KNOWING THE FACTS

Technical Bulletin
Deaeration

Deaeration - Knowing the facts

Air and dirt in hydronic systems cause operational problems and their removal is a key factor in achieving maximum efficiency.

Venting and degassing equipments are both indispensable features of a water distribution system. This guide focusses on the removal of air from systems and a separate companion guide describes the methods of addressing dirt in the same systems.

What is deaeration?

Deaeration is the process of separating air from water and then eliminating the air from a water distribution system.

Why is air present in the water?

Cold mains water used to fill systems is often more than 95% saturated with dissolved air consisting of a mixture of Oxygen-O2 (21%) and Nitrogen – N2 (78%) and other trace gases which can exist in a dissolved state integral with the water molecules. With non-dissolved air, the gases are separate from the water molecules and are entrained in the form of bubbles of various sizes down to the microscopic level.

The ability of water to retain air is proportional to pressure (according to Henry's Law) and inversely proportional to temperature. When the temperature or pressure of water is changed such that the solubility is reduced, dissolved air will be released from the water in the form of bubbles.

There are three forms of entrapped air:

- Stationary air pockets at high points
- Entrained micro-bubbles
- Dissolved within water

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What problems arise from air in water?

Nitrogen is the main cause of classic air problems whereas oxygen is the main cause of corrosion. Air management is an important factor in any closed loop hydronic system. If neglected, the presence of air can lead to many unexpected consequences; premature deterioration of equipment and decrease in overall system efficiency. Free gas bubbles may significantly affect the circulation. As bubbles pass along a water distribution system, they can coalesce (bind together) in areas of low velocity to create localised air pockets which remain in place and reduce flow rate. Control of dissolved oxygen is a key aspect of controlling corrosion and in order to manage the corrosion risk the oxygen concentration should ideally be reduced as quickly as possible after commissioning. Oxygen is a highly reactive gas and if air is constantly present in a system because of inadequate deaeration, continuous exposure would accelerate corrosion of ferrous materials, affecting steel piping, cast iron boilers, expansion tanks, eventually leading to reduced performance and leaks. The mixture of air in water is acoustically active. Flow noise in pipes, fittings and radiators is quite irritating for building occupants and is a sign of the presence of air in the system.

Why is deaeration important?

A new hydronic system begins life completely filled with air and the main objective is minimising the amount of air present during filling and then eliminating the remainder. Traditionally, systems are filled from the bottom up to allow air to be expelled by air vents. Hydronic balancing and control valves require deaerated water in order to achieve designed flow characteristics. Presence of air in the system could change the Kv of balancing valves and their water flow characteristics. Air would also cause excess turbulence and unstable pressure signals downstream of a valve.
Commissioning should not be attempted without prior elimination of air from a system. Unlike water, air is a good insulator. If air is present in heat transfer devices such as coils, radiators and heat exchangers for example, it significantly reduces the rate of heat transfer and overall efficiency. Air trapped in a hydronic heating system can reduce energy efficiency by up to 10% and contribute to corrosion which in turn can result in blockages in pipes and equipment.

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Maintenance work on systems, fresh makeup water and porous joints and non-metallic tube are examples of how air can be repeatedly introduced into a system after it is put into service.

How does deaeration work?

Automatic Air Vents are designed to continuously remove air without manual intervention which accumulates in hot and cold water distribution systems. Placed at high points in a water distribution system Automatic Air Vents will ensure efficient initial venting of accumulated air to atmosphere during filling because the water is not flowing. Air vents will not capture bubbles from flowing water. After initial venting, the system water will still contain micro-bubbles and dissolved gases.
Gas bubbles and micro bubbles are carried along with the flow therefore separation is only possible with specific devices. Micro bubbles are extremely small and occur in large numbers and have a tendency to stick to surfaces making the separation process more difficult.
With dissolved gases, the gas molecules are bonded between the water molecules in such a manner that they can only be removed by means of pressure reduction or temperature increase. Due to the pressure and temperature differences in a system, dissolved gases can desorb into bubbles.

Which products are used for deaeration?

Air separation is achieved using specific products at various locations. As described above, Automatic Air Vents will provide system venting during initial filling of the system (and draining where necessary).
Air vents are not intended for operational venting when directly installed on flowing pipes. They are designed such that accumulated gases are vented off but they are not able to separate bubbles from flowing water.
The design of separators causes the flow velocity to be locally reduced within the main body allowing existing bubbles in the less turbulent water to rise to the top and the gases are expelled through an integral, top mounted Automatic Air Vent.

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Separators for micro-bubbles are compact units and are suitable for operational de-gassing and continuous venting. An internal mesh type of baffle with sharp edges induces the micro-bubbles to cling to the surface which then coalesce into larger bubbles which rise and are expelled to atmosphere.

Manual Air Vents are often sufficient to eliminate air pockets in heat emitters such as radiators.

What is the size range and connections for Altecnic deaeration products?

Brass automatic air vents are available from 1/8" to ¾" with a single internally threaded connection in the base. 1/8" to ½" are optionally available with an externally threaded service check valve to allow removal from live systems.
Air separators with brass bodies are available in ¾" – 2" threaded connections and 22mm and 28mm compression ends for copper pipe.
Larger air separators have steel bodies and flanged connections from DN50 to DN300 and optional weld ends DN50 to DN150.

Where should deaeration products be located?

Automatic air vents are installed in the flow and return pipework at high points, such as risers, to ensure efficient initial venting.

Separators for micro-bubbles should preferably be installed in the hottest part of the system, typically close to and downstream of the boiler and before the pump. For cool water systems, the separator should be installed in the return, upstream of the chiller.

Can deaerators be installed in any orientation?

To ensure correct operation of the venting feature, separators and automatic air vents must be installed with the operating axis in the vertical plane. Conventionally, they are fitted in horizontal pipework but the new Altecnic 551 DISCALSLIM® allows installation in horizontal, vertical and inclined pipework. The adjustable orientation of the 551 means the venting feature can always be positioned vertically, irrespective of the pipe orientation.

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Does deaeration apply to both hot and cold water systems?

Air separation is applicable to all water systems

Do deaerators require regular inspection and maintenance?

There is no manual operation involved with air vents and separators. The products should be routinely visually inspected as with other pipeline products.

How is dirt in the system reduced?

Dirt may largely be products of corrosion due to air in the system. Dirt is removed by the inclusion of dirt separators and that is the subject of a separate guide where combined air and dirt separators will be explained.

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Got a Problem? - Common Trouble Shooting Issues

Ensure that the air vents and separators are installed and commissioned in accordance with the manufacturer's installation and maintenance instructions.
Check that all connections are tight and that joints are sealed but not over tightened.

Some radiators have cool areas, usually near the top

This indicates the presence of a stationary air pocket. This can be eliminated by opening the manual air vent until water appears. This may only be temporary and the air pocket is likely to eventually return. This means that other solutions for removing air should be introduced.

Noises can be heard from the water pipes

Noise is generated when air bubbles present in the water are passing along the pipework and through fittings. This is likely to be an irritation to nearby occupants.
A deaeration device or air eliminator should be fitted to remove the air bubbles.
Ensure the vent cap on air vents is open to allow upper air pockets to be vented.

Difficulty in commissioning manual balancing valves

Manual balancing valves, especially in small sizes, can give erratic readings at the pressure test points when air is present in the form of static air pockets. This can sometimes be confirmed by air bubbles in the plastic tubes to the manometer. Knocking the pipe will release some of the air through the valve seat and down the pipeline allowing the valve to be set. The air pocket will eventually re-establish and reduce the performance of the valve. This can also apply to small control valves in a system.The solution is to install a suitably located air separator.

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