Practical Guidelines to Solving Water/Wastewater Math Problems

1. Does the answer make sense?

If your result for a problem in which you are trying to calculate the number of pounds of chemical necessary to chlorinate a reservoir is 2,000,000 pounds of chlorine, you have probably forgotten to convert "gallons" to "MG". You should note that some formulas call for "MG" while others call for "gallons". There is a huge difference between "gallons" and "MG" (a factor of million). Two million pounds of any chemical is a lot of chemical. Your answer needs to be practical for it to be correct. Conversely, if you get a chlorine residual of "0.000006", you have probably done something similar also.

2. You do not use "$\pi R^2 H$" for every problem.

This equation is used only when you calculate a volume for an object shaped like a cylinder such as a length of pipe or a standpipe.

3. Use labels thru out your calculation.

If you use labels thru out your calculation, you will never be confused as to whether you should multiply or divide by a certain factor.

Example-Converting from gallons to cubic feet. How many cubic feet are there in 1000 gallons?

The conversion factor is 7.5 gallons per cubic foot so do you multiply by 7.5 or divide by 7.5?

<u>Correct Method</u>

$$\frac{1000\ \cancel{\text{Gallons}} \times 1\ \text{Cubic Foot}}{7.5\ \cancel{\text{Gallons}}} = 133.3\ \text{Cubic Feet}$$

Notice that if you divide by 7.5, "Gallons" cancels above and below the line so your answer is "Cubic Feet".

<u>Incorrect Method</u>

$$\frac{1000\ \text{Gallons} \times 7.5\ \text{Gallons}}{1\ \text{Cubic Foot}} = \frac{7500\ \text{Gallons}^2}{\text{Cubic Foot}}$$

If you multiply by 7.5, none of the labels cancel so your answer is "Gallons Squared per Cubic Feet". There is no such thing as "Gallons Squared per Cubic Feet" so your answer is obviously wrong. So if use your labels thru out your calculations, you will not be confused as to whether to multiply or divide by a certain number.

4. What does the question ask?

At the end of each problem, there is usually a question such as "How many hours does it take to fill this reservoir?" From this question you can get a clue that (in this case) your answer must be in hours so when you do your calculating, "time" must be above the line. If you get an answer in seconds, minutes, days, etc., you must then convert to "hours".

5. If you are asked to paint a reservoir, this is a surface area problem-NOT a volume problem!

When you paint something such as a reservoir, you paint flat surfaces. You do not fill the reservoir with paint unless you want to use a lot of excess paint. At some point in your calculations, you must get "square feet", "square yards", etc.-NOT "cubic feet" or "cubic yards". If your reservoir is standpipe, you must calculate the surface area of a cylinder. The formula for the surface area for the sides of a cylinder is "$2\pi RH$"-NOT "$\pi R^2 H$".

Note that "2R" is not the same as "R^2". "2R" is the same as "R + R" while "R^2" is the same as "R x R".

6. Sometimes you may have to convert a formula the form that you need

If you are asked "What is the velocity of water in a pipe where the flow is 300 gallons per minute and the pipe's diameter is 12 inches?", you need to use some form of the formula "Q = AV". In its present form, you can calculate quantity if you are given "area" and "velocity".

This formula can be converted to find velocity as follows:

$$Q = AV \rightarrow \frac{Q}{A} = \frac{\cancel{A}\ V}{\cancel{A}} \rightarrow \frac{Q}{A} = V \quad \text{So velocity} = \frac{\text{quantity}}{\text{area}}$$

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7. When working with a percentage, you must convert to a decimal

In the dosage and pounds formulas that use "percentage of chemical", you must convert the percentage to a decimal value. Example-If you use the following dosage formula-

$$\text{Dosage} = \frac{(\text{lbs chemical per day})\ (120{,}000)\ (\%)}{\text{gallons of water treated}}$$

If your chemical is 65%, you use the decimal form .65 in the formula-NOT 65%.

The decimal form of a percentage is found as follows-

$$\frac{\%}{100\%} = \text{Decimal form of percentage}$$

8. Do not work in "inches" unless it is a pressure problem

Always convert from inches to feet such as for pipe size. If you work with inches, 99% of the time you will get a wrong answer. The conversion factor of "7.5 gallons per cubic feet" is from CUBIC FEET to GALLONS---NOT CUBIC INCHES to GALLONS. The only time you should use inches is when dealing with pressure in "pounds per square inch".

9. Know how to use your calculator

To get an answer for this problem- $\frac{2000}{10}$,you enter "2000" in your calculator, push the "divide" key, enter "10" in the calculator, then press the "equals" key to get your answer. If you enter "10" then "2000", you get an answer that is wrong.