



WASTEWATER TECHNOLOGY TRAINERS

Transforming today's operators into tomorrow's water quality professionals

Problem of the Day 2014.Oct.27

Discussion

The primary objective of wastewater treatment is to protect public health. The impact chlorination has had on public health is miraculous (see the graphic in WWTT's blog "Raising the Bar" at <http://wastewatertechnologytrainers.com/945/>). When it comes to chlorination problems, all operators should remember:

$$\text{Dose} = \text{Demand} + \text{Residual} \quad (1)$$

From this simple equation, two other equations are derived:

$$\text{Demand} = \text{Dose} - \text{Residual} \quad (2)$$

and

$$\text{Residual} = \text{Dose} - \text{Demand} \quad (3)$$

While the demand is the amount of chlorine used to achieve disinfection, in order to ensure the demand is met, maintaining a certain residual after so many minutes of contact time is often a regulatory requirement. Regardless of how much chlorine is dosed, what the demand is, or how much residual there is after the given contact time, the process objective of chlorination is to reduce the number concentration of indicator organisms (total coliforms, fecal coliforms, or *E. coli*) to required levels.

At least in California, operators taking their first certification exam should be very aware that when math problems are given in multiple-choice format, **the possible answers given are not random**. What the test authors do is to figure out the more common ways operators will incorrectly do the arithmetic, like using 7.48 instead of 8.34. Often, operators taking exams will willy-nilly start hitting their calculator keys until a number shows up in the display that matches one of the numbers in the multiple choice list. The test authors are counting on you to make these mistakes.

The unit approach advocated by WWTT will prevent you from making these mistakes. Don't let the test authors trick you!

Problem

Today's Problem of the Day is straight from a California Grade I practice exam that WWTT uses in its Grades I&II Operator Certification and Math Review Class (<http://wastewatertechnologytrainers.com/>)

Problem of the Day: The chlorine residual was measured at 1.2 mg/L and the dosage was calculated to be 5.0 mg/L. What would be the chlorine demand?

- a. 1.2 mg/L
- b. 3.8 mg/L
- c. 4.2 mg/L
- d. 6.0 mg/L
- e. 6.2 mg/L

Solution

Which of the three equations given on the previous page, 1, 2 or 3, should you use knowing the following information from the problem statement, labeled the way WWTT recommends:

- Chlorine **residual** = 1.2 mg Cl₂/L
- Chlorine **dose** = 5.0 mg Cl₂/L
- Chlorine **demand** = **unknown**

Obviously, since we are given residual and dose and need to solve for demand, we are going to use Equation 2:

$$\text{Demand} = \text{Dose} - \text{Residual}$$

Putting in the numbers we know and solving:

$$\text{Demand} = 5.0 \text{ mg Cl}_2/\text{L} - 1.2 \text{ mg Cl}_2/\text{L} = \underline{\underline{3.8 \text{ mg Cl}_2/\text{L}}}$$

The answer is letter b:

Problem of the Day: The chlorine residual was measured at 1.2 mg/L and the dosage was calculated to be 5.0 mg/L. What would be the chlorine demand?

- a.
- b. 3.8 mg/L**
- c.
- d.
- e.

It is interesting to note, as discussed above, that one of the possible answers, 6.2 mg/L, letter e, is the result if you thought that:

$$\text{Demand} = \text{Dose} + \text{Residual (wrong!)}$$

Again, don't let those test authors trick you and don't just punch numbers into your calculator. **Know your stuff!**