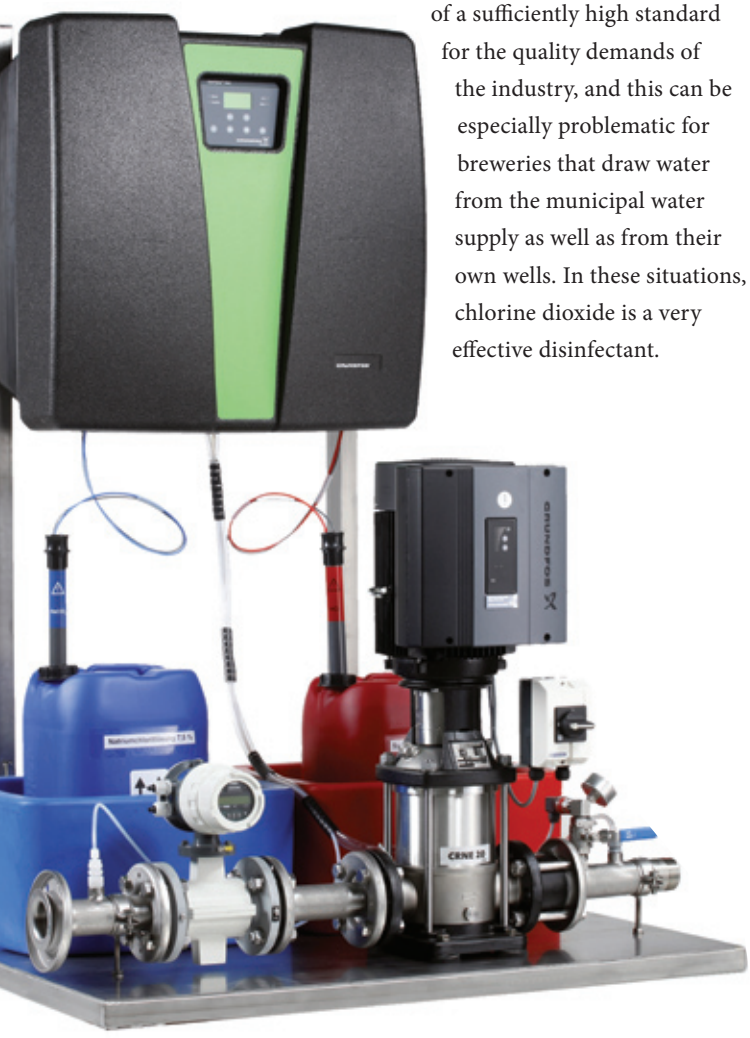
CHLORINE DIOXIDE – ENSURING WATER QUALITY FOR THE BREWING PROCESS

MARTIN KELLER, MSC (ENG), GRUNDFOS ALLDOS, E-MAIL: M.KELLER@ALLDOS.COM

Water quality is one of the single most important factors for brewing quality beer. Making up over 90 per cent of the end product, there is an increasing focus on the microbiological quality of the water used in the brewing process.

Of course, water used in the food and beverage industry has to conform to the regulations governing drinking water in respective countries. However, these regulations are often not of a sufficiently high standard for the quality demands of the industry, and this can be especially problematic for breweries that draw water from the municipal water supply as well as from their own wells. In these situations, chlorine dioxide is a very effective disinfectant.



The Hydro Protect disinfection system from Grundfos offers a customisable plug-and-play solution that combines the benefits of a chlorine dioxide disinfection and booster system, specially tailored to cope with the problems of beverage-spoiling germs.

NECESSITY FOR WATER DISINFECTION

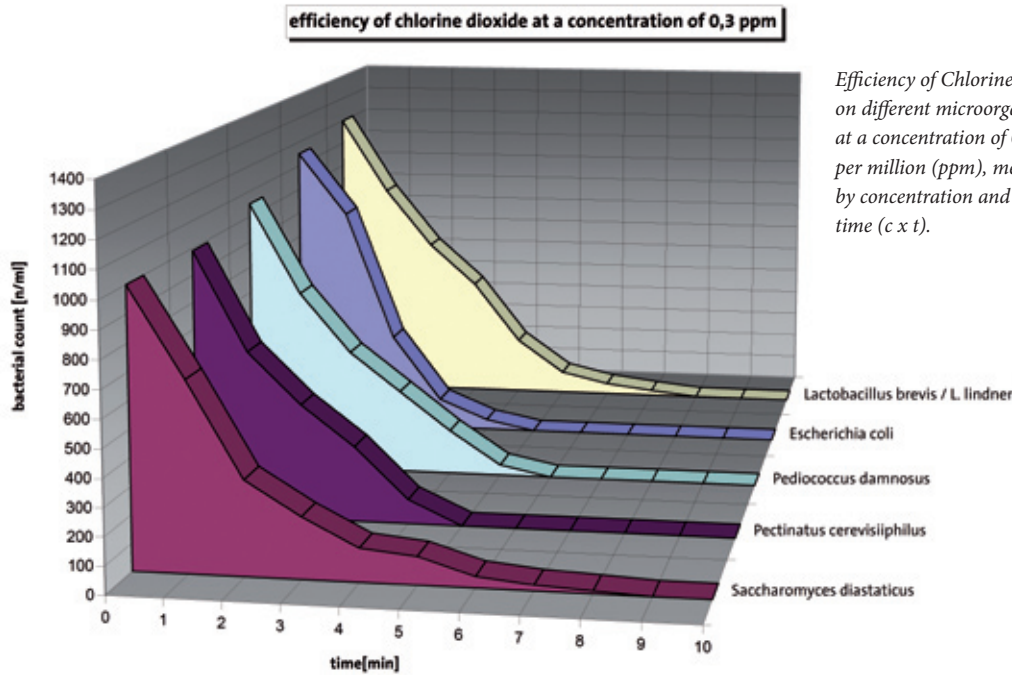
Increasingly, germs that spoil beer and other beverages are found in drinking water. If a brewery is using the municipal water supply, it could be the case that the levels of beverage-spoiling germs are kept within the legal requirements since these are non-pathogenic. However, if the brewery draws water from its own well, then the responsibility rests entirely with the owner. In this case, suitable water disinfection is absolutely necessary.

COMPARISON OF THE MAIN WATER DISINFECTION METHODS

Chlorine dioxide has long been a tried and trusted oxidant and disinfectant, and the importance of chlorine dioxide in water treatment has increased enormously in recent years. Since there is no formation of unwanted by-products such as chlorine phenoles, trihalomethanes and chlorine amines, chlorine dioxide is the disinfectant choice for breweries and in the food and beverage industry.

Dosing with chlorine dioxide is very effective against all kinds of germs, such as Escherichia coli (E. coli) or Legionella, and is also effective against non-pathogens like beer spillage and slime bacteria. By its ability to affect the microbial cell membrane proteins and lipids, chlorine dioxide is the first choice to control the biological films that build up in pipe systems. It is also an effective protection against a reoccurrence of infection. →

Name and application of disinfectant	Advantages	Disadvantages
Chlorine Applied in a gaseous form	• efficient oxidant and disinfectant • effective against most pathogenic microorganisms	• strict requirements for transportation and storage • formation of disinfection by-products, such as trihalomethanes (THM) • formation of bromates and presence of bromides • formation of chlorophenols
Sodium hypochlorite Applied in a liquid form (usual trade concentration: 10-12%), can be generated on-site by electrochemical generation	• effective against most pathogenic microorganisms • relatively safe during storage and use • when produced on-site, no transportation and storage of hazardous chemicals is required	• loses its activity during lw-products, such as trihalomethanes, chlorophenols and bromates in presence of bromides • accumulates chlorates over a longer storage time
Ozone Applied in a gaseous form and has to be generated on site	• strong disinfectant and oxidant • controls taste and odour • does not form chlorinated by-products	• formation of disinfection by-products, such as aldehydes, ketones, carboxylic acids and brominated by-products • deozonising after-treatment is required • no residual disinfection effect
UV Exposing water with UV radiation	• no storage and transportation of chemicals required • not formation of disinfection by-products	• no residual disinfection effect • disinfecting activity depends on water turbidity, wavelength and dose of UV radiation • high operating (energy) cost
Chlorine dioxide On-site generation, applied in liquid form	• most effective disinfectant among the chlorine containing agents • efficient in small doses • effective disinfectant for all types of microorganisms • no formation of trihalomethanes; destroys some THM precursors • no formation of chlorophenols; destroys phenols • no reaction with bromides to form bromates or brominated by-products	• requires on-site generation equipment • formation of chlorite and chlorate • requires a strict chemical handling



Efficiency of Chlorine Dioxide on different microorganisms at a concentration of 0.3 parts per million (ppm), measured by concentration and contact time (c x t).

THE RIGHT INSTALLATION FOR THE BREWERY

In addition to meeting the relevant legislative requirements for the design of a chlorine dioxide plant (in Germany, this is defined in DVGW-Arbeitsblätter W224 and W624, GUV 8.15 e.g. VGB 65) and the need for compliance with regulations for maximum dosage (in Germany, TrinkwV 2001), it is very important to ensure the correct installation of the plant.

The figure above shows the disinfectant effect on different microorganisms, and shows that the time for the inactivation of different microorganisms varies, depending on the level of concentration and contact time. Most drinking water regulations enforce a maximum value of approximately 0.4 ppm chlorine dioxide, whereas the maximum value for chlorite, for example in Germany, is 0.2 ppm.

With these variables taken into consideration, the contact time is clearly a key factor. However, attention is rarely given to this. Returning once again to the figure above, a minimum contact time of 10 minutes is clearly shown as necessary for completely killing off beer-spoiling germs.

A PARTICULAR PROBLEM FOR SMALLER BREWERIES

Especially smaller production plants almost never manage to meet the requirements for contact time, largely because of the smaller pipe dimensions and shorter pipe lengths used in the brewery. Even with a correct dosage of chlorine dioxide at the right concentration, a freshwater rinse of the bottle washer or of the CIP plant can result in an infection. Even using spray processes, this problem increases by the degassing of the residual chlorine dioxide.

With the Hydro Protect disinfection system, Grundfos ensures that industrial production runs smoothly with good water supply. Hydro Protect is an ingenious plug-and-play system that combines the benefits of a disinfection and booster system superbly.

In particular, Hydro Protect is specially tailored to cope with the problem of limited contact time. A modular system composed of a combined pressure boosting system and a chlorine dioxide plant with control measurement, a metering unit plus a contact tank specially dimensioned for the system, Hydro Protect represents a customised solution, ideal for the food and beverage industry as well as many other applications.