio between the mass of the fluid per unit volume. In general, these varies with pressure and temperature. It is measured by hydrometer. Specific gravity is defined as the ratio of the weight of a volume of the liquid to the weight of an equal volume of water at the same temperature. The American Petroleum Institute (API) has adopted a scale, which is referred as the API scale. The nature of the crude oil (light oil, medium density oil or heavy oil) is concluded by API gravity which is calculated as follows

$$\text{API gravity} = \frac{141.5}{\rho} - 131.5$$

#### C Pour Point

The lowest temperature at which crude oil can flow is known as the pour point. Pour point is crucial in the oil sector, just as the other factors. When the temperature of crude oil falls below its pour point, it cannot be stored or transported through a pipeline. The paraffin concentration of crude oil affects the pour point.

The Pour point of crude oil is determined by heating the sample above its cloud point. The specimen is next chilled in the cooling bath to allow the formation of paraffin wax crystals. The test jar is held horizontally for 5 seconds at every 3°C. If it doesn't flow, the Pour point temperature is calculated by adding 3°C to the corresponding temperature.

#### D Distillation of Crude Oil

The separation of this crude oil into separate fractions is accomplished by the distillation process. This approach is used to determine each fraction's initial boiling point and boiling point. The crude oil is assembled in the distillation column, and as the temperature rises in the column, the crude oil separates into different components, referred to as "fractions." After then, the fractions are captured separately. Initial Boiling Point is the temperature at which the first drop of distillate fraction is collected (IBP).



Figure. 2 - Distillation apparatus

#### E Asphaltene Content

Asphaltene is a heavy proportion of crude oil with a unique structure and molecular makeup, making it one of the crude oil's most complex components. Asphaltene content gives information regarding Asphaltene present in crude oil.

The 210°C residue of the distillation sample is refluxed in n-Hexane for roughly 2 hours and maintained in the dark (overnight) to promote asphaltene precipitation for asphaltene determination. Maltene is the filtrate obtained after filtration (kept for wax determination). The residue is then dissolved in hot Toluene, yielding Asphaltene.

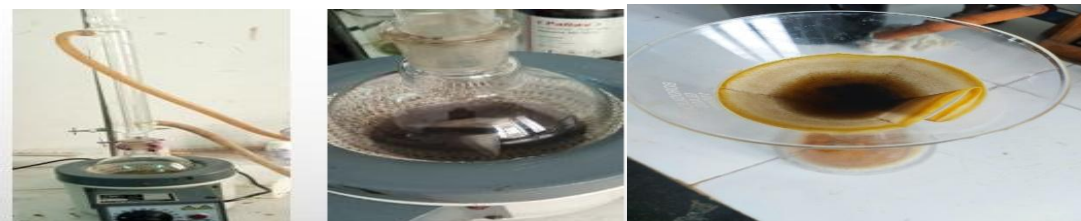


Figure. 3 - Determination of Asphaltene content

#### F Wax Content

Wax is straight chain saturated hydrocarbons with carbons ranging from  $C_{18}$  to  $C_{36}$ . Maltene, together with a wash of hot n-Hexane, is filtered through hot silica. After adding Acetone for wax precipitation, the filtrate was maintained in a deep freezer at  $-20^{\circ}C$  overnight. The filtration process collects the wax crystals.



Figure. 4 - Determination of Wax content

#### G Melting Point and Congealing Point Of Wax

The temperature at which wax completely melts is known as the melting point of wax. The temperature at which molten wax solidifies completely is known as the congealing point. It is an important parameter to know about the waxes responsible for deposition in pipeline.

## III RESULTS AND DISCUSSIONS

Some important physico-chemical parameters of Crude Oil of Western Onshore Field are listed in Table - 1.

TABLE I

PHYSICO-CHEMICAL PARAMETERS OF CRUDE OIL OF WESTERN ONSHORE FIELD

S.N	Parameters	Results	Explanation
1	Water Content	Traces of water	Crude contains a trace of water. (Old field).
2	Density	0.8270kg/cm <sup>3</sup> at 15°C	Density low, means light oil.
3	Specific Gravity	0.889	light crude oil
4	°API Gravity	39.43	A high API gravity in conjunction with a low density indicates light crude oil.
5	Pour point	33°C	Crude is difficult to flow because it freezes easily.
6	Asphaltene content	0.44%	Naphthenic oil

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#### IV CONCLUSIONS

- The physicochemical qualities of crude oil are crucial in the petroleum business. Decision-making is aided by the assessment of its parameters.
- The parameters studied included Water content, Density, API Gravity, Pour Point, Distillation, Asphaltene, and Wax content.
- Their knowledge aids in transportation, processing, specification, and even the sale of oil at the upstream, midstream, and downstream levels, making them even more important.
- These criteria also allow for a better knowledge of the many products that can be obtained during the transformation of crude oil, as well as the equipment that will be required to reduce contamination-related harm.
- The crude oil in question is light in colour, has a low Pour Point, and contains traces of water.

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