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# Effect of sewage water discharge on Red Sea and shore Water and soil chemical characteristics

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## ABSTRACT

Jeddah City Saudi Arabia sewage water (untreated and treated) is discharged into the Red Sea water south of the city. The discharged water may contain harmful toxic elements that may affect the living organisms in the sea water, and also the coastal habitat particularly naturally growing plant species. A study was andertaken to assess and evaluate the concentrations of the macro- and micro-lements, the heavy and toxic metals, saults, and to determine acidity and conductivity of the Red Sea water and soil a, and the shore water and soil and compare them with results collected from unpolluted area away from this affected area. The results indicated highly significant accumulation of saults, macro ande micro-elements, and heavy and toxic metals in the sea and coastal water and soil compared to the unpolluted site . Out of all Ca, Na and Cl in the sea and shore water expressed no significant differences between the polluted and unpolluted sites. For the sea and shore water the highest concentrations were for Mg, K and P, while for their soil the highest concentrations were for Ca, Mg, K, P, Na and Cl. AS for the heavy metals Cu, Mn, Cr, Al, Zn and Co dominated in the sea and shore water, while for the sea and shore soil the domination was for Cu, Mn, B, Cr and Al. Some of these elements , Ca, Mg, Na, K, Cl, Cu, Cr and Ni are concentrated at levels above that suggested and recommended by the Metreological Environmental Protection Agency (MEPA), Ministry of Water and Electricity (MWE) and Food and Agricultural Organization (FAO, 1985).

**Key Words:** Sewage water, Red sea water, Shore soil, macro-micro-elements

## INTRODUCTION

Sewage water normally is discharged into the sea water, and this practice creates a global problem. Sewage effluent discharge and human activities in the coastal areas and marine water led to dumping of various kinds of pollutants such as heavy metals into the marine ecosystems (Censi et al. 2006; Pote et al. 2008). The high concentrations of metals and other elements in sea water cause several problems through their accumulation in the body of marine animals and organisms (Wen et al., 2007; Wcisio et al., 2008). In his comparison of the concentration of the metals Al, Fe, Mn, Cu, Zn, Cr, Cd and Pb in the Red Sea water southern Corniche area of Jeddah taken 1999 with those taken 2009 (Basaham et al. 2009) to see effect of sewage effluent dumping in this area, and found that concentrations of these heavy metals were doubled during this period. The sewage water discharged into the Red Sea water is partially treated polluted water , and Al-Khumra treatment plant south Jeddah city which receives daily about 200,000-300,000 $m^3$ sewage water partially treats this water (El-Sayed and Niaz ,1999) . The mean concentrations of the heavy metals Zn, Mn, Cu, Cd in the Red Sea water in front of Jeddah City reached 8.00, 2.43, 1.7 and 1.09 i1g/g respectively (Saad and Fahmy ,2009) . The Red Sea coastal area water in the southern area of Jeddah City near the sewage effluent discharge was analyzed and the trace metals Zn, Cu and Ni were found the metals with the highest concentrations (Radwan et al., 2009) . In Jeddah City there are 177 discharge points along Jeddah coast receiving treated and untreated sewage which is dumped directly into the Red Sea water and the most important of the effluent is that of Al-Khumra Sewage Treatment Plant (KSTP) which discharges its wastewater south of Jeddah with daily amount of (300,000 **m3)** (El Sayed 2002b). On the other hand the daily volume of sewage water discharged into the Red Sea waters in the vicinity of Jeddah city as declared by National Water Company reaches up to 375000 $m^3$ (El-Riyadh Newspaper,7-5-2012). The average concentrations of Fe, Cu and Zn in the sediment of the sewage effluent discharged in the Red Sea water was estimated by El-Yami (2010) as 8574, 112 and 1557 µg/g. El-Nakhlawy et al., (2016) mentioned that wastewater irrigated areas produced the highest concentration of toxic metals in plant and soil samples compared to irrigated sites with normal water. The discharge of the industrial waste water in seawater near the city of Zonguldak beaches were assessed by Coban et al. (2009) and found to have the following concentrations Mn 15.0±O.98, Cr 12±8.6, Mg 715±8.3, Cu i22± 1.5, Ni 142±ıo.6, Pb 39±9.0 and Zn 834±4.1. The aim of this study is to estimate the concentration of chemicals, elements, salts, trace and heavy metals in sewage water, Sea and shore water of Red Sea south of Jeddah City, Saudi Arabia as affected by sewage water discharge and compare it with unpolluted location 30 km away.

## Materials and Methods

### Collection of water samples:

Seawater samples were collected from twelve points along the coastal region from a depth of 30 cm and placed in sealed clean glass bottles with all the information's written, and taken to the laboratory

The water samples (5 L) were filtered through filter papers and put into clean bottles for analysis. Also water samples were collected from the sewage water discharged into the sea water, finally treated, secondary treated and untreated.

### Collection of soil samples:

Soil samples were collected from twelve points inside the Red Sea coastal water, and twelve points along the shore at depth of (0-30 cm) and placed in plastic bags and taken to the laboratory. The samples were dried at $60^oC$ in an oven for 24 hours, and passed through a thieve 2mm aperture and then mixed thoroughly. To prepare soil filtrate 50 gm were taken in a flask and 250 ml of distilled water were added and the flasks closed and placed in a vibrator for 6 hours. The filtrate was then filtered through Whitman filter paper and placed in bottles and put in the fridge for analysis.

Analysis of the samples:

pH value:

pH value was analyzed using the pH-meter Titrator Mettler DL55.

EC;

It was determined using the EC-meter model Mettler MC 226.

Determination of macro-elements and heavy metals:

A number of instruments were used for determination of macro-elements and heavy metals, like Atomic Absorption Spectrophotometer, Model Analyst 800, Perkin Elmer (USA). The instrument Inductively Coupled Plasma, Optical Emission Spectrometer, Model Optima 4100 DV Perkin . The following formula was used to calculate the concentration in mg/kg of SPM mg/kg (Dry weight) = Concentration* Dilution / Dry weigh .

TDS:

The amount of TDS in a water sample is measured by filtering the sample through a 2.0 µm pore size filter, evaporating the remaining filtrate and then drying what is left to a constant weight at 180ºC.

**Statistical analysis**

The collected data were statistically analyzed using the analysis of variance (ANOVA) and mean comparisons (Least Significant Difference (LSD) test) according to El-Nakhlawy (2008), using SPSS (Statistical Package for the Social Sciences) version 13.0.

## RESULTS

**Concentration of the main elements in normal water and sewage water semi-treated and untreated:**

Table (1) illustrates the mean concentrations of the main elements analyzed in the tap water and in the semi-treated and untreated sewage water. Sewage water has no effect on pH of the water and it remained 6.5 as in the tap water. The total dissolved solids (TDS) increased in the untreated sewage water to very high rate 2450 mg/L and doubled to 94.2 times compared to tap water TDS concentrations. The total suspended solids (TSS) concentration also increased to high level in sewage water reaching 362 mg/L or 67 times greater than tap water with only 5.4 mg/L . The carbonates ($HCO_3$) are very high in sewage water with concentration of 415 mg/L compared to tap water with only 5.9 mg/L . The sulfates (SO4) are very high in the sewage (1296 mg/L) and semi-treated sewage 1108 mg/L) water compared to tap water (246 mg/L). The phosphates are high in the untreated sewage water (25.5 mg/L0 and 0.1< in the tap water . The ammonium ($NH_4$) , the nitrates ($NO_3$) and nitrites ($NO_2$) are also low in the tap water compared to untreated sewage water . The macro-elements Ca, Mg, K, Fe are high in the sewage water compared to tap water , while Na and Cl are very high in sewage water (576 and 768 mg/L) compared to tap water with 0.1< mg/L .

Table (1): Concentration of the main elements (mg/L) in normal water and sewage water semi-treated and untreated:

| | | Sewage water | |
|---|---|---|---|
| Element | Tap water | untreated | Semi-treated |
| pH | 6.5 | 6.3 | 6.5 |
| TDS | 25.8 | 2450 | 25.8 |
| TSS | 5.4 | 362 | 5.6 |
| $HCO_3$ | 5.9 | 415 | 60.2 |
| $SO_4$ | 246 | 1296 | 1108 |
| $PO_4$ | 0.1< | 25,5 | 0.1< |
| $NH_4$ | 9.1 | 23.8 | 20.5 |
| $NO_3$ | 7.3 | 22.4 | 10.2 |
| $NO_2$ | 0.2 | 0.34 | 0.6 |
| Ca | 5.2 | 86.8 | 6.6 |
| Mg | 11.5 | 25.4 | 23.7 |
| K | 0.1< | 21.4 | 0.1< |
| Fe | 0.1< | 0,1 | 0.1< |
| Na | 0.1< | 576 | 0.1< |
| Cl | 0.1< | 768 | 0.1< |

**Concentration of micro and heavy metals in normal water and sewage water semi-treated and untreated:**

Table (2) illustrates that 8 of the heavy metals zinc (Zn), cupper (Cu), manganese (Mn), boron (B), chromium (Cr), nickel (Ni) arsenic (As) and barium (Ba) present in the untreated sewage water at concentrations significantly higher than their concentrations in the tap water, with B attaining very high concentration (1296 mg/L) in the untreated SW and 1108 mg/L in the semi-treated SW. The heavy metals molybdenum (Mo), mercury (Hg), cadmium (Cd), silver (Ag), aluminum (Al), cobalt (Co), selenium (Se) concentrations in all types of water are negligible (0.1<).

There is no significant difference in concentration of Pb between tap and sewage water.

Table (2): Concentration of micro and heavy metals (mg/L) in normal water and sewage water semi-treated and untreated:

| | | Sewage water | |
|---|---|---|---|
| Element | Tap water | untreated | Semi-treated |
| Zn | 3.3 | 25.8 | 25.8 |
| Cu | 2.8 | 5.6 | 5.4 |
| Mn | 0.9 | 60.2 | 5.9 |
| B | 4.8 | 1296 | 1108 |
| Mo | 0.1< | 0.1< | 0.1< |
| Cr | 1.6 | 20.5 | 9.1 |
| Ni | 4.1 | 10.2 | 7.3 |
| Pb | 0.5 | 0.6 | 0.2 |
| As | 0.13 | 6.6 | 5.2 |
| Ba | 10 | 23.7 | 11.5 |
| Hg | 0.1< | 0.1< | 0.1< |
| Cd | 0.1< | 0.1< | 0.1< |
| Ag | 0.1< | 0.1< | 0.1< |
| Al | 0.1< | 0.1< | 0.1< |
| Co | 0.1< | 0.1< | 0.1< |
| Se | 0.1< | 0.1< | 0.1< |

**Mean values of pH in sea water and shore water, and sea soil and shore soil:**

There is no significant differences between values of the pH in the samples of water of the polluted and unpolluted sites in the sea and the shore and coastal areas.

**Table (3): pH values in sea and shore water and soil (means + standard deviation):**

| | Type of sample | Polluted site | Unpolluted site | Significance |
|---|---|---|---|---|
| Water | Sea water | 7.,8±0,01 | 7.7±0,001 | 0.781 |
| | Shore water | 7.9±0,001 | 7.8±0,001 | 0.712 |
| Soil | Shore soil | 7.9±0,01 | 7.4±0,21 | 0.217 |
| | Coastal soil | 7.8±0,1 | 7.6±0,04 | 0.351 |

**Mean values of EC in sea and shore water, and sea and shore soil:**

Table (4) illustrates that the site polluted by sewage water exhibiteb high electric conductivity (EC) in both Sea water and soil and in both shore water and soil compared to the unpolluted site, with the shore water giving the highest EC (8.6 mm/cc).

**Table (4): EC values in sea and shore water and soil (millimose/cm) (means + standard deviation):**

| | Type of sample | Polluted site | Unpolluted site | Significance |
|---|---|---|---|---|
| Water | Sea water | 5.7± 0.19 | 4.4±0.01 | 0.031* |
| | Shore water | 8.6±0,01 | 5.1±0.001 | 0.032* |
| Soil | Shore soil | 7.3±1.3 | 5.9±1.1 | 0.029* |
| | Coastal soil | 6.9±0.4 | 5.4±0.01 | 0.026* |

**Concentration of macro -elements in Sea Water and shore water In polluted and unpolluted sites :**

Table (5) illustrates that the concentrations of the macro-elements Mg, K and P are significantly high in the Sea Water and shore water in polluted site compared to the unpolluted site, but Ca, Na and Cl show no significant variation in concentration in polluted and unpolluted sites. Sodium (Na) and Cl gave very high concentration in the Sea and shore waters in polluted and unpolluted sites, and the high concentrations of Cl and Na in the soil may be related to high concentration of soluble salts. The concentration of the six macro-elements in the shore water is higher than their concentration in the Sea water.

Table (5): **Concentration (mg/L) of macro -elements in Sea Water and shore water in polluted and unpolluted sites :**

| Element | Source | Polluted | unpolluted | Significance |
|---|---|---|---|---|
| Ca | Sea water | 446±96 | 420±59 | 0.219 |
| | Shore water | 531±107 | 491±11 | 0.070 |
| Mg | Sea water | 1495±50 | 121±67 | 0.010** |
| | Shore water | 1757±19 | 14 ±147 | 0.010** |
| K | Sea water | 44.9±3.9 | 44±4.1 | 0.001** |
| | Shore water | 60.1±9.9 | 49±14 | 0.004** |
| P | Sea water | 18.7±0.6 | 10.9±0.02 | 0.051** |
| | Shore water | 28.2±1.2 | 12.7±1.6 | 0.032** |
| Na | Sea water | 11561±251 | 11397±28 | 0.690 |
| | Shore water | 13373±184 | 11350±218 | 0.190 |
| Cl | Sea water | 15722±122 | 14312±89 | 0.102 |
| | Shore water | 19702±209 | 18588±193 | 0.352 |

**Concentration of macro -elements in Sea soil and shore soil in polluted and unpolluted sites :**

Table (6) illustrates that the concentrations of the macro-elements Ca, Mg, K, P, Na are significantly high in the Sea soil and shore soil in polluted site compared to the unpolluted site, but Cl shows no significant variation in concentration in polluted and unpolluted sites. Chlorides (Cl) gave very high concentration in the Sea and shore soils in polluted and unpolluted sites, then Na also gave high concentrations. Potassium (K) and P gave the lowest concentrations in both polluted and unpolluted sites in both Sea and shore soils compared to other elements. The high concentrations of Cl and Na in the soil may be related to high concentration of soluble salts.

Table (6): **Concentration (mg/L) of macro -elements in Sea soil and shore soil in polluted and unpolluted sites :**

| Element | Source | Polluted | unpolluted | Significance |
|---|---|---|---|---|
| Ca | Sea soil | 728±38 | 661±42 | 0.042** |
| | Shore soil | 1333±32 | 948±14 | 0.036* |
| Mg | Sea soil | 1131±35 | 114±21 | 0.001** |
| | Shore soil | 1011±28 | 292±49 | 0.005** |
| K | Sea soil | 382±3,2 | 52±4,5 | 0.002** |
| | Shore soil | 284±1,6 | 61±2,7 | 0.001** |
| P | Sea soil | 34.5±0.3 | 19.3±0.9 | 0.049** |
| | Shore soil | 38.7±2,7 | 18.1±0,8 | 0.37* |
| Na | Sea soil | 10208±108 | 7773±288 | 0.035* |
| | Shore soil | 6117±14 | 5370±22 | 0.028* |
| Cl | Sea soil | 22281±257 | 19115±601 | 0.022 |
| | Shore soil | 21001±174 | 18444±236 | 0.019 |

**Concentration of trace and heavy metals in Sea Water and shore water in polluted and unpolluted sites :**

Table (7) illustrates that the concentrations of the heavy metals Cu, Mn, Cr, Ni and Al are significantly high in the Sea water and shore water in polluted site compared to the unpolluted site, and the other four metals Zn, Mo, Co and Fe show no significant variation in concentration in polluted and unpolluted sites. Manganese (Mn) gave high concentration in the Sea and shore water in polluted and unpolluted sites compared to the other metals, and its concentration in water of polluted site in very high (84. Mg/L) compared to its concentration in unpolluted site (0.14 mg/L), while Zn, Co, Mo, Fe gave very low concentrations in both polluted and unpolluted sites in both Sea and shore water compared to other elements. These results correlated with the results of Gupta et al. (2008) who analyzed the chemical constituents of effluent released from sponge iron industries and distribution of heavy metals in soil near to effluent discharge channel and found that the concentration of total suspended solids (TSS), total hardness (TH), iron ($Fe^{2+}$), are greater in the nearby water than in water away from this site, and in the soil along the sides of the effluent channel also shows higher concentration of heavy metals than the background soil.

**Table (7): Concentration (mg/L) of heavy metals in Sea Water and shore water In polluted and unpolluted sites :**

| Element | Water | Polluted | unpolluted | Significance |
|---|---|---|---|---|
| Zn | Sea water | 0.12±0,001 | 0.1 | |
| | Shore water | 0.1 | 0.1 | |
| Cu | Sea water | 0.12±0,001 | 0.02±0,003 | 0.001** |
| | Shore water | 0.13±0,002 | 0.03±0,001 | 0.001** |
| Mn | Sea water | 84±0,02 | 0.14±0,001 | 0.001** |
| | Shore water | 6.27±1,3 | 0.17±0,001 | 0.001** |
| B | Sea water | 5.34±0,34 | 4.08±0,28 | 0.152 |
| | Shore water | 6.57±0,74 | 5.19±0,28 | 0.211 |

| | | | | |
|---|---|---|---|---|
| Cr | Sea water | 0.13±0,001 | 0,0002±0,001 | 0.006** |
| | Shore water | 0.13±0,002 | 0,002±0,001 | 0.006** |
| Ni | Sea water | 0.14±0,002 | 0,001±0,001 | 0.001** |
| | Shore water | 0.11±0,001 | 0,002±0,002 | 0.001** |
| Mo | Sea water | 0.1 | 0.1 | |
| | Shore water | 0.1 | 0.1 | |
| Al | Sea water | 1.9±0,001 | | |
| | Shore water | 2.1±0,01 | 0.001 | 0.001** |
| Co | Sea water | 0.01 | 0.001 | |
| | Shore water | 0.002 | 0.1 | |
| Fe | Sea water | 0.1< | 0.1 | |
| | Shore water | | | |

**Concentration of micro and heavy metals in Sea soil and shore soil in polluted and unpolluted sites :**

Table (8) shows that there are significant differences in heavy metal concentrations between Sea soil and shore soil except for Zn, Cr and Fe, and concentrations are low except for Mn with (8.74 mg/L) and (3.21 mg/L) in Sea and shore soil and B (6.91 mg/L) in Shore soil.

Table (8): **Concentration (mg/L) of heavy metals in Sea soil and shore soil In polluted and unpolluted sites :**

| Element | Water | Polluted | unpolluted | Significance |
|---|---|---|---|---|
| Zn | Sea soil | 0.1< | 0.1< | |
| | Shore soil | 0.1< | 0.1< | |
| Cu | Sea soil | 0.07±0,00004 | 0.02±0,003 | 0.025* |
| | Shore soil | 0.9±0,001 | 0.03±0,001 | 0.015* |
| Mn | Sea soil | 8.74±0,92 | 0.24±0,06 | 0.001** |
| | Shore soil | 3.21±1,7 | 0.37±0,02 | 0.001** |
| B | Sea soil | 0.1±0,06 | 2.49±0,03 | 0.009** |
| | Shore soil | 6.91±0,02 | 2.48±0,03 | 0.007** |
| Cr | Sea soil | 0.1< | 0.1< | |
| | Shore soil | 0.1< | 0.1< | |
| Ni | Sea soil | 013±0,001 | 0.001±0,0001 | 0.006** |
| | Shore soil | 0.12±0,001 | 0.001±0,0001 | 0.006** |

| | | | | |
|---|---|---|---|---|
| Mo | Sea soil | 0.01 | | |
| | Shore soil | 0.01 | | |
| Al | Sea soil | 0.02 | | |
| | Shore soil | 0.08 | | |
| Co | Sea soil | 1.3±0,002 | 0.03±0,001 | 0.007** |
| | Shore soil | 0.24±0,003 | 0,001 | 0.004** |
| Fe | Sea soil | 0,003 | 0,001 | |
| | Shore soil | 0,002 | 0,001 | |

## DISCUSSION

### pH value:

pH is an indicator of the acidity or basicity of water but is seldom a problem by itself. The normal pH range for irrigation water is from 6.5 to 8.4; pH values outside this range are a good warning that the water is abnormal in quality. The results indicated no significant differences in pH vales in the sewage water and tap water and it ranged between (6.3-6.5), and also in Sea and shore water, and in Sea and shore soil and ranged between (7.4-7.9). So pH reduced in sewage water compared to tap water and this agrees with the finding of Alghobara et al. (2014), but not with the findings of Ghafoor et al. (1995) who mentioned increase of pH value in sewage water compared to normal water. On the other hand El-Khateeb et al. (2012) found pH in sewage water to range between (8.01 to 8.40). It seems that pH value in sewage water varies according to elements and constituents dumped in the sewage water.

### Electrical conductivity (EC):

Electrical conductivity (EC) is widely used to indicate the total ionized constituents of water. It is directly related to the sum of the cations (or anions), as determined chemically and is closely correlated, in general, with the total salt concentration. Electrical conductivity is significantly high (≤0.05) in Sea and shore water and in Sea and shore soil in the polluted site compared to unpolluted soil, and is highest in the polluted shore soil (8.6 ds/m). This finding agrees with that of Alghobara et al. (2014) who found increase in EC of soil irrigated with sewage water, and increase in EC is due to salt input.

### Macro-elements in sewage water and tap water:

Sewage water is mainly comprised of water (99.9%) together with suspended and dissolved organic and inorganic solids. The physicochemical characters studied are , total dissolved solids (TDS), total suspended solids (TSS), calcium, magnesium, chloride, potassium, iron, sodium, chlorides. **Increase in TDS concentrations in polluted waters often result from industrial effluent, changes to the water balance (by limiting inflow, by increased water use or increased precipitation), or by salt-water intrusion**. The total dissolved solids (TDS) in untreated sewage water is very high (2450 ds/m) compared to tap water (25./ ds/m) , also the sulfate ($SO_4$) is very high in sewage water (1296 ds/m) compared to tap water (246 ds/m). This is positively correlated with the finding of Al-Salem (1987) were the total dissolved solids IN AMMAN, JORDAN ranged up to 1170 mg/l, while in other places it is low, Krishnan et al. (2007) registered TDS in sewage water to be 200 mg/L in three different places of Sivakasi . This indicates that TDS concentration in sewage water varies with variations in organic and inorganic materials deposited in the water. The term TSS is often used to describe the concentration of solid-phase material suspended in water-sediment mixture, and usually expressed in milligrams per liter (mg/L) . The total suspended solids (TSS) in sewage water are also high (362 mg/L) compared to tap water (5.4 mg/L) , and is in correlation with the results of Krishnan et al. (2007) who got high TSS in sewage water reaching 150 mg/L, and with results of Al-Salem, (1987) who detected 900 mg/L TSS in waste water in Amman, Jordan, also with the results of (Sulthana et al. 2013; Ghafoor et al. 1995). Carbonate ($HCO_3$) concentration in the sewage water are very high (415 mg/L) compared to tap water with only (5.9 mg/L). On the other hand the phosphate (PO4), ammonium (NH4), nitrate (NO3), nitrite ($NO_2$), are high in sewage water compared to tap water. This is in agreement with the results of [Ghafoor et al. 1995] who advocated high values of pH, hardness, alkalinity, total soluble salts, nitrates, nitrites and cations like sodium, potassium, calcium and magnesium in sewage water compared to normal water. As for the macro-elements Ca, Mg, K, Na, Cl their concentrations are significantly high in sewage water compared to normal water, and the highest concentration is for the chloride (Cl) and sodium (Na). This is positively correlated with the findings of Krishnan et al. (2007) and Abdel-Ghaffar et al. (1988) who registered concentration of Cl in waste water up to 222.1 and 320 mg/L , and Na up to 205 mg/L, Ca up to 128 mg/L, Mg up to 96 mg/L, K up to 35 mg/L . Iron (Fe) is negligible in both sewage and tap water.

### Macro-elements in Sea and shore water in polluted and unpolluted sites:

The macro-elements calcium (Ca), magnesium (Mg), potassium (K), phosphorus (P), sodium (Na), chlorides (Cl) analyzed in Sea and shore water gave variable concentrations in these waters, and all gave higher concentrations in polluted site compared to the unpolluted site, with significant differences in concentrations between the two sites in both Sea and shore water in the case of Mg, K and P. Chlorides (15722 mg/L and 19702 mg/L) and sodium (11561 mg/L and 13373 mg/L) attained very high concentrations in both Sea and shore water in polluted and in unpolluted sites . This is positively correlated with the values obtained by (Anthoni, 2006) who found that chlorides (Cl) and sodium (Na) in seawater had attained the highest concentrations (19345 and 10752 mg/L respectively). This result can also be correlated with the results of (Rump ,1999) who said that Sodium (Na) is one of the elements in natural waters and its concentration varies and reaches more than 1000 mg/L in salty waters , and its content increases in sewage water . Ca reached (416 mg/L) and Mg is high reached (1295 mg/L), and as (Rump, 1999) said Mg is one of the elements found in abundance in the earth crust. It is clear that concentration of the elements are higher in the shore water compared to the Sea water. This is because the shore water is not subjected to mixing with other water like seawater.

### Macro-elements in Sea and shore soil in polluted and unpolluted sites:

Concentrations of the macro-elements (Ca), (Mg), (K), (P), (Na), (Cl) in Sea and shore soil show significant differences between the polluted and unpolluted sites and also between Sea and shore soil concentrations. Chlorides and sodium attained very high concentrations in both Sea and shore soils in polluted and in unpolluted sites, Cl gave (22281 mg/L in polluted and 19115 mg/L in unpolluted Sea soil, and 21001 mg/L in polluted and 18444 mg/L in unpolluted shore soil) and Na attained (10208 mg/L in polluted and 7773 mg/L in unpolluted Sea soil, and 6117 mg/L in polluted and 537 mg/L in unpolluted shore soil). Mg, K, Na and Cl gave higher concentrations in Sea soil compared to the shore soil, while concentrations of Ca and P are significantly high in shore soil than in Sea soil .

### Heavy metals and trace elements in Sea and shore water in polluted and unpolluted sites:

These are elements which normally present in relatively low concentrations, usually less than a few mg/l. Heavy metals are a special group of trace elements and the ten studied here included Zinc (Zn), Copper (Cu), manganese (Mn), boron (B), Chromium (Cr), nickel (Ni), molybdenum (Mo), aluminum (Al), cobalt (Co), iron (Fe) . These are called heavy metals because in their metallic form, their densities are greater than 4g/cc. Concentrations of most of these trace and heavy metals in the Sea and shore water are low less than one (≤0.1 mg/L), with exception of Mn with 8.4 mg/L in Sea water and 6.27 mg/L in shore water, B with 5.34 mg/L in Sea water and 6.57 mg/L in shore water and Al with 1.9 mg/L in Sea water and 2.1 mg/L in shore water . Concentrations of Cu, Mn, Cr, Ni, Al in Sea and shore water at polluted site are significantly higher than their concentration in unpolluted site, while Zn, B, Mo, Co and Fe showed no significant differences between their concentrations in Sea and shore water between the polluted and unpolluted sites. These results are in positive correlation with the results of (Alghobara et al. 2014) who found significant increase ($p < 0.05$) of Fe, Mn, Cu, Zn and Pb in area subjected to sewage water compared to area not subjected to sewage water.

### Heavy metals and trace elements in Sea and shore soil in polluted and unpolluted sites:

Concentrations of most of the trace and heavy metals in the Sea and shore soil are low less than one (≤0.1 mg/L), with exception of Mn with 8.74 mg/L in Sea soil and 3.21 mg/L in shore soil, B with 2.49 mg/L in Sea soil and 6.91 mg/L in shore soil and Co with 1.3 mg/L in Sea soil and 0.24 mg/L in shore soil. There are significant differences between concentrations of Cu, Mn, B, Ni, Co in Sea and shore soil at polluted site and unpolluted site, while Zn, Cr, Co and Fe showed no significant differences between their concentrations in Sea and shore water between the polluted and unpolluted sites. Zinc, Cr and Fe concentrations are very low in both Sea and shore soil, and Cu and B concentrations are high in shore soil, but Mn concentration is high in Sea soil. It can noted that the trace and heavy metal concentrations in Sea and shore water are higher than their concentrations in the Sea and shore soil except for Co. Ali et al. (1996) mentioned that sewage water contains significant amounts of toxic metals such as arsenic, chromium, cadmium, copper, lead, nickel, zinc, cobalt, magnesium and iron compared to soil.

## CONCLUSION

There is overall increase in the total dissolved solids (TDS), total suspended solids (TSS), bicarbonates, sulfates, phosphates, ammonium and nitrates in the untreated and semi-treated sewage water compared to tap water. Calcium (Ca), Mg, K, Na, Cl concentrations are higher in untreated and semi-treated sewage water than in tap water , particularly chlorides, sulfates, TDS which gave very high concentrations in sewage water. Sewage water untreated and semi-treated dominated tap water in concentrations of trace and heavy metals Zn, Cu, Mn, B, Cr, Ni, As and Ba. The EC in Sea and shore water and soil in polluted site are significantly higher than in unpolluted site. The concentrations of Mg, K and P in Sea and shore water and Ca, Mg, K, P and Na in Sea and shore soil in polluted site are significantly higher than in the unpolluted site. Sodium (Na) and Cl concentrations are very high in Sea and shore water and soil in both polluted and unpolluted sites. The concentrations of Cu, Mn, Cr, Ni, Al in Sea and shore water and in Sea and Cu, Mn, B, Ni, Co, shore soil are significantly higher in polluted site than in unpolluted site. The dangers of discharging sewage water into the Red Sea water will pollute the Sea water and Shore soil , and this will be having adverse and toxic effects on fishes and other organisms living in Sea water , and these toxic metals will find their way into the fishes and consequently into the human body feeding on these fishes. Also forage plant species growing in the vicinity of these areas will accumulate toxic heavy metals and when animals graze on them they will reach the human bodies. Discharge of industrial waste water in sea water generally can lead to accumulation of heavy metals in the tissues of the organisms (Gochfeld, 2003; Yi et al 2008).

## REFERENCES

Abdel-Ghaffar A.S., El-Attar H.A. and Elsokkary I.H. (1988) Egyptian experience in the treatment and use of sewage and sludge in agriculture. Ch. 17, Treatment and Use of Sewage Effluent for Irrigation, M.B. Pescod and A. Arar (eds). Butterworths, Sevenoaks, Kent.

Alghobar, M. A.; Ramachandra, A. ; Suresha, S. (2014). Effect of sewage water irrigation on soil properties and evaluation of the accumulation of elements in Grass crop in Mysore city, Karnataka, India. American Journal of Environmental Protection 2014; 3(5): 283-291.

Ali, K., Javid, M.A., Javid, M., (1996). Pollution and industrial waste. 6th National Congress Soil Sci., Lahore. 122-131.

Al-Salem, (1987). Evaluation of Al- Samra Waste Stabilization Pond System and its suitability in unrestricted irrigation . Paper presented to the Land and Water Department Division . Food and Agriculture Organization , UN, Rome.

Anthoni,J.F.(2006). Chemical composition of seawater. www.seafriends.org.nz/oceano/seawater.htm

Basaham, A. S., A. E., Rifaat, M. H., El-Mamoney and M. A., El-Sayed. (2009). Re-evaluation of the impact of sewage disposal on coastal sediments of the southern corniche, Jeddah, Saudi Arabia. J.K.A.U. Marine Sci., 20, 2009, pp.109-126.

Censi P.; Spoto SE.; Salano F.; Mazzola S. (2006). Heavy metals in coastal water system. A case study from the North Western Gulf of Thailand. Chemosphere 64:1167-1176.

Coban B.; Balkis N. and Aksu A. (2009). Heavy metal levels in Zonguldak, Turkey. J. Black Sea, Mediterranean Environ., vol.15: 23-32.

El Sayed, M.A. (2002b) Distribution and behavior of the dissolved species of nitrogen and phosphorus in two coastal Red Sea lagoons receiving domestic sewage, JKAU: Mar. Sci., 12: 47-73.

El-Khateeb, M.A. A.M. Arafa, A.M. Abd El-Dayem and R.A. Watfa (2012). Effect of Sewage Water Irrigation on Macro Nutrients, Heavy Metals and Frequency Percentage of Fungi in Soil Cultivated with Woody . Journal of Horticultural Science & Ornamental Plants 4 (2): 177-185, 2012 ISSN 2079-2158

**El-Nakhlawy** F.S., Shaheen M. and Ishan M. (2016). Assessment of landscape health status by *Cyperus rotundus* and soil analysis under waste water irrigation. Planta Daninha 2017; v35:e017161097.

El-Riyadh News Paper (2012). Project signed to increase water supply in Kingdom. The Saudi National Water Company.

El-Sayed, M.A. and Niaz, G.R. (1999) Study of Sewage Pollution Profile along the Southern Coast of Jeddah, Study of Some Organic and Inorganic Pollutants. Report, KAU, SRC, p. 111.

El-Yami M.Y. (2010). Ecological studies of some Molluscs in Jeddah area on Red Sea Coast with special emphasis on the accumulation of certain heavy metals in their tissues. Ph.D thesis Zoology (Marine Science), 2010.

FAO. (1985). Water quality for agriculture. R.S. Ayers and D.W. Westcot. Irrigation and Drainage Paper 29 Rev. 1. FAO, Rome.174p.

Ghafoor, A., Rauf, A., Arif, M., Muzaffar, W., (1995). Chemical composition of effluent from different industries of the .Faisalabad city. Pak. J. Agric. Sci., 31: (4) 367-369.

Gupta, S., S. Nayek, R.N. Saha and S. Satpati, 2008. Assessment of heavy metal accumulation in macrophyte, agricultural soil and crop plants adjacent to discharge zone of sponge iron factory. Environ. Geol., 55: 731-739.

Krishnan, R. R.; Dharmaraj, K.; Kumari, B. D. (2007). A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. Journal of Environmental Biology January, 28(1) 105-108

Pote JL, Haller JL, Loizeau AG, Bravo V, Satri G; Wildi W. (2008). Effect of sewage treatment plant outlet pipe extension on the distribution of contaminants in the sediment of the bay of Vidy, lake Geneva, Swizerland, Bioresour, Twchnol; 99:7122-7131.

Radwan K.M. (2009). Spacial and seasonal distribution of total dissolved copper and nickel in the surface coastal waters of Rabigh, Eastern Red Sea, Saudi Arabia. J. Earth Sci., vol. 22, No. 1: pp. 29-44.

Rump,H.H., (1999). Laboratory Manual for the examination of water , wastewater and soil. 3rdedn., Wily –VHC. New York.

Saad MAH and Fahmy MA (2009) Heavy metal pollution in coastal Red
Sea waters, Jeddah. J KAU: Mar Sci 7:67–73

Sulthana, A., Latha, K.C., Ramya, R., Sridhar, R., Balasubramanian, S., (2013). Factor Analysis and Discriminant Analysis of Wastewater Quality in Vidyaranyapuram Sewage Treatment Plant, Mysore, India: A Case Study. Environmental & Analytical Toxicology. 3-7.

Wcisio E; Loven D; Kucharski R; Szdzuj J (2008). Human health risk assessment, case study. An abandoned metal smelter site in Poland. Chemosphere 96:223-230.

Wen C; Kao CF; Chen CF; Dong CD (2007). Distribution and accumulation of heavy metals in sediments of Cachsiung harbor. Taiwan. Chemosphere 66:1431-1440.