Lodos activados.

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

```
 CCCCC   AAAAA   PPPPPP   DDDDD    EEEEEE   TTTTTTTT     PPPPPP    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      AAAAAAA  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
```

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: UTLA1.TXT

SMALL FACILITIES

IS NOT A VALID PROCESS CARD
LIQUID LINE
BLOCK PRELIM
BLOCK PRIMAR
BLOCK ACTIVA
BLOCK FILTRA
BLOCK CHLORI
HLOR NOT A VALID PROCESS - ON BLOCK CARD
SECONDARY SLUDGE LINE
BLOCK BMIX
IX NOT A VALID PROCESS - ON BLOCK CARD
PRIMARY SLUDGE LINE
BLOCK AEROBI
BI NOT A VALID PROCESS - ON BLOCK CARD
BLOCK DRYING
NG NOT A VALID PROCESS - ON BLOCK CARD
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
1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0 INFLUENT

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

1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0----------
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----------
1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 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

1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0----------
0 PRIMARY CLARIFIER
0 Circular Clarifier
0D Surface overflow rate 0.100E+04 gal/day-sqft
Surface area 0.139E+03 sq ft
D Side water depth 0.900E+01 feet
Detention time 0.162E+01 hours
Solid loading 0.384E+01 lb/sqft-day
D Weir loading 0.150E+05 gal/day-ft
Weir length 0.924E+01 feet
Volume of sludge produced 0.880E+03 gal/day
D Suspended solids removal 0.580E+02 %
D BOD removal 0.320E+02 %
D COD removal 0.400E+02 %
D TKN removal 0.500E+01 %
D PO4 removal 0.500E+01 %
0----------
1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0QUANTITIES FOR SEDIMENTATION
0CIRCULAR CLARIFIER
0PRIMARY CLARIFIER
Excess capacity factor 0.100E+01
Calculated surface area 0.139E+03 sq ft
Adjusted surface area 0.139E+03 sq ft
Average daily wastewater flow 0.139E+00 MGD
Number of circular clarifiers 2
Number of batteries 1
Surface area per unit 0.693E+02 sq ft
Diameter of unit 0.100E+02 feet
Earthwork required 0.378E+04 cu ft
Sidewater depth 0.900E+01 feet
Thickness of the slab 0.101E+02 inches
Wall thickness 0.115E+02 inches
Total wall concrete required 0.851E+03 cu ft
Total slab concrete required 0.274E+03 cu ft
Maintenance manpower required 0.200E+03 pers-hours/yr
Operation manpower required 0.350E+03 pers-hours/yr
Electrical energy required 0.750E+04 kWhr/yr

LIQUID CHARACTERISTICS

FLOW (MGD) SOLIDS (mg/l) (mg/l) (mg/l)
Maximum 0.1386 Suspended 193.20 BOD5 395.08 TKN 48.45
Average 0.1386 Volatile 60.00 % BOD5S 250.00 NH3 35.00
Minimum 0.1386 Settleable 0.00 COD 660.00 NO2 0.00
CODS 500.00 NO3 0.00
Temp (W) 14.0 C Oil & grease 94.00 PO4 19.00
Temp (S) 17.0 C Cations 160.00
pH 8.0 Anions 160.00

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	880.44	0.00	0.00
% Solids	4.00	0.00	0.00
% Volatile	60.00	0.00	0.00

==========

0----------
0ACTIVATED SLUDGE
0D Hydraulic detention time 0.300E+02 hours
D Solids detention time 0.250E+02 days
D Underflow concentration 0.100E+05 mg/l
Volume of aeration tank 0.173E+00 MG
Mixed liquor suspended solids 0.351E+04 mg/l
Food to microorganism ratio 0.901E-01
Sludge production 0.203E+03 lbs/day
Sludge recycle ratio 0.341E-04
0----------

==========

0QUANTITIES FOR ACTIVATED SLUDGE
0 Diameter of package plant 0.480E+02 feet
Volume of reinforced slab concrete 0.153E+04 cu ft
Operation manpower required 0.126E+04 pers-hrs/yr
Maintenance manpower required 0.695E+03 pers-hrs/yr
Energy required 0.104E+05 kWhr/yr
O & M material and supply costs 0.285E+01 %

LIQUID CHARACTERISTICS
FLOW (MGD) SOLIDS (mg/l) (mg/l) (mg/l)
Maximum 0.1386 Suspended 30.00 BOD5 3.55 TKN 10.00
Average 0.1386 Volatile 60.00 % BOD5S 0.99 NH3 10.00
Minimum 0.1386 Settleable 0.00 COD 5.32 NO2 0.00
CODS 1.48 NO3 0.00
Temp (W) 14.0 C Oil & grease 0.00 PO4 15.00
Temp (S) 17.0 C Cations 160.00
pH 8.0 Anions 160.00

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	880.44	2360.37	0.00
% Solids	4.00	1.00	0.00
% Volatile	60.00	60.00	0.00

==========

0 ANALYZE 1 TRAIN No 1
0----------
0PACKAGE PLANT GRAVITY FILTRATION
0I Hydraulic loading rate 0.500E+01 gpm/sq ft
I Number of filter cells 4
D Minimum backwash rate 0.200E+02 gpm/sq ft
D Minimum backwash period 0.100E+02 min
I Number of backwash volumes 2
Filter area required (hydraulic loading) 0.192E+02 sq ft
Filter area required (peak flow) 0.257E+02 sq ft
Design filter surface area 0.257E+02 sq ft
Volume of backwash surge tank 0.343E+03 cu ft
0----------
1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0QUANTITIES FOR GRAVITY FILTRATION
0 Volume of reinforced slab concrete 0.696E+02 cu ft
Volume of reinforced wall concrete 0.445E+03 cu ft
Width of backwash surge tank 0.495E+01 feet
Length of backwash surge tank 0.990E+01 feet
Volume of earthwork required 0.529E+04 cu ft
Electrical energy required 0.120E+04 kWhr/year
Maintenance manpower required 0.136E+03 pers-hours/year
Operation manpower required 0.208E+03 pers-hours/year
O & M material and supply costs 0.500E+01 %

LIQUID CHARACTERISTICS

FLOW	(MGD)	SOLIDS	(mg/l)		(mg/l)		(mg/l)
Maximum	0.1386	Suspended	12.00	BOD5	0.99	TKN	10.00
Average	0.1386	Volatile	60.00 %	BOD5S	0.99	NH3	10.00
Minimum	0.1386	Settleable	0.00	COD	1.48	NO2	0.00
				CODS	1.48	NO3	0.00
Temp (W)	14.0 C	Oil & grease	0.00	PO4	15.00		
Temp (S)	17.0 C	Cations	160.00				
pH	8.0	Anions	160.00				

0 SLUDGE CHARACTERISTICS

	Primary	Secondary	Chemical
Volume (gal/d)	880.44	2360.37	0.00
% Solids	4.00	1.00	0.00
% Volatile	60.00	60.00	0.00

1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0----------

0LIQUID PREL 0 PRIM 0 ACTI 0 FILT 0
0----------
0 ===> COST SUMMARY <===

0		OPER	MAINT		TOTAL		
	CAPITAL	AMMORT	LABOR	LABOR	POWER	MATERIAL	CHEMICAL	O & M
UNIT	COST	COST	COST	COST	COST	COST	COST	COST
	$	$/yr	$/yr	$/yr	$/yr	$/yr	$/yr	$/yr
SCREENS	33994	3989	16	30	35	679	0	760
PRIM CLA	79673	8662	1867	770	371	796	0	3804

ACT SLUD 161568 18923 6716 2675 514 3988 0 13893
FILTRATI 295524 34696 1108 523 59 11746 0 13436
0SUB TOTAL 570761 66272 9708 4000 981 17211 0 31893
0DIRECT COSTS
Control and instrument 7 $
Profit/overhead 125568 $
0 SUB TOTAL (OTHER DIRECT) 125575 $ TOTAL CONSTRUCTION COST 696336 $
0INDIRECT COSTS
Misc non const costs 34816 $
Admin/legal 13926 $
201 planning 24371 $
A/E design fee 55051 $
Inspection 13926 $
Contingencies 55706 $
Technical costs 13926 $
0 SUB TOTAL (INDIRECT) 211722 $
0LAND COSTS 36517 $ 9. acres
INTEREST DURING CONSTRUCTION 70843 $

0ADMINISTRATIVE COST 2142 $/yr
LABORATORY COST 10987 $/yr
0TOTAL PROJECT COST 1015418 $ TOTAL CONSTRUCTION COST 696336 $
FINAL YEAR O & M 45033 $/yr TOTAL STEP III COST 935996 $
INITIAL YEAR O & M 45033 $/yr PRESENT WORTH (APP. A) 1417537 $
1Comision Nacional del Agua, Gerencia de Tratamiento de Agua, Mexico
==========
0 ANALYZE 1 TRAIN No 1
0----------
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 0.102E+07 $
EPA Eligible cost 0.979E+06 $
Local share 0.289E+06 $
Annual debt service 0.306E+05 $/year
Principal and interest reserve 0.437E+04 $/year
Contingency reserve 0.437E+04 $/year
Total annual operating cost 0.844E+05 $/year
Treatment cost
Cost per 1000 gallons treated (new system) 0.167E+01 $/T gal
Cost per 1000 gallons treated (total system) 0.167E+01 $/T gal
Cost per billing unit (new system) 0.167E+01 $/T gal
Cost per billing unit (total system) 0.167E+01 $/T gal
Cost per household (new system) 0.175E+02 $/month
Cost per household (total system) 0.175E+02 $/month
0----------
1

0 Present TRN Project TRN Construct TRN O&M TRN Energy TRN
Worth # Cost # Cost # Cost # Cost #
1417537 1 1015418 1 696336 1 45033 1 981 1
0TRAIN N 1
LIQUID PREL 0 PRIM 0 ACTI 0 FILT 0