

WTS Cost TopHat Example

Consider a prototype system with the following characteristics:

1. coagulant dosage of 25 mg/L
2. flowrate 1,000 mL/min
3. run time of 60 minutes
4. 2 inches of anthracite and 4 inches of filter sand
5. replace filter material once every five years
6. 4 prototype sedimentation tanks

Compute the total yearly cost of this system

Coagulant and Flocculation Cost

$$wt_c \left[\frac{kg}{gal} \right] = \text{coagulant dosage} \left(\frac{mg}{liter} \right) \left(\frac{3.785 \text{ liters}}{\text{gallon}} \right) \left(\frac{kg}{10^6 mg} \right)$$

$$NCF = \left[\frac{\text{required daily volume (gpd)}}{5 \times 10^6 \text{ (gpd)}} \right] \times SF$$

$$\text{Cost}_{CF} = NCF \left(\frac{\$25,000}{\text{year}} \right) + \left(wt_c \frac{kg}{gal} \right) \left[\text{required daily volume (gpd)} \right] \left(\frac{365 \text{ days}}{\text{year}} \right) \left(\frac{\$1}{kg} \right)$$

Sedimentation Cost

$$t_p = \frac{n_t (1.56 \text{ gallons})}{\left(\text{flowrate} \frac{\text{ml}}{\text{minute}} \right) \left(\frac{\text{liter}}{1,000 \text{ml}} \right) \left(\frac{\text{gallon}}{3.785 \text{ liter}} \right)}$$

$$Q_{ST} = \frac{75,000 \text{ gallons}}{t_p}$$

$$Q_{SE} = \frac{Q_{ST} \times \text{filter run time}}{60 \text{ minutes}}$$

$$NS = \left[\frac{\text{required daily volume (gpd)}}{Q_{SE} \text{ (gpm)}} \right] \left[\frac{\text{day}}{1,440 \text{ min}} \right] \times SF$$

$$\text{Cost}_s = NS \left(\frac{\$35,000}{\text{tank}} \right)$$

Filter Cost

$$Q_F = \left(\text{flowrate} \frac{\text{ml}}{\text{minute}} \right) \left(\frac{\text{liter}}{1,000\text{ml}} \right) \left(\frac{\text{gallon}}{3.785 \text{ liter}} \right) \left(\frac{1}{0.0668 \text{ ft}^2} \right)$$

$$Q_{FT} = Q_F \left(\frac{\text{gpm}}{\text{ft}^2} \right) \times 1,000 (\text{ft}^2)$$

$$Q_{FE} = \frac{Q_{FT} (\text{gpm}) \times \text{filter run time}}{60 \text{ minutes}}$$

$$NF = \left[\frac{\text{required daily volume (gpd)}}{Q_{FE} (\text{gpm})} \right] \left[\frac{\text{day}}{1,440 \text{ min}} \right] \times SF$$

$$\text{Cost}_F = NF \left(\frac{\$45,000}{\text{filter}} \right)$$

Filter Media Cost

$$\text{Cost}_{FM_A} = \left(\frac{\$9.50}{\text{ft}^3} \right) \left(\frac{\text{thickness (in)}}{12 \text{ inches}} \text{ft} \right) (1,000 \text{ ft}^2) \left(\frac{NF}{\text{\# of years}} \right)$$

$$\text{Cost}_{FM_S} = \left(\frac{\$5.90}{\text{ft}^3} \right) \left(\frac{\text{thickness (in)}}{12 \text{ inches}} \text{ft} \right) (1,000 \text{ ft}^2) \left(\frac{NF}{\text{\# of years}} \right)$$

Total Cost

Cost_{CF} =

Cost_S =

Cost_F =

Cost_{F_{Ma}} =

Cost_{F_{Ms}} =

Total Cost =