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*Full Length Research Paper*

# Assessment of lead content in effluent of WWTP used agriculture in the scope of market garden of Sebkha (Nouakchott, Mauritania)

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**In order to contribute modestly to the assessment of lead content in the effluent of the WWTP in the scope of Sebkha gardener, the samples were taken at the WWTP between October and December 2011. In addition to studying the evolution of lead, electrical conductivity, chlorides, sodium and chemical oxygen demand were studied with the statistical analysis methods were applied to the results obtained. The results show that lead levels recorded at the effluent of the WWTP ranging from 104.5 µg/L and 176.5 µg/L. The statistical analysis of results shows that lead is strong and positive correltion with electrical conductivity, chloride and sodium and positively moderately correlated and significant with the Chemical Oxygen Demand.**

**Keywords**: Lead, effluent, Aftout Es Sahli, Sebkha, Nouakchott, Mauritania.

## INTRODUCTION

The mixture of industrial and domestic wastewater contains nitrogen, phosphorus, potassium, total dissolved solids, viruses, trace organic and trace metals specially heavy metals. Living organisms require trace amounts of some heavy metals including cobalt, copper, iron, manganese, molybdenum, vanadium, strontium, and zinc. Excessive levels of essential metals however, can be detrimental to the organism. Non-essential heavy metals of particular concern to surface water systems are cadmium, chromium, mercury, lead, arsenic, and antimony (Kennish, 1992). Heavy metals come from local sources mostly industry (mainly non-ferrous industries, but also power plants and iron, steel and chemical industries), agriculture (irrigation with polluted water use of mineral fertilizers especially phosphates, contaminated manure, sewage sludge and pesticides containing heavy metals) from waste incineration, burning of fossil fuels and road traffic. Water pollution by heavy metals is mainly caused by point source emissions from mining activities and a wide variety of industries.Metals are used

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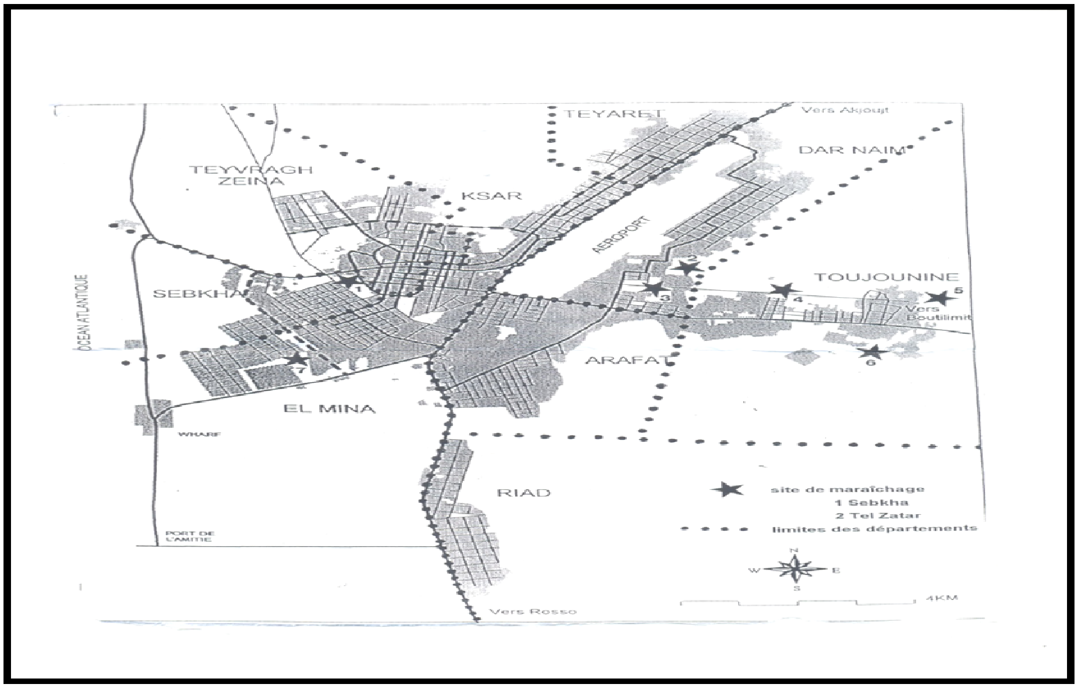


**Figure 1.** The map of localisation of Nouakchott city.

by man as well as reactive materials in industry (surface treatment, chemical intermediate,) and agriculture (pesticides). Industrial activities, as well as car traffic emit fine metal particles in the atmosphere, mainly in urban areas (Azimi et al., 2005).

Metals are deposited and spread in various environmental compartments such as water bodies and soil. Metals deposited on soils, however, can reach streams by runoff during rainfall events. In the case of combined sewer collection of wastewater, the wastewater is composed of a mixture of domestic sewage, industrial wastewater and stormwater. The metals in runoff from atmospheric deposition but also the corrosion of runoff surfaces (eg roofs, gutters) (Gromaire et al., 2001).

Indeed, most metals in runoff are mainly associated with suspended solids or colloids (Makepeace et al., 1995). In industrial water, metals direct result of their use in industrial processes. These wastewaters are characterized by high variability of their pollutant load. The metal load of domestic sewage is rather cyclical as it flows from the daily activity of households. The metals contained in household wastewater are caused on the one hand, the corrosion of drinking water pipes and, secondly, the use of metals in household activities and household products. In some areas, the tailings are, also, a point source of heavy metals (Braungardt et al., 2003; Figuiera and Roberto, 2005).

Lead exists in inorganic form, as opposed to its organic form such as tetraethyl lead, which comes mostly from the combustion of fuels and whose toxicity is more important to aquatic organisms (Body et al., 1991). Lead is indeed responsible for numerous adverse humans (brain disorders, reproduction and metabolism ...). Lead accumulates in the tissue of the legs. The type of lead poisoning causes the most severe encephalopathy. Lead toxicity is induced by lead ions react with certain groups of proteins such as enzymes. They are disabled. Lead can also interact with other metal ions.

Wastewater irrigated urban Nouakchott in the scope of vegetable Sebkha have been several studies: microbiological, physicochemical (Cissé and Tanner., 2000; N'diaye et al., 2010). These studies showed the one hand the existence of two groups of effluents: an effluent domestic and industrial effluent from a few industrial units connected to the sewerage system. On the other hand, the presence of two types of pollution: pollution from salt and organic industrial units connected to the WWTP (Treatment Plant Polluted Waters) and a phosphate and nitrogen pollution from discharges of some domestic quarters connected to the network sanitation of the city. This study, which is part a result of this work, is to contribute modestly to the assessment of lead content in the effluent of the WWTP in the scope of Sebkha gardener (Figure 1).

## MATERIALS AND METHODS

### Study of Area

The area of present study is the city of Nouakchott is a coastal city, located about 18 °07 North latitude and

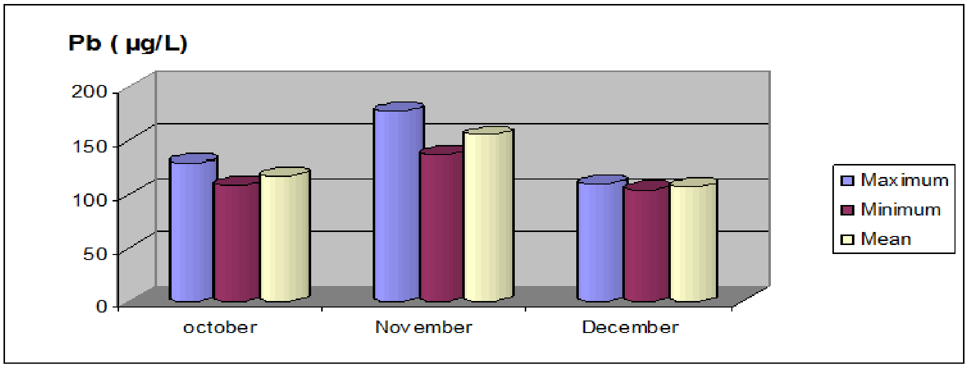


**Figure 2.** Variations in Lead recorded during October to December 2011.

16 °01 West longitude as Nouakchott is located in the southern part of the Sebkha Ndramcha which locates a sub-ply flush and its level is directly related to that of the Atlantic Ocean. Nouakchott is supplied with drinking water from the well field to Idini, located on the road of hope about 60 km from the city (Mint El Bezeid, 2006).

The network of water supply in the city of Nouakchott does not cover all urban areas. Eighty percent of the populations get their supplies from boreholes where to buy water or donkey tankers (Ould, 2007). These methods are adequate with a sparing use of water. The demographic and economic growth experienced by the city in recent years and future development plans PIP (Priority Investment Plan) will result in a change of lifestyle habits and the appearance of more intensive urban water. These factors bode therefore higher consumption. Finally, the ultimate cause, which advocates a conservative assumption, is to liaise with global warming which is confirmed in this part of West Africa (Nouaceur, 2008).

Note that currently the city of Nouakchott is supplied with drinking water from the wellfield Idini, located on the road of hope about 60 km from the city and the largest amount comes from the Senegal River (Aftout ES Sahli). The city of Nouakchott benefits only up to 4% of system sewage through the sewer. This wastewater is routed to the WWTP. The rest of the population use latrines, pits and cesspools, septic tanks or has no exhaust system at all (STUDI, 2000). Collection site where the sewage is all raw sewage drained by some of the city of Nouakchott and some industrial units and hospital also connected to the WWTP.

## Sampling and analysis of wastewater

The samples were made at the WWTP between October and December 2011.

The wastewater samples were collected in polyethylene bottles of 1 liter. The analyzes were carried out immediately after sampling, the laboratory water chemistry of the INRSP (National Institute for Research in Public Health) of Nouakchott. The parameters studied are lead (Pb), Electrical Conductivity (EC), Chlorides ($Cl^-$), sodium ($Na^+$) and Chemical Oxygen Demand (COD).

The electrical conductivity was measured by a conductivity type Hanna HI 8733. The chlorides are measured by volumetric method in the presence of Mohr silver nitrate. For sodium, a photometer flame atomic emission Corning type is used. Lead was determined by the hydride generation method using an Atomic Absorption Spectrophotometer Fluorescence AFS 9130 Beijing Titan Instruments Co. Ltd. COD was determined with a Spectrophotometer HACH DR 5000 model. The Inter-elemental correlation was obtained intermediate with XLSTAT 2010 Software.

## RESULTS AND DISCUSSION

Figure 2 shows the temporal evolution of lead content in the effluent of the WWTP. Effluents from the WWTP are characterized by levels of lead ranging from 104.5 µg/L and 176.5 µg/L (Figure 2). Lead levels recorded at the WWTP effluent are well below 5 mg/L considered the concentration limit for irrigation water (Ministry of Environment of Morocco, 2002).

Table 1 gives the maximum, minimum, average and standard deviations of other physicochemical parameters such as electrical conductivity, chlorides, sodium and COD recorded from samples taken between October and December 2011. The maximum average value of conductivity recorded in the effluent of the WWTP is 1560 µS/cm and the mean minimum is 1050 µS/cm (Table 1). The maximum value reached in chloride recorded at the WWTP is 248 mg/L and the minimum value is 158 mg/L with an average of 248 mg/L (Table 1). However the maximum and minimum concentrations of sodium in the WWTP effluent are 61 mg/L and 74 mg/L (Table 1). COD values ranged from 75 mg/L and 250 mg/L with an average of 152.9 mg/L (Table 1).

Data processing of the five parameters by principal

**Table 1.** Statistics of the analytical data.

| Variable | Minimum | Maximum | Mean | Standard Deviation |
|---|---|---|---|---|
| **EC (µS/cm)** | 1050 | 1560 | 1333,1 | 188,3 |
| **$Na^+$ (mg/L)** | 61 | 74 | 66,6 | 5,15 |
| **$Cl^-$(mg/L)** | 158 | 248 | 200,1 | 30 |
| **COD (mg/L)** | 11,2 | 21,2 | 16,6 | 3 |

**Table 2.** Inter-elemental correlation.

| Variables | Ec | $Na^+$ | $Cl^-$ | Pb | COD |
|---|---|---|---|---|---|
| **Ec** | **1** | | | | |
| **$Na^+$** | 0,930 | **1** | | | |
| **$Cl^-$** | 0,733 | 0,594 | **1** | | |
| **Pb** | 0,826 | 0,815 | 0,886 | **1** | |
| **COD** | 0,234 | 0,460 | 0,323 | 0,580 | **1** |

component analysis, using variables such as electrical conductivity, lead, chlorides, sodium, and COD and individuals as the nine samples taken between October and December 2011. The correlation matrices are intermediate data in Table 1.

Lead has a strong positive correlation with the chlorides (0.886), electrical conductivity (0.825) and sodium (0.815) (Table 2). Correlations between lead and minerals Na +, Cl-and electrical conductivity, we can say that the lead content in the effluent of the WWTP's behavior as inorganic lead salts. Lead is present in a variety of sources: old pipes (thus running water in this case), old paint, lead batteries, wiring, fillings, ammunition, formerly gasoline, PVC plastics, pens, pesticides, printing ink, fertilizer, cosmetics, hair dyes, etc. We can say, probably, than any system designed to eliminate lead in the effluent of the WWTP has to go through desalination, demineralization, etc.

Lead is positively correlated with COD (0.580) (Table 2). COD represents the oxygen consumed by oxidizable matter in the water chemically. It is representative of most of the organic compounds but also oxidizable inorganic salts (sulfides, chlorides, etc.). COD allows assessing the concentration of organic or inorganic materials, dissolved or suspended in water, through the amount of oxygen necessary for their total chemical oxidation (Rodier, 1996). The positive correlation between lead and COD informs us a close connection between lead and organic compounds in the WWTP effluent especially organic derivatives such as tetraethyl lead from petroleum urban cars and stations selling hydrocarbons. Knowing that the organic lead is used in the production of oil. Most lead is used industrially applied to the manufacture of computer and television screen. The compound tetraethyl lead is used as a fuel additive. Early manufacturers have liked to have fuel efficient at high octane. That is why, dice 1930, the bodies antioxidants such as tetramethyl lead (Pb $(CH_3)_4$) were introduced in petrol. Delaying the explosion of the fuel air, their use can increase the octane rating of near 20%. Unfortunately, lead can cause severe disease lead poisoning.

## CONCLUSION

Overall, the analysis of the WWTP effluent used in agriculture in the scope of vegetable Sebkha showed the presence of lead at variable concentrations but do not exceed the maximum limits for water intended for irrigation (Ministry of Environment of Morocco, 2002). The irrigation from wastewater will bring these elements, but other trace elements, not necessary for the plant such as lead, mercury, cadmium, bromine, fluorine, aluminum, nickel, chromium, selenium and tin. The bioavailability of these elements in the soil can cause their accumulation in plant tissues and in some cases; the contents of these elements can reach levels of phytotoxicity (Faby and Brissaud, 1997).

However, Yadav et al. (2002) found that levels of heavy metals in plants irrigated with sewage for 30 years are below the toxicity threshold for plants. Compared to these two findings, the study of the mobility of lead in soil in the scope of Sebkha gardener becomes an imperative.

In this study, we see that there is a close relationship between human activities in the city, consumer products at large and the compounds found in water.

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