Problem of the Day

2015.Jun.19

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The BOD load to the aeration basins calculated in yesterday's Problem of the Day was estimated to grow 8,234 lb MLVSS/d. The aeration basin volume at the plant is 2.2 million gallons. Calculate the increase in the MLSS concentration from MLVSS growth over the weekend (two days) assuming no wasting.

Introduction

The mixed liquor suspended solids (MLSS) is comprised of two components: mixed liquor volatile suspended solids (MLVSS) and mixed liquor fixed, or inorganic, suspended solids (MLISS). As a profession, we equate MLVSS to biomass. As mentioned yesterday, for every pound of BOD going into an aeration basin, approximately three-quarters of a pound of biomass grows. Many activated sludge plants, especially smaller plants, don't waste over the weekend. Although every plant has its own unique set of constraints, I want to be on record saying that it is **not** good operational strategy to cease wasting over the weekend. Still, I know the reality that many plants face so this question has quite a bit of practical application.

This is a reverse pounds equation where we are calculating the increase in the MLVSS concentration over two days knowing how many pounds of MLVSS the system generates per day (8,234 lb MLVSS/d). We can do this.

Solution

Although the question asks for the increase in the MLSS concentration over two days, we have to assume that the increase in MLSS concentration is strictly the result in an increase in the MLVSS concentration. So the units we want in the answer are mg MLVSS/L. These units are entered between heavy vertical lines, as always, followed by an equals sign and the blank solution bridge.

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$$\left|\frac{\text{mg MLVSS}}{\text{L}}\right| = \frac{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}{}$$

The following list summarizes the information given in the problem statement expressed in the appropriate units:

1. MLVSS generation = 8,234 lb MLVSS/d
2. Time period = 2 d
3. Aeration basin volume = 2.2 Mgal
4. MLSS concentration increase due solely to MLVSS concentration increase (assumed)

Rule: Whenever a question asks to solve for mg/L, the solution bridge will **always** begin with M·mg/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.

$$\left|\frac{\textbf{mg} \text{ MLVSS}}{\textbf{L}}\right| = \left|\frac{\text{M·}\textbf{mg}}{\textbf{L}}\right| \frac{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}{}$$

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

$$\left|\frac{\textbf{mg MLVSS}}{\textbf{L}}\right| = \left|\frac{\text{M·}\textbf{mg}}{\textbf{L}}\right| \left|\frac{\text{8,234 lb } \textbf{MLVSS}}{\text{d}}\right| \frac{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad}{}$$

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. There are two days over the weekend the plant is not wasting. We enter this on the solution bridge so d cancel denominator and numerator

mg MLVSS	=	M·**mg**	8,234 lb **MLVSS**	2 ~~d~~	
L		**L**	~~d~~		

Next, the M in the numerator is canceled by entering Mgal in the denominator.

mg MLVSS	=	~~M~~·**mg**	8,234 lb **MLVSS**	2 ~~d~~		
L		**L**	~~d~~		2.2 ~~M~~gal	

The density of water is entered to cancel the remaining unwanted units. Since all the units have now canceled except those needed in the answer, we know the solution bridge is complete. The arithmetic gives the answer.

mg MLVSS	=	~~M~~·**mg**	8,234 ~~lb~~ **MLVSS**	2 ~~d~~		~~gal~~
L		**L**	~~d~~		2.2 ~~Mgal~~	8.34 ~~lb~~

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mg MLVSS	=	~~M~~·**mg**	8,234 ~~lb~~ **MLVSS**	2 ~~d~~		~~gal~~
L		**L**	~~d~~		2.2 ~~Mgal~~	8.34 ~~lb~~

8,234 x 2 ÷ 2.2 ÷ 8.34 = **898 mg MLVSS/L**.

Discussion

The answer tells us that over the weekend the MLSS will increase by at least 898 mg/L, or about 900 mg/L. So on Monday morning, the operator will have to play catch-up: (s)he'll have to waste what wasn't wasted over the weekend plus whatever MLVSS grows on Monday. Operators have to remember that the MCRT (mean cell residence time) or the SRT (solids residence time) controls the growth rate of the microbes in the system. The growth rate, in turn, controls, to a large degree, sludge quality and, therefore, effluent quality. The MCRT is controlled by the WAS flow rate. A stable biomass **cannot** result if the WAS is turned off on Friday, turned way up on Monday, and then turned down on Tuesday or whenever the operator has caught up to the solids (s)he didn't waste over the weekend. As more and more is required of wastewater treatment plants and the operators that run them, we have to get smarter at what we do and stabilize and optimize our operation to the greatest extent possible.

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.