ISSN: 0976-3031

*Available Online at http://www.recentscientific.com*

**CODEN: IJRSFP (USA)**

*International Journal of Recent Scientific Research*
*Vol. 9, Issue, 5(D), pp. 26722-26729, May, 2018*

**International Journal of Recent Scientific Research**

**DOI: 10.24327/IJRSR**

**Research Article**

# PHYSICOCHEMICAL PROPERTIES OF CRUDE OIL BLENDS IN AKWA IBOM STATE, NIGERIA

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**DOI: http://dx.doi.org/10.24327/ijrsr.2018.0905.2111**

**ARTICLE INFO**

***Article History:***

Received 17th February, 2018
Received in revised form 21th March, 2018
Accepted 28th April, 2018
Published online 28th May, 2018

***Key Words:***

FUN: Frontier Universal Nestoil; Trace Metals; Min and Max: Minimum and Maximum concentrations.; DR: Direct reading, powder pillows, ASTM: American Society for Testing and Method.Sed/Water: Sediment and Water; Spe/Gravity: Specific Gravity.

**ABSTRACT**

Physicochemical properties of six crude oil blends was investigated in Akwa Ibom State, Nigeria. The essence was to determine the physical and trace metal composition of the crude oil samples in Akwa Ibom State, Nigeria. The study was undertaken between March-2016 and March - 2018.Standard approved procedure as recommended by Association of applied chemist and American Society for Testing and Methods were used to evaluate the physicochemical properties of the various crude oil blends selected for the purpose of this study. Trace metals Iron(Fe), Lead(Pb), Zinc(Zn). Vanadium(V), Nickel(Ni), Chromium(Cr), Cadmium(Cd) were assessed in Crude oil samples. Specific gravity, density, sulphur, water, pour point, boiling ranges as well as salt contents of the crude oil blends were also determined. Trace metals presence in light, medium and heavy crude oil samples are non-biodegradable and can easily enters into the food chain through spillages and gas flaring. This can accumulate in edible, medicinal plant species as well as surface and underground water sources located in crude oil producing communities. As results of increase in trace metal concentration in the affected plant and water samples severe ecological and environmental consequences can occur thereby exposing human being to trace metal toxicity. The study revealed that the selected crude oil blends contains Pb, Fe, Zn, Cd, V, Ni, Cr in relative proportion depending on the source of crude oil samples. Therefore, in an event of gas flaring and crude oil spillages during processing, production and transportation the land, water and air environment could be negatively affected by trace metals release from crude oil impacted environment. Consequently, depending on the volume released into the immediate environment soil may be polluted leading to decrease in crop yield and production. Also trace metal enhancement in surface water such as stream, rivers hinder aquatic species growth and development and further renders such water bodies unsuitable for domestic use. Therefore, consumptions of edible plant, fishes, surface /underground water bodies impacted by crude oil pollution posed adverse effect on human health and development.



## INTRODUCTION

Ahmad *et al.* (2010) mentioned that crude oil as one of the fossil fuels is used globally as source of energy both in private and industrial settings to generate power. Ahmad *et al*. (2010) also stated that crude oil is formed naturally underneath the earth surface due to decayed organic matter such as vegetables and animals. As one of the fossil fuels crude oil generates obnoxious substances which have attendant effect on the environment (Chikwendu, 1998). In its natural state crude oil consists of both organic and inorganic substances in variable proportions. It can be classified as light, medium or heavy deepening on the chemical, vegetative and geological formation (Adekoya, 1995). As further mentioned by Adekoya (1995) trace metal in crude oil can occur in organic and inorganic forms as results of interactions with other compounds. Also, vanadium/Nickel ratios characteristics of particular crude formations are unique and constant for crude oil of particular geological formation (Nnorom an Ewuzie, 2015).

Supahan (2014) also mentioned that during accidental spillages, contamination of soil, surface and underground water qualities often occur possible at the production and processing site especially during exploration process. This view was further opined by Chikwendu (1998) that introduction of

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organic and inorganic substances from crude oil industrial activities becomes obvious especially when there is spillage or continuous gas flaring into the environment. Therefore, the effect of these substances in human is relatively important because some of these metals at minimal and maximum concentration is potentially dangerous to humans (Akpoveta and Osakwe, 2014). As mentioned by Akpoveta and Osakwe (2014) lead (Pb) and cadmium(Cd) present in crude oil does not have any potential health benefit to human. They are toxic and can lead to severe chronic and acute heath problems in humansin an event of exposure (Akpoveta and Osakwe, 2014). Akpoveta and Osakwe (2014) further stated that in surface water crude oil pollution prevent penetration of sunlight as well as cause reduction in oxygen underneath the water surface thereby leading to death of aquatic species in event of spillage on water surface. In some cases, inorganic substance such as hydrogen sulphide present in crude oil may also cause depletion of oxygen because of it chemical and physical properties. In the soil since crude oil sample is not easily degraded in an event of spillage, there is that tendency for the crude oil to sink underneath the soil matrix. However, part can also evaporate to atmosphere causing depletion of oxygen level within the immediate environment. Therefore, this study was undertaken to identify the trace metal concentration in the crude oil sample so as to determine their level of correlation with the physical properties of the Crude oil blends in Akwa Ibom State, Nigeria.

## MATERIALS AND METHODS

### *Study Area*

This study was carried out in Akwa Ibom State, Nigeria. Crude oil is one of the natural resources found in Akwa Ibom state both onshore and offshore the coastal communities of the state. These communities include Ibeno, Eket, Esit Eket,Onna, Uraun, Mbo and Oron Local Government Areas. Akwa Ibom State is bound to the North by Abia State, to the East by Cross River and Rivers State.

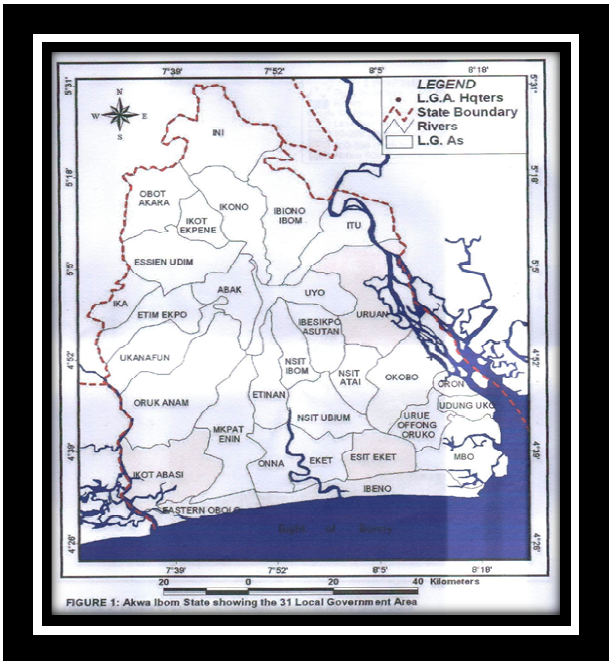

FIGURE 1: Akwa Ibom State showing the 31 Local Government Area

Specific Study Locations of Crude Oil Company

The study area specifically shares south boundary with the River State and Cross River State. The exploration and exploitation of crude oil production activities is undertaken mostly onshore by Shell Petroleum Development Company (SPDC). Other Multinational organizations involves in crude oil exploration, production and processing off shores are: Mobil producing Nigeria, Addax Producing Nigeria, Chevron producing Nigeria, Total producing Nigeria. Other Companies involves in crude oil exploration, production and processing on marginal locations onshore are: Frontier Universal Nest oil Energy company and Monopolo oil and gas Company. Majority of people within the study location are peasant farmers. Rainfall in the study area is all year round in view of the wet land nature of the coastal communities.

### *Sample collection and Preparation*

1× 6 factorial experimental design in randomized block was utilized to enhance sample collection. This facilitated random collection of six crude oil samples at the producing communities. Samples were taken into polyethylene labelled containers, and then taken to the laboratory for analysis.

### *Sample Preparation and Laboratory Analysis*

Samples were prepared according to the method defined by Suparhan (2014). Sulphuric acid (H2SO4), nitric acid (HNO3) and hydrochloric acid (HCl) were used in the sample digestions. 5g of each sample was weighed and then 5cm3 of concentrated H2SO4 was added while the mixture was stirred. A strong exothermic reaction occurred. Then, the mixture was treated with 5cm3 of concentrated HNO3, followed by 20cm3 of concentrated HCl and heated until there was no evolution of gas. The mixture was filtered and the residues formed was washed with hot concentrated HCl. Next, the residual was transferred to a digestion flask, heated with 10cm3 of concentrated HCl and filtered. The filtrate was heated at temperature below 1500°C to drive off excess HCl, then transferred to a 100 cm3 volumetric flask and made to the mark with distilled water. The sample was brought to volume and analysed using UV/IR Spectrophotometer. In this case in each 25mls of the test samples, applicable powder pillows were used and followed as defined in UV/IR spectrophotometer model3900 for several metals such as cadmium (Cd), chromium (Cr), Lead (Pb), Iron (Fe), and zinc (Zn),Vanadium(V) and Nickel(Ni). In some cases, dilution factors were determined and applied on the machine reading so as to obtained the actual reading of the trace metal.

### *Analysis of Inorganic Substances in Crude Samples*

Other inorganic substances as indicated in this study were analysed using approved and acceptable standards ASTM test method procedure for Sulphur ASTMD (3240), Density/Specific Gravity (ASTM D1298), Salt(ASTMD 3230), Pour point(ASTM D 5853), water by distillation(ASTM D4006), Water by centrifuge (Method)(ASTM D 4007), Boiling point(ASTM D-96)

### *Statistical Analysis*

Data were descriptive analysed for mean and regression coefficient determined to ascertained the level of the significance between the trace metals and crude oil physical

properties at p<0.01, p<0.02 and p<0.05 confidence levels according to Appenteng *et al*.(2013).

## RESULTS AND DISCUSSION

### *Pearson Correlation Coefficient between Crude Physical and Trace Metal Properties*

Pearson correlation analysis between physical properties of crude oil and trace metals revealed a strong negative relationship between API and iron at p< 0.01 with r value of -0.861(Table 1). Thus, higher API values in these crude oils may result in low iron concentration and vice versa. Results in Table 1 also indicate weak positive correlation for API with lead, cadmium, vanadium and chromium at p < 0.05 with r values of 0.191, 0.161, 0.321 and 0.365 respectively. Consequently, an increase in API values may cause insignificant increment in the concentration of Pb, Cd, V and Cr. However, API correlated negatively and insignificantly with zinc and very weak with nickel at P < 0.05 with r = -0.228 and -0.001. Thus, increase in API values may reduce the concentration of Zn and Ni insignificantly.

The relationship between sediment/water and trace metals in studied crude oils indicated strong positive one with iron at P < 0.01 with r = 0.855. Hence, higher concentrations of sediment/water in crude oil may cause corresponding increase in concentration of iron and vice versa. Sediment/water exhibited positive but insignificant association with zinc, cadmium and nickel at P < 0.05 with r values of 0.415, 0.086 and 0.170 respectively. Nevertheless, sediment/water showed weak negative relationship with lead, vanadium and chromium at P < 0.05 with r = -0.279, -0.432 and -0.254 respectively.

Pour point of crude oils analyzed showed positive but insignificant relationship with iron, lead and nickel at P < 0.05 with r values of 0593, 0.254 and 0.138 respectively. Thus, a change in pour point crude oil in the positive direction may elevate concentration of Fe, Pb and Ni fairly. However, pour point correlated negatively but insignificantly with zinc, cadmium, vanadium and chromium at P < 0.05 with r values of -0.099, -0.388, -0.257 and -0.560 respectively. Consequently, an increase in pour point of crude oil may reduce the concentration of Zn, Cd, V and Cr insignificantly.

Specific gravity of crude oils investigated correlated positively and significantly with iron at P < 0.01 with r = 0.869. Thus, concentration of iron in crude oils assessed was directly proportional to the specific gravity. Specific gravity of oils analyzed exhibited weak positive association with zinc at p < 0.05 with r value of 0.245. However, the relationship exhibited by specific gravity of oil with lead, cadmium, vanadium and chromium was a weak negative one at P < 0.05 with r = -0.209, -0.151, -0.322 and -0.346 correspondingly. Thus, increase in specific gravity of oils assessed may result in an insignificant reduction in the concentration of these metals. Specific gravity of oils examined showed very weak association with nickel at P < 0.05 with r value of -0.004.

Results in Table 1 indicate a strong positive relationship between density of crude oils examined and iron at P < 0.01 with r value of 0.868. Hence, an increment in density of crude oils assessed may result in a corresponding increase in the concentration of iron. Density of crude oils examined showed weak positive relationship with zinc at P < 0.05 with r value of 0.242. The relationship exhibited by density of crude oils with lead, cadmium, vanadium and chromium was a weak negative one at P < 0.05 with r = -0.210, -0.155, -0.320 and -0.346 respectively. The relationship between Densities of crude oils examined with nickel was a very weak negative one at p < 0.05 with r value of -0.008.

Boiling points of crude oils assessed exhibited weak negative association with zinc, cadmium, nickel and chromium at P < 0.05 with r values of -0.399, -0.549, -0.189 and -0.306 respectively. Consequently, increase in the boiling points of these crude oils may result in a fair decrease in the concentration of Zn, Cd, Ni and Cr. The relationship between iron and boiling points of crude oils assessed was a very weak negative one at P < 0.05 with r = -0.020. Thus, a change in the boiling points of crude oils assessed may have little negative or no impact on the concentration of iron. However, lead and vanadium correlated positively but insignificantly with boiling points of crude oils at P < 0.05 with r values of 0.572 and 0.281. Thus, a change in boiling points of crude oils examined may impact fairly on the concentration of lead and vanadium.
Results in Table 1 indicate a significant positive relationship for salt of crude oils with iron and zinc at P < 0.01 and 0.05 with r values of 0.946 and 0.717 respectively. Thus, increase in salt contents of crude oils examined may result in corresponding increase in the concentration of Fe and Zn. However, moderate negative relationship was exhibited by salt content for lead and nickel at P < 0.05 with r values = -0.562 and -0.378. Thus, a change in salt content of crude oils examined may affect concentration of Pb and Ni moderately and positively. However, salt content of crude oils assessed showed a very weak positive association with vanadium at P < 0.05 with r value of 0.010. Hence, elevation in salt content of crude oils assessed may result in a little or no effect on the concentration of vanadium.

Percentage of water in crude oils assessed correlated positively and significantly with iron at P < 0.01 with r value of 0.854. Hence, the amount of water in crude oil examined varied directly with the concentration of iron and vice versa. Percentage of water in crude oils assessed correlated positively with zinc and nickel at P < 0.05 with r values = 0.411 and 0.170 respectively. A very weak positive relationship was exhibited by percentage of water with cadmium at P < 0.05 with r = 0.081. Thus, a change in water content of crude oils may not affect the concentration of cadmium significantly. Nevertheless, percentage of water correlated negatively but insignificantly with lead, vanadium and chromium at P < 0.05 with r values of -0.279, -0.424 and -0.255 respectively. Consequently, increase in water content of crude oils examined may reduce the concentration of lead, vanadium and chromium.

Sulphur content of crude oils assessed correlated positively and significantly with iron and zinc at P < 0.02 and 0.01 with r values of 0.780 and 0.942 respectively. Hence, increase in concentration of sulphur content of crude oils assessed may result in corresponding increase in concentration of iron and zinc. Cadmium and vanadium also correlated positively but insignificantly with sulphur content in crude oils assessed at P < 0.05 with r values of 0.668 and 0245. Thus, increase in sulphur content of crude oils examined may result in a fair increase in concentration of cadmium and vanadium. A very weak positive correlation was exhibited by sulphur content of crude oil with chromium at P < 0.05 with r = 0.076. However, a very weak negative

relationship was showed by sulphur content of crude oil for lead at P < 0.01 with r value of -0.076

**Table 1** Correlation coefficients between physical properties and trace metals in crude oil

| | Iron | Zinc | Lead | Cadmium | Vanadium | Nickel | Chromium |
|---|---|---|---|---|---|---|---|
| API | -0.861* | -0.228 | 0.191 | 0.161 | 0.321 | -0.001 | 0.365 |
| Sed/wat | 0.855* | 0.415 | -0.279 | 0.086 | -0.432 | 0.170 | -0.254 |
| Pour point | 0.593 | -0.099 | 0.254 | -0.388 | -0.257 | 0.138 | -0.560 |
| Sp. gravity | 0.869* | 0.245 | -0.209 | -0.151 | -0.322 | -0.004 | -0.346 |
| Density | 0.868* | 0.242 | -0.210 | -0.155 | -0.320 | -0.008 | -0.346 |
| Boiling point | -0.020 | -0.399 | 0.572 | -0.549 | 0.281 | -0.189 | -0.306 |
| Salt | 0.946* | 0.717*** | -0.562 | 0.230 | 0.010 | -0.378 | 0.149 |
| % water | 0.854* | 0.411 | -0.279 | 0.081 | -0.424 | 0.170 | -0.255 |
| Sulphur | 0.780** | 0.942* | -0.076 | 0.668 | 0.245 | -0.129 | 0.076 |

*Correlation is significant at p < 0 .01 level **Significant at p < 0.02 ***Significant at p < 0.05 (two-tailed). API = American Petroleum Institute gravity; sed/wat = sediment/water and Sp. Gravity = specific gravity.

## *Physicochemical Properties of Crude Oil*

Results for American Petroleum Institute (API) gravity scale commonly used for the determination of density of crude oil are shown in figure 2 . Results obtained revealed the following ranges for API: Asabo blends (28.90 – 30.10 ); Os o blends (38.90 – 40.10 °), Edop blends (28.60 – 29.90 ), QIT blends (26.80 – 32.10 ) and Fun blends (40.10 – 49.80 ). However, crude oil from the study area (Uruan) showed a range of 40.00 – 44.10 indicating that, Uruan blends may have higher amount o f dissolved gases than other blends from Akwa Ibom State except Fun blends ( Chinenyeze and Ekene, 2015). The obtained API range for Uruan blends is higher than that reported in blends by Tijjani *et al.* (2012).

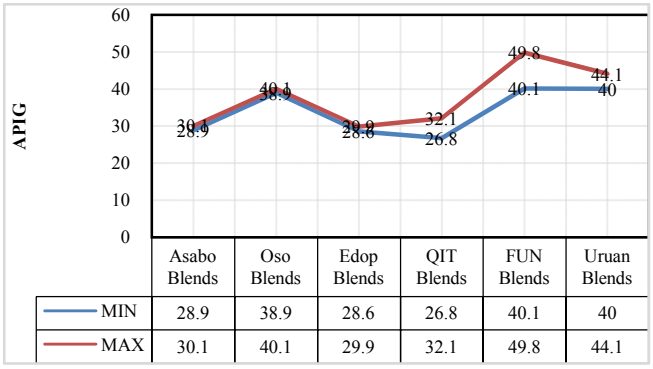


**Figure 2** Graph Minimum and maximum API gravity of different crude oil from Akwa Ibom State.

## *Sediment and Water*

Sediment/water in different crude oils from Akwa Ibom State as indicated in figure 3 varies as follows: Asabo blends (18.60 – 33.20 % V); Oso blends (0.08 – 4.00% V), Edop blends (7.00 – 22.00 %V), QIT blends (24.30 – 31.00 %V) and Fun blends (0.05 – 0.08%V). Sediment/water contents in blends from studied area (Uruan) varied from 0.05% V to 0.15% V. Thus, Uruan blends with low sediment/water contents may not pose serious problem of corroding metallic surfaces during the process of refining. The range of sediment/water in Uruan blends is consistent with that reported by Appenteng *et al*. (2013).

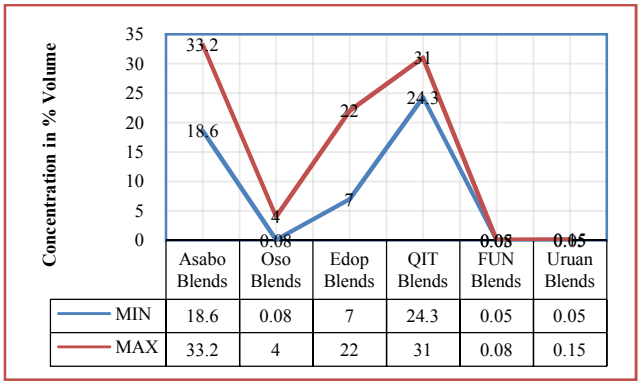


**Figure 3** Graph Minimum and maximum sediment/water in different crude oil from Akwa Ibom State.

## *Pour Point*

Figure 4 shows the pour point of different crude oil blends. Pour point of crude oil signifies the lowest temperature at which there is a lo ss of fluidity in the oil . Pour point indicates the quantity of aliphatic and aromatic compounds present in crude oil. Results in figure 4 indicate ranges for pour point as follows: Asabo blends (+55 – +60º F); Oso blends (+55 – +60), Edop blends (+60 – +60), QIT blends (+55 – +55) and Fun blends (+35– +40). However, pour point in the studied Uruan blends ranged between +40º F and +45 ºF, this range is much higher than that reported by Yasin *et al.* (2013). Thus, pour point of Uruan blends is lower than those of other blends from Akwa Ibom State except that of Fun blends.

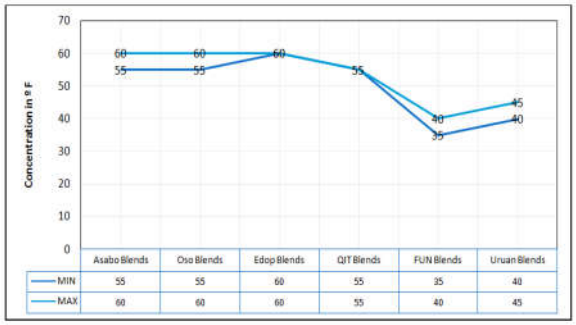


**Figure 4** Graph Minimum and maximum pour point in different crude oil from Akwa Ibom State.

## *Specific Gravity*

Figure 5 above shows the specific gravity of different crude oil blends. Specific gravity of different blends from Akwa Ibom State varies as follows: Asabo blends (0.8756 – 0.8822ºF); Oso blends (0.8236 – 0.8304 ºF), Edop blends (0.8767 – 0.8838 ºF), QIT blends (0.8649 – 0.8939 ºF) and Fun blends (0.7805 – 0.8246 ºF) (Figure 4). The studied Uruan blend showed a range of 0.8156 – 0.8203 ºF for specific gravity of the crude. Thus, Uruan crude is lighter than other crudes from Akwa Ibom State except FUN blends. The obtained range for specific gravity of crude from Uruan is higher than that reported in crude oils by Yasin *et al*. (2013).


**Figure 5** Graph Minimum and maximum values for specific gravity in different crude oil from Akwa Ibom State.

## *Density*

The density of various crude oil types in Akwa Ibom state as shown in figure 6 vary as follows: Asabo blends (0.875 – 0.882 g/cm3); Oso blends (0.824 – 0.830 g/cm3), Edop blends (0.876 – 0.883 g/cm3), QIT blends (0.865 – 0.893 g/cm3) and Fun blends (0.780 – 0.824 g/cm3). The density of studied Uruan blends varied from 0.815 g/cm3 to 0.820 g/cm3 indicating that, apart from FUN blends, crude oil from Uruan is lighter than other crudes from Awa Ibom State. The obtained range for density in Uruan crude is lower than that reported in crude oil by Adetoro *et al*. (2015).

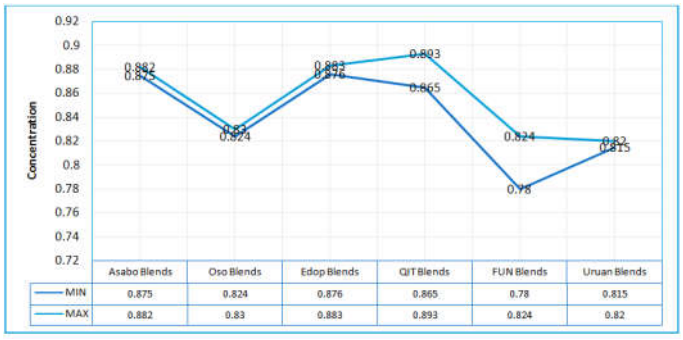


**Figure 6** Graph Minimum and maximum values for density of different crude oil from Akwa Ibom State.

## *Boiling Point*

Boiling points of the different crude oils from Akwa Ibom State as indicated in figure as follows: Asabo blends (29.90 – 30.00 ° C); Oso blends (30.00 – 35.00 ° C), Edop blends (29.80 – 33.10 ° C), QIT blends (29.60– 30.00 ° C) and Fun blends (27.90 – 29.90 ° C). The studied Uruan crude recorded a range of 30.00– 32.00 ° C indicating that crude from Uruan boils at a higher temperature range than Asabo, QIT and FUN blends.


**Figure 7** Graph Minimum and maximum boiling points for different crude oil from Akwa Ibom State.

## *Salt Content*

Vii. Salt contents of the different crude oils in Akwa Ibom State range as follows : Asabo blends (6.51 – 11.56 PtB ); Oso blends (1.01 – 3.14PtB ), Edop blends (8.53 -14.32PtB ), QIT blends (14.31 – 21.26PtB ), FUN blends (2.94 – 6.85PtB) (Figure 8 ). The salt contents of studied Uruan blends varied from 6.05PtB to 9.16PtB. Consequently, Asabo, Edop and QIT crude oils have higher amounts of salts than Uruan crude. However, the obtained range of salt in Uruan crude is also higher than that reported by Appenteng *et al*. (2013).


**Figure 8** Graph Minimum and maximum values for salt in different crude oil from Akwa Ibom State.

## *Percentage Water by Distillation*

Water in the various crude oils from Akwa Ibom State as indicated in figure 9 varies as follows: : Asabo blends (18.65 – 33.25%); Oso blends (0.075 – 4.15%), Edop blends (7.15 – 22.10%), QIT blends (24.40 – 31.10%), FUN blends (0.075 – 0.10%). Water contents of crude oil from the studied Uruan area ranged from 0.075% to 0.20%. Apart from FUN blends other blends from Akwa Ibom State have higher water content than Uruan crude. Thus, the growth of plants and destruction of refinery plant may be drastically reduced in Uruan crude. However, the obtained range of water in Uruan crude is higher than that reported by Yasin *et al*. (2013).

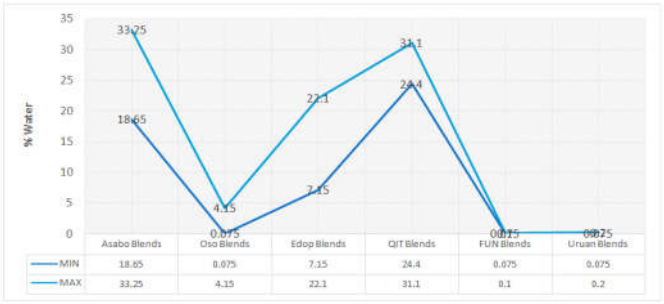


**Figure 9** Graph Minimum and maximum percentage of water by distillation in different crude oil from Akwa Ibom State.

## *Sulphur*

Sulphur contents of different crude oils from Akwa Ibom State are shown in figure 10 . The minimum and maximum Sulphur contents of the different blends varied as follows: Asabo blends (0.02– 0.16Wt %); Oso blends (0.02 – 0.06Wt %), Edop blends (0.01 – 0.06Wt %), QIT blends (1.10 – 1.16Wt %), FUN blends (0.01 – 0.02Wt %). Crude oil from the studied area (Uruan) had Sulphur contents ranging from 0.11% to 0.16Wt %. The processes used for treatment of crude oil from Uruan may not be as much as that used for QIT blends. Thus, crude oil from Uruan may be classified as better crude compared to QIT blends. The Sulphur contents of Uruan crude are lower than that reported by Adetoro *et al*. (2015) in crude oil.

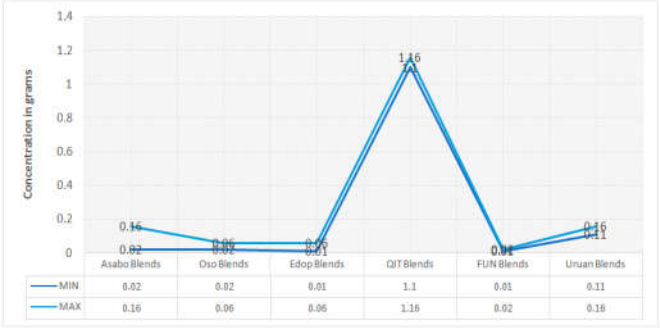


**Figure 10** Graph Minimum and maximum values for sulphur in different crude oil from Akwa Ibom State.

### *Fe* (*Iron*)

Figure 11 illustrates the trend for minimum and maximum concentrations of iron in different crude oils from Akwa Ibom State as follows: Asabo blends (21.53 – 61.46mg/kg); Oso blends (9.85 – 21.16mg/kg), Edop blends (32.16 – 60.06mg/kg), QIT blends (39.69 – 74.36mg/kg) and Fun blends (10.06 – 14.66mg/kg). Iron concentrations in studied Uruan blends varied between 21.36mg/kg and 27.88mg/kg. This range is much higher than those reported by Tijjani *et al*. (2012). The high level of iron contents in Uruan crude could be attributed to equipment used, handling procedures etc and may cause corrosion of turbines distillation towers (Oderinde, 1984).

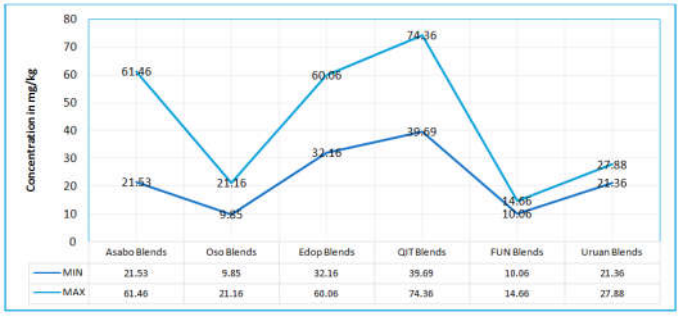


**Figure 11** Graph Minimum and maximum values of iron in different crude oil from Akwa Ibom State.

### *Zn*(*Zinc*)

Results for the distribution of zinc in the different crudes from Akwa Ibom State are shown in figure 12. Results obtained indicate the following ranges: Asabo blends (3.35 – 8.15mg/kg); Oso blends (1.06 – 8.16mg/kg), Edop blends (5.46 – 10.11mg/kg), QIT blends (21.35 – 27.36mg/kg) and Fun blends (6.37 – 10.06mg/kg). Crude oil from studied Uruan area indicated a range for zinc as 7.84 – 14.36mg/kg. Accordingly, apart from QIT blends crude from Uruan recorded higher concentration of zinc than other blends. Nevertheless, the obtained range of zinc is much lower than that reported by Onojake *et al*. (2011) in crude oil.

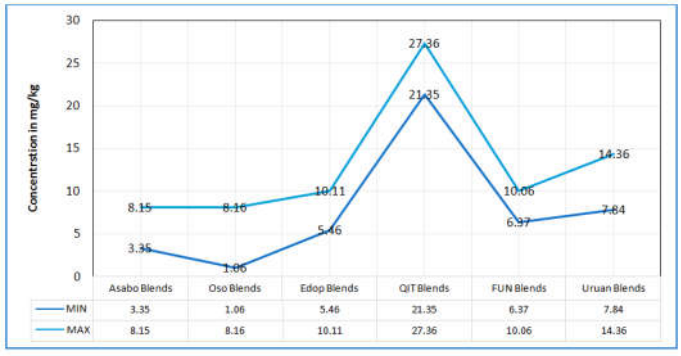


**Figure 12** Graph Minimum and maximum values of zinc in different crude oil from Akwa Ibom State.

### *Pb (lead)*

Lead concentrations in the different crudes from Akwa Ibom State as indicated in figure 13 vary as follows: Asabo blends (0.00 - 0.00mg/kg); Oso blends (0.00 – 0.005mg/kg), Edop blends (0.00 – 0.00mg/kg), QIT blen ds (0.00 – 0.001mg/kg) and Fu n blends (0.00 – 0.00mg/kg). Lead concentrations in crude blends from studied Uruan area were low detectable limit. Thus, Uruan crude could be considered a better blend than Oso and QIT blends as the concentrations of lead is much low. The obtained range of lead in studied Uruan crude is much lower than that reported by Akpan (2005).

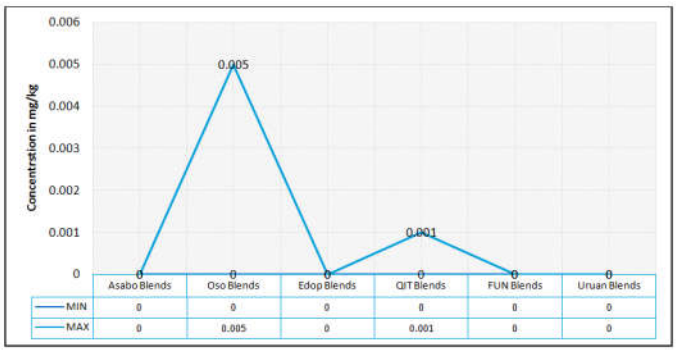


**Figure 13** Graph Minimum and maximum values of lead in different crude oil from Akwa Ibom State.

### *Cd (Cadmium)*

Results in figure 14 indicate ranges for cadmium in crude oil assessed as follows: Asabo blends (0.21 – 1.46mg/kg); Oso blends (0.96 – 1.65mg/kg), Edop blends (0.92 – 0.99mg/kg), QIT blends (0.14 – 4.36mg/kg) and Fun blends (0.65 – 3.16mg/kg). However, crude oil from the study area (Uruan) showed a range of 0.14 – 3.34mg/kg. Hence, Asabo, Oso and FUN blends have lower concentration of cadmium than Uruan crude. However, the range of cadmium in Uruan crude is much higher than that reported in Nigerian crude by Onojake *et al*. (2011).

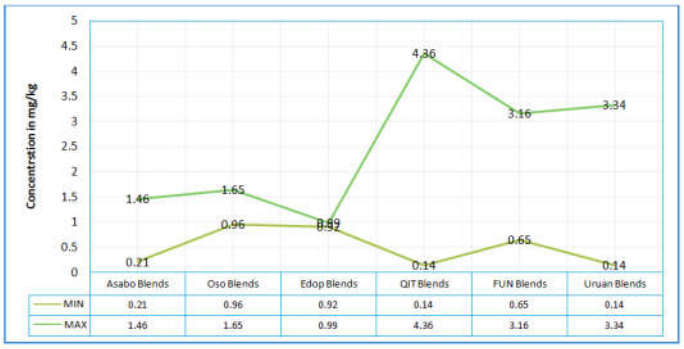


**Figure 14** Graph Minimum and maximum values of cadmium in different crude oil from Akwa Ibom State.

### *V* (*Vanadium*)

Vanadium concentrations in the different crude oil from Akwa Ibom State as indicated by figure 15 range as follows: Asabo blends (0.53 – 0.72mg/kg); Oso blends (0.94 – 1.16mg/kg), Edop blends (0.94 – 1.14mg/kg), QIT blends (0.96 – 1.14mg/kg) and Fun blends (0.98 – 1.02mg/kg). However, concentrations of vanadium in crude oil from the studied Uruan area varied from 0.94mg/kg to 1.21mg/kg. Concentrations of vanadium in crude oil from Uruan were higher than those of other blends within A kwa Ibom State. Consequently, the efficiency of catalysts may be reduced by the high level of vanadium in crude from Uruan during refining processes (Johanna *et al*., 1991). The range of vanadium obtained in crude oil from Uruan is also higher than that reported by Akpan (2005).

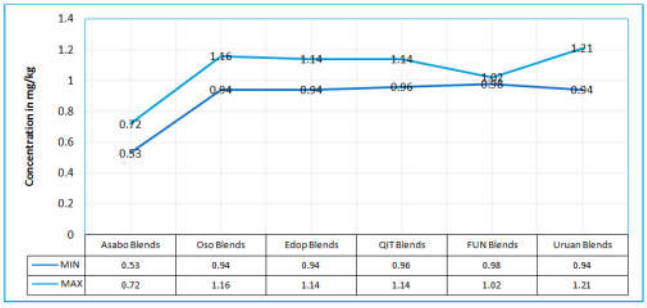


**Figure 15** Graph Minimum and maximum values of vanadium in different crude oil from Akwa Ibom State.

### *Ni (Nickel)*

Ranges obtained for nickel concentrations in the different crude oil blends from Akwa Ibom State are illustrated in figure 16. The obtained results indicate ranges for the different blends as follows: Asabo blends (3.69 – 6.14mg/kg); Oso blends (3.92 – 4.86mg/kg), Edop blends (1.86 – 3.14mg/kg), QIT blends (2.87 – 3.64mg/kg) and Fun blends (2.85 – 4.11mg/kg). A lower range of 2.86 – 3.11mg/kg was recorded for Crude oil from the studied Uruan area. However, the obta ined range of nickel in Uruan crude oil is much lower than that reported in crude by Onojake *et al*. (2011).

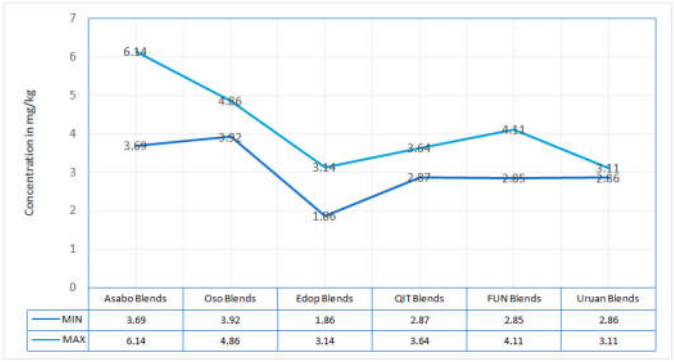


**Figure 16** Graph Minimum and maximum values of nickel in different crude oil from Akwa Ibom State.

### *Cr (Chromium)*

Figure 17 gives the minimum and maximum concentrations of chromium in the different crude oil blends from Akwa Ibom State as follows: Asabo blend s (0.01 – 0.03mg/kg); Oso blends (0.01 – 0.02mg/kg), Edop blends (0.01 – 0.02mg/kg), QIT blends (0.01 – 0.03mg/kg) and Fun blends (0.01 – 0.01mg/kg). Concentrations of chromium in studied Uruan crude were higher with a range of 0.02 - 0.06mg/kg. The range obtained for chromium in crude oil from studied Uruan area is also higher than that recorded by Akpan (2005).

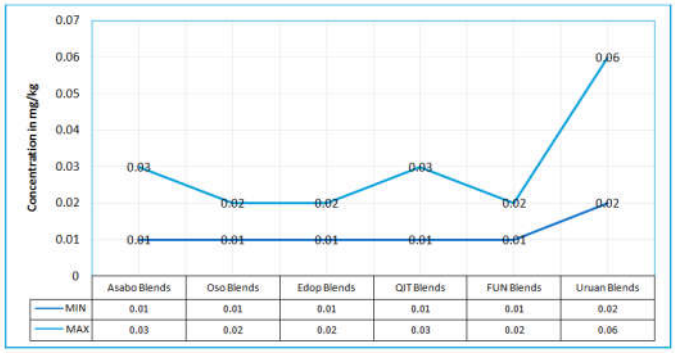


**Figure 17** Graph Minimum and maximum values of chromium in different crude oil from Akwa Ibom State.

### *V/Ni(Vanadium/Nickel) Ratios*

Vanadium/nickel ratio according to Onojake *et al.* (2011) isusedrfor the determination of source and type of rocks deposit and nature of crude oil. Results for the V/Ni ratio in crude oil from different locations within Akwa Ibom State are shown in figure 18 . Results obtained indicate the following ranges for V/Ni ratios: Asabo blends (0.09 – 0.17); Oso blends (0.22 – 0.28), Edop blends (0.30 – 0.59), QIT blends (0.28 – 0.40) and Fun blends (0.25 – 0.35). Vanadium/nickel ratios in crude oil from the study area (Uruan) ranged from 0.31 to 0.41. This range is higher than that reported by Onojake *et al.* (2011) in crude oil. The low V/Ni ratios in samples from other studied area indicates that, crude oil form in the area could be derived from marine organic matter with moderate sulphur content (Barwise, 1990)

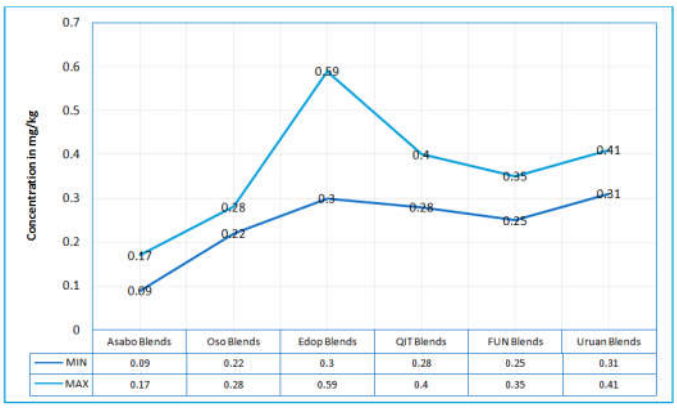


**Figure 18** Graph Minimum and maximum values of V/Ni ratio in different oil from Akwa Ibom

## CONCLUSION

The study provided information on some trace metals of blended crude oil samples in Akwa Ibom State Nigeria. chromium (Cr) and lead(Pb) concentrations were low in the crude oil blends analysed. Also, the sulphur content of the studied crude oil samples was actually low when compared with that of heavy other crude oil in locations. The result also show that Akwa Ibom crude oil blend is naturally sweet. This work therefore demonstrate that Akwa Ibom crude oil blends contain trace metals Fe, Zn, Pb, V, Ni.Cd.Cr. The onshore crude oil blends contain higher proportion of trace metal concentration than the offshore blends except for the lead which was low in all the crude oil blends tested. Therefore, the presence of trace metals in crude oil blends in Akwa Ibom state is linked to the chemical, vegetative and geological formation.

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**How to cite this article:**

Anthony Okon Etim.2018, Physicochemical Properties of Crude Oil Blends In Akwa Ibom State, Nigeria. *Int J Recent Sci Res.* 9(5), pp. 26722-26729. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0905.2111

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