



# WASTEWATER TECHNOLOGY TRAINERS

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

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## Problem of the Day 2014.Oct.10

### Discussion

In yesterday's Problem of the Day, we showed that clarifier surface overflow rate is a measurement of the velocity of the flow exiting the clarifier. Particles that have settling velocities less than the SOR will end up in the effluent. The equation for calculating SOR was given yesterday and is repeated here:

$$\text{SOR} = \frac{Q}{A}$$

where SOR = surface over flow rate, Q = effluent flow, and A = the clarifier surface area which is the area through which the flow is passing.

**The units on SOR are always: gal/d-ft<sup>2</sup>.** Always. Certification examinees must remember this and the equation given above.

### Problem

Now for today's problem.

**Problem of the Day:** The Springdale WWTP has two secondary clarifiers 75 feet in diameter. The average flow to the plant during wet weather is 10.2 MGD. What is the surface overflow rate of these clarifiers at this flow?

## Solution

As always, the first thing we have to do is identify the units needed in the answer. The surface overflow rate in clarifiers is always in units of gal/d-ft<sup>2</sup>. As before, we put these units between heavy vertical lines followed by the equals sign and the blank track.

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$$\left| \frac{\text{gal}}{\text{d}\cdot\text{ft}^2} \right| = \underline{\hspace{10em}}$$

The equation given above (SOR = Q/A) is used to start the railroad track. Remember the equation for calculating the area of a circle is  $A = 0.785 \times \text{diameter}^2$ , so this is the area per secondary clarifier (SC).

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$$\left| \frac{\text{gal}}{\text{d}\cdot\text{ft}^2} \right| = \left| \frac{10.2 \text{ Mgal}}{\mathbf{d} \quad 0.785 \quad \mathbf{75 \text{ ft}} \quad \mathbf{75 \text{ ft}}} \right| \frac{\text{SC}}{\hspace{10em}}$$

Notice that the railroad track now contains all the units in the denominator needed in the answer, as shown in bold. From the problem statement, we know there are two secondary clarifiers (SC), so this is entered into the railroad track in the denominator to cancel the SC in the numerator.

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The only thing remaining is to convert Mgal to gal. WWTP uses the conversion factor, 1,000,000 gal/Mgal or, in shorthand, **10<sup>6</sup> gal/Mgal**, so you don't have to think about whether you divide or multiply by 1,000,000. Just make the units not needed cancel, in this case, Mgal. This is very handy under the pressure of an exam.

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$$\left| \frac{\text{gal}}{\text{d}\cdot\text{ft}^2} \right| = \left| \frac{10.2 \text{ Mgal}}{\mathbf{d} \quad 0.785 \quad \mathbf{75 \text{ ft}} \quad \mathbf{75 \text{ ft}}} \right| \frac{\text{SC}}{2 \text{ SC} \quad \frac{10^6 \text{ gal}}{\text{Mgal}}}$$

All the units have canceled now except those needed in the answer, gal/d-ft<sup>2</sup>, so the math is complete. The arithmetic gives the answer:

$$10.2 \times 1,000,000 \div 0.785 \div 75 \div 75 \div 2 = \underline{1,155 \text{ gal/d}\cdot\text{ft}^2}$$

By the calculation we did yesterday, this is equal to 0.0018 ft/s, although you would never see SOR reported in these units. Still, as discussed yesterday, this is **about a thousand times slower** than the velocity typical in a the grit chamber! If you were traveling a thousand times slower than your friend going

60 miles/hr, it would take you about an hour to go from goalpost to goalpost on a football field. If that's as fast as you can run, you'll never make the team!

Let us know what you think about Problem of the Day by adding a comment. We'd love to hear from you. Also, if there are problems you'd like us to solve, let us know that, too!