International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 8 No. 2 Sep. 2014, pp. 705-716

http://www.ijias.issr-journals.org/

The impact of leachate on well water (city dump of Kenitra, Morocco)

Mina Elmarkhi, Sanae Sadek, Khadija Elkharrim, Fatima Benelharkati, and Driss Belghyti

Biology / Ibn Tofail University, Morocco

ABSTRACT: Our study is the follow up and spatial analysis of a number of physico-chemical parameters of water wells located at different distances from the city dump Kenitra. The absence of a source of drinking water in the region pushes the population to feed by groundwater sinks. The results show that the majority of the analysed parameters exceed drinking water standards for the discharge of three wells (P1, P2, P3) at said source of water, it is found that the pH (7.8) EC (3.3ms/cm), Ca^+ Mg (7.6ms/cm), Ca^{2+} (186.4mg/L) Mg^{2+} (80.6 mg/l) , Na^+ (43.7 mg/l), K^+ (6.6 mg/l) NH_4^+ (2.7mg/l), Cl (94.5 mg/l), HCO_3(287.7mg /l), CO3 (797.5 mg / l), SO_4 (26.0 mg / l).
Far exceed the WHO drinking water standards and water standards and Moroccan waters twenty wells in the area Mnasra physicochemical results Ph (7.4) EC (0.8ms/cm), Ca Mg^+(3.1ms/cm), Ca_2^+(106.8mg/l), Mg_2^+ (11.3 mg/l), Na^+(68.5 mg / l), K^+(7.4 mg/l) NH_4^+ (2 mg/l), Cl (94.5mg/l), HCO_3(236.4 mg/l), CO_3(95.8 mg/l), SO_4(86.3 mg/l), Thus, the diagnosis revealed the presence of a very important pollution by leachate wells discharge is compared with the well Mnasra region. As well as the phenomenon of the increase of the water can be generated by processes of erosion, leaching and infiltration of land in the region (phosphate layers, marl and limestone intercalated) caused by the acidity due this pollution

KEYWORDS: Physical, chemical, water from underground wells, infiltration, leaching, pollution, discharge.

1 INTRODUCTION

Microbiological contamination, parasitological, virological and physico-chemical water groundwater poses real public health problems. Thus, the non-potable water consumption is the leading cause of mortality and morbidity in the world [1] , 88% of cases of diarrhea worldwide are attributed to unsafe water consumption, inadequate hygiene or insufficient is responsible for 1.5 million deaths each year, mostly among children ([2], [3]). Urban agriculture is practiced in a very fragile ecosystem (permeable soil, groundwater surface water). In this context, we used some physico-chemical elements as an indicator of inorganic pollution in nearby groundwater dischargehence the interest in our study on chemical impacts on the quality of the water.'Groundwater Oueladberjal of the region of where it has been on three wells échantionnage (Pa, Pb, Pc) of the discharge and twenty wells (P1, P2, ..., P20) of the Mnasra region, the analyzes were performed the laboratory L'ORMVAG (Office régional de la mise en valeur agricole de GHARB) of KENITRA.

2 MATERIALS AND METHODS STUDY

2.1 PRESENTATION OF THE OULED BERJAL DISCHARGE KENITRA

The landfill Kenitra of OuledBerjal "Is located 5 Km north of the city, on the secondary road from Sidi Allal Tazi to Kenitra, On the left bank of the estuary of the river Sebu. This is a landfill located within the urban area in a loop of the Oued Sebu surrounding sides East, South and West, not far from the port and industrial area. The landfill is located 3 km north of the town of Kenitra.

2.2 PHYSICO-CHEMICAL ANALYZES

Analyses are performed at the level of the laboratory environment of the Faculty of Science.

3 RESULTS AND DISCUSSION

3.1 POTENTIAL HYDROGEN (PH) WATER WELLS

The pH is an indicator of pollution by excellence, it varies following to the basic nature of the effluent (cooking, washing...) or acid (acetic acid and chlorinated derivatives ...), the biological pH range of between 5.5and 8.5. Outside this range, the pH has adverse effects on aquatic life and blocks assimilative process [4]. A decrease in pH may increase toxicity [5].

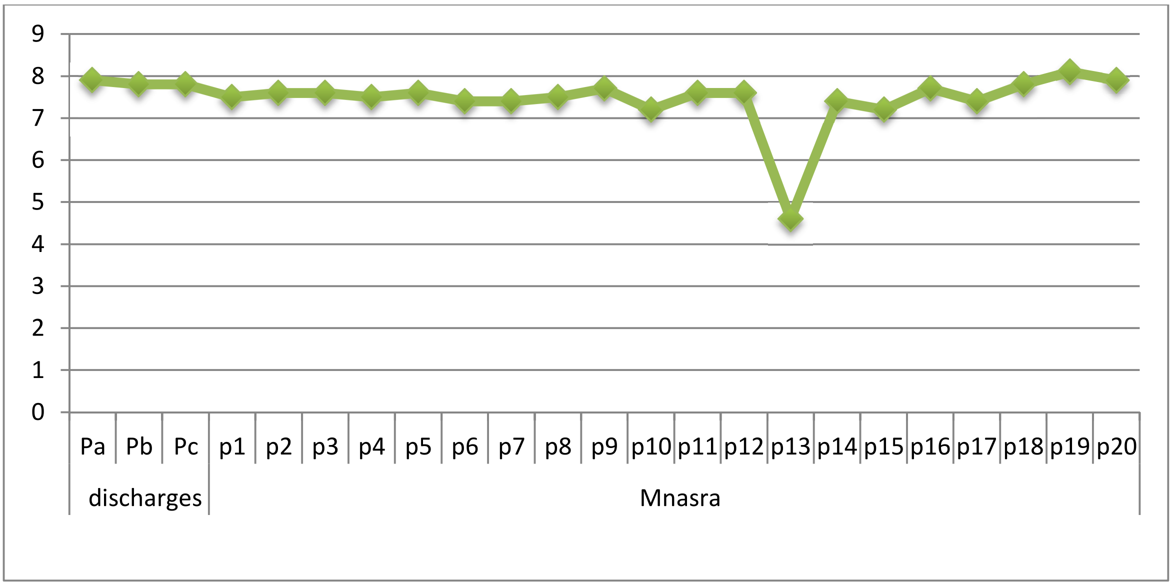

Figure 1: Variation temporelle du pH des eaux de puits.Figure1: Temporal variation in the pH of well water

Ph values recorded at wells around the landfill oulad Berjal (P1, P2 ... P20) range between 8.1 and7 same values found water ph of the three wells discharge (Pa, Pb , Pc), they meet the standards authorized (CNS), except that the P 13 is 4.6.

3.2 CONDUCTIVITY

The electrical conductivity reflects the total mineralization of water. It is the ability of a solution to conduct an electric current. This ability depends on several factors such as the presence of ions, and their total concentrations. She tells us a good approximation of salinity. High conductivity results in either an abnormal ph or, more often, a high salinity of natural or anthropogenic [6].

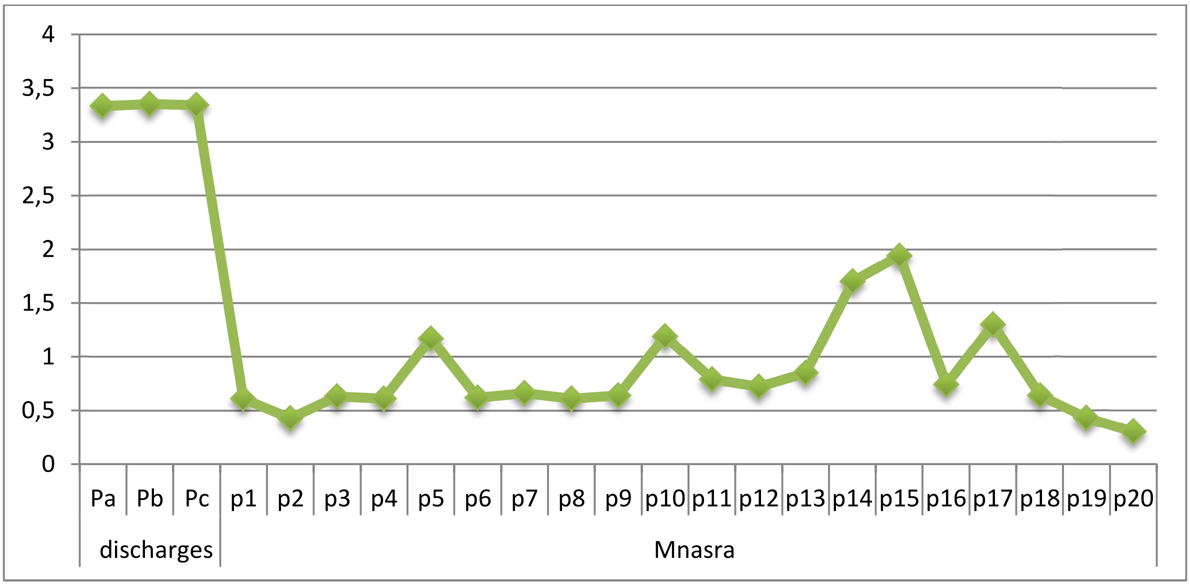

Figure 2: Temporal Variation of electrical conductivity (ms/cm) water wells

The average value of the conductivity of water wells in Mnasra is around 0.82 mS/cm with a minimum 0.33 mS/cm and a maximum value of 1.94 mS/cm value, there is a fluctuation over at least substantially between the various wells, the discharge exhibits a high mineralization of about 3.33 mS/cm due to the organic material and evaporation phenomenon, this value exceeds 2700µs/cm, considered to limit direct discharge.

3.3 SALINITY

The salinity of the water depends on various factors and represents the total solids dissolved in water. Aquatic organisms can tolerate a specified amount of salt in the water. Very high or very low salinity affects their distribution in the water. Streams are exposed to significant variations in salinity due to seasonal climatic changes.

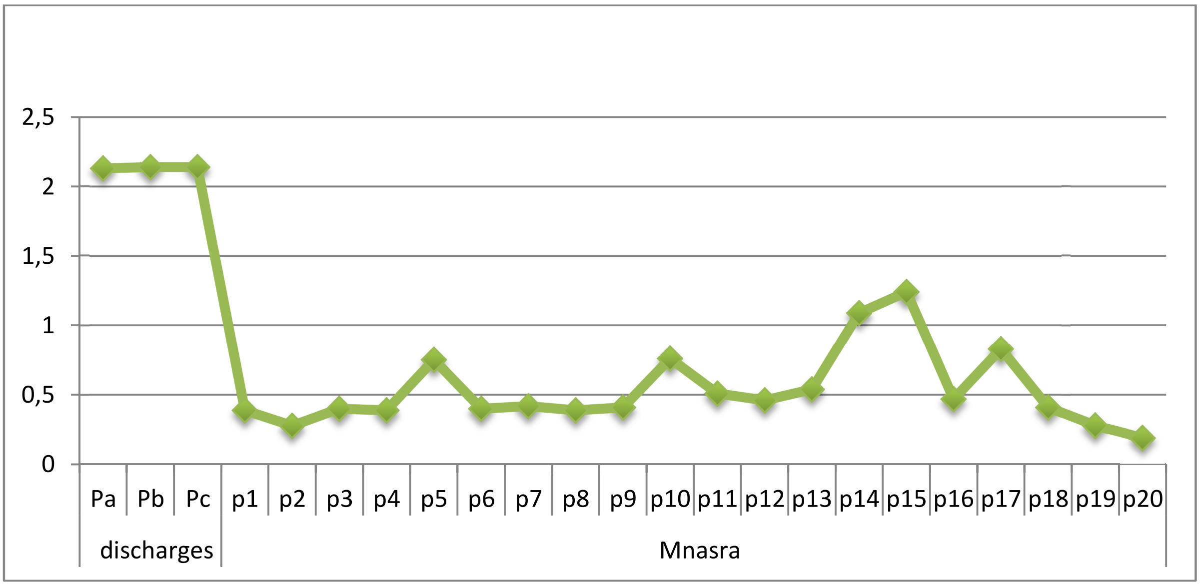

Figure3: Temporal Variation of salinity well water

The results are correlated with the results of the conductivity (ms / cm). The values of salinity wells located around the site during the study period ranged from a minimum of 0.19 g/l and a maximum de1.24 g/l with an average of 0.53 g /l. same salinity three wells discharge is 2.14 g/l which is attributed to the contribution of urban waste.

The time evolution of the salinity can be explained by the important activity of the bacteria which degrade complex organic material in inorganic compounds.

3.4 HARDNESS: CALCIUM (Ca^{2+}) + (Mg^{2+})

This parameter represents the amount of water salts of alkaline earth metals (calcium, magnesium, strontium and barium). Since strontium and barium are often present in water in trace amounts, the total hardness is reduced to the concentration of calcium and magnesium ions, expressed in milli moles or milligrams per liter (mmol/l or mg/l) or in French degrees (°F).

Table 1: Classification of water depending on the value of its hardness

water	Concentration
Very sweet	0 - 1.4 mEq / L = 0-7 ° F
Fresh	1.4 - 2.8 mEq / L = 7-14 ° F
Fresh medium	2.8 - 4.4 mEq / L = 14 -22 ° F
Hard enough	4.4 - 6.4 m eq / l = 22 - 32 ° F
Hard	6.4 - 8.4 m eq / l = 32 to 42 ° F
Very hard	More than 8.4m eq / l = more than 42 ° F

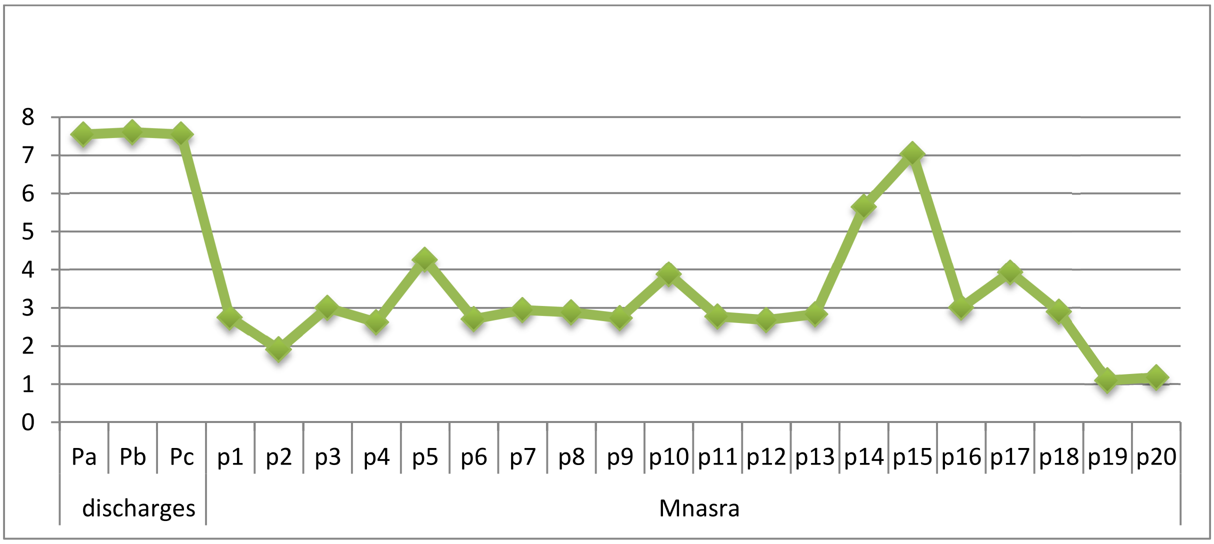

Figure 4: Temporal variation of hardness of well water

The analytical results of the hardness of well water in situ region mnasra, the value averaged about 3.13 mg/l with a minimum value of 1.1 mg/l and a maximum value of 7, 04 mg/l; that exceeds the limits set by the release Moroccan standard. These higher values indicate very hard water.

This parameter has a large variation would be related to the lithology of the aquifer and in particular its composition in magnesium and calcium.

Moreover, its maximum value is 50 mEq/l. by Moroccan standards of portability of water, rock formations containing divalent metals (Mg^{2+}, Ca^{2+} ....) responsible for this hardness.

The same wells discharges have been very hard.

3.5 CALCIUM (Ca^{2+})

Calcium is a dominant element of drinking water; the calcium content is directly related to the geological nature of crossed by rivers land varies from 11 to 50 mg/l.

Calcium is an alkaline earth metal extremely widespread in nature, especially in limestone rocks in the form of carbonate ($CaCO_3$).

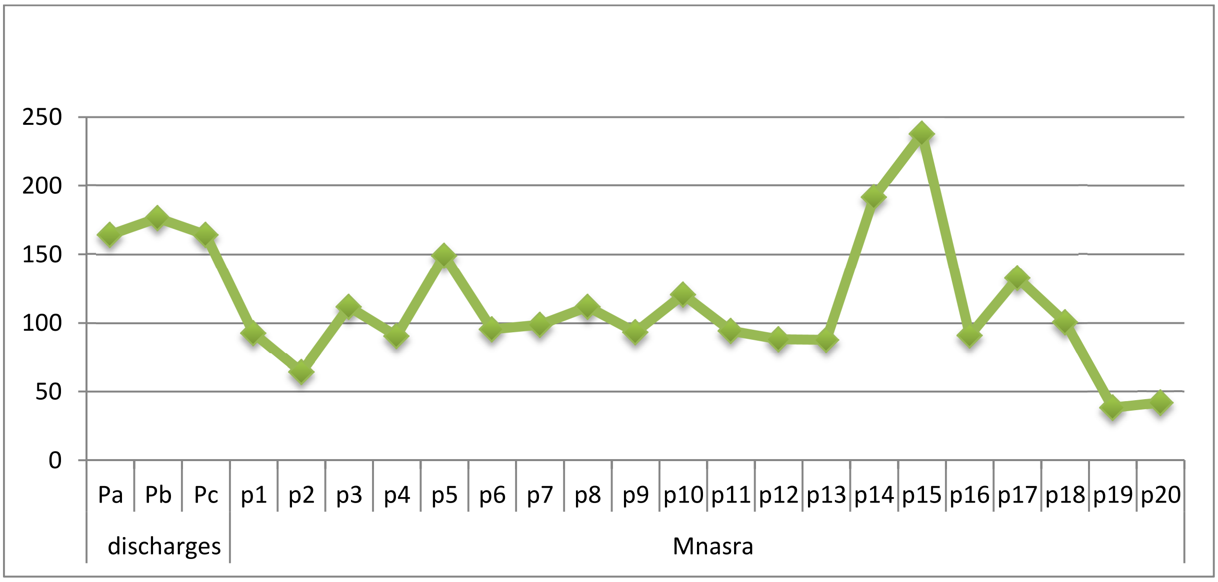

Figure 5: Temporal variation of calcium (Ca^{2+}) of well water

For calcium, Analyses showed an average concentration of about 106.76mg/l. with a minimum of 38.4mg/l in the well 19 and up to 237.6mg/l found in the well 14. Calcium concentration decreases, as one move away from the discharge.

The results obtained in the assays of calcium exceed the standards which are 200 mg/l.

3.6 MAGNESIUM (Mg^{2+})

Calcium (Ca) and magnesium (Mg) are elements that are abundant in the soil and rock; they are essential to the health of human beings. Magnesium, the eighth most abundant natural element. Present in all natural waters.

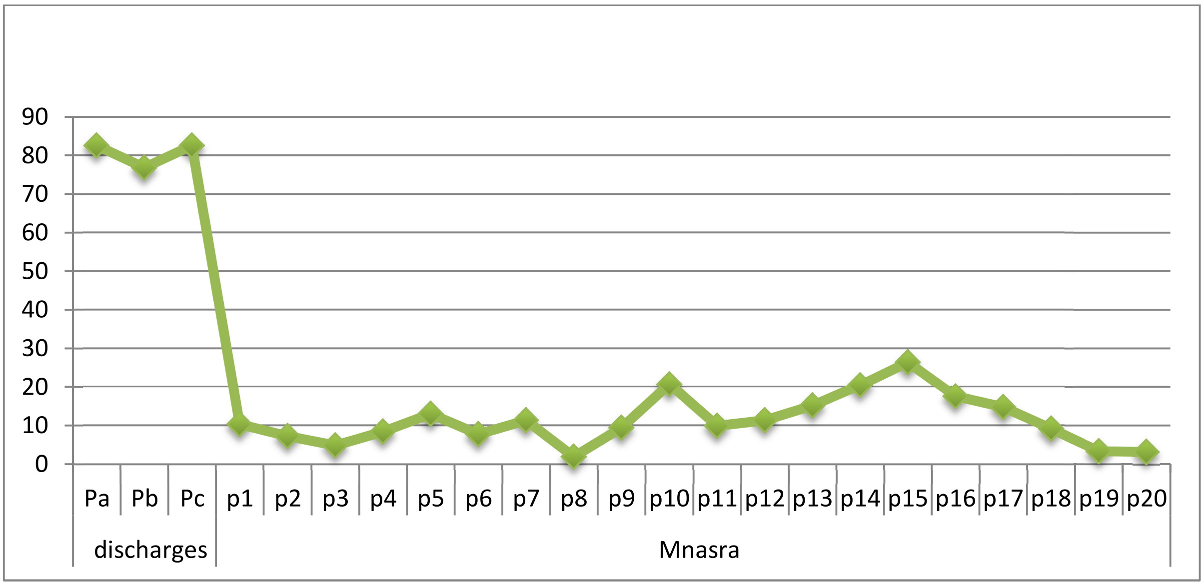

Figure 6: Temporal variation of magnesium (Mg^{2+}) of well water

For magnesium, the analysis revealed an average water concentration of the well is of the order of 11, 26mg / liter with a minimum of 1, 91 mg / l and a maximum of 26.4 mg / l. from Figure strongest magnesium concentration is observed in the discharge, with an average of 82.56 mg / L which exceeds the standard Moroccan what set at 50 mg / l.(Ministry of the Environment, 2002), this implies a change in the mineralization of discharges.

3.7 Sodium (Na^{+})

This is one of the major constituents of the earth's crust 2.83%, there are in all the water because the solubility of these salts is very high. A large amount of ions sodium in water affects soil permeability and poses problems of infiltration. This is because the sodium present in the soil in the form replaces exchangeable calcium and magnesium adsorbed on the clay soil and causes the dispersion of particles in the sol. latter alteration results in the soil aggregate which becomes hard and compact, thereby reducing the speed of infiltration of water and air, thereby affecting its structure.

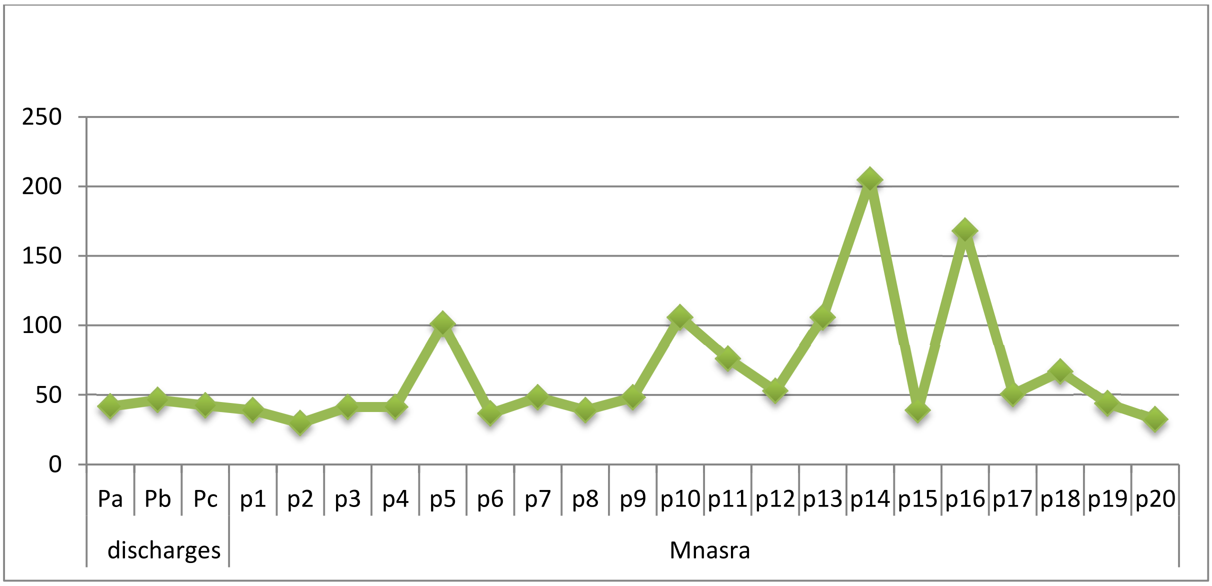

Figure7: Temporal variation in the sodium (Na^{+}) well water

Sodium is present in all wells with a very high concentration at P5, P10, P13, P14 and P16.This may be due to the impact of discharges containing a quantity of sodium. And also to the extensive use of Sodium in the field of agriculture.

The alkalinity of the irrigation water is evaluated using the NAS. More SAR, the greater the water poses a risk of sodicity due to the exchange that operate the balance between Na + in the soil solution and Ca^{2+} / Mg^{2+} complex absorbing.

The problem of sodium decreases if the amount of calcium and magnesium is high relative to the amount of sodium. This relationship is called: sodium adsorption ratio (SAR), which is defined by the following equation: **SAR =** $\frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$

Indeed the SAR affected 15.53 is greater than 9 (severe damage) these waters are considered dangerous for irrigation.

3.8 Potassium (K^+)

This is an alkali metal that is found naturally associated with other elements found in sea water and in many minerals, it oxidizes rapidly in contact with the air and reacts violently with water, it chemically similar to sodium.

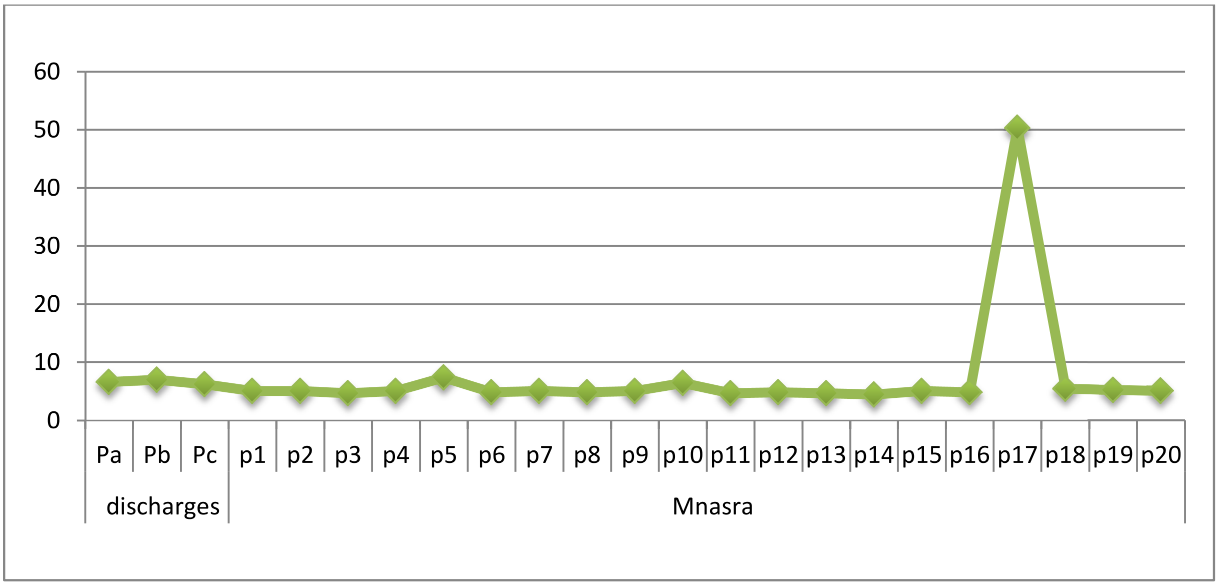

Figure 8: Temporal variation of Potassium (K^+) of well water

From Figure 8 there is no variation between the well water and the discharge of the water drilling Mnasra except the wells 17, it may be explained by the discharges which contain a significant amount fertilizer in addition to the surrounding body of Sebou is contaminated. They could be attributed to the inorganic filler produced by large urban waste.

The sodium concentration of 17 wells (50 mg/l) greatly exceed the limit value (12 mg/l) recommended by the Moroccan standard (Ministry of the Environment, 2002).

3.9 Ammonium NH^{4+}

The ammonium ion (NH^{4+}) is the reduced form of nitrogen; it is mainly due to the decomposition contained in phytoplankton and micro-organisms natural protein, it can also be based on the contribution of urban effluents sleek, industrial or agricultural waste. It is found in natural waters at concentrations that may vary from 0.1 to over 10 mg /l.

The ammonium ion does not present dangers to health, but its presence, particularly in surface waters can be considered as an indicator of pollution. However, there is a disturbing element, because it interferes with the chlorine to form chloramines amending the smell and taste of water (chlorine taste), it is also a food for some bacteria that can grow well in networks distribution, so it should be removed from water intended for human consumption.(www.gls.fr).

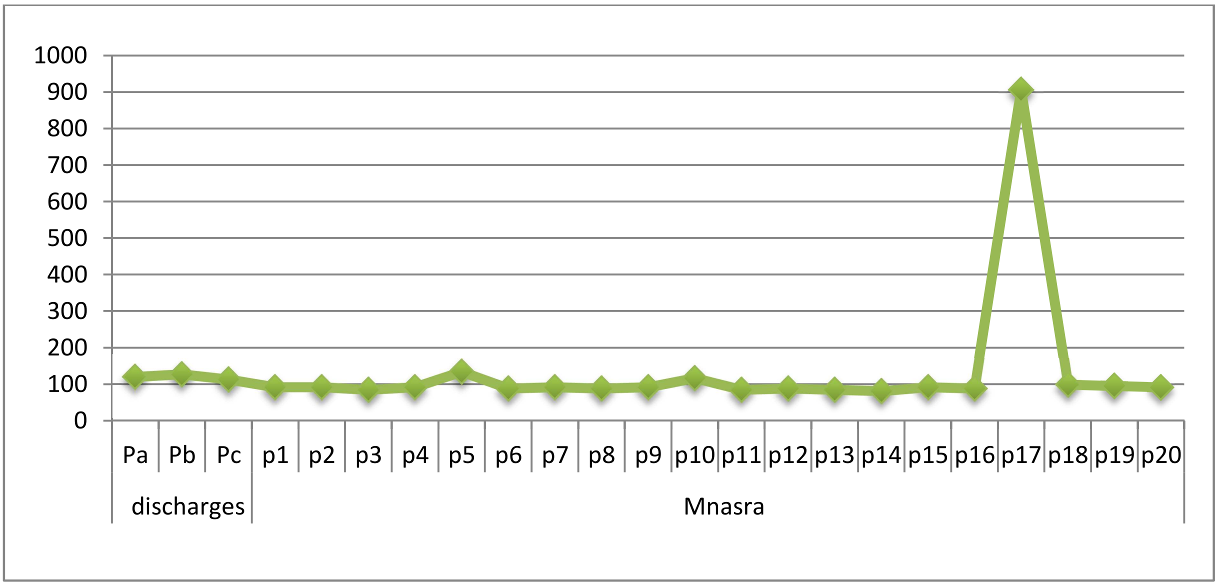

Figure 9: Variation temporal ammonium (NH_4^{+}) water wells

The figure shows variations in the concentration of ammonium ions which varies between 1.62 and 152.82 mg/l, with an average value of about 72.98 mg / l, that is greater than the limit specified in the EU directive value (98 / 83/CE 3 November 1998).

Level of well water discharge, a low concentration of ammonium was observed by against the more we are away from a high concentration is observed, this is due the nitrogenous organic material, and gas exchange between the atmosphere and water [7]. So it is a good indicator of pollution of rivers by urban effluents.

3.10 CHLORINE (CL^-)

Chloride ions are negative anions chlorine (Cl^-). This is very abundant in the environment, it is present in water, soil, rocks, and in many foods, it is found in varying concentrations in natural waters and in freshwater reaches several milligrams.

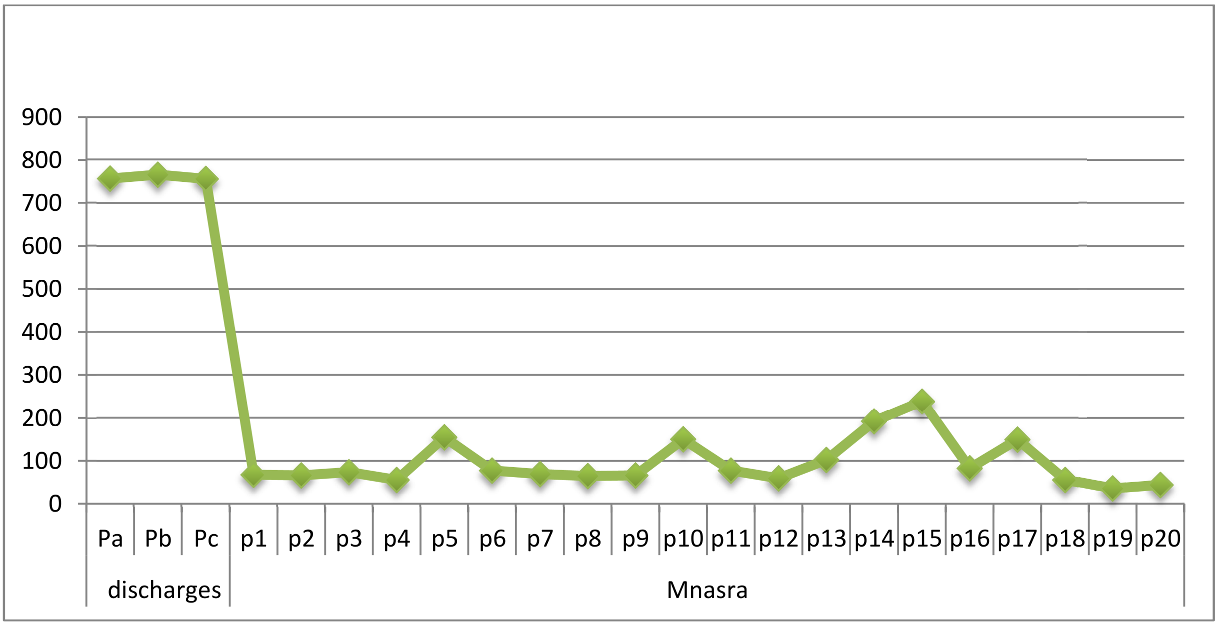

Figure 10: Temporal variation of chloride (Cl^-) water wells

Cl water wells vary from a minimum 35.5mg/l and the maximum 765.35 mg/l with an average of 94.46mg/l of the discharge shaft which is 759.22 mg/l (Figure10). The presence of chloride ions in excess in well discharge and a net decrease with small fluctuations between wells that are gradually moving away from the landfill, this could be explained only from the good part of the high conductivity observed in the study areas. This is a parameter that provides information on the salinity of the medium these results are consistent with[8] .These values do not meet the standard Moroccan (750mg/l) for well water discharge.

3.11 NITRATE (NO_3^-)

The nitrate (NO^{3-}), and nitrite (NO^{2-}) ions are naturally present in the environment. They are the result of nitrification of the ammonium ion (NH^{4+})' and water present in the soil, which is oxidized to nitrite by bacteria of the genus Nitrosomonas, and then nitrate by bacteria of the genus Nitrobacter (Health Canada, 1992). Nitrates are highly soluble in water; they readily migrate into groundwater when levels exceed the needs of vegetation (Health Canada, 1992).Nitrate toxicity resulting from their reduction to nitrite and methemoglobin formation on the one hand and their possible endogenous synthesis of N-nitro so compounds contribution other.

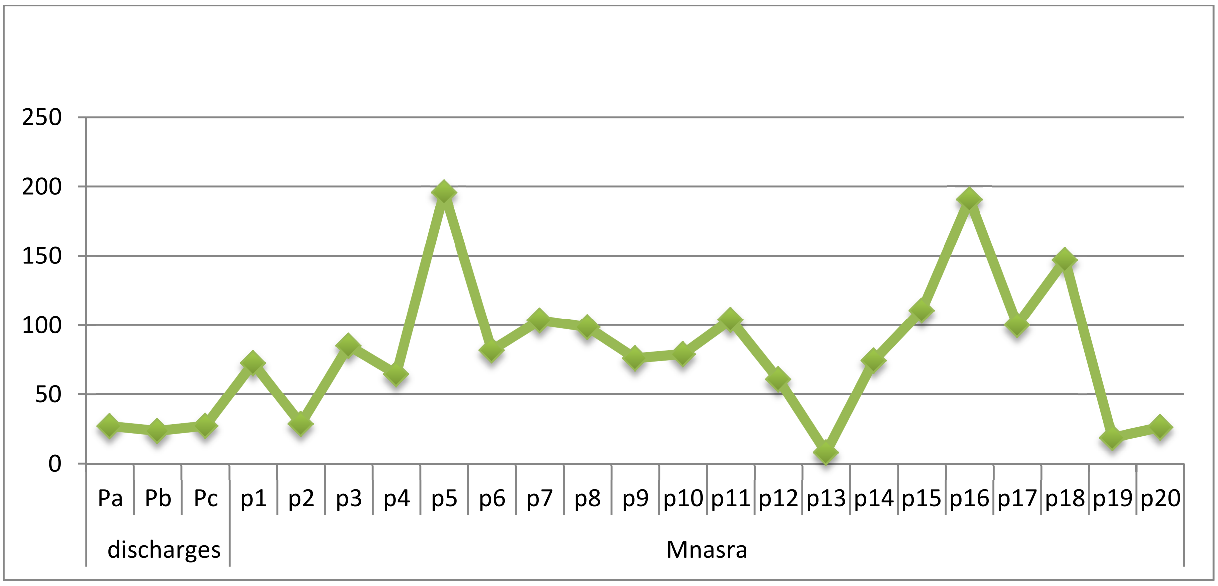

Figure11: Temporal variation of nitrate (NO_3^-) water wells

The temporal variation of nitrate (Figure 10) shows a substantial change in the levels of nitrate in well P4; P16; P18 with an average value of about 78.45 mg / l, resulting in a marked deterioration in the quality of well water. Higher values indicate discharge of wastewater into surface and ground water environments, especially the excessive use of fertilizers used in agriculture [9]. The use of synthetic fertilizers and manure associated with crops and intensive farming promotes the appearance of nitrates [10].The nitrate concentration is mainly due to the genera waste Indeed, this value does not meet the Moroccan standards (45-50 mg /l).

3.12 BICARBONATE (HCO_3^-)

Bicarbonate, or hydrogen, is a poly-atomic ion of the chemical formula HCO_3^-. In water, the carbon dioxide (carbonic acid), bicarbonate ion and carbonate ion are inbalance , a function of ph.

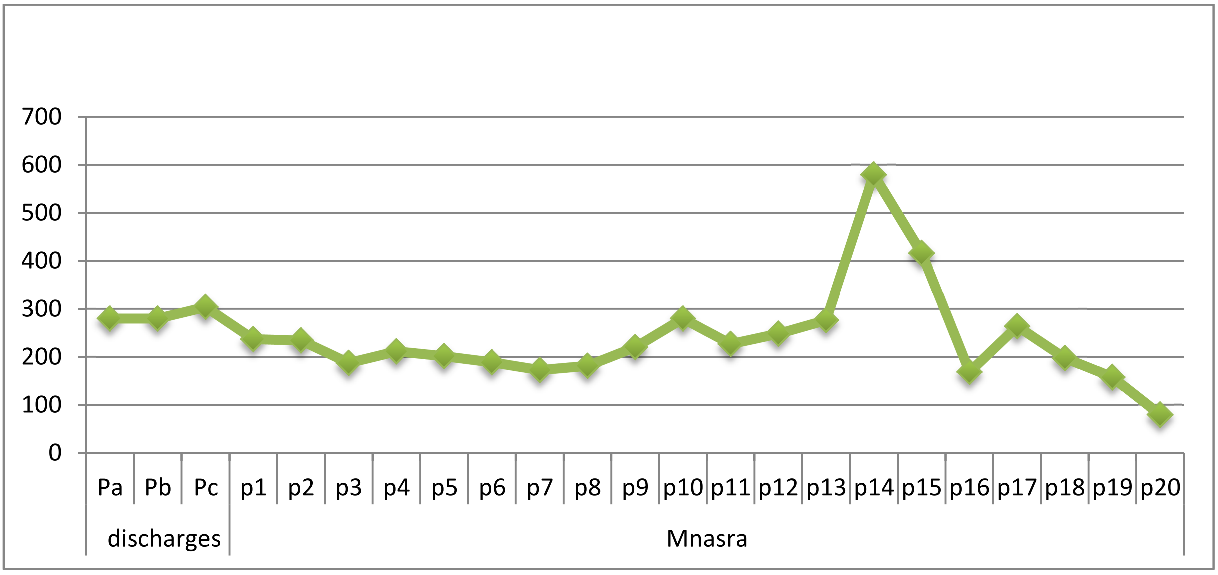

Figure 12: Temporal variation of bicarbonate (HCO_3^-) water wells

Contents bicarbonate water wells vary between 579.6mg / l, and 79.38mg / l maximum value was recorded in 14 wells (Figure12), these levels far exceed the limits recommended by the Moroccan standard in water for one hand for human consumption and other waters used for irrigation (518mg / l) Ministry of the Environment. (2002).

The general equation governing the content of HCO_3^- is groundwater according to production rate of CO_2 in the ground, $Ca^{2+,}$ temperature and ionic strength of the groundwater.

3.13 Sulfate (SO_4^{2-})

Sulfate ions are composed of sulfates their presence in drinking water contamination resulting mainly related to the discharge of domestic and industrial effluents or natural phenomenon of sulfate reduction.

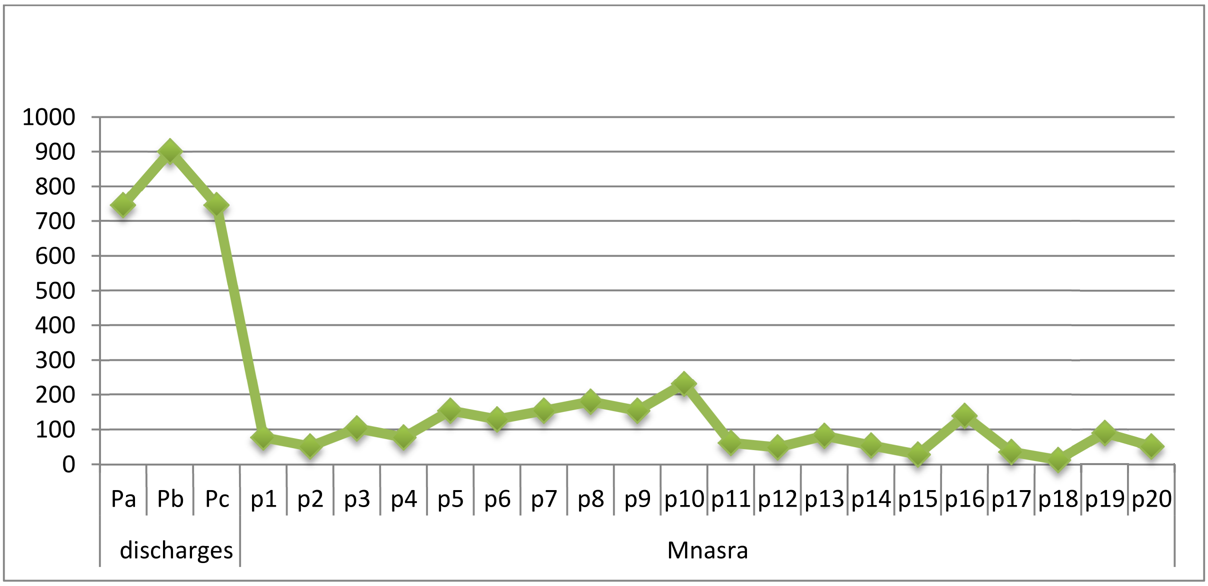

Figure13: Temporal variation of sulphate ($SO4^{2-)}$ water wells

Temporal Variation of sulphate ions is vary between 12.86 mg / l and 900.38mg / l with an average of about 108.12mg / l, the discharge of the wells have a high sulphate content of from wells mnasra. This increase to the origin of the discharges of waste discharge, following their diffusion in groundwater level by the presence of a large quantity sulfate in the soil. Against by the maximum value is set at 400 mg / l according to Moroccan standards of potability of water, so these values do not exceed the maximum permissible value.

The amount of sulphate is important due to the organic content of the waste is degraded to intermediate metabolites that are partly or completely mineralized by the aerobic microorganisms in the final metabolites (SO_4^{2-}), these results are consistent with (Chofqi and al.2004) and after the grid water quality leachate greatly exceed the standards, because they are classified in the very poor range.

4 DISCUSSION AND CONCLUSION

According to the study of physico-chemical parameters (hydrogen potential (ph), Conductivity, Salinity, Hardness, Calcium (Ca^{2+}), Magnesium Mg^{2+}, Sodium (Na^+), Potassium (K^+), Ammonium NH_4^+, Chloride (Cl^-), nitrate (NO_3^-), Bicarbonate (HCO3-), sulfate (SO_4^{2-}), water groundwater discharge and Mnasra region, we see that there is increase in most of the Parameters studied for the well water discharge compared with well water Mnasra as (conductivity, salinity, hardness, calcium (Ca^{2+}), Magnesium Mg^{2+}, Sodium (Na+), Potassium (K^+), the ammonium NH^{4+}, chloride (Cl^-), nitrate (NO^{3-}), Bicarbonate ($HCO3^-$, sulfate ($SO4^{2-}$) and from the comparison of these results with the standards of the grid groundwater quality and simplified grid for assessment of the overall quality of water surface (Table 2,Table 3).

Table 2: Simplified Scheme for evaluating the overall quality of surface water

Parameter	O_2 dissolute (mg/l)	DBO5 (mgO_2/l)	DCO (mgO_2/l)	NH4+ (mg/l)	PT (mg/l)	CF (mg/l)
Excellent	>7	>3	<30	<0.1	<0.1	<20
good	7	3-5	30-35	0.1-0.5	0.1-0.3	$20\text{-}2.10^3$
medium	5-3	5-10	35-40	0.5-2	0.3-0.5	$2.10^3\text{-}20.10^3$
worst	3-1	10-25	40-80	2-8	0.5-3	$>2.10^3$
Very worst	<1	>25	>80	>8	>3	-

Table 3: groundwater quality Grid

Parameter	Cond	DBO5 (mgO_2/l)	DCO (mgO_2/l)	NH4+ (mg/l)	PT (mg/l)	CF (mg/l)
Excellent	>400	>3	<30	<0.1	<0.1	<20
good	400-1300	3-5	30-35	0.1-0.5	0.1-0.3	$20\text{-}2.10^3$
medium	1300-2700	5-10	35-40	0.5-2	0.3-0.5	$2.10^3\text{-}20.10^3$
worst	2-1	10-25	40-80	2-8	0.5-3	$>2.10^3$
Very worst	<1	>25	>80	>8	>3	-

This allowed us to infer that the well water in the two regions are overloaded Because the groundwater pollution is the result of infiltration and diffusion of leachate in permeable or cracked soil. Mechanisms of dissolution and chemical precipitation occurring during infiltration are closely related to physico-chemical conditions, hydrodynamic and biological compartments of the aquifer system through which the leachate (soil, unsaturated zone and the saturated zone aquifer), the latter setting mitigation, transfer time, the level of propagation and the final retention of pollutant [11].The risk of groundwater pollution by landfill leachate has been the subject of several studies. Thus, since 1960, some authors [12]; [13] have shown in their work that the pollution of the water by the discharge is almost undetectable, others ([14] showed the presence of a real threat to many discharges studied in Wales and Canada. However, the use of wastewater in various fields has adverse and even fatal risks. Irrigation with wastewater has the potential risks to animal health and the environment, related to chronic poisoning by ingestion of chemicals accumulated in irrigated crops, which has a negative impact on surface water underground waters and users by the health plan, the real problems associated with the use of these wastewaters are the lack of appropriate treatment and informal setting that often accompanies the practice. However, microbiological risks are detected, with a possible transmission of bacterial, viral or parasitic diseases.

REFERENCES

[1] ChofqiA.2004, highlighting the mechanisms of contamination of groundwater by leachate from uncontrolled discharge (Eljadida-Morocco): Geology, hydrgéologie, Geoelectric, Geochemistry and Epidemiology. Univ. ElJadida thesis, Morocco, 250p

[2] K Youcef ehila Mr. A ina, F. M ezouari, G. M atejka, D. M amma: What prospects for the landfill and eco-friendly disposal of solid waste in developing countries vis-à-vis impacts on urban hydrosphere, 2007.

[3] B Erthe C. (2006). Study of the organic matter contained in leachate from different channels treat household and similar waste. Ph D thesis, University of Limoges.

[4] CNS, 1994: Comité Normes et Standards. (CNS), 1994: Ministère de l’environnement du Maroc. Rabat

[5] Rodier, 1984 : L’analyse de l’eau, eaux naturelles, eaux résiduaires, eaux de mer. 7ème édition, Dunod

[8] Levallois et Phaneuf, 1994: Bactéries hétérotrophes aérobies et anaérobies facultatives. Fichessynthèses sur l'eau potable et la santé humaine. Groupe scientifique sur l'eau, Institut national de santé publique du Québec, 3 p.

[9] Chofqi, et al.2004:, highlighting the mechanisms of contamination of groundwater by leachate from uncontrolled discharge (Eljadida-Morocco) : Geology, hydrgéologie, Geoelectric, Geochemistry and Epidemiology. Univ.ElJadida thesis, Morocco, 250p

[10] Khattabi, 2001: Interests studying hydrogéologiqueshydrogéologiques parameter and hydrobiologies for understanding the functioning of the treatment plant housewife leachate E 'd tueffont (Belfort, France). Thesis, University of Franche Comte, France.

[11] An Y.J., (2004), Soil ecotoxicity assessment using cadmium sensitive plants. Environmental. Science Technology 127:21–26

[12] Andreadakis A., Gavalaki E., Mamais D., Tzimas A. (2003), Wastewater reuse criteria in Greece. Global Nest: the Int. J. Vol 5, No 1, pp 9-14,

[13] Andreozzi R., Raffele M. and Nicklas P. (2003), Pharmaceuticals in STP effluents and solar photodegration in aquatic environment, Chemosphere, 50, 1319–1330.

[14] Asano T. (1998), Wastewater reclamation and reuse. Water quality management library, 1475 pages.