Air Management in Hydronic Systems

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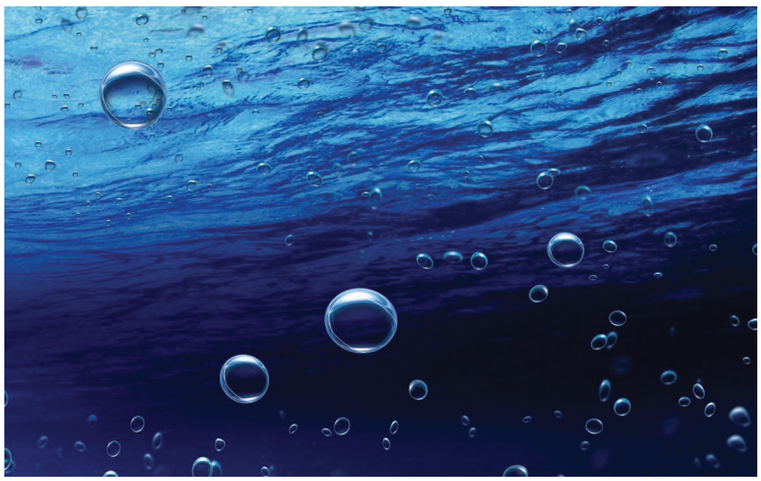
Hydronic systems are filled with water and any air in the piping system rises to the high points. This air must then be vented out of the system. If the air is allowed to gather at these high points, it can prevent the circulation of water. A typical circulator pump can not push the air down a vertical pipe, since air is lighter than water. Only positive displacement by means of opening a drain and pushing the air down the pipe with more water (purging) will remove the air pocket.



Once you have vented the high points of the system, circulation can take place. However, air problems can still occur. We must provide some means for preventing air from getting back into the piping system. This is because water "holds" a percentage of air in solution. As the temperature of the water increases, the amount of air held in solution decreases and is released in the form of air bubbles.

In a hot water system, large quantities of air are released in the boiler when the water is heated. The air bubbles will travel out into the system and find low velocity areas where they will collect, causing air binding and no circulation. This will require the venting of these air pockets again! When this air is vented, the systems pressure drops, causing the fill valve to respond, bringing in more water. This sets up a never-ending cycle that not only is a nuisance but is also very corrosive to the system components.

Full of Hot Air

It is obvious from the above information that we must do something with the air as soon as it is released from solution (*i.e., when the boiler heats the water*). The logical place for this to occur is right at the outlet of the boiler. The question is: *Do we vent these air bubbles out to the atmosphere or do we direct them up into a plain steel compression tank?* The answer to this question has been argued and debated over the years. Venting the air to the atmosphere and using a diaphragm expansion tank is the most popular method and with good success. The important thing is to know how to install or replace either method properly.

The *air control* system came from the old gravity hot water systems that used an open expansion tank located in the attic. As water is heated, it expands in volume. By installing this tank, technicians provided a place for this expanded water to go so that the pressure did not build to the point of causing the relief valve to open. They normally piped this tank off the supply main up to the attic. Because the flow rate was so slow in a gravity system, the air had no problem finding its way up to this open tank. However, when the systems were being changed over to forced circulation, they started to experience air-binding problems. This was caused by the "booster" pumps. The water was moving at a flow rate that was too fast to allow the air bubbles to make a sharp turn and go up the pipe leading to the open tank in the attic.

Catching Bubbles

The engineers at the time realized they had to control the air as soon as it was released from the boiler. They came up with various devices designed to "catch" the air bubbles and direct them towards the expansion tank. This brings up an important point. The air bubbles move through the piping towards the tank by gravity. This means the piping must be pitched up towards the tank, which has to be located above the boiler. That is why you will see these tanks suspended from the ceilings in the boiler room.

Automatic air vents should not be used with this type of system. They defeat the purpose of what you are trying to accomplish—control the air but do not vent it. Every time air is vented from the system, it is lost from the expansion tank. This venting action also lowers the system's pressure. Of course, an automatic water feeder opens in response to this drop, bringing in fresh make-up water that enters the expansion tank. This raises the water level in the tank and after a few cycles there is no more space left for expansion. The relief valve will then discharge water every time the boiler fires up.

The only type of vent you can use is a manual one, which can be opened to vent air on initial filling of the system. The purpose behind *air control* was to use the body of air as a spring to maintain pressure on the system as well as accept the expanding water that happens when the boiler heats the water. If you lose the body of air through automatic vents or leaks, etc., it will be replaced by water. Since water is not compressible, when it is heated and expands the pressure builds. When the relief valve discharges, the system pressure drops and more make-up water is added. This water contains a lot of oxygen, which is very aggressive and attacks the ferrous metals in the system.

Air Elimination

The other system is called *air elimination*. This means venting air out of the system using automatic vents and using a diaphragm expansion tank. This expansion tank has some type of rubber membrane that separates the system water from the air. The tank comes pre-charged from the factory with 12 psig of air charge. Because the air is separated from the system water, you are no longer concerned with directing air bubbles out of the boiler and up into the expansion tank. This gives you the flexibility of installing the diaphragm tank anywhere. It can be installed on the floor, suspended from the bottom of an air separator or even suspended from the ceiling. The size of the tank is generally smaller than the steel expansion tank because there is no water in the tank until the system water is heated.

An important point that is often overlooked is the pre-charge of the tank. It should match the system's required fill pressure. If a tank is installed into a system where the fill pressure is greater than the factory pre-charge (12 psig), you should increase the air charge to match the fill pressure setting. If you do not (and a lot of people don't), water will enter the tank once the fill pressure exceeds the air charge in the tank. The problem is the tank becomes undersized and allows the system pressure to exceed the setting of the relief valve.

In these examples, the tank gets blamed for being defective when all it needs is an increase in its air charge to match the fill pressure. The most common device used to help eliminate the air is an air scoop. This separator slows the velocity of the water flow, allowing the air bubbles to separate from the pumped flow. On the top of this "scoop" is an automatic vent that releases the air out of the system. It is important that the air separator be installed correctly.

Whether you are working on an older steel compression tank style system or installing a new residential hydronic heating system with a diaphragm expansion tank, it is important that you "handle" the air properly in both systems to avoid callbacks and customer complaints. **ICM**

If you have any questions or comments please call me at 1-800-423-7187 or email me at *gcarey@fianince.com*.