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Sanitary Engineering Project

Group 2

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ABSTRACT

This research project focuses on the examination of aquatic vegetation, the quality of water, its treatment, as well as the supply and distribution of water. Additionally, we analyze population estimates and water quantities. Furthermore, our investigation extends to the field of sewage treatment facilities, encompassing aspects such as sewage volume, wastewater treatment, collection, sanitation, the potential for wastewater reuse, and the volume of wastewater following the treatment process.

- PROJECT DEFINITION

This project involves the construction of a water treatment plant and the design of both the water distribution network and the sewage network.

THE PROBLEM

The challenge at hand is to create a water treatment plant capable of supplying water to a city in both 2040 and 2060. This entails determining the appropriate number and sizes of pipes for the water distribution network to ensure efficient delivery to households, as well as identifying the optimal number and diameters of pipes for the sewage network.

STUDY OBJECTIVES

The primary objectives of this study are as follows:

- Designing a water treatment plant
- Planning the water distribution network
- Establishing the wastewater network design

EXISTING SOLUTIONS

For the water treatment plant, the existing solutions involve the use of pumping mechanisms, filters, and tanks to treat the water and produce clean, potable water suitable for human consumption. Regarding the distribution network, pipes, pumps, and elevated tanks are utilized to transport water to residential areas. In the case of the wastewater network, the design revolves around determining pipe slopes, utilizing gravity, and selecting appropriate diameters to convey the wastewater to the sewage plant.

DESIGN CONSTRAINTS

There are no specific design constraints or limitations identified for this project

- CUSTOMER NEEDS and BACKGROUND

The customer's needs revolve around water treatment, extraction of drinking water, ensuring water delivery to the highest level in the distribution network, maintaining suitable water pressure during peak consumption hours, and efficient collection of wastewater from households for transport to sewage stations. These requirements should be met while ensuring economic viability and maintaining water quality.

-GENERATED IDEAS Water treatment plant:

The water treatment process involves treating water obtained from the source and disinfecting it by adding chlorine (CL2). Water distribution network: The design of the distribution network includes determining the appropriate pipe diameters to withstand pressure and ensure water reaches all areas of the city, even the farthest points. Wastewater network: The wastewater network is responsible for transporting wastewater from the city to the wastewater treatment plant.

-FINAL DESIGN **Water treatment plant: The final conceptincludes the utilization of pumps, filters, and tanks to treat water and produce purified water suitable for human consumption. Water distribution network: The distribution network involves the use of pipes, pumps, and overhead tanks to deliver water to residential areas. Sewage pipe network: The design of the sewage pipe network considers factors such as pipe slope and gravity,along with the selection of suitable pipe diameters for transporting waste water to treatment**

(Water Treatment Plant)

Population and Water Consumption

The previous census records for the required city are as follows:

P1996 = 70994 capita
P2006 = 87681 capita
P2016 = 109460 capita

Forecasting Population:

A. Arithmetic Method:

Year	Population(p)	ΔP	Δt	Ka=ΔP/Δt
1996	70994	--	--	---
		16687	**10**	1668,7
2006	87681			
		21779	**10**	2177,9
2016	109460			
				Sum of Ka=1924

Ka (Average)= sum of ka / NO. Ka = 1923.3 capita/year.

$P_n = P_o + ka * \Delta t$

- **$P_{2040} = P_{2016} + ka * \Delta t$**

= 109460+ 1923.3 (2040 – 2016) = 155620 capita

- **$P_{2060} = P_{2016} + ka * \Delta t$**

= 109460 + 1923.8 (2060 – 2016) = 194085 capita

B. Geometric Method:

Year	Population(p)	Ln(P)	ΔLn(P)	Δt	Kg
1996	70994	11.17	--	--	--
			0.21	10	0.021
2006	87681	11.38			
			0.22	10	0.022
2016	109460	11.60			
					Sum of kg=0.0215

Kg (Average) = 0.0215 capita/year.

$Ln(P_n) = ln(P_o) + Kg * \Delta t$

$Ln(P_{2040}) = ln\ P_{2016} + kg * \Delta t$

= 11.60 + 0.0215 (2040 – 2016) = 12.16

P_{2040} = 182773 capita.

$Ln(P_{2060}) = \ln P_{2060} + kg * \Delta t$

$= 11.60 + 0.0215\ (2060 – 2016) = 12.53$

$P_{2060} = 280969$ capita

C. Annual Growth Rate Method:

Year	Population(p)	P_n/P_o	Δt	$(P_n/P_o)^{\frac{1}{\Delta t}}$	m/100
1996	70994	--	--	---	---
		1.235	10	1.0213	0.0213
2006	87681				
		1.248	10	1.0224	0.0224
2016	109460				
					Sum of m= 0.0218

M (average) = sum of m/N.o.m = 0.0218 capita/year

$P_n = P_o * (1 + mav)^{\Delta t}$

- $P_{2040} = P_{2016} * (1 + mav)^{\Delta t}$
  $= 109460 * (1 + 0.0218)^{2040-2016} = 183669$ capita
- $P2060 = P2016 * (1 + mav)^{\Delta t}$
  $= 109460 * (1 + 0.0218)^{2060-2016} = 282719$ capita

- ## Final Results:

	Method 1	Method 2	Method 3
P_{2040}	155620	182773	183669
P_{2060}	194085	280969	282719

P_{2040} Av = 174021 capita ***P_{2060} Av = 252591capit***

- ## Design Flow:

❖ Stage (1): (2040)

q_{2040} = 250 L/c/d

q = 0.25 m/c/d

P (2040) av = 174021 capita

❖ Stage (2): (2060)

q_{2060} = 270 L/c/d

q = 0.27 m/c/d

P (2060) = *252591* capita

Flow	Stage (1)		Stage (2)	
……..	$\frac{m^3}{day}$	L/Sec	$\frac{m^3}{day}$	L/Sec
Qav	43505	503.53	68200	789.34
$Q_{max\ monthly}$	60907	704.94	95480	1105
$Q_{max\ daily}$	78309	906.35	122760	1420.8
$Q_{max\ hourly}$	108762.5	1258.8	170500	1973.35
Q_{design}	66997	778.7	105028	1215.5

(Water Treatment Plant Units)

❖ Design Discharge Qd:

- **Stage 1:**

  $Q_d = \frac{66997}{24*60*60} = 0.777\ m^3$ / sec

- **Stage 2:**

  $Q_d = \frac{105028}{24*60*60} = 1.211\ m^3$ / sec

Shore intake

❖ Design Of Conduit Pipes:

Stage 2

$Q_d = 1.216\ m^3$ / sec

Assume V = 1.0 m^3 / sec

Assume N = 4

$A = N\frac{\pi\ \varphi^2}{4}$

$1.216 = 4 * \frac{\pi\varphi^2}{4}$

φ = 622mm = 600 mm

$A_T = 4*\frac{\pi*(0.6)^2}{4} = 1.13m^2$

$V_{act\ stage\ (2)} = \frac{Qd}{At} = \frac{1.216}{1.13}$ = 1.076 m / sec → (0.8 → 1.5) Ok.

Stage 1

Check Of V_{act} → N = 3

$A = \frac{N\ \pi\ \varphi^2}{4} = 3*\frac{\pi*(0.6)^2}{4} = 0.85\ m^2$

$V_{act\ stage\ (1)} = \frac{0.775}{0.85} = 0.91\ m/sec$ → (0.8 → 1.5) Ok

- ☒ Stage 1 = 3 ∅ 600
- ☒ Stage 2 = 4 ∅ 600

❖ Losses:

Assume L = 100 m

- Stage 1:

h.L = $\frac{F.L.V}{2g\emptyset}$ = $\frac{0.04*100*(0.91)^2}{2*9.81*(0.6)}$ = 0.28 m =28 cm

- Stage 2:

h.L = $\frac{F.L.V}{2g\emptyset}$= $\frac{0.04*100*(1.076)^2}{2*9.81*(0.6)}$ = 0.39 m =39 cm

❖ Design Of Screen :

Assume = B = 1.5 ∅= 1.5 * 0.6= 0.9 m

a = 1.5 cm

∅ = 60 mm

S = 3 cm

ϴ = 60 º

B = N * S + (N – 1) a → 0.9 = .03 N + (N – 1) * 0.015 →

N = 21

No. Of Opening = 21

No. Of Bars = N – 1 = 20

h.LScreen = $\frac{1.4\,[(v_2^{\,2}-v_1^{\,2})]}{2g}$

v1 = $\frac{\varphi_t/N}{B*d}$ = $\frac{1.216/4}{0.9*2.1}$ =0.16 m/sec

d = w.L – b.L = 6.6 – 4.5 = 2.1 m

d1 = d – (0.5 – 1) = 2.1 – 0.8 = 1.3 m

v2 = $\frac{\emptyset}{A_{net}}$ = $\frac{1.216/4}{N*s*d1/sin\emptyset}$ = $\frac{1.216/4}{21*0.03*1.3/sin(60)}$ = 0.32 m/sec

Stage (1)

v1 = $\frac{\varphi_t/N}{B*d}$ = $\frac{0.775/4}{0.9*2.1}$=0.102 m/sec

v2 = $\frac{\emptyset}{A_{net}}$ = $\frac{0.775/4}{N*s*d1/sin\emptyset}$ = $\frac{0.775/4}{21*0.03*1.3/sin(60)}$ = 0.211 m/sec

h.L = 1.4 * $\frac{(0.211)^2-(0.102)^2}{2*9.81}$= 1.73*$10^{-3}$ m → stage 1

h.L = 1.4 * $\frac{(0.32)^2-(0.16)^2}{2*9.81}$ = 3.9*10^{-3} m → stage 2

Design of sump:

- **Stage 2:**

  Assume T = 5 min

  V = Q * T = 5*60*1.216 = 365 m^3

  D_{sump} = [w.L –b.L_{source} +1+1] =

  = 18-11+1+1 = 4m

  Area $_{sump}$= $\frac{\forall}{d}$ = $\frac{365}{4}$ = 91 m^2

  Assume width = 3 m

  ∀ = L * w * d

  365 = L * 3 * 4→ L = 30 m

  Sump = [30 * 3 * 24]

Sump [30 * 3* 4]

❖ Design of low left pump:

- **rising main:**

- **Stage 2:**

L=30 m   N=7

$Q_d = 1.216 \frac{m^3}{sec}$ N = 7 → 1.5n → n = 5

N =7 →[5working + 2stand by]

$Q_p = \frac{Q_d}{n} = \frac{1.21}{5} = 0.243 \frac{m^3}{sec}$ → 243Lit/sec

Assume ∀ = 1.5 m/sec

$A = \frac{1.216}{1.5} = 0.81\ m^2 \rightarrow 0.81 = \frac{N\,\pi\,\emptyset^2}{4} \rightarrow N = 1$

$\emptyset = 1000$ mm → $V_{act} = \frac{1.228}{0.785} = 1.5$ m/sec

$H_{static} = G.L - w.L_{sump} + 6$

$= 24 - 21 + 6 = 9$ m

HP= ϒ * Qp*Ht/75*0.63= 46 hp =50 hp

- **Stage 1:**

N = 5 →[3 working + 2 stand by] Hp =50

S= 20/5= 4 m ok

→ Neglect the friction losses in suction pipe

$Q_2 = 0.775 \frac{m^3}{sec}$

$\emptyset = 1000$ mm → $V_{act} = \frac{0.775}{0.785} = 0.98$m/sec

(Coagulation)

- Alum solution tanks:

S = (20 → 40) mg/L

Q_d * s * (365 *10^{-6})

= 105028 * 40 * (365 *10^{-6}) = 1533 t/year

$\forall = \frac{Q_d * s}{c * \gamma * 10^6} = \frac{105028*40}{1.05*0.1*10^6}$ = 40 m^3 /day

Assume No. of tanks = 3 tanks

$\forall$ for one tank = $\frac{\forall}{3} = \frac{40}{3}$ = 13.3 m^3 / day

A = $\frac{\forall}{d} = \frac{13.3}{1.5}$ = 8.8 → A = L^2

L = $\sqrt{8.8}$ = 2.96 m

3 tanks with dimension [3 * 3* 1.5] m

- **Outlet Pipe:**
- Assume V = 0.8 m/sec

Q = A * V = $\frac{40}{24*60*60}$ = A * 0.8

A = 5.8 * $10^{-4} m^2$

5.8 * 10^{-4} = $\frac{\pi}{4} \emptyset^2$, $\emptyset$ = 2.7 cm

Sec	P	Qfire	Qmax daily +Qfire	Qmax hourly	Max	QP
1-1	252591	60	1420.8+60		1480.8	
2-2	227331.9	54		1973	1973	2Φ900
3-3	202072.8	48		1578.4	1578.4	3Φ700
4-4	151554.6	36		986.5	986.5	7Φ500
5-5	101036.4	24		591.9	591.9	8Φ400
6-6	50518.2	12		295.95	295.95	6Φ250

Rapid mixing tank :-

Stage (II)

V=QD*T

= 1.215*60 = 72.9 m^3

A= 72.9/3 = 24.3

$24.3=2\frac{\pi}{4}*\varphi^2$

$\varphi=5.5$

V act $=1*3*\frac{\pi}{4}*(5.5)^2=71.23$ m^3

$T=\frac{V}{Q}=71.23/1.215=58$ sec

Stage (I)

V act $=1*3*\frac{\pi}{4}*(5.5)^2=71.23$ m^3

$T=\frac{V}{Q}$

$=71.23/0.778=90$ sec

P=G^2*M*V

$700^2*1.002*10^{-3}*75.36=37664$ Watt

5) Clariflculator tank :-

Stage (II)

- ***Sedemintation zone :***

Volume = Q_d * T = 105028*3.5/24= $15316 m^3$

Area = V / d = 15316 / 4 = $3829.2 m^2$

$A=N*(\pi\varphi^2) / 4$

$3829.2 = N * (\pi\ 35^2) / 4$

N = 4 tanks

(use 4 tanks with φ = 35m)

- ***flocculation zone :***

Volume = Q_d * T = 105028* 0.5 /24 = 2188.08 m^3

Area = V / d = 2188.08/ 3.5 = 625.166 m^2

$625.166=4*\frac{\pi}{4}*\varphi^2$

(use 4 tanks with φ = 12m)

Stage (I)

- ***Sedemintation zone :***

Volume = Q_d * T = 66997*3.5/24=9770.3 m^3

Area = V / d = 9770.3 / 4 = 2442.57m^2

$A=N*(\pi\varphi^2) / 4$

$2442.57 = N * (\pi\ 35^2) / 4$

N = 3tanks

(use 3tanks with φ = 35 m)

- ***flocculation zone :***

Volume = Q_d * T = 66997* 0.5 /24 = 1395.77 m^3

Area = V / d = 1395/ 3.5 = 398.571 m^2

$398.571=4*\frac{\pi}{4}*\ \varphi^2$

(use 4tanks with φ = 12 m)

6) rapid sand filter :-

Stage (II)

$Q_d = 1.07 * 1.4 * 68200 = 102163.6 \ m^3 / d$

Take :- Area one filter = 60.8 m2 = (7.3 * 8)

Take :- R.O.F = 140 m / d

$$Area = \frac{Qd}{R.O.F} = \frac{102163.3}{140} = 729.74 \ m^2$$

$$Number\ of\ filter\ (N) = \frac{Area\ total}{Area\ one} = \frac{729.74}{60.8} = 12$$

12filter+2B.W

$$R.O.F_{act} = \frac{Qd}{N * Area\ one} = \frac{102163.3}{12 * 60.8} = 140.02 \ m / d$$ **(OK) .**

Stage (I)

Take :- Area one filter =60.8 m2 = (7.3* 8)

Number of filter (N)=465.50/60.8=7.65

$$R.\ O.\ F\ act = \frac{Qd}{N * Area\ one} = \frac{43505 * 1.4 * 1.07}{8 * 60.8} = 133.98$$

8 filter+2B.W

GROUNG TANK

Stage (II)

C1 = 95480 $*\frac{30}{24*60}$ $=1989.16m^3$

C2 = 0.4 * 68200*1=27280 m^3

C3=95480*8/24=31826.3m^3

C fire = $\frac{120*252591}{10000}$

=3031

Capacity=31826.3+4/5*3031=34251.1m^3

34251.1 =N*50*40*5

N=3tanks (50 * 40 *5) m

Stage (I)

$$C1 = 60907 * \frac{30}{24*60}$$

=1268.8

C2 = 0.4 * 43505*1=17402 m^3

C3=60907*8/24=20302.3 m^3

$$C\ fire = \frac{120*174021}{10000}$$

=2088.252

Capacity=20302.3+4/5*2088.252=m^3

21972.9 =N*50*40*5

N=2tanks (50 * 40 *5) m

Table parts of plant :-

Parts of plant	Stage (II)	Stage (I)
Conduit pipe	4conduit pipes ϕ = 600 mm Losess = 0.39 m	3 conduit pipes ϕ = 600 mm Losess = 0.36 m
Sump	L= 30 m W = 3 m d = 4 m	L= 30 m W = 3 m d = 4m
pump	5 pump work 2 stand by H_p =46H_p / pump	3 pump work 2 stand by H_p =50H_p / pump
Raising main	one pipe ϕ = 1000mm Losess = 0.63 m	
Rapid mixing tank	One tank ϕ = 5 d=3	
Flocculation	4 Tanks ϕ = 12 m d = 3.50 m	3Tanks ϕ = 12m d = 3.50 m
sedemintation	4 Tanks ϕ = 35 m d = 4.00 m	3Tanks ϕ = 35 m d = 4.00 m
Rapid sand filter	12 filters + 2 B.W	8 filters + 2 B.W
Ground Tank	3 Tanks L= 50 m W = 40 m d = 5 m	2 Tanks L= 50 m W = 40 m d = 5 m

(Waste Water Treatment Plant)

(Waste Water)

- Design Flow:

❖ Stage 1:

Q_{av} = 43505 m^3 / day , p = 174021

☒ **In Summer:**

P.F =1+ $\frac{14}{4+\sqrt{p}}$ =1.8

$Q_{av\ waste}$ = 0.8 * 43505 = 34804 m^3 / day

Q_{max} = P.F * $Q_{av\ waste}$ + $Q_{in\ filteration}$

= 1.8 * 34804 + (0.15 * 34804) = 67867.8 m^3 / day

☒ **In Winter:**

M.F = 0.2 $P^{0.167}$ = 0.2 * $174^{0.167}$ = 0.50

Q_{min} = 0.7 * M.F * $Q_{av\ waste}$ + $Q_{in\ filteration}$

= 0.7 * 0.50* 34804 + (0.1 * 34804) =15661.8

❖ Stage 2 :

Q_{av} = 68200 m^3 / day, P = 252591 capita

- In Summer:
- P.F =1+ $\frac{14}{4+\sqrt{p}}$ = 1.7

$Q_{av\ waste}$ = 0.8* 68200 = 54560m^3 / day

Q_{max} = 1.7 * 54560 + (0.15 * 54560) =100936 m^3 / day =1.168 m^3 / sec

- In winter:

M.F = 0.2 * $(252)^{0.167}$ = 0.50

Q_{min} = 0.8 *0.50 *54560+(0.2 * 54560) = 32736

Stage 1		
Units	m^3/ Day	m^3/ Sec
Q_{max}	67867.8	0.78
Q_{av}	43505	0.50
Q_{min}	15661.8	0.18
Stage 2		
Units	m^3/ Day	m^3/ Sec
Q_{max}	100936	1.168
Q_{av}	68200	0.78
Q_{min}	32763	0.37

Factor = $\frac{Q_{max}}{L_{total}}$

L_{total} = 14600 m

Factor = $\frac{1168}{14600}$ = 0.08

L_{served}= $\frac{Q_{design}}{factor}$

$\emptyset mm$	Slope %	V full (L/sec)	d max Ø	Q max Q full	Q max L/s For each pipe	L served
200	5	0.71	0.75	1.3	20	250
250	4	0.74			32	400
300	3.33	0.76			49	613
350	2.8	0.78			68	850
400	2.5	0.80			90	1125
450	2	0.77			110	1375
500	1.8	0.79			140	1750
600	1.4	0.79			200	2500
700	1.3	0.84			291	3800
800	1.0	0.81	0.90	1.95	431	5700
900	0.8	0.78			526	6995
1000	0.8	0.84			700	8750

❖ Pump Station: -

$$v = \frac{Q * \theta}{4}$$

$$v = \frac{1.168*20*60}{4}$$ =350 m^3

A TOTAL = 350/2=175m^2

A_{net}=0.4*A_{total}

A_{net}= 0.4*175= 70m^2

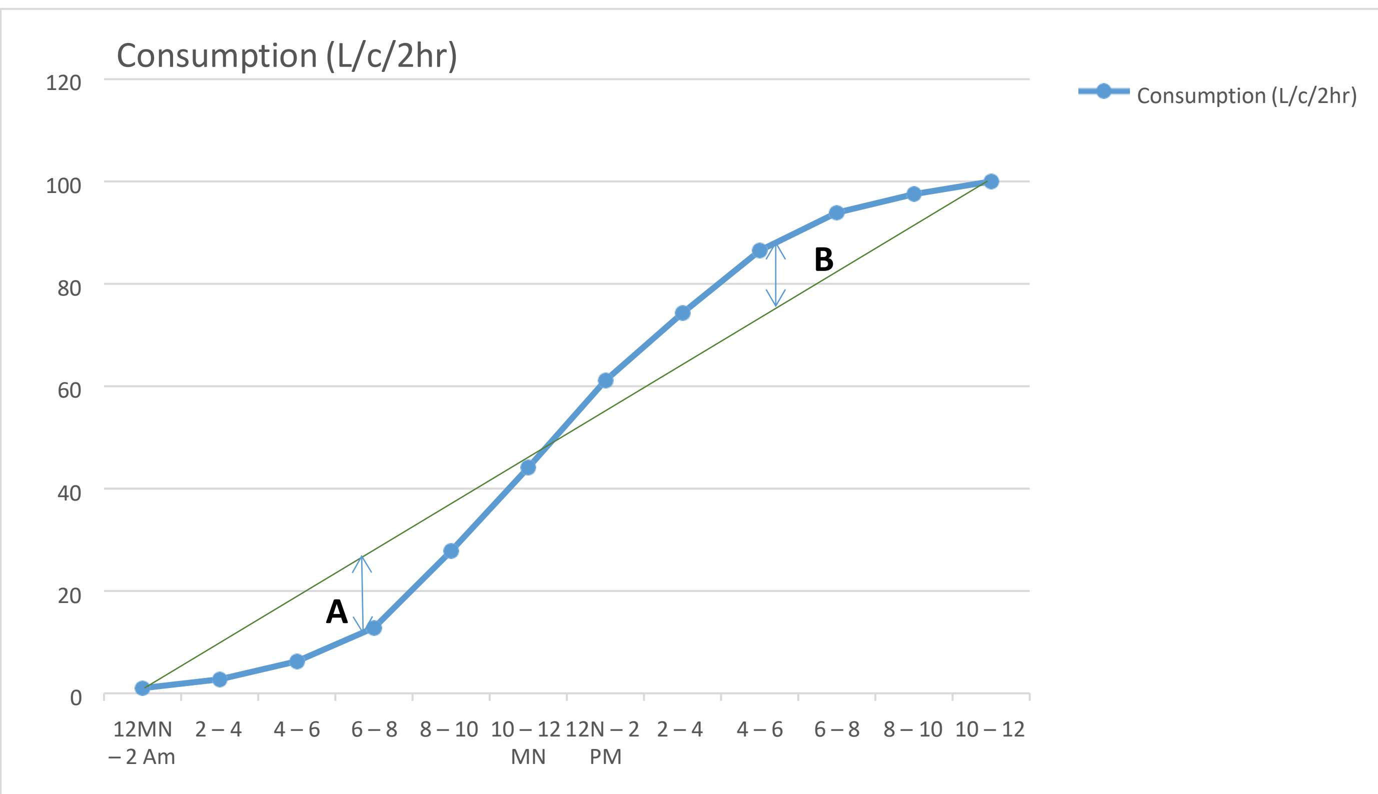
$*Ø^2 A = \frac{\pi}{4}$

$*Ø^2\ 70 = \frac{\pi}{4}$

Ø= 14.3m

10)Elevated tank :-

Time	Consumption lit/capita/2hrs	Accumulative
12 MN - 2Am	1	1
2-4	1.7	2.7
4-6	3.5	6.2
6-8	6.6	12.8
8-10	15.1	27.9
10-12N	16.2	44.1
10N-2PM	17	61.1
2-4	13.2	74.3
4-6	12.2	86.5
6-8	7.4	93.9
8-10	3.6	97.5
10-12Mn	2.5	100



A = 30-12 = 18
B = 90-75 = 15

$$Capacity = \frac{1.8 * (A + B)P}{1000} + \frac{1}{5}\ Ge$$

$$C = \frac{1.8 * (18 + 15)P}{1000} + \frac{120 * P}{5 * 10000}$$

stage (II) :-

Capacitiy Of tanke :-

$$C = \frac{1.8\ (18+15)252591}{1000} + \frac{120*252591}{5*10000} = 15610.12\ m^3$$

Assume NO. of tanks = 8tanks.

$$\text{Volume} = \frac{15610.12}{8} = 1951.26\ m^3 \qquad \text{Assume}\ \ d = \frac{3\ \varphi}{4}$$

$$V = \frac{3\pi\varphi^3}{16} \quad \rightarrow \quad \varphi = 15.70m \qquad \text{Take} \quad d = 12.00\ m$$

Rate Of pumps :-

$$R = \frac{1.8 * p\ q}{T * 1000}$$

$$R = \frac{1.8*252591*100}{24*1000} = 1894.43\ m^3 / hr$$

stage (I) :-

Capacitiy Of tanke :-

$$C = \frac{1.8\ (18+15)174021}{1000} + \frac{120*174021}{5*10000} = 10754.49\ m^3$$

Assume NO. of tanks = 4 tanks.

$$\text{Volume} = \frac{10754.49}{8} = 1344.3 m^3 \qquad \text{Assume}\ \ d = \frac{3\ \varphi}{4}$$

$$V = \frac{3\pi\varphi^3}{16} \quad \rightarrow \quad \varphi = 15.70m \qquad \text{Take} \quad d = 12.00\ m$$

Rate Of pumps :-

$$R = \frac{1.8 * p\,q}{T * 1000}$$

$R = \frac{1.8*174021*100}{24*1000} = 1305.15\ m^3 / hr$

Sludge Tank

Assume: Ret. time = 15 min

Assume: wash 2 filters at the same time

$V_{B.W} = B.W * A_f * T = 700 * 2 * 52 * \frac{15}{24*60*60} = 758.00\ m^3$

Assume: 4 clariflocculator tanks disludging at the same time

$V_{clari} = \frac{Q*s.s*R}{(1-WC)*10^6} = \frac{74304*150*0.90}{(1-0.97)*10^6} = 334.40\ m^3$

$V_{total} = 758 + 335 = 1093\ m^3$

Take depth of Tank = 8 m

∴ Area = 1093 / 8 = 136.625 m^2

∴ L = (136.625)^ 0.5 = 11.70 m

∴ Take one tanks (11.70 * 11.70 * 8.00)

Lift Station Design

***Assume:*-** **b = 2 m , h/D = 0.40 , θ = 15 min**

Volume $= \frac{\theta * q}{4}$

$V = \frac{15*0.806*60}{4} = 181.35\ m^3$

Area of Segment $= \frac{V}{b} = \frac{181.35}{2} = 90.675\ m^2$

$\frac{\text{Area of Segment}}{D^2} = 0.2934$

$D^2 = 306.05\ m^2$ ∴ D = 17.60 m

$\frac{h}{D} = 0.40$ ∴ h = 7.10 m

- Conclusion

Recognizing the importance of enhancing sanitation practices is more effective than simply introducing technological advancements. This approach is considered advantageous for the community as it emphasizes collaboration between suppliers and beneficiaries through dialogue and information sharing. Ultimately, individual users have the ultimate authority in deciding whether to adopt or reject new technologies. The success of the project lies in the hands of these users, as the value of the investment relies not only on community support but also on the acceptance of families and individuals. It is crucial to convince individuals about the benefits of improved hygiene and the advantages that come with adopting new technologies, outweighing any associated risks. Providers must also take into account the social context and limitations that influence personal decisions. By understanding the community's perspectives, providers can identify positive attributes that may elicit negative responses and utilize the community's values, beliefs, and practices to drive positive change.

STANDARDS

1. **The Egyptian Code for Drinking Water and Sewage Networks, 2010.**
2. **The Egyptian Code for Sewage Treatment Plants.**
3. **The Egyptian Code for Water Treatment Plants.**

4. **The Egyptian Code for Drinking Water and Sewage Networks, 2010.**
5. **The Egyptian Code for Sewage Treatment Plants.**
6. **The Egyptian Code for Water Treatment Plants.**

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