



**WASTEWATER TECHNOLOGY  
T R A I N E R S**

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

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**Problem of the Day  
2015.Jun.06**

**Problem of the Day**

A pump empties a chlorine contact tank in 3 hours and 25 minutes. The pump pumps at 325 gallons per minute. How many gallons of water were in the tank when the pumping began?

## Introduction

Operators are frequently asked to calculate how long it will take to fill a tank or reservoir, how long it will take to empty a tank or a reservoir, or the detention time in a tank or reservoir. It is always the same equation:

$$\text{Time} = \frac{V}{Q}$$

where V is volume and Q is the flow rate into or out of that volume. Again, this is the same equation whether you're calculating fill time, empty time or detention time.

Today's problem gives how long it takes a 325-gpm pump to empty a chlorine contact tank, 3 hours and 25 minutes. It is the same equation but rearranged. The problem statement asks for how many gallons were in the tank. Are gallons a unit of volume (V) or flow (Q)? I think we all know gallons are a unit of volume, so V in the equation above is the unknown, so we have to multiply both sides of the equation by Q in order to get V all by itself:

$$V = Q \times \text{Time}$$

But the units would have told us this, too. Always trust the units!

## Solution

The question asks to calculate volume in gallons. These units, therefore, are entered between heavy vertical lines followed by an equals sign and the blank solution bridge.

**Problem of the Day:** A pump empties a chlorine contact tank in 3 hours and 25 minutes. The pump pumps at 325 gallons per minute. How many gallons of water were in the tank when the pumping began?

$$\left| \text{gal} \right| = \underline{\hspace{2cm}}$$

Two pieces of information are given in the problem:

1. Pump flow rate = 325 gal/min
2. Empty time = 3 hours and 25 minutes

Mixed units, like 3 hours and 25 minutes, don't work well on the solution bridge. We have to combine the hours and the minutes into one unit. We have two choices: hours or minutes. Knowing the the pumping rate is 325 gallons per minutes, it is obvious we should express the time it takes to empty the tank in minutes:

$$\text{Time, min} = (3 \times 60) + 25 = 205 \text{ min}$$

If we didn't know how to do the algebra and rearrange the equation above, we know we need gallons in the numerator of the solution bridge and there is only one place that the units gal show up: No. 1 in the list above. This is how the solution bridge is started.

$$\left| \text{gal} \right| = \frac{\left| \begin{array}{c} 325 \text{ gal} \\ \text{min} \end{array} \right|}{\hspace{2cm}}$$

As before, the units gal need to be preserved and the unwanted units, min, need to be canceled. The time to empty the tank, 205 min, is entered in the numerator of the solution bridge so min cancel.

	gal		=		325 gal		205 min	
					min			

Because all the units have canceled except those needed in the answer, we know the solution bridge is complete and the arithmetic gives the answer.

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	gal		=		325 gal		205 min	
					min			

$325 \times 205 = \underline{\underline{66,625 \text{ gal}}}$ .

**Discussion**

Same equation every time:

$$\text{Time} = \frac{V}{Q}$$

**Happy calculating! Let us know, by leaving a comment, if you want us to do a specific problem, if you see a mistake, or if you have a question on any of the Problems of the Day you are looking at.**