# Experimental Investigations of Physiochemical of Waste Water from Assalaya Sugar Factory, Sudan

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**Abstract:**

The object of this work was to study the Physiochemical of wastewater in the White Nile state. The wastewater is one of the problematic situations in the state. TheWhite Nile state is considered the center of the sugar industry in Sudan, and includes the sugar factories of Assalaya, Kenana and White Nile. This study was carried out during Jane,2014 to Jane 2016 to determine the chemical contaminationin wastewater of Assalaya sugar factory. The study area was divided in to four locations A, B, C and D which wastewater samples were collected from them, and analyzed for determination the parameters TDS range 788 – 134 mg/l with average 442 mg/l, TSS range was 287.666 – 32.000 mg/l his average 286.166 and TS range 1084 – 170 mg/l his average 732 mg/l. We observed some measured values were higher than recommended level of WHO but the average value of TS was higher than WHO acceptable value 700mg/l. The organic constituents BOD and COD determined by titrimetric analysis but TOC determined by TOC-UV. 700.OR. The BOD found in range 2101 – 12.67 mg/l and average 1157.67 mg/l, COD rage 2401.60 – 23.088 mg/l with average 1397 mg/l and TOC werefound in range 253.63 – 10.58 mg/l his average 193.65. The BOD values were higher than the recommended levels of WHO 770mg/L.

**Keywords**: Waste water, Chemical oxygen demand, Biological oxygen demand, Totaldissolved solids, Total solids and total suspended solids

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**المستخلص:**

الهدف من هذاالعمل هوالدراسة الفيزيوكيميائية لمياه الصرف الصحي في ولاية النيل الأبيض. تعتبر مياه الصرف الصحي من المشاكل التي تعاني منها الولاية. حيث تعتبر ولاية النيل الأبيض مركز صناعة السكر في السودان ، وتضم مصانع السكر في عسلاية وكنانة ومصنع النيل الأبيض. أجريت هذه الدراسة خلال الفترة من 2014 إلى جين 2016 لتحديد التلوث الكيميائي في مياه الصرف الصحي لمصنع سكر عسلاية. قسمت منطقة الدراسة إلى أربعة مواقعأوبوجود ،حيث تم جمع عينات مياه الصرف الصحي منها وتحليلها لتحديد معاملاتمجموع المواد الصلبة الذائبةتتراوح 788 - 134 مجم / لتر بمتوسط 442 مجم / لتر ، وكان مدىمجموع المواد الصلبة العالقة 287.666 - 32.000مجم / لتر و متوسطه 286.166 ومدى المواد الصلبة 1084 - 170 مجم / لتر بمتوسط 732 مجم / لتر. لاحظنا أن بعض القيم المقاسة كانت أعلى من المستوى الموصى به لمنظمة الصحة العالمية ولكن متوسط قيمةمجموع المواد الصلبة كان أعلى من القيمة المقبولة لمنظمة الصحة العالمية 700 ملجم / لتر. تم تحديد المكونات العضوية ، الحاجة الحيوية للأكسجينوالحاجة الكيميائية للأكسجين ( كمية المادة المؤكسدة اللازمة لاختزال مادة) ،عن طريق التحليل بالمعايرة ولكنمجموع الكربون العضويوالذي تم تحليله بواسطة TOC-UV. 700.. تم العثور على الطلب الأوكسجيني البيولوجي في المدى 2101 - 12.67 مجم / لتر ومتوسط 1157.67 مجم / لتر ، ووجد الحاجة الكيميائية للأكسجين في المدى 2401.60 - 23.088 مجم / لتر بمتوسط 1397 مجم / لتر وتم العثور علىمجموع الكربون العضوي في النطاق 253.63 - 10.58 مجم / لتر متوسطه 193.65. كانت قيم الحاجةالحيوية الاكسجين أعلى من المستويات الموصى بها لمنظمة الصحة العالمية والبالغة 770 ملغم / لتر.

## Introduction:

Use of wastewater in agriculture could be an important consideration when its disposal is being planned in arid and semi-arid regions. However, it should be realized that the quantity of wastewater available in most countries will account for only a small fraction of the total irrigation water requirement. Nevertheless, wastewater used will result in the conservation of higher quality water and its use for purpose other than irrigation. As the marginal cost of alternative supplies of good quality water usually be higher in water. shortarea, it makes good sense to incorporate agricultural reuse in to water resources but also takes advantage of the nutrients contained in sewage to grow crops UN (1985).

The availability of this additional water near population centers will increase the choice of crops which farmers can grow. It is advantageous to consider effluent reuse at the same time as wastewater collection, treatment and disposal are planned so that sewerage system design can be optimized in terms of effluent transport and treatment methods. Kuwait (1988). The cost transport of effluent from in appropriately sited sewage treatment plants to distant agricultural land is usually always be appropriate for agricultural use of the effluent.Arar(1988).

Many countries have included wastewater reuse as important dimension of water resources planning. In the more arid areas of Australia and the USA wastewater is used in agriculture, releasing high quality water supplies for potable use. Some countries for example the Hashemite kingdom of Jordan and kingdom of Saudi Arabia, have a national policy to reused all agriculture has developed rapidly since 1958 and now over 1.33 million hectares are irrigated with sewage effluent .In the Sudan there have not a national policy to reuse all treated wastewater effluent and have not already made considerable progress toward this end .The wastewater in Sudan was considered as one of most challenging problems facing environment and health of people .In white Nile state however ,there was no detailed studies which play a big positive role in the national economy and advancing the development and process on all different kinds of life, positive aspects or negative aspects that would affect human, animals and plants and all various components of the environment .this trend may negatively affect, both human and other lives as the result of environmental pollution due to by products and waste of manufacturing pollution due to by products will most often be harmful it they are not handled in a correct way .

The combination of wastewater from the sugar factory and sewage water of Assalaya town is mixed in large basins and poured in ‘’Elgassir creek’’ .The farmers used this mixture for irrigation of their vegetable crops .According to the information in last summer of the year 2010 which coincided with outbreaks of diarrheal disease in the white Nile state, especially in Rabak town ,contaminated drinking water and vegetables grown in the cartridge may be the main cause of the breaks of the diarrheal disease .The problem of wastewater in White Nile State has not been studied in details .The wastewater is one of the problematic situation in the state .Until now there was no practical trials involved for the solution of this problem in the white Nile state .According to the nature of the state, most of the biggest sugar factories were established since a long time ago ,for example Assalaya sugar factory.K. V. Radha(2018) Wastewater treatment processes in recent trends have attained good removal efficiencies but still fail to remove anthropogenic recalcitrant pollutants released by some industries in the wastewater.

Material and Methods

**Chemical and reagents:**

All the chemical which used in an experiments werean analytical reagent-grade were employed for the preparation of all solutions. The double distilled water used for preparation of all solution.

Collection of Samples:

The wastewater samples were collected prewashed polyethylene bottles from four locations A, B, C and D of wastewater steam in Assalaya sugar factory areaduring Jane2014 to Jane 2016.

Determination Total dissolved solids (TDS):

Total dissolved solid will be determined by evaporating the water sample to dryness following *AOAC (1984*). 20mL of each sample were transferred to weighted evaporating dish (pt. dish) andevaporated to dryness by heating for(1-2hr) at100Cº to constant weight.

**Calculation**:

$$\text{mg/L of TDS} = \frac{\text{mg residue}}{\text{ml sample}} x100$$

Determination of total solids (TS) and total suspended solids (TSS):

The total solids and total suspended solids of the sample will be determined as described by Punmia and Ashok (1998) – cleaned dish will be taken and ignited to constant weight ($W_1$). Then 25 ml of well mixed sample will be transferred to an above dish. The sample will be evaporated to dryness at 103 $^0$C for 24 hours, in constant temperature oven. Then the dish will be cooled in a desiccator and weight will be determined ($W_2$)

**Calculation:**

$$\text{mg/l of TS} = \frac{w_2 - w_1}{v}$$

Where

$W_1$= weight of empty dish

$W_2$=weight of the dish after evaporation

V=volume of the sample

Total solids (TS) include total suspended solid and total dissolved solid (TDS)

mg/l of TSS=TS-TDS

Determination of Biological Oxygen Demand (BOD):

The biochemical oxygen demand (BOD) will be determined using Winkler method as described by EEA (2001) as follows. Two 100ml bottles will be obtained with lid and cleaned will. Twenty-five ml samples will be taken in each bottle and 75 ml of the sample will be added to each of the two bottles. Then the two bottles closed well.one bottles will be kept in the incubator at (20-22$^0$C) for 5 days. Then 10 ml of manganese sulphate solution and 2ml of alkali–iodide solution will add to the other bottle below the surface of the liquid by using a syringe. Then the bottle closed and mixed by inverting it several times. When precipitate settles leaving a clear supernatant above the precipitate, shaken a gain slowly by inverting the bottle and when the setting has produced at least 50 ml supernatant 8ml of cons $H_2SO_4$ will be added. Then the bottles will be closed and mixed by a gentle inversion until dissolution was completed one hundred ml of the sample will be titrated with 0.05 M $Na_2S_2O_3$ solution until a pale yellow solution reached. The 2 ml of freshly prepared starch solution will be added and titration will continue until a blue colour appeared. The procedure will then be repeated using 100ml distilled water (blank). then repeated for incubator sample after 5days.

**Calculation:**

BOD as mg/l=16($V_1$-$V_2$)

Where $V_1$= ml of $Na_2S_2O_3$ used for the sample before incubation

$V_2$= ml of $Na_2S_2O_3$ used for the sample after incubation

Determination of chemical Oxygen Demand (COD):

Chemical oxygen demands (COD) will be determined according to method described by EEA (2001). Ten ml of the sample will be taken in a 100ml bottles then 5ml of conc $H_2SO_4$ will be added and about 1g of copper sulphate ($CuSO_4$) also added. Then 3ml of prepared N/40 $KMnO_4$ solution will be added and immersed the bottle in boiling water for 30 min while keeping the surface of the boiling water at the higher level than the surface of the sample. three mls will be then be prepared N/40 solution oxalate ($Na_2C_2O_4$) will be added and immediately titrated with N/40($KMnO_4$) until violet colour appeared, then repeated for the blank separately under the same condition using 10ml of distilled water instead of 10 ml of sample

**Calculation:**

COD as mg/l= (sample of ml B) (A8000x1/40)

Where A= ml of $KmnO_4$ used for sample

B=ml of $KmnO_4$ used for blank

1/40 = normality of $KmnO_4$

8000= ml-equivalent weight of oxygen in 1000ml/l

Determination of Total organic carbon(TOC):

The total organic carbon(TOC) determined by water analyze (model=TOC OR 700UV).

**Results and discussion:**

In the Sudan the problem of wastewater was considered as the one most challenging problems facing environment and health of people. In the White Nile state however, there was no detailed studies concerning this problem. There is no doubt the factories paly a big positive role in the national economy and advancing the development and process on all different kinds of life, positive aspect or negative aspects that would affect human, animals, and plans and all various components of the environment this trend may negatively affect, both human and other lives as the result of environmental pollution due to byproducts and waste of manufacturing pollution due to by products will most often be harmful if they are note in a correct way.

Table (1) shows the level of statistical analysis of different general parameters for comparison between different locations .The results showed that there was higher concentration of TDS mg/l,TSS mg/l and TS mg/l in location A and B,when compared to the Standard(WHO).The results were also showed that there was lower concentration of the same above parameters in location C and D when compared with Standard(WHO),except TSS was higher in location(C and D).The results indicated that the concentration of these general parameters tend to be higher whenapproached to the factory (location A and B).The overall results indicate that the concentration of these general parameters increased with increasing rate wherever the distance from the factory was decreasing.

Table (1) The general parameters

| Location | TDS mg/l | TSS mg/l | TS mg/l |
|---|---|---|---|
| A | 788.000 | 287.666 | 1084.000 |
| B | 711.000 | 779.000 | 1492.000 |
| C | 135.000 | 46.000 | 182.000 |
| D | 134.000 | 32.000 | 170.000 |
| Mean | 442.000 | 286.166 | 732.000 |
| (Standard(WHO | 500,000 | 30.000 | 700.000 |

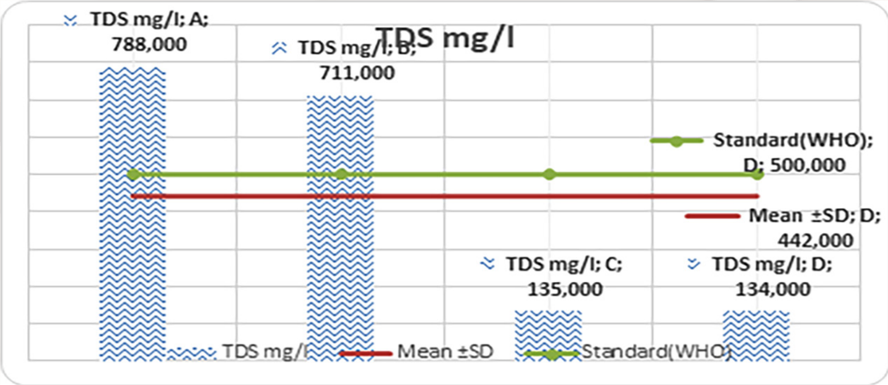


Fig. (1) TDS mg/l parameters

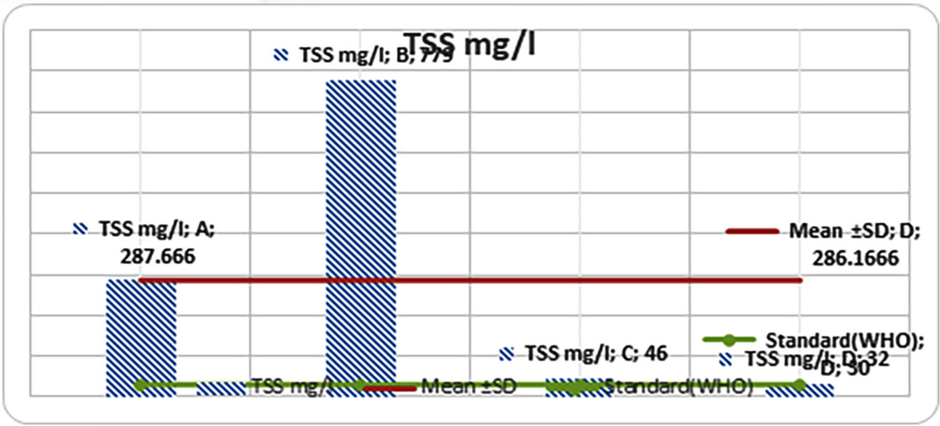


Fig. (2) TSS mg/l parameters

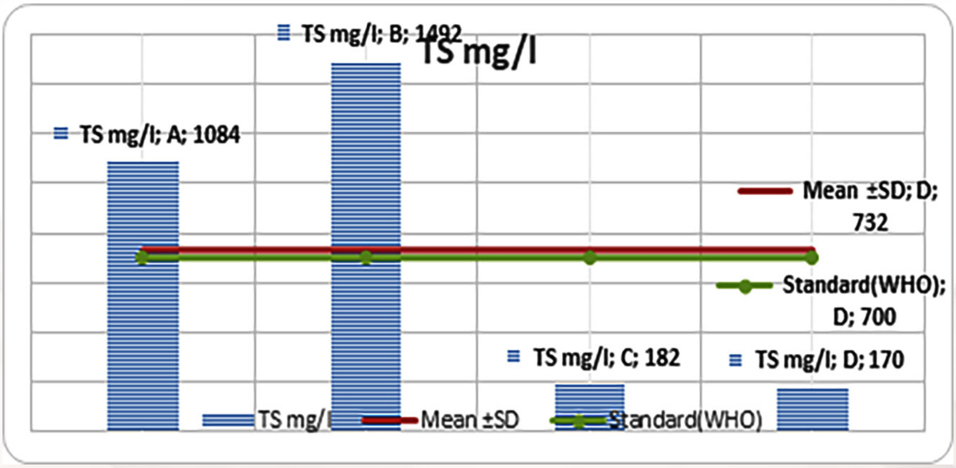


Fig. (3) TS mg/l parameters

The table (1), and Fig, ( 1, 2 & 3) shows the level of statistical analysis of different general parameters for comparison between different locations .The results showed that there was higher concentration of TDS mg/l ,TSS mg/l ,and TS mg/l in location A and B ,when compared with the Standard(WHO).The results were also showed that there was lower concentration of the same above parameters in location C and D when compared with Standard(WHO),except TSS was higher in location(C and D) .The results indicated that the concentration of these general parameters tend to be higher when we approach to the factory (location A and B) .The overall results indicate that the concentration of these general parameters increased with increasing rate wherever the distance from the factory was decreasing .

Table (2) statistical analysis of organic constituents

| Location | BOD mg/l | COD mg/l | TOC mg/l |
|---|---|---|---|
| A | 2101.000 | 2401.600 | 253.630 |
| B | 1301.000 | 1601.000 | 253.360 |
| C | 1210.670 | 1560.330 | 252.900 |
| D | 12.670 | 23.088 | 10.580 |
| Mean ±SD | 1157.670 | 1397.000 | 193.650 |

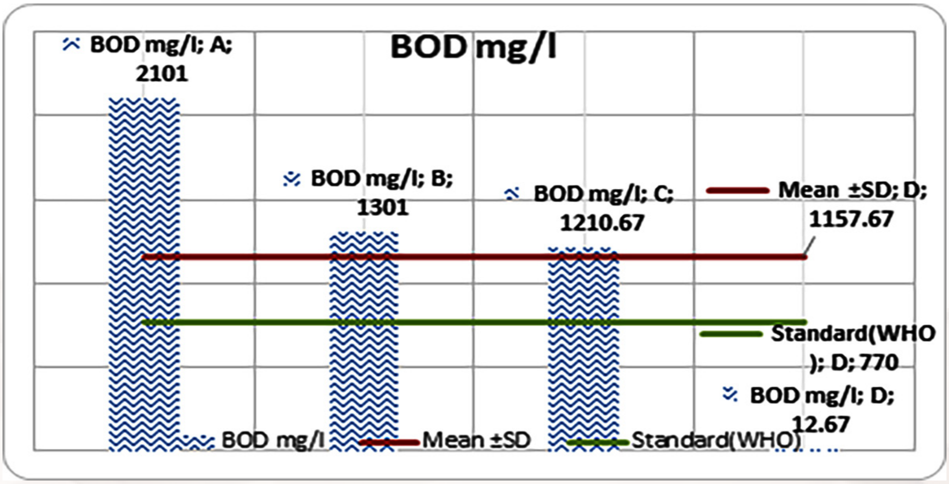


Fig (4)BOD mg/l parameters

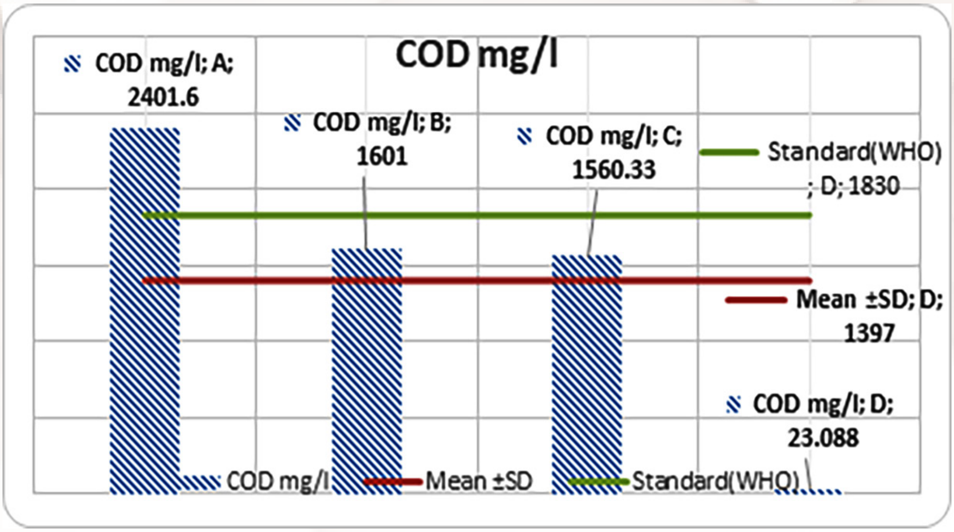


Fig. (5) COD mg/l parameters

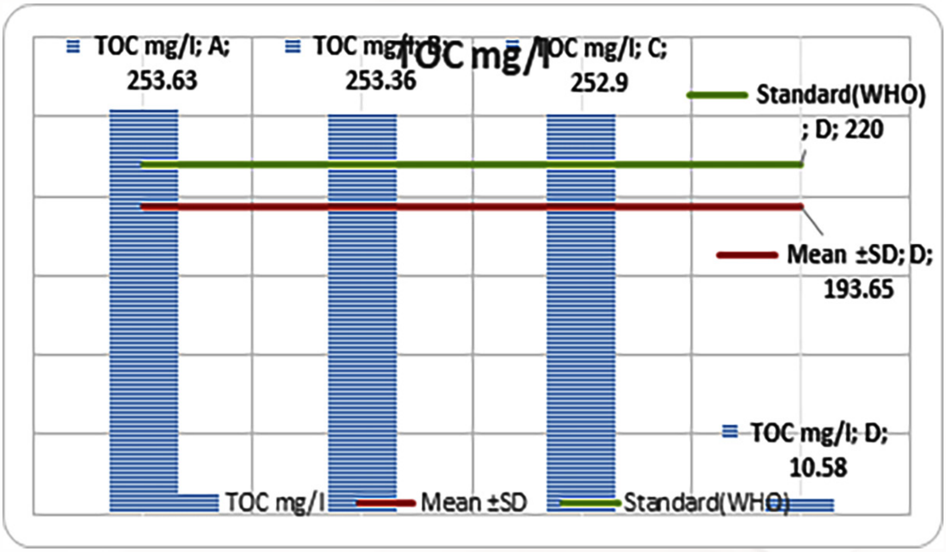


Fig. (6) TOC mg/l parameters

The Table (2) and Fig, (4, 5 &6) shows that the level of statistical analyses of different organic constituents for comparison between different location. The results showed that there was higher concentration of BOD mg/l, COD mg/l in location A, B, andC, when compared with the Standard(WHO). The results were also showed that there was lower concentration of the same above organic constituents in location D when compared with Standard(WHO). The results indicated that the concentration of these organic constituents tend to be higher when we approach to the factory (A, B and C), and tend to be lower when remote away from the factory(D).

For the TDS mg/l, TSS mg/l,and TS results showed that there was higher concentration of TDS mg/l ,TSS mg/l ,and TS mg/l in location A and B, The results were also showed that there was lower concentration of the same above parameters in location C and D when compared with Standard(WHO),except TSS was higher in location (C and D).The TDS was too higher that may increase the concentration of all parameters, because some of the which wastewater was consist of different sold material on its way from factory throughout location .The result represented that the TS was high concentration due to decomposed of giving some precipitate and sold material .The study also observed that the summation of mean of (TDS+TSS) were equal to the mean of TS that mean the two parameters effected in the TS finally the study explain all the general parameters (TDS,TSS,TS) were highly concentration in this location.

For BOD, COD and TOC.The results showed that there was higher concentration of BOD mg/l, COD mg/l in location A, B, andC, when compared with the standard(WHO). The results were also showed that there was lower concentration of the same above organic constituents in location D when compared with Standard(WHO).More over the concentration of the TOC was a raised also aerobic oxidation both (organic material and bacterial and oxygen).The result state that the concentration of the (BOD mg/l) was high concentration due of many factors a raised the concentration of (BOD) such as: sugar and oil both of them were come from chanceries, nutrients material a big equivalent number of microorganism and suspended material .The results also state that the concentration of the (COD) was high due to presence of organic constituents, quantity of organic constituents and types of organic constituents. it has been noticed practically in this study, that chemical oxygen demand (COD) values divided by biological oxygen demand (BOD) values(COD÷BOD) where a raised this values then equal or exceed (5) then there are doubt on the availability of biological decomposition if the organic materials. In this cause this organic material may need a long time to be occurred or it may content some component that inhibit the process of decomposition and may stop the process of biological oxidation. The TOC however visas and filtration mud both of them were contended of high organic constituent it has been noticed practically in this study.

**Conclusions:**

The experimentaleffort in this article involved the investigation of the critical factors that influence wastewater treatments. The focus of this paper was to determine the physiochemical and physical properties of the waste water from (ASF) and compared with standard of WHO for wastewater reuse in the eastern Mediterranean region (Saudi Arabia and Jordanian standards for example). The sample of waste water were collected from four sources from (ASF). The study shows that all waste water samples contain higher amount of BOD value (2001mg/l) However, the COD value also higher amount (24001mg/l). Others parameters like (TSS) the study shows that the value were not permissible to use for any purpose according to WHO standard waste water and addition the wastewater was contained bad odour and reddish color and this indicate that the wastewater were contained higher a mounts of elements. For this reasons the wastewater is not useful to use for agriculture, irrigation and energy purpose unless after being treated. Generally, wastewater reuse standards in countries of the Region are either adopted from WHO standards or other international standards without adapting them to suit local conditions. It is vitally essential that such adopted guidelines be adapted to prevailing epidemiological, sociocultural and environmental local conditions. Local studies are essential as they may result in a relaxation of the guidelines and thus augment the quantities of reclaimed water without compromising public health, or may result in the need for more stringent standards to protect public health. In either case, such studies are deemed necessary to ensure effective and safe implementation of wastewater reuse guidelines, as this will increase confidence in reclaimed water as a valuable resource.

The treatment of waste is quite important. More attention and concentration are being given to industrial waste disposal both nationally and internationally. The Sudanese Government must be concerned with the treatment process by providing a complete treatment system in the industrial areas and this result in minimizing the cost of production and will generate revenue to the country.

## References:

(1)Agricultural Affairs and fish Resources Authority, Kuwait. (1988) treated sewage effluent for irrigation in Kuwait.

(2)ArarA. (1988) Back ground to treatment and use of sewage effluent, Ch.2, treatment and use of sewage effluent for irrigation, M.B.Pescod and an arar (Eds).Bifferworths, seven oaks,kent.

(3)Association of Official Analytical Chemists (AOAC) (1984). Official methods of analysis14.thed .Washington, DC.

(4)Horpestad, A., D. Skaar, and H. Dawson, (2001), "Water Quality Impacts from CBM Development in the Powder River Basin,

(5)Kuravappullam V. Radha, KarunamoorthySirisha, (*2018) in* Advanced Oxidation Processes for wastewater treatment.

(6)Punmia,B.C, Ashok Jain, (1998) wastewater Engineering. (2ndEdition).Arihant consultant ,Bombay.

(7)European Environment Agency(EEA)(Copenhagen, Denmark), (2001), Indicr: Biochemical Oxygen demand in rivers.

(8)UN Department of technical cooperation for development, (1985), the use of Non-conventional water resources series No. 14, United Nations DTCF,NewYork.

(9)World Health Organization Regional Office for the Eastern Mediterranean Regional Centre for Environmental Health Activities, CEHA (2006), A compendium of standards for wastewater reuse in the Eastern Mediterranean Region

(10)Yasin, S., T. Iqbal, M. Rustam and M. Zafar, 2012.Environmental Pollutionfrom Automobile VechicleSevice Stations. Journal of Quality and Technology Management., 8(1): 61-70.