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Treatment of waste water by aerobic lagoon: Groundwater Quality Preservation : Adrar/Algeria

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ABSTRACT

Adrar, a city located at the extreme western south of Algeria, uses underground water as the unique source of drinking water, unfortunately, this ground water is subject to contamination by the ceaseless urban water discharged by the city. The objective of this work is to examine the efficency of the biological treatment of this raw waste water through natural lagoon; prior to their release into the receiving environmlent ; by the removal of elements characteristics of pollution mainly DCO, MES, P and N, we have found a removal efficiency in DCO of 63%, in MES 66%, nitrites and nitrates70% and 40% of phosphorus. These findings are considered satisfactory and hence prevent the contamination of drinking water and preserve the quality of Adrar's ground water.

Key words : *Ground water, Wastewater, Lagoons, Environment.*

Introduction

Algeria as many other countries is faced with the challenging issues of population growth and land settlement to harmoniously economy and ecology, that is to say, meet the needs of goods production and services without modifying or destroying the quality of water, soil and air. (Edlin, 1993). This work attempts to apply a biological treatment in order to remove organic pollutants from wastewater discharges while safeguarding the quality of our groundwater.

Presentation of Adrar : Study area

Adrar is the first of the 48 Algerian cities according to the Algerian administrative division in 1995. It is a saharian town in the southern wester of Algeria between 1 ° 3 ° west of the Greenwich circle and between 20 ° 30 ° north of Equator line, bordered on the north by the wilaya of El Bayedh and Ghardaia the west by Bechar and Tindouf, the east by Tamanrasset and south by Mauritania and Mali. The wilaya of Adrar covers a total area of 427,698 km ^{2} in 2008 for a global population, estimated in 2008, of more than 389.898 inhabitants. The region is formed by four major geographical areas from north to south as it is shown in the Fig. 1 and consists of 11 Daïras, 28 towns and 299 Ksars (villages). It is characterizd bya continental desert climate with rare /even insignificant rainfall, the annual average for the period 2000-2010 is 12 mm.

- The GOURARA : Timimoun Region,
- The TOUAT : Adrar region,
- The TIDIKALT : Aoulef région,
- The TANEZROUFT : Bordj Baji Mokhtar region

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Agricultural activity

Adrar is a city with an agricultural vocation characterized by palm oasis and traditional irrigation system "Fouggara." It is known for its production of dates and tomatoes. The distribution of agricultural land in the municipality of Adrar is presented as follows:

Table 1. Distribution of Agricultural Land in the Municipality of Adrar

Total agricultural area	43 358,5 (ha)
Usable agricultural area	1779 (ha)
Number of agricultural holdings	890
Usable agricultural irrigated area	1653(ha)

Methodology

A. wastewater system

Before the creation of the sewerage system in the city, the inhabitants used a traditional drainage system similar to a septic tank that causes several health problems. Nowadays, about 98% of the sewerage system in the city of Adrar is bound. It forms a joint network of 178.91 km length, with diameters ranging from Ø200 and Ø600 of PVC type or cement. The daily wastewater volume is set at 80% of the volume of the consumed drinking water.

B. Lagoon Koussen

The principle of wastewater by natural or ecological lagoon has been known since antiquity. Indeed, the self-purification processe involved in this technique generates a chain of purifying reactions, occurs spontaneously in which micro- organics degrade the organic matter and convert it into minerals harmless to the receiving environment (Stoddard, 2002 and Roques, 1990). Under these conditions, it is deemed possible to obtain an excellent organic remediation, and an excellent microbial decontamination (Milaude, 1990 and Cheremisinoff, 2002). The Settling ponds of Adrar consist of three (03) sets of three (03) ponds for each as it is shown in the following figures.

Water quality of Ksar Tidmaine (region of Touat)

Demands for fresh water are increasing every year from 4% to 5% while the natural resources remain invariable if not decreasing, due to pollution because of the infiltration of waste water. We have

Fig. 1. Input of wastewater treatment plant

Fig . 2. Out put wastewater treatme

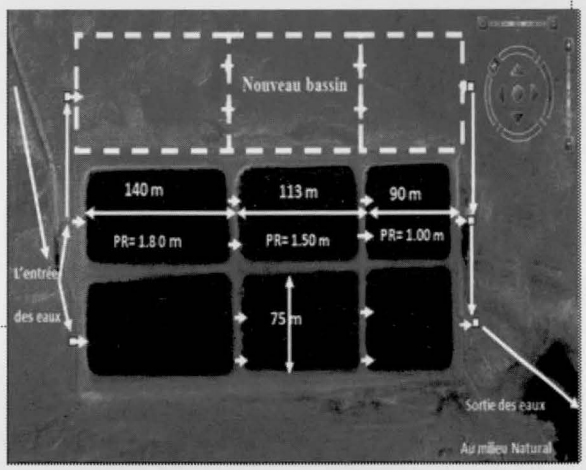

Fig. 3. Size of wastwater treatment plant of ponds

determined the physico-chemical composition of the water of TIDMAINE, the sample taken from the water of this region presents the physico-chemical analysis shown in Tables 2, 3 and 4.

The different physico-chemical parameters of the water of Tidmaine's region employ three main methods to mention:

- Volumetric method,
- Titrimetric method
- Comolrimetric method.

According to the values in the Table above, it is clear that the pH and conductivity are in the standards, so that water is not subjected to contamination by microorganisms, then it is of good quality and safe. The same applies to the turbidity of this water which is before settling is very low and after settling, it is zero, so the water is not charged for suspension.

But, the values of nitrates are high compared to the standards, and even the oxidizable material, its value is moderately higher than standards, these results assume that the water could be contaminated?

Table 2. Physico-chemical Parameters

Result	Global mineralization
ca[++] mg/L	123
Mg [++] mg/L	77
Na [+] mg/L	229
K[+] mg/L	14
Cl[-] mg/L	350
SO4[—] mg/L	395
HCO_3[-] mg/L	171
CO_3[—] mg/L	0
SiO_2 mg/L	10.60
TH °F	62
TAC °F	14
TA °F	0
Minéralization mg/L	1383
Amont of ions mg/L	1422
Mn mg/L	-

Table 3. Mineralization Rates

Phisico-chemical parameters	Results
pH	7.14
Conductivity (ms/cm)	2.23
Turbidity (NTU)	0.22
Turbidity of decanted water (NTU)	0.00
Dry residu à 110°C mg/L	1400.00
Temperature °C	15.5°C

Table 4. Factors of Pollution

Results	Pollution Parameters
Dissolved Oxygen (mg/L)	-
NH_4[+] mg/L	ID
NO_2[-] mg/L	ID
NO_3[-] mg/L	62.00
PO_4[-]	ID
Matter.OX (mg/L)	5.10
Irron (mg/L)	-

And to see better quality of our water, with the physico-chemical parameters shown in Tables 3 and 4, we define the standards values of all the parameters that characterize the quality of drinking water. The following table 5 shows the standards parameters of drinking water.

By comparing the findings of each physicochemical parameter with those of the International standards, on average the water is of drinkable quality except for the high content of nitrates which suspect a pollution due to waste water infiltration

So to meet the need and the urgency to treat waste water before being discharged into the receiving environment, Adrar choses to purify the natural waste water rejection by lagoon, and hence, preserves the drinkable water quality coming from the underground layers (Edline, 1993).

Interpretation of Results

The physico-chemical analyses are conducted on several samples taken during the month of May 2011. The sampling was done in two different points, the first is the upstream part of the basin and the second is the downstream parts. The following table 6 summarizes the physico-chemical characteristics of a representative sample (wastewater) before and after the biological treatment.

For a better understanding of the effectiveness of this biological treatment, we calculated the removal efficiency of each pollution characteristic as it is demonstrated in the following Table 7.

Conclusion

The population growth led to an increase in water consumption, therefore, an increase in the volume of waste water discharged into receiving environments. The Coverage for drinking water and sanitation becomes a goal hard to achieve in our country. To this end the waste water presents a serious threat to public health, ecosystems, and even the economy. Faced with growing water needs, our country is bound to preserve the quality of drinking water especially groundwater and develops various methods to get it from sea water and wastewater under technically, economically and environmentally permissible conditions. (WEF, Press, 2008).

Table 5. Standards of Drinking Water

Standard Parameters	OMS	French	Algeria
pH	6,5 - 9	6,5 - 8,5	6,5 - 8,5
Conductivity (µs/cm a 20°C)	-	400	2800
Oxydizability (mg d'O_2/L)	5	5	3 to the max
Total hardness (°F)	50	60	10 to 30
Ca++(mg/L)	-	100	75 - 200
Mg++(mg/L)	-	50	150
Alkalinity (°F)	50	>2,5	50
Cl^- (mg/L)	250	250	200 - 500
SO_4^{2-} (mg/L)	400	250	250
Turbidity (NTU)	-	-	-
NO_2^- (mg/L)	40	50	50
NO_3^- (mg/L)	3	0,1	0,1
K+ (mg/L)	-	150	200
NH_4^+ (mg/L)	1,5	0,5	0,5to the max
Dry residu at 180°C (mg/L)	-	-	1500-2000

Table 6. Physico-chemical characterization of the waste before and after treatment with natural lagoon Water.

	Upstream of the basin	Downstream of the basin
pH	8.10	8.03
T°	27.80	27
G (ms/cm)	1.82	0.74
NH_4^+ (mg/L)	2.20	1.30
NO_2^- (mg/L)	0.19	0.04
NO_3^-(mg/L)	7	2
PO_4^{3-} (mg/L)	14.80	8.60
DCO (mg/L)	249	90
TUB (NTU)	60	20

Table 7. Efficiency of the Biological Treatment

Paramètres de pollution	Efficiency (%)
DCO (mg/L)	63.85
TUR (mg/L)	66.67
NO_2^- (mg/L)	78.94
NO_3^-(mg/L)	71.43
PO_4^{3-}(mg/L)	41.89

Water consists the essence of our life; however, it can be a source of disease. As far as Adrar city is concerned, groundwater is the only source of drinking water and even if the water is deep underground, it may be contaminated by the infiltration of domestic waste water discharged by the city (Martin, 1985 and Scriban, 1993). For the prevention of ground water contamination, the city of Adrar resolved this issue by treating the discharge of urban waste water through biological treatment and more specifically by natural lagoon. This treatment resulted in almost complete degradation of pollutants (Larpent *et al.*, 1992 and Kibi *et al.*, 2000).

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