Annex 5

RESULTS FROM THE BASELINE LAGOON EFFLUENT ANALYSIS

Universidad Nacional de Ingeniería
Facultad de Ingeniería Química
Managua, Nicaragua

Resultados de Análisis

Interesado: Compañía Licorera de Nicaragua, S.A
Fecha: Managua, 18 de Febrero del 2002.

Resultados de Análisis Físico-Químicos de muestra de efluente de un punto de muestreo.

Parámetros	Valor	Decreto 33-95
Temperatura	30°C	40 °C
pH	7.97	6-9
Sólidos Sedimentables	7.50 ml/l/h	1 ml/l
Sólidos Suspendidos Totales	13931 mg/l	200 mg/l
DBO_5	10800 mg/l	180 mg/
DQO	14210 mg/l	260 mg/l
Aceites y Grasas	11 mg/l	10 mg/l
Nitrógeno total	18.44	n.e
Nitrógeno Orgánico	12.00 mg/l	n.e
Nitrógeno Amoniacal	3.88 mg/l	n.e
Fósforo	38.27 mg/l	n.e

n.e no especificado en normas

Determinaciones realizadas con el Standard Methods for the Examination of Water and Waste Water, 20th edition,1998.

Ing. Indiana García
Responsible del Análisis

cc. Archivo Personal

Apdo. 5595 * Fax: 267-3709 Planta Telefónica: 267-0274 / 77 * 267-0280 / 81 * Tel. Ofic.: 278-1463 / 270-1523

Annex 6

THEORETICAL CALCULATIONS AND USUAL VALUES FOR STABILIZATION POND USED (Ref. Metcalf and Eddy. Wastewater Engineering. McGraw-Hill. Third Edition. 1991. p.p 644 – 645)

644 DESIGN OF FACILITIES FOR THE BIOLOGICAL TREATMENT OF WASTEWATER

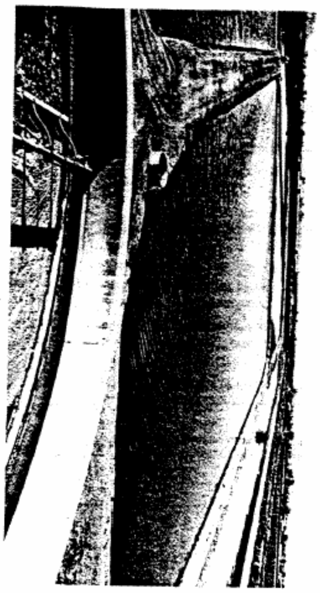

FIGURE 10-43
Typical facultative stabilization ponds.

by Wehner and Wilhelm [65] for a reactor with an arbitrary flow-through pattern (between a complete-mix pattern and a plug-flow pattern), as follows:

$$\frac{S}{S_o} = \frac{4a \exp(1/2d)}{(1+a)^2 \exp(a/2d) - (1-a)^2 \exp(-a/2d)} \qquad (10\text{-}30)$$

where S = effluent substrate concentration
S_o = influent substrate concentration
a = $\sqrt{1 + 4ktd}$
d = dispersion factor $= D/uL$
D = axial dispersion coefficient, ft²/h (m²/h)
u = fluid velocity, ft/h (m/h)
L = characteristic length, ft (m)
k = first-order reaction constant, 1/h
t = detention time, h

To facilitate use of Eq. 10-30 for stabilization ponds, Thirumurthi developed the graph in Fig. 10-44, in which the term kt is plotted against S/S_o for dispersion factors varying from zero for an ideal plug-flow reactor to infinity for a complete-mix reactor [45]. For most stabilization ponds, the dispersion factors are within the range of 0.1 to 2.0. Because the contents of aerobic ponds must be mixed to achieve the best performance, it is estimated that a typical value for the pond dispersion factor would be about 1.0. Typical values for the overall first-order BOD_5 removal-rate constant k vary from about 0.05 to 1.0 per day, depending on the operational and hydraulic characteristics of the pond. The use of Fig. 10-44 is illustrated in Example 10-9. The design of an aerobic stabilization pond is illustrated in Example 10-10.

TABLE 10-20
Typical design parameters for stabilization ponds

Parameter	Type of pond: Aerobic low rate[a]	Aerobic high rate	Aerobic maturation	Aerobic-anaerobic facultative[b]	Anaerobic pond	Aerated lagoon
Flow regime	Intermittently mixed	Intermittently mixed	Intermittently mixed	Mixed surface layer		Completely mixed
Pond size, acres	<10 multiples	0.5–2	2–10 multiples	2–10 multiples	0.5–2 multiples	2–10 multiples
Operation[c]	Series or parallel	Series	Series or parallel	Series or parallel	Series	Series or parallel
Detention time,[c] d	10–40	4–6	5–20	5–30	20–50	3–10
Depth, ft	3–4	1–1.5	3–5	4–8	8–16	6–20
pH	6.5–10.5	6.5–10.5	6.5–10.5	6.5–8.5	6.5–7.2	6.5–8.0
Temperature range, °C	0–30	5–30	0–30	0–50	6–50	0–30
Optimum temperature, °C	20	20	20	20	30	20
BOD_5 loading,[d] lb/acre · d	60–120	80–160	≤ 15	50–180	200–500	
BOD_5 conversion, %	80–95	80–95	60–80	80–95	50–85	80–95
Principal conversion	Algae, CO_2, bacterial cell tissue	Algae, CO_2, bacterial cell tissue,	Algae, CO_2, bacterial cell tissue NO_3	Algae, CO_2, CH_4, bacterial cell tissue	CO_2, CH_4, bacterial cell tissue	CO_2, bacterial cell tissue
Algal concentration, mg/L	40–100	100–260	5–10	5–20	0–5	
Effluent suspended solids,[e] mg/L	80–140	150–300	10–30	40–60	80–160	80–250

[a] Conventional aerobic ponds designed to maximize the amount of oxygen produced rather than the amount of algae produced.
[b] Pond includes supplemental aeration. For ponds without supplemental aeration, typical BOD_5 loadings are about one-third of those listed.
[c] Depends on climatic conditions.
[d] Typical values. Much higher values have been applied at various locations. Loading values are often specified by state regulatory agencies.
[e] Includes algae, microorganisms, and residual suspended solids. Values are based on an influent soluble BOD_5 of 200 mg/L and, with the exception of the aerobic ponds, an influent suspended solids of 200 mg/L.
Note: acre × 0.4047 = ha
ft × 0.3048 = m

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