Problem of the Day

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The final effluent from the Moccasin Run WWTP is dosed with 21.5 mg/L chlorine. The flow is 4.8 MGD. How many pounds per day of chlorine are used?

Introduction

Again, this is a very straightforward pounds-per-day calculation. In the last couple of Problems of the Day I have introduced a different approach to these kinds of problems. Instead of using the conversion factor M·mg/L, I now express mg/L as so many pounds per million pounds (that is, a ppM). In doing so, I am consistent with how I solve problems when concentration is given in percent rather than mg/L. We'll do a few more problems to "test" this approach.

Solution

The following information is given in the problem statement or assumed. Note the manner in which I have modified the way I express mg/L and others.

1. Final effluent (FE) flow = 4.8 Mgal FE/d
2. Chlorine (Cl_2) dose = 21.5 mg/L = 21.5 ppM = 21.5 lb Cl_2/M lb FE
3. Density of FE = 8.34 lb FE/gal FE (assumed since not given)

Today's problem asks to calculate lb Cl_2/d. These units, then, are put between heavy vertical lines, as always, followed by an equals sign and the blank solution bridge.

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$$\left|\frac{\text{lb } Cl_2}{\text{d}}\right| = \frac{\qquad\qquad}{\qquad\qquad}$$

The only place the units lb Cl_2 appear in the list is in the numerator of No. 2. This, then, is entered to start the solution bridge to get the units needed in the numerator of the answer as shown in bold.

$$\left|\frac{\textbf{lb } \textbf{Cl}_2}{\text{d}}\right| = \left|\frac{21.5\ \textbf{lb } \textbf{Cl}_2}{\text{M lb FE}}\right| \frac{\qquad\qquad}{\qquad\qquad}$$

The only place the units d appear in the list is in the denominator of No. 1. This, then, is entered to get the units needed in the denominator of the answer as shown in bold. Note the Ms cancel in the denominator and numerator.

$$\left|\frac{\textbf{lb } \textbf{Cl}_2}{\textbf{d}}\right| = \left|\frac{21.5\ \textbf{lb } \textbf{Cl}_2}{\cancel{\text{M}}\ \text{lb FE}}\right| \left|\frac{4.8\ \cancel{\text{M}}\text{gal FE}}{\textbf{d}}\right| \frac{8.34\ \text{lb FE}}{\text{gal FE}}$$

The density of the final effluent (FE) is entered to cancel the units lb FE and gal FE.

$$\left|\frac{\textbf{lb } \textbf{Cl}_2}{\textbf{d}}\right| = \left|\frac{21.5\ \textbf{lb } \textbf{Cl}_2}{\cancel{\text{M}}\ \cancel{\text{lb FE}}}\right| \left|\frac{4.8\ \cancel{\text{Mgal FE}}}{\textbf{d}}\right| \frac{8.34\ \cancel{\text{lb FE}}}{\cancel{\text{gal FE}}}$$

Since all the units have now canceled except those needed in the answer, **lb Cl_2/d**, we know the solution bridge is complete. The arithmetic gives the answer.

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$$\frac{\textbf{lb } Cl_2}{\textbf{d}} = \frac{21.5 \textbf{ lb } Cl_2}{\cancel{M}\ \cancel{lb\ FE}} \frac{4.8\ \cancel{Mgal\ FE}}{\textbf{d}} \frac{8.34\ \cancel{lb\ FE}}{\cancel{gal\ FE}}$$

21.5 x 4.8 x 700 x 8.34 = **861 lb Cl_2/d**.

Discussion

Again, this is no more than the pounds-per-day calculation, but with a slightly different "solution bridging" approach. Note by representing the mg/L concentration as ppM and expressing it in terms of "lb per M lb," I don't have to use the conversion factor L/M·mg. The resulting solution bridge is one step shorter.

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.