Flocculation

Flocculation

Nominal Polymer Range: 0.05 - 0.5 g/m³

Low Dose

0.05 g/m³ (m³/264.17 gal)
= 0.0001893 g/gal

0.0001893 g/gal (40 MGD)
= 7572 g/day

7572 g/day (lbs/453.59 g)
= 16.69 lbs/day

High Dose

0.5 g/m³ (m³/264.17 gal)
= 0.001893 g/gal

0.001893 g/gal (40 MGD)
= 75,720 g/day

75 720 g/day (lbs/453.59 g)
= 166.9 lbs/day

Estimated Dose

0.1 g/m³ (m³/264.17 gal)
= 0.0003785 g/gal

0.0003785 g/gal (40 MGD)
= 15,140 g/day

15,140 g/day (lbs/453.59 g)
= 33.38 lbs/day

High-Rate Sedimentation

High Rate Sedimentation Basin - Sizing

40 MGD = 181,843.6 $\frac{m^3}{d}$

Tank Surface Area, As = 181,843.6 $\frac{m^3}{d}$ / 180 $m^3/d - m^2$
↳ assumed overflow Rate

As = 1010.24 m^2

3 tanks = 336.75 m^2 each

Selected width = 4.8 m

↳ Settler length = $\frac{336.75\ m^2}{4.8\ m}$ = 70.16 m

↳ tank length = $\frac{70.16}{0.75}$ = 93.54 m
— efficency

SWD = 4m Depth of Sludge = 2m

Approach velocity = $\frac{60{,}614.5\ \frac{m^3}{d} / 1400 * 60}{4.8m * 3.6}$ = 0.041 m/s > 0.01 m/s

Tube velocity = $\frac{0.584\ \frac{m}{s}}{4.8m(\sin(1.05))}$ = 0.0024 m/s < 0.0025 m/s
↳ a little slow but OK

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Rapid Sand Filter Hand Calculations

Rapid Sand Filter – Basin Design

$$\#\text{ of Beds} = 0.0195 * \left(1514116.5 \frac{m^3}{d}\right)^{0.5} = 7.6 = 8 \text{ beds}$$

$$\text{Area of Bed} = \frac{1514116.5 \frac{m^3}{d}}{8 * 293 \frac{m^3}{d\text{-}m^2}} = 64.6\ m^2$$

(293 $\frac{m^3}{d\text{-}m^2}$: assumed filtration rate)

Assumed Cell width = 3.5 m

$$\text{Bed length} = \frac{64.6\ m^2}{2 * 3.5\ m} = 9.23\ m$$

$$L/W = \frac{9.23\ m}{3.5\ m} = 2.64$$

Gullet width = 0.6 m

$$\#\text{ of launders} = \frac{9.23\ m}{2m} = 4.62 = 5$$

$$\text{Spacing of troughs} = \frac{9.23\ m}{5} = 1.85\ m$$

$$\text{Max Particle Travel Distance} = \frac{9.23\ m}{2 * 5} = 0.92\ m$$

$$\text{Max Backwash Trough Flow} = 40 \frac{m}{hr} * 0.92m * 2 * 3.5\ m = 258.4\ m^3/hr$$

Through a figure in refreneed textbook:

W = 0.53 m Y = 0.375 m

Trough Freeboard = 0.05 m Trough Depth: 0.64

Margin of Safety = 0.15m

$$\text{Trough Elevation} = 0.69m\left(\frac{1+30}{100}\right) - 0.69m + 0.64m + 0.15m = 1\ m$$

$$\text{Backwash Tank Volume} = 40\ m/hr * 9.23m * 0.25 * 3.5m * 4 = 1292\ m^3$$

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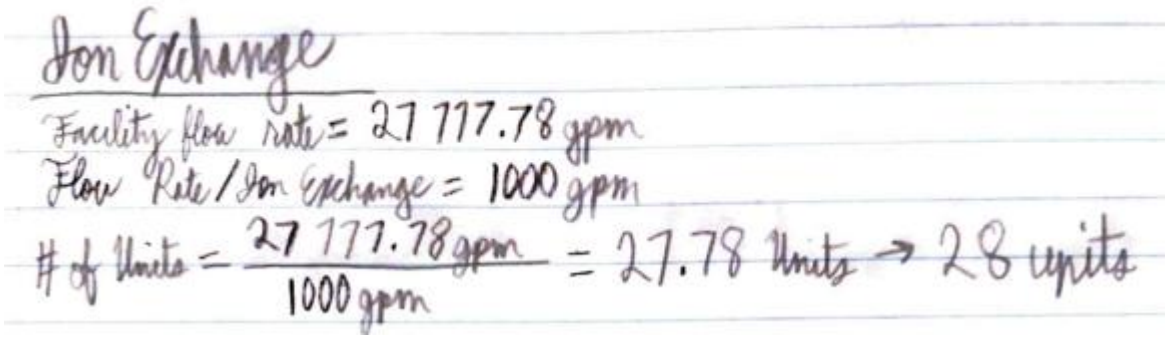
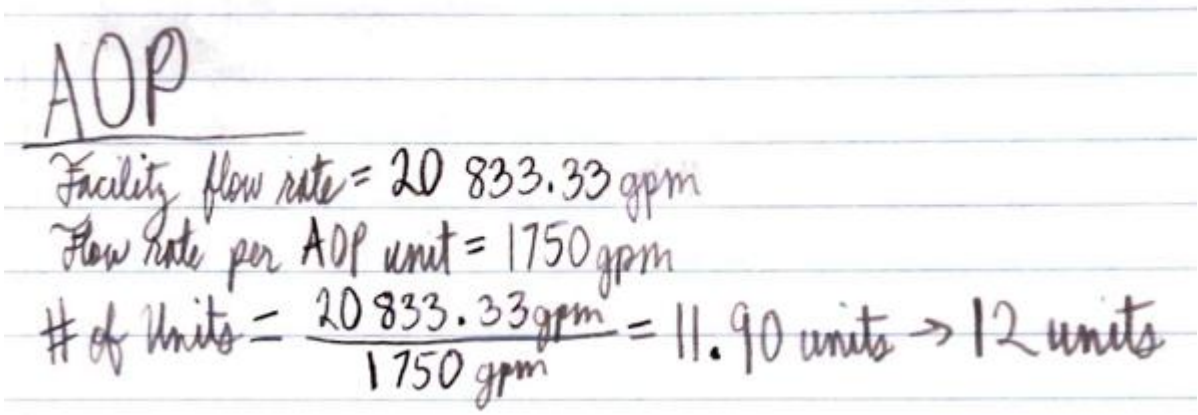
Ion Exchange



AOP



UV Dose

UV Dose

$D = I(t)$

Where:

D = UV Dose, mJ/cm^2

I = UV Intensity, mW/cm^2

t = Exposure time, s

$I = 1000\ W\ (1000\ mW/W) / 46698.16\ cm^2$

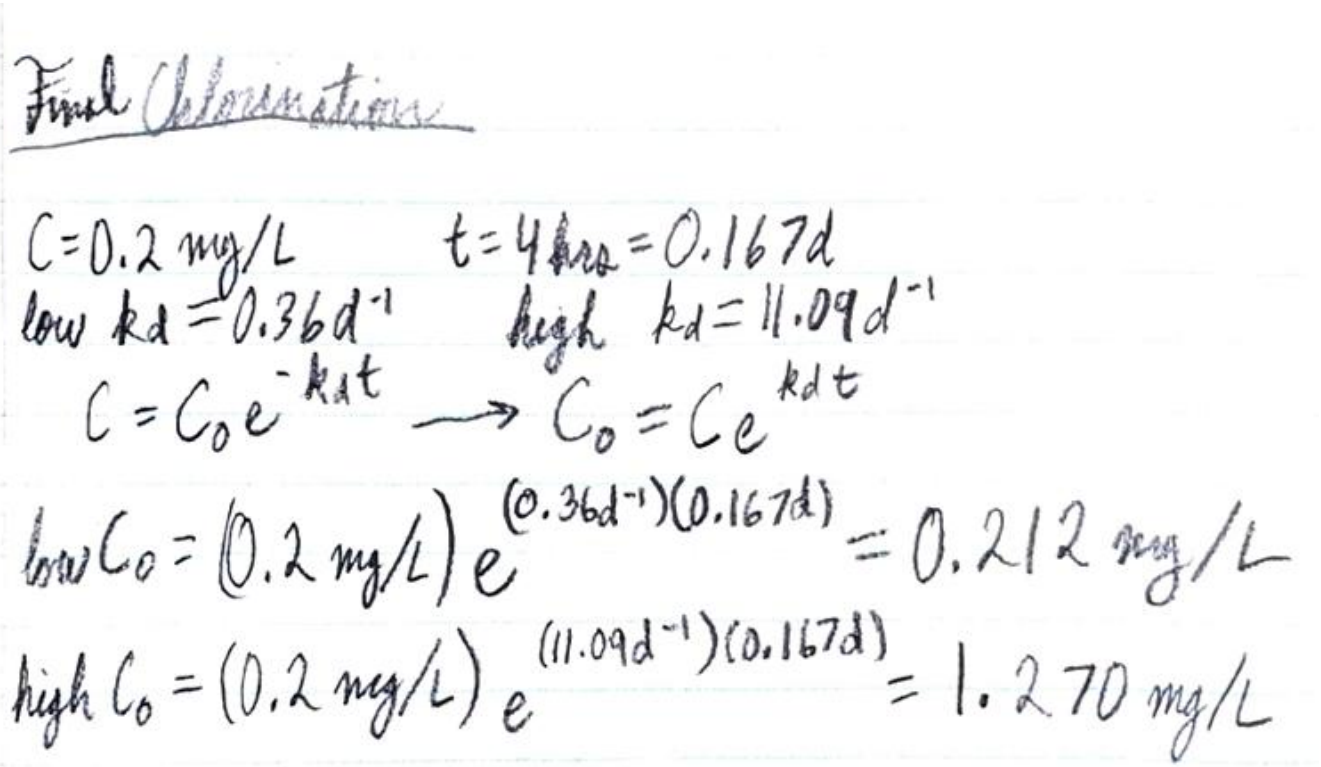
$= 21.41\ mW/cm^2$

↳ where cross sectional area ($46698.16\ cm^2$) and power (1000 W) given by manufacturer website

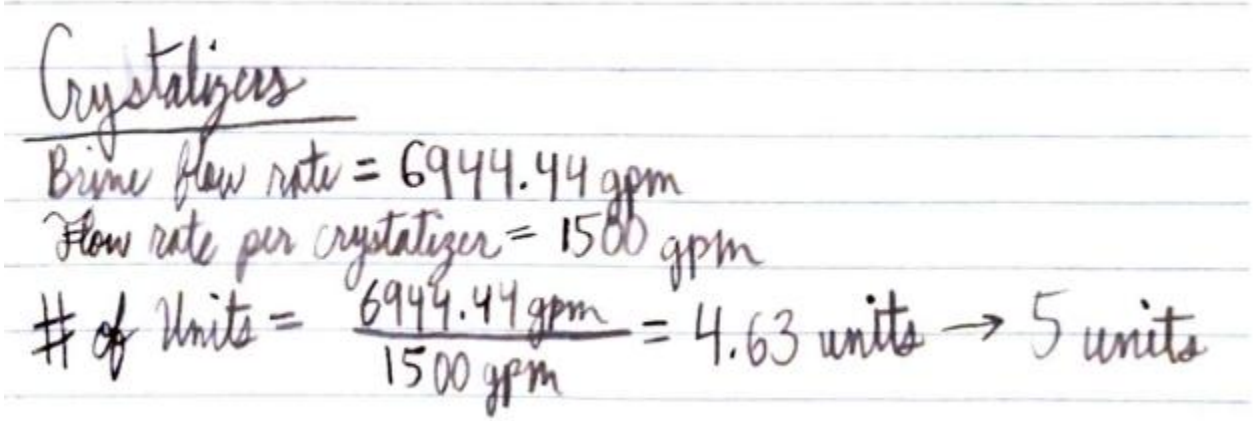
$D = I(t)$

$t = \frac{D}{I} = \frac{300\ mJ/cm^2}{21.41\ mW/cm^2} = \boxed{14.01\ s}$

Final Chlorination



Brine Management/Crystallizers



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