



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

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

**Problem of the Day
2015.Jun.27**

Problem of the Day

A belt filter press is operated 14 hours per day, seven days per week. On average, the press discharges 60,000 pounds of cake per day at a total solids concentration of 22%. The density of the cake is 66.5 pounds per cubic foot. Calculate the number of cubic yards of cake produced per week.

Introduction

Today's problem us "fun with units." As was mentioned in yesterday's Problem of the Day, the key to using the solution bridge approach to solving problems is labeling. So that's what we're practicing today. Why would you want to mater the solution bridge approach to solving problems?

Simple. Because it's failsafe and foolproof.

Students ask all the time, "How do I know if I am going to use all the information given in a problem?"

My answer, "If the units work out and you didn't use some of the information given in a problem, you didn't need it." Today's problem demonstrates.

Solution

The question asks for the answer in cubic yards of cake per week (yd³ cake/wk). These units are entered between heavy vertical lines, as always, followed by an equals sign and the blank solution bridge.

Problem of the Day: A belt filter press is operated 14 hours per day, seven days per week. On average, the press discharges 60,000 pounds of cake per day at a total solids concentration of 22%. The density of the cake is 66.5 pounds per cubic foot. Calculate the number of cubic yards of cake produced per week.

$$\left| \begin{array}{c} \text{yd}^3 \text{ cake} \\ \text{wk} \end{array} \right| = \underline{\hspace{10em}}$$

The following list summarizes the information given in the problem statement expressed in the appropriate units:

1. Operation = 14 hr/d, 7 d/wk
2. Cake production = 60,000 lb cake/d
3. Cake density = 66.5 lb cake/ft³ cake
4. TS concentration = 22% = 22 lb TS/100 lb cake
5. Cake production = 13,120 lb cake/14 hr

The units needed in the answer are yd³ cake/wk. The units yd³ do not appear anywhere in the list, so we start the solution bridge with a conversion factor.

$$\left| \begin{array}{c} \text{yd}^3 \text{ cake} \\ \text{wk} \end{array} \right| = \left| \begin{array}{c} \text{yd}^3 \\ 27 \text{ ft}^3 \end{array} \right| \underline{\hspace{10em}}$$

Now, to get yd³ cake in the numerator and to cancel the unwanted units ft³, the density of the cake is entered because that is the only place these units appear in the list (No. 3). This is entered so the unwanted units cancel, denominator and numerator.

$$\left| \begin{array}{c} \text{yd}^3 \text{ cake} \\ \text{wk} \end{array} \right| = \left| \begin{array}{c} \text{yd}^3 \\ 27 \text{ ft}^3 \end{array} \right| \left| \begin{array}{c} \text{ft}^3 \text{ cake} \\ 66.5 \text{ lb cake} \end{array} \right| \underline{\hspace{10em}}$$

We need to cancel the units lb cake. These only appear in one other place in the list, No. 2. This is entered so the unwanted units cancel, denominator and numerator.

$$\left| \begin{array}{c} \text{yd}^3 \text{ cake} \\ \text{wk} \end{array} \right| = \left| \begin{array}{c} \text{yd}^3 \\ 27 \text{ ft}^3 \end{array} \right| \left| \begin{array}{c} \text{ft}^3 \text{ cake} \\ 66.5 \text{ lb cake} \end{array} \right| \left| \begin{array}{c} 60,000 \text{ lb cake} \\ \text{d} \end{array} \right| \underline{\hspace{10em}}$$

We need to cancel the units d. These only appear in one other place in the list, No. 1. This is entered so the unwanted units cancel, denominator and numerator. Note, entering No. 1 so d cancel also puts the necessary units wk in the denominator.

yd³ cake	=	yd³	ft³ cake	60,000 lb-cake	7 d
wk		27 ft ³	66.5 lb-cake	d	wk

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

Problem of the Day: A belt filter press is operated 14 hours per day, seven days per week. On average, the press discharges 60,000 pounds of cake per day at a total solids concentration of 22%. The density of the cake is 66.5 pounds per cubic foot. Calculate the number of cubic yards of cake produced per week.

yd³ cake	=	yd³	ft³ cake	60,000 lb-cake	7 d
wk		27 ft ³	66.5 lb-cake	d	wk

$$60,000 \times 7 \div 27 \div 66.5 = \underline{\underline{234 \text{ yd}^3 \text{ cake/wk}}}$$

Discussion

Pretty straightforward. Notice we didn't use 14 hr/d or 22 lb TS/100 lb cake. The units told us what to use and what not to use.

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.