Average reading time: 3 minutes

Drinking water treatment with carbon dioxide

Carbon dioxide helps meeting the most stringent drinking water quality standards

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Clean drinking water – a key health factor

Municipal waterworks must ensure compliance with EU drinking water directives across the entire supply system across the board. Carbon dioxide (CO_2) and know-how from Messer can help to meet the high quality requirements for drinking water.

The correct pH value is decisive

Drinking water should not be corrosive and should not form scale. For this, the pH value of the water must be in balance with the degree of hardnes.

Hardness is a natural property of water, caused mainly by calcium and magnesium ions. A certain degree of hardness may be considered healthy due to its mineral content, and it can also protect parts of equipment that come into contact with water from corrosion. Excessive calcium hardness, however, forces higher decalcification effort when water heating devices are used in households. The need for soap and surfactants for washing also increases with the degree of hardness.

Decarbonization in the fluidized bed reactor

At the inlet of fluidized bed reactors, sodium hydroxide or lime is added to increase the pH value. At the reactor outlet, however, the residual hardness and pH value of the water are often not in equilibrium, which leads to so-called post-softening. The consequences are scale formation on downstream pipes and valves as well as shorter running times of the downstream filters. To prevent this, pH control with acid is required, for which the use of carbonic acid is ideal.

Fluidized bed reactor

Carbonic acid is formed when carbon dioxide is introduced into water. Carbonic acid is a natural component of water, which is why the quality of drinking water does not change.

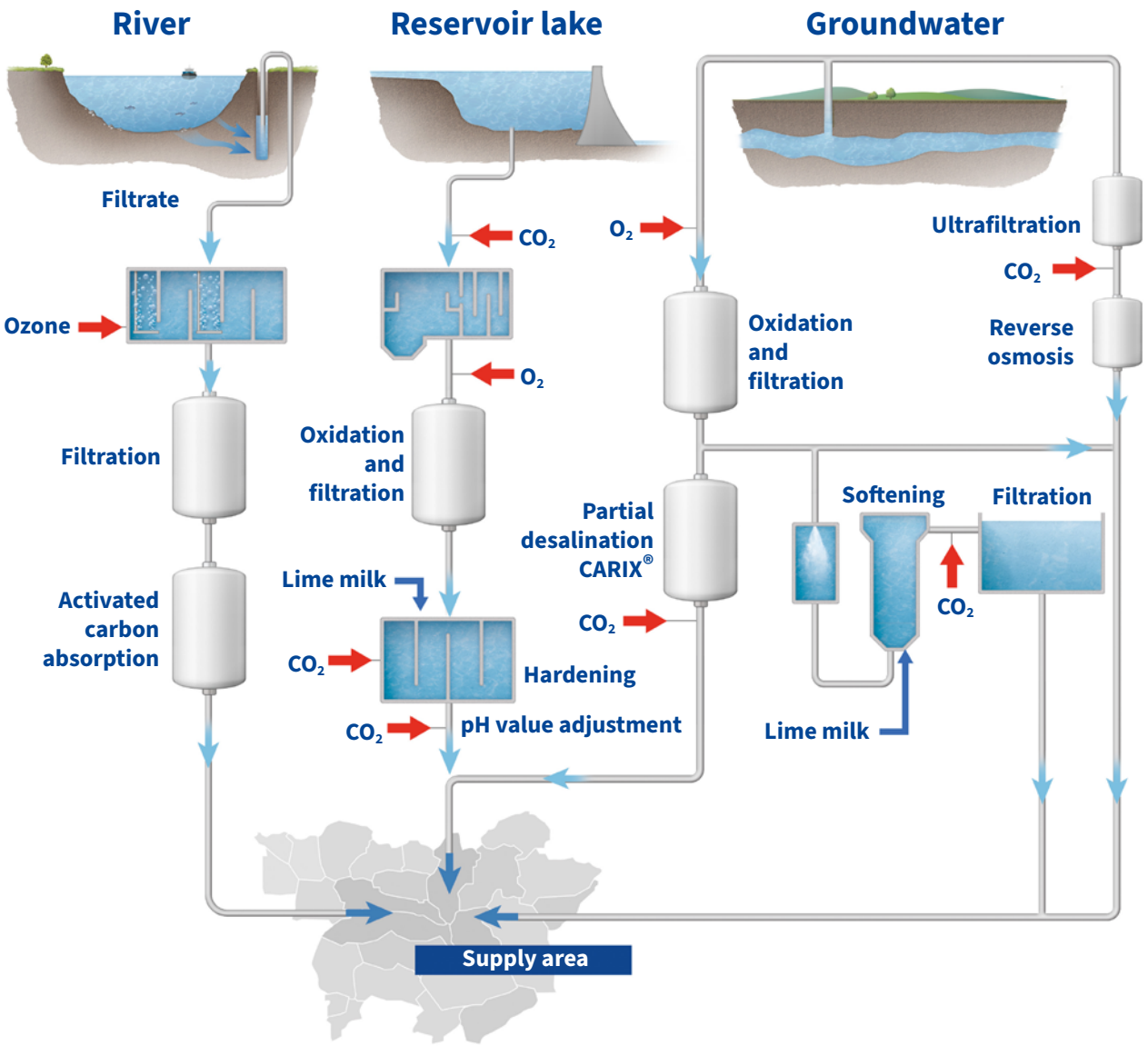
The CO_2 measurement and injection systems installed by Messer dissolve the CO_2 in the water shortly before or at the outlet of the fluidized bed reactor. This prevents the further precipitation of insoluble salts and thus protects against scale formation.

The flatter curve of CO_2 compared to mineral acids shows that the addition of carbon dioxide causes only slight shifts in the pH value, even in the vicinity of the neutral range. Acidification is thus practically ruled out, and complex control technology is not required. In addition, the continuous measurement of small, varying quantities is easier with a gas than with a liquid.

Advantages of carbon dioxide for pH control

- No salinization of the water, as the sulfate and chloride concentrations are not increased. This is important for the corrosion chemical properties of the water
- Easy and safe storage / use of CO_2
- No corrosion on plant components
- More precise pH control with lower investment costs

CO_2 can be used in many drinking water treatment processes



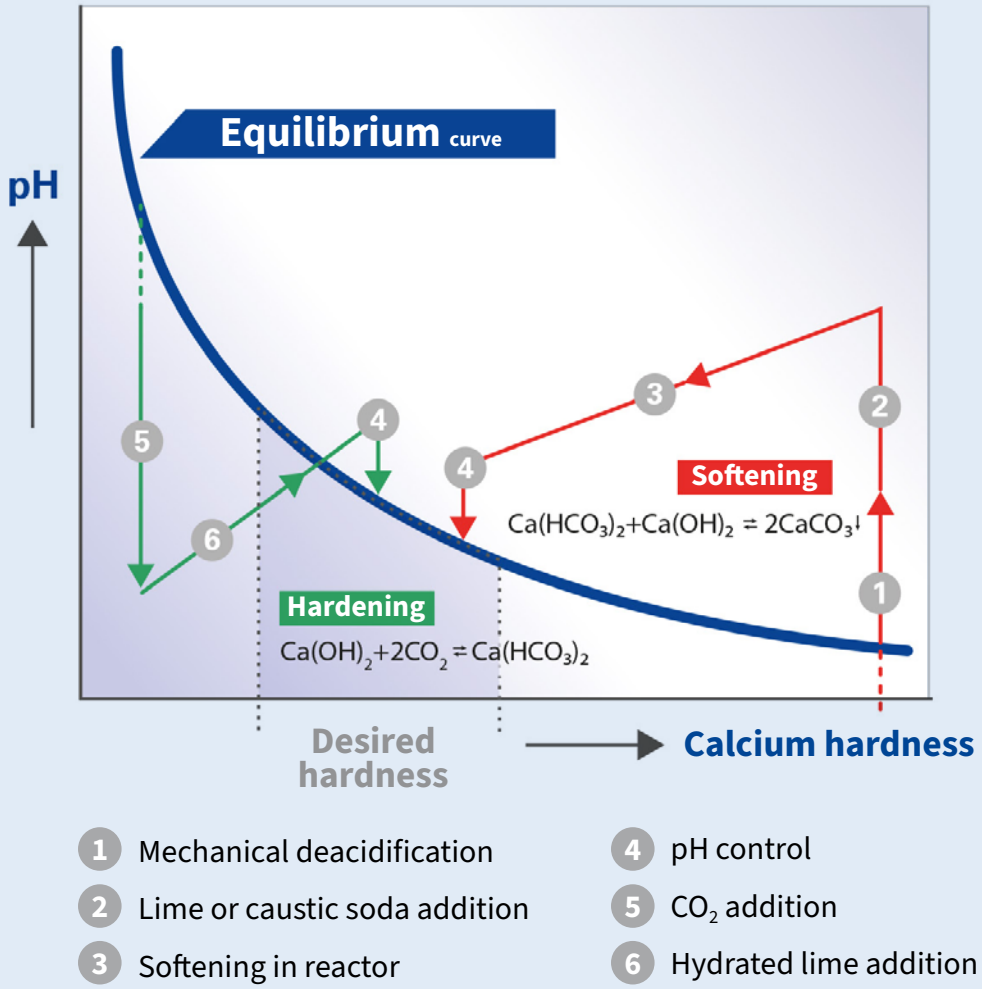
Mineralization - Adjusting water hardness with the use of CO_2

Raw water, for example from reservoirs or from wells in granite, sandstone or basalt areas, can be very soft (not infrequently below 3 °dH) and thus corrosive. Even the constantly increasing quantities of drinking water desalinated by reverse osmosis or distillation offer only a very low buffer capacity and are too corrosive without further treatment. Mineralization of this water to at least 3 °dH can prevent corrosion in the pipelines.

The most economical method of mineralization is to dissolve lime milk in equal weight with appropriate amounts of CO_2. This ensures that all the added hydrated lime can react to form soluble calcium bicarbonate.

pH control with CO_2 also offers advantages for waterworks in other treatment processes: In membrane separation processes, such as nanofiltration or reverse osmosis, acidification with CO_2 - even for water with high hardness, e.g. 7.5 mmol/l calcium - prevents blocking of the membranes by scaling (unwanted precipitation of insoluble salts). A constant throughput is maintained. Since reverse osmosis membranes also do not retain CO_2, a large part of the carbon dioxide required for hardening is already present in the permeate downstream of the membrane.

CO_2 can also be used to regulate the pH value during flocculation. Raw water from rivers and dams is usually first treated with aluminates as flocculants. In warm climates, it is often observed that increased algae growth in summer consumes a lot of CO_2 from the water, so that the pH of the raw water rises to values above 9. At this value, the aluminum from the aluminates is already partially in solution. This can be avoided by controlling the pH value with CO_2.



Softening and mineralization of drinking water with CO_2 and lime milk

Partial desalination with carbon dioxide

A combination of high hardness and significant nitrate, chloride or sulfate content can be successfully treated with the Carix® process*. It is based on the combination of a weak acid cation exchanger (against hardness) and an anion exchanger (against nitrate, chloride and sulfate). Both exchangers are used together in one reactor. When the two ion exchange resins are fully loaded, they are regenerated together and simultaneously by introducing carbonic acid.

The advantages of the Carix® process

- Simplified, economical process by reducing hardness, sulfate, chloride, and nitrate levels to desired levels in one step
- Regeneration requires only carbon dioxide and no additional salts
- The rinse water from regeneration contains only the salts separated from the raw water. Therefore, many Carix® operators are allowed to discharge their rinse water into surface waters
- Most of the carbon dioxide used is recyclable
- Beneficial effect on the corrosion index (Larson index), since not only bicarbonates (as in rapid decarbonation) but also sulfates and chlorides are reduced. Depending on requirements, the mixing ratio between anion and cation exchangers can even be adjusted so that the focus is shifted from softening to an anticorrosive effect.

** Carix® is a registered trademark of VA TECH WABAG*

About Messer

Messer is the world‘s largest privately owned specialist for industrial, medical and specialty gases. Under the brand, ***Messer - Gases for Life‘,*** the company offers gases and services in Asia, Europe and America. The cooperation between the more than 11,500 highly qualified international employees is based on mutual respect. Messer pays particular attention to diversity and inclusion.

Messer‘s ‚Gases for Life‘ are used in industry, environmental protection, medicine, the food industry, the electronics industry, welding and cutting technology, 3D printing, construction, research and science. Messer offers one of the largest product portfolios on the market and develops application technologies for gases in state-of-the-art competence centers. ‚Gases for Life‘ are as important as water and electricity in most industrial processes and can play a significant role in their decarbonization, for example through the use of green hydrogen, CCUS or oxyfuel technology. In its customers‘ processes, Messer‘s customized gas solutions ensure greater safety, efficiency, quality, capacity and environmental compatibility and/or reduce the associated emissions and costs.

As a pharmaceutical company, Messer is also a provider of medical and pharmaceutical gases and complete solutions and has proven itself to be a reliable supplier of vital products.

Messer Image film ›

The company was founded in 1898 and is majority-owned by the Messer family.

Service and Advice

Take advantage of the experience of our application specialists. We will be happy to show you how drinking water treatment with carbon dioxide can be successfully implemented. In recent years, more than 200 plant projects have been implemented in waterworks throughout Europe using know-how and gases from Messer.

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