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# Integration of geophysical investigation and chemical indicators to assess the environmental impact of industrial wastewater for the fertilizer plant/ west of Basrah

Al-Mosawi. Walla Majeed[1]; Mohanad Kadhum[2]; Al-Rubaye Aymen Abdulateef [3]

and Jabrat Allah A. H.[4]

[1,2,3]Marine Science Centre; General Commission for Groundwatwr/ Basra

**Abstract**

There is an international tendency towards more comprehensive specifications for a more numbers of indicators of pollution resulting from the water of industrial activities, even more stringent, so that it imposes minimum limits for some high-risk pollutants on humans, environment and environment of plant and animal life, thus, the industry looks at the treatment of industrial wastewater is it an urgent necessity.

The current study included assessing the impact of industrial wastewater and its potential for the chemical fertilizer plant in Khor Al-Zubair area by geophysical interpretation which is completed by a resistivity method integrating measurement of some hydrochemical variations of this water, these included electrical conductivity (EC), (pH) and the concentration of Ammonia $NH_3$ and Nitrates ($NO_3^-$), as well as measuring some of the chemical variations of groundwater in the study area. The results revealed that the depth of groundwater in the study area is about 5 m, and the study area is affected by the intrusion of saline water more than it is affected by industrial wastewater, in addition, the study area is not suitable for agriculture purposes because of the abundance of debris and existence of transported soil, sediment and debris in the area, as well as existence remains of ancient military sites.

The results of measurement of the chemical variations of industrial wastewater for three sites and for many periods of time with different operating conditions of the plant revealed that the values of these variables are somewhat fluctuating for these periods due to the production efficiency and different operating conditions of the plant. The most prominent factor that affected in these waters are $NH_3$ concentrations, which recorded some dangerous levels.

**keywords:** Chemical fertilizer plant; Industrial wastewater; Geophysical interpretation; hydrochemical variations

## Introduction

The main impact factor of industrial wastewater is a negative impact on the soil and water systems, it has an impact on the lives of biological communities at all levels, and can have negative effects on the environment of the muddy lands, which are considered one of the main biodiversity environments in Iraq (Nature Iraq, 2017).

The water is an essential element in industries, and it is difficult to establish accurate water quality specifications for many industries (Al-Shammari and Al-Kenani, 2012), as water specifications used in industrial facilities vary from any industry to another, natural water occasionally is used directly without treatment, and in other industries it is necessary to use highly treated water and its specifications are close to distilled water.

Since the 1960s, Iraq has relied on limited chemical fertilizer imports due to its high expenses and the farmers rely on organic fertilizer (if available), so, the production is poor compared to neighboring countries, this made the specialists in the agricultural aspect to import fertilizer to increase vegetable production. After the increasing costs of imported fertilizers, a plan was performed for production of fertilizers for the purpose of domestic consumption and export (if possible). In 1971, the General Chemical Fertilizer Company plant in Basra was built with a production capacity of 50,000 tons of ammonium gas that used to make ammonium sulfate (138,000 tons) per year, which is still used in the Urea production (53,000 tons per year).

Despite the significant decline in the construction and development of industrial facilities in Iraq, especially after the 1990s and the events of 2003, this does not neglect the negative impact of solid and liquid residues resulting from the rest of these facilities, the production of fertilizers leads to release gases into the atmosphere, the most important of which are carbon oxides and nitrogen (Isherwood, 1998). The estimations of the Organization for Economic Cooperation and Development (OECD) for 1997 revealed that fertilizer production is contributed 1.2 % of these total oxides emissions (equivalent to 280 million tons of carbon dioxide per year), in addition, the industry release the other gases such as Sulfur oxides and Carbon Monoxide (ESCWA, 2005).

Fertilizer plant / southern region of Iraq, is one of the important industrial plants for Urea industry, the amount of released cooling water from the plant in Ammonia and Urea lines is about 750-800 $m^3/h$, this water is rich in Ammonia, Urea and it have high salinity (Al-Akaili, 2017). The current study focuses on determining the outfall drain industrial wastewater for fertilizer plant and the possibility of determining the negative impact on the nature of the soil and groundwater both which is drained from it in side basins and which is drained from it to the Khor Al-Zubair waterway, as well as its impact on the environment of marine life in the region, and the possibility of recycling and using this water for other purposes (agriculture, wetlands, artificial marshes, oil injections) after the necessary treatment.

## The study area

The study area is located west of Basrah, 25 km south of Al-Zubair City (Figure 1), it represents the assembly basins and canal of industrial wastewater drainage for the fertilizer plant. Fertilizer plant / southern region is one of the leading factories in the manufacture of Urea which is rich in Ammonia- ($NH_3$), the industrial wastewater produce from the Ammonia and Urea units of the plant and then transport through a pipe for a distance of 1600 m to pour into a drainage basin, which is 600 m away from the plant (the water in the drainage basin returns adjacent to the main drainage pipe), after the drainage basin, this water is supposed to be transported to a drainage canal to flow directly into Khor Al-Zubair waterway for a distance of 4.72 km after the necessary treatment, this canal passes under the paved road of of Khor Al- Zubair port through many of small pipes.

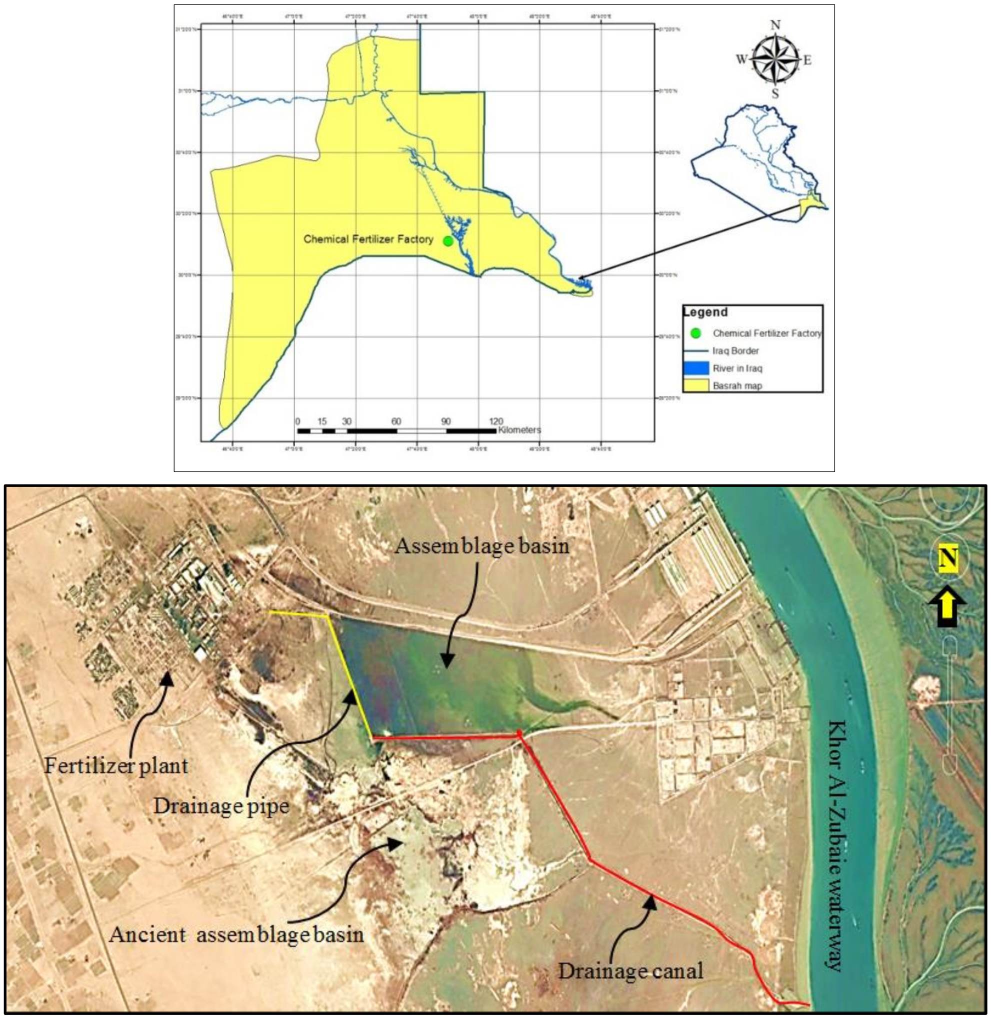


Figure 1. Location of Fertilizer plant and accessories of the industrial wastewater outfall drain.

## Methodology

Three field trips were conducted to survey the study area, many water and sediment samples have been collected from the study area. The first field trip was on 9-3-2016, in this trip the area was explored in detail, the plant was operational and the industrial wastewater had high flow with a sharp smell of Ammonia in the area. It was also noted during this trip that there is an ancient drainage basin is located south of the new drainage basin on the other side of the paved road (Form-2), the reason of industrial wastewater diversion from the ancient site to the new site is not known.

Water samples were collected from the main pipe that is coming out of the plant, and from the drainage basin as well as from the drainage canal to identify some chemical properties of water such as, electrical conductivity (EC), pH, Ammonia concentrations ($NH_3$) and Nitrates ($NO_3^-$ ), while the sediments are collected from the ancient basin, as well as a soil sample that is selected from outside the study area for comparison purposes. These analyses have been performed to identify which soil is affected by industrial wastewater even after diversion, the other two field trips were subsequently conducted on 21-5-2017 and 6-10-2017 to recognize the changes in the study site during different operational conditions of the fertilizer plant.

Geophysical surveys were carried out by resistivity method along of a profile about 1.5km (Figure-2) to identify the depths of groundwater and determine the range and depth of polluted soil (if it exist). The resistivity method is one of the most suitable geophysical methods for hydrogeological studies, thus, the method has been used for a long time in the context of hydrogeological investigations to determine the thickness, depth, extension and levels of aquifers. The applications of this method are expanded to identify water quality in some cases and the hydraulic properties of aquifers, as well as in the investigation of groundwater contamination from various sources.

The performed resistivity section is completed by vertical electrical sounding (VES) using the Schlumberger array for four VES points, 500m spacing between each point, and 32 the resistivity measurements at each point, the distance between the two-volt poles (80) meters and the distance between the two current poles (AB) (500) meters. Qualitative resistance data is processed and interpreted using IPI2WIN software to obtain the apparent resistivity space section (pseudo sections), that is a qualitative interpretation method to make initial idea about the variation of resistivity value with different distance AB/2 as well as completing of geoelectrical section that is initially linked with the geological and hydrogeological information available in the study area.

In addition to measuring the hydrochemical variations for the industrial wastewater and the resistivity section, one of the water wells is used to measure some of the hydrochemical variations of groundwater to indicate their impact or not by industrial wastewater.

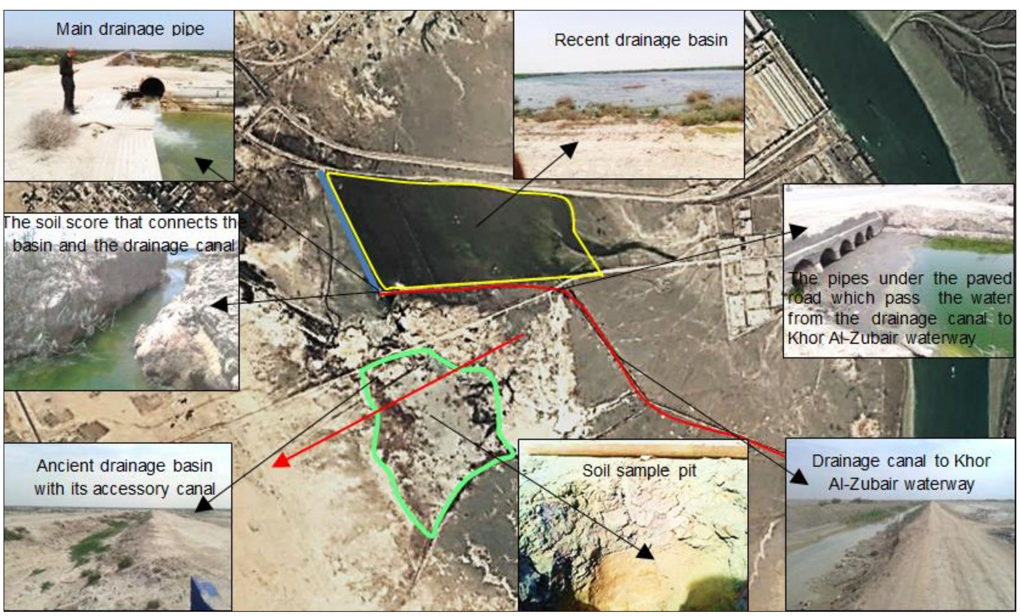


Figure 2. Illustrations of the ancient and recent industrial wastewater outfall drain sites of the fertilizer plant with the soil sample collection site and the resistivity track line (red arrow).

**Results**

Assessing the impact of industrial wastewater on humans and the environment requires measuring many physical and chemical variations, and determining these variations depends mainly on the nature of the medium in which these waters can affect. The limited parameters of the Iraqi specifications for the resulted industrial activity to surface water and drained sewage systems (Law 25 of 1967) (Table-1) are limited to certain parameters and do not elaborate on all variables. For more details on the industrial water discharges of the fertilizer plant and the water quality for the production lines, it can be reviewed (Al-Akaili, 2017), in this study, many of the chemical variations of industrial wastewater have been measured inside the plant before exiting the plant for the purpose of using this water to irrigate the tomato crop after developing some solutions and techniques for treatment.

Table 1. Iraqi specifications for drained industrial activity water.

| Contaminant | Discharge to river | Discharge to sewage |
|---|---|---|
| Total suspended solid (TSS) | 60 mg/l | 750 mg/l |
| pH | 9.5-6.0 | 9.5-6.0 |
| Biological oxygen demand BOD | Less than 40 mg/l | Less than 1000 mg/l |
| Chemical oxygen demand COD | Less than 100 mg/l | - |
| Chlorides salt | - | 600 mg/l |

The current study is focused mainly on measuring EC, pH, $NH3$ and $NO^{-3}$ in industrial wastewater after exiting the fertilizer plant, both in the outer drainage basins and the canal that flows into Khor Al-Zubair, then assessing the condition in which this water is discharged, if it is discharged properly then it does not affect the soil, groundwater in the area and the biodiversity of Khor Al- Zubair waterway, or it needs careful planning, and this was performed during many field trips.

**Apparent resistivity section**

To assess the impact of industrial wastewater discharges on groundwater, first it needs to know the depths and quality of groundwater in the study area, so the resistivity measurements were used and correlated with one of the drilled wells in the study. This section uses a linear vertical scale to reduce the effect of layers near the surface and the apparent resistivity values which will be a function of both the space distance between the current poles and its position on the surface, thus, these sections represent one of the methods of qualitative interpretation of resistivity method, so these sections it is called (Pseudo-Section). (Figure-3).

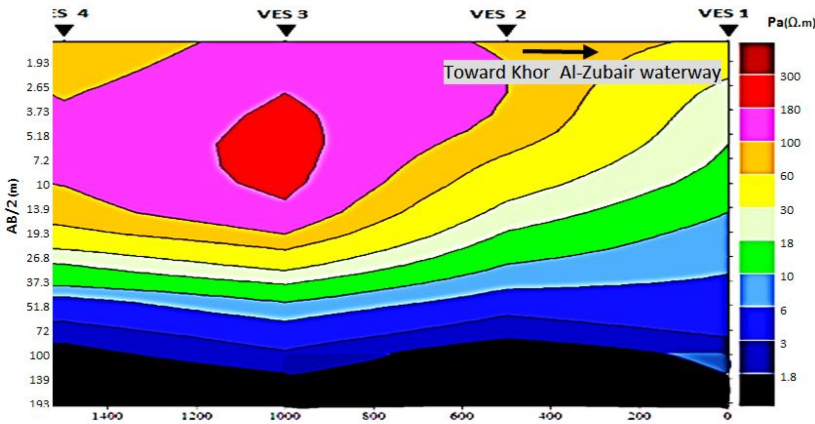


Figure 3. The apparent resistivity section of the study area and its surrounding (the total distance of the section is 1.5 km), the section illustrate the decrease in the resistivity values with the depth along the track and starting from the east near Khor Al-Zubair towards the farms.

In general, the apparent resistivity section revealed there is a gradual variation in the distribution pattern of apparent resistivity values with an increase in the array spread of the electrodes (increase the penetration depth), which can indicate a change in the moisture content and sediment with depth, also it can show that these values decrease with the depth, especially at the possible depth of groundwater. As well as decreasing the apparent resistivity values along the track towards the east side that adjacent of Khor Al-Zubair waterway, so, it can clearly observe that the lines of the iso-apparent resistivity descend downwards away from Khor Al-Zubair waterway and towards the farms, which indicates clearly to an increase in the values of electrical conductivity of groundwater and sediment. As well as these values are varied laterally and vertically, especially at the array distances between 1.5 and 10 meters.

The geoelectrical section depicted that the surface layer is characterized by lateral heterogeneity in high resistivity values, which ranged from (47-108) Ω.m. with thickness ranging from (2.9-0.6) meters. The high recorded values due to the presence of silt and flooded dry deposits which are coming from the Khor Al-Zubair waterway during the time, in addition to the impact of the soil by the industrial waste water for the ancient dry basin, therefore it expects that there is a high proportion of organic matter with presence of Ammonium Oxides resulting from the melting of ammonia in the water and its transmission to the soil as these oxide forms. In other sites the surface layer has been characterized by the presence of sand and silt dry deposits with the presence of gypsum deposits. The second layer, the resistivity values was about (20) Ω.m. with thickness (4.3) meters for point no.1 that represents the boundaries of the study area, and it represents

the third layer for point no.2 with resistivity value of (31.4) Ω.m and thickness (6.4) meters, this layer represents a clay lens extending below each of the two points (1.2). For points (4.3,2), the second layer was characterized by high resistivity values ranging from (302-150) Ω.m. with a thickness of 1-14 meters, it represents a dense sand layer with dry soft gravel. The geoelectrical section depicted that the depth of groundwater in the study area is about 5 m (specifically near point no.1), and it is noted that there is a decrease in the resistivity values for the layers which have groundwater with increase the depth, on the other hand decrease in the resistivity values toward Khor Al- Zubair waterway, as shown in figure 4. The results of the resistivity survey exposed that the decrease in the resistivity values for the study area towards Khor Al Zubair waterway and with increase the depths, that indicates increase in groundwater salinity, which refers to the effect of sea water intrusion from Khor Zubair waterway as well as the rising saline water of the formations under the Dibddibba formation due to the effect of the layer pressures as indicated in (Al-Mosawi. and Khorshid, 2013). The previous studies (Zohdy et al., 1974; Prasad et al., 1983; Sathymurthy and Banerjee, 1985; Gnanasundar and Elango, 1999) are reported that the zones saturated with saline water show a very low resistivity of less than 10 Ω.m, this was confirmed by the results of the measurement of some chemical variation of groundwater, including ($Cl^-$), (TDS) and (EC) with values 3195 ppm, 10790 ppm and 16555 µmoh respectively.

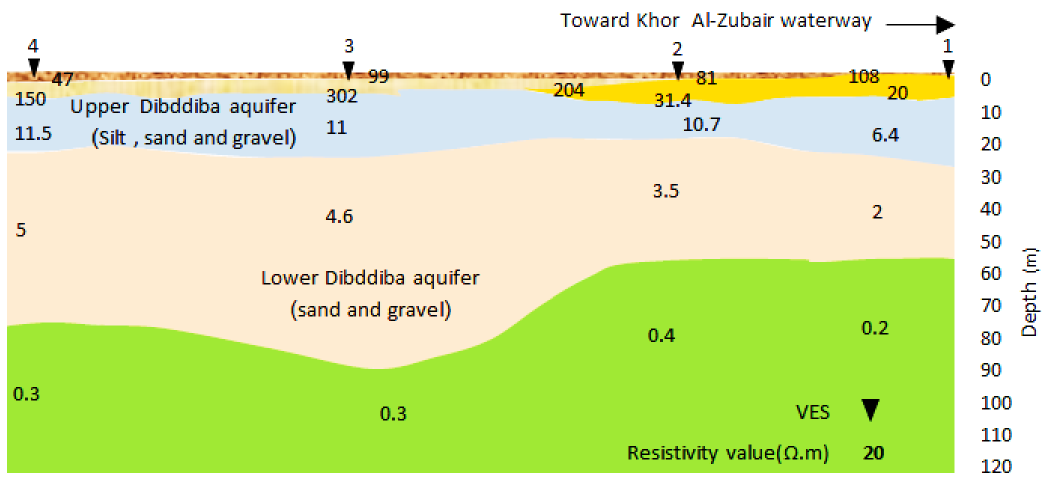


Figure 4. The geoelectrical section of the study area and its vicinity, the decrease in the resistivity values of groundwater towards the study area and Khor Al- Zubair creek, that resulting from increased salinity of groundwater due to the intrusion of marine water and deep salt water

In the study area, going into the details of groundwater contamination with industrial wastewater may not give much importance because the groundwater is contaminated and affected by saline water more than it is affected by industrial wastewater, and the land or soil are not exploited for agriculture because of the abundance of debris and various remain which are represented former military sites during the First Gulf War, where it was observed that there was soil, sediment and debris transported to the area, especially in the site of the ancient basin surrounding.

However, if industrial wastewater is drained in the exploited soil for agriculture (which is not far from the study area) the impact of this water may reach the groundwater and may contaminate by Nitrates. The contamination of groundwater by Nitrates increases the worries of environmental protection concerns because of its seriousness to human health and agricultural productivity, the additional load of Nitrogen in the soil and increase soil leakage pressure as well as groundwater rising are the main causes that increase the concentration of Nitrates (Zhang et al.,1998; Vidal *et al.*,2000).

**Chemical variations of industrial wastewater**

The Industrial water samples have been collected during three different periods of operational conditions for the plant from many drained water locations, Table.2 shows the locations and hydrochemical variation according to the time periods indicated for all field trips.

Table 2. Hydrochemical variation of drained industrial water for fertilizer plant during different periods of time**.**

| Date | Site | $NO_3^-$ (ppm) | $NH_3$ (ppm) | EC (Ms/cm) | pH |
|---|---|---|---|---|---|
| 09/03/2016 | Main pipe | 19.16 | 313.2 | 10.8 | 10.9 |
| | Discharge basin | _ | 80.7 | 10.4 | 9.05 |
| | Discharge canal | 16.98 | 235.6 | 10.3 | 10.4 |
| | Connection of discharge canal with Khor Al- Zubair waterway | - | 93.5 | 8.2 | 9.1 |
| 21/05/2017 | Main pipe | - | 52.8 | 7.1 | 8.6 |
| | Discharge basin | - | 38.6 | 7.1 | 8.4 |
| | Discharge canal | - | 45.1 | 7 | 8.5 |
| | Connection of discharge canal with Khor Al- Zubair creek | - | 32.3 | 9 | 8.4 |
| 10/06/2017 | Main pipe | 16.1 | 158.2 | 10.3 | 9.4 |
| | Discharge basin | 46.3 | 41. 9 | 10.1 | 8.7 |
| | Discharge canal | 4.2 | 41.12 | 10 | 8.6 |
| | Connection of discharge canal with Khor Al- Zubair creek | - | - | - | - |

From table 2, pH value and concentration of Ammonia in these waters, the higher concentration of Ammonia which led to the rise of pH values in site-1(the main pipe) that represents the drainage canal (Figure 1), where pH values is reached 10.9, which indicates base water caused by the presence of Hydroxide ion that is produced by a high concentration of Ammonia, that is reached 313.2 ppm. The high concentration of toxic Ammonia made the water in the drainage canal as semi-transparent and tend to green blue colour and very poor in terms of biological activities such as fish or algae except for reed plants that grew in the second part of the drainage canal due to the relative decrease in concentration of Ammonia and pH values, as the drainage canal progresses towards the Khor Al- Zubair waterway the Ammonia gas is released from exposed wastewater. The dissolving of the Ammonia gas in exposed water is not fixed because it is a volatile and non-standard gaseous substance, but those concentrations remain relatively high until their arrival. and mixed it with seawater.

Although Ammonia in water is a very important source of Nitrogen for algae growth, it can contribute to increased Eutrophication of stagnant water bodies, especially those with a limited Nitrogen content. However, increasing the concentration of Ammonia above 100 micromulari may hinder the growth of algae, especially with the high pH value, thus very high Ammonia concentrations with pH values more than 10 may explain the absence of the canal from algae and other biological activities. Ammonia is found in two cases in the water system, the ionic case ($NH4^{+}$) and the non-ionic case (NH3). Non-ionic Ammonia is a very toxic case of aquatic organisms, especially for the fish, both cases are called total Ammonia. Toxic Ammonia (non-ionic) can dissolve to less harmful Nitrates through certain vital processes, pH values play a main role in converting toxic Ammonia into Ammonium salts, which are much less toxic, when pH values are less than 7 in the acid medium, toxic ammonia transforms to Ammonium, opposite in the basal medium (Al-Salman, 2007). The toxic range of non-ionic Ammonia varies depending on the type of organism. Generally, the concentration of less than 0.02 ppm is considered safe.

For example, trout fishs are severely harm when the concentration of Ammonia exceeds 0.2 ppm, while carp fish may bear concentrations of up to 2 ppm (Salman, 2000), while in the air Ammonia combines with Sulfate ions and dissolves in rainwater to return quickly to the soil and surfaces water. The final natural transformation of Ammonia to Nitrite and then to Nitrates is done by aerobic bacteria, where the bacteria responsible for transferring of Ammonia to Nitrite are Nitrosomonas, while Nitrobacter bacteria are responsible for completing the transformation process, where Nitrite is oxidized to Nitrate, which may interpret the high concentration of Nitrates in conjunction with the high concentration of Ammonia for most samples during the study period.

$$\text{NH3} \xrightarrow{\text{Nitrosomonas}} NO_2^{\ominus} \xrightarrow{\text{Nitrobacter}} NO_3^{\ominus}$$

The results of the second trip indicate a significant change through the decrease in the values of pH and Ammonia concentrations along the drainage canal, therefore its impact on the water of Khor Al Zubair waterway is reduced by a large proportion due to two main reasons, the first is to change the course of the wastewater through a small stream or a soil score (figure.6) that make to drain an amount of the wastewater to the exposed swamp to the east of the plant (Figure 1), then reducing the amount of pollutants reaching to Khor Al-Zubair waterway. The second reason is that industrial water that outflows from drainage pipes have lower pH values and Ammonia concentrations than in the past (Table 2), which is due to differences in operating conditions and production efficiency.

In the third field trip, it was observed increase in the Ammonia concentrations values from the second trip but less than the first trip, while pH was similar to the second trip and it is recorded the highest concentrations also at the main pipe site. In this trip most plants were severely affected again when recurrence the process production in the plant and the pH values were increased again to above 9 due to the introduction of new amounts of Ammonia (Figure-5), where reed plants were clearly affected and the water lack of bioactivity. The highest values of EC are recorded in the first trip and converged with the values of the third trip, while the lowest measurements are recorded in the second trip, the highest values are recorded at the main pipe site about 10.8 dS/ m during the first trip.

The results depicted that the values of pH and EC are directly proportional and compatible in terms of increase and decrease, but they are somewhat fluctuating from a measurement period to another due to the production efficiency and operating conditions of the plant, as well as what it output laboratories of chemicals for the plant may increase the EC values of industrial wastewater. It is worth mentioning that the wastes of the laboratory outputs are discharged directly to the canal that transports the water of the Ammonia and the Urea lines until it is gathered in the final assembly basin, this makes to fluctuate EC values in this water during the months of the year (Al-Akaili, 2017).

For the purpose of assessing the industrial wastewater drained of the fertilizer plant, it is appear that the discharge is carried out in an unconsidered manner, both in processing and discharge. Part of the wastewater in the main pipe flows to the drainage basin and the other part flows to the drainage canal through an incorrectly unregulated soil score (Figure 6). The drainage canal passes the water to Khor Al-Zubair waterway through many of small pipes which pass under the paved road, most of these pipes are almost out of use due to damage and almost blocked by sediments and calcifications (Figure-7).

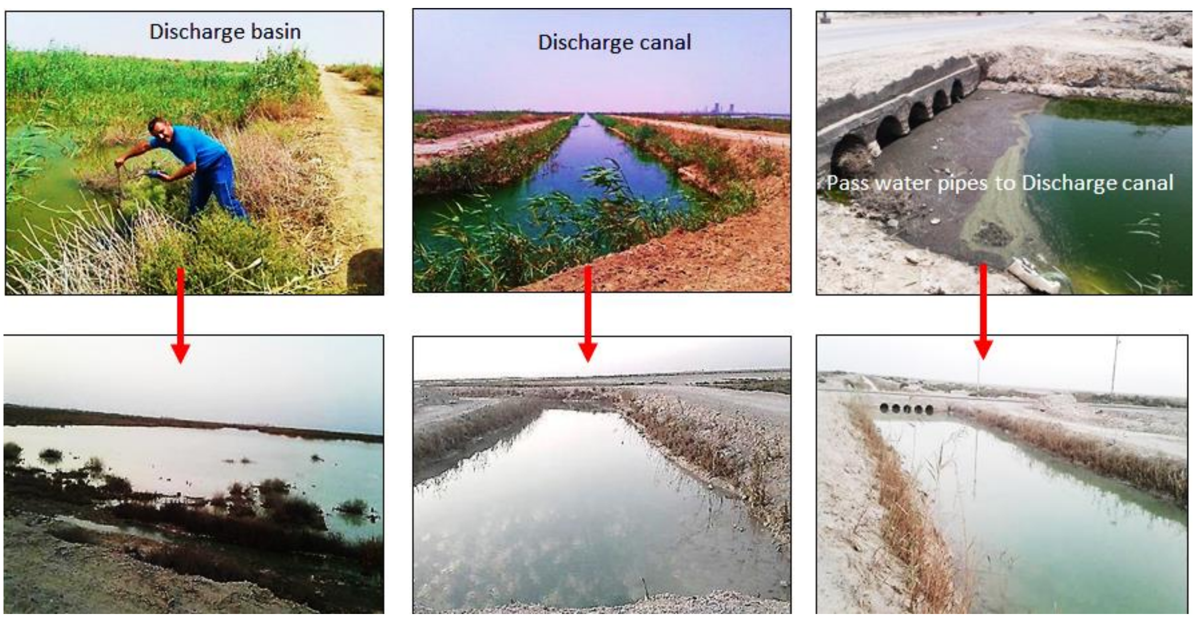


Figure 5. Variable conditions of the study area during many operational periods of the fertilizer plant. At the top industrial wastewater free of Ammonia concentrations (second trip), at the below the industrial wastewater contain high concentrations of Ammonia (first and third trips.

Figure6. The soil score that connects the basin and the drainage canal.

Figure7. The pipes under the paved road which pass the water from the drainage canal to Khor Al-Zubair waterway.

The contaminated water has finally been dumped into Khor Al-Zubair waterway; thus, it is the importance exist of industrial wastewater treatment stations, the industry sees to industrial wastewater treatment as an urgent necessity, especially when it affects its future water courses clearly or when the facility is accepted by the public consideration against for its efforts and costs. The industry must try to treat industrial wastewater at the lowest cost, which reaches the appropriate limits for future drainage, this can be determined through study, research and experimentation.

Pre-planning processing will get time to make appropriate decisions, while bad planning for reducing processing costs can lead to an urgent need for quick solutions that could lead the industry to a decision to stop production. In order to prevent any future hazard to the environment, industrial wastewater must be treated before being pumped out of the plant in drainage basins or water canals so that the process of treatment and discharge complies with the requirements of the specified laws for the characteristics of industrial wastewater. At the planning and development stage, must be given the highest priority the standards for the protection of land and water resources and safety of aquatic life in rivers and waterways, as well as protection of the marine environment from pollution and protection of public health.

If the process treatment of industrial water discharges were carried out as proper planning, a long way has been gone in protecting the environment, not in the study area, but in other industrial sites, particularly at oil production sites that are widespread in southern Iraq. Not only that, but properly treating this water may provide an opportunity for recycling and using it in other fields, which may be agricultural or industrial, as well as it can also be used as a means of increasing wetlands or forming so-called industrial marshes, especially in the scarcity of water sources that Iraq is suffering from (Figure.8)

Figure-8. Density of vegetation at the drained basin site during the discharge of industrial water free of contaminants.

There are many executions must be made for the industrial wastewater, which depends on its quality, including: Applying a preliminary treatment within the facility so that the wastewater specifications are within the limits that allow it to be discharged directly. These treatments can include chemical and physical treatments as well as aerobicteria and anaerobic biotherapy by aeration basin. Layering the exited water from aeration basin and making the amount of treated water with its load of pollutants as little as possible. Low polluted water should not be mixed with highly polluted water without necessary executions, and the industrial wastewater should not be mixed with other wastewater directly because this may hinder the monitoring process, then this water can be discharged directly to the nearest waterway.

## Conclusion

-The depth of the groundwater in the study area is about 5 m, the study area is affected by the intrusion of saline waters more than affected by industrial wastewater, the saline waters coming from Khor Al-Zubair waterway the formations under the Dibddibba formation, additionally, the study area is not appropriate for agriculture because of the abundance of debris in the soil, transmitted sediment and debris to the area, which represents the remnants of for ancient military sites**.**

-Ammonia, pH and EC for industrial wastewater for three sites and for many periods of time are proportional and compatible in terms of increase and decrease, but they are somewhat fluctuating between the period and the other, this is due to efficiency the productivity and operating conditions of the plant during the time, as well as the outputted chemicals material by the laboratories of the plant. The most affected factor in these waters is the Ammonia concentration.

-The assessment of the industrial wastewater discharge of the fertilizer plant revealed that the discharge process is carried out in an unconsidered manner and there is bad planning in both treatment and drainage, whether it is released of this water in the drainage basin or which is drained into Khor Al-Zubair waterway through a canal that is connected to the drainage basin with an unregulated incision. These factors are harmful for the marine environment and need to be addressed before they are drained.

-If the treatment processes were carried out systematically and suitably planning for industrial wastewater drainage operations, it would be possible to use this water for other purposes, which may be agricultural and other industrial, and even used to increase the area of wetlands**.**

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# تكامل المعلومات الجيوفيزيائية والمؤشرات الكيميائية في تقييم التأثير البيئي لمياه الصرف الصناعي لمعمل الأسمدة في منطقة خور الزبير/ غرب البصرة

ولاء مجيد الموسوي, [1] ; , مهند كاظم التميمي [2] ; , أيمن عبد اللطيف الربيعي [3] ; جبرة الله عبد الجبار حنون [4]

[1,2,3]جامعة البصرة- مركز علوم البحار , الهيئة العامة للمياه الجوفية / البصرة

**المستخلص:**

هنالك توجه عالمي نحو مواصفات أشمل ولعدد أكبر من مؤشرات التلوث الناتج من مياه الانشطة الصناعية بل وأكثر صرامة بحيث تفرض حدوداً دنيا لبعض الملوثات العالية الخطورة على الانسان والبيئة وبيئة الاحياء النباتية والحيوانية, لذلك تنظر الصناعة الى معالجة مياه الصرف الصناعي على أنها ضرورة ملحة. تضمنت الدراسة الحالية تقييم تأثير مياه الصرف الصناعي ومآلها لمعمل الاسمدة الكيمياوية في منطقة خور الزبير وعلى شبكة من الاخوار والمسطحات الطينية ( والتي تشكل بيئة فريدة ذات تنوع أحيائي مهم وانتاجية حياتية عالية) بالاستفادة من تفسير البيانات الجيوفيزيائية المنجزة بطريقة المقاومة النوعية بالتكامل مع قياس بعض المتغيرات الكيميائية لهذه المياه والتي تضمنت التوصيل الكهربائي (EC) والاس الهيدروجيني (pH) وتراكيز الامونيا $NH_3$ والنترات ($NO_3^-$), فضلاً عن قياس بعض المتغيرات الكيميائية للمياه الجوفية في المنطقة.
أظهرت النتائج الجيوفيزيائية مع نتائج قياس المتغيرات الكيميائية للمياه الجوفية ان عمق المياه الجوفية في منطقة الدراسة بحدود 5 م وان منطقة الدراسة متأثرة باقتحام المياه البحرية القادمة من خور الزبير أكثر من تأثرها بمياه الصرف الصناعي, فضلاً عن ان منطقة الدراسة غير صالحة للزراعة لكثرة الانقاض ووجود ترب ورواسب وركام منقولة للمنطقة والتي تمثل بقايا لمواقع عسكرية قديمة. أظهرت نتائج قياس المتغيرات الكيميائية لمياه الصرف الصناعي ولثلاث مواقع ولعدة فترات زمنية وبظروف تشغيلية مختلفة للمعمل ان قيم هذه المتغيرات متذبذبة نوعاً ما بين فترة قياس وأخرى ويعود السبب الى الكفاءة الانتاجية وظروف التشغيل المختلفة للمعمل, وان العامل الابرز والاكثر تأثراً في هذه المياه هي تراكيز $NH_3$ التي سجلت بعض المستويات الخطرة.