

# Determination of salt content in crude oil, turbine oil and some refinery products volumetrically

\*Qasim Y. Mohammed

Erbil Polytechnic University, Koya Technical Institute, Oil Technology Department, Erbil, Iraq

\* Corresponding author: E-Mail: qasimyahya63@epu.edu.krd

## ABSTRACT

Salts (as chloride) in crude oil, diesel, kerosene, gasoline and turbine oil was determined. The samples under this study collected from different places in Kurdistan region, Iraq.

The extraction process occurs in toluene, mixture of absolute and acetone using dual extraction apparatus at 60°C for 20 minutes, finally the chlorides was determined volumetrically.

The final results for various samples show a salt content (ppm) of crude oil (307.32 – 441.58) ppm, diesel (19.68 – 579.27) ppm, kerosene (102.02 – 531.94) ppm, gasoline (92.76 – 563.76) ppm, turbine oil (recycled) 30.77 ppm and turbine oil (used) 324.55 ppm.

**KEY WORDS:** Crude oil, Turbine Oil, Refinery Products, Dual Extraction.

## 1. INTRODUCTION

The presence of salt in the crude oil leads to several problems during transporting and the refining processes, including corrosion of lines, fouling, and also the deactivation of catalysts employed at the refinery (Al-otaibi, 2003). The chemical composition of these salts varies, but the major portion is nearly always: Sodium chloride, lesser amounts of calcium chloride, and Magnesium Chloride (Erik Fetter Pruneda, 2005).

In petroleum industry, there is great variation in salt content oil depending on the source and the producing wells or zones within field (Mohameda, 2003).

The most common methods used to measure salt content in petroleum industry are: Classical Mohr's method (IP 77, 1972), Potentiometric method (ASTM D-6470, 2015), and Electrometric method (ASTM D-3230, 2013).

The concentration of sodium chloride as a contaminant depends on: Fuel additives, Water content in the system, and the sodium salt involved in the system. This method is reasonably accurate; rapid and since only one extraction is required.

## 2. EXPERIMENTAL PROCEDURE

**Tested samples:** Samples from different fuel stations of crude oil, diesel, kerosene, gasoline and turbine oil at (Erbil, Sulaimania and Koya, Kurdistan region, Iraq) tested to determine the salts concentration using dual extraction apparatus from Linetronic Technologies (Switzerland).

**Reagents:** Toluene from (Aldrich - Sigma), Absolute ethanol from (Aldrich - Sigma), Acetone from (BDH), 5 N Nitric Acid from (BDH), 0.05 N Potassium Thiocyanate from (Scharlau), 0.05 N Silver Nitrate from (Merck) and Ferric ammonium sulphate (Ferric Alum Indicator) from (Merck).

**Procedure of test:** The crude oil salt removal was carried out using a dual glass extraction apparatus from Linetronic Technologies (Switzerland) which is specially designed in accordance with the IP 77 (1972), (Smith, 1992). The extraction apparatus consists of a 500 ml boiling flask, Hopkins reflux condenser with aspirator, thistle tube, heating tube, 250W heating coil and 400ml Pyrex beaker.

In most experiments, 80 g of the sample Weighed into a 250 ml beaker and heat it to 60°C. Heat 40 ml of toluene to the same temperature and add it slowly to the sample with constant stirring until solution is complete. Transfer this solution quantitatively to the flask of the extraction apparatus through the thistle tube, and wash it in with two 15 ml portions of toluene, each at about 60°C.

Without allowing the mixture in the flask to cool, add 25 ml of hot absolute ethanol and 15 ml of hot acetone. Boil the mixture vigorously for 2 minutes, remove the source of heat and when boiling has ceased add 125 ml of distilled water. Boil the mixture for a further 15 minutes.

Allow the phases to cool and separate. Draw off the lower layer and filter it, if necessary, through a Whitman No.41 or equivalent filter paper (because some alcohol and acetone remain dissolved in the toluene phase, the volume of extract available is taken as 160 ml).

Measure into a beaker 100 ml of the extract and add 5 ml (5 N) of the nitric acid. Cover the beaker with a clock-glass and bring the contents to the boil. Test the vapours periodically for hydrogen sulphide with lead-acetate paper and continue to boil for a further 5 minutes after a negative result is obtained. Cool and then rinse the contents of the beaker into a titration flask with distilled water. Add 10 ml of isopropyl alcohol and 3 ml of ferric alum indicator.

From a burette add 0.5 ml of the 0.05 N thiocyanate solution. Titrate the mixture with 0.05 N silver nitrate solution to a colorless end point, agitating the contents of the flask continuously, and add an excess, of 5 ml of the silver nitrate. Stopper the flask and shake it vigorously for 15 seconds to coagulate the precipitate.

Titrate slowly with the thiocyanate solution until the end point is approached, as indicated by slower fading of the red coloration. Shake the flask again and continue the titration drop-wise until a red coloration persists after vigorous shaking. Make a blank titration by repeating the procedure, replacing the 80 g of sample with 95 ml of toluene.

### 3. RESULTS AND DISCUSSION

The determination of salt content on crude oil and its products its product is an important task, the extraction procedure used for this purpose involved using of an extracting solvent such as toluene, xylene and others, as a consequence, a good homogenous condition in the mixture must be satisfied (Montserrat Fortuny, 2008).

The extraction procedure involving heating of very viscous samples may represent a risk to the experimental setup. The increased viscosity of the sample means that a totally mixing energy needed to keep the homogeneity at the same desired level (Qasim, 2013).

Toluene is recommended as a diluent for the oil, since it has good solvent action on most petroleum's, with consequent low fire and poison hazards, and a low specific gravity. The efficiency of salt extraction by this method depends greatly on the agitation given to the mixture after addition of the water (Jakoby, 2004).

The shaking time of 5 minutes given in the above procedure had been found sufficient to extract at least 95 percent of the salt from even the most difficult samples. Usually, in the usually, in oil salt content determination, extremely accurate analyses are not required, and some sacrifice may be made in accuracy in order to permit a rapid determination (Jim Barker, 2013). Controlling the temperature during procedure is a very delicate job, because heating will decrease viscosity and reduce the continues phase viscosity (Abdulfatai Jimoh, 2004).

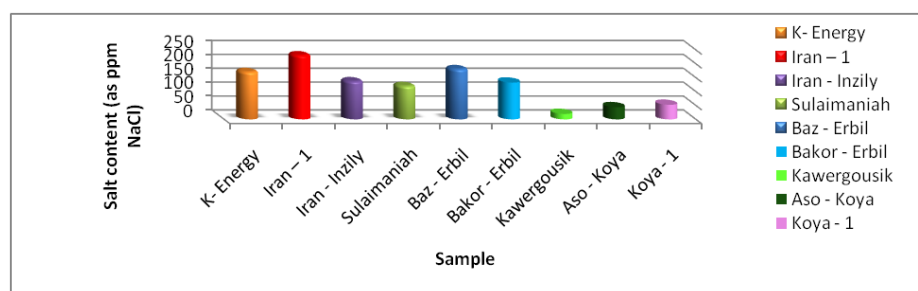
Any excessive heat might lead to evaporation, which results not only in a loss of oil volume, but also in a reduction in price because of decrease in the API gravity (Fortuny, 2007).

Salts in emulsion sometimes come in solid crystalline form, so, the need to dilution with freshwater to dissolve these crystals and dilution has become a necessity in desalting processes (Al-Otaibi, 2010).

The results of cumulative salt contents obtained using this procedure for all samples are displayed in Tables 1, 2,3,4,5 and figures 1,2,3,4 and 5.

**Table.1. Salt content in different samples of diesel as % NaCl and ppm NaCl**

No.	Sample	% NaCl	ppm NaCl
1	K- Energy	0.02045	171.570
2	Iran – 1	0.027465	231.8065
3	Iran – Inzily	0.01636	137.9136
4	Sulaimaniah	0.014025	117.8116
5	Baz – Erbil	0.007468	579.270
6	Bakor – Erbil	0.015778	90.2966
7	Kawergousik	0.001690	19.684
8	Aso – Koya	0.003693	43.9269
9	Koya – 1	0.005843	52.4994



**Figure.1. Flow chart shows salt content in diesel samples**

**Table.2. Salt content in different samples of turbine oil as % NaCl and ppm NaCl**

No.	Sample	% NaCl	ppm NaCl
1	Turbine oil ( recycled)	0.00350	30.7715
2	Turbine oil ( used)	0.0374	324.558

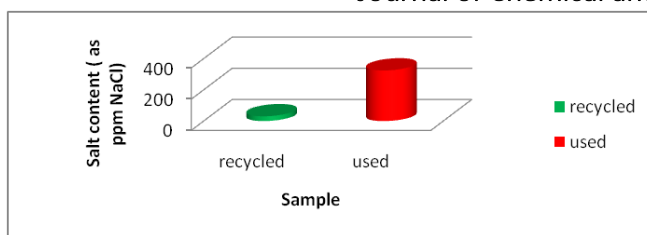


Figure.2. Flow chart shows salt content in turbine oil (as recycled and used) samples

Table.3. Salt content in different samples of gasoline as % NaCl and ppm NaCl

No.	Sample	% NaCl	ppm NaCl
1	Houger – Erbil	0.02454	181.806
2	Amraz – Koya	0.07596	563.765
3	Sulaimaniah -1	0.01227	92.765
4	Sulaimaniah -2	0.05726	436.454

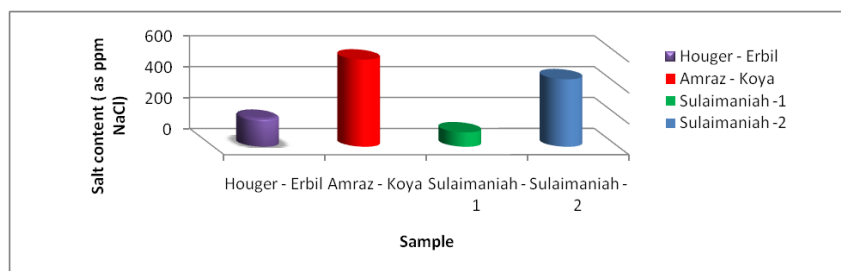


Figure.3. Flow chart shows salt content in gasoline samples

Table.4. Salt content in different samples of crude oil as % NaCl and ppm NaCl

No.	Sample	% NaCl	ppm NaCl
1	TT – 02 oil field	0.03564	307.325
2	TT-15 oil field	0.04149	326.534
3	Ainzala oil field	0.04850	441.587
4	Khormala oil field	0.04382	408.220

TT- Taq Taq area in Kurdistan region – Iraq

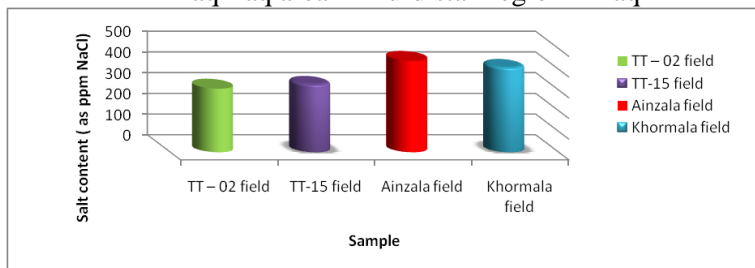


Figure.4. Flow chart shows salt content in crude oil samples

Table.5. Salt content in different samples of kerosene as % NaCl and ppm NaCl

No.	Sample	% NaCl	ppm NaCl
1	Koya – 1	0.01285	102.021
2	Koya – 2	0.03272	259.271
3	Sulaimaniah -1	0.06723	531.949
4	Ranya	0.04090	324.089

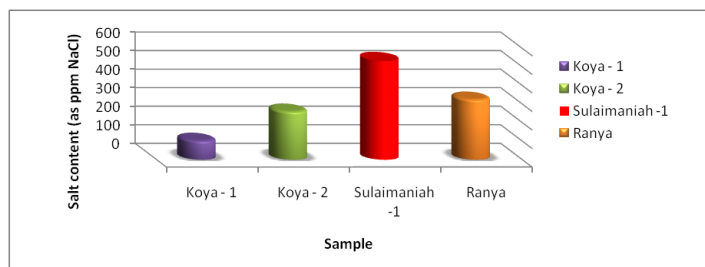


Figure.5. Flow chart shows salt content in kerosene samples

#### 4. CONCLUSION

The salt content as NaCl (as % and ppm) in crude oil, turbine oil and some refinery products (kerosene, diesel and gasoline) was determined, by extraction and then, titration. The samples were collected from different places at Kurdistan region, Iraq.

#### 5. ACKNOWLEDGMENTS

Insincerely thank for the Koya technical institute, Oil technology, chemical analyzing department, for providing the necessary infrastructural facilities during my research.

#### REFERENCES

- Abdulfatai Jimoh, The use of diesel oil treated with inorganic salt, an alternative to kerosene, AUJ.T, 8 (1), 2004, 27-34.
- Al-Otaibi M, Elkamel A, Al-Sahhaf T, & Ahmed A. S, Experimental investigation of crude oil desalting and dehydration, Chemical Engineering Communications, 190 (1), 2010, 65-82.
- ASTM D-3230, Standard test method for salts in crude oil, electrometric method, 2013.
- ASTM D-6470, Standard test method for salts in crude oils, potentiometric method, 2015.
- Erik Fetter Pruneda, Enrique Rivero Borrell Escobedo y Francisco Javier Garfias Vazquez, Optimum Temperature in the Electrostatic Desalting of Maya Crude Oil, J Mex Chem Soc, 49 (1), 2005, 14-19.
- Fortuny M, Oliveira CBZ, Melo RLFV, Nele M, Coutinho RCC, Santos AF, Effect of salinity, temperature, water content, and pH on the microwave demulsification of crude oil emulsions, Energ Fuels, 21, 2007, 1358–1364.
- IP 77, Determination of salt content – extraction and volumetric titration method, 1972.
- Jakoby B, Vellekoop MJ, Physical sensors for water-in-oil emulsions, Sensor Actuat A, 110, 2004, 28–32.
- Jim Barker and Stephen Cook, Sodium contamination of diesel fuel, its interaction with fuel additives and the resultant effects on filter plugging and injector fouling, SAE Int. J. Fuels Lubr, 6 (3), 2013.
- Mohameda AMO, Gamala M, Zekri AY, Effect of salinity and temperature on water cut determination in oil reservoirs, J Petrol Sci Eng, 40, 2003, 177–188.
- Montserrat Fortuny, Elisangela B, Silva, Agnaldo C, Filho, Rosana L.F, Melo V, Marcio Nele, Raquel C.C, Coutinho, Alexandre F, Santos, Measuring Salinity in crude oils, Evaluation of methods and an improved procedure, Fuel, 87, 2008, 1241–1248.
- Qasim Y, Mohammed and Wali M, Hamad, Desalting of crude oil and some products at Kurdistan region, Iraq, Journal of Applicable Chemistry, 2 (2), 2013, 197-201.
- Smith HV, Arnold KE, Crude oil emulsions. In, Bradley HB, editor, Petroleum engineering handbook, 3rd ed, Richardson, Society of Petroleum Engineers, 19 (1), 1992, 19-34.
- Speight JG, Handbook of petroleum analysis, New York, Wiley, Interscience, 2001.