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Water quality evaluation of the river Tislit-Talsint (East Morocco)

H. Taouil[1]*, S. Ibn Ahmed[1], A. El Assyry[2], N. Hajjaji[3], A. Srhiri[3]
(1)Laboratoire de Synthèse Organique et Procédés d`Extraction,
Université Ibn Tofail. Département de Chimie, B.P. 133, 14000 Kenitra, Maroc.
(2)Laboratoire d'Optoélectronique et de Physico-chimie des Matériaux,
Université Ibn Tofail, Département de Physique, B.P. 133, Kénitra, Maroc.
(3)Laboratoire d'Electrochimie, et des Etudes de Corrosion et d'Environnement,
Université Ibn Tofail, Département de Chimie, BP 133, 14000 Kenitra, Maroc.

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* Corresponding author. E mail: hamidsup@yahoo.fr ;

Abstract
In this paper we gave an assessment of the water quality of the river (Tislit-Talsint in the east morocco), water samples of the river were made during two campaigns during a dry period (May/2011). The physicochemical analysis results, presented in this work, showed that the pH values measured in the river waters put them in the class excellent to good surface water, thus low mineralization due to the low conductivity with an average of 850 µs/cm. Nitrate Analysis shows that nitrate levels are extremely low; the sulfates values are conform to the WHO standards (250 mg/l). In all study stations, the levels found in potassium ion, meet the WHO standard (12 mg/l), except the station SR1 (21.85 mg/l) has a high content of this element.

At the end of this study, it can be argued that the use of the Tislit-Talsint river water without treatment could be a significant health risk.

Keywords: Evaluation, Physicochemical parameter, Water quality, Tislit-Talsint River, Morocco.

Introduction
Talsint region figure 1, because of its geographical location and its resources, especially in water [1], is an economic center and preferred place (rural exodus) for the rural population of which a part of it is nomadic. This reinforces the present and future demographic and urban development in relation to the entire region. A complete diagnosis of the current situation of metal pollution and rigorous monitoring of its evolution are proving to be of a great need to be able to judge the water quality and its impact on the environment. It is in this context that we conducted the study to determine the main physicochemical parameters of the river water at the sampling sites indicated on the map shown in figure 2.

Medium Study
Talsint Center belongs to the southern slope of the High Atlas, it belongs to the basin of Guir (figure 1), which contains many discontinuous groundwater and deep aquifers whose recognition remains to be done [2].

Talsint Center is located at the confluence of two major wads "Tisli" and "Ezawia" which form the river Talsint [3], it leads over to the gravel pit the prefecture "Bouanane" devastating to Algeria. Their geographical locations, our study environments is located on the crossroads of two regional roads, the MR601 and the MR604 (to Bnidjit and Anwal) at 190 km from Er-Rachidia city in southwest and at 126 km from the Missouri city to the west [3], (figure 1).

The average annual rainfall was about 244.9 mm for the period 1983/2007, with large interannual variations; it is only about 500 mm for the period 2008/2010: the extremes are 61 mm recorded in 1998/99 and 684.5 mm in 2009/2010[2].

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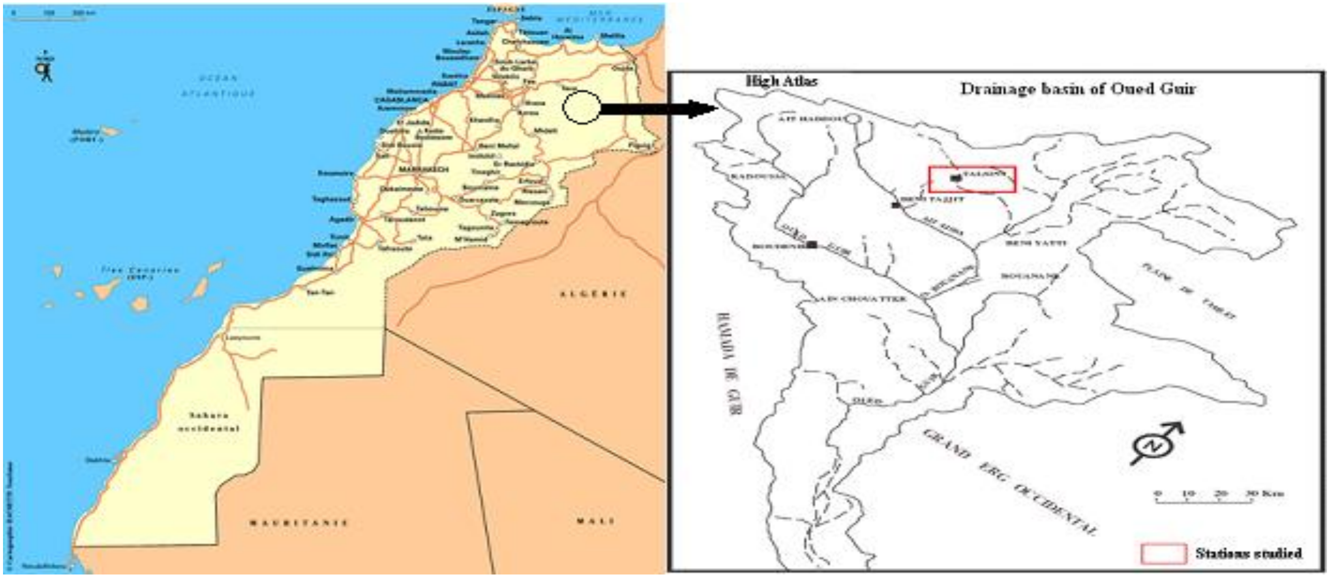

Figure1: Study area location in the watershed of the river Guir.

Physical and climatic data

On the bioclimatic, the region is characterized by pre-Saharan and Saharan environments, Its high temperatures in summer and very cold in winter, the average minima of the coldest month (January) is -5 °C and average maximum temperatures of the hottest month (July) is 47 °C.

2. Materials and methods

2-1. Choice of stations

Samples collected river waters were made during two campaigns during a dry period (May/2011). In order to determine the main physicochemical parameters of the river water and to characterize the quality of these waters, nine stations were selected on the study area. Their choice is a compromise between the possibilities of sampling and the need to account for the spatial organization of water sources, these stations are marked as follows:

So: Control station is located 30 km upstream of the river Talsint away from rural and agricultural pollution.
SC1: Station is located on Tisli Wadi, located in the vicinity of cultivated fields I "Qasar Ghazwane."
SR1: Station is located on Tabonderte Wadi downstream of the discharges rural domestic 1 (Douar Issardane and Rajae Fiallah ...).
SR2: Direct debit of rural domestic waste 2 (Douar Eqardass, Hay Toba and Talsint center…) just near the solid waste material surrounding neighborhoods. Note that this station is located on Tislit wadi downstream of its confluence with Tabonderte Wadi.
SR3: Station is located on Wadi Ezzaouia upstream of its confluence with Wadi Tislit just a point near the household garbage 3.
SC2: Station is located on Wadi Talsint downstream of the confluence of Wadi Tislit with Ezzaouia Wadi, next to cultivated fields 2.
SS: Station is located on Wadi Talsint, just downstream of the station SC2.

2-2. Materials and Methods

Water samples were stored in polyethylene bottles carefully washed beforehand by a slightly acidified solution, then rinsed several times with distilled water [4]. Water samples used for the determination of the main physicochemical parameters are processed on the ground with ultra pure HNO3.

Situ measurements

Of water samples, we measured some physicochemical parameters:
- pH: using a pH-meter type field: WTW pH 325.
- Conductivity: Using a conductivity-meter type field: WTW LF 96.
- Temperature: Using a conductivity-meter type field: WTW LF 96.

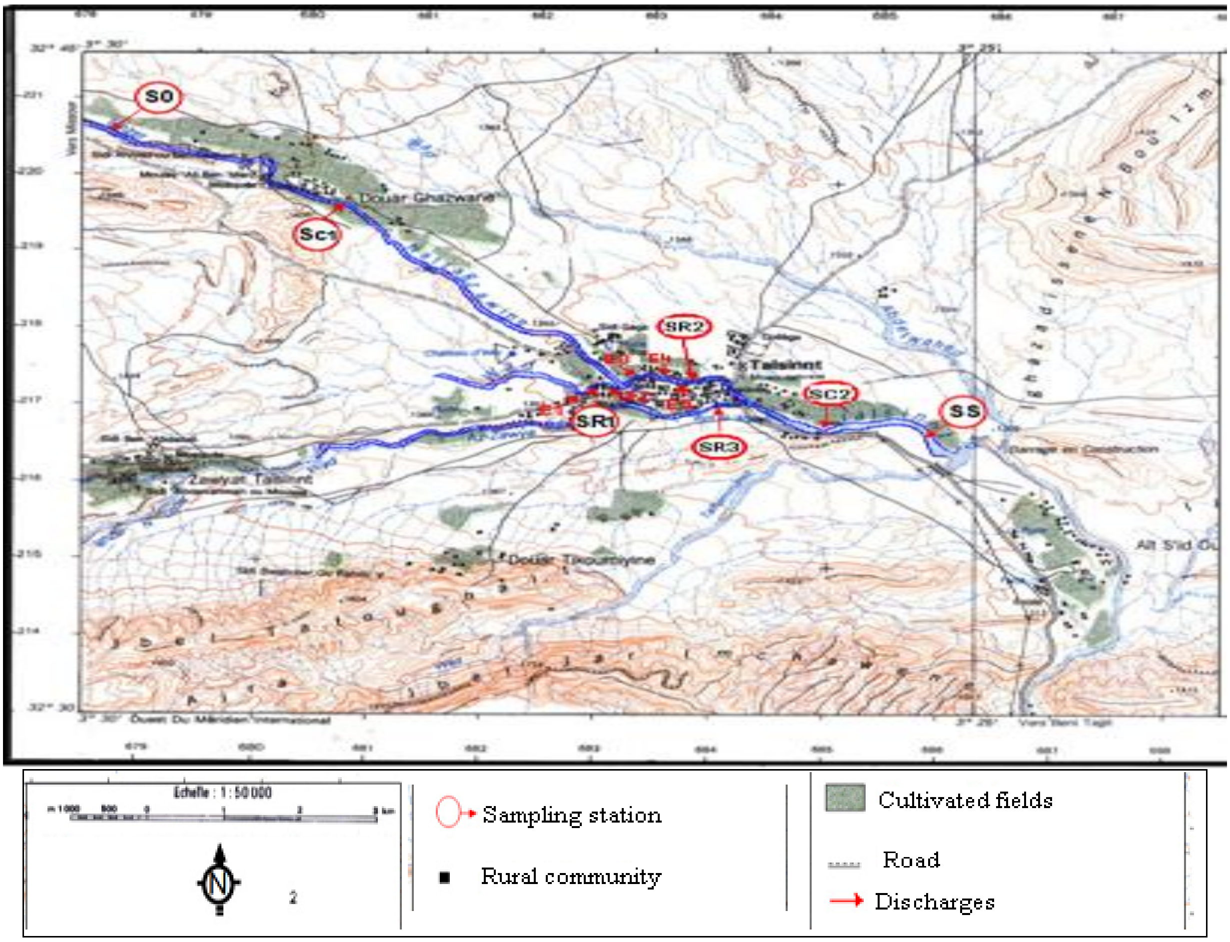

Figure 2: Location of water sampling stations.

Measurements in the laboratory

For water samples, we filtered water volume known on a 0.45μm pore filter, and the filtrate was used for the measurement of sulfate, chloride, sodium, potassium, magnesium, calcium and certain nitrogen content using ion chromatography.

3. Results and discussion

The physicochemical quality assessment of the river water was followed by the analysis of water collected at seven sites during the low water period (May/2011). Thus, the main physicochemical parameters of water that we have determined are: pH, temperature, electrical conductivity, K^+, Na^+, Ca^{2+}, Mg^{2+}, SO_4^{2-}, Cl^- et NO_2^-.

3.1. pH

The pH is the degree of acidity or alkalinity of the water environment. It mainly depends on the water origin, the land crossed petrographic nature, quality and quantity of wastewater discharges [5]. The pH also governs the chemical forms under which the metals are in the water as well as the transition from one form to another [6], and this parameter characterizes a large number of physicochemical equilibrium. It affects most chemical and biological mechanisms in the water. It is very sensitive to temperature, salinity, and breathing organisms [7-9]. This is a limiting factor in aquatic ecosystems: If the pH is less than 4.5 or greater than 10 it becomes toxic to living organisms [10, 11].

The pH of the river water studied (Figure 3) shows no significant changes with a minimum of 7.52 at the station SC1 and a maximum of 8.55 at station SS. The results show that pH values are relatively high throughout the studied part of the town, this may be due to:

- Nature limestone and marl of geological formations of the watershed promotes the release of carbonates and bicarbonates, which increase the alkalinity.
- In terms of areas of discharges of tributaries, the pH remains high because of richness in organic matter from wastewater.

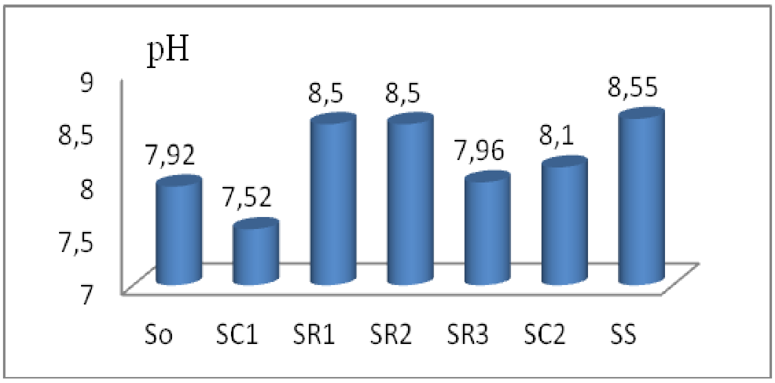

Figure 3: Spatial variation of average pH of the Tislit-Talsint river waters (May/2011).

In addition, the pH values measured in the river waters in question put them in the class excellent to good surface water, and they show that in most stations, the waters are favorable for irrigation 6.5<pH<8.5 (Moroccan standards) [12]. These values are also placed in the range of potability presented by European standards (6.5 to 9). In addition, the pH values found in the different study stations are not a danger to the flora and fauna.

3.2. Temperature

The thermal regime of a river depends on local conditions such as climate, sunshine duration and depth. The temperature of the water plays a very important role in increasing the chemical activity, bacterial activity and water evaporation [13]. Temperature is a key driver in control of all physicochemical parameters of a given ecosystem. It acts as a physiological factor affecting metabolism growth of micro-organisms living in water. Work [14] showed that the temperature of the water varies depending on the stations of the Degree of salinity and distance from input to downstream. It shows a sinusoidal appearance with maxima during hot and minima in cold periods. In our study area, we noticed that the temperature does not present large variations from one station to another (Figure 4) and remains lower than the annual average temperature in the region of 20 °C, with a minimum of 12.2 °C (station SR1) and a maximum of 12.6 °C (reference station So).

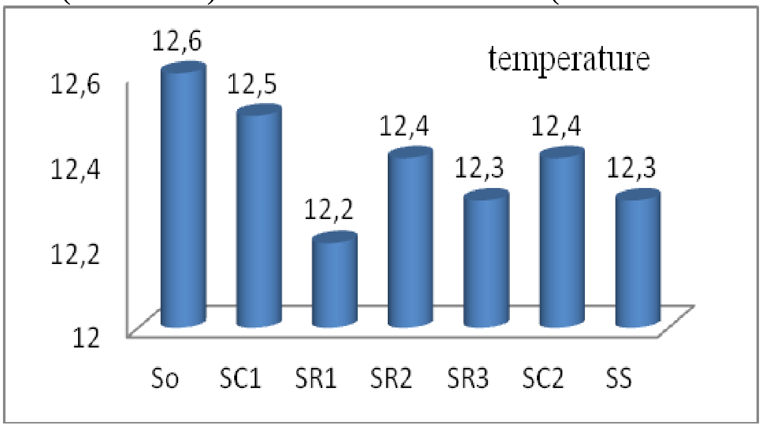

Figure 4: Spatial variation of average temperature (°C) of the Tislit-Talsint river waters.

3.3. Electrical conductivity

Electrical conductivity means the capacity of water to conduct an electric current and it is determined by the content of dissolved substances, the ionic charge, the capacity of ionization, the mobility and water temperature. Therefore, it provides information on the degree of mineralization of water. In other words, the measurement of the water conductivity allows us to appreciate the amount of salts dissolved in water (chlorides, sulphates, calcium, sodium, magnesium ...); it is more important when the temperature of the water increases.

In our river, the electrical conductivity is between 560 and 1330 µS/cm (figure 5). The mean values of the conductivity observed in the entire ecosystem are lower compared to those found in the Sebou River [15], they are oscillating between 1000 and 1400 µS/cm.

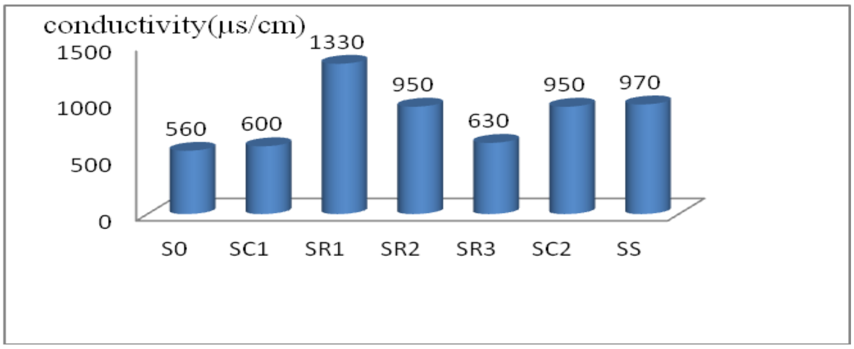

Figure 5: Spatial variation of the average conductivity of the Tislit-Talsint river waters.

The studied river waters are the mean value of the conductivity is below the limit value for irrigation (12000 µS/cm). According to the standard Moroccan these values are also below the standard of potability (2700 µS/cm) as maximum allowable value. Therefore, the values obtained are favorable for a normal ecological balance.

3.4. Potassium

Potassium resulting from the alteration of potassic clays and dissolution of chemical fertilizers are used extensively by farmers. The presence of this element can be related to the discharge of domestic wastewater into the plain [16].

In our study, potassium levels are between 0.97 and 21.85 mg/l (Figure 6). In all stations studied, the contents found in this element meet the WHO standard (12 mg/l), except the station SR1 (21.85 mg/l) which thus has a high content of this element, and this can be explained by discharges from domestic wastewater discharge upstream of this station.

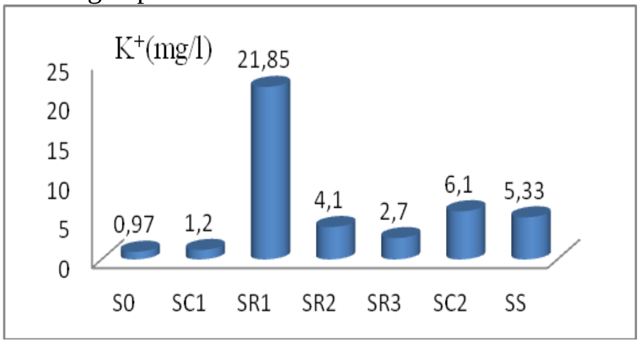

Figure 6: Spatial variation of average content of potassium ions in Tislit-Talsint river waters.

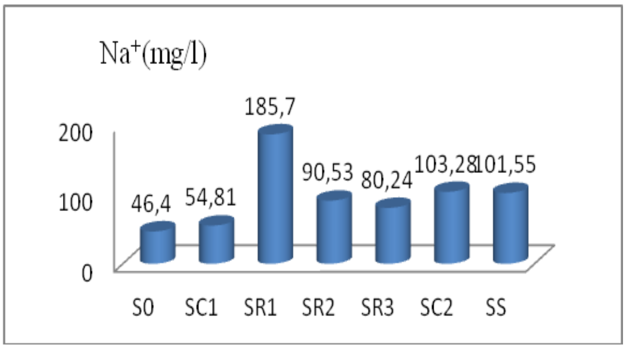

Figure 7: Spatial variation of mean sodium ion in Tislit-Talsint river waters.

3.5. Sodium

In nature, the sodium content in the water is relatively constant and vary only in the order of a few tens of milligrams per liter irrespective of the geological formations leaching containing sodium chloride, the salt may be derived from the decomposition minerals such as sodium silicates and aluminum, fallen marine origin and came from the saltwater of underground aquifers [17, 18].

In our study, the sodium content of water samples collected is between 46.4 and 185.7 mg/l (figure 7). In all stations studied, the levels found in the sodium ion meet WHO standard (150 mg/l), except the station SR1 (185.70 mg/l), which has a high content of this element, and this can be explained by the decomposition of minerals preventing soil of the region, for this particular level (SR1).

3.6. Calcium and magnesium

Ions (Mg^{2+}) originate as calcium ions, the dissolution of carbonate formations rich in magnesium (dolomite) [16]. These are the two ions that attach the total hardness of the water. The calcium content of the samples collected is between 82.99 and 153.28 mg/l (figure 8), and the magnesium is between 21.28 and 45.73 mg/l (figure 9). The values found are consistent with WHO standards: 50mg/l for magnesium and 270 mg/l for calcium.

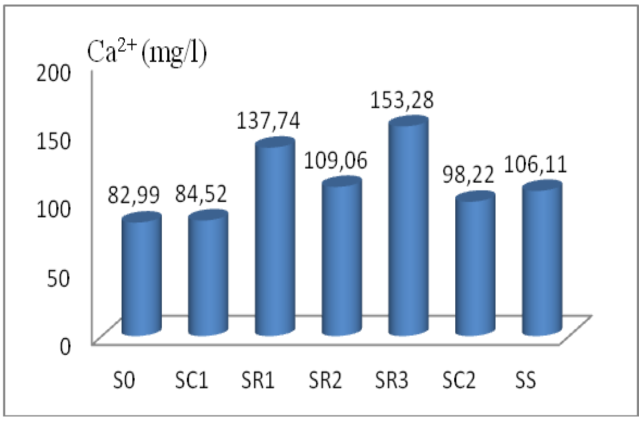

Figure 8: Spatial variation of mean calcium ion of the Tislit-Talsint river waters.

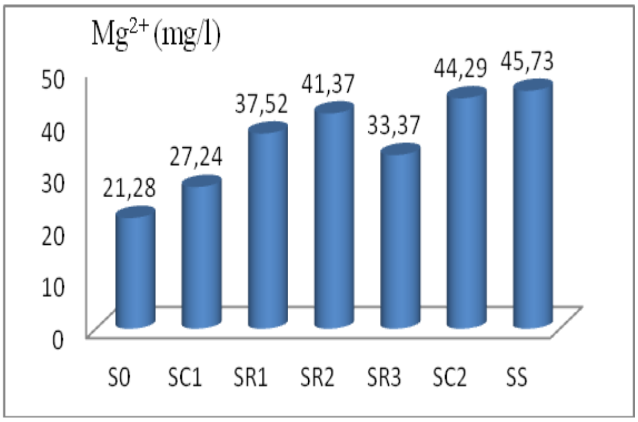

Figure 9: Spatial variation of average level magnesium ions of Tislit-Talsint river waters.

3.7. Suphate

Suphate may originate from the bacterial oxidation of reduced sulfur compounds, including metal sulfides, and organic sulfur compounds; Suphate ions are readily soluble in water. Sulfur is a nonmetallic element that exists in natural state in soils and rocks in organic form (sulfur protein) and the mineral (sulfides, sulfates and elemental sulfur). In confined groundwater in limestone waters are very moderately suphated and may locally exceed 1g/l to make the water undrinkable [17].

In our case, the values of this parameter in the studied waters are highly variable and ranged from 59.27 mg/l as minimum value and 152.09 mg/l as the maximum value. (figure 10). Thus in all study sites the values found are consistent with WHO standards (250 mg/l).

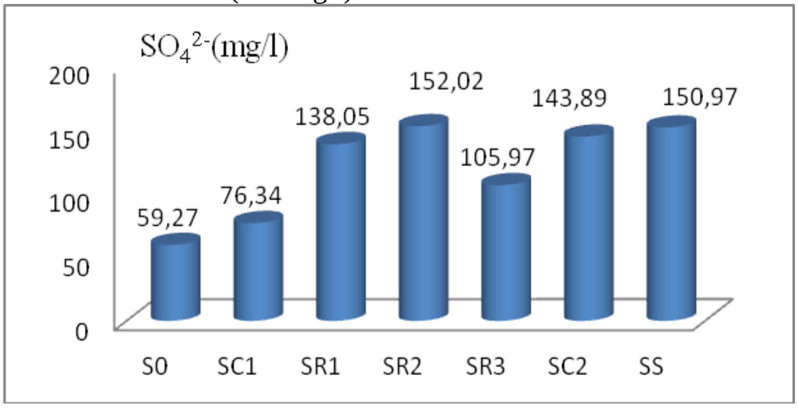

Figure 10: Spatial variation of mean sulfate ion of Tislit-Talsint river waters.

3.8. Chlorides

Chlorides exist in almost all water at concentrations highly variable. The presence of chlorides in high concentrations in water containing sodium gives a salty taste. In addition, the chlorides are essential to diets. Effluent industry keeps meat and some vegetables are known by a high salt content, especially chloride. Previous studies have found that the salinity of wastewater is a major handicap for reused water in agriculture.

In our case the values of this parameter in the waters studied are highly variable and ranged from 66.03 mg/l as minimum value and 135.43 mg/l as the maximum value (figure 11). Thus in all study stations the values found are consistent with WHO standards (200 mg/l).

3.9. Nitrates

The nitrogen found in wastewater can be an organic or mineral character, it comes in four forms:

• Organic nitrogen is converted in ammoniacal nitrogen.

• Ammoniacal nitrogen (NH_4^+) reflects a process of ammonification of organic matter nitrogenous. Ammonium ions undergo a nitration by action of nitrifying bacteria.

• The nitrite (NO_2^-) comes from incomplete oxidation of ammoniacal nitrogen or nitrate reduction by denitrification. Nitrites are unstable and are rapidly transformed into nitrates.

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• The nitrate nitrogen (NO_3^-) is produced by nitrification of ammonia nitrogen. It plays an important role in the development of algae and participates in eutrophication.

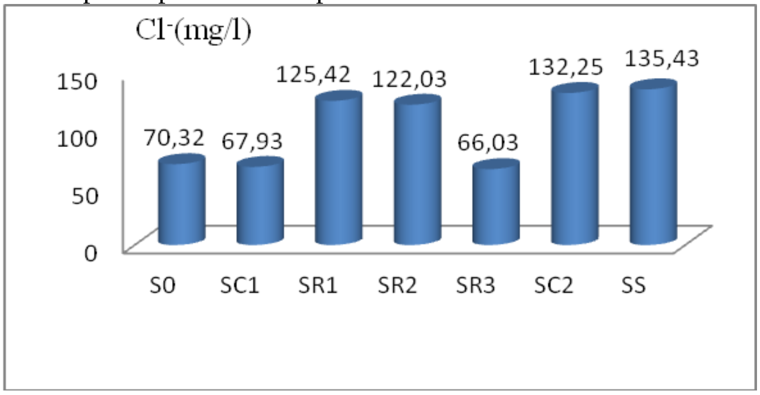

Figure 11: Spatial variation of the mean chloride ion of Tislit-Talsint river waters.

In wastewater, nitrogen is primarily in ammonium form. The concentrations of the oxidized forms of nitrogen are low. As well nitrate nitrogenous are the most dominant forms in rivers and groundwater aquifers. They usually come from the decomposition of organic matter by bacterial oxidation of nitrite and thus constitute the ultimate product of nitrification. According to Moroccan standards for water quality for human consumption is 50 mg/l. Inputs of NO_3^- come mainly from the water flow in the watershed, lateral inflowsand cultures (nitrogen fertilizers). NO_3^- can also come from domestic wastewater and industrial water sometimes [19, 20].

The histogram of nitrate according to the study stations (figure 12) shows that these levels ranged from 0.2 mg/l (station SR1) and 12.38 mg/l (station S0). As well the values found in nitrates remain well below the permissible value by Moroccan standards (50 mg/l). Therefore studied waters are not subject to the risk of nitrate pollution.

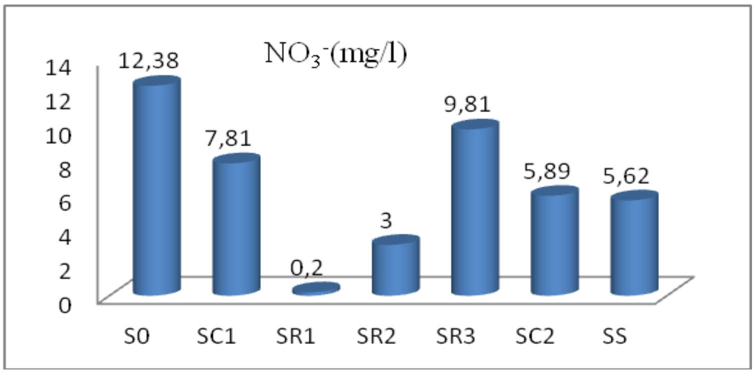

Figure 12: Spatial variation of the mean nitrate ion of Tislit-Talsint river waters.

Conclusion

In order to determine the impact of water pollution of Tislit-Talsint River on the region's environment, a physicochemical study was performed on seven stations of sampled water in low water period (May/2011). The results show that the physicochemical parameters of the water of the studied river in most stations studied are lower than the standards set for usage and irrigation and is therefore of a good quality, with some heterogeneity in their physicochemical parameters. Perspective, other parameters should complement the analyzes. It is interesting to note that the behavior of some descriptive parameters of the physicochemical quality of waters is not likely to disrupt the aquatic life. However, Taouil and the group [21] were interested in the evaluation of metallique pollution of the river waters of Tislit-Talssint, these authors noted that the concentrations of lead, cadmium and nickel exceed the accepted limits for water intended for human consumption; but they notice that this water is good for the irrigation.

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References

1. Azelmat N., Ben brahim M.M., (2009), Le Patrimoine culturel comme facteur de développement durable, étude de cas : le pays de Talsint. Master: Patrimoines culturel et naturel, inter culturalité et développement**,** Mémoire de DESA, Université Mohamed Premier, Oujda, Maroc
2. Office National de l'Eau Potable, (2007), étude d'assainissement du centre de Talsint et quartiers périphériques (province de Figuig). Rapport provisoire, Direction Régionale de l'Oriental, Maroc.
3. Taouil H., Ibn Ahmed S., Hajjaji N., Srhiri A., *Sciencelib*, 3 N°111109 (2011).
4. Afnor, (1972). Echantillonnage. Précaution à prendre pour effectuer, conserver et traiter les prélèvements. T90-100
5. Bennasser L., Fekhaoui M., Benoit-Guyod J.C., Gérard M., *Water Research*, 31 (4) (1997) 859-867.
6. Azzaoui S., El Hanbali M., Leblanc M., *Water Qual. Res. J. Canada*, 37 (4) (2002) 773–784.
7. Alexander C.R., Lee R.F., Burton D.T., *Human and Ecological Risk Assessment*, 11 (2005) 861-877.
8. Bougherira N., Rezek A., Drouiche A., Hamzaoui W., Chaib N., Djabari L., *J. Mater. Environ. Sci*, 2 (S1) (2011) 463-468.
9. Zahi F., Djamai R., Drouiche A.M., Medjani F., *J. Mater. Environ. Sci*. 2 (S1) (2011) 439-444.
10. Bloundi M. K., Faure P., Duplay J., *Comptes rendus - Geoscience*, 340 (12) (2008) 840-849.
11. Bloundi M.K., Duplay J., Quaranta G., *Environmental Geology*, 56 (5) (2009) 833-843.
12. Ministère de l'Environnement du Maroc, *Normes marocaines, Bulletin officiel du Maroc*, N° 5062 du 30 Ramadan 1423. Rabat (2002).
13. Alami I.I., Rhidouani A., Zeraouli M., Echchelh A., Addou M., Ahmed S.B., *Phys. Chem. News*, 58 (2011) 25.
14. Boussalwa E., Douira A., Mokhtar N., *Riv. Idrobiol*. 39 (2000) 560-579.
15. Mergaoui L., Fekhaoui M., Bouya D., Gheït A., Stambouli A., *Bull. Inst. Sci*., 25 (2003) 67-75.
16. Gouaidia L., Guefaifia O., Boudoukha A., LaidHemila M., Martin C., *Physio-Géo. Géographie Physique et Environnement*, 6 (2012) 141-160.
17. Kourradi R., (2007), évaluation du degré de la pollution anthropique de l`estuaire de Bou Regreg et impact sur la biologie et dynamique de scobicularia plana (Linné, 1758) et solen marginatus (Linné, 1767), Thèse de Doctorat, Université Mohammed V, Rabat, Maroc.
18. Cheggour M., Texier H., Moguedet G., Elkaïm B., *Hydrobiologia*, 207(1) (1990) 209-219.
19. El Morhit M., Fekhaoui M., Serghini A., El Blidi S., El Abidi A., Yahyaoui A., *Larhyss Journal*, n°12 (2013) 7-24.
20. EL Morhit M., Fekhaoui M., Serghini A., El Blidi S., El Abidi A., Bennaakam R., Yahyaoui A., Jbilou M., *Bulletin de l'Institut Scientifique*, Rabat, section Sciences de la Terre, n°30 (2008) 39-47.
21. Taouil H., Ibn Ahmed S., Hajjaji N., Srhir A., *Sciencelib*, 4 N° 120111 (2012)

(2013) ; http://www.jmaterenvironsci.com