International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 6, Issue 3 (March 2017), PP.01-04

Determining Changes in Interfacial Tension of Crude Oil using Alkalis

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Abstract :- The current work is performed to determine the change of interfacial tension (IFT) of crude oil using alkaline salt. Ever since the discovery of crude oil it turned into one of the most important resource of the world, and since the availability of the crude oil is currently declining compared to that of its early period of production it is necessary to obtain the maximum output from the available source keeping this in mind the enhanced oil recovery (EOR) techniques was introduced, the alkaline flooding is one of the chemical enhanced oil recovery techniques in which high pH alkaline chemicals are injected to the reservoir for recovering the residual oil, and it is one of the oldest EOR technique. This study is conducted to understand this change in IFT by using alkalis and to determine the best alkali salt.

Keywords: - Alkalis, Surface tension, Tensiometer, Interfacial tension.

I. INTRODUCTION

The main aim of this project is to study the change in interfacial tension of crude oil using alkalis; this method of using alkalis salts to reduce interfacial tension of crude oil comes under the category of Enhanced Oil Recovery (EOR). Most of the current world oil production comes from mature fields. Increasing oil recovery from the aging resources is a major concern for oil companies and authorities [1]. So in order to obtain this oil from the reservoir in an economic way the Enhanced Oil Recovery (EOR) method called alkaline flooding is introduced, in the alkaline flooding method a suitable alkaline salt is mixed with water and the water is pumped in to the reservoir through an injunction well and the well is closed for some period of time, this time is called as the incubation period, during the incubation period due to the presence of alkaline the reservoir the interfacial tension between the formation water and crude oil gets declined and the production will get enhanced. The main aim of this project is to identify the change in interfacial tension between oil and formation water using different alkalis.

1.1 Surface Tension, Interfacial Tension

Interfacial or surface tension exists when two phases are present. These phases can be gas/oil, oil/water, or gas/water. Interfacial tension is the force that holds the surface of a particular phase together and is normally measured in dynes/cm. The surface tension between gas and crude oil ranges from nearly zero to approximately 34 dynes/cm. It is a function of pressure, temperature, and the composition of each phase. The surface tension of any fluid is a surface phenomenon which is measured respect to unit length; it is due to the surface tension of a fluid which make it occupies the least surface area possible. The surface tension force affects the shapes and the motions of the liquid that have open surfaces [2]. Surface tension is always measure at the interfaces of liquids and air. Water is having the higher surface tension (67 dynes/cm) because of its hydrogen bonding. Surface tension when referring to energy per unit of area, it is common to use the term surface-energy. The surface tension is measured in the unit of Dynes/cm.

1.2 Alkalis

The word alkali is derived from an Arabic word al-qaly which means the calcined ashes; one of the important properties of an alkali salt is that they will get soluble in water much faster due this property of alkalis it can be defined as a base that dissolves in water. A solution of alkali salt will have a pH greater than 7.0, the few other properties of alkaline aqueous solution include: concentrated solutions of alkali sails are caustic and due to the saponification of the fatty substances on our skin we feel that alkaline solutions are slippery or soapy to the touch, Alkalis are water soluble in nature although some like barium carbonate are only soluble when reacting with an acidic aqueous solution.

The molarity of Alkali salt solution is calculated by using the formula.

$$\text{Molarity (M)} = \frac{weight\ of\ salt\ in\ grams}{molecular\ weight\ of\ salt} * \frac{1000}{volume\ of\ solvent\ in\ ml} \quad (1)$$

1.3 Du Nouy Ring Tensiometer

The Du Nouy ring method is one technique by which the surface tension and interfacial tension of liquids can be measured. This technique was developed by French Physicist Pierre Lecomte du Nouy in 1925. It is one of the oldest four common methods available for determining the surface tension. In particular, because the most widely used of these methods, historically, has been the ring method. In the Du Nouy ring method a platinum ring is used to measure surface tension and interfacial tension. The ring is dipped completely into the liquid to be analyzed. It is then slowly withdrawn from the liquid until maximum force is attained and the reading can be noted from the Dial And Vernear, it is a circular dial consisting of a scale from 0 -90 which coin-side with a vernier. The point coin-sides with the dial give the measurement of interfacial tension or surface tension in Dynes /cm.

Figure 1: Du Nouy Ring Tensiometer

1.3.1 Platinum Ring

Platinum is a chemical element with symbol Pt and atomic number 78. It is dense, malleable, ductile, highly unreactive, precious, gray-white transition metal. Its name is derived from the Spanish term platina, translated into "little silver"[3].

It has six naturally occurring isotopes. It is one of the rarer elements in Earth's crust. It occurs with nickel and copper ores, mostly in South Africa. Because of its scarcity in Earth's crust, only a few hundred tonnes are produced annually, and given its important uses, it is highly valuable and is a major precious metal commodity.

Figure 2: Du Nouy Ring

Platinum is one of the least reactive metals it is of this property of platinum it has a high verity of industrial application. It has remarkable resistance to corrosion, even at high temperatures, and is therefore considered a metal it was first used by pre-Columbian South American natives to produce artefacts.

Platinum is used in catalytic converters, laboratory equipment, electrical contacts and electrodes, platinum resistance thermometers, dentistry equipment, and jewellery. Being a heavy metal, it leads to health issues upon exposure to its salts; but due to its corrosion resistance, metallic platinum has not been linked to adverse health issues.

Material property	Value
Atomic number	78
Atomic mass	195.09 $g.mol^{-1}$
Density	21.4 g.cm at 20°C
Melting point	1772 °C
Boiling point	3800 °C
Energy of first ionization	867 kJ. mol^{-1}
Energy of second ionization	1788 kJ. mol^{-1}
Vanderwaals radius	0.138 nm

Table 1: Properties of Platinum

II. EXPERIMENTAL CONDUCTION

Volume of sample taken = 30ml
Weight of Alkaline salt taken = 1g
Volume of water taken = 20ml

Molarity Sodium Chloride solution:-
Molecular weight of Sodium Carbonate sample = 58.5

$$\frac{1}{58.5} * \frac{1000}{20} = 0.85M$$

Molarity Sodium Bicarbonate solution:-
Molecular weight of Sodium Bicarbonate sample = 84.01

$$\frac{1}{84.01} * \frac{1000}{20} = 0.59M$$

Molarity Sodium Hydroxide solution:-
Molecular weight of Sodium Hydroxide sample = 40

$$\frac{1}{40} * \frac{1000}{20} = 1.25M$$

Molarity Sodium Carbonate solution:-
Molecular weight of Sodium Carbonate sample = 105.99

$$\frac{1}{105.99} * \frac{1000}{20} = 0.47M$$

III. EXPERIMENTAL PROCEDURE

Mix one gram of Sodium Chloride with 20 ml of water. Take the crude oil sample in a transparent container. Lift the container up to the level so that the platinum ring toughest the water surface. Try to separate the contact of water and platinum ring by raising the platinum ring by using knur led knob A. Not down the vernier reading at the point where water and platinum ring gets separated, not down the value as initial interfacial tension. Bring back the platinum ring to its initial position as before add 5 ml of Sodium Chloride solution, in to the sample and wait for 10 minute. Try to separate the contact of water and platinum ring by raising the platinum ring by using knur led knob A, and not down the value as change in interfacial tension. Repeat the step by adding another 5ml, then continue it for full 20ml. repeat the procedure using Sodium Bicarbonate solution, Sodium Hydroxide solution and Sodium Carbonate solution.

IV. OBSERVATION & GRAPH

Trial no:	Volume of solution (ml)	CHANGE IN INTERFACIAL TENSION (Dynes/cm)			
		Sodium Chloride	**Sodium Bicarbonate**	**Sodium Hydroxide**	**Sodium Carbonate**
1	0	44	44	44	44
2	5	42	40	39	40
3	10	41	35	37	41
4	15	39	32	35	37
5	20	38	28	33	35

Table 1: IFT Changes

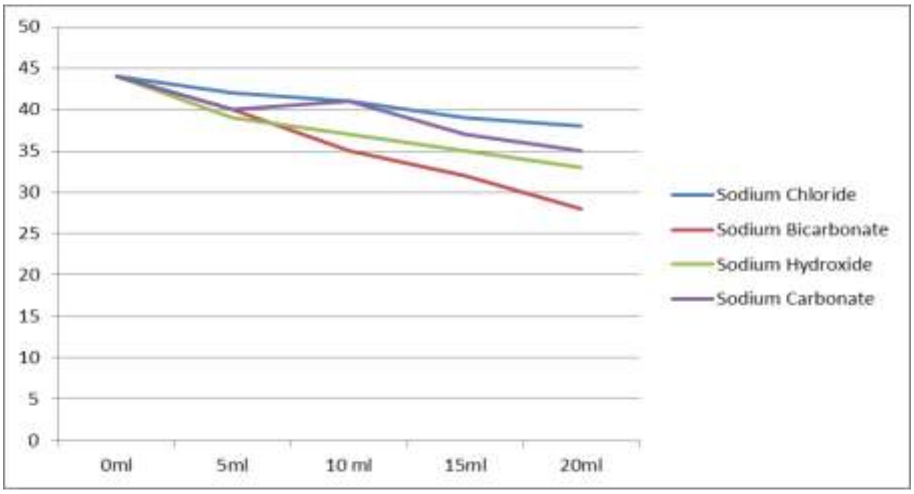

Figure 3: Profile showing IFT change

V. CONCLUSION

From the above observation we conclude that the change in interfacial tension is more while using Sodium Bicarbonate, by using 20 ml of by Sodium Bicarbonate the inter facial tension get reduced to 28 Dynes/cm, but it to be noted that the Sodium bicarbonate and Sodium carbonate can’t be used in a carbonate reservoir because it may damage the reservoir.

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