

Condensation in your fuel tank?

Frequently we hear it said that the cause of water in fuel tanks is due to condensation. I have long doubted this assertion but the issue has come up so frequently that I was finally motivated to try to prove to the point. The basis of my belief or assumption is that:

There isn't enough air volume within a tank to hold much vapor.

On average, tanks are half full, further reducing volume

The amount of water vapor in air is very small, even at 100% humidity

Conditions aren't right to cause condensation in a fuel tank

Research produced the following values for the maximum amount of liquid water in air at the following temperatures:

30C/86F	30-grams/cubic meter
20C/50F	17-grams/cubic meter
10C/13F	9-grams/cubic meter

There are 28 grams per ounce, so 30 grams = 1.07 oz; 17 grams = 0.6428 oz.

A cubic meter equals 264 gallons of liquid volume, therefore:

A 200 gallon tank = 0.76 cubic meter.

At 86F, an empty 200 gallon tank could contain 22.8 grams of water vapor, or 0.81 oz.

At 50F, an empty 200-gallon tank could contain 12.92 grams of water vapor, or 0.46 oz.

Note that this is the maximum amount of water vapor that a completely empty tank could contain, in neither case a full ounce of water.

In order to condense water out of the atmosphere a surface must be much colder than the air. The problem for the condensation in tank theory is; how do we end up with a fuel tank that is much colder than the air? One way would be to have a very cold day that suddenly warms up dramatically, but when does this ever happen? The weather can turn cold very fast, but does not suddenly get very warm.

Aluminum is second only to copper for rapid heat transfer properties; it will therefore adjust to atmospheric temperature changes quickly. Gasoline and diesel fuel, like water absorbs [sic] heat and cold slowly. Thus one might expect to see sweating on the outside of a tank as the day warms up from cold mornings, but do we? Well, I can say that after 35 years of inspecting boats, I've rarely seen tanks sweating. Note: Sweating may be likely to occur with boats in very cold waters when warm days are encountered.

This issue first came up a number of years ago over a question of whether internal engine rusting could be due to condensation caused by sudden temperature changes as from day to night and vice versa. Since that time, inspection of hundreds of engines showed that rust only occurs on the underside of valve covers due to water contamination of the oil. Very few engines have rusty undersides of valve covers, thereby proving the point that ice-cold engine blocks in the morning don't sweat at it warms up during the day. If that is true, then how could it be true that fuel tanks sweat?

My answer is that they don't and these calculations prove it. My initial assumptions were correct. You do not need to store or lay up your boat with full fuel tanks. If you are getting water in your fuel, it is getting there some other way.

Contaminated Fuel

Years ago we had serious fuel contamination problems due to underground steel storage tanks that rusted and leaked. Today all tanks are fiberglass, so this no longer happens (that I know of). However, those underground tanks do have fill plates on the ground surface (usually the parking lot) that can leak just like your boat deck plate. As the marina pumps its tanks nearly dry before the next fuel delivery, those who buy fuel from the near empty tank are the ones that are going to get the water (because it's pumped from the bottom of the tank). This despite the fact that the dock fuel pump has a water separating filters. I've opened the panels on occasion and have found the sight bowls completely filled with water, so at this point the water is being passed on to the customer. *Next time you buy diesel, ask to see the filter at the pump! You have to remove the lower pump panel to see it.*

However, it is important to note if you're getting water from your fuel retailer, chances are that it won't be a small amount. Most likely it will be a lot and your filters will fill up and engines crap out post-haste.

Leaking Fill Caps

By far the most common cause of contaminated boat tanks are deck fill caps that leak. Most of these things are stupidly mounted flat on decks, which may puddle with water. The cap has a tiny little O-ring that is supposed to seal and keep water out. DOES IT? I wouldn't depend on one of these things unless I could prove that it doesn't leak. Check the condition of the o-ring and weather it is sealing.

One way to check positively is to clean the o-ring seat thoroughly; next apply some black or any color paint to the o-ring and screw the cap in place, tight. Then remove it and see if the paint has been completely transferred to the ring seat. If not, you now know where the problem is.

Another problem is the simple failure to seat the cap fully after refueling. This actually happens a lot, so check to see if the cap is loose.

The Tank Vent

Improperly located fuel tank vent fittings are one of the top causes of water getting into tanks. When this is the cause, if you are a salt-water boater, then it will be salt water in your tank. A fuel tank vent fitting on the side of the hull should be angled down and aftward. If angled in any other direction, you've got a problem that needs fixing. Watch out for deteriorated plastic and zinc alloy fittings; some of these things deteriorate incredibly fast.

The vent line should have a riser loop on the inside. That is, it travels upward first, then downward. If not, that is another potential problem.

Check the Fuel Gauge Sender

One final possibility is the fuel gauge sender plate on top of the fuel tank. These are often made of steel or have steel screws that can rust away, a situation I've seen several times. Is water puddling on the tank top? Test all screws with a screwdriver to make sure they are securely seated.

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