# USE OF PLANTS AND LOCAL MATERIALS FOR DOMESTIC WASTEWATER TREATMENT IN ARID ZONE (SOUTH WEST OF ALGERIA)

**[1]BENDIDA ALI, [2]KENDOUCI MOHAMED AMINE, [3]TIDJANI ABDELLATIF EL-BARI**

[1,2]Department of civil engineering and hydraulic, university of Tahri Mohamed, Bechar, Algeria
[3]Department of hydraulic, University of Science and Technology Mohamed Boudiaf, B.P:1505 El-Mnaouer 31000, Oran, Algeria
E-mail: ali_bendida@live.fr

**Abstract -** In urban areas, population growth generates significant amounts of wastewater that is treated in sewage treatment plants specialize or reject directly controlling interest in the natural environment. Many scientists are looking into the issue to try to find solutions to clean water and make it drinkable. We are interested in the technique of sand filtration (in the region southwest of Algeria), as an essential phase for the treatment of wastewater, such methods are known to be well suited to rural areas, since they have a good quality of treatment, a relatively simple operation and low maintenance. The method is based on the following principle: a slow filtration, water passes under a constant hydraulic load (30 cm water) the filter bed (60 cm of sand), the hydraulic load is kept constant during the experiment.
A physicochemical analysis is performed on the water sample before and after filtration, the filter bed to give us a discount of around 50% in the levels of contaminant parameters such as NTK, Ammonium, Nitrate, and Nitrite. The reduction of BOD, COD and suspended solids is about 90%. It was observed a significant increase in the potassium from 33.19 mg / l to 99.89mg / l.

**Keywords -** Sand dune (Western Erg) Algeria, Wastewater, Filter Bed, Permeability, Treatment, Physicochemical Analysis

## I. INTRODUCTION

The preservation of our environment and our water resources depend on our ability to clean up wastewater before returning to the wild. Waste water is water after domestic or industrial use, their treatment is a necessity to preserve the direct environment of man and preserve, rivers, groundwater.
In Algeria the situation is aggravated both by the concentration of the population on the coastal strip, where urban centers and industrial areas are located, and by the inadequacies of existing infrastructures which are not in a position to cope with environmental management of wastewater discharges. Although there is still no dramatic situation, there are nevertheless symptoms of pollution, especially of the water and the environment in general, which deserve attention now to avoid any eventuality and not to leave things take seriously.
In Bechar, which is situates in an arid zone, is characterized by interference from urban waste and an almost complete absence of industrial waste. Like all cities in Algerian, it faces pollution problems, the main causes of which are:

- Discharge of wastewater into the wild without purification.
- Absence of sewage treatment and treatment systems.
- Presence of uncontrolled discharges of solid waste near Bechar River.
- Irrigation of agricultural land by polluted wastewater, especially soil. Which lie in the banks of the river [1].

It is therefore necessary to explore new and reliable wastewater treatment technologies adapted to the realities of developing countries.
The choice of economic and efficient processes is the concern of several researchers. The use of natural processing methods (screened filters) has been shown to be effective in the treatment of industrial and domestic wastewater. Compared to conventional systems, planted systems have several advantages. They are less expensive to build and operate, can be built on the wastewater site, require few mechanized equipment and are less sensitive to changes in polluting loads.

## II. MATERIALS AND METHODS

### 2.1 Experimental device

The experiment is carried out in the town of Bechar characterized by an arid climate where the average annual precipitation is about 72.97 mm; the average annual temperature is 21.10 ° C. In addition, a dry period all year, causing an agricultural deficit.
The experimental pilot is made of a plastic bin of 45 cm length, 35 cm width and 30 cm high (5 cm of gravel 8/15 and 5 cm of gravel 3/8) and sand (10 Cm). Each tank is inclined with a slope of 5% directed downstream.

### 2.2 Description of plant used

The Imperata cylindrica is a species of the Mediterranean, the tropic, and the Sahara in humid

places with long narrow leaves. Perennial plant creeping, its size is located of 30 to 80 cm in height [2].

### 2.3 Waters used for the infiltration

The samples are collected at the oued of Béchar located in the center of the wilaya of Béchar, This area is characterized by the interference of urban discharges and the lack of industrial releases[3]..

## III. RESULTS AND DISCUSSION

### 3.1 Measurement of Ph

The value of pH for the rejection before filtration is 8.14. According to the results represented on the Figure 1, we note that during the period of filtration, the pH is weakened by report to the initial mixture but the values remain in the normative range of waters (6.5 - 8.5). The rate of démunissions of pH is 5.89%.

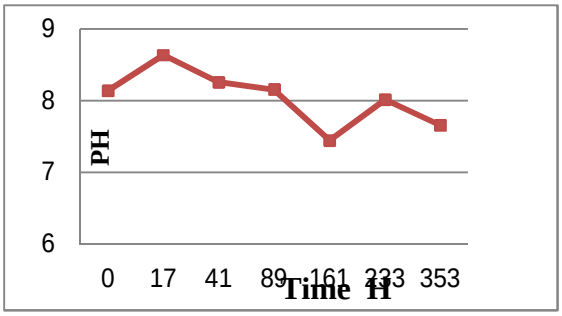



**Figure 1. Evolution of Ph**

### 3.2 Measurement of conductivity and salinity.

The conductivity and salinity for the rejection before filtering are 3930 µs/cm, 1.97 ppm, respectively, thus showing the values important enough. We note from the curves represented on the Figure 2 that during 13 days, the values of the Conductivity and Salinity, undergo an increase. So there is an increase compared to the initial mixture. The conductivity and salinity. The rate of increase in the Conductivity and Salinity are respectively 21,77%, 23.23%,

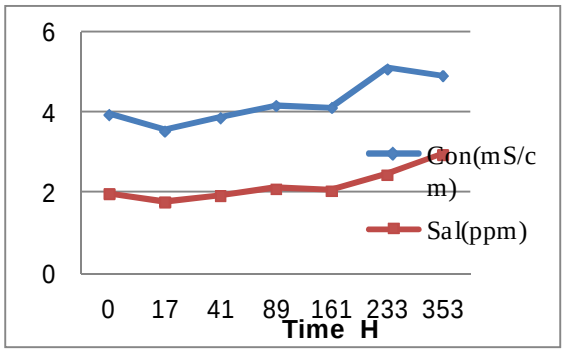



**Figure.2. Evolutions of Conductivity and Salinity**

### 3.3 Determination of suspended solids

According to this curve (Figure 3) it is observed that the concentration of SS is lower than those of initial mixture. The performance of cleansing is 87,7 %%. The value of the concentration of my initial mixture is 156mg/l. The waters collected at the end of the processing to meet the standard relating to the discharge of wastewater into the natural environment (50 mg/L) [4].

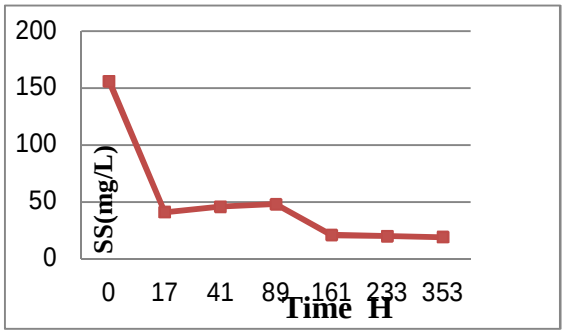



**Figure.3. Evolutions of SS**

### 3.4 Determination of the chemical oxygen demand (COD)

The value of the cod for the rejection before filtration is 215 mg/l. According to the results represented on Figure 4: an abatement of 95% is observed. , the time factor of stay is very important to achieve the rate of abatement.

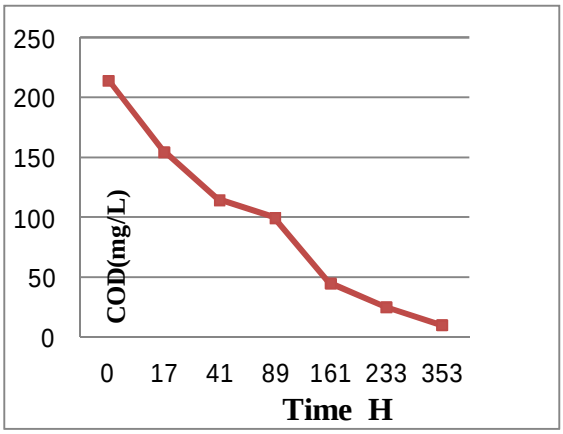



**Figure.4. Evolution of COD**

### 3.5 Sulfate and Chloride

The levels of sulfate and chloride before filtering are 795.76 mg/L and 923 mg/L, respectively. The sulfates and chlorides present a very important concentrations, these levels which is may be due to the releases of urban nature, it has the use of detergents on the basis of sulphites (metastable state) which transforms (oxidation) in sulfate.

According to the representative waveforms of the evolution of sulfate and chloride, there is a decrease in the content of $SO_4^{2}$ compared to the initial mixture in function of time, there was a decrease in the concentration of chlorides, but after the 4th Levy we note a growth in relation to the initial mixture (figure 5).

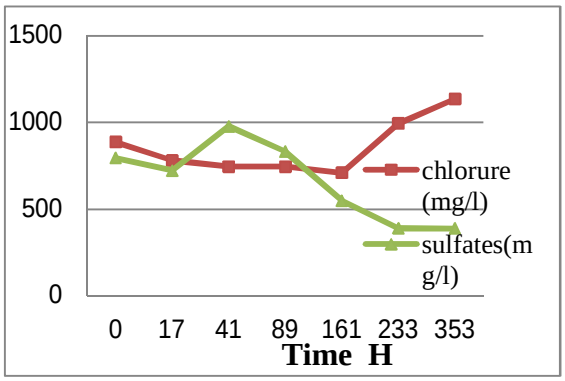



**Figure 5. Evolution of chloride and sulfate**

### 3.6 The nitrogen of the Kjeldahl method (NTK),ammonium, nitrate and nitrite

Urine is the main indicator of the presence of the nitrogen in waste water in urban areas, as well as detergents have Basis of ammonium, reactions of ammonification may take place in transforming this organic nitrogen in ammonium NH4+ (reduced form of nitrogen), in effect the demand for oxygen by the ammonium is very high this are molecules (nitrogen compound fragrant) to the origin of the bad odors. The maximum value of nitrates is 7.94 mg/l. The Kjeldahl nitrogen present concentrations of alarming the maximum is observed in the rejection (62.18 mg/L), the value of the ammonium is 26.60mg/l.

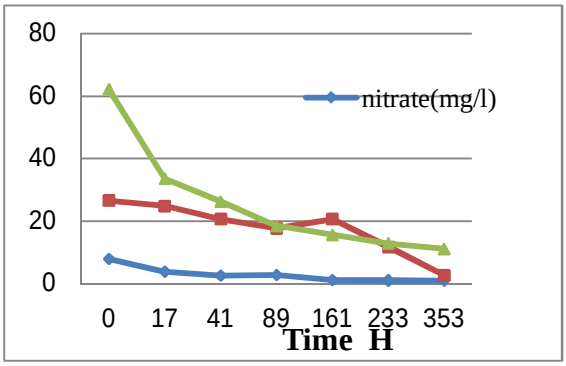



**Figure 6. Changes in NTK, ammonium and nitrate**

- **Nitrates**

According to Figure 6 , we note that the levels of nitrate are lower compared to the initial mixture, the rate of decline is 86,84%. The decrease in the content of nitrate is observed and doubtlessly is because of the phenomena of processing and consumption by microorganisms.

- **Ammonium**

According to Figure 6, we note a decrease in the three trays by report to the initial mixture, the rate of decrease is 90%.

- **Nitrogen in the Kjeldahl method (NTK)**

The evolution of the concentration of the nitrogen of the Kjeldahl method is presented on Figure 6, there was a decrease in the concentration of the nitrogen of the Kjeldahl method by report to the initial mixture, during the time I culture, the rate of decrease is 82%.

## IV. GENERAL INTERPRETATION

The decrease of the concentrations of the physico-chemical parameters is explained by various processes more or less nested. The pH decline reflects an acidification of the medium. This acidification could result from the oxidation of organic matter and of the NH4+ [5]. In effect, the oxidation of organic matter produces carbon dioxide (CO2) which acidifies the middle. Similarly, the nitrification (oxidation of NH4+) causes a acidification of waters. The values of the pH remained in the range (6.5 - 8.5).

- **The conductivity**

The results obtained show that the electrical conductivity of mixture is lower than that of tray . The increase in the electrical conductivity of the trays is explained by an increase of salts in the massive or filter due to the phenomena of evaporation.

According to [6], most of the species to survive in an environment of conductivity between 0-2 mS/cm, and sensitive species are affected by a conductivity of 4-8mS/cm, whereas the tolerant species that can develop in environments at higher conductivity to 8mS/cm.

During the period of treatment in the current work , the conductivity of the Middle remains between 3-5mS/cm. In these conditions this water can be used for irrigation (according to the standards applied in California) [7].

- **Suspended solids**

The decrease in the concentration of SS in the different trays was due to the physical filtration that removing the coarse materials in surface and the finer, by either Blocking between pores, by interception and mounting on the grain or by chemical interactions [8]. The elimination of 87.7% of SS in the tray is similar to that reported by Jean et al (2008). (85.5%).

- **COD**

The bins planted gives filtrate the concentration of COD is lower than that of initial mixture, this is likely due to the physical containment of the organic matter from the water worn in the tray and the oxidation; the rate of elimination of COD is 95,35% , this result is approaching the rate of elimination 91,99% obtained by Zhang et al. (2007) in the presence of I. pseudacorus, as species . These results are probably related to the presence of plants that create physico-chemical conditions favorable to the oxidation of organic matter by the microbial flora; these bring oxygen in the massif filtering via the roots and rhizomes [9,10,11] ; where a major reduction of the COD is ensured by the microbial decomposition [12,13].

- **Nitrogen compounds**

Concerning the nitrogen compounds:, NH4, TNK, $no_3$, their concentrations in the tray are inferior to that of the initial mixture and the performance of cleansing performance for NH4+ is 90% , a rate of elimination of 80.75% of ammonium is obtained after 5 days time of retentions by Tam et al, (2009) in the presence of (TYPH. latifolia) as a species.

Two other phenomena may provided the reduction of ammonium in the medium, it is of the volatilization of ammonia and nitrification. The volatilization is favored at high pH (pH =9) and will be responsible for reduction of 21% of nitrogen [14]. In our work, the pH remains less than 9 which means that the rate of volatilization of ammonia remains low.

Concerning the nitrification, according S.Y. Chan, nitrification is easy with a dissolved oxygen content between 2-3 mg/L, therefore the phenomenon is not negligible in the aerobic conditions leading to the formation of nitrate.

For the nitrogen of kheldahl, compared with the rate of 65,60% of elimination obtained by Tama and al the rate obtained is 81,98%.

- **Chlorides and Sulfates**

Concerning the chlorides, their concentration in the tray is superior to that of the initial mixture, this is explained by an increase in the evaporation during the time of culture. These two elements are proportional to the salinity of the medium it can influence on photosynthesis, it influences the balance of Ca and Mg in the tissues i.e., a decrease in these two cations and increase of K and Na in the tissues which will affect photosynthesis [15].

## CONCLUSION

The choice of wastewater treatment processes designed to be reused, the power of systematic elimination of pathogens should be the main consideration. It must also take account of the fact that conventional methods may be less reliable in this regard. The phytoremediation is the use of green plants to eradicate, contain, or make them less toxic environmental contaminants. This technique can be the subject of several strategies, such as: the phytoextraction, the phytodégradation, phyto-stabilization, the phytovolatilisation and the rhizofiltration. This study fits into the context of the contribution to the estimate of the polluting load of wastewater the city of Béchar located in the South West of Algeria, to study the effectiveness of treatment in system of swamps constituted by aquatic plants (Imperata. cylindrica). The choice of species has been done on the basis of climate and soil, but also the natural vegetation may be present on the site. The results obtained show abatements encouraging for contaminants such as the Materials in suspension. It is therefore necessary to make a number of research in order to contribute to a better understanding in the reuse of treated wastewater.

## REFERENCES


[1] M.A. Kendouci1, B. Kharroubi, S. Mebarki, A. Bendida (2016) physicochemical quality of groundwater and pollution risk in arid areas: the case of Algerian Sahara. Arab J Geosci (2016) 9:146.

[2] P. Quezel, S. Santa, (1962). Nouvelle flore de l'Algérie et de régions désertiques méridionales. Tom I. Vuibert. Paris. pp- 44 ,82.

[3] Bendida A, Tidjani A, Badri A, Kendouci MA, Nabou M (2013) Treatment of domestic wastewater from the town of Bechar by a sand filter (sand of Beni Abbes, Bechar, Algeria). Energ Proc ELSEVIER 36:825–833

[4] Kendouci MA (2012) Development of local materials for wastewater pretreatment. Magister Thesis, University of Bechar, Algeria

[5] Münch C., Kuschk P., Röske I, (2004). La stimulation racinaire de l'élimination de l'azote concerne-t-elle des zones limitées ou l'ensemble d'un marais artificiel. Ingénieries N° spécial-2004, 5-11.

[6] Cristina S.C. Calheiros, António O.S.S. Rangel, Paula M.L. Castro, (2008). Evaluation of different substrates to support the growth of Typha latifolia in constructed wetlands treating tannery wastewater over long-term operation. Bioresource Technology 99, 6866–6877.

[7] B. Ouanouki, N. Abdellaoui, N. Ait Abdallah, (2009). Application in Agriculture of Treated Wastewater and Sludge from a Treatment Station (Algérie). J. Scientific. Res. Vol.27 No.4, pp.602-619.

[8] Jean-Marie. P, Lacina. C, Pascal. N, Germain. G, (2008). Traitement des Eaux Résiduaires Urbaines par un Marais Artificiel à Drainage Vertical Planté Avec Panicum Maximum sous Climat Tropical. J. Scientific. Res. 23 (1), pp.25-40.

[9] Martens R. (1982). Apparatus to study the qualitative relationship between root exudates and microbial population in the rhizosphere. Soil. Bio. Biochem. 14, 315-317.

[10] Brix H. (1994). Function of Macrophytes in constructed wetlands. Wat. Sci. Tech. 29, 71-78.

[11] Kroer. N, Barkay .T, Soerensen. S, Weber. D, (1998). Effect of root exudates and bacterial metabolic activity on conjugal gene transfer in the rhizosphere of a marsh plant. FEMS Microbiol. Ecol. 25, 375-384.

[12] Greenway, M., Woolley, A., 1999. Constructed wetlands in Queensland: performance efficiency and nutrient bioaccumulation. Ecol. Eng. 12, 39–55.

[13] T. Bindu, V.P. Sylas, M. Mahesh, P.S. Rakesh, E.V. Ramasamy,(2008). Pollutant removal from domestic wastewater with Taro (Colocasia esculenta) planted in a subsurface flow system ecological engineering 3 3 , 68–82.

[14] O.R. Zimmo, N.P. van der Steen, H.J. Gijzen, 2003 Comparison of ammonia volatilisation rates in algae and duckweed-based waste stabilisation ponds treating domestic wastewater, Water Research 37, 4587–4594.

[15] Zou, C.Q., Wang, X.F., Wang, Z.Y., Zhang, F.S., (2005). Potassium and nitrogen distribution pattern and growth of flue-cured tobacco seedlings influenced by nitrogen form and calcium carbonate in hydroponic culture. J. Plant Nutr. 28, 2145–2157.


★★★