Example if the removal efficiency is 60% and the outlet concentration is 120mg/l:

$$TSS_{in} = \frac{120}{1 - 0.6} = 300mg/l$$

Note: You may derive the above formulas by algebraically manipulating: $\%Removal = \dfrac{TSS_{in} - TSS_{out}}{TSS_{in}}$

Example Problem:

How many lbs of solids are removed daily by a primary clarifier treating a 6 MGD flow if the average influent TSS concentration is 300 mg/l and the clarifier TSS removal efficiency is 67%.

$TSS_{out} = (300mg/l - 300*0.67) = 99mg/l$

$lbs \ solids \ removed = (300 - 99)mg/l * 8.34 * 6MGD = \boxed{10,058 \ \ lbs \ \ solids \ \ removed \ \ per \ \ day}$

Type 2 Problems: These involve calculating the amount of sludge pumping given the solids removed. The solids removed from the primary clarifier is sludge with a typical solids concentration of about 3% to 5%.

Given the amount of total solids removed and given the sludge concentration, the volume of sludge pumping can be calculated as follows:

$$\frac{ft^3 \ sludge \ pumped}{day} = \frac{lbs \ solids \ (removed)}{day} * \frac{1 \ lb \ sludge}{(\%) \ lbs \ solids} * \frac{gal \ sludge}{8.34lb \ sludge} * \frac{ft^3 \ sludge}{7.48 \ gal}$$

So for the solids removed in the above example, if the primary sludge has 5% solids, the required sludge pumping can be calculated as:

$$\frac{ft^3 \ sludge}{day} = \frac{10,058 \ \cancel{lbs \ solids}}{day} * \frac{1 \ \cancel{lb \ sludge}}{0.05 \ \cancel{lbs \ solids}} * \frac{\cancel{gal \ sludge}}{8.34 \cancel{lb \ sludge}} * \frac{ft^3 \ sludge}{7.48 \ \cancel{gal}} = \boxed{3,224\frac{ft^3 \ sludge}{day}}$$

4.8 Pumping

4.8.1 Calculating volume pumped given the pump flow rate

Method:

    Step 1. Multiply the pump flow rate by the time interval

Make sure:

- The time units - in the given time interval and in the pump flow rate match

4.8.2 Calculating time to pump a certain volume

Method: Step 1. Calculate the total volume pumped

    Step 2. Divide the total volume by the pump flow rate

Make sure:

- The volume units - in the volume that needs to be pumped and in the pump flow rate match
- The time unit in the pump flow rate needs to be converted to the time unit that you need the answer in