Introduction

I can remember one of the first things I was taught as a young firefighter was the principles of fire behavior. In addition to its behavior, one also needed to understand what it would take to control the fire and then extinguish it.

One area that we had to understand was that of latent heat. Latent heat is a fancy way of saying the amount of heat that will be given off or absorbed by a substance (generally in the fire service this substance is water) when it changes from a solid to a liquid or from a liquid to a gaseous vapor.

Once a substance is converted from a solid to a liquid, it is said to have taken on the "latent heat of fusion." When a substance goes from a liquid to a gaseous vapor it is known as "latent heat of vaporization." To understand this better we need to have some additional information.

What is a BTU?

First, we need to know what the British thermal unit (BTU) is and how it effects latent heat. A BTU is understood to be the amount of energy or heat required to raise the temperature of one pound of water one degree Fahrenheit. In general, a BTU is nothing more than a measurement of a quantity of heat.

When water freezes or melts, it has reached a temperature of 32 degrees Fahrenheit and has a BTU equivalent 143.4 BTUs per pound. When water reaches the boiling point at 212 degrees Fahrenheit and turns to steam, the required amount of BTUs is 970.3. For simplicity, we can round off the numbers.

Do the Math

To get a temperature of around 40 degrees Fahrenheit to the boiling point of water requires 172 BTUs. This is where some addition takes place. We add the 172 BTUs of energy needed to go from the 40 degrees Fahrenheit to 212 degrees Fahrenheit to the 970 BTUs when the water turns to steam and come up with a total of 1,142 BTUs.

Knowing that 1,142 BTUs per pound of water is absorbed, we can start to put the formula to work for us

in determining how much water will be required to extinguish a given fire condition. Keep in mind that a gallon of water weighs roughly 8.3 pounds. Therefore, we take the 1,142 BTUs and multiply it by 8.3 pounds of water per gallon and come up with a total of 9,478 BTUs per each gallon of water.

This then is the total amount of energy that a gallon of water will absorb if it is allowed to reach its "latent heat of vaporization." In a normal room and content fire situation, we can expect the fire to produce about 720,000 BTUs per 100 square feet of space.

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