POST TREATMENT OF DOMESTIC WASTEWATER IN SHALLOW WASTE STABILIZATION PONDS FOR AGRICULTURAL IRRIGATION REUSE

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The aim of this study

To evaluate the performance of a series of shallow WSP for treating a mixture of domestic wastewater and landfill leachate in a series of shallow waste stabilization ponds pretreated anaerobically in a UASB so as to produce an effluent suitable for agricultural irrigation within the norms of Brazilian environmental legislation.

Figure 1: Scheme of experimental WSP system the UASB received a mixture of domestic sewage and landfill leachate (5%)

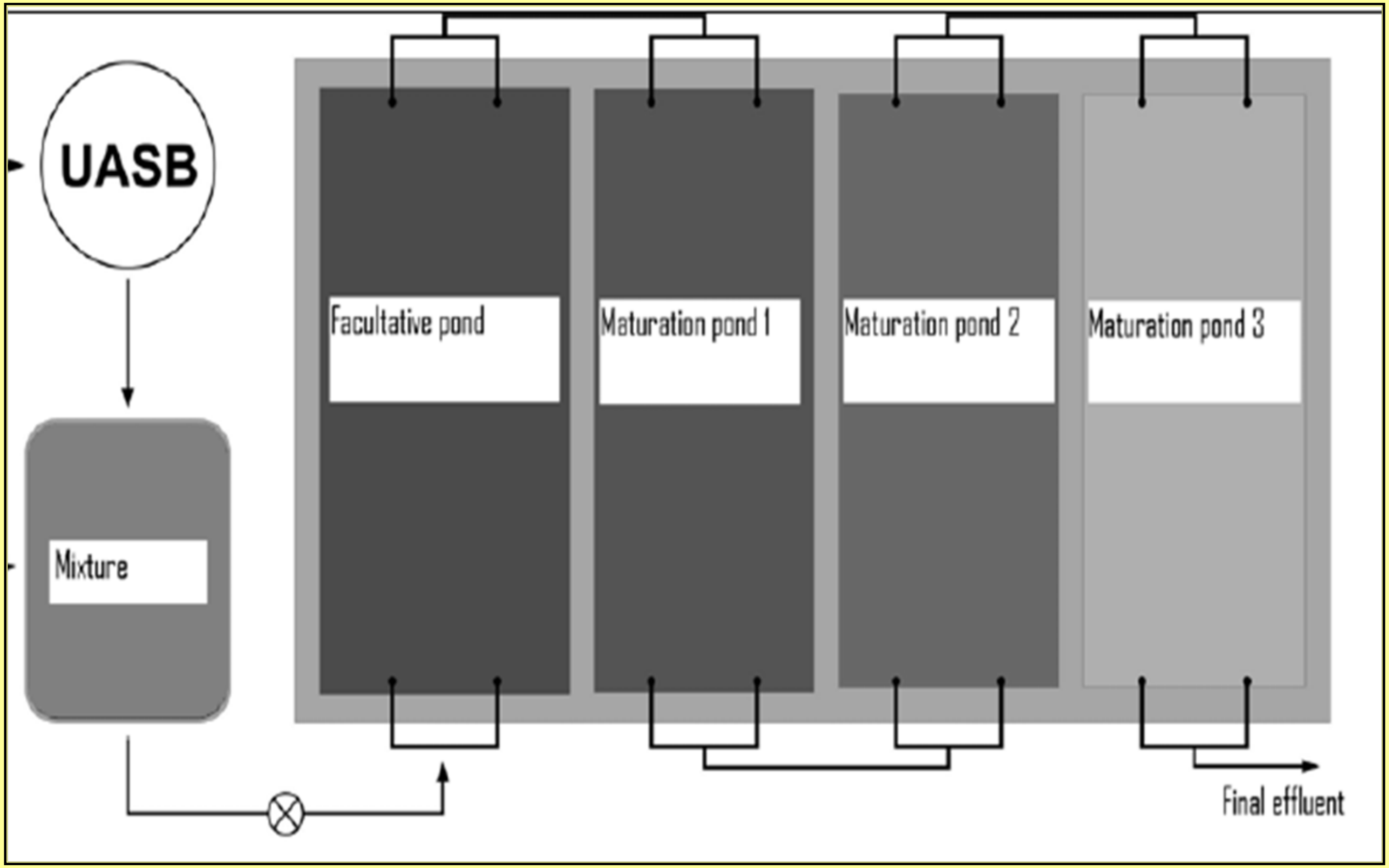

Table 1: Physical and operational features of the WSP system

pond	Width (m)	Length (m)	Depth (m)	Surface area (m^2)	Volume (m^3)	HRT (days)	
						Phase 1	Phase 2
Facultative	1,00	2,05	0,57	2,05	1,17	4,7	3,1
Maturation 1	0,88	2,04	0,53	1,79	0,95	3,8	2,5
Maturation 2	0,88	2,01	0,48	1,76	0,84	3,4	2,3
Maturation 3	0,89	2,00	0,44	1,78	0,78	3,1	2,1

Total HRT's in days: Phase 1 = 15; Phase 2 = 10

COD surface loading Kg há-1 d-1: Phase 1 = 2540; Phase 2 = 850

Table 2. Equilibration tank substrate characterization – phase 1

Parameter	Unit	*n*	minimum	maximum	mean[1]
pH	-	18	7,7	8,1	7,8
Total alkalinity	$mgCaCO_3.L^{-1}$	18	282	980	642
Volatile acids	$mgH_{AC}.L^{-1}$	18	34	110	72
BOD_5	$mg.L^{-1}$	16	126	262	183
COD	$mg.L^{-1}$	17	304	661	445
Total solids	$mg.L^{-1}$	18	1007	2114	1422
Volatile total solids	$mg.L^{-1}$	18	208	1144	398
Suspended solids	$mg.L^{-1}$	18	92	196	141
Volatile suspended solids	$mg.L^{-1}$	14	83	167	118
Ammonia	$mg.L^{-1}$	18	29	117	77
Total phosphorus	$mg.L^{-1}$	16	5,7	18,2	12,0
Soluble orthophosphate	$mg.L^{-1}$	16	3,4	11,2	7,0
Termotolerant coliform	$CFU.100ml^{-1}$	18	$1,8.10^6$	$2,4x10^7$	$6,5x10^6$

[1]Arithmetic mean for all the parameter except for termotolerant coliform, which was used the geometric mean.

Table 3. Physico-chemical and microbiological characterization of final effluent – phase 1

Parâmetro	Unit	*n*	minimum	maximum	mean
pH	-	18	7,8	9,4	8,6
Total alkalinity	$mgCaCO_3L^{-1}$	18	236	629	407
Volatile acids	$mgH_{AC}L^{-1}$	18	13	32	22
BOD_5	$mg.L^{-1}$	16	2,7	34,0	20,1
COD	$mg.L^{-1}$	17	61	615	208
Total solids	$mg.L^{-1}$	18	788	1998	1207
Volatile total solids	$mg.L^{-1}$	18	68	843	202
Suspended solids	$mg.\ L^{-1}$	18	20	109	49
Volatile suspended solids	$mg.L^{-1}$	14	2	95	38
Ammonia	$mg.L^{-1}$	18	1,7	22,0	7,8
Total phosphorus	$g\ L^{-1}$	16	2,5	9,1	4,6
Soluble orthophosphate	$mg\ L^{-1}$	16	2,0	6,2	3,6
Termotolerant coliform	$CFU.100ml^{-1}$	18	130	$6,6x10^3$	$1,0x10^3$
Chorophyll *a*	$\mu g.L^{-1}$	18	71	678	263

[1]Arithmetic mean for all the parameter except for termotolerant coliform, which was used the geometric mean.

Table 4. equilibration tank substrate characterization – phase 2

Parâmetro	Unit	*n*	minimum	maximum	mean
pH	-	18	7,7	8,5	8,0
Total alkalinity	$mgCaCO_3.L^{-1}$	18	264	392	329
Volatile acids	$mgH_{AC}.L^{-1}$	18	7	56	24
BOD_5	$mg.L^{-1}$	18	13	73	44
COD	$mg.L^{-1}$	18	42	203	149
Total solids	$mg.L^{-1}$	14	614	767	708
Volatile total solids	$mg.L^{-1}$	14	50	137	92
Suspended solids	$mg.L^{-1}$	14	41	106	68
Volatile suspended solids	$mg.L^{-1}$	14	34	88	57
Ammonia	$mg.L^{-1}$	18	14,3	73,3	41,7
Total phosphorus	$mg.L^{-1}$	16	1,1	10,2	5,0
Soluble orthophosphate	$mg.L^{-1}$	16	3,1	4,8	3,8
Termotolerant coliform	$CFU.100ml^{-1}$	18	$6,0x10^4$	$7,5x10^6$	$2,2x10^6$

[1]Arithmetic mean for all the parameter except for termotolerant coliform, which was used the geometric mean.

Table 5. Physico-chemical and microbiological characterization of final effluent – phase 2

Parâmetro	Unit	*n*	minimum	maximum	mean
pH	-	18	8,1	9,3	8,7
Total alkalinity	$mgCaCO\ L^{-1}$	18	194	284	237
Volatile acids	$mgH_{AC}.L^{-1}$	18	8	20	13
BOD_5	$mg\ L^{-1}$	18	3	27	14
COD	$mg\ L^{-1}$	18	15	285	120
Total solids	$mg\ L^{-1}$	14	636	777	713
Volatile total solids	$mg\ L^{-1}$	14	12	74	37
Suspended solids	$mg\ L^{-1}$	14	11	69	32
Ammonia	$mg\ L^{-1}$	18	2,6	15,0	7,3
Total phosphorus	$mg\ L^{-1}$	16	1,1	7,5	4,6
Soluble orthophosphate	$mg.L^{-1}$	16	1,4	7,2	3,8
Termotolerant coliform	$UFC.100ml^{-1}$	18	22	$3,1x10^3$	$3,7x10^2$
Chorophyll *a*	$\mu g.L^{-1}$	17	74,6	1.215,8	271,0

[1]Arithmetic mean for all the parameter except for termotolerant coliform, which was used the geometric mean.

Conclusions

- A series of shallow waste stabilization ponds were shown to be suitable for the combined treatment of leachate and domestic wastewater.

- The series was very efficient in terms of thermo-tolerant coliform removal, requiring an HRT of approximately 10 days for the effluent to reach the level of treatment considered adequate for reuse in irrigation (<10^3 100ml^{-}1).

- The substrate BOD_5:COD ratio and the HRT both influenced treatment efficiency.

- Furthermore, nutrient concentration in the final effluent was another favourable aspect of the effluent quality in terms of reuse in agricultural irrigation.