

Performance of the Constructed Wetland System for the Treatment of Water from the Corumbataí River

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ABSTRACT

The aim of this work was to study the constructed wetland system for the treatment of water from the Corumbataí river simulated on a laboratory scale. The parameters analyzed at different points of the system were ammonia, biochemical demand for oxygen (BDO), chemical demand for oxygen (CDO), chlorides, apparent color, conductivity, dissolved oxygen, magnesium (Mg), sodium (Na), potassium (K), silicon (Si), total phosphorous, total coliforms and Escherichia coli, total dissolved solids (TDS), turbidity, and macrophyte biomass. The results demonstrated that this alternative water treatment system was effective in removing the microorganisms (total coliforms and E. coli), among other parameters analyzed, for varying periods of the treatment, promoting notable improvement in the quality of the water treated from the Corumbataí River.

Key Words: Aquatic macrophytes, filtering soil, microfiltration, bioreactor, microorganisms

INTRODUCTION

Water has become increasingly scarce due to the lack of urban planning, rapid increase in the pollution, waste, and the lack of water re-usage and effective environmental education programs. Water use regulation was proposed as a useful tool in beginning discussion of water quality goals according classification system proposed by the CONAMA resolution (Souza and Tundisi, 2003). The high cost of implementing the basic sanitation projects can lead to higher public debt and compete for the resources that are badly needed for other essential services, such as the health and education (Rebouças et al., 1999). The efforts to

develop the projects that are both low cost and effective have, paradoxically, been more intensive in the wealthier countries of Europe and the United States, since 1970. Some proposals for the effluent and water treatment exist in literature, amongst these, of the use of ultrasound for the reduction of the number of the bacteria (Domingos et al., 2005). An alternative process for treating the water, effluents, and domestic sewage is the CWs (constructed wetland system) (Salati et al., 1999). Despite evidence of the toxic effects on the aquatic plants when the effluent has a high organic load (Haynes and Goh, 1978; Gersberg et al., 1986), these CWs have been used as the secondary and tertiary treatments (Green et al., 1996; Stober et

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al., 1997; Neralla et al., 1998; Billore et al., 1999), and can be used for the primary treatment of the water or effluents as an alternative to the traditional process currently in use. Furtado et al., 2002 investigated the methanogenic activity in sediment of the Imboacica (human impacted), Cabiúnas and Comprida coastal lagoons in Rio de Janeiro State (Brazil).

The use of CWs to treat the river water and residual water has been studied in a number of countries (Hammer, 1989; Cooper and Findlater, 1990; Olson and Marshall, 1992; Moshiri, 1993; Kadlec and Knight, 1996), and the problems associated with it have also been studied (Pant et al., 2001; Gómez Cerezo et al., 2001; Braskerud, 2002a,b; Söderqvist, 2002; Pant and Reddy, 2003). The use of the aquatic macrophytes in the CWs has been proven for reducing the amount of the organic matter (Brix, 1993; Nguyen, 2000), remove the nutrients (Mitsch et al., 2000), and reduce the pathogens (Perkins and Hunter, 2000). In Brazil, this treatment has been questioned with respect to its efficiency and cost/benefit; nevertheless, based on the studies by Carmen Lúcia Roquette Pinto, of the Universidade Federal Fluminense, and findings presented at the 6th International Conference on the Wetland Systems for Water Pollution Control, in Águas de São Pedro, São Paulo (SP), 1998, it has gradually become a subject of study. In this study, we sought to verify, on a laboratory scale, the efficiency of descending flow CWs containing particulates, microorganisms, macroorganisms, peat, and inert industrial residues, for the treatment of water from the Corumbataí River in Rio Claro, SP.

MATERIALS AND METHODS

The collection site for the water samples from the Corumbataí River was in the district of Assistência, in the municipality of Rio Claro, SP, UTM coordinates X 230064 and Y 7507759. One thousand five hundred liters of water were collected for use in the CW system, with physical-chemical properties (Palma-Silva and Tauk-Tornisielo, 2001) that placed them in class 4, according to CONAMA Resolution 357/2005 (CONAMA, 2005).

The CWs was constructed in 250L PVC boxes in a series of 4 tanks (reactors), in a continuous flow. The following was placed in each reactor, as illustrated in Figure 1: reactor 1, class 4 water

from the Corumbataí River; reactor 2, floating aquatic macrophyte *Eichhornia crassipes*, covering 80% of the water surface; reactor 3, three different sizes of gravel (a = 25 – 50mm; b = 6,4 – 12,7mm; c = 2,4 – 4,8mm), plus soil of cerrado area and Si residue; reactor 4, the same three sizes of gravel as in reactor 3, plus soil of cerrado area and peat. Four collection points were established in the system, at the exits of reactor 1 (P1), reactor 2 (P2), reactor 3 (P3), and reactor 4 (P4). At each collection point, 1L of water was sampled, with 0.1L being used for the analyses of microbiological parameters, carried out by the Centro de Estudos Ambientais (CEA – Center for Environmental Studies) at UNESP, Rio Claro, SP. Water samples were collected from the CWs for a period of 20 days, with the first being conducted two hours after the experiment was initiated (T0). The T10 samples were collected on the 10th day of the experiment, T15 on the 15th, and T20 twenty days after the experiment began. The samples were collected in 1L polyethylene bottles and cooled in a Styrofoam box. The analyses of the samples were conducted on the same day they were collected, with the exception of the total nitrogen analysis, for which the samples were acidified and kept refrigerated for later quantification. Collection flasks (100mL), tightly closed with stoppers wrapped in protective paper, were previously sterilized for the microbiological analyses of the samples.

The physical, chemical, and microbiological parameters were determined using the methodology established in Standard Methods for the Examination of Water and Wastewater (1998) for the analysis of ammonia, biochemical demand for oxygen (BDO), chemical demand for oxygen (CDO), chlorides, apparent color, conductivity, dissolved oxygen, Mg, Na, K, Si, total phosphorous, total dissolved solids (TDS), and turbidity. Total coliforms and *Escherichia coli* were determined using Colilert kits (IDEXX Laboratories Inc. Westbrook, ME).

The biomass of macrophyte was determined by gram (dry weight) throughout the experiment (Elias et al., 2001). Samples were taken to quantify the biomass at T0, T5, T10, T15, and T20. At the time the aquatic macrophytes were taken from reactor 2 (Fig. 1), they were weighed after 5 minutes to allow the drainage of excess water (fresh weight). The dry weight of the plants was obtained after 48 hours at 72°C.

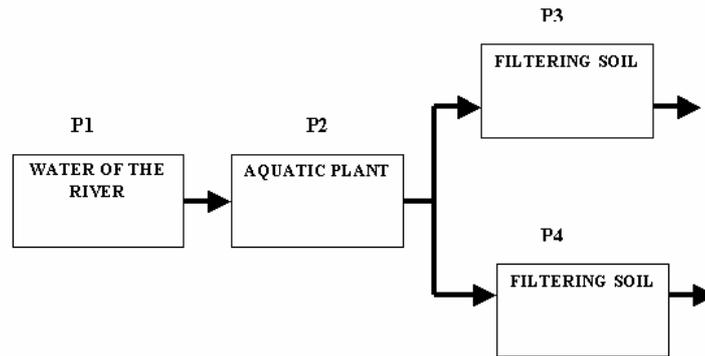


Figure 1 - Diagram of the constructed wetland system for the treatment of water from the Corumbataí River. Legend: P1 = Reactor 1; P2 = Reactor 2; P3 = Reactor 3 and P4 = Reactor 4

RESULTS AND DISCUSSION

Growth rate of the macrophytes

The results regarding the growth rate of the macrophytes during the 20 days of the experiment are presented in Figure 2. The macrophytes showed growth in the CWs during the experiments with treatment of water from the Corumbataí River, however great variation was observed in the mean dry weight of the samples, as evidenced by the large standard deviation in the statistical

analyses – a fact that was also observed by Elias et al. (2001). Various environmental factors may have contributed to this result, such as the size of the space available for the plants in the reactor, increasing the competition for the nutrients and light in the system. Despite the large standard deviations, an increase in the biomass of the plants can be observed in the CWs. This increase can be attributed to the assimilation by the aquatic plants of the nutrients provided by the river water.

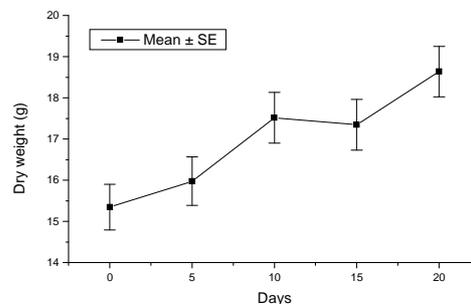


Figure 2 - Growth curve of *Eichhornia crassipes* determined for the amount of biomass (dry weight) in the CW system during the treatment of the water of the River Corumbataí.

Water analyses

The results of the analyses samples water at T0, T5, T10, T15, and T20 are presented in Tables 1, 2, 3 and 4. The results obtained at T0 (Table 1) demonstrate that the best performance for almost all the parameters studied occurred in the system composed of reactor 4, containing aquatic macrophyte, and three sizes of gravel plus soil and peat. Efficiency greater than 80.0% was observed for turbidity, total phosphorous, Mg, total

coliforms and *E. coli*. The system composed of reactor 3 also had greater than 95.0% efficiency for total coliforms and *E. coli*. Elias et al. (2001) found 87.0% efficiency in the reduction of ammonia in a CW system using floating aquatic plants (*Eichhornia crassipes*) and rice, while Jing et al. (2001) obtained 78.0-100.0% efficiency in the reduction of ammonia in a similar system used to treat river water. These results had presented better comparative efficiencies when to those

obtained here with the use of *E. crassipes*, only. Thus, the results obtained here could be optimized with mixing cultures of this floating aquatic plant with other similar plants to the rice.

Table 1 - Analyses of water parameters of Corumbataí River, in period T0 days, in CWs. Legend: P1 = Reactor 1; P2 = Reactor 2; P3 = Reactor 3; P4 = Reactor 4 and E = Efficiency.

Parameters	P1	P2	E. (%) P1-P2*	P3	E. (%) P1-P3**	P4	E. (%) P1-P4***
Water temperature °C	27.1	26.5	-	27.2	-	27.4	-
Ambient temperature °C	33.5	33.5	-	33.5	-	33.5	-
Turbidity (UNT)	30.3	13.8	54.5	18.6	38.6	3.6	88.1
Conductivity ($\mu\text{S}\cdot\text{cm}^{-1}$)	193.0	186.0	3.6	191.0	1.0	157.0	18.7
pH	7.1	6.5	-	6.5	-	6.1	-
Total nitrogen ($\text{mg}\cdot\text{L}^{-1}$)	10.1	9.8	3.0	9.8	3.0	9.1	9.9
Dissolved oxygen ($\text{mg}\cdot\text{L}^{-1}$)	9.0	8.9	-	9.0	-	9.2	-
Ammonia ($\text{mg}\cdot\text{L}^{-1}$)	1.4	0.5	64.3	0.4	71.4	0.4	71.4
CDO ($\text{mg}\cdot\text{O}_2\cdot\text{L}^{-1}$)	22.5	28.5	-26.7	40.0	-77.8	19.0	15.6
BDO ($\text{mg}\cdot\text{O}_2\cdot\text{L}^{-1}$)	14.1	12.1	14.2	11.4	19.1	8.4	40.4
Apparent color (Pt/L)	186.5	107.5	42.4	91.5	50.9	46.0	75.3
Total Phosphorus ($\mu\text{g}\cdot\text{L}^{-1}$)	200.0	82.2	58.9	79.6	60.2	22.7	88.7
Chlorides ($\text{mg}\cdot\text{L}^{-1}$)	8.5	21.0	-147.1	34.0	-300.0	31.0	-264.7
TDS ($\text{mg}\cdot\text{L}^{-1}$)	96.0	93.5	2.6	98.5	-2.6	78.0	18.8
Na ($\text{mg}\cdot\text{L}^{-1}$)	9.0	6.1	32.2	4.1	54.4	3.2	64.4
K ($\text{mg}\cdot\text{L}^{-1}$)	2.4	1.8	25.0	0.9	62.5	1.3	45.8
Si ($\text{mg}\cdot\text{L}^{-1}$)	6.9	5.8	15.9	10.8	-56.5	4.2	39.1
Ca ($\text{mg}\cdot\text{L}^{-1}$)	9.7	16.1	-66.0	22.6	-133.0	16.2	-67.0
Mg ($\text{mg}\cdot\text{L}^{-1}$)	8.2	4.9	40.2	2.0	75.6	1.6	80.5
Total coliforms MNP/100 mL	1.0×10^5	3.0×10^4	70.0	1.1×10^3	98.9	3.6×10^3	96.4
<i>E. coli</i> MNP/100 mL	1.6×10^4	6.4×10^3	60.0	1.0×10^1	99.9	3.1×10^2	98.1
* (P1-P2)/P1.100	**(P1-P3)/P1.100		*** (P1-P4)/P1.100				

Variation in the percentage of reduction of CDO has been found in different types of CWs. The results shown in table 1 show to minor efficiencies in relation to those finding in the T10 period (Table 2) and of other authors, mainly in reactor 4. Koottatep and Polprasert (1997) obtained 71.0% (1 day) and 83.0% (5 days) efficiency in the reduction of CDO, and Manfrinato (1989), using the edapho-phytodepuration method, obtained 84.0 % efficiency using only aquatic plants. Solano et al. (2004) using this system in small villages, achieved 50.0% and 88.0% efficiency in the reduction of CDO in October and summer, respectively. In the CWs used by Schulz et al. (2004), there was 30.0-31.0% efficiency in the reduction of CDO after 56 and 98 days, respectively. Lee et al. (2004), in a system with three periods of hydraulic retention (HRT), obtained 84.0% efficiency in phase I (1 to 109 days), with lower values at longer periods of time.

The results found in the systems CWs showed the efficiency with the maximum of 75.0% reduction in CDO after 10 days of treatment with the reactor 4 (Table 2). Values exceeding 80.0% efficiency were obtained for turbidity, total phosphorous, total coliforms, and *E. coli* in the system composed of reactor 4. More than 100.0% efficiency in the reduction of most probable number of *E. coli* occurred at T10, T15, and T20, with the greatest reduction in total coliforms (99.9%) occurring at T10 and T15.

With regard to nitrogen, maximum performance (14.3%) was achieved in the system when the water passed through reactor P4, containing gravel, soil, and peat, after 20 days of treatment (T20). Koottatep and Polprasert (1997) obtained 84.0-86.0% efficiency in the removal of total nitrogen at 8 weeks of treatment; Schultz et al (2004) reported 19.0% efficiency at 14 days and 30.0% at 70 days; Lee et al. (2004) obtained

24.0% efficiency in phase I, with lower rates of efficiency in the other two phases. All the results

presented for these authors had greater efficiencies in relation to those finding in the system used here.

Table 2 - Analyses of water parameters of Corumbataí River, in period T10 days, in CWs. Legend: P1 = Reactor 1; P2 = Reactor 2; P3 = Reactor 3; P4 = Reactor 4 and E = Efficiency.

Parameters	P1	P2	E. (%) P1-P2*	P3	E. (%) P1-P3**	P4	E. (%) P1-P4***
Water temperature °C	30.4	28.7	-	28.2	-	29.1	-
Ambient temperature °C	33.0	33.0	-	33.0	-	33.0	-
Turbidity (UNT)	19.3	4.6	76.2	0.9	95.3	0.9	95.3
Conductivity (µS.cm ⁻¹)	199.5	185.6	7.0	219.0	-9.8	174.0	12.8
pH	8.0	6.8	-	6.5	-	5.9	-
Total nitrogen (mg.L ⁻¹)	8.7	8.4	3.4	8.0	8.0	7.7	11.5
Dissolved oxygen (mg.L ⁻¹)	8.3	8.3	-	7.9	-	8.1	-
Ammonia (mg.L ⁻¹)	0.2	0.1	50.0	0.5	-150.0	0.4	-100.0
CDO (mg.O ₂ .L ⁻¹)	12.0	11.0	8.3	10.0	16.7	3.0	75.0
BDO (mg.O ₂ .L ⁻¹)	11.4	10.0	12.3	7.5	34.2	7.7	32.5
Apparent color (Pt/L)	183.0	60.0	67.2	78.0	57.4	80.0	56.3
Total Phosphorus (µg.L ⁻¹)	180.9	64.0	64.6	44.9	75.2	27.0	85.1
Chlorides (mg.L ⁻¹)	13.0	6.0	53.8	6.5	50.0	5.9	54.6
TDS (mg.L ⁻¹)	94.0	87.0	7.4	103.0	-9.6	82.0	12.8
Na (mg.L ⁻¹)	9.2	9.4	-2.2	9.3	-1.1	9.2	0.0
K (mg.L ⁻¹)	2.6	0.7	73.1	1.3	50.0	1.4	46.2
Si (mg.L ⁻¹)	6.8	6.2	8.8	15.0	-120.6	4.9	27.9
Ca (mg.L ⁻¹)	9.7	9.1	6.2	21.3	-119.6	15.4	-58.8
Mg (mg.L ⁻¹)	7.7	7.2	6.5	3.1	59.7	2.2	71.4
Total coliforms MNP/100 mL	73x10 ³	6.1x10 ³	91.6	0.1x10 ³	99.9	0.6x10 ³	99.2
<i>E. coli</i> MNP/100 mL	1.2x10 ³	0.1x10 ³	91.7	0.0	100.0	0.0	100.0

*(P1-P2)/P1.100

***(P1-P3)/P1.100

***(P1-P4)/P1.100

Manfrinato (1989), using the edapho-phytodepuration method for preliminary treatment of water, reported 92.3% efficiency in the reduction of turbidity after the contaminated water passed through the aquatic plants. A higher value was achieved in the system used here after 20 days, however the water treated passed through the reactor containing aquatic plants as well as the one with soil, gravel, and peat (Table 4).

Schulz et al. (2004) obtained 41.0-53.0% efficiency in reducing total phosphorous after 56 to 70 days of treatment, respectively, and Lee et al. (2004) reported 47.0% in phases I and II, corresponding to 1 to 182 days, and 59.0% in phase II, from 183 to 244 days. The results showed a maximum efficiency of 97.4% at 20 days (Table 4) in the system-containing reactor 4, representing an improvement compared to the results obtained by Lee et al. (2004).

In the systems studied here, that made up of reactors 2 and 4 proved to be more efficient. In the beginning of the experiment, T0, in the system

contend reactors 2 and 4 had been observed the biggest efficiencies for the values reduction of conductivity, apparent color, Na and Mg. In the T10 period, in this same system, had occurred the biggest efficiencies for the reduction of the CDO, chlorides and *E. coli*.

The biggest efficiencies had been verified in the T15 period for total nitrogen and total coliforms and in the T20, for turbidity, total phosphorus, TDS and Si. The reactor only contends floating aquatic plant provided the biggest efficiencies for K and Ca, in the T20.

The results had demonstrated that bigger efficiencies for the treatment of the water of the used river had occurred in the system contend a reactor contend floating aquatic plant together with another reactor contend gravel, ground and peat.

Jing et al. (2001) conducted research-using CWs to treat river water and obtained 13.0 to 51.0% efficiency in the reduction of CDO.

Table 3 - Analyses of water parameters of Corumbataí River, in period T15 days, in CWs. Legend: P1 = Reactor 1; P2 = Reactor 2; P3 = Reactor 3; P4 = Reactor 4 and E = Efficiency.

Parameters	P1	P2	E. (%) P1-P2*	P3	E. (%) P1-P3**	P4	E. (%) P1-P4***
Water temperature °C	29.7	28.0	-	28.5	-	31.5	-
Ambient temperature °C	33.0	33.0	-	33.0	-	33.0	-
Turbidity (UNT)	8.5	5.4	36.5	0.9	89.4	0.9	89.4
Conductivity ($\mu\text{S.cm}^{-1}$)	186.2	180.2	3.2	203.0	-9.0	174.7	6.2
pH	7.5	6.6	-	6.3	-	6.3	-
Total nitrogen (mg.L^{-1})	9.8	9.4	4.1	9.1	7.1	8.4	14.3
Dissolved oxygen (mg.L^{-1})	7.5	6.8	-	4.2	-	3.9	-
Ammonia (mg.L^{-1})	0.12	0.17	-41.7	0.5	-316.7	0.3	-150.0
CDO ($\text{mg.O}_2\text{.L}^{-1}$)	20.0	24.5	-22.5	14.0	30.0	15.5	22.5
BDO ($\text{mg.O}_2\text{.L}^{-1}$)	10.9	10.1	7.3	6.1	44.0	8.6	21.1
Apparent color (Pt/L)	95.0	61.0	35.8	42.0	55.8	27.0	71.6
Total Phosphorus ($\mu\text{g.L}^{-1}$)	136.9	72.0	47.4	17.5	87.2	16.0	88.3
Chlorides (mg.L^{-1})	8.2	5.1	37.8	5.6	31.7	7.0	14.6
TDS (mg.L^{-1})	88.0	85.0	3.4	95.0	-8.0	80.5	8.5
Na (mg.L^{-1})	8.8	9.5	-8.0	9.5	-8.0	9.8	-11.4
K (mg.L^{-1})	2.5	1.3	48.0	1.0	60.0	1.2	52.0
Si (mg.L^{-1})	6.9	6.5	5.8	14.4	-108.7	4.5	34.8
Ca (mg.L^{-1})	9.7	9.0	7.2	19.5	-101.0	16.2	-67.0
Mg (mg.L^{-1})	6.9	6.8	1.4	3.4	50.7	2.6	62.3
Total coliforms MNP/100 mL	18.0×10^3	0.6×10^3	96.5	0.0×10^3	99.8	2.1×10^3	99.9
<i>E. coli</i> MNP/100 mL	0.1×10^3	0.1×10^3	0.0	0.0	100.0	0.0	100.0
*(P1-P2)/P1.100		**(P1-P3)/P1.100		****(P1-P4)/P1.100			

Table 4 - Analyses of water parameters of Corumbataí River, in period T20 days, in CWs. Legend: Legend: P1 = Reactor 1; P2 = Reactor 2; P3 = Reactor 3; P4 = Reactor 4 and E = Efficiency.

Parameters	P1	P2	E. (%) P1-P2*	P3	E. (%) P1-P3**	P4	E. (%) P1-P4***
Water temperature °C	28.1	26.3	-	28.6	-	26.4	-
Ambient temperature °C	32.0	32.0	-	32.0	-	32.0	-
Turbidity (UNT)	24.9	3.5	85.9	0.9	96.4	0.8	96.8
Conductivity ($\mu\text{S.cm}^{-1}$)	194.4	175.0	10.0	201.0	-3.4	183.2	5.8
pH	7.8	6.0	-	6.9	-	6.5	-
Total nitrogen (mg.L^{-1})	9.8	9.4	4.1	9.5	3.1	9.1	7.1
Dissolved oxygen (mg.L^{-1})	7.3	7.2	-	5.5	-	5.7	-
Ammonia (mg.L^{-1})	0.32	0.26	18.8	0.5	-56.3	0.4	-25.0
CDO ($\text{mg.O}_2\text{.L}^{-1}$)	30.0	17.5	41.7	35.0	-16.7	27.0	10.0
BDO ($\text{mg.O}_2\text{.L}^{-1}$)	9.1	8.5	6.6	5.4	40.7	5.9	35.2
Apparent color (Pt/L)	174.0	74.0	57.5	79.5	54.3	74.0	57.5
Total Phosphorus ($\mu\text{g.L}^{-1}$)	186.5	40.1	78.5	23.3	87.5	4.8	97.4
Chlorides (mg.L^{-1})	7.3	6.6	9.6	4.7	35.6	5.5	24.7
TDS (mg.L^{-1})	92.0	66.5	27.7	93.0	-1.1	56.0	39.1
Na (mg.L^{-1})	9.3	9.8	-5.4	9.9	-6.5	10.2	-9.7
K (mg.L^{-1})	2.5	0.1	96.0	0.8	68.0	1.0	60.0
Si (mg.L^{-1})	7.1	6.7	5.6	13.8	-94.4	3.9	45.1
Ca (mg.L^{-1})	10.3	8.2	20.4	19.5	-89.3	15.6	-51.5
Mg (mg.L^{-1})	7.1	6.5	8.5	3.9	45.1	2.9	59.2
Total coliforms MNP/100 mL	54×10^3	1.9×10^3	96.5	0.7×10^3	98.6	0.4×10^3	99.3
<i>E. coli</i> MNP/100 mL	0.2×10^3	0.0	100.0	0.0	100.0	0.0	100.0
*(P1-P2)/P1.100		**(P1-P3)/P1.100		****(P1-P4)/P1.100			

Ansola et al. (2003), verifying the performance of the CW system, obtained better results than Jing et

al. (2001), successfully reducing CDO by 80.0-89.0%, BDO by 82.0-87.0%, and *E. coli* by

99.9%. Nor these results had always been similar to those found here, probably had to the different used systems, environmental conditions of the process, design and other factors.

In summary, the system studied here obtained the best performance for: turbidity, 96.8% at T20; conductivity, 18.7% at T0; total nitrogen, 14.3% at T20; ammonia, 71.4% at T0; CDO, 75.0% at T5; BDO, 44.0% at T15; apparent color, 75.3% at T0; total phosphorous, 97.4% at T20; chlorides, 54.6% at T10; TDS, 39.1% at T20; Na, 64.4% at T0; K, 96.0% at T20; Si, 45.1% at T20; Ca, 20.4% at T20; Mg 80.5% at T0; total coliforms, 99.9% at T10 and T15; and *E. coli*, 100.0% at T10, T15, and T20.

CONCLUSIONS

The CW system studied here proved to be effective in treating river water, mainly the system composed of the reactor containing aquatic plants with other reactor containing three different sizes of gravel plus soil of cerrado area and peat, achieving maximum efficiency for the most of the parameters studied, although at different retention times. However, a trust of floating aquatic plants could produce bigger efficiencies of the systems for the reduction of pollutant components in waters of the rivers. Bigger efficiencies above of 85% had only been verified for turbidity, total phosphorus, total coliforms, *E.coli* and K.

RESUMO

Na intenção de reduzir nutrientes e microrganismos das águas de rio, foi estudado um processo alternativo de tratamento, como o sistema construído de áreas alagadas (CWs), em escala de laboratório. Os parâmetros analisados em diferentes pontos do sistema utilizado foram amônia, demanda bioquímica de oxigênio (DBO), demanda química de oxigênio (DQO), cloretos, cor aparente, condutividade, oxigênio dissolvido, magnesium (Mg), sodium (Na), potassium (K), silicium (Si), fósforo total, coliformes totais e *Escherichia coli*, sólidos totais dissolvidos (TDS), turbidez e biomassa da macrófita. Os resultados demonstraram que este sistema alternativo de tratamento de água do rio Corumbataí foi eficiente na remoção dos microrganismos: coliformes totais

e *Escherichia coli* dentre outros parâmetros analisados, em diferentes tempos de tratamento, promovendo melhoria acentuada na qualidade da água tratada.

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