Problem of the Day

2015.Jul.09

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Calculate the number of pounds of MLVSS in two aeration basins. Each aeration basin is 150 feet long and 40 feet wide. The water depth is 18 feet. The MLVSS concentration is 2,050 mg/L.

Introduction

This is a straightforward pounds calculation. While many operators would first find the volume in the two aeration basins in Mgal as a "side" calculation, WWTT recommends doing all the math on one solution bridge so the arithmetic—punching the numbers into your calculator—can be checked a couple of times to make sure you've keyed in the numbers correctly.

Solution

The question asks to calculate pounds of MLVSS. These units, as always, are put between heavy vertical lines followed by the equals sign and the blank solution bridge.

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$$\left| \text{lb MLVSS} \right| = \text{———————————————}$$

To get the needed units MLVSS on the solution bridge, WWTT starts with the concentration of MLVSS.

$$\left| \text{lb } \mathbf{MLVSS} \right| = \left| \frac{2{,}050 \text{ mg } \mathbf{MLVSS}}{\text{L}} \right| \text{———————————}$$

Whenever mg/L are entered (unless solving for mg/L), the conversion factor to cancel mg and L is entered.

$$\left| \text{lb } \mathbf{MLVSS} \right| = \left| \frac{2{,}050 \text{ } \cancel{\text{mg}} \text{ } \mathbf{MLVSS}}{\cancel{\text{L}}} \right| \left| \frac{\cancel{\text{L}}}{\text{M}\cancel{\text{mg}}} \right| \text{———————————}$$

One of the reasons the conversion factor Mmg/L is so useful is because it reminds us we need an Mgal in the calculation. But we don't have one so we enter another conversion factor to cancel the Ms. Note gals cancel, too, numerator and denominator.

$$\left| \text{lb } \mathbf{MLVSS} \right| = \left| \frac{2{,}050 \text{ } \cancel{\text{mg}} \text{ } \mathbf{MLVSS}}{\cancel{\text{L}}} \right| \left| \frac{\cancel{\text{L}}}{\cancel{\text{M}}\cancel{\text{mg}}} \right| \left| \frac{\cancel{\text{Mgal}}}{10^6 \text{ } \cancel{\text{gal}}} \right| \text{———————————}$$

To get the needed units lb on the solution bridge, the density of water is entered. This results in another gal unit that needs to be canceled.

$$\left| \mathbf{lb\ MLVSS} \right| = \left| \frac{2{,}050 \text{ } \cancel{\text{mg}} \text{ } \mathbf{MLVSS}}{\cancel{\text{L}}} \right| \left| \frac{\cancel{\text{L}}}{\cancel{\text{M}}\cancel{\text{mg}}} \right| \left| \frac{\cancel{\text{Mgal}}}{10^6 \text{ } \cancel{\text{gal}}} \right| \left| \frac{8.34 \text{ } \mathbf{lb}}{\text{gal}} \right| \text{———————————}$$

We cancel the gal using another well known conversion factor.

$$\left| \mathbf{lb\ MLVSS} \right| = \left| \frac{2{,}050 \text{ } \cancel{\text{mg}} \text{ } \mathbf{MLVSS}}{\cancel{\text{L}}} \right| \left| \frac{\cancel{\text{L}}}{\cancel{\text{M}}\cancel{\text{mg}}} \right| \left| \frac{\cancel{\text{Mgal}}}{10^6 \text{ } \cancel{\text{gal}}} \right| \left| \frac{8.34 \text{ } \mathbf{lb}}{\cancel{\text{gal}}} \right| \left| \frac{7.48 \text{ } \cancel{\text{gal}}}{\text{ft}^3} \right| \text{———————————}$$

The cubic feet (ft^3) in the denominator reminds us we now have to calculate the volume of each aeration basin (AB). Remember length times width times depth per AB.

$$\text{lb MLVSS} = \frac{2{,}050\ \cancel{\text{mg}}\ \textbf{MLVSS} \mid \cancel{\text{L}} \mid \cancel{\text{M}}\text{gal} \mid 8.34\ \textbf{lb} \mid 7.48\ \cancel{\text{gal}} \mid 150\ \cancel{\text{ft}} \mid 40\ \cancel{\text{ft}} \mid 18\ \cancel{\text{ft}}}{\cancel{\text{L}} \mid \cancel{\text{M}}\text{mg} \mid 10^6\ \cancel{\text{gal}} \mid \cancel{\text{gal}} \mid \cancel{\text{ft}}^3 \mid \text{AB}}$$

How many aeration basins are there?

$$\text{lb MLVSS} = \frac{2{,}050\ \cancel{\text{mg}}\ \textbf{MLVSS} \mid \cancel{\text{L}} \mid \cancel{\text{M}}\text{gal} \mid 8.34\ \textbf{lb} \mid 7.48\ \cancel{\text{gal}} \mid 150\ \cancel{\text{ft}} \mid 40\ \cancel{\text{ft}} \mid 18\ \cancel{\text{ft}} \mid 2\ \cancel{\text{AB}}}{\cancel{\text{L}} \mid \cancel{\text{M}}\text{mg} \mid 10^6\ \cancel{\text{gal}} \mid \cancel{\text{gal}} \mid \cancel{\text{ft}}^3 \mid \cancel{\text{AB}}}$$

Since all of the units have canceled except those needed in the answer, we know the solution bridge is complete. The arithmetic gives the answer.

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$$\text{lb MLVSS} = \frac{2{,}050\ \cancel{\text{mg}}\ \textbf{MLVSS} \mid \cancel{\text{L}} \mid \cancel{\text{M}}\text{gal} \mid 8.34\ \textbf{lb} \mid 7.48\ \cancel{\text{gal}} \mid 150\ \cancel{\text{ft}} \mid 40\ \cancel{\text{ft}} \mid 18\ \cancel{\text{ft}} \mid 2\ \cancel{\text{AB}}}{\cancel{\text{L}} \mid \cancel{\text{M}}\text{mg} \mid 10^6\ \cancel{\text{gal}} \mid \cancel{\text{gal}} \mid \cancel{\text{ft}}^3 \mid \cancel{\text{AB}}}$$

2,050 x 8.34 x 7.48 x 150 x 40 x 18 x 2 ÷ 1,000,000 = **27,623 lb MLVSS**.

Discussion

Some operators will control their activated sludge process by maintaining a target mass of “bugs” in the system. While the mass of MLVSS in an activated sludge system is often taken as a surrogate measurement of mass of microbes, activated sludge operators need to understand that the mass of MLVSS is fixed by the MCRT (or SRT), the BOD load, and the temperature of the wastewater. Because the MCRT (or SRT) fixes the growth rate of the microbes in the system which, in turn, controls sludge and effluent quality, the MCRT (or SRT) is **the** control parameter of most importance. Once you have found an MCRT (or SRT) that gives you good sludge and effluent quality, maintain it and let the MLVSS mass trend up and down depending on the BOD load and wastewater temperature. Keep in mind one simple fact: the MLVSS mass is a response variable so cannot be used as a control variable.

Happy calculating! Let us know, by leaving a comment, if you want us to do a specific problem, if you see a mistake, or if you have a question on any of the Problems of the Day you are looking at.