Boat Fuel Tank Winterization - Empty is the New 'Full'

As the summer season transitions into fall, boaters begin to think about getting their boats ready for winter. Fuel system considerations are usually a major part of the process and for the longest time it was thought that filling the fuel tank and adding a stabilizer was good advice in order to prevent condensation in the fuel tank. Allowing water to accumulate in a fuel tank over the winter months can result in fuel contamination, and for aluminum tanks, it can cause corrosion of the tank itself. So, all good reasons to take precautions to avoid fuel problems in the spring commissioning process as well as premature fuel tank replacement.

With the introduction of blended fuels and the higher prices of fuel over the past decade, questions arose about the necessity of filling your fuel tank for 6 months of storage. First there is the cost to consider. When fuel was around $1.00 per gallon there was not too much anxiety about filling a 100 gallon tank. When fuel prices skyrocketed up to $4.00 a gallon and marina prices approached $6.00 per gallon in some places, financial considerations begged the question; should I really be doing this? Since then, there has been a growing number of boaters and boat industry professionals challenging the status quo and questioning the real benefits of a full tank of fuel over the winter. There has been much discussion on the Internet about the virtues of full tanks versus empty tanks, and even some scientific experimentation. Surprisingly enough, these trials and experiments of empty tank winterization showed little/no accumulation of water in the fuel tank. How could this be?

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. . . "continually forcing the less dense air and water vapor out of the tank."

Perhaps it is best to start with the theory behind the full tank strategy and work from there. The theory being that, if the tank is full of fuel, there is little or no room for air and the moisture it carries. The less air the less moisture; at least that is the theory. I am not sure how much this theory was originally put to the test, but it seemed reasonable back in the day and became the standard for winterization procedures going forward. Some boating professionals and enthusiast have even gone to lengths in calculating the potential for water accumulation in a boat's fuel tank during the course of a winter. So, why hasn't the use of the empty tank theory been a disaster?

Answering this question, I offer some additional theory to the entire aspect of fuel storage and winterization. It relates back to the original theory of air in the tank and the moisture it carries. In reality, once a fuel tank is used and as long as there is some fuel in the tank, the 'air' space in the tank will actually be filled with fumes and not pure 'air'. As the liquid fuel evaporates over time, there will be a constant supply of fumes into the open space of the tank. A simple demonstration of this concept is to look at a plastic gas jug that is partially filled and tightly sealed. The evaporation of fumes will actually create pressure in the tank, bulging its shape. This is commonly known as vapor pressure. A similar process occurs with a vented fuel tank, yet the vent allows excess fumes to escape so that no pressure builds.

Boaters all know, or should know, that fuel fumes are heavier than air. So, in a typical boat fuel system, the fumes that are created by evaporation will tend to occupy the space in the tank and force any moisture laden air out of the tank. Certainly there will be some air in the tank and some moisture, but not to the extent that some people have theorized. The fuel vapor dominates. An illustration of a typical boat tank installation is shown below. As you can see, the

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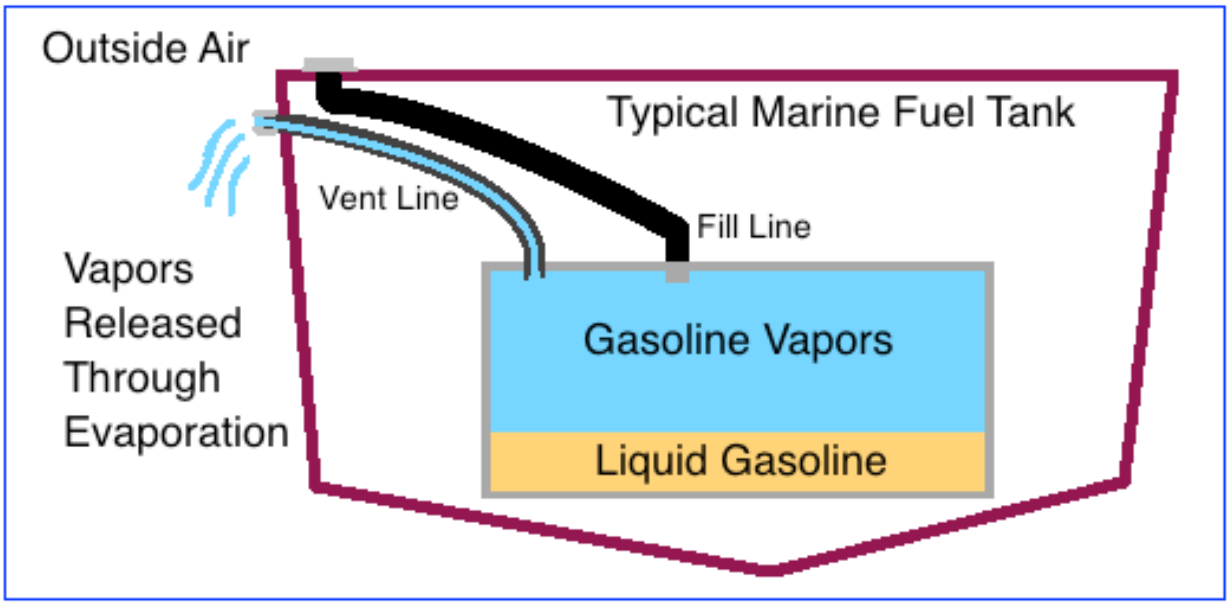
outside air, being lighter than gasoline vapors, is not going to have much opportunity to enter the tank over the course of a winter. What is the moisture carrying ability of fume rich air versus pure air? . . . Not very good . . . So, there is not the opportunity for an abundance of moisture to enter the tank as the original ‘full tank’ theory assumes. Essentially, the tank does not ‘breath’ as the full tank theory implies. It exhales more than it breaths, keeping the moisture levels within the tank low. That is why the empty tank theory actually works, and in fact any level of fuel in the tank will work in terms of avoiding moisture



accumulation. The fume rich air will continually force any moisture laden air out of the tank and keep it out. Water contamination of fuel tanks does happen on occasion, but the causes are more likely to be from direct sources of water entering the fuel tank, such as rain, ice, and snow than from condensation within the tank.

The reason that the full tank theory works is the same reason that the empty tank theory works; fuel vapor is heavier than air. Knowing that, there seems to be a good reason to go with an empty (or near empty) tank. After all, when you think about a large tank of gasoline sitting for six months over the winter, nothing good can happen to it.

Happy Boating.

Ted Penfield

