CHEMICAL FEED SYSTEMS

GENERAL

This chapter describes in individual sections the different chemical feed systems used at the Glasgow WTP.

Calculating Dry or Gaseous Chemical Feed Rates and Applied Dosages

The feed rate (pounds per day) of dry or gaseous chemical can be calculated using the equation below.

$R = D_A \times Q_{RW} \times 8.34$

where:

R	=	dry or gaseous chemical feed rate (lbs/day)
D_A	=	applied chemical dosage (mg/L)
Q_{RW}	=	raw water flow (mgd)
8.34	=	conversion factor from mg/L to lbs/million gallons

If the feed rate is known, the dosage applied can be calculated by rearranging the equation as shown below.

$$D_A = \frac{R}{Q_{RW} \times 8.34}$$

Calculating Liquid Chemical Feed Rate and Applied Dosages

To calculate the liquid feed rates in pounds per day, use the equations above. It is often useful to calculate liquid feed rates in gallons per day. Since, the chemical solutions may not be 100 percent active, the specific gravity of the liquid chemical solution needs to be included as well as the active percent (by weight) of the chemical. For example, alum is typically 48.5 percent active by weight and the specific gravity is typically 11.1 lbs/gal. Therefore, the active chemical concentration is then 0.485 x 11.1 = 5.4 lbs/gal.

$$R_{gal} = \frac{R}{C_A}$$

R_{gal}	=	liquid chemical feed rate (gal/day)
R	=	liquid chemical feed rate (lbs/day)
C_A	=	Active Chemical Concentration (lbs/gal)

To convert gal/day into mL/min for calibrating chemical feed pumps, use the following equation.

R_{gal} (gal/day) x 3.785 L/gal x 1,000 mL/L / (1,440 min/day)

METERING PUMP CALIBRATION

This section describes the calibration of the liquid chemical metering pumps associated with the Alum, Polymer 1, Polymer 2, and Polymer 3 feed systems.

Pump Calibration in Manual and Automatic Modes

The metering pumps should be calibrated in both the manual and automatic modes. Calibration in manual mode ensures that the pump is operating in accordance with the manufacturer's specifications. Calibration in automatic mode ensures that the desired chemical dosage is actually being fed. Each pump should be calibrated independently after each extended shut down and weekly, or at the most monthly, for pumps during normal operation.

For manual mode, each pump should be tested one time at the maximum output rate. The procedure for calibrating the pump is:

1. Slowly open the isolation valve at the bottom of the calibration column to allow chemical solution to fill the calibration column by gravity. Watch the calibration column closely to avoid overfilling. Water can be added to the calibration column instead of chemical solution if it is easier to read the graduations on the column.
2. Close the supply valve from the chemical supply to ensure the solution in the calibration column becomes the chemical feed source.
3. To test the maximum pump output, adjust the stroke length of the pump to 100% and adjust the pump speed to 100%. Refer to pump manufacturer's Operation and Maintenance Manual if necessary.
4. With a stopwatch in hand, turn the pump on. Start the stopwatch when the pump starts. As soon as the calibration column is emptied, stop the stopwatch and turn off the pump.
5. To return the pump to normal automatic operation, open the ball valves closed in Step 2. Adjust the stroke length of the pump and the pump speed.
6. To calculate the pump feed rate in gallons per hour (Q_A), divide the calibration column volume by the time (in seconds) required to drain the calibration column and multiply by necessary conversion factors as shown in the equation below.

$$Q_A(gph) = \frac{500\ mL}{t\ sec} x\ \frac{3600\ sec}{1\ hr} x \frac{1\ gal}{3785\ mL}$$

For automatic calibration, each pump should be tested one time at the maximum output rate. The procedure for calibrating the pump is:

1. Follow Steps 1 through 3 from the manual calibration method above.
2. With a stopwatch in hand, make sure the pump is in AUTO and controlled by the Plant PLC. Start the stopwatch when the pump starts. As soon as the calibration column is emptied, stop the stopwatch and turn the hand switch to OFF.
3. To return the pump to normal automatic operation, open the ball valves closed in Step 1. Adjust the stroke length of the pump and the pump speed.

4. To calculate the dosage rate supplied by the pump in mg/L (D_A), divide the calibration column volume by the time (in seconds) required to drain the calibration column and multiply by necessary conversion factors.

$$Q_A(gph) = \frac{500\ mL}{t\ sec} x\ \frac{3600\ sec}{1\ hr} x \frac{1\ gal}{3785\ mL}$$

Then use the equation shown below.

$$\mathrm{D_A}(mg/L) = \frac{\mathrm{Q_A} \times \mathrm{C_A} \times 24}{\mathrm{Q_{RW}} \times 8.34}$$

where:

D_A	=	Chemical Dosage (mg/L)
Q_A	=	Pump Feed Rate (gallons/hour)
C_A	=	Active Chemical Concentration (lbs/gal)
24	=	Conversion factor (hours/day)
Q_{RW}	=	Raw Water Flow Rate (MGD)
8.34	=	Conversion factor from mg/L to lbs/ million gallons

5. To determine if the pump is properly calibrated, compare the calculated dosage to the dosage recorded at the Plant PLC; the two values should be equal.
6. If the pump is not calibrated properly, rearrange the equation above to solve for the feed rate (Q_A) using the target feed rate. For example, if the target feed rate is 6 mg/L use D_A= 6.

$$\mathrm{Q_A}(gph) = \frac{\mathrm{D_A} \times \mathrm{Q_{RW}} \times 8.34}{\mathrm{C_A} \times 24}$$

After calculating the pump feed rate, calculate the time required to empty the 500 mL calibration column using the following equation.

$$t\ (\mathrm{sec}) = \frac{500\ mL}{Q_A} x\ \frac{3600\ sec}{1\ hr} x \frac{1\ gal}{3785\ mL}$$

Use the calibration column and “drain time” to adjust the pump stroke length settings so that the calibration column is emptied in the calculated time. When adjusted, repeat the calibration process to verify pump is calibrated correctly.