Problem of the Day

# 2014.Nov.09

## 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

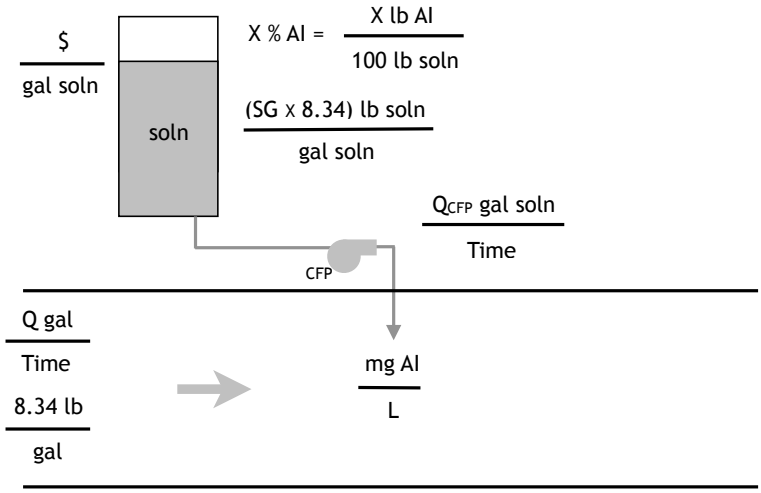
Chemical suppliers talk about the "trade strength" of sodium hypochlorite. This is not the same as "available chlorine." Certification exams will be worded in terms of "available chlorine."

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

- Effluent flow = 1.8 Mgal/d
- Sodium hypochlorite (hypo) is 12.5% available chlorine = 12.5 lb $Cl_2$/100 lb hypo
- Density of sodium hypochlorite = 10 lb hypo/gal hypo
- Sodium hypochlorite feed rate = 9.5 gal hypo/hour
- **Calculate: chlorine dose in mg $Cl_2$/L**.

## Solution

This is a chemical dosing problem. 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). These are listed below in the same order as described in those problems.

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

1. Percent concentration of AI in the feed solution = 12.5% $Cl_2$ = 12.5 lb $Cl_2$/100 lb hypo
2. Density of feed solution = 10 lb hypo/gal hypo
3. Solution feed rate delivered by the chemical feed pump, $Q_{CFP}$ = 9.5 gal hypo/hr
4. Flow rate of water to which the chemical is being dosed, Q = 1.8 Mgal/d
5. Density of water = 8.34 lb/gal
6. Resulting concentration of AI in the water = **unknown, find chlorine dose in mg $Cl_2$/L**.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **mg $Cl_2$** / **L** | = | ~~M~~**mg** / **L** | 12.5 ~~lb~~ **$Cl_2$** / 100 ~~lb hypo~~ | 10 ~~lb hypo~~ / ~~gal hypo~~ | 9.5 ~~gal hypo~~ / ~~hr~~ | ~~d~~ / 1.8 ~~Mgal~~ | ~~gal~~ / 8.34 ~~lb~~ | 24 ~~hr~~ / ~~d~~ |

All the units have canceled except those needed in the answer, **mg $Cl_2$/L**. The arithmetic gives the answer:

12.5 x 10 x 9.5 x 24 ÷ 100 ÷ 1.8 ÷ 8.34 = **19 mg $Cl_2$/L**.

Happy calculating!

Let us know if you see any mistakes or what us to do a specific problem.