Design Of Clarriflocculator

Design of Clarriflocculator for flow of 15 Mld i.e. 625 $m^3/_{hr}$

Following are design criterias considerd while designing Clarriflocculator

i) Depth of Tank = 3 to 4.5 mt. = 3.5 mt

ii) Detention Time (D. T.) = 10 to 90 min. = 30 min.

iii) Total Area of paddles = 10 to 25 % of aea of the tank

Step 1]

$$Q = \frac{625}{60\ x\ 60} = 0.1736 \quad m^3/_{sec}$$

Detention time = 30 x 60 = 1800 sec

Volume of Clarriflocculator = Q x D.T.

= 0.1736 x 1800

= 312.5 m^3

Step 2]

Surface Area of Clarriflocculator = $Volume/_{depth}$

= $312.5/_{3.5}$

= 89.28 = 90 m^2

Step 3] To Find Diameter of Inlet Pipe :

:

Assuming that the inlet Velocity in the pipe (V_i) = 1.5 $m/_{sec}$

Area of Inlet Pipe = $Q/_{V_i} = 0.1736/_{1.5}$

= 0.1157 m^2

We Have ; Area = $\frac{\pi}{4}$ x d^2

0.1157 = $\frac{\pi}{4}$ x d^2

d = 0.383 mt = 0.4 mt.

Step 4] Calculation of Diameter of Clarriflocculator ;

Area = $\frac{\pi}{4}$ x (D^2 - d^2)

90 = $\frac{\pi}{4}$ x (D^2 - 0.4^2)

D = 10.71 = 11 mt.

Step 5] Design of Paddles :

Assuming Paddle Area = 10 % of C/S area of Tank (Clarriflocculator)

Area = $\frac{\pi}{4}$ x (D^2 - d^2)

= $\frac{\pi}{4}$ x (11^2 - 0.4^2)

= 94.90 m^2.

Area of Paddle = $\frac{10}{100}$ x 94.90 = 9.49 = 9.50 m^2

Providing 15 No. Of Paddles

∴ Area of Each Paddle = $^{9.5}/_{15}$ = 0.64 m^2

Assuming depth of each paddle = 2 mt.

∴ Width of Each Paddle = $^{0.64}/_{2}$ = 0.32 mt.

5 Shafts will support 15 Paddles so, each shaft will support 3 paddles .

Assuming that the shaft of paddle is at a distance of 1 mt. From center of shaft ; r = 1 mt.

Let, Perierial Velocity of Paddles (V_p) = 0.25 to 0.8 = 0.4 m/sec

$V_p = \frac{2\,\pi\ r\ n}{60}$

$0.4 = \frac{2\,\pi\ 1\ n}{60}$

∴ n = 3.81 = 4 r. P. M.

Step 6) Calculation of Shear Gradient (G) :

G = $\sqrt{\frac{P}{\mu\ X\ C}}$ where ;

P = Power Input = $0.5 \text{ x } C_d \text{ x } \rho \text{ x } A_{paddle} \text{ x } (V_p - V)^3 / 75$

= $0.5 \text{ x } 1.8 \text{ x } 1000 \text{ x } 9.50 \text{ x } (0.4 - 0.1)^3 / 75$

= 770 Watt

= $\frac{770}{75}$ = 10.26 H.P.

V = Velocity at tip of paddle = 25 % of V_p

= 0.25 x 0.4

= 0.1 m/sec

C_d = Coefficient of Drag = 1.8 for blade

$$G = \sqrt{\frac{P}{\mu \ X \ C}} = \sqrt{\frac{770}{0.89\,x\ 10^{-3}\ X\ 312.5}}$$

$$= 52.61 \quad Sec^{-1}$$

It should between 10 to 75 ; Hence of and Safe.

Step 7] Design of Clarifier :

Assume surface overflow rate = 40 $m^3/_{m^2/_{day}}$

Area of Circular Clarifier = $\frac{Q}{40}$ $m^3/_{sec}$

$$= \frac{01736\ x\ 24\ x\ 60\ x\ 60}{40}$$

$$= 375\ m^2$$

Now, Total Area = Area of Clarrifier + Area of Flocculator

$$= 375 + \frac{\pi}{4} \text{ x } 11^2$$

$$= 470\ m^2$$

Diameter in aspect to the total Area

We Have ; Area = $\frac{\pi}{4}$ x d^2

$$470 = \frac{\pi}{4} \text{ x } {D_c}^2$$

D_c = 24.46 mt. = 25 mt.

Step 8] Check for Weir Loading :

Length of Weir = π x D_c = π x 25

= 78.5 mt

Weir Loading = $\frac{Q}{L} = \frac{625\ x\ 24}{78.5}$ = 191 $m^3/_{day/_{mt}}$

It is in between 100 to 300 $m^3/_{day/_{mt}}$; Ok and safe

Step 8] Design of Notches :

Providing V shape Notch with vertex angle = 90

Assume depth of Notch = 5 cm and width as 10 cm with spacing between them is 30 cm C/C

Number Of Notches required = $\frac{Length\ of\ weir}{Spacing}$

$$= \frac{78.5}{0.3} = 262 \text{ No.}$$

Assuming 262 Notches having depth as 5 cm and width 10 cm ith vertex angle as 90^0

Q = 1.417 x $H^{\frac{5}{2}}$

0.1736 = 1.417 x $H^{\frac{5}{2}}$

∴ H = 0.43 mt. Of water is present over the v Notch

Step 9] Design of Collecting Channel :

Provide flat bottom Collecting channel with free fall of 0.2 mt to collect the clarified water from tank.

∴ Discharge carried by this channel ;

$\frac{Q}{2}$ = 1.375 x b x $h^{\frac{3}{2}}$

∴ h = 0.17 mt.

Provide depth of channel = 0.17 + Free fall

= 0.17 + 0.20

= 0.7 mt = 0.4 mt

∴ Providing size of the channel = 0.9 x 0.4 mt.