Problem of the Day
2015.Jun.03

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Two aeration basins have a combined volume of 1.6 million gallons. The operator calculated there are 28,000 pounds of solids in the two aeration basins. What MLSS concentration did she use in her calculation?

Introduction

This is a "reverse" pounds equation. In case you haven't figured it out, WWTT doesn't advocate the memorization of a bunch of equations and pie charts. If you know how to use them and you've memorized the right pie chart, the are somewhat clever in the way they algebraically manipulate an equation for you without you knowing it. Units will do the same thing for you without the memorization. If you do use equations or pie charts, that's fine. WWTT recommends only that you still carry units through to make sure they work out. If the units don't work, you will not get the correct answer no matter what equation or pie chart you're using.

Today's solution starts with one of WWTT's favorite conversion factors:

$$\frac{M{\cdot}mg}{L} \quad \text{or} \quad \frac{L}{M{\cdot}mg}$$

This conversion factor has been derived various times in Problem of the Day, must recently on 2015.May. 26. Instead of using it to cancel units, in today's problem it is used to get the units we need onto the solution bridge.

Solution

As with most problems, the solution bridge starts with identifying the units needed in the answer. The question specifically asks to "[c]alculate the MLSS concentration." In wastewater math problems concentration is most commonly given in mg/L but sometimes percent is used. There is a **HUGE** difference between mg/L and percent: mg/L is parts per **million** parts; percent is parts per **hundred** parts. What would you rather have: a million bucks or a hundred bucks? See, a **HUGE** difference. So, the units we need in the answer are mg MLSS/L. These are entered between heavy vertical lines, as before, followed by an equals sign and the blank solution bridge.

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$$\left|\frac{\text{mg MLSS}}{\text{L}}\right| = \left|\quad\right|\quad\left|\quad\right|\quad\left|\quad\right|\quad$$

Here is what we know from the problem statement, expressed in appropriate units:

1. Total aeration basin volume = 1.6 Mgal
2. 28,000 lb MLSS

Rule: Whenever a question asks to solve for mg/L, the solution bridge will **always** begin with Mmg/L. It's that simple. Doing so puts the units mg and L needed in the answer on the solution bridge, as shown in bold.

$$\left|\frac{\textbf{mg}\ \text{MLSS}}{\textbf{L}}\right| = \left|\frac{M{\cdot}\textbf{mg}}{\textbf{L}}\right|\quad\left|\quad\right|\quad\left|\quad\right|$$

Although there are options for what to enter next, WWTT likes to enter mg/L of what; in this case, MLSS, as shown in bold.

$$\left|\frac{\textbf{mg MLSS}}{\textbf{L}}\right| = \left|\frac{M{\cdot}\textbf{mg}}{\textbf{L}}\right|\left|\ 28{,}000\ \text{lb}\ \textbf{MLSS}\ \right|\quad\left|\quad\right|$$

For some operators who are just getting used to the solution bridge, the blank box below 28,000 lb MLSS bothers them. If that is the case, you can enter a 1 wherever there is a blank box. Doing so will not change the answer.

All the units needed in the answer are now on the solution bridge along with other unwanted units that need to be canceled in the usual way, numerator and denominator. Next, the M in the numerator is canceled by entering Mgal in the denominator.

mg MLSS		M̶·mg	28,000 lb **MLSS**	
L	=	**L**	1.6 M̶gal	

The density of water is entered to cancel the remaining unwanted units.

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mg MLSS		M̶·mg	28,000 l̶b̶ **MLSS**		g̶a̶l̶
L	=	**L**		1.6 M̶gal	8.34 l̶b̶

Since all the units have cancelled except the units needed in the answer, mg MLSS/L, we know the solution bridge is complete. The arithmetic gives the answer:

28,000 ÷ 1.6 ÷ 8.34 = **2,098 mg MLSS/L**.

Discussion
As stated above, this is a reverse pounds equation where the number of pounds are given and concentration has to be calculated: the number of pounds is divided by volume in Mgal (or flow in Mgal/d if pounds per day are given) and 8.34 lb/gal. This kind of calculation is common on certification exams when an F:M ratio is given and the examinee has to calculate either the MLSS or MLVSS concentration.

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.