



Anexos

Sistema Lagunar.

Computer Assisted Procedure for the Design and Evaluation of
Wastewater Treatment Systems

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CCCCC AAAAA PPPPPP DDDDD EEEEE TTTTTTTT PPPPP CCCCC
CC CC AA AA PP PP DD DD EE TT PP PP CC CC
CC AA AA PP PP DD DD EE TT PP PP CC
CC AA AA PPPPPP DD DD EEEEE TT ==== PPPPPP CC
CC AAAAAA PP DD DD EE TT PP CC
CC CC AA AA PP DD DD EE TT PP CC CC
CCCCC AA AA PP DDDDD EEEEEEE TT PP CCCCC
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Version 2.06

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*****
* Comision Nacional del Agua *
* Gerencia de Tratamiento de Agua*
* Cda. de J. Sanchez Azcona #1723*
* Mexico, D.F. 03100 *
* 524-3795 *
*****
```

Input data file: UTLA.TXT

SMALL FACILITIES

```
IS NOT A VALID PROCESS CARD
LAGOON MOD 0
ANAEROBIC LAGOON
BOD LOADING RATE 5051 LB/ACRE-DIA
DEPTH 13 FT
END
LAGOON MOD 1
FACULTATIVE LAGOON
BOD LOADING RATE 112 LB/ACRE-DIA
DEPTH 5 FT
END
LAGOON MOD 2
AEROBIC LAGOON
BOD LOADING RATE 30 LB/ACRE-DIA
END
TITLE LAGUNAS CONVENCIONALES
LIQUID LINE
BLOCK PRELIM
BLOCK LAGOON0
BLOCK LAGOON1
BLOCK LAGOON2
WASTEWATER CHARACTERISTICS
```



AVERAGE FLOW 0.1386 MGD INITIAL 0.1386 MGD (GASTO = 6 L/SEG)
TEMPERATURE SUMMER 17 WINTER 14 C
SUSPENDED SOLIDS 460 MG/L
VOLATILE SOLIDS 60 %
BOD5 581 MG/L
SBOD 250 MG/L
COD 1100 MG/L
SCOD 500 MG/L
PH 8.0
PO4 20 MG/L
TKN 51 MG/L
NH3 35 MG/L
OIL AND GREASE 94 MG/L
DESIRED EFFLUENT CHARACTERISTICS
UNIT COSTS (COSTOS COMUNES DE PLANTAS, ESTIMADOS)
EIGHT INCH PIPE 4.4 DLL/PIE CODO 44 D/U TEE 70.4 DLL/U VALV 770 DLL/UNID
BUILDING COST 22 DLL/PIE2 = 236.5 DLL/M2
WALL CONCRETE 22 DLL/YARDA3 = 286 DLL/M3
SLAB CONCRETE 99 DLL/YARDA3 = 129.8 DLL/M3
EXCAVATION COST 4.4 DLL/YARDA3 = 5.874 DLL/M3
ELECTRICITY .0495 DLL/KWHR
CRANE RENTAL 74 DLL/HR
LABOR RATE 7.2 DLL/HR
OPERATOR 5.5 DLL/HR
INSTALLATION LABOR RATE 7.7 DLL/HR
LAND COST 4057.5 DLL/ACRE (APROX. 10000 Dlls/HA)
MARSHALL AND SWIFT INDEX 1200 ESTIMADOS A SEPT. 1998
LARGE CITY EPA INDEX 320
ENGINEERING NEWS RECORD INDEX 6580.7
PIPE COST INDEX 595
END
CONTROL CARDS
ANALYSE
OUTPUT QUANTITIES
LIST TOTAL OF 10 TRAINS
GO I=10.00 NYD=20.00 NYC=1.5
1 COST ANALYSIS INPUT PARAMETERS
Interest rate 10.000 %
Planning period 20 years

0 UNIT PRICES AND COSTS INDICES

I Building	22.00 \$/sq ft
I Excavation	4.40 \$/cu yd
I Wall concrete	22.00 \$/cu yd
I Slab concrete	99.00 \$/cu yd
I Marshall and Swift index	1200.00
I Crane rental	74.00 \$/hr
I EPA construction cost index	320.00
D Canopy roof	15.75 \$/sq ft
I Labor rate	7.20 \$/hr
I Operator class II	5.50 \$/hr
I Electricity	0.05 \$/kWhr
D Chemical costs	
Lime	0.03 \$/lb
Alum	0.04 \$/lb
Iron salts	0.06 \$/lb
Polymer	1.62 \$/lb



I Engineering News Record cost index 6580.70
 D Handrail 25.20 \$/ft
 I Pipe cost index 595.00
 I Pipe installation labor rate 0.00 \$/hr
 I Eight inch pipe 4.40 \$/ft
 I Eight inch pipe bend 44.00 \$/unit
 I Eight inch pipe tee 70.40 \$/unit
 I Eight inch pipe valve 770.00 \$/unit

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1
 0 INFLUENT

LIQUID CHARACTERISTICS

FLOW (MGD)	SOLIDS (mg/l)	(mg/l)	(mg/l)	(mg/l)
Maximum 0.1386	Suspended 460.00	BOD5 581.00	TKN 51.00	
Average 0.1386	Volatile 60.00 %	BOD5S 250.00	NH3 35.00	
Minimum 0.1386	Settleable 15.00	COD 1100.00	NO2 0.00	
	CODS 500.00	NO3 0.00		
Temp (W) 14.0 C	Oil & grease 94.00	PO4 20.00		
Temp (S) 17.0 C	Cations 160.00			
pH 8.0	Anions 160.00			

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	0.00	0.00	0.00
% Solids	0.00	0.00	0.00
% Volatile	0.00	0.00	0.00

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1
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0BAR SCREENS

0D Wet weather flow factor 0.350E+01
 Wet weather flow 0.485E+00 MGD
 D Maximum head loss through screens 0.500E+00 feet
 D Bar spacing 0.100E+01 inches
 D Width of bars 0.313E+00 inches
 D Bar shape factor 0.167E+01
 D Slope of bars 0.100E+02 degrees
 Width of channel 0.200E+01 feet
 Depth of channel 0.216E+01 feet

0-----

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1
 0QUANTITIES FOR BAR SCREENS

0 Length of channel 0.140E+02 feet
 Volume of earthwork 0.342E+03 cu ft
 Volume of wall concrete 0.658E+02 cu ft
 Volume of slab concrete 0.543E+02 cu ft
 Operation manpower 0.317E+01 pers-hrs/yr
 Maintenance manpower 0.801E+01 pers-hrs/yr
 Energy requirement 0.727E+03 kWhr/yr
 O & M material and supply cost 0.200E+01 %



LIQUID CHARACTERISTICS

FLOW (MGD)	SOLIDS (mg/l)	(mg/l)	(mg/l)	
Maximum 0.1386	Suspended 460.00	BOD5 581.00	TKN 51.00	
Average 0.1386	Volatile 60.00 %	BOD5S 250.00	NH3 35.00	
Minimum 0.1386	Settleable 15.00	COD 1100.00	NO2 0.00	
		CODS 500.00	NO3 0.00	
Temp (W) 14.0 C	Oil & grease 94.00	PO4 20.00		
Temp (S) 17.0 C	Cations 160.00			
pH 8.0	Anions 160.00			

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	0.00	0.00	0.00
% Solids	0.00	0.00	0.00
% Volatile	0.00	0.00	0.00

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

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0LAGOON

0I BOD loading	0.505E+04 lb/acre-day
I Depth	0.130E+02 feet
I Anaerobic lagoon	
Surface area	0.133E+00 acres
Volume	0.563E+00 MG
Detention time	0.406E+01 days

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0QUANTITIES FOR LAGOONS

0Number of cells	2
Surface area per cell	0.665E-01 acres
Length of one side of cell	0.658E+02 feet
Depth of cut	0.111E+02 feet
Volume of earthwork	0.193E+05 cu ft
Pipe diameter	0.400E+01 inches
Length of pipe	0.176E+03 feet
Number of butterfly valves	3
Diameter of butterfly valves	0.400E+01 inches
Volume of wall concrete	0.120E+03 cu ft
Volume of slab concrete	0.800E+01 cu ft
Operation and maintenance manhours	0.176E+03 pers-hrs/year

LIQUID CHARACTERISTICS

FLOW (MGD)	SOLIDS (mg/l)	(mg/l)	(mg/l)	
Maximum 0.1386	Suspended 100.00	BOD5 203.35	TKN 51.00	
Average 0.1386	Volatile 60.00 %	BOD5S 152.51	NH3 51.00	
Minimum 0.1386	Settleable 0.00	COD 305.02	NO2 0.00	
		CODS 228.77	NO3 0.00	
Temp (W) 14.0 C	Oil & grease 14.10	PO4 6.00		
Temp (S) 17.0 C	Cations 160.00			
pH 6.8	Anions 160.00			



SLUDGE CHARACTERISTICS			
	Primary	Secondary	Chemical
Volume (gal/d)	0.00	0.00	0.00
% Solids	0.00	0.00	0.00
% Volatile	0.00	0.00	0.00

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0LAGOON

0I BOD loading	0.112E+03 lb/acre-day
I Depth	0.500E+01 feet
I Facultative lagoon	
Surface area	0.210E+01 acres
Volume	0.342E+01 MG
Detention time	0.247E+02 days

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0QUANTITIES FOR LAGOONS

0Number of cells	2
Surface area per cell	0.105E+01 acres
Length of one side of cell	0.226E+03 feet
Depth of cut	0.210E+01 feet
Volume of earthwork	0.179E+06 cu ft
Pipe diameter	0.400E+01 inches
Length of pipe	0.800E+02 feet
Number of butterfly valves	3
Diameter of butterfly valves	0.400E+01 inches
Volume of wall concrete	0.560E+02 cu ft
Volume of slab concrete	0.800E+01 cu ft
Operation and maintenance manhours	0.176E+03 pers-hrs/year

LIQUID CHARACTERISTICS

FLOW (MGD)	SOLIDS (mg/l)	(mg/l)	(mg/l)	(mg/l)
Maximum 0.1386	Suspended 100.00	BOD5 71.17	TKN 51.00	
Average 0.1386	Volatile 60.00 %	BOD5S 53.38	NH3 51.00	
Minimum 0.1386	Settleable 0.00	COD 106.76	NO2 0.00	
	CODS 80.07	NO3 0.00		
Temp (W) 14.0 C	Oil & grease 2.12	PO4 1.80		
Temp (S) 17.0 C	Cations 160.00			
pH 6.8	Anions 160.00			

SLUDGE CHARACTERISTICS			
	Primary	Secondary	Chemical
Volume (gal/d)	0.00	0.00	0.00
% Solids	0.00	0.00	0.00
% Volatile	0.00	0.00	0.00

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0LAGOON

0I BOD loading	0.300E+02 lb/acre-day
D Depth	0.300E+01 feet



I Aerobic lagoon
 Surface area 0.274E+01 acres
 Volume 0.268E+01 MG
 Detention time 0.193E+02 days

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0QUANTITIES FOR LAGOONS

0Number of cells 2
 Surface area per cell 0.137E+01 acres
 Length of one side of cell 0.256E+03 feet
 Depth of cut 0.120E+01 feet
 Volume of earthwork 0.145E+06 cu ft
 Pipe diameter 0.400E+01 inches
 Length of pipe 0.560E+02 feet
 Number of butterfly valves 3
 Diameter of butterfly valves 0.400E+01 inches
 Volume of wall concrete 0.400E+02 cu ft
 Volume of slab concrete 0.800E+01 cu ft
 Operation and maintenance manhours 0.176E+03 pers-hrs/year

LIQUID CHARACTERISTICS

FLOW (MGD)	SOLIDS (mg/l)	(mg/l)	(mg/l)	(mg/l)
Maximum 0.1386	Suspended 100.00	BOD5 24.91	TKN 51.00	
Average 0.1386	Volatile 60.00 %	BOD5S 18.68	NH3 51.00	
Minimum 0.1386	Settleable 0.00	COD 37.37	NO2 0.00	
	CODS 28.02	NO3 0.00		
Temp (W) 14.0 C	Oil & grease 0.32	PO4 0.54		
Temp (S) 17.0 C	Cations 160.00			
pH 6.8	Anions 160.00			

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	0.00	0.00	0.00
% Solids	0.00	0.00	0.00
% Volatile	0.00	0.00	0.00

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

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0LIQUID PREL 0 LAGO 0 LAGO 1 LAGO 2

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0 ===> COST SUMMARY <===

	OPER		MAINT		TOTAL					O & M
UNIT	CAPITAL COST	AMMORT COST	LABOR COST	LABOR COST	POWER COST	MATERIAL COST	CHEMICAL COST	CHEMICAL COST	O & M COST	
	\$	\$/yr	\$/yr	\$/yr	\$/yr	\$/yr	\$/yr	\$/yr	\$/yr	
SCREENS	33994	3989	16	20	35	679	0	750		
LAGOONS	8052	914	939	0	0	0	0	939		
LAGOONS	35722	3911	939	0	0	0	0	939		
LAGOONS	29079	3186	939	0	0	0	0	939		
0SUB TOTAL	106848	12002	2834	20	35	679	0	3567		

0DIRECT COSTS

Control and instrument 7 \$



Profit/overhead 23508 \$
 0 SUB TOTAL (OTHER DIRECT) 23515 \$ TOTAL CONSTRUCTION COST 130363 \$

0INDIRECT COSTS

Misc non const costs 6518 \$
 Admin/legal 2607 \$
 201 planning 4562 \$
 A/E design fee 14441 \$
 Inspection 2607 \$
 Contingencies 10429 \$
 Technical costs 2607 \$

0 SUB TOTAL (INDIRECT) 43771 \$

0LAND COSTS 137955 \$ 34. acres

INTEREST DURING CONSTRUCTION 23406 \$

0ADMINISTRATIVE COST 2142 \$/yr

LABORATORY COST 10987 \$/yr

0TOTAL PROJECT COST 335495 \$ TOTAL CONSTRUCTION COST 130363 \$

FINAL YEAR O & M 16701 \$/yr TOTAL STEP III COST 316492 \$

INITIAL YEAR O & M 16701 \$/yr PRESENT WORTH (APP. A) 528819 \$

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0 LAGUNAS CONVENCIONALES ANALYZE 1 TRAIN No 1

0USER CHARGE SUMMARY

D EPA grant 0.750E+02 %
 D State grant 0.000E+00 %
 D Allowance for financing 0.300E+01 %
 Bonds Percent Rate Life
 D Revenue 100.00 10.00 30
 D General obligation 0.00 0.00 30
 D Other 0.00 0.00 30
 D Number of billing units 0.506E+05 \$/T gal
 D Existing sewer rate 0.000E+00
 D Persons per household 0.350E+01
 D Gallons/capita/day (water use) 0.100E+03 gal/cap-day
 D Current annual O & M cost 0.000E+00 \$/year
 Total project cost 0.335E+06 \$
 EPA Eligible cost 0.198E+06 \$
 Local share 0.189E+06 \$
 Annual debt service 0.200E+05 \$/year
 Principal and interest reserve 0.286E+04 \$/year
 Contingency reserve 0.286E+04 \$/year
 Total annual operating cost 0.425E+05 \$/year
 Treatment cost
 Cost per 1000 gallons treated (new system) 0.839E+00 \$/T gal
 Cost per 1000 gallons treated (total system) 0.839E+00 \$/T gal
 Cost per billing unit (new system) 0.839E+00 \$/T gal
 Cost per billing unit (total system) 0.839E+00 \$/T gal
 Cost per household (new system) 0.881E+01 \$/month
 Cost per household (total system) 0.881E+01 \$/month

1 LAGUNAS CONVENCIONALES

0 Present TRN Project TRN Construct TRN O&M TRN Energy TRN
 Worth # Cost # Cost # Cost # Cost #
 528819 1 335495 1 130363 1 16701 1 35 1

0TRAIN N 1

LIQUID PREL 0 LAGO 0 LAGO 1 LAGO 2