Problem of the Day

2014.Nov.12

Discussion

The Water Environment Federation is the trade organization for water professionals, including wastewater treatment operations professionals (http://wefcom.wef.org/home). Individual states, or groups of states, sponsor local chapters. On October 29, 2014, I gave a 6-hour Math for Operators Workshop at the annual conference of the Pacific Northwest Clean Water Association (PNCWA). PNCWA represents Idaho, Oregon and Washington (http://www.pncwa.org/). All operators should seriously consider joining their local association. In California it is the California Water Environment Association (http://www.cwea.org/).

Long story short: I randomly covered a series of math problems in the PNCWA workshop, and I have been requested by several attendees to send them the problems. Instead, I am going to post them here (starting with the 2014.Nov.04 Problem of the Day). They are good practice for all visitors to WWTT's Problem of the Day.

For those of you who may be new to WWTT's Problem of the Day, we insert a page break after the problem statement so you can print it without looking at the solution. **See what you can do to solve the problem before looking at the solution**.

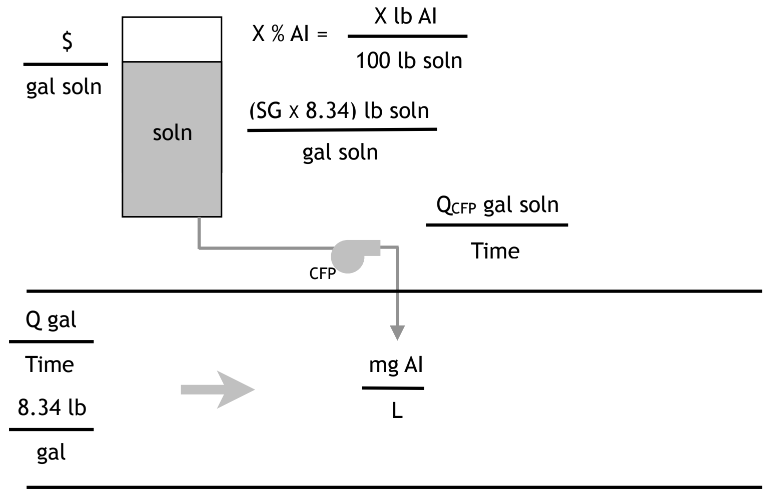
Problem

Problem of the Day: Given the following information, calculate the polymer dose.

- Influent flow = 1,950 gal/min
- Concentration of polymer (poly) in feed solution (soln) = 0.33% = 0.33 poly/100 lb soln
- Solution specific gravity = 1
- Solution feed rate = 1.25 gal/min
- **Calculate: polymer dose, mg poly/L**.

Solution

This is a chemical dosing problem where polymer (poly) is the active ingredient. WWTT puts all chemical dosing problems in terms of the following graphic:



Generic graphic for setting up chemical dosing problems (AI = active ingredient, SG = specific gravity, CFP = chemical feed pump, Q_{CFP} = flow rate of chemical feed pump, and Q = process flow).

The six elements (sometimes more) that are important in doing these calculations were discussed in the 2014.Oct.18, 20 and 26 Problems of the Day (http://wastewatertechnologytrainers.com/wp-content/uploads/2014/10/2014.Oct_.18.pdf, http://wastewatertechnologytrainers.com/wp-content/uploads/2014/10/2014.Oct_.20.pdf, http://wastewatertechnologytrainers.com/wp-content/uploads/2014/11/2014.Oct_.26.pdf).

The first thing to take note of in this problem is that the flow rate to which the polymer solution is being added is given in units of gal/min. In all problems where we have mg/L, either given or to be solved for, an “Mgal” is needed to make the units work. Many training materials, and a lot of piecharts, have operators convert all flows to MGD. This is a ridiculous waste of time. In chemical dosing problems in particular, the time unit in the flow rate for the chemical feed pump will end up canceling the time unit in the flow rate into which the chemical feed pump is pumping. Since they are both currently in “min,” we will leave the flow in minutes but convert gal to Mgal. Doing so is a simple railroad track.

1,950 ~~gal~~	Mgal	=	0.00195 Mgal
min	10^6 ~~gal~~		min

The problem is trying to trick us by giving a specific gravity of 1. Obviously, this just means the density of the solution is equal to that of water. But if you’re in doubt:

1.0	8.34 lb	=	8.34 lb soln
	gal		gal soln

The problem can now be solved.

Problem of the Day: Given the following information, calculate the polymer dose.

1. Percent active ingredient in feed solution = 0.33% poly = 0.33 lb poly/100 lb soln
2. Density of feed solution = 8.34 lb soln/gal soln (from above)
3. Solution feed rate delivered by the chemical feed pump (Q_{CFP}) = 1.25 gal soln/min
4. Flow rate of water to which the chemical is being dosed, Q = 0.00195 Mgal/min
5. Density of water = 8.34 lb/gal
6. Resulting concentration of polymer in the water: **Calculate dose in mg poly/L**.

mg poly	=	~~M~~ **mg**	0.33 ~~lb~~ **poly**	8.34 ~~lb soln~~	1.25 ~~gal soln~~	~~min~~	~~gal~~
L		**L**	100 ~~lb soln~~	~~gal soln~~	~~min~~	0.00195 ~~Mgal~~	8.34 ~~lb~~

All the units have canceled except those needed in the answer, **mg poly/L**. The arithmetic gives the answer:

0.33 x 8.34 x 1.25 ÷ 100 ÷ 0.00195 ÷ 8.34 = **2.16 mg poly/L**.

Happy calculating!