Solving for an Unknown Value

Introduction

This section gives a very simplified explanation of how to solve the basic equations used to determine the amount of restricted ingredients permitted.

Methods

Generic Model

To algebraically isolate an unknown value to one side of the equation and have all of the known values on the other, identical functions need to be performed on both sides of the equation.

The following ppm formula will be used to illustrate the generic model.

$$\text{ppm (parts per million)} = \frac{\text{lb. Restricted Ingredient (RI)} \times \text{\% Pump} \times 1{,}000{,}000}{\text{lb. Pickle}}$$

If all the values in the equation are known except the pounds of RI, isolate the pounds of RI (which is X) on one side of the equation and solve for it.

$$\frac{X \times \text{\% Pump} \times 1{,}000{,}000}{\text{lb. Pickle}} = \text{ppm}$$

In this instance, move all the known values to the right side of the equation, leaving the X on the left side where it is the numerator. First multiply each side of the equation by “lb. Pickle”. This cancels “lb. Pickle” from the X side of the equation and removes any denominator.

$$\frac{\text{lb. Pickle} \times X \times \text{\% Pump} \times 1{,}000{,}000}{\text{lb. Pickle}} = \text{ppm} \times \text{lb. Pickle}$$

$$X \times \text{\% Pump} \times 1{,}000{,}000 = \text{ppm} \times \text{lb. Pickle}$$

Next, to leave X by itself, divide both sides of the equation by "1,000,000" x “% Pump”. This cancels "1,000,000" x “% Pump” on the X side of the equation.

$$X \times \frac{\text{\% Pump} \times 1{,}000{,}000}{\text{\% Pump} \times 1{,}000{,}000} = \frac{\text{ppm} \times \text{lb. Pickle}}{\text{\% Pump} \times 1{,}000{,}000}$$

$$X = \frac{\text{ppm} \times \text{lb. Pickle}}{\text{\% Pump} \times 1{,}000{,}000}$$

Now solve for X. This same procedure is used to isolate X to one side of any equation.

Example

In the equation on page 28, the unknown is the maximum percent pump and is represented by the X in the equation below

$$200 = \frac{1.75 \times X \times 1{,}000{,}000}{1{,}000}$$

In this instance, all the known values are moved to the left side of the equation, leaving “X” on the right and keeping it in the numerator. First multiply each side of the equation by 1000. This cancels 1000 from the X side of the equation and removes any denominator.

$$200 \times 1{,}000 = \frac{1.75 \times X \times 1{,}000{,}000}{1{,}000} \times \frac{1{,}000}{1}$$

$$200 \times 1{,}000 = 1.75 \times X \times 1{,}000{,}000$$

Next, divide each side of the equation by 1.75 ×1,000,000. This cancels 1.75 ×100,000 on the X side of the equation and isolates the unknown to the right side of the equation.

$$\frac{200 \times 1000}{1.75 \times 1{,}000{,}000} = \frac{1.75 \times X \times 1{,}000{,}000}{1.75 \times 1{,}000{,}000}$$

Next, solve the equation for X.

$$\frac{200 \times 1{,}000}{1.75 \times 1{,}000{,}000} = X$$

$$\frac{200{,}000}{1{,}750{,}000} = X$$

$$0.1142 = X$$

Finally, multiply 0.1142 by 100 to convert to a percent and 11.42% is the maximum percent pump.

Example

In the equation, the maximum amount of sodium nitrite is the unknown and represented by the X in the equation.

$$200 = \frac{X \times 0.12 \times 1{,}000{,}000}{950}$$

In this instance, all the known values are moved to the left side of the equation, leaving “X” on the right and keeping it in the numerator. First multiply each side of the equation by 950. This cancels 950 from the X side of the equation and removes any denominator.

$$200 \text{ x } 950 = \frac{X \times 0.12 \times 1{,}000{,}000}{950} \text{ x } \frac{950}{1}$$

Next, divide each side of the equation by 0.12 ×1,000,000. This cancels 0.12 ×100,000 on the X side of the equation and isolates the unknown to the right side of the equation.

$$\frac{200 \times 950}{0.12 \times 1{,}000{,}000} = \frac{X \times 0.12 \times 1{,}000{,}000}{0.12 \times 1{,}000{,}000}$$

Next, solve the equation for X.

$$\frac{200 \times 950}{0.12 \times 1{,}000{,}000} = X$$

$\frac{190{,}000}{120{,}000}$ = 1.58 lb. is maximum amount nitrite allowed per 100 gal of curing solution