Evaluating the Performance of Horizontal Subsurface Flow Constructed Wetlands Using the Plant *Cynodon dactylon* in an Arid Climate.

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ABSTRACT:

The target of this study is to show the potential of *Cynodon dactylon* in the purification of wastewater with a horizontal flow system under a dry and hot climate. This subject involves a comparison between a planted station and an unplanted bed (used as witness) focusing on the plant's ability to treat wastewater. The study was carried out through an experimental pilot station in the urban area of wastewater treatment (ONA EL Oued, Algeria). The process consists of circular beds with a capacity of 130 L filled with superimposed layers of gravel (25/15) mm and sand, 45cm and 15cm deep respectively. The first bed was planted with freshly collected stems of the plant *Cynodon dactylon* (40 stems/m^2) and an unplanted bed taken as a witness. The procedure consists of providing the bed with urban wastewater (feed) after primary treatment (physical treatment) with a flow rate of 30 L per day over regular intervals once every week. The water obtained after staying 5 days in the bed is collected in a vase. After analysis the results revealed important removal fractions of the main pollutants namely : chemical oxygen demand (COD) 82.21%, biochemical oxygen demand (BOD_5) 85%, total suspended solids (TSS) 94.41% ,amnium(NH_4^+) 99 ,68, nitrit(NO_2^{-}) 85,49% natarat(NO_3^-) 82.92%, orthophosphate (PO_4^{2-}) 80,64% ,E. coli 99.41%, coliformes fecaux 99.97 % and total streptococcus 99.90 %. The presence of the plant stems in the unplanted bed leads to the creation a crossing water channel so as to avoid plugging.The considerable decrease of pollutants content and harmful organisms enables the reuse of the treated water in agriculture and industry.

Keywords: ***Constructed wetland, Cynodon dactylon, Arid climate, Coliformes Fecaux, Total streptococcus, Bacteria, Characterized, Wastewater*.**

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INRODUCTION

Water is one of the most important elements involved in the creation and development of healthy life. The exponential growth of population and industrialization will cause a huge lack of water if we don't start to use it in a sustainable way. To achieve this, a high level of responsibility towards water usage is required, and it must be recycled according to its pollution content in order to maintain water quality and protect our environment. Many methods of water treatment have been researched and employed by responsible nations around the globe. There are many parameters that must be considered when a wastewater treatment choice is made, including level of pollution and the amount of water, to be recycled in a certain time.

The use of plants for wastewater treatment is appropriate in smaller communities and agglomerations because they are easily constructed, inexpensive to maintain and very efficient. Constructed wetlands use plants which are able to cope with different concentrated pollutants in water and help bacteria's to break down these substances have design pilot station using surface flow systems and floating aquatics. A subsurface flow hybrid is a combination of three inter dependent elements the growing media, the plants in this system the wastewater comes into contact with a wide range of microorganisms that occur in high densities on the surface of the growing media and around the plant roots. A plant was needed which thrives in water logged conditions, tolerates high level of pollutants, has a high capacity of absorbing these pollutants, particularly nitrogen and has also high biomass production under these extremely adverse conditions. have studied comparative analysis of planted and unplanted. They performed daily water content analyses in the interval between subsequent sludge loadings in a real scale system. A comparative analysis of planted and unplanted system confirmed that the mechanical function of plants is essential in the winter, when the unplanted did not present any dewatering capability. have shows the importance of small scale decentralized wastewater treatment using reed bed treatment systems. The treatment plant has been constructed having the capacity to treat of wastewater per day. The vertical flow and horizontal flow was constructed. A typical hyprid flow system can remove the BOD_5 of up to 97%; the Horizontal flow system can remove only up to 65%. The system is found to be highly effective in removing pollutants such as suspended particles, ammonia-nitrogen, BOD_5, COD and pathogens. In general, the performance of the Constructed wetland has been excellent. Regular monitoring of the systems shows high pollutant removal efficiency achieving close to 100% removal of total coliforms and organic pollutants.

MARERIAL AND METHODS

Presentation of the study area:

El Oued city situated to the South East of Algeria, in the northern reaches of the Erg Oriental (33° to 34° north and 6° to 8° East). It is characterized by an arid climate. The average annual temperature is of the order 22 ,66°C, the warmest month is July with 43.34° C, the coldest month is January with 10.76°C. The warm period lasts from May to October, with an average of 29.98° C. This period knows a significant evaporation which can achieve the 33.44 mm in the month of July. The peak of insolation corresponds to the month of June, with an hourly volume of 344 hours. The annual average of the insolation is 273,40 hours/month. The cold period, spreads from November to April, with an average of 14,99° C. The rainfed period of the year is very short (2 to 3 months), the annual precipitation averages are of the order of 5.47 mm. The moisture average annual is of the order of 47,39%. The values of the Moisture oscillate between 67.7% during the month of December, 30.9% during the month of July. The region is also characterized in spring and summer by winds dry and hot causing the sirocco or "Chihili" appear during the summer period and sand storms.

Choice of the plant :

In the literature the purifying different have been used: the *Pistia stratiotes*[1], *water hyacinth*[2], *Imperata cylindrica*[3], *Phragmites australis*, [4-5-6-7-8-9], *Typha latifolia*[5-8-9-10-11], *Scipus validus*, *Juncus effusus*, *Typhadomin gensis*, *Amaranthus*, *Chorcourus*, *Nerium oleander* , *Tamarix Africa*, *papyrus cypurus*[12], *Arundo Donax*, *Tilapia* and *Panicum maximum*[12]. Taylor *et al*[13] has tested 19 different plants for the elimination of the organic load. *Carex aquatilis Wahlenb, Carex bebbii Olney, Carex microptera Mack., Carex nebrascensis, Carex praegracilis, Carex utriculata, Schoenoplectus acutus, Calamagrostis canadensis, Deschampsia cespitosa (L.), Hordeum jubatum L., Leymus cinereus, Panicum virgatum L., Phalaris arundinacea L, Phragmites australis (Cav.), Juncus arcticus, Juncus torreyi, Typha latifolia L. , Iris issouriensis, Prunella vulgaris L.* has Témacine 21 species have been planted at the beginning of the experience: *Ficus carica, Vetiver zizanioides, Laurus nobilis, Jasminum grandiflora, Lantana camara, Touggourt pink, Damascus Rose, Hibiscus rosa sinensis, Nerium oleander, Mentha spicata, Cyperus spp., lonicera caprifolium, Pelargonium Rosa, Punica granatum, Morus nigra, Atriplex halumis, Typha latifolia, Washingtonia spp., Cymbopogon citratus, Juncus spp., Canna edulis*, 18 species on the 21 planted at the beginning of the experience have not resisted to the conditions of the local climate.

The present study focused on a plant *Cynodon dactylon*, also known as *Vilfa stellata*[14] *dūrvā* grass, *Dhoob*, Bermuda grass, *dubo*, dog's tooth grass,[15] Bahama grass, devil's grass, couch grass, Indian *doab*, *arugampul*, *grama*, wiregrass and scutch grass, is a grass that originated in the Middle East.[16] Although it is not native to Bermuda, it is an abundant invasive species there. It is presumed to have arrived in North America from Bermuda, resulting in its common name.[17]In Bermuda it has been known as *crab grass*.

Scientific classifition :

Kingdom:	Plantae

Clade:	Angiosperms
Clade:	Monocots
Clade:	Commelinids
Order:	Poales
Family:	Poaceae
Genus:	*Cynodon*
Species:	Plantae
Kingdom:	Angiosperms
Clade:	Monocots

Binomial name :

Cynodon dactylon

Presentation of the experimental protocol :

The experimental driver consists of two drums of plastics of a capacity of 110 liters, filled from the bottom to the top on a thickness of 45 cm of gravel and 10 cm of sand (Figure 1). A too-full is placed 5 cm below the sand to avoid any overflow of water. The keg is planted with young stems to reason to 80 stems/m^2. The drums are powered by with semi trailers of water of 30 liters the once a week. The waters come from the wastewater having undergone a treatment Primary treatment at the level of the sewage plant in Kouinine (north of the city of El-Oued).

The flow is done in percolation through the substrate. The residence time of the water is of 5 days. The treated waters are recovered by a tap placed in the bottom of the WAS.

Water samples are collected after primary treatment at the level of the water treatment station located at Kouinine (north exit of the city). The analyzes were carried out at the Laboratory of recovery and promotion of Saharan resources of the University of Ouargla and the Laboratory of these wage treatment plant at Kouinine.Our measures have worn on fifteen parameters: Temperature,pH, Electrical conductivity,Turbidty , Solid suspension, Dissolved oxygen Chemical oxygen Demand,Biochemical oxygen demand , Ammonium ,Nitrite, Nitrate , Orthophosphate *Coliformes Fecaux , Total Streptococcus*, *E. Coli*.

For the determination of the pH, we used a pH meter Hanna (pH 213). The conductivity has been determined with the help of a multi-parameter (HQ Hach40d). For the SS and according to the quantity of suspended solids, two methods have been used: method of filtration on fiberglass according to the Standard (NF EN 872:1996) and the centrifugation according to the standard (NF T 90-105-2). The dissolved oxygen is determined by an oximeter (WTW pH/Oxi 340 i), the BOD_5 was determined by a BOD meter (WTW-OxiTop), the COD, nitrites, nitrates and orthophosphate were determined by colorimetry to the assistance of a

colorimeter (Hach DR/890).

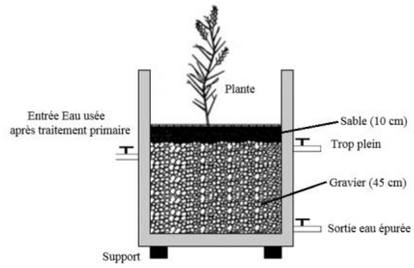

Fig. 1: Experimental device

Photo 1: Experimental device

RESULTS ANDDISCUSSIONS

Characteristics of the effluent to treat :

The waters to treat are of urban wastewater from the city of El-Oued, they are collected at the entrance of the sewage plant in Kouinine. The characteristics of this effluent are shown in Table 1.

All parameters measured for the raw wastewater fall in the range of the Values generally observed for the Urban Waste Water, with the exception of the value of nitrates which come without doubt of the oxidation of ammoniums to nitrite and then to nitrate.

Features effluent to be treated. The water to be treated are urban wastewater from the city of El-Oued, they are collected at the entrance of the treatment plant Kouinine. The characteristics of the effluent are indicated in table 1.

Table 1: shows the values of the measured parameters of the urban wastewater used to feed the beds during the phase of purification moyne,minimum and maximum values are shown.

Parameter	Num	Moy	Min	Max
T C°	48	24.45	15	28
pH	48	7.98	7.61	8.28
E C	48	6.05	5.12	5.73
Turbidty	48	281.25	231	356
TSS(mg/l)	48	267.41	250	236
D Oxygen(mg/l)	48	0.676	0.2	1.6
COD(mg/l)	48	326.07	300	352
BOD_5(mg/l)	48	166.66	120	190
No_2^-(mg/l)	48	0.115	0.011	0.450
NO_3^-(mg/l)	48	32.98	26.5	51.6
NH_4^+(mg/l)	48	60.85	55	67.0
PO_4^{3-} (mg/l)	48	32.2	21	49.3
Coliformes Fecaux	24	330500	240000	463000
Total Streptococcus	24	219160	280000	200000
E. Coli	24	145000	120000	180000

Purification efficiency :

The yield of purification is calculated according to the formula

R % = (Xi-Xf) x100 /Xi

Xi= concentration of the parameters inside the bed (mg/L).

Xf= concentration of the parameters at the output of the bed (mg/L).

Evolution of Temperature :

In the figure 2 we notice that the temperature of the inflow water deacrise at the beginnig the constant when they pass from Feb till August ,it dcreases to 28C°. In the three months October untill Decembe can be interprete due to the fact that climat it remain more cold all these stocks are linked to the temperature of season.

Table -1 : Evolution of Temperature

T C°	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	oct	nov	Dec
in flow	15	16	17,7	18,7	19,5	21,0	22	28	22,1	20,8	20,5	14,1
witness	16	17,9	17,5	17,7	20,6	21,5	23,2	28	23,1	18,2	18,5	12,7
Cynodon	17,1	17,1	17,0	17,0	20,5	21,1	23,5	28,3	27,5	17,7	21,4	18,2

Evolution of the pH :

The evolution of the pH values of wastewater to the entry and exit of the system planted and not planted during the period from December to November, are gathered in the figure 3.

Throughout the year of study for the bed planted where not planted, there is a slight acidification of purified water. The acidification for the bed planted is more important. This slight acidification of the environment can be interpreted by an oxidation of the COD and NH_4^+, the carbon dioxide (CO_2) product of, the oxidation of the COD acidifies the middle, nitrification (oxidation of NH_4^+) causes a acidification of the filtrates ; plants can also release of root exudates (acids tannic and gallic), which cause acidification of the environment.

Table -2 : Evolution of pH

pH	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	7,82	8,06	8,17	7,74	8,28	8,27	8,13	8,09	7,64	7,61	7,95	8,00
witness	7,41	7,28	7,40	7,50	7,99	8,00	7,20	7,55	7,40	7,59	7,50	7,65
Cynodon	7,09	7,00	7,10	7,46	7,22	6,90	7,12	6,82	6,83	7,13	6,79	7,15

The evolution of the Electrical conductivity :

The evolution of the values of the conductivity of the wastewater to the entry and exit of the system planted and not planted, during the period from December to November, are gathered in the figure 4.

The conductivity increases to the output of the witness and the bed planted, this increase could be linked to the mineralization of organic matter. Our results are similar to those found by Finlayson and Chick[18], for the same plant and that interpret this phenomenon by evapotranspiration from the vegetation which tends to concentrate more of the effluent.

Evolution of Conductivity Electronic (ms/cm) : Table -3

E C	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	5,73	5,17	5,22	5,14	4,97	5,61	5,12	5,26	5,52	5,37	5,14	5,32
witness	5,56	7,14	7,00	7,72	6,65	6,55	7,11	7,20	10,6	10,5	7,2	8,8
Cynodon	6,50	6,44	9,30	10,3	10,2	10,2	10,0	9,43	20,6	21,9	20,5	20,8

Evolution of Total Solid Suspension :

The evolution of the values of my wastewater to the entry and exit of the system planted and not planted during the study period, are gathered in the figure 5.

One obtains yields of abatements of contents in suspension very satisfactory that in all cases exceed the 85%. For the witness, the yields oscillate between the 89,29 % (month of September) and 93,30% (month of August). The minimum yield for the bed planted is 88,11 % (month of December) and this performance achieved 96,76% during the month of July. There is a small improvement in the retention of material in suspension when going from the bed not planted in bed planted because the most important part of contents in suspension is retained by filtration through the gravel, the roots of plants contribute to the retention of another part of contents in suspension.

Table -3 : Evolution of TSS (mg/l)

TSS	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	255,4	280,9	280	270,2	280,3	250	273	288,2	260	265,3	260	245,7
witness	26	23,33	23,2	23	23,22	25	25	23,11	24	24, 2	26,7	28,07
Cynodon	36	14,5	20,2	14	14,9	14,8	16	20	10	16	16,5	11,5

Evolution of Turb (NTU)

Table-6: Evolution of Turb (NTU)

Turb	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	334	321	231	233	230	237	321	336	293	253	266	320

witness	190	192	196	195	175	175	175	165	189	190	126	118
Cynodon	111	101	101	115	100	102	105	100	82.5	86,3	84,2	80,2

During the period from January to December ,sample of wastewaters were collected from the EL oued station every 7 days analyses were made ,including measurements of turbidity. In the inflow (untreated water) the turbidity level vary between 230 NTU to 336 NTU .

Evolution of the dissolved oxygen :

The evolution of the values of the dissolved oxygen of wastewater to the entry and exit of the system planted and not planted during the study period, are gathered in the figure 7.

A significant improvement in the quantity of dissolved oxygen is observed in the bed planted and in the bed not planted, for the maximum values going from 1.26 mg/L to 2.04 mg/L for the witness, 2.85 mg/L for the bed planted. The degradation of the organic matter fact that the waters become less loaded and therefore the oxygen concentration becomes more important.

O_2 dis (mg/l) Table -4:

O_2 dis	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	0,82	1,60	1,50	0,30	0,50	0,40	0,40	0,20	0,9	0,8	0,2	0,5
witness	4,5	4,20	4,20	4,00	4,10	4,19	4,10	4,10	3,9	3,30	3,70	3,50
Cynodon	6,00	6,20	6,20	5,14	5,10	5,10	5,00	4,50	6,90	7,00	7,9	7,5

Evolution of the Chemical Oxygen Demand :

The evolution of the values of the COD of wastewater to the entry and exit of the system planted and not planted during the study period, are gathered in the figure 8.

For the witness, the yields in terms of COD oscillate between the 73,13% (month of May) and 78,63% (Month November), the minimum yield for the bed planted is 84.54% (month of November) and this performance reached 89.92% per cent during the month of March. A net improvement of the abatement of the COD is observed when going from the witness to bed planted. The biological degradation by action of bacteria added to physical phenomena, filtration are without doubt to the origin of the drawdown of the organic matter. The plants are creating of 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, something which allows the aerobic bacteria to proliferate is to ensure an oxidation of organic matter[19].

The sedimentation of my and their filtration by the gravel and the roots of the plants have certainly contributed to the elimination of the carbonaceous pollutants[20].

Table-9: Evolution of COD (mg/l)

COD	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	357	406	370	386	324	424	374	354	343	360	363	300
witness	180	195	295,5	310	208	366	248	228	227	130	170	150
Cynodon	98	104	100	102	69	106	109	89	67	100	99,0	80

Evolution of the biochemical oxygen demand:

The evolution of the values of the BOD_5 of wastewater to the entry and exit of the system planted and not planted during the study period, are gathered in the figure 9.

For the witness, the yields in terms of BOD_5 oscillate between 58,28% (month of June) and 79.83% (Month September). The minimum yield for the bed planted by the plant *Cynodon* is 79,84%% (July) and this performance reached 87.98% during the month of September. The same phenomena of the abatement of the COD are involved in the retention of the BOD_5.

Table-7: Evolution of BOD_5 (mg/l)

BOD_5	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	390	210	290	290	300	300	280	340	396	204	290	290
witness	32.00	32.10	31.9	32.0	32.0	34.0	32.0	27.9	38.0	26.1	32,0	32.0
Cynodon	9.80	9.80	9.80	9.80	14.5	14.5	21.3	21.3	15.0	9.80	9.80	9.80

Evolution of NH_4^+

Ammonia is a widely used indicator of the efficacy of wastewater treatment systems [21]. The production of ammonia is the first step in mineralization of organic nitrogen. In terms of wastewater quality, elevated ammonia-nitrogen concentrations may indicate high organic compound contamination associated with the aerobic and anaerobic processing of dead and dying cells and tissues[22]. Therefore, the reduction of ammonia concentrations in constructed wetland effluent implies that organic nitrogen is being converted, through microorganism facilitated transformation, to various species of inorganic nitrogen, such as ammonium ion, nitrite, and nitrate. The constructed wetland units achieved excellent removal efficiencies of ammonia-nitrogen, with overall concentrations decreasing by 99,81% during treatment.The value of ammonium where obtained for the untreated water (wastewater) vary between (55,70 mg/l and 66,81 mg/l) . However the ammonium average value for the treated water (*Cynodon dactylon*)the amount is less than vary between (1,20 mg/l and 0.30 mg/l). This results give us yield range betwen (99,81 % 99 ,30%).We can be interpreted by the fact that part of ammonium is assimilated by plant (*Cynodon dactylon*)while the other part is converted to nitrite and then to nitrate by biological oxidation by nitrifying bacteria. According[23].aquatic macrophytes are equipped with an internal air space well developed through plant tissues which ensures the transfer of oxygen to the plants (roots) and rhizomes. The oxygen diffuses through the roots stimulates the growth of nitrifying bacteria in the rhizosphere[24].

$$NH_4^+ + 3/2\ O_2 \rightarrow NO_2^- + 2H^+ + H_2O \text{ — Nitrosomonas}$$

$$NO_2^- + 1/2\ O_2 \rightarrow NO_3^- \text{ —Nitrobacter}$$

Table -10: Evolution of NH_4^+

NH_4^+	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	65,85	66,00	56,0	55,1	66,8	66,8	65,0	55,0	67,0	55,7	62,1	58,0
witness	65,20	65,10	55,8	55,0	65,7	66,7	65,8	53,9	58,8	52,3	51,5	49,6
Cynodon	0,339	0,339	0,33	0,30	0,34	0,50	0,56	0,34	0,51	0,60	0,44	1,20

Evolution of nitrite :

The evolution of the values of nitrite of wastewater to the entry and exit of the systems planted and not planted, during the study period are gathered in the figure 11.

For the witness, the yields of nitrites oscillate between 41,96% (month of February) and 80.64% (Month January). The minimum yield for the bed planted is 69.23% (month of February) and this performance achieved 88,84% during the month of January. The elimination of nitrite is significant enough in the beds planted and in the bed not planted, with a yield of 80.64% for the witness to a performance of 88,84% for the bed planted. Nitrites are oxidized to nitrates (nitration) by bacteria Nitrobacter and a party is assimilated by plants:

NO_2^-	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	0,318	0,322	0,32	0,30	0,35	0,35	0,20	0,32	0,39	0,35	0,34	0,31
witness	0,310	0,310	0,31	0,31	0,32	0,33	0,28	0,31	0,46	0,48	0,44	0,85
Cynodon	0,625	0,965	0,66	0,62	0,46	0,44	0,46	0,32	0,35	0,36	0,34	0,42

Evolution of nitrate :

The evolution of the values of nitrate of wastewater to the entry and exit of the systems planted and not planted during the study period, are gathered in the figure 12.

For the witness, the yields of nitrates oscillate between the 6.13% (month of June) and 79,47% (month of January). The minimum yield for the bed planted is 47,48 % (month of February) and this performance reached 91.20% during the month of August. The elimination of nitrates is significant enough in the bed planted and in the bed not planted, a performance of 79,47% for the witness, one goes to 91,20% for the *Cynodon dactylon.* Nitrates are absorbed by the plants in the presence of light for photosynthesis.

Table-11: Evolution of NO_3^-

NO_3^-	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	42,6	42	35,5	30,8	25,7	28,6	30,2	29,7	25,6	31,7	31,5	28
witness	3,8	9,6	9,6	9,1	10,3	11,1	9,5	7,5	9,8	10,1	8,2	9,2
Cynodon	2,5	6,65	2,9	3,7	5	8,15	5,77	3,2	3,5	5,24	4,25	4,3

Evolution of orthophosphate :

The evolution of the values of orthophosphate of wastewater to the entry and exit of the systems.

Table-11: Evolution of orthophosphate :

PO_4^{3-}	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	35	30	21	33,1	28,7	49,3	29,2	23,7	31,8	30,0	30,5	44,1
witness	16,55	14,40	14,0	12,8	11,9	13,4	8,8	11, 6	11,8	13,7	12,9	13,1
Cynodon	2,77	5,85	5,50	6,90	5,70	6,70	5,77	5,23	5,90	9,49	8,70	6,27

planted and not planted during the study period, are gathered in the figure 13.

For the witness, the yields of orthophosphate oscillate between the 37.89 % (month of March) and 73.22 % (month of December).The minimum yield for the bed planted is 60,32 % (month of October) and this performance reached 93.12% during the month of April. The assimilation can be done in different ways either by bacterial assimilation and by the plant[25]. the plant assimilates for these fabrics in growth, the phosphorus through its rhizome and these roots or by adsorption by the massif filter. Our results are superior to those found by Abissy[26] who obtains a yield of 10%.

Bacteria removal :

Evolution of Coliformes Fecaux:

Figure 13 shows the number of colonies in the wastewater and the treated waters. In general the number of colonies of Coliformes Fecaux in wastewater is greater than that in the treated water in both planted and unplanted basins at a rate of 3305000,00 UFC/100mL in wastewater and a rate of 319,67 UFC / 100ml and 36937,00 in treated water in planted and unplanted basins respectively. The purification yield in both basins is 99.99% and 99,13% respectively.

Table-27: Evolution of Coliformes Fecaux

Coliformes Fecaux	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	**380000**	**320000**	**190000**	**353000**	**265000**	**555000**	**240000**	**259000**	**306000**	**310000**	**325000**	**463000**
witness	**14750**	**12200**	**11800**	**10800**	**10600**	**15500**	**10800**	**10500**	**11800**	**15600**	**11000**	**12400**
Cynodon	**180**	**385**	**350**	**400**	**450**	**370**	**355**	**323**	**340**	**213**	**250**	**220**

Total *Streptococcus* :

Figure 14 shows the number of colonies of total *streptococcus* in the wastewater and the treated waters. The number of colonies is about 230000.58UFC/100mL in wastewater and337.9166 UFC / 100mL and 319000,5833 UFC / 100mL in treated water in planted and unplanted basins respectively. The purification yield in both basins is 99.97% and 96% respectively.

There is a considerable decrease in bacteria in the treated water reaching up to 99% and this can be explained by the natural death of the bacteria as a result of change in the living medium orsmash of organic materials[27]. Moreover the difference in the removal rate of bacteria between the planted and unplanted basins is due to the fact that plant roots secrete acids (toxic biologically) which contribute to the killing of bacteria as was interpreted by VINCENT et al [28].

Table-28: Evolution of StreptocoqueTotaux

StreptocoqueTotaux	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	230000	240000	200000	250000	210000	260000	280000	240000	200000	230000	270000	220000
witness	25000	30000	32000	28000	31000	24000	25000	20000	18000	22000	19000	21000
Cynodon	300	320	340	300	350	325	330	360	350	355	360	365

E. Coli: (99.41%),

Figure 15 shows the number of E. coli colonies in the wastewater and the treated water. In general the number of E. coli colonies in the wastewater is greater than the number of colonies in the treated water in both planted and unplanted basins. The number of colonies is 148000,9166 UFC/100 mL in wastewater and 11700,9166UEC/100ml and 290,9166UFC/100 mL in planted and unplanted basins respectively. Removal yield of E. coli in treated water in the planted and unplanted basins is 99.80 % and 97,51 %, respectively.

Escherchia Coli	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
in flow	155000	145000	145000	120000	180000	140000	145000	165000	177000	135000	120000	160000
witness	14700	12200	11800	10800	10600	13000	12500	10500	11800	10600	11000	12000
Cynodon	180	200	220	300	250	500	355	123	540	113	190	520

CONCLUSION

This study, which covered the period from December 2015 to November 2016 with the follow-up of fifteen parameters. Temperature , pH, electrical conductivity, TSS, Turbidity COD,

BOD_5, dissolved oxygen, ammonium, nitrite, nitrate , orthophosphate Total *Coliforms* , Total *streptococcus* and ***E. Coli*** have allowed to show that the plant *Cynodon dactylon*

which supports the conditions of very difficult climate, may very well be used for the purification of urban wastewater in an arid climate. Yields very satisfactory were obtained: for the particulate pollution and organic, the rates of drawdown have reached the 94,41% for the substances in suspension (TSS), the 82,21% for the Chemical Oxygen Demand (COD), and 85% for the biochemical oxygen demand in 5 days (BOD_5) with a net increase of the dissolved oxygen concentration. The elimination of nitrogen pollution and of phosphorus is translated by rates of drawdowns of amnium 99 ,68% , 88,84 % for nitrites, 84,49 % for nitrates and 82,92 % for the orthophosphate(PO_4^{3-}). The yields of purification for *Coliformes Fecaux, Total streptococcus* and *E. Coli* are more than 99,80% the different pollutants are very significant especially for particulate pollution and the organic pollution.

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