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Contamination of Southern Iraq Waterways

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Abstract - In this study a certain chemical elements Cu, Mn and Pb were determined in water, and another set of Cd, Cu, Fe, and Zn were determined in sediments from selected sites (1) Qurnah, (2) Al-Noor Bridge, (3) Saad Bridge, (4) Sindbad Island, (5) Al-Ashar, (6) Abu Al-Khaseeb, (7) Seebah, and (8) Al-Faw along the Southern Iraqi water ways during the year 2015. Low levels of heavy metals were recorded in the water of Shatt Al-Arab river, they were in the range 0.00735 - 0.02090, 0.00505 - 0.02145, and 0.00150 - 0.0837 µg/l for Cu, Mn, and Pb respectively, and lower values recorded were for the toxic Pb metal. On the other hand levels of heavy metals in the sediments were little bit high and in the range 0.1172488 - 0.614806, 17.175343 - 40.156639, 8156.970 - 21021.63, and 31.864781 - 79.160779 µg/g dry weight for Cd, Cu, Fe, and Zn respectively. Fe recorded the highest levels of heavy metals in all sites due to the nature of the sedimentary valley in Iraq. Low levels of heavy metals Cu, Fe, and Zn were recorded in the sediments of Seebah (site no.7) due to the effect of sediment movements through Karun River from the Iranian territories. More over levels of all investigated heavy metals were recorded high values in the water from Ashar (site 5) due to corrosion of marine vessels sunk in the area since the Iraqi-Iranian War 1980-1988.

تلوث مياه الممرات المائية في جنوب العراق

فارس جاسم محمد الامارة و زهير علي عبدالنبي وعباس عادل حنتوش ولمى جاسم العنبر و محمود شبيب حيدر

قسم الكيمياء وتلوث البيئة البحرية /مركز علوم البحار/جامعة البصرة - البصرة – العراق

المستخلص: في الدراسة الحالية تم تقييم مجموعة من العناصر الكيميائية النحاس والمنغنيز والرصاص في عينات مياه ومجموعة اخرى الكادميوم والنحاس والحديد والخارصين في الرواسب من مواقع منتخبة على طول نهر شط العرب: 1) القرنة، 2) جسر النور، 3)جسر سعد، 4) جزيرة السندباد،5) العشار، 6)ابا الخصيب، 7)السيبه، و 8) الفاو خلال عام 2015. سجلت ادنى القيم للعناصر الثقيلة في مياه شط العرب حيث كانت بحدود 0.004352 – 0.2090 ، 0.00505 – 0.02145 ، 0.00150 – 0.0837 مايكروغرام /لتر لكل من النحاس والمنغنيز والرصاص على التوالي وادنى القيم المسجلة كانت لمعدن الرصاص السام. ومن ناحية اخرى، كانت مستويات العناصر الثقيلة في الترسبات عالية نوعا ما وبحدود 0.1172488 – 0.614806 ، 17.175343 – 40.156639 ، 8156.970 – 21021.63 ، 31.864781 – 79.160779 مايكروغرام /غرام وزن جاف لكل من الكادميوم والنحاس والحديد والخارصين على التوالي.

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سجل الحديد اعلى المستويات بين العناصر الثقيلة في كل مواقع الاعتيان اعتمادا على طبيعة السهل الرسوبي في العراق. اقل القيم للعناصر الثقيلة النحاس والحديد والخارصين سجلت في ترسبات منطقة السيبة (موقع رقم ٧) والناتجة سبب حركة الترسبات خلال نهر الكارون الذي ينبع من الاراضي الايراني . اضافة الى ذلك فان مستويات العناصر الثقيلة المسجلة في مياه منطقة العشار (موقع رقم ٥) كانت عالية ويعود السبب الى تأكل ابدان السفن البحرية الغارقة في شط العرب منذ الحرب العراقية – الايرانية ١٩٨٠-١٩٨٨.

الكلمات المفتاحية: عناصر كيميائية، مياه، ترسبات، شط العرب، مطيافية الامتصاص الذري

Introduction:

Aquatic waters are deteriorate by certain materials to attain their bad quality. Among those materials are the heavy metals which defined as chemical elements which have density greater than 5 gm/cm^3 (Hawkes, 1997), and they exert environmental contamination since human started processing ores (Sharma *et al.*, 2003). Since then their impacts increased mainly during the 19th and 20th centuries (Forester and Witman, 1983). Heavy metals are classified as essential elements such as Cu, Fe and Zn (Tuzen, 2009) and potentially toxic elements such as Cd, Hg and Pb (Clements and Newman, 2002). levels have increased due to anthropogenic pollutants [3x] (Ghannam, *et al.*, 2015). Among hazardous environmental chemical elements is Hg due to its toxicity and its accumulation in different organs of aquatic organisms (Hosseini *et al.*, 2013).

Aquatic environment receives chemical elements as pollutants from industrial and agricultural activities especially petroleum industries (Unlu *et al.*, 1996) which reflects in polluting living organisms. More over heavy metals are accumulate in sediments and measurements of chemical elements in sediments will reflect the past exposure (Al-Khafaji *et al.*, 1997; Clements and Newman, 2002).

Rivers that drain water carry all types of environmental pollutants into the estuaries and open seas (Delaune *et al.*, 2008), they transferred either as particulate or dissolved phases in the water. Chemical elements as a pollutants are determined in water, sediments, and biota (Camusso *et al.*, 1995).

In bottom fishes and carb species caught at Shatt Al-Arab river, certain heavy metals were bio monitored (Rahmanpour *et al.*, 2014), and certain levels of chemical elements were recorded in the water of Shatt Al-Arab river (Abdulreza *et al.*, 2010).

The permissible levels of pollutants in waters of Shatt Al-Arab River are effected due to dilution factor by upstream rivers Tigris and Euphrates (Abdullah, 2013).

Since the eighties and the nineties of the last century Southern Iraqi waterways were found polluted to a certain level with chemical elements (Abaychi and DouAbul, 1985; Al-Saad *et al.*, 1996). On the other hand, Al-Khafaji *et al.* (1997) reached the same conclusion with the exception of Fe. Later on, Al-Khafaji (2005) pointed out an increase of chemical elements in the suspended phase of Shatt Al-Arab waters, while Awad *et al.* (2004) noticed that chemical elements were within the acceptable limit with the exception of Ni. Moreover, Mohammad (2012), reported that chemical elements concentrations in the discharging water to the Northern Arabian Gulf were higher than allowed limit by WHO and IRPR.

High levels of certain chemical elements, Cr, Ni, and Cu, were observed in the downstream of Karun river within the Iranian territories as a result of human activities (UN-ESCWA, 2013; Digomalin *et al.*, 2004), and they in turn reflect upon the water quality of the Southern part of Iraq as well as waters of Northern Arabian Gulf . Recently, in a study for another chemical elements, Rahmanpour *et al.* (2014) reported levels of Cd, Hg and Pb in the sediments from the aquatic area on the border between Iraq and Iran which were; 0.21, 1.33 and 1.2 in (μg/g) for Cd, Hg and Pb, respectively.

Increasing population lead to increase contamination in southern Iraq, with different pollutants such as petroleum hydrocarbons, heavy metals, and pesticides which represent the main sources of toxicity problems in the aquatic environment of Southern Iraqi waterways affecting the human lives throughout the food chain (Reza and Singh, 2010; Abdullah, 2013).

Study Area:

Shatt Al-Arab (Arvand) River is the biggest river which discharge water into Arabian Gulf. It originated from Qurnah town where Tigris and Euphrates rivers are joined and passes the main cities of Basrah, Abadan and Khoramshahr along it's banks from which the people of these cities are supplied with fresh water and play as a main resource of fishing. It flows south towards Northern Arabian Gulf for a distance of 199 km, it exposed to different sources of pollution from Tigris, Euphrates rivers, Al-Hwaiezah marsh, and waste water discharges from the cities located on its banks as the most effective source (Sarasiab *et al.*, 2014). In addition to the Euphrates and Tigris rivers, the Karkhah and Karun rivers which originated from Zagarose mountains within the Iranian territories are contribute to the contamination of Southern Iraqi water ways (UN_ESCWA, 2013).

Materials and Methods

Water Sampling:

For the current study 8 sampling sites were selected starting with site No. 1 at Al-Qurnah the confluence site for Tigris and Euphrates rivers, ended with site No. 8 at Al-Faw city on the top of the Arabian Gulf, as shown in Figure (1). Samples were collected from each site, as water by water sampler and sediments by grab sampler. Samples were collected and transferred to the laboratory of elemental analysis in Marine Science Center and stored in fridge prior to analysis.

Digestion of Samples:

In the laboratory chemical elements in water and sediments were digested with HNO_3 (analytical grade), and the digested samples were stored in a nitric acid prewashed polyethylene bottle in refrigerator, prior to the chemical elements analysis.

Chemical Elements Analysis:

The water and sediment extracts were analyzed spectrophotometrically for the determination of chemical elements by Atomic Absorption, in which Angstrom AA320N air acetylene flame Atomic Absorption Spectrophotometer fitted with special Hallow Cathode Lamps for each element was used. Each sample was analyzed in triplicate so as to ascertain the validity of the method, and the average of the results reported.

Figure 1. Map For Southern part of Iraq Showing the position of water sampling sites (1-8) within Shatt Al-Arab River.

Results and Discussion:

Northern part of Arabian Gulf's receives freshwater from Southern Iraqi waterways represented by Shatt Al-Arab river and Shatt Al-Basrah canal, therefore the ecological balance of marine habitats in the northern part of Arabian Gulf will be maintain (Forester and Whitman, 1983).

The concentrations of chemical elements in the water and bottom sediments from different sites along Southern Iraqi waterways are presented in Tables (1 and 2), respectively.

Low levels of heavy metals were recorded in the water of Shatt Al-Arab river, they were in the range 0.0073 - 0.0209, 0.0050 - 0.0214 and 0.0015 - 0.0837 µg/l for Cu, Mn and Pb respectively, and lower values recorded were for the toxic Pb metal in most sites except site No. 8 which recorded the highest concentration for Pb due to highly traffic and fishing area over all times. On the other hand levels of heavy metals in the sediments were little bit high and in the range 0.1172 - 0.6148, 17.1753 - 40.1566, 8156.9700 - 21021.630 and 31.8647 - 79.1607 µg/g dry weight for Cd, Cu, Fe and Zn respectively. Fe recorded the highest levels of heavy metals in all sites due to the nature of the sedimentary valley in Iraq.

Table 1. levels of heavy metals (µg/l) in waters of Shatt Al-Arab River, NW Arabian Gulf.

No.	Sampling Site	Location	Cu	Mn	Pb
1	Qurnah	E472620.33 N310017.58	0.01895	0.02145	0.00140
2	Shatt Al-Arab, Al-Noor Bridge	E473013.3 N305410.1	0.01005	0.01190	0.01180
3	Shatt Al-Arab, Saad Bridge	E474200.2 N304452.0	0.02015	0.01060	0.01095
4	Sindbad island	E474637.15 N303445.27	0.01430	0.01640	0.00320
5	Ashar	E475114.96 N303032.42	0.01085	0.01640	0.00170
6	Abu Al-Khaseeb	E480131.64 N302736.98	0.01665	0.00925	0.00190
7	Sebah	E481548.32 N302015.43	0.02090	0.02885	0.00150
8	Al-Faw	E482747.62 N295921.01	0.00735	0.00505	0.08370

Low levels of heavy metals Cu, Fe and Zn were recorded in the sediments of Seebah (site no.7) due to the effect of sediment movements through Karun River from the Iranian territories. More over levels of all investigated heavy metals were recorded high values in the water from Ashar (site 5) due to corrosion of marine vessels sunk in the area since the Iraqi-Iranian War 1980-1988.

The concentrations of studied chemical elements in all sites occur in descending order of Mn ~ Cu>> Pb for water, and Fe>> Zn> Cu>>Cd for sediments. Results shown in Tables (1 and 2) indicate that concentrations of chemical elements are high in sediments and greater than in water, this can be explained as chemical elements do not exist in soluble form for a long time in water, they are present mainly as suspended collides or fixed on a particulate of organic and mineral substances. Moreover, sediments are important sinks for various pollutants among which are the chemical elements (Ikem *et al.*, 2003), and play a useful role in the assessment of chemical elements contamination (Clements and Newman, 2002)

Table 2. The levels of heavy metals (µg/g) in sediments of Shatt Al-Arab River, NW Arabian Gulf.

No.	Sampling Site	Location	Cd	Cu	Fe	Zn
1	Qurnah	E472620.33 N310017.58	0.1172488	28.245564	20360.61	50.309966
2	Shatt Al-Arab, Al-Noor Bridge	E473013.3 N305410.1	0.1880510	36.972369	16817.562	57.31031
3	Shatt Al-Arab, Saad Bridge	E474200.2 N304452.0	0.5586172	31.628914	17647.77	72.113925
4	Sindbad island	E474637.15 N303445.27	0.1310547	40.156639	17423.156	74.555792
5	Ashar	E475114.96 N303032.42	0.614806	47.985796	18564.597	79.160779
6	Abu Al-Khaseeb	E480131.64 N302736.98	0.1628878	32.286727	21021.63	63.417929
7	Sebah	E481548.32 N302015.43	0.4514453	17.175343	8156.9708	31.86471
8	Al-Faw	E482747.62 N295921.01	0.489053	26.969589	17854.53	64.797986

Conclusion:

Contaminated pollutants in the Southern Iraqi Waterways arises from flowing of polluted water through Tigris and Euphrates Rivers as well as polluted matters flowing from western Iranian Territories. They have great effects as they passing through a number of cities and towns whose sewage flows into Shatt Al-Arab river directly without any treatment (Chodri and …….).

Excessive use of water by Iraqis and Iranians has reduced flow rate in this river to a certain extent that pollutants increase to cause related phenomenon's such as red tide (Al-Shawi, 2016).

Aquatic environments such as Shatt Al-Arab River is especially at high risk for heavy metals contamination since much of the polluted water inside Iraqi cities as well as Iranian cities are runoff through this river towards the Arabian Gulf (Hosseini *et al.*, 2012).

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