



**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.Jul.02**

**Problem of the Day**

Find the total aeration basin volume in million gallons at a plant with six aeration basins. Each basin is 45 feet wide, 175 feet long and 22 feet deep. In operation, there is three feet of freeboard.

## Introduction

I remember when I was an operator at the Breckenridge Sanitation District just upstream of Dillon Reservoir on the Blue River in Summit County, Colorado, reviewing the calculation for the volume of the aeration basin volume used to calculate SRT: length times width times depth. But I wanted to be exact. There were two concrete columns in the aeration basins that were part of the superstructure that held the surface aerators in place. I calculated the volume occupied by the two columns and subtracted it from the length-times-width-times-depth calculation. It wasn't much, but I impressed the chief plant operator with my attention to detail!

## Solution

This is a very straightforward calculation but you have to know what is meant by "freeboard." Freeboard is the distance from the top of the tank down to the water surface. So the depth of the water in today's problem is 22 feet minus 3 feet, 19 feet of water depth.

The question asks the answer to be in Mgal so these units, as always, are entered between heavy vertical lines followed by an equals sign and the blank solution bridge.

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	Mgal		=	_____
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The solution bridge is started by knowing that volume is calculated by multiplying length times width times depth. But remember, this is per aeration basin (AB).

	Mgal		=	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">175 ft</td> <td style="padding: 2px 10px;">45 ft</td> <td style="padding: 2px 10px;">19 ft</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 2px 10px;">AB</td> </tr> </table>	175 ft	45 ft	19 ft	AB				_____
175 ft	45 ft	19 ft										
AB												

There are six aeration basins at the plant. You don't have to figure out if you should multiply or divide by 6 if you use units.

	Mgal		=	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">175 ft</td> <td style="padding: 2px 10px;">45 ft</td> <td style="padding: 2px 10px;">19 ft</td> <td style="padding: 2px 10px;">6 AB</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 2px 10px;">AB</td> <td></td> </tr> </table>	175 ft	45 ft	19 ft	6 AB	AB					_____
175 ft	45 ft	19 ft	6 AB											
AB														

While ft<sup>3</sup> is a unit of volume, it is not the unit of volume needed in the answer, Mgal. I take two steps in converting units. First, I convert ft<sup>3</sup> to gal.

	Mgal		=	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">175 ft</td> <td style="padding: 2px 10px;">45 ft</td> <td style="padding: 2px 10px;">19 ft</td> <td style="padding: 2px 10px;">6 AB</td> <td style="padding: 2px 10px;">7.48 gal</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 2px 10px;">AB</td> <td></td> <td style="text-align: center; padding: 2px 10px;">ft<sup>3</sup></td> </tr> </table>	175 ft	45 ft	19 ft	6 AB	7.48 gal	AB				ft <sup>3</sup>		_____
175 ft	45 ft	19 ft	6 AB	7.48 gal												
AB				ft <sup>3</sup>												

Then gal are converted to Mgal.

	Mgal		=	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">175 ft</td> <td style="padding: 2px 10px;">45 ft</td> <td style="padding: 2px 10px;">19 ft</td> <td style="padding: 2px 10px;">6 AB</td> <td style="padding: 2px 10px;">7.48 gal</td> <td style="padding: 2px 10px;"><b>Mgal</b></td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 2px 10px;">AB</td> <td></td> <td style="text-align: center; padding: 2px 10px;">ft<sup>3</sup></td> <td style="text-align: center; padding: 2px 10px;">10<sup>6</sup> gal</td> </tr> </table>	175 ft	45 ft	19 ft	6 AB	7.48 gal	<b>Mgal</b>	AB				ft <sup>3</sup>	10 <sup>6</sup> gal		_____
175 ft	45 ft	19 ft	6 AB	7.48 gal	<b>Mgal</b>													
AB				ft <sup>3</sup>	10 <sup>6</sup> gal													

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

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<b>Mgal</b>	=	175 ft	45 ft	19 ft	6 AB	7.48 gal	<b>Mgal</b>
		AB				ft <sup>3</sup>	10 <sup>6</sup> gal

$$175 \times 45 \times 19 \times 6 \times 7.48 \div 1,000,000 = \underline{\underline{6.72 \text{ Mgal}}}$$

**Discussion**

The problem statement didn't say anything about how many of the plant's aeration basins were in service. If only four were in use, then the calculation would be modified appropriately to calculate the mass of solids in the aeration basins used in controlling the SRT.

*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.*