

# Trace Metals in water accompanied Crude Oil In Buzurgan Field, Maysan Province : Iraq

Asaad Kadhim Eqal  
Southern Technical University, Technical Institute-Amara  
Department Of Mechanics-Amara , Iraq

**Abstract**-The present study aimed to analyze the trace metal constituents of water accompanied crude oils in Amara city southern Iraq . two oil fields (south Buzurgan field and north Buzurgan field) were involved for the investigation of metals Ni , Cr, V ,Na ,Ca ,Mg ,K and S in water. Samples analysed using Atomic Absorption spectrophotometer (PgAA500) . The results showed that the concentration of Ni ranged between ( 0.161 to 0.76 1 ) ppm , Cr ( 0.334 to 0.812 ) ppm, V ( 0.034 to 0.095 ) ppm , Na ( 0.251 to 21.43 )ppm, Ca ( 1.323 to 4.324 ) ppm, Mg (0.110 to 2.521 )ppm , K ( 0.354 to 2.507 ) ppm , sulfur ranged (199 to 298.65) ppm , other ratios like TTM , V/Ni and V/V+Ni were considered .The current study concluded that the most abundant trace metals in water accompanied crude oils samples were S, Na , Ca, Mg ,K ,Cr and Ni.

**Keywords:** Trace Metals, Crude Oils, water accompanied, Nickel, Vanadium, Hydrocarbons, sulfur, field, atomic

## 1 INTRODUCTION

Crude oil is a complex matrix composed predominantly of saturated and aromatic hydrocarbons, but also containing heteronuclear compounds, emulsified water and minerals [1,2]. However, the amount of trace metals in crude oil usually varies from a few parts per million to more than 1000 ppm. These metals are sodium, potassium, lithium, calcium, strontium, copper, silver, vanadium, manganese, tin, lead, cobalt, titanium, gold, chromium and nickel. Usually these metals are found in combination with naphthenic acid as soaps and in the form of complex organometallic compounds such as metalloporphyrins [3]. The deposits of metal found in crude oil depending on the large extent of the geological location of oil formation as well as the source rock and reservoir rock [4]. In sulphate rich waters, metals are associated with H<sub>2</sub>S production through bacterial and thermal reduction of sulfates, which can alter their distributions in crude oils [5,6]. Concentration and ratios of trace metals in crude oils can be used to classify oils into families. Oil of low V/Ni ratios (< 0.5) are expected for petroleum or crude oil derived from marine organic matter, with high to moderate sulfur content. Crude oil or petroleum from lacustrine and terrestrial organic matter has V/Ni ratios (1-10). The concentration of metals in crude oil varying from one paper to another , according to the place of study .In this context Mohammad F. All 1983 found that the most abundant trace metal in Saudi Arabia , were vanadium and nickel [7]. In addition several studies investigated the present of metals in crude oil and result were different [8,9,10,11,12]. On the other hand no study was found to estimate metal constituent in water accompanied to crude oil .So The aim of this study is to investigate the trace metals in water accompanied crude oils in Amara city Maysan province.

## 2 Materials and Methods

### 2.1 Water separation from crude oil

Water is normally present in crude oil reservoirs. Minimizing the water level in the oils can be reducing pipeline corrosion and minimizing pipeline usage [13,14]. Water or brine typically accompanies crude oil during its recovery from a reservoir. In general the trace metals are present in the crude oils as inorganic salts (mainly as chloride and sulphate of K, Mg, Na and Ca), associated with water phase of crude oil

emulsions [15].

### 2.2. Sample collection and analyses

Six water samples were collected from central processing facility (CPF) Buzurgan that supplied with crude oil from two position south Buzurgan field and north Buzurgan field in clean sample bottles. The water samples were obtained from three different crude oil wells (Bu-6, Bu-3 , Bu-16) respectively in south Buzurgan field and three different crude oil wells (Bu-1, Bu-2, Bu-15 ) in north Buzurgan field .The samples were analyzed for trace metal using Atomic Absorption Spectrometer (PgAA500) in Basra University Marine Science Centre.

### 2.3. Statistical Analysis

The data analyzed for percent ,range ,means and standard deviation tests .

## 3 Results and Discussion

Table 1 shows the percent content of water ,salt and sediment in crude oil samples collected from different wells in two positions , south and north Buzurgan field .The well Bu-1 having the highest percent of water while the Bu-3 well having the lowest percent , this may resulted from source rocks types, depositional environment and maturation of crude oils.

Table 2 shows the concentration of seven of the trace metals associated with water accompanied crude oils from south and north Buzurgan field which was measured by using Atomic Absorption Spectrometer (PgAA500). Mean Na concentration in water samples the well Bu-12 in north Buzurgan field having the highest Na concentration (21.43) ppm while the well Bu-1 in north Buzurgan field having the lowest Na concentration (0.251) ppm .These values are lower than the values of (20.98 to 35.6) ppm which was found by Jargalsaikhan Sainbaya [9]. Considering the Ca concentration, well Bu-16 in south Buzurgan field found to have highest concentration (4.324) ppm while the Bu-1 in north Buzurgan field had the lowest concentration (1.323) ppm. These values are higher than the values of (1.78 to 2.63) ppm which was presented by Jargalsaikhan Sainbaya [9]. The Mg concentration in water samples ranged between (2.521) ppm Bu-6 (south) and (0.110) ppm in Bu-9 (north) . These values are higher than the values of (0.19 to 1.11) ppm which was reported by Jargalsaikhan Sainbaya [9]. In addition, the highest K concentration was found (2.507) ppm in Bu-6 (south) while the lowest concentration (0.354) ppm found in Bu-1 (north).

• Asaad Kadhim.Eqal . Southern Technical University, Technical Institute- Amara , Iraq. E-mail: [asaadka77@gmail.com](mailto:asaadka77@gmail.com), mobile 009647705523762

TABLE 1  
SHOW THE WATER, SALT AND SEDIMENT IN CRUDE OIL IN MAYSAN PROVINCE

No.of position	Name of Wells	API Gravity	Salt content Mg/l	Water content %	Sediment content %
Position 1	Bu-3	22.1	510	2	0.2
	Bu-6	21.7	105	3.2	0.5
	Bu-16	24.2	11	2.2	0.3
Position 2	Bu-1	22.8	202	5.1	0.8
	Bu-9	19.9	226	3.4	4.6
	Bu-12	22.4	412	3.4	2.2

These values are higher than the values of (0.05 to 1.60) ppm which was found which was showed by Mohammad F [7]. Furthermore the concentrations of Cr, Ni and V have a different range of (0.821) ppm in Bu-16 south and (0.339) ppm

in Bu-3 south for chrome, (0.721) ppm north and (0.161) ppm south for Ni and for V the concentration was found to be high in Bu-12 north (0.095) ppm and low in Bu-1 north (0.034) ppm. Separated detail is presented in table 3 and 4.

TABLE 2  
CONCENTRATION OF THE TRACE METALS ASSOCIATED WITH WATER (PPM) IN SOUTH AND NORTH BUZURGAN FIELD.

Trace Metals	Concentration (ppm)							
	South Buzurgan Field				North Buzurgan Field			
	Bu-3	Bu-6	Bu-16	TTM	Bu-1	Bu-9	Bu-12	TTM
Na	15.34	7.432	1.994	24.766	0.251	13.42	21.43	35.101
Ca	2.440	3.540	4.324	10.304	1.323	2.654	1.415	5.392
Mg	1.435	2.521	0.415	4.371	0.204	0.110	2.465	2.779
K	1.656	2.507	1.879	6.042	0.354	1.121	1.627	3.102
Cr	0.339	0.478	0.812	1.629	0.423	0.761	0.523	1.707
Ni	0.643	0.216	0.161	1.02	0.334	0.721	0.567	1.622
V	0.064	0.041	0.053	0.158	0.034	0.056	0.095	0.185

TABLE 3  
CONCENTRATION OF THE TRACE METALS ASSOCIATED WITH WATER IN SOUTH BUZURGAN FIELD.

Trace metals	Concentration (ppm)		
	Bu-3	Bu-6	Bu-16
Na	15.34	7.432	1.994
Ca	2.440	3.540	4.324
Mg	1.435	2.521	0.415
K	1.656	2.507	1.879
Cr	0.339	0.478	0.812
Ni	0.643	0.216	0.161
V	0.064	0.041	0.053

TABLE 4  
CONCENTRATION OF THE TRACE METALS ASSOCIATED WITH WATER IN NORTH BUZURGAN FIELD.

Trace metals	Concentration (ppm)		
	Bu-1	Bu-9	Bu-12
Na	0.251	13.42	21.43
Ca	1.323	2.654	1.415
Mg	0.204	0.110	2.465
K	0.354	1.121	1.627
Ni	0.423	0.761	0.523
Cr	0.334	0.721	0.567
V	0.034	0.056	0.095

Table 5 reports the trace metal in all wells in order to obtain the relationship of the concentration of trace metal in different well and type of trace metals that shown in figure 1 were the Na (21.43) ppm the highest concentration and V (0.034) the lowest concentration . Also from table 5 the total trace metals TTM and other ratios are used in the determination of source rocks types, depositional environment and maturation of

crude oils compare to the concentration of trace metals . The calculated V/Ni ratios are lower in water samples which ranged from ( 0.08- 0.188) .These values lower than (0.5) , there for the crude oil derived from marine organic matter, with high to moderate sulfur content [6].The ratio of V/V+Ni for the water samples ranges from (0.068 - 0.245) . This is in good agreement with those obtained by Onojake Mudiaga C [10].

TABLE 5

CONCENTRATION OF THE TRACE METALS ASSOCIATED WITH WATER, TOTAL TRACE METALS (TTM), V/Ni AND V/V+Ni RATIOS

Trace metals	Concentration (ppm)					
	South Buzurgan field			North Buzurgan field		
	Bu-3	Bu-6	Bu-16	Bu-1	Bu-9	Bu-12
Na	15.34	7.432	1.994	0.251	13.42	21.43
Ca	2.440	3.540	4.324	1.323	2.654	1.415
Mg	1.435	2.521	0.415	0.204	0.110	2.465
K	1.656	2.507	1.879	0.354	1.121	1.627
Cr	0.339	0.478	0.812	0.423	0.761	0.523
Ni	0.643	0.216	0.161	0.334	0.721	0.567
V	0.064	0.041	0.053	0.034	0.056	0.095
TTM	21.917	16.735	9.638	2.923	18.843	28.122
V/Ni	0.0995	0.1889	0.329	0.080	0.0735	0.181
V/V+Ni	0.0905	0.159	0.247	0.074	0.068	0.153

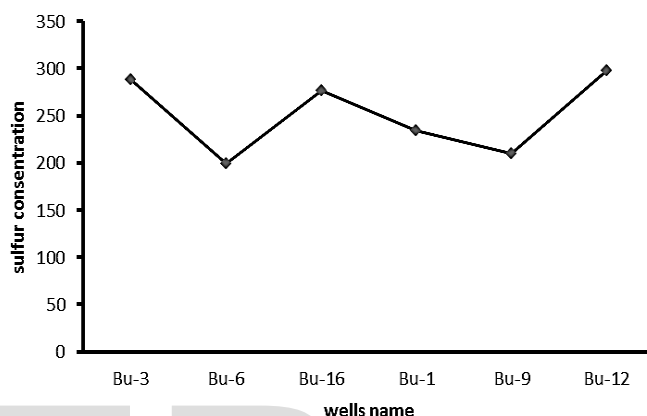
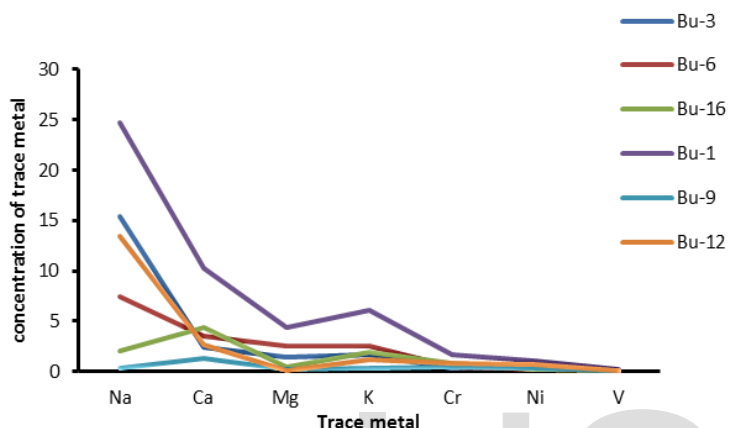


Fig.1 shows the relationship between the concentration of trace metal and trace metal in different wells.

Fig. 2 shows the concentration of sulfur in different wells in both fields.

Concentration of sulfur associated with water samples in different wells were the well Bu-12 have the highest sulfur concentration (298 ) ppm while well Bu-6 have the lowest concentration (199) ppm (figure 2).The current study found

that there is different ratios in concentration of trace metals according to the concentration of sulfur as shown in table 6 .However the correlations of sulfur with the studies trace metals have been considered .

TABLE 6 shows the relationship between the trace metal and concentration of sulfur

Trace metals	Concentration (%)					
	South Buzurgan field			North Buzurgan field		
	Bu-3	Bu-6	Bu-16	Bu-1	Bu-9	Bu-12
Na	5.33%	3.73%	0.72%	0.11%	6.39%	7.19%
Ca	0.85%	1.78%	1.56%	0.57%	1.26%	0.47%
Mg	0.50%	1.27%	0.15%	0.09%	0.05%	0.83%
K	0.58%	1.26%	0.68%	0.15%	0.53%	0.55%
Cr	0.12%	0.24%	0.29%	0.18%	0.36%	0.18%
Ni	0.22%	0.11%	0.06%	0.14%	0.34%	0.19%
V	0.02%	0.02%	0.02%	0.01%	0.03%	0.03%

4 CONCLUSION

The current study concluded that there are trace metals in water associated with crude oil Buzurgan field in southern Iraq. The most abundant trace metal involved in this study is Na followed by Ca ,Mg , K ,Ni ,Cr , V and S. These trace metals may be resulted from the deposits found in crude oil depending on the large extent of the geological location of oil

formation as well as the source rock and reservoir rock might differ according to the place of study.On the other hand the ratios TTM , V/Ni and V/V+Ni suggest that the crude oil derived from marine organic matter, with high to moderate sulfur content. The trace metal concentration increase with increase the sulfur content.

References

[1] Afshin Pak, Toraj Mohammadi . Wastewater treatment of desalting units , Desalination 222 (2008) 249-254.  
 [2] H. Ahmad1A. I. Tsafe, A. A. Zuru, R. A. Shehu, F. A. Atiku and A. U. Itodo Physicochemical And Heavy Metals Values Of Nigerian Crude Oil Samples , International Journal of Natural and Applied Sciences, 2010, 6(1): 10-15.  
 [3] Mohammad Farhat Ali , Saeed Abbas A review of methods for the demetallization of residual fuel oils Fuel Processing Technology 87SER © 2015 (2006) 573-584. http://www.ijser.org  
 [4] Madu A. N, Njokup. C, Iwuoha G. A. Extent Of Heavy Metals In Oil Samples In Escravous, Abteye And Malu Plat form In Delta State Nigeria. Learning Publics Journal of Agriculture and Environmental Studies Vol 2 (2).41- 44 (2011).  
 [5] Machel, H. G. Bacterial and the Thiochemical sulfate Reduction indigenetic settings old and new insights. Sediment. Geol., 140. (2001) 143-175.  
 [6] Barwise, A. J. G.. Role of nickel and vanadium in petroleum classification. Energy and Fuels, (1990) 4, 647-652. Mohammad F. All, Ahmed Bukharl, and Mohammad Saleem, Trace

Metals in Crude Oils from Saudi Arabia, *Ind. Eng. Chem. Prod. Res. Dev.* 1983, 22, 691-694.

- [8] P.K Tamrakar and K.S Pitre, *Analysis Of Crude Oil For Its Trace Metal Content Indian Journal of chemistry* , 2000 , pp .779-789.
- [9] Jargalsaikhan Sainbaya, Dalantai Monkhoobor, Budeebazar Avid , *Determination of Trace Elements in the Tamsagbulag and Tagaan Els Crude Oils and Their Distillation Fractions Using by ICP-OES Advances in Chemical Engineering and Science*, 2012, 2, 113-117.
- [10] Onojake Mudiaga C. (Corresponding author), *Trace Metals Geochemistry of Crude Oils from Umutu/Bomu Fields in South West Niger Delta Nigeria* , *Energy and Environment Research* Vol. 1, No. 1; December 2011.
- [11] M.Y. Khuhawar, M. Aslam Mirza and T.M. Jahangir, *Determination of Metal Ions in Crude Oils , Crude Oil Emulsions* 2012 ISBN 978-953-51-0220-5.
- [12] I. Muhammad P.O. Ikeh B.B. Usman B.G. Dan Shehu K. Salawu D. A. Mikailu, *Determination of Vanadium, Nickel, Copper and Iron as Complexes of Bis-Acetylpyvalyl Methane (Ethylene Diamine) in Nigerian onshore and offshore Crude Oils Using HPLC* ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online) 2013 Vol.3, No.8.
- [13] Abdurahman H. N., and M. Nuraini. *Chemical Destabilization on Water in Crude Oil Emulsions* , *World Academy of Science, Engineering and Technology* , 2010. Vol:4 0000-00-00.
- [14] Andrew P. Sullivan and Peter K. Kilpatrick. *The Effects of Inorganic Solid Particles on Water and Crude Oil Emulsion Stability* *Ind. Eng. Chem. Res.* 2002, 41, 3389-3404.
- [15] Speight, J.G., *Handbook of Petroleum Analysis*, John Wiley and Sons Inc. (2001), New Jersey, 519.

IJSER