Levels of Mercury in oil companies and relation of them with the other elements for avoid side effect on the extraction and refining operation and environment

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Abstract:

For the first time in Iraq, the estimation of the mercury amount in all the establishments of oil mininstry, is stuided in this wrok.

It was found that the presence of mercury in the crude oil, theassociated gas, and the associated water as well as in most flare gases. Also, it was observed that the concentration of mercury on the surface of the soil near the flame is increased its concentration in winds of the flame, where most of the days of the year the wind is coming from the north West towards the south-east.

The test of mercury has become a global provision to determine its quantity in crude oil and natural gas, which is required the effective ways, led by the Technical Department of the Ministry of Oil to request the petroleum research and development center to determine the amount of mercury in a number of oil companies.

This work is proposed by the analytical department of the petroleum research and development center where the cold testing device was imported for the determination of the tiny amount of mercury in gases, liquids and soil and the detection limit in Nano grams. It is the first device operating in the oil sector using for the determination of mercury amount.

However, the search results and quantification of mercury, important relationships were identified in terms of the presence of mercury and other crude oil components or tests on

crude oil. It was found that there is a correlation between the concentration of mercury and the sulfur content in oil.

Mercury is a volatile substance either vapor, dust, or sulfuric. Therefore, the oil gas contains a percentage of mercury, over time, formed by the burning of the gas and the pollution of air and the soil surrounding the flame, which constitutes an environmental hazard that must be avoided in the future. In addition, the accompanying water has a significant content of mercury.

الخلاصة:

لاول مرة يجرى في العراق و عموم المنشآت النفطية بحث لتقدير كمية الزئبق شمل شركات النفط و الغاز في المنطقتين الوسطى و الجنوبية و الشركات التي شملها البحث هي شركة نفط الوسط، شركة مصافي الوسط، شركة تعبئة الغاز، شركة نفط ميسان، شركة نفط الجنوب، شركة مصافي الجنوب، شركة غاز الجنوب، شركة غاز البصرة... و اتضح من البحث وجود الزئبق في النفط الخام و الغاز المصاحب و الماء المصاحب و كذلك في معظم غازات الشعلة flare gas و لاحظنا تركيز الزئبق فوق سطح التربة القريبة من الشعلة و زيادة تركيزه في منطقة هبوب الرياح للشعلة حيث ان معظم ايام السنة تكون الرياح قادمة من الشمال الغربي باتجاه الجنوب الشرقي.

و قد اصبح فحص الزئبق فحص ملزم عالميا لتحديد كميته في النفط الخام و الغاز الطبيعي و يستوجب ايجاد طرق فعالة لازالته مما حدى بالدائرة الفنية لوزارة النفط بالطلب من مركز البحث والتطوير النفطي لتحديد كمية الزئبق في عدد من المواقع النفطية و لذلك تم زيارة تلك المواقع برفقة عدد من منتسبي الدائرة الفنية علما ان البحث مقترح من قبل قسم التحليلية التابع لمركز البحث و التطوير النفطي حيث تم استيراد جهاز فحص الزئبق بالطريقة الباردة، في الغازات و السوائل و المواد الصلبة بالنانوغرام و هو اول جهاز يعمل في القطاع النفطي و يستخدم لاجراء فحوصات تقدير الزئبق لهذا البحث الموسع و من خلال نتائج البحث و تحديد كمية الزئبق تم ربط علاقات مهمة من حيث وجود الزئبق و بقية مكونات النفط الخام او الفحوصات التي تجرى على النفط الخام و تبين وجود علاقة ربط بين تركيز الزئبق و نسبة الكبريت في النفط و هي علاقة طردية حيث يزداد محتوى الزئبق تبعا لتركيز الكبريت في النفط الخام. كذلك و كون الزئبق مادة سهلة التطاير اما بشكل بخار او بشكل غبار او بشكل مركب كبريتي لذلك كان نصيب الغاز النفطي ان يحتوي على نسبة من الزئبق تشكل بمرور الوقت و نتيجة لحرق الغاز تلوث التربة و الهواء المحيط بالشعلة مما يشكل خطرا بيئيا يجب تلافيه مستقبلا ... بالاضافة الى ذلك فان الماء المصاحب ذو محتوى لا يستهان به من الزئبق ..

عليه يعتبر الزئبق من المواد الخطرة لما له من تاثيرات سمية وضارة على الاشخاص والمعدات, أي إن الوجود البسيط للزئبق يمكن أن يسبب مخاطر بيئية وصحية.

1. Introduction:

There are a number of processes taking place in oil and gas sector such as exploration, extraction of oil and gas, and refining of crude oil.

Oil and gas are extracted from many locations in the world both land and sea. In addition to the exploration, extraction and refining of oil and gas, some analytical studies also consider that the combustion of oil and gas and their consumption in finished products contributes to the release of a wide range of gases, including mercury, and releases it into the air, land and water. Mercury can be produced as a by-product and a solution containing mercury, Mercury is considered a hazardous substance due to its toxic and harmful effects on people and equipment. A few amount of mercury presence can cause environmental and health risks.

Mercury can pose a serious hazard when mixed with minerals, especially aluminum. This can lead to a phenomenon known as liquid metal cracking (LME), which leads to many serious failures in large installations.

Mercury can cause damage to the welds and this leads to the closure of the facility, with serious economic effects. In the worst case, the damage may be completely out of control or the facility will cease to operate permanently in pipelines, cooled components, heat exchangers and hydrogenation catalysts. Therefore, Mercury in natural gas should be 10 micrograms per cubic meter, or less, before processing to prevent damage to heat exchangers and other equipment. This mercury may become a by-product.

In addition, the tendency of mercury is accumulated in the body and targeted fat tissue or organs, high in fat as blood due to its tendency to dissolve in fat, which leads to the occurrence of symptoms of serious diseases in the nervous system known as crying mercury developed if the dose is high and may lead to the lives of infected person [1].

2. Theory:

Mercury is a chemical element with the Hg symbol and atomic number 80 in the periodic table, a silvery liquid and the density (13.54 g / cm^3), free of lead-like silver in its appearance at -38.9 ° C, boiling at 356.9 ° C, Mercury is one of the most important of these heavy metals. It is a non-common element in nature. The pre-final sequence comes with 16 elements in the list of elements. It is one of the strangest in its properties. It is the only mineral element with liquid strength at its normal temperature and its abilities for evaporation. It is an attractive, silvery color silver known to man for thousands of years. This element is mentioned in Aristotle's writings asa liquid silver.

Mercury properties:

Mercury is a good solvent of some minerals such as gold, silver, platinum, copper, sodium and potassium.

- **Physical properties:**

The element of mercury is characterized by a bright silver color due to its low melting point and high vapor pressure, and weak the inter-bonding forces. Mercury is low viscosity, while it has high electrical resistance. Mercury dissolves in water and in several other solvent such as benzene, hexane, methanol and Rexan. If the mercury liquid is placed on any surface, it may not be wetted because of its high surface tension value as six times of the water surface tension value.

- **Chemical properties:**

There are a number of chemical properties for Mercury shown below:

1- Interacts with all halogens such as chlorine at room temperature.
2- does not interact significantly with oxygen and dry air at room temperature, but this reaction can be activated using ultraviolet light
3- Reacts strongly with ozone gas and gives the mercury oxide compound.
4- Reacts directly to heating with sulfur, selenium and telorium while it does not react with other elements such as nitrogen, phosphorus, carbon, silicon, germanium.
5- Do not react with dry hydrides such as hydrogen sulphide ammonia below 200 c°.
6- Does not react with hydrochloric acid or diluted sulfuric acid while if the concentration of acid, it may react with the salts of mercury.
7- Reacts with nitric acid, and does not react significantly with phosphoric acid.
8- Reacts strongly with ammonia solutions in the air.

9- Mercury salts have been used as catalysts. For example, mercury sulfate is used as a catalyst in the process of oxidation of naphthalene to sulfate and in accelerating the conversion of acetylene to acetaldehyde [2].

Mercury levels in the environment:

Mercury is known to be an environmental pollutant because of its abundant use. The world's oceans contain an estimated total of 50 million tons of this element. Its soil concentrations are between 0.01-0.06 ppm, rising up to 0.09 ppm, its concentration in the air of the world is between 2-5 ng / m^3, and the dose of 100 mg/person/day can cause symptoms.

Mercury is dispersed in soil and rocks in varying amounts throughout the earth's crust and may also be found in enclosed layers, some of which contains oil and gas reservoirs, where they can be retained and increased. Mercury in crude oil is believed to be a mixture of volatile primary mercury, decomposed in oil and its liquefaction.

Non-volatile species may include suspended particles of mercury sulfide, where HgS, the most common form of mercury, the most stable and high temperature degradation to release the mercury element. This is a challenge for oil transport and sampling. Because of volatile mercury damages pipes and reservoirs, its presence in oil may require preventive measures when handled, stored and handled. Sulfur exposure in the supply chain and the refining process would be critical in the way that volatile mercury behaves [3].

Mercury hazards and environmental damage:

Mercury vapor can be found at the room temperature, especially indoor, poses a health hazard to individuals in laboratories, dental clinics and workplaces where mercury is transported like metal. The inhalation causes poisoning of this mineral poison and its symptoms appear after absorbing it a great deal from this way. The salts of mercury are quickly absorbed from the intestines as well as their irritating effect on the mucous membranes of the stomach and intestines. Fish and marine organisms have a special ability to concentrate mercury salts in their bodies from water contaminated with these salts. Their consumption as food is a source of chronic mercury poisoning, which is called by Minamata in Japan [4].

The Iraqi environmental limited determinants of soil mercury concentration (0.3 ppm) and water (0.05 µg/L) and air (50 ng/m^3).

The toxic effect of mercury is explained by one of the following theories:

1- The tendency of mercury to react with the sulfur groups Sulfhydryl syllables Groups, leading to the disruption of the effectiveness of these enzymes.
2- The binding of mercury to Phosphate Ligands, which leads to the disruption of permeability of living cell membranes.
3- Mercury disable the ability of the thyroid gland to take and absorb the necessary iodine for the body.
4- Mercury prevents our bodies from preparing to represent the zinc element necessary to sustain enzyme activity.
5- Mercury reduces the capacity of anti-toxin liver systems, which increases the harmful effects of these toxins [5].

The advantages of mercury detection and measurement:

Monitoring and limiting mercury can be done by:

- Improved operating time for operations.
- Maintain property integrity and product quality.
- Increase the volume of recovery.
- Reduce mercury emissions in the environment.
- Reducing occupational health hazards (6).

3. Experimental part:

3.1 Materials:

1- Standard mercury solution (1000 ppm) BDH Company.
2- Potassium dichromate ($K_2Cr_2O_7$) THOMAS BAKER.
3- Hydroxylamine hydrochloride ($NH_2OH.HCl$) THOMAS BAKER.
4- Sodium hydroxide (NaOH) Company APPLICHEM GMBH.
5- Tin Chloride ($SnCl_2.2H_2O$) THOMAS BAKER.
6- Potassium bromide (KBr) THOMAS BAKER.

7- Potassium bromate ($KBrO_3$) THOMAS BAKER.

8- Sulfuric acid (H_2SO_4), and) M.Wt 98.07, SP.GR 1.84, ASSAY 98%) HIMEDIA.

9- Nitric acid (HNO_3)(M.Wt 63.01, SP.GR 1.41, ASSAY 68%) HIMEDIA.

10- Hydrochloric acid HCl (M.Wt 36.46, SP.GR 1.14, ASSAY 35%) BDH.

3.2 Equipment:

Mercury testing device: The mercury analyzer available in the laboratory is a Zeeman mercury spectrometer (RA-915+), which is used to examine mercury in liquid, solid and gaseous forms by connecting the attached parts as shown in Figure (1).

It is a portable device, highly sensitive and selective in performance to eliminate interference with impurities and multi-functional as it works to detect mercury vapor in the air, water, natural gases, oil derivatives and solids.

Fig. (1) Mercury analyzer device.

The principle of the device:

The device depends on the cold vapor technique by convert the mercury in its compounds to mercury in the atomic case in gas form without using of flame by reducing the agent such as the following equation:

$$HgCl_2 + SnCl2 \longrightarrow \underset{gas}{Hg^0} \uparrow + SnCl_4$$

3.3 Procedures:

Solutions for the determination of mercury

Several solutions are prepared to estimate the amount of mercury in aqueous solutions:

1- Standard mercury solutions: A series of standard solutions of a 1000 ppm mercury solution is prepared with a range of concentrations (0.05, 0.1, 0.2, 0.3 μg/L).

2- Cleaning solution: 10 g of potassium dichromate is dissolved in 100 ml of concentrated sulfuric acid. This solution is used to clean the glass and tools used in the measurement process and to be stored in a darkened container and remains valid for three months.

3- Potassium dicromate solution 4%: 4 g of potassium dichromate is dissolved in 100 ml distilled water. This solution is then used in the preparation of the dilution solution and is kept in a darkened container and remains valid for three months.

4- Dilution solution: 500-600 ml of distilled water is placed in a pyrex Baker and add 50 ml of concentrated nitric acid and stir and leave to cool, then transfer to a single liter container and add (5 ml) of 4% potassium dicromate solution. Previously the volume complements to one liter. Saves in a dark pot and stays fit for three months.

5- Hydroxylamine hydrochloride solution 100 g/L)): dissolve 2.5 g of hydroxylamine hydrochloride in 25 ml container and complete the size to the mark. This solution is later used to digest the models.

6- Sodium hydroxide solution (30%): 30 g of solid sodium hydroxide is dissolved in 100 ml of distilled water. This solution is used to capture acid fumes during the measurement process.

7- Hydrochloric acid (4 mol/L): Add 167 ml of concentrated hydrochloric acid to 250 ml of distilled water in a 500 ml flask and complete the volume to the mark. This solution is used to digest the samples later.

8- Reduce solution ($SnCl_2.2H_2O$ 2%): Put 40 ml of distilled water in a 200 ml baker and add 20 ml of concentrated hydrochloric acid. Add 4 g of tin chloride and heat until dissolved and then transferred to a flask the volumetric capacity (200 ml) complements the size to the mark and is later used to reduce the sample. The solution remains stable for a week.

9- Potassium bromate solution ($KBrO_3$ 0.033 mol/L): Dissolve 0.556 g of potassium bromate in 100 ml of distilled water. It is later used to digest the samples. The solution remains stable for a week.

10- Potassium bromide solution (KBr 0.2 mol/L): 2.38 g of potassium bromide is dissolved in 100 ml of distilled water. It is later used to digest the sample. The solution remains stable for a week.

11- Bromate-Potassium Bromide Solution Solution: A solution (KBro3 0.033 mol/L) is mixed with a solution (KBr 0.2 mol / L) by 1:1 and is used to digest the samples.

Determination of mercury in liquid substances:

Before Determination the mercury in liquid, the sample must be digested. We take 40 mL of the sample and put it in a 50 mL volume flask, add 7.5 mL hydrochloric acid and 1 ml of potassium bromate bromide and complete the volume to the mark.

We plot a calibration curve by taking different concentrations (0.0, 50, 100, 200 ng/L) of a standard solution for mercury (1000 ppm) After connecting the device and the sub device using for liquid material and using the tin chloride solution as a reducing agent ($SnCl_2.2H_2O$ 2%) to obtain the results shown in Table (1) and the calibration curve shown in Figure (2).

Table (1) Liquid substances concentration for calibration curves.

NO.	Mercury mass/ ng	s-blank	Ref.date ng/L
1	0.0	0.0	0.0
2	5.00	8424	200
3	3.75	6050	100
4	2.50	3949	50

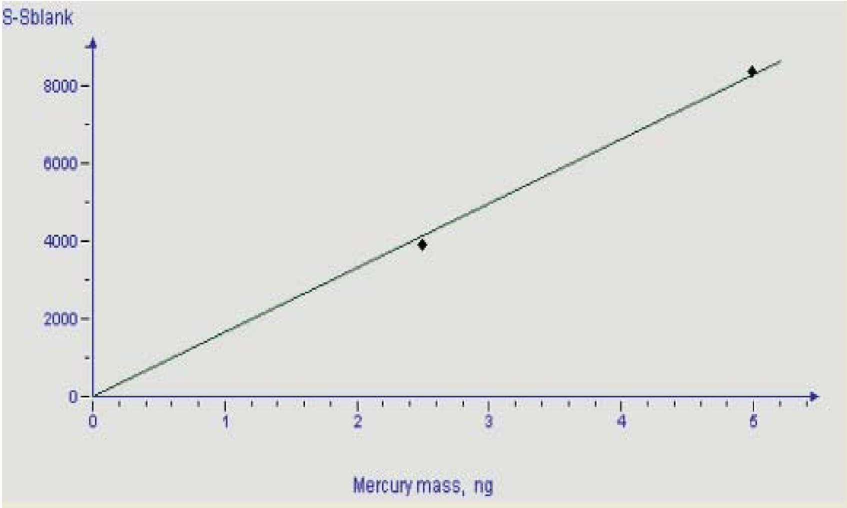

Fig. (2) Calibration curve for liquid substances.

Determination of mercury in solids and hydrocarbons:

The calibration curve using different weight (0.0, 5,10,50,100 mg) from standard solid material containing (420 ng) is plotted after the atomization process of the material within the Hg by exposing the samples to a temperature of 750-900 °C, we obtain the following results shown in Table (2) and the calibration curve shown in Figure (3). This method is also used to estimate the mercury content in the hydrocarbons material after supported on activated charcoal.

Table (2) The weights of standard solid material using to apply the calibration curve.

NO.	Mercury mass/ ng	s-blank	Ref.date ng/g	Calculated
1	0.0	0.0	0.0	0.0
2	21.00	13050	420.0	418.9
3	4.62	3021	420.0	440.7
4	2.10	1328	420.0	426.3

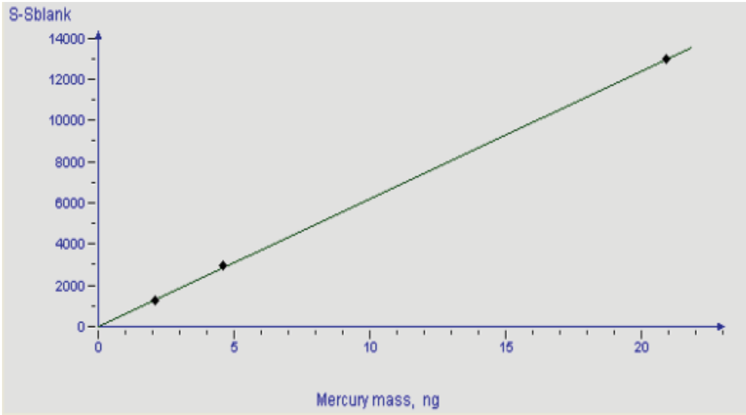

Fig. (3) The calibration curve for solid and hydrocarbon materials.

The concentration of mercury in the air and gases is estimated directly because the calibration curve is stored in the device. The main device connects to the instrument for the determination of mercury in the air and gas, which contains a set of filters for air or gas purification and passes through the filter carrying the reduced agent and the same principle operation of the device (mercury atomization process) after that Mercury is estimated in gases.

4. Results:

The research team apply visits to various sites in companies and fields of the Iraqi oil sector and conduct field tasting and bring samples of soils, sludge and water for laboratory testing and estimate the percentage of mercury in them as well as other tests such as nickel, Vanadium, sulfur estimate and density as shown in Tables 3, 4, 5, 6, 7, 8 and 9).

A- Midland oil Company (Al-Ahdab oil field)

Table (3) The results of tests for Ahdab oil field samples.

Type of sample	Conc. of mercury	Sulphur content %	V (ppm)	Ni (ppm)	API	Density (g/cm^3)	Sp.gr
Crude oil	2.8 ng/g	2.789	63.14	12.31	27.34	0.88988	0.8908
Water companion	11.8 ng/l						
soil	6.1 ng/g						
Dry gas	3.2 ng/m^3						

B - Midland Refineries Company (Al Doura Refinery)

Table (4) The results of tests for Al Doura Refinery samples

Type of sample	Conc. of mercury	Sulphur content %	V (ppm)	Ni (ppm)	API	Density (g/cm^3)	Sp.gr
Crude oil (kana oil)	7.7 ng/g	2.305	62.56	26.84	30.99	0.8702	0.8709
Crude oil (Strategic Line)	8.1 ng/g	2.340	68.08	38.5	30.09	0.8749	0.8756
Soil from the flare right side	42.3 ng/g						
Soil from the flare left side	18.3 ng/g						
Burner Gas	11.3 ng/m^3						
Water before treatment	0.03 ng/l						
Water after treatment	Nil						

C - South Oil Company:

Table (5) The results of tests for South Oil Company samples

Type of sample	Conc. of mercury	Sulphur content%	V (ppm)	Ni (ppm)	API	Density (g/cm^3)	Sp.gr
Crude oil (toba oil field)	6.1 ng/g	2.289	67.36	11.95	26.31	0.8954	0.8966
Gas in Khor al-Zubayr oil feild (feeder gas)	3.3 ng/m^3						
Gas in Khor al-Zubayr oil feild (dry gas)	2.8 ng/m^3						
Gas in the north Rumaila oil field (feeder gas)	4.8 ng/m^3						
Gas in the north Rumaila oil field (dry gas)	4.53 ng/m^3						
Soil from Khor al-Zubayr oil field around working flare	3.3 ng/g						
Soil from Khor al-Zubayr oil field around stopped flare	1 ng/g						
Soil in the north Rumaila oil field around working flare	4.0 ng/g						
Soil in the north Rumaila oil field around stopped flare	0.9 ng/g						

D- Midland oil company (east Baghdad oil field):

Table (6) The results of tests for east Baghdad oil field samples.

Type of sample	Concentration of mercury	Sulphur content%	V (ppm)	Ni (ppm)	API	Density (g/cm^3)	Sp.gr
Crude oil (east Baghdad)	25.7 ng/g	3.33	112.5	65.044	23.50	0.9117	0.9129
Soil from the flare north side	29.6 ng/g						
Soil from the flare south side	36.2 ng/g						
Burner Gas	9.125 ng/m^3						
Industrial water	21.5 ng/l						
Maxing water from west water and Industrial water before treatment	7.8 ng/L						
Water from RO unite	Nil						

E- Gas filling company:

Table (7) The results of tests for Gas filling company samples

Type of sample	Concentration of mercury
Soil from the flare north east side	21.5 ng/g
Soil from the flare south west side	30 ng/g
Dry gas	11 ng/m^3

F- Missan Oil Company:

Table (8) The results of tests for Missan Oil Company crude oil samples

Type of sample	Conc. of mercury	Sulphur content%	V (ppm)	Ni (ppm)	API	Sp.gr	Density (g/cm^3)
Abu Gharb 1 station (crude oil before separating)	4.7	2.281	69.13	26.36	20.8651	1.0767	1.0767
Abu Gharb 1 station (crude oil after separating)	NIL	2.233	65.36	24.11	20.45	0.9312	0.9304
Abu Gharb 2 station (crude oil before separating)	13.1	2.552	65.47	24.24	21.85	0.9227	0.9219
Abu Gharb 2 station (crude oil after separating)	NIL	2.510	57.98	21.30	20.8635	0.9287	0.92777
North Fakkah station (Crude oil before separating)	11.5	2.4035	66.116	19.42	26.12	0.8951	0.8939
North Fakkah station (Crude oil after separating)	NIL	2.358	61.31	14.42	20.80	0.9291	0.9283
South Fakkah station (Crude oil before separating)	5.2	2.3457	105.5	31.48	24.99	0.9042	0.9030
South Fakkah station (Crude oil after separating)	NIL	2.300	95.41	22.86	22.95	0.9161	0.9149
South Bazrkan station 1 (Crude oil before separating)	Nil	2.7013	69.58	33.69	23.96	0.9102	0.9094
South Bazrkan station 1 (Crude oil after separating)	NIL	2.660	64.13	29.71	21.02	0.9278	0.9269
South Bazrkan station 2 (Crude oil before separating)	NIL	2.544	71.94	35.47	21.66	0.9239	0.9227
South Bazrkan station 2 (Crude oil after separating)	NIL	2.502	62.19	30.01	15.31	0.9639	0.9626
South Bazrkan station 3 (Crude oil before separating)	NIL	2.612	70.01	35.12	22.47	0.9190	0.9790
South Bazrkan station 3 (Crude oil after separating)	NIL	2.574	65.34	28.07	20.16	0.9330	0.9318
North Bazrkan station (Crude oil before separating)	12.5	2.453	67.5	27.31	24.07	0.9096	0.9083
North Bazrkan station (Crude oil after separating)	NIL	2.411	61.81	25.00	24.50	0.9070	0.9058
Halfaia station (Crude oil before separating)	1.2	2.9113	62.177	16.58	21.43	0.9253	0.9240
Halfaia station (Crude oil after separating)	NIL	2.872	54.15	10.03	20.11	0.9287	0.9273

Table (9) The results of tests for Missan Oil Company soil, water and gas samples.

Type of sample	Con. Of mercury in soil ng/g	Con. Of mercury in separator ng/L water	Con. Of mercury in separator gas ng/m^3
Abu Gharb 1 station	1.8	Nil	2.9
Abu Gharb 2 station	Nil	9.2	2.1
North Fakkah station	5.3	Nil	4.1
South Fakkah station	3.6	Nil	9
South Bazrkan station 1	1.5	Nil	2.41
South Bazrkan station 2	1.8	Nil	3.96
South Bazrkan station 3	1.4	Nil	4.18
North Bazrkan station	1.9	10.6	4.57
Halfaia station	8.5	Nil	-

After the mercury was determinate in the samples from the fields and the oil companies, several other tests were carried out on the same samples as shown in the tables above in order to establish a relationship between the presence of mercury in the crude oil with the other elements such as nickel, vanadium, sulfur and API. For crude oil samples prior without separating and before any treatment, as shown in Table (10) and figures (7,6,5,4) for the relationship of the presence of mercury with the other elements.

Table (10) Summary of the results of tests of crude oil samples before any treatment

Type of sample	Con. Of mercury	Sulphur content%	V (ppm)	Ni (ppm)	API	Sp.gr	Density (g/cm^3)
Abu Gharb 1 station (crude oil before separating)	4.7	2.281	69.13	26.36	20.86	1.0767	1.0767
Abu Gharb 2 station (crude oil before separating)	13.1	2.5523	65.47	24.24	21.85	0.9227	0.9219
North Fakkah station (Crude oil before separating)	11.5	2.4035	66.116	19.42	26.12	0.8951	0.8939
South Fakkah station (Crude oil before separating)	5.2	2.3457	105.5	31.48	24.99	0.9042	0.9030
North Bazrkan station (Crude oil before separating	12.5	2.45	67.5	27.31	24.07	0.9096	0.9083
Halfaia station (Crude oil before separating)	20.3	2.9113	62.177	16.58	21.43	0.9253	0.9240
Al-Ahdab oil field (Crude oil before separating)	17.5	2.789	63.14	12.31	27.34	0.8908	0.8898
Crude oil (kana oil)	7.7	2.305	62.56	26.84	30.99	0.8709	0.8702
Crude oil (Strategic Line)	8.1	2.340	68.08	38.5	30.09	0.8756	0.8749
Crude oil (toba oil field)	6.1	2.289	67.36	11.95	26.31	0.8966	0.8954
Crude oil (east Baghdad)	25.7	3.33	112.5	65.04	23.50	0.9129	0.9117

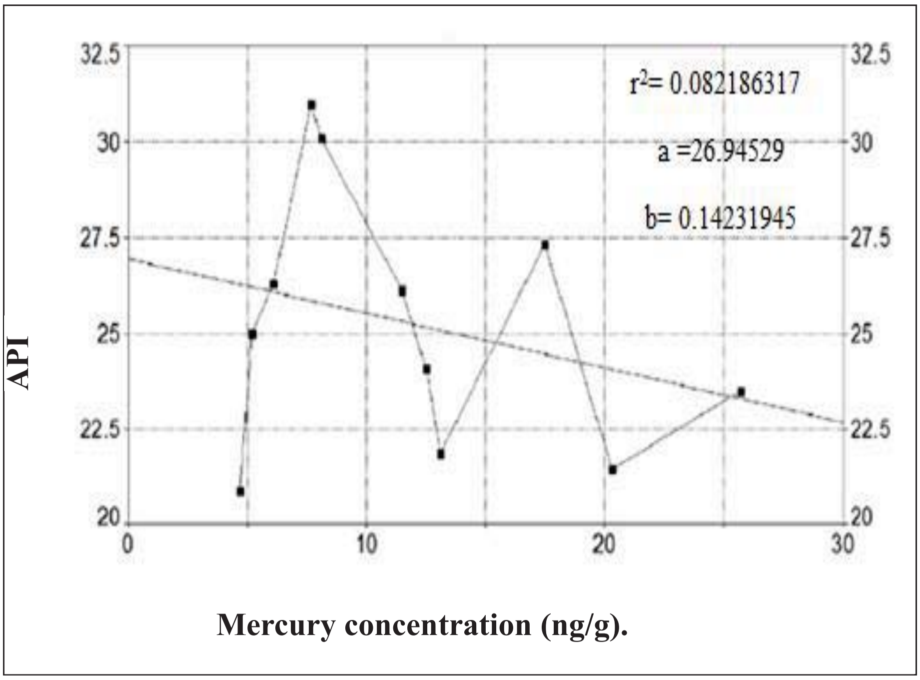

Fig. (4) The relationship between mercury and API.

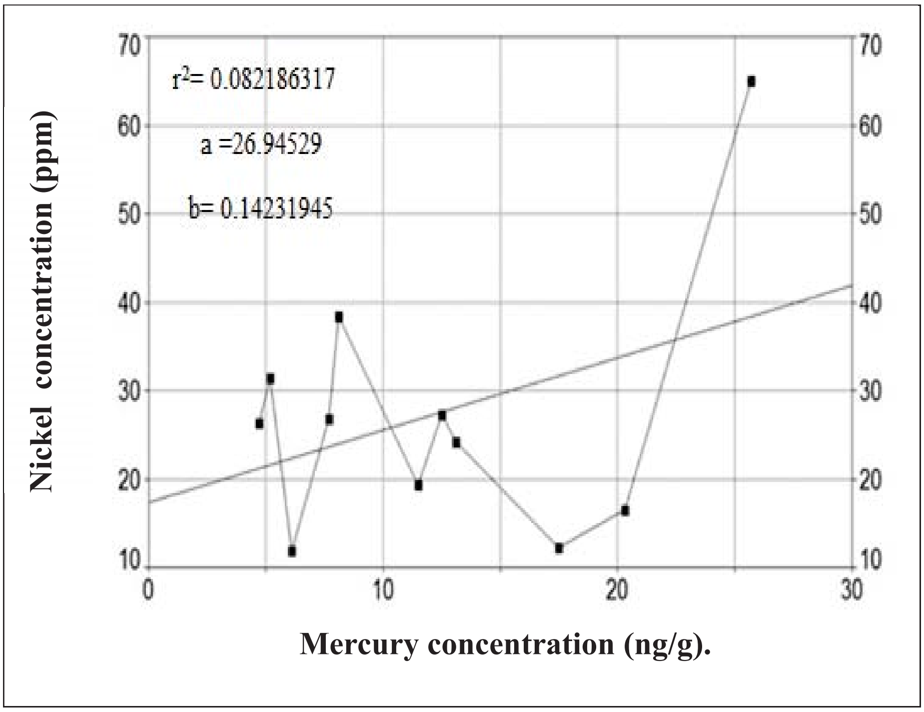

Fig. (5) The relationship between Mercury and Nickel.

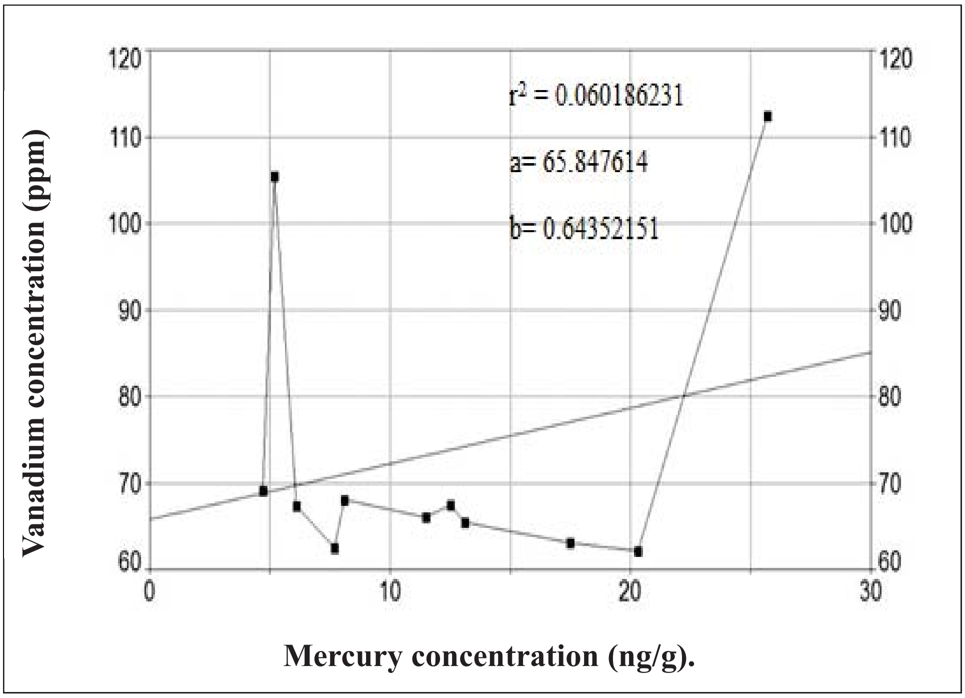

Fig. (6) The relationship between mercury and Vanadium.

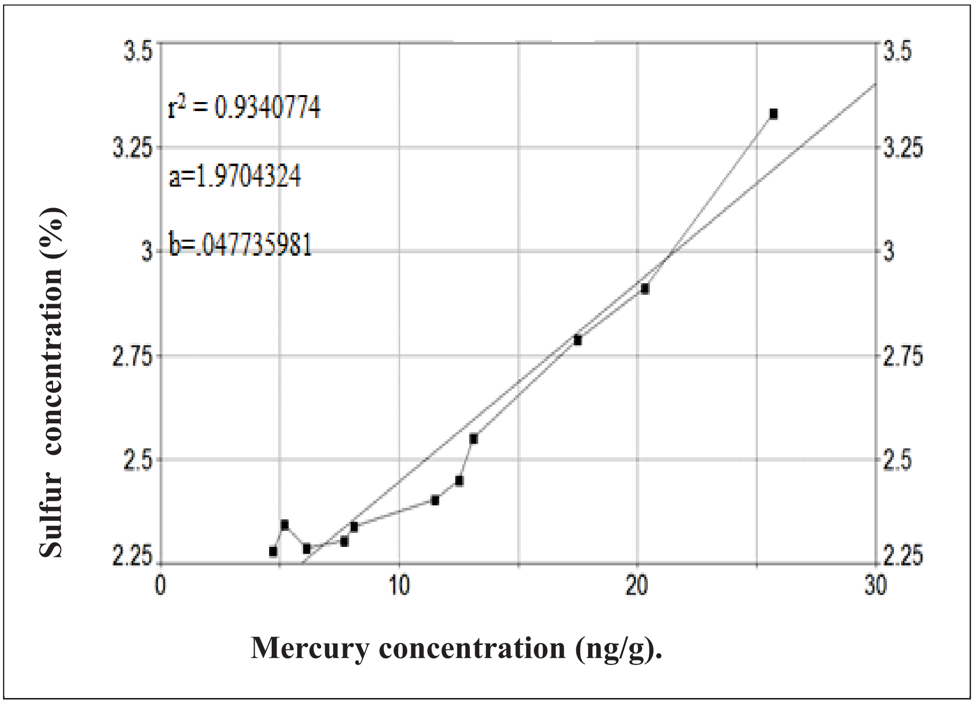

Fig. (7) The relationship between mercury and Sulfur.

4- Conclusions:

1. The Iraqi oil contains very low percentages of mercury up to (25 ng/g) maximum as the results showed that these percentages range is different from one region to another.
2. Mercury can be found in the associated gas as well as the flame gas at percentage up to (11 ng/m3).
3. Mercury is present in the soil around the flier and at different concentrations in different directions. It has high concentrations in the wind direction. This indicates that mercury is released with burning gases and accumulates for long periods of time, so their concentration is high.
4. .Mercury is present in the associated water with concentrations up to (21 ng/L) indicating the presence of mercury in inorganic salts dissolved in water.
5. The largest percentage of the presence of mercury in the crude oil is in the accompanying water and this proved by the results of tests for the oil company Missan, where samples were taken before and after the isolation and the results of tests for the nets after the removal of water associated with mercury-free.
6. The relationship of the presence of mercury with one of the specifications of crude oil was one of the objectives of the research has proved the results have no relationship to the presence of mercury with the (API) crude oil, indicating that the proportion of mercury does not depend on the density of oil, but depends on the type of crude oil to another.
7. To establish a relationship to the presence of mercury with one of the elements such as nickel or vanadium or sulfur was studied through the previous graphs, which showed that there is no relationship to the presence of mercury with the element of nickel, and the relationship with the element of vanadium is almost inverse relationship with the absence of some points that deviated from the linear equation.

The relationship of the presence of mercury with sulfur is a linear relationship approaching linearity where the standard deviation (0.966) and the slope of the straight line (0.047). The relationship of the presence of mercury to sulfate can be shows by equation (3):

$y = a + bx$ …… (1)

$x = \frac{y-a}{b}$ ……. (2)

$x = \frac{y-1.9704}{0.0477}$ ……. (3)

y = sulfur concentration

a = constant

b = Slop

x = mercury concentration

5- References:

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