## Design of flocculators

$$G = \sqrt{\frac{P}{\mu V}}$$ P = power, V = volume

$$G = \sqrt{\frac{gH}{\nu t_D}}$$

$$P = \frac{C_d \rho V_r^3 A}{2}$$ (power)

$C_D = 1.5 - 1.8$

$V_r = 0.7 - 0.8$ of paddle speed

Velocity of paddle $= 2\pi r n$

$r$ = distance of centreline of paddle from shaft

$n$ = rev. of paddle / s

### N-1

Data:

$P = ?$

$G = 50\ s^{-1}$

$V = 2800\ m^3$

$\mu = 1.07 \times 10^{-3}\ Ns/m^2$

$T = 20°C$

Sol:

$$G = \sqrt{\frac{P}{\mu V}}$$

$$50 = \sqrt{\frac{P}{1.07 \times 10^{-3} \times 2800}}$$

$P = 7490$ watts

### N-2

$\frac{1\ mg}{L} = \frac{1\ g}{m^3}$

Data:

$Q = 30{,}000\ m^3/d$

Alum dose (C) $= 13\ mg/L = 13\ g/m^3$

Daily chemical consumption = ?

Required dosage of $Ca(OH)_2$ = ? No alkalinity

Sol:

Daily consumption $= Q \times C$

$= (30{,}000)(13)$

$= 390{,}000\ g/d$

$= 390\ kg/d$

$Al_2(SO_4)_3 \cdot 18H_2O + 3Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3CaSO_4 + 18H_2O$

666 g — 222 g

For 666 g = 222 g

For 1 g $= \frac{222}{666}$ g

For 390,000 g $= \frac{222}{666} \times 390{,}000$

$= 130000$ g

$= 130$ kg

### N-3

Data:

$P = 0.6\ KW$

$Q = 70\ l/s$

$t_d = 20\ s$

$T = 18°C$

$\mu = 1.06 \times 10^{-3}\ Ns/m^2$

$G = ?$

Sol:

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

$V = Qt$

$= \frac{70}{1000} \times 20$

$V = 1.4\ m^3$

$$G = \sqrt{\frac{P}{\mu V}}$$

$$= \sqrt{\frac{0.6 \times 10^3}{1.06 \times 10^{-3} \times 1.4}}$$

$= 635\ s^{-1}$

### N-4

Data:

$Q = 76000\ m^3/d = 0.88\ m^3/s$

$L = 30\ m$

$W = 12.5\ m$

$H = d = 5.5\ m$

Flocculant Tank, $V = 2062.5\ m^3$

i) $P_{in} = ?$

ii) $G = ?$

iii) $t_D = ?$

Paddle

$l = 12\ m$

$w = 0.3\ m$ $\Rightarrow A = 3.6\ m$

paddle move by 4 horizontal shaft

$n = 2.5$ rpm

Centreline of paddle is 2 m from shaft

$r = 2\ m$

$C_d = 1.8$

$\mu = 1.31 \times 10^{-3}\ Ns/m^2$

Sol:

Speed of paddle $= \frac{2\pi r n}{60}$

$= \frac{2\pi \times 2.5 \times 2}{60}$

$= 0.5236\ m/s$

$V_r = 0.75$ speed of paddle

$= 0.75 \times 0.5236$

$= 0.3927\ m/s$

i) $$P = \frac{C_D \rho V_r^3 A}{2}$$

$$= \frac{1.8 \times 1000 \times (0.393)^3 \times 3.6}{2}$$

$P_{in} = 196.7$ Watts

$P_{in} = 8 \times 196.7 = 1573.6$ watts

ii) $$G = \sqrt{\frac{1573.6}{1.31 \times 10^{-3} \times 2062.5}}$$

$G = 24\ s^{-1}$

iii) $t_D = \frac{V}{Q} = \frac{2062.5}{0.88} = 2343.75\ s$

$= 39.06$ min

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No 5

Data:

Flocculator tank

$L = 30\,m$

$w = 12.5$ $\quad V = 2062.5\,m^3$

$d = 5.5\,m$

Paddle dimension

$L = 12\,m$ $\quad A = 3.6\,m^2$

$w = 0.3\,m$

4 shaft each contain 2 paddles

$n = 2\,m$

$C_D = 1.8$ $\quad r = ?$

$G = 30\,s^{-1}$

$\mu = 1.31 \times 10^{-3}\,Ns/m^2$

Sol:

As $P = G^2 \mu V$

and $P = \frac{C_d \rho V_r^3 A}{2}$

Computing

$$G^2 \mu V = \frac{C_d \rho V_r^3 A}{2}$$

$$(30)^2 \times 1.13 \times 10^{-3} \times 2062.5 = \frac{1.8 \times 1000 \times V_r^3 \times 3.6}{2}$$

$$V_r = 0.909\,m/s$$

As $V_r = 0.75 \times$ paddle speed

$V_r = 0.75 \times 2\pi r n$

$0.909 = 0.75 \times 2\pi r \times 2$

$r = 0.096$ rpm