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Development of Colorimetric Analysis for Determination the Concentration of Oil in Produce Water

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Abstract: In the present study simple, sensitive, specific and validated colorimetric method has been developed for the quantitate estimation of oil in produce water, there are many methods to determine oil in water such as gas chromatography, flame ionization detection and so, samples prepared to colorimetric analysis by excecated oil from produce water, the concentration of samples were found by density of crude oil in range of 100-250 mg/L, with correlation coefficient closed to 0.9983, 0.9993, 0.9988 and 0.9999, the method was validated for linearity and accuracy. The relative error %for estimation of oil in water (OIW) were found as 29.89, - 31.504 and 7.025 for light, heavy extracted crude oil respectively. Proposed method was successfully applied for the quantitative estimation of oil in produced water.

Keywords: produced water, colorimetric, standard curve, oil in water.

1. INTRODUCTION

Natural rocks rich of fluids such as water, oil or gas, the source of water may flow the oil from below, it become produce water when the reservoir is produced the fluid to the surface, it called formation water also (Veil et al. 2004), oil in produce water contain two of organic compounds total petroleum hydrocarbon (TPHs) contain only C and H it`s saturated, unsaturated and aromatics, heteroatoms such as sulphur, nitrogen and oxygen see fig 1 below (Colorado & Conservation 2011), organic compound in water as two form first dispersed oil organic compound in small droplets from micro to hundreds and contain both aliphatic and aromatic hydrocarbons, second dissolved oil mean organic compound in soluble, it contain some compound such as BETX (benzene, ethyl, toluene and xylene), NPD (naphthalene, phenenthrane, dibenzothiophene) and some poly aromatic hydrocarbon compounds.(Yang & Nel 2006).

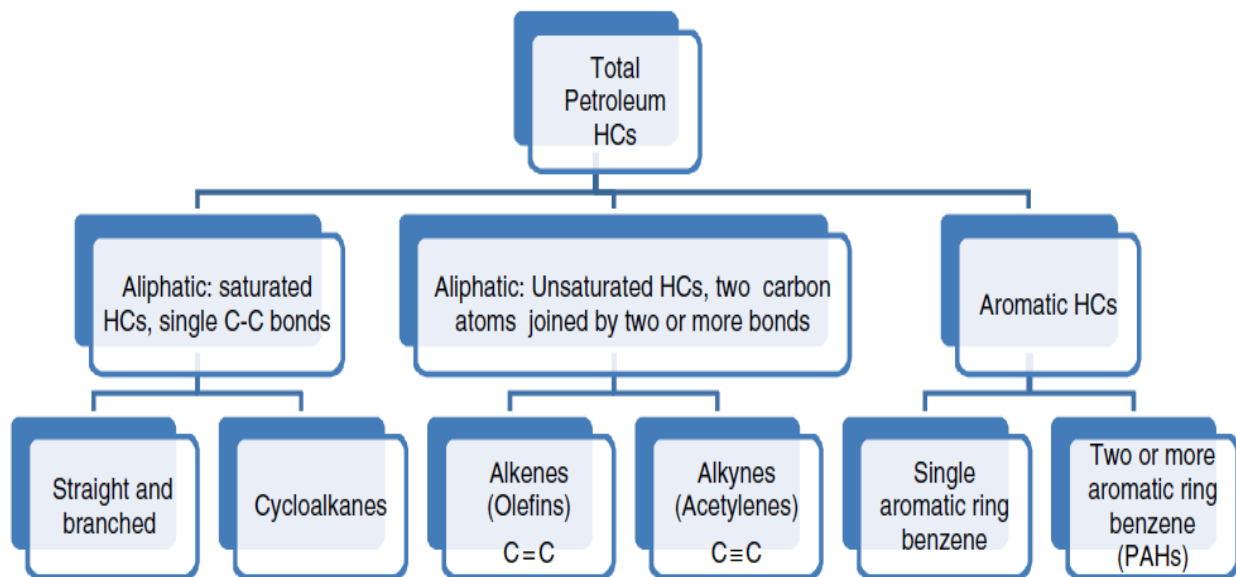


Fig 1: Oil in produced water(Yang & Nel 2006)

First step to water management is to determination oil in produce water and suggest suitable methods to treatment, can help operators increase production when characteristics of produce water known.

Many methods to determine oil in produce water, there are three main types:

- Infrared absorption
- Gravimetric analysis
- Gas chromatography
- Colorimetric methods

Infrared spectroscopy (IR) the most widely established methods, it required the use of ozone depleting solvent (ODS) to measure the oil in water, first acidified then extracted by chlorofluoro carbon solvent (CFC) by using Freon-113 (1, 1, 2-trichloro-1, 2, 2-trifluoroethane) for a liquid–liquid extraction (LLE). However there is alternative (LLE) solvent for IR to measure oil such as using automated direct aqueous supercritical fluid extraction method (Ramsey 2008; Veil et al. 2004) The infrared test procedure is not a commercially available field kit, it was only with the development of portable IR spectrometers (Lambert et al. 1999) . Gravimetric methods based of measuring the weight of empty flask and samples after treated by suitable solvent. Gas chromatography GC used to determine the concentration of oil in water it aided by flame ionization detector (FID). However to determine concentration of samples by colorimetric methods, first organic samples extracted by solvent and the directly measuring the color by spectrophotometric, the technique determine the total organic compound, the advantage of this methods is lower analysis costs and reduced time required to obtain results, (Lambert et al. 2001).

The goal of this study was to investigate the effect of molar absorptivity variance in the measurement of OIW and validating of the colorimetric method using different standard calibration curves prepared from different types of crude oil. to obtained acceptable methods of analysis faster and cheaper.

2. MATERIALS AND METHODS:

Samples:

The samples were selected from block-6 Elfulla petroleum field Sudan, samples prepared for analysis by solvent extraction used (n- hexane), although the density and specific gravity of the samples were measured using Anton Parr density meter according to ASTM No (D4052), however standard stock solutions were prepared by accurately weight 0.10 g of crude oil in 100ml calibrated volumetric flask and made up the volume with purified gas oil up to 100ml.

Preparation of working standard solution: working standard was prepared by transferring of 37.50, 25.00 and 12.5 ml standard stock solution into 100 ml calibrated volumetric flask and made up the volume with purified gasoil to get concentration of 750, 500 and 250ppm respectively.

Preparation of standard curves: Standard curve was prepared by using the concentration range of 1000- 250 mg/l by this method and selecting absorbance at 420 nm. The result is recorded in table no. 1 And graph are given in figures no. 1, 2 and 3.

3. RESULTS AND DISCUSSION:

Density, API and specific gravity were measured and recorded in table 1. The regression characteristics like slope (b), intercept (a), correlation coefficient (r), absolute and relative errors were calculated and the results are summarized in Table 1.

The results of sample analysis showed that there is a significant difference in the oil in water determined using the three standard curves prepared using light, heavy and bond extracted oil. This difference due to the origin of the crude oil from which the standard curve was prepared, since, heavy crude contains the heavier hydrocarbons its color is mainly darker than the light crude oil in which the lighter hydrocarbons are dominated. Accordingly molar absorptivity for both are different. In another hand, standard curve prepared from the crude oil extracted from produced water itself, shows a less relative error and that can be related to the blending of crude oil (light and heavy) during process, and resulting in a medium molar absorptivity.

Table 1: result of crude oil analysis and standard curves linearity.

	Light crude oil	Heavy crude oil	Ext. crude oil
Density @ 25 C°	0.8545	0.9263	0.8711
API	29.31	17.15	26.41
S.G	0.8799	0.9500	0.8961
Regression equation (*y)	0.0013X- 0.0114	0.0025X- 0.0124	0.0016X- 0.0124
Slope (a)	0.0013	0.0025	0.0016
Intercept (b)	0.0114	0.0124	0.0124
Correlation coefficient(r)	0.9983	0.9993	0.9988
Absolute Error	289.92	- 315.04	70.25
Relative Error %	29.89	- 31.504	7.025
Relative Error ppt	298.92	- 315.04	70.25
*y = a + bc where c is the concentration of OIW in mg/L (ppm).			

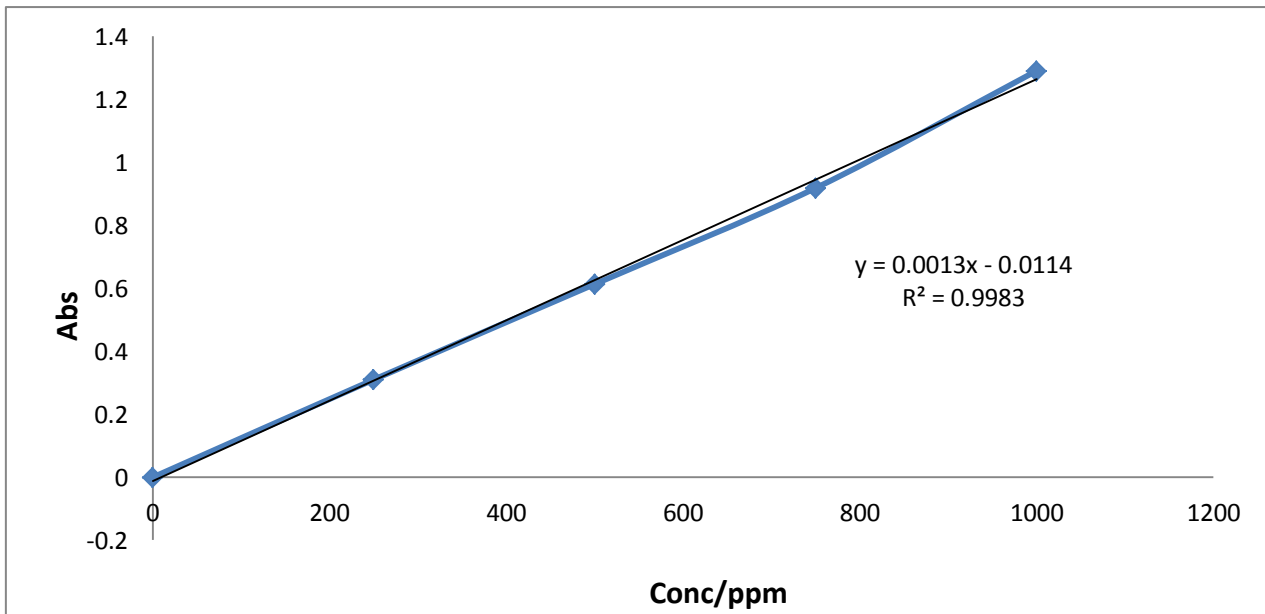


Fig.2: standard calibration curve of light crude oil.

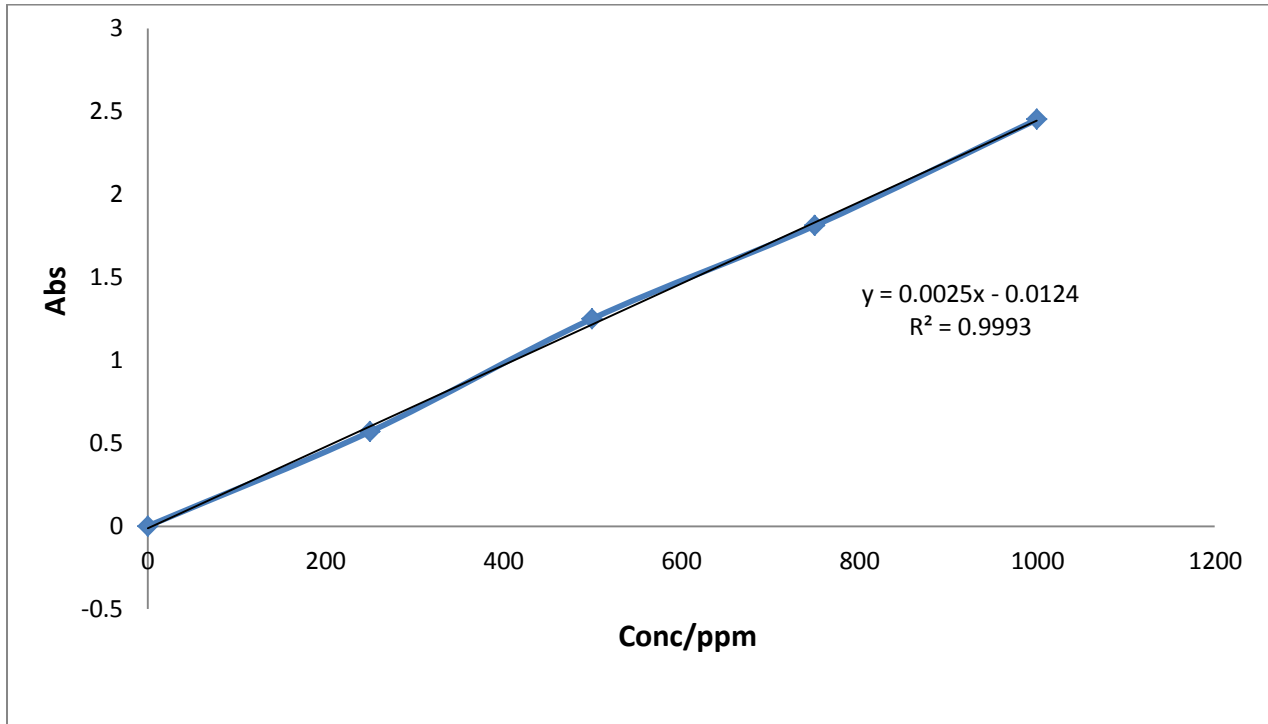


Fig.3: Standard calibration curve of heavy crude oil.

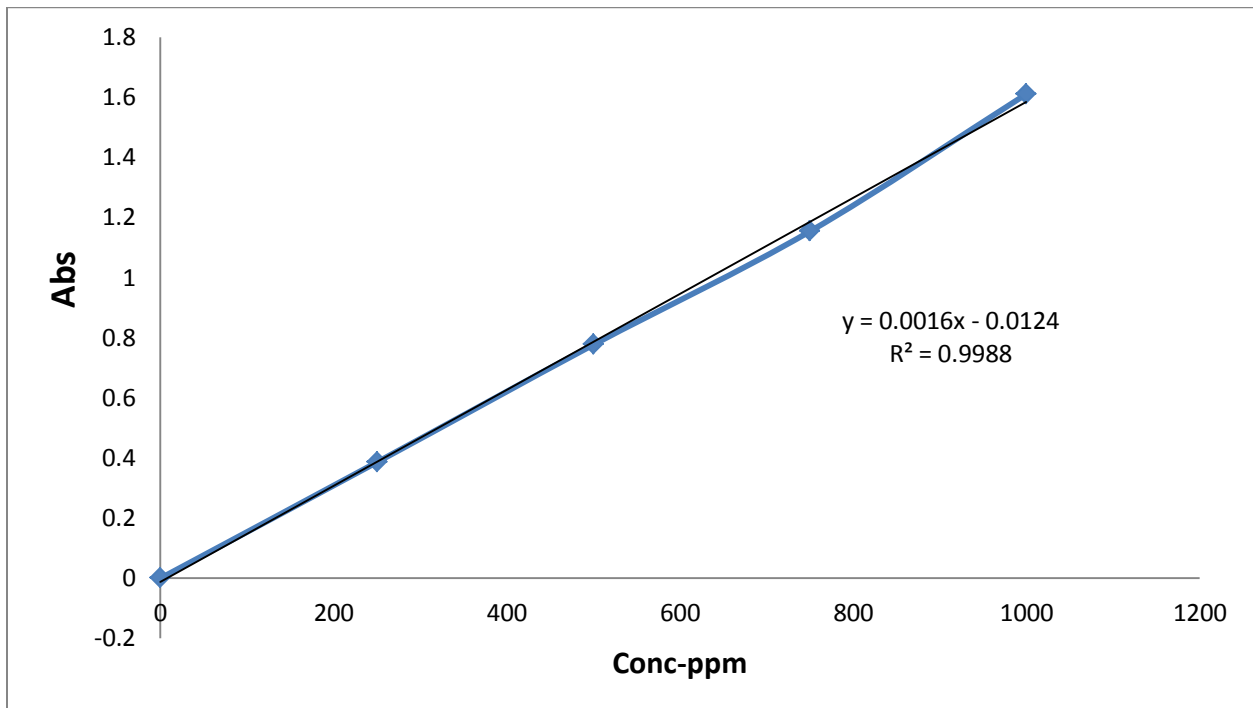


Fig.4: standard calibration curve of extracted crude oil.

4. CONCLUSIONS

Three samples of oil in water determined by colorimetric analysis, the result shown different concentration due the original of oil (heavy, light and extracted oil), high in heavy and light, it used colorimetric as low cost technique as well as friendly to environmental, in addition results are more likely to represent the real oil content in produce water, however the field kits of technique are commercially available.

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