



Air and dirt in closed systems

The best techniques for removing the smallest micro bubbles and dirt particles.

White paper



Air and dirt in the system

Air bubbles and dirt particles accumulate in the water in heating, ventilation and air conditioning systems, and give rise to corrosion and resistance in a system. This leads to reduced efficiency and a greater likelihood of broken parts, with potentially expensive repairs as a consequence.

Origins of air and dirt

Air in the central heating system is hard to avoid and its origins are various. The system is full of air before it is filled with water. There is a good chance that air bubbles will remain in bends in the pipelines when they are being filled. Moreover, there is dissolved oxygen in the water, and miniscule leaks and the wrong pressure in the system lead to oxygen entering the system.

Avoiding dirt particles is also difficult. Oxygen reacts to iron and this then leads to corrosion and gives rise to magnetite. Often, there will also be sand and welding splatter in systems that have not been rinsed properly. An incorrect pH value and high conductivity can also cause unwanted dirt particles.

Temperature

Temperature affects the properties of water. Depending on the pressure, water emits salts, minerals and gasses as the temperature increases. As soon as the temperature drops, the absorption of these elements intensifies. This additional absorption of salts, minerals and gasses ultimately leads to a reduction in the transfer of heat/cold.

Problems from air and dirt

Air

Macro and micro bubbles in the heat flow hinder heat transfer and cause disturbing noises in the system. Also, corrosion arises when metal oxidises when it comes into contact with oxygen. So air is responsible in various ways for the reduced efficiency and a shorter lifespan of the boiler.

Dirt

Dirt (especially magnetite) settles in various places, including pumps, heat exchangers, three-way valves, pipelines, radiators and heat meters. This leads to an increase in resistance, particularly in modern, narrow systems, and this can entail high repair costs. Accumulation of scale also reduces the efficiency and the lifespan of the system.



The various solutions

Air and dirt separators prevent persistent problems because they purify the water in the system. There is a wide variety of solutions available on the market, so it is important to have a clear idea of the attributes that a good air or dirt separator should have.

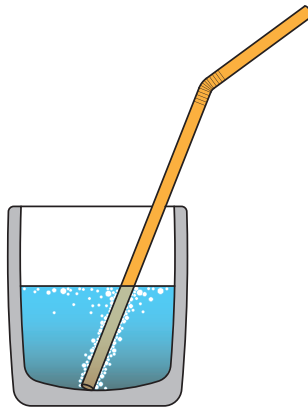
Solutions for air separation

Automatic air vent

An automatic air vent works using an air chamber and a float. The free air pushes the float down in the automatic air vent, which in turn opens a valve and the air escapes. This only removes large air bubbles (macro bubbles – free air/gasses that are present in the system).

Coalescence

This technique, which is suitable for separating small bubbles, is based on the principle that these bubbles attach themselves to an object – picture a straw in sparkling water – in the system. The small bubbles gather together to form a larger air bubble that is then big enough to float upwards.



Cyclone technology

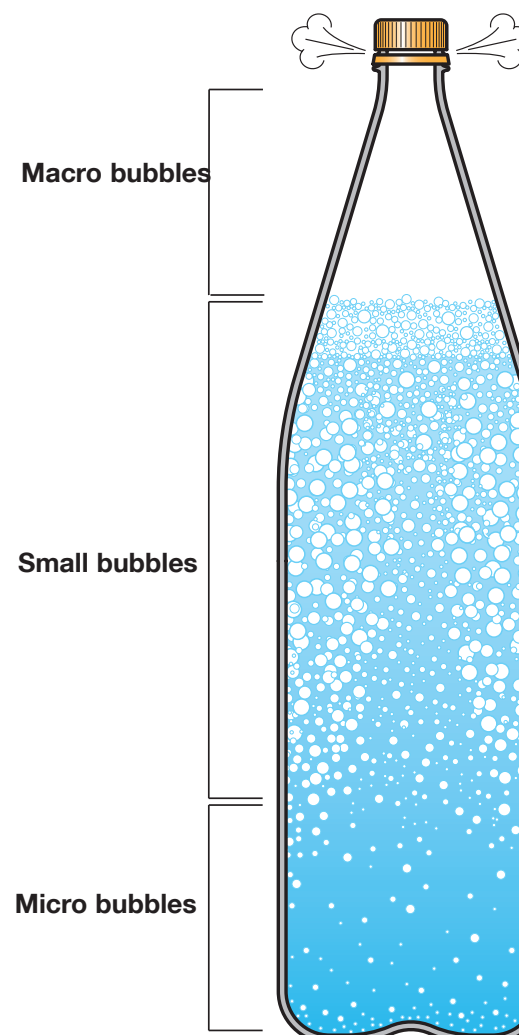
Cyclone technology is sometimes also referred to as centrifuge technology. The relatively heavy water is pushed up against the walls of the air separator through the rotational movement (vortex separation) and the relatively light air collects in the middle. From there the air bubbles can rise and thus be removed from the system. This solution has an effect on the larger bubbles in the water. This solution does however depend on the velocity of the liquid and the pressure in the system, which means that the result can be unpredictable.

Negative pressure

Opening a bottle of sparkling water is a clear metaphor for this technology. At a lower pressure, the water contains less dissolved gasses, and any surplus gasses are separated. This slightly more expensive solution requires a lot of energy, relatively speaking. This is because the degassed water has to be pressurised again before it goes back into the system.

Three kinds of air bubbles

In the installation world, we make a distinction between macro bubbles, small bubbles and micro bubbles. Macro bubbles are the large bubbles that move freely and that can float upwards of their own accord. Small bubbles are only just perceptible to the naked eye, but are not large enough to rise and are therefore carried away by water. Micro bubbles are not perceptible to the human eye and are dissolved in the water. They are the most persistent of the three.





Double thrust function

In this solution, part of the oxygen-rich water is scrubbed using a separation element and then propelled through the plenum chamber of the separator. Once in the plenum chamber, the water decelerates causing the bubbles to rise and leave the system via the float. The degassed water is then returned to the main flow via an injection point upstream. As a result, the micro bubbles that are in the supply are thrust against the wall and then propelled into the plenum chamber, and so the process is repeated. In this technology, resistance is negligible and even the smallest micro bubbles are removed.

Solutions for dirt separation

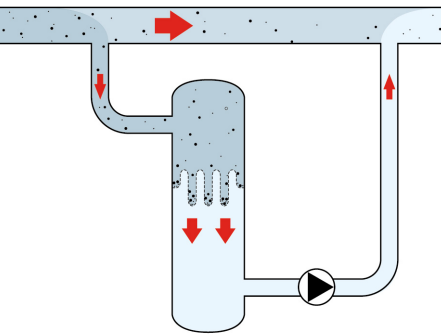
Filter

Better quality water extends the lifespan of the system and it saves energy. A filter in the system traps the dirt particles in the water flow that are larger than the filter mesh. The filter, however, increases the resistance because there is a build up of dirt particles that get stuck in the filter. This means that while using a filter is simple, it is maintenance intensive and has a negative impact on the performance of the system.

Side stream filtration

In this technology, some of the main flow is diverted to a filter. The filter makes sure that all the dirt particles that are larger than the mesh size are not returned to the main flow.

This does not cause an increase in resistance because the filter is not installed directly in the main flow. The flowing water is no longer cleaned once the filter is completely full. Therefore, the filter must be cleaned regularly. It takes longer to remove all the dirt using this technology, given that only part of the water is redirected each time.



Traditional dirt separation

Placing a dirt separator in the system that is larger than the size of the pipe reduces the speed of the water. Also, filling materials are used, which means that the dirt particles are more likely to collide. The speed is temporarily reduced to zero during the collision, which in turn means that the dirt particles are given the opportunity to sink.

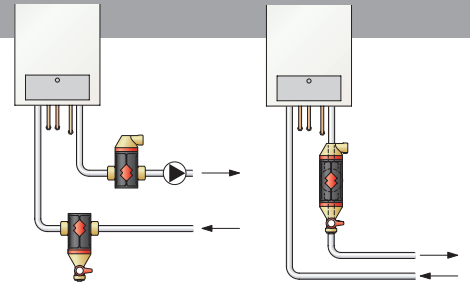
Double thrust function

In this solution, contaminated water is scraped off using a separation element and then propelled through the plenum chamber of the separator. The flow speed slows down in the plenum chamber, causing dirt particles to sink to the bottom, where they end up in the collection reservoir. The water is then returned to the main flow via an injection point upstream. As a result, the dirt present in the water supply is thrust against the wall and then propelled into the plenum chamber. This process is constantly repeated. In this technology, resistance is negligible and even the smallest dirt particles are removed.

System

Depending on which primary function is required (dirt or air separator), air, dirt and combined separators can be installed in various ways. Install the product before the boiler in the return pipe if dirt separation is the primary function.

Is the primary function air separation or is it a combination of air and dirt separation? Then install it preferably directly after the boiler or the mixing valve in the supply pipe, before the circulation pump. By doing so, the system will capture the bubbles straight after the water is heated. In a cooling system, the best place would be just before the cooling equipment.

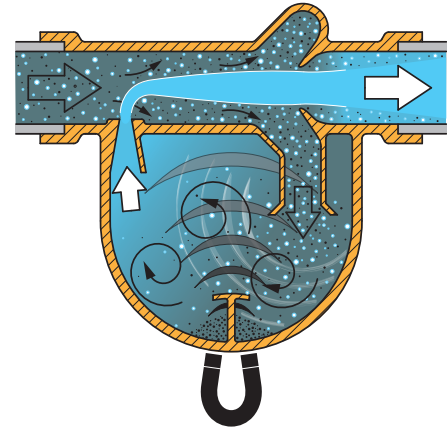




The best solution

For air and dirt separators, it is crucial that the speed of the water flow is optimum, the resistance is negligible and the capture technology operates optimally. Only then is the system really capable of removing the smallest micro bubbles and dirt particles.

For this reason, the latest air and dirt separators on the market do not have brushes, blades or other obstructions that slow the water flow down. Instead, a double thrust function is used. In this process, the first thrust effect is created by a separation element that separates the contaminated water. The second effect is created by returning the clean water to the main flow again via an injection point (the Venturi principle). This gives rise to extra thrust, which pushes the bubbles and the dirt particles in the water supply to the outside where they are then separated again. This way, many of the micro bubbles and dirt particles are propelled to the plenum chamber in the most optimum way. This produces an unprecedented high level of efficiency.



Advantages of the double thrust function

- Per cycle, around 40% of the air and dirt is separated in the 10% of the water that is taken out of the main flow.
- Resistance is very low because only 10% of the water is scraped off. It can be applied to speeds of up to as much as 3 m/s.
- Inside the plenum chamber, the flow rate is then sharply reduced, allowing for optimum separation of the micro bubbles and dirt particles.

Venturi

The Venturi effect is based on the principle that the flow rate of liquid or gas increases if the flow channel is constricted.

Magnets

The most efficient setup would involve putting magnets on the outside of the separator. These magnets are stuck opposite the outflow opening so that all ferrous dirt particles are immediately attracted and captured. Even the smallest dirt particles – from as small as 4 μm – are caught using neodymium magnets.

If you have any further questions, please contact:

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