A water treatment plant is to be designed to produce water for the town of Gray. The estimated population for design is 20,000 people and the anticipated annual average water demand is 150 gallons per capita per day. The maximum daily demand to annual average daily demand is 1.5:1. The maximum hourly demand to annual average demand is 2.5:1. The minimum hourly demand to annual average daily demand is 0.5:1.

1. Determine the process design flow of the water treatment plant (mgd).

2. Determine the design capacity of the high-pressure service pumps (mgd).

3. Determine the conveyance pipes capacity (mgd) from the source to the water treatment plant.

4. What is the typical detention time in a flash mixer.

5. Calculate the horsepower required for the flash mixer if \( G = 790 \text{ sec}^{-1} \), volume = 124 ft\(^3\), and \( N = 2.73 \times 10^{-5} \text{ lb-sec/ft} \).

6. Calculate the pounds of ferric hydroxide sludge that is generated at the annual average daily demand flow if 30 mg/L of ferric hydroxide is added to the water and reacts with natural alkalinity according to the following equation:
   \[
   \text{Fe}_2(\text{SO}_4)_3 + 3\text{ Ca(} \text{HCO}_3 \text{)}_2 \rightarrow 2\text{ Fe(OH)}_3 \rightarrow +3\text{ CaSO}_4 + 6\text{ CO}_2
   \]

7. Calculate the overflow rate (gpd/ft\(^2\)) at the annual average daily demand flow if two sedimentation tanks, 100 ft by 25 ft by 10 ft are utilized. Tanks operate in parallel.

8. Determine the detention time (hr) of the sedimentation tanks at the annual average daily demand flow with both tanks in service.

9. Calculate the total weir length per settling basin if a weir loading of 20,000 gpd per foot of weir is to be used at the maximum hourly demand flow.

10. What is the horizontal flow velocity (fps) through the sedimentation tanks at the maximum hourly demand flow?