Drinking water hygiene

Cleaning of the domestic installation optimized permanent disinfection

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Legionella is a serious problem that operators of medium to large domestic drinking water installations are increasingly confronted with. If there is legionella contamination, it is often extremely difficult and financially costly to remove it. A quick and rather inexpensive way of solving the problem is thermal or chemical disinfection. However, lasting success is often not guaranteed. In many cases, only a thorough mechanical cleaning of the drinking water system leads to the success of permanent chemical disinfection.

WA drinking water installation was installed in accordance with the recognized rules of technology and if it is still operated according to these rules today, it can be assumed that no mi-
biological problems occur. I f this is not the case, and this is more likely to rule rather than the exception, the risk of legionella contamination increases. The causes are manifold (see **box**): Stagnation, incorrect operating temperatures and a lack of maintenance are the most common. From a water temperature of 20 °C, the rate of legionella proliferation increases slightly, peaks in the 30 °C to 45 °C range and drops again to 55 °C. At this temperature, there is hardly any proliferation of legionella. From this temperature onwards, there is hardly any multiplication. They are not killed off until well above 60 °C. It is therefore strongly advisable to set the hot water temperature of the boiler to 60 °C and not to set it to a lower temperature for the sake of supposed energy savings.
lower value. Increase
Biofilms and corrosion products are the main sources of legionella. Stagnation promotes the growth of the bacteria.

In practice, the structural and operational deficiencies mentioned above often cannot be completely eliminated. Structural limitations and financial possibilities play an important role here. In order to eliminate microbial contamination, quick and supposedly inexpensive countermeasures such as chemical or thermal disinfection are therefore often taken first.

Causes of legionella contamination

- ☐ Stagnant water due to excessively large dimensioned cables and/or too many unused taps, often on the End of long end strands
- ☐ Dead strands
- ☐ Stagnant circulation pipes due to non-existent hydraulical adjustment
- ☐ no achievement of the DVGW 551 required 55 °C at the inlet of the Circulation pipe in the hot water preparer
- ☐ < 60 °C set hot water temperature temperature

Mixing device (scalding protection) protection), but only 42 °C to the hot water distribution system

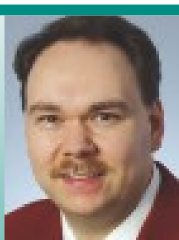
- ☐ No sufficient flow rate of the drinking water membrane expansion vessel
- ☐ Time interval between cleaning of water heaters and filters too big
- ☐ No regular exchange (every 2-3 months) years) of the shower hoses and shower heads

Thermal and chemical disinfection is often not an optimal solution

The aim of thermal disinfection is to apply hot water at approx. 70 °C to all pipes and fittings for at least 3 minutes to ensure that all the water is completely drained.

bacteria are killed. But in the
In practice, this is often not possible for several reasons: Firstly, especially in widely branched pipes, it is not possible to ensure that all taps are heated to 70 °C, as the water is not heated to the required temperature.

Authors



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Water cools down too much on its way and the water heater is not designed to heat the required amount of water. Secondly, there is always biofilm in the system if there is a high legionella count. This

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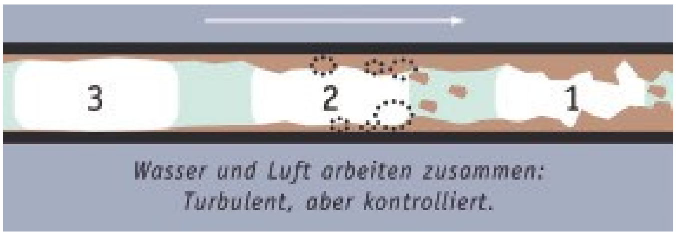
However, hot water can only damage the upper layers of this slime layer, but never completely remove it. After heating, the biofilm will emit legionella again. Thermal disinfection can only kill the legionella bacteria that come into direct contact with the hot water in the pipe system for long enough. However, this is not enough for long-term success. An often forgotten disadvantage of this type of disinfection is the accelerated corrosion process in galvanized pipes and the possible heating of the nearby cold water pipes. The high operating costs should also not be ignored.

Chemical disinfection involves

A distinction is made between permanent and shock disinfection. In the case of permanent disinfection, i.e. the uninterrupted addition of disinfectant (e.g. chlorine dioxide) using a stationary dosing system, a maximum concentration of 0.2 mg ClO_2 /l is injected into the water flow. This quantity is sufficient to remove free legio- in the water, provided that the dosing agent is not consumed on the way to the taps. This consumption is caused by biofilms and deposits from corrosion products. If these are properly formed, no chlorine dioxide will be detectable at the medium to long-distance taps. However, approx. 95 % of the bacteria in the water distribution network are in the biofilm. They are largely protected from the



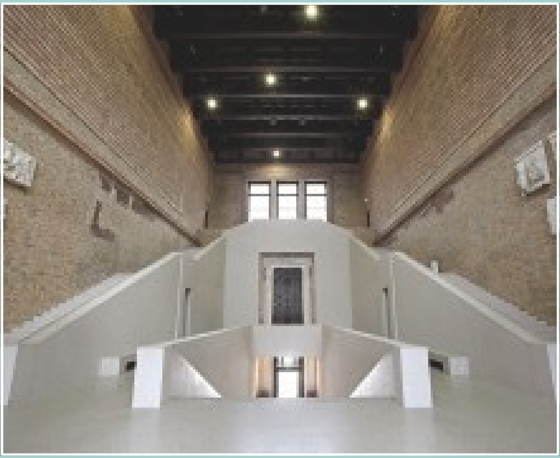
Picture 1

Functional principle of the pulse Rinsing process Comprex

The water is protected from attack by the low-dose disinfectant solution. This allows the legionella to re-enter the passing water and infect it again and again. It should also be borne in mind that legionella prefer to multiply in amoebae. These unicellular organisms have a very strong envelope. Only chlorine dioxide with a concentration of at least 3 mg/l will kill these alternating animals. Although shock disinfection is able to achieve this due to the higher concentration, it cannot completely eliminate the biofilm.

Neither the chemical nor the thermal disinfectants are able to remove the biofilm even with a longer exposure time.

Preview 2/2010



Ventilation ducts often not only have to meet high fire protection requirements, but also specific material requirements such as moisture and frost resistance. One example of particularly water- and frost-resistant ducts is the ventilation system for the rebuilt Neues Museum in Berlin.

Ventilation and fire protection

Ventilation ducts defy fire and moisture

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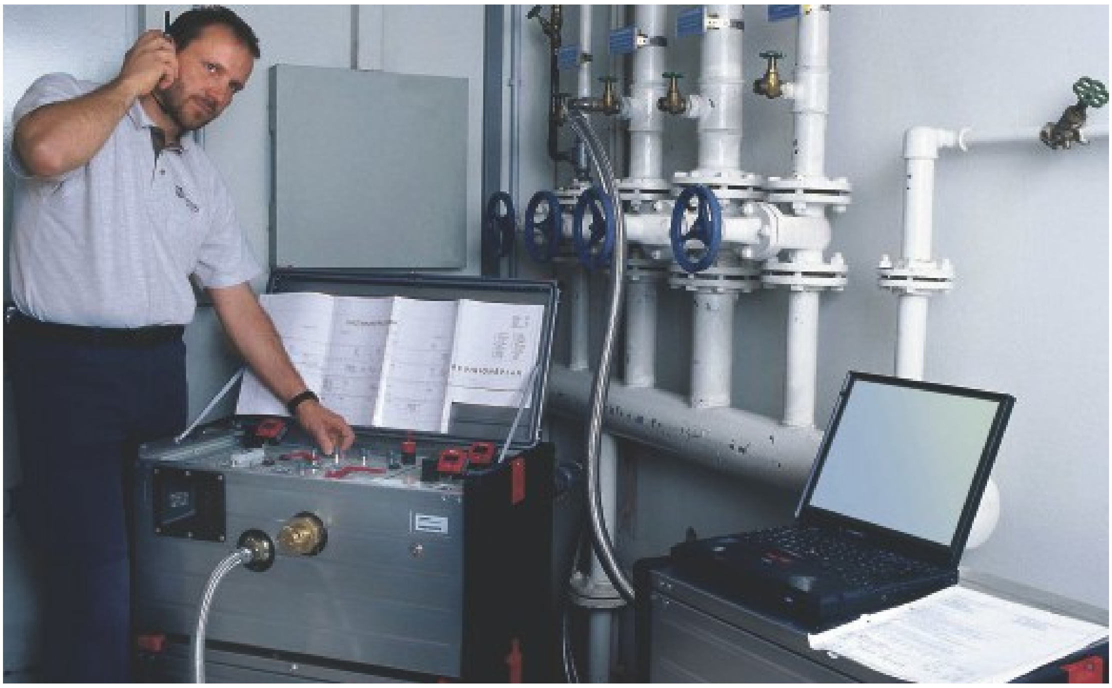
Sewage and fat: We're getting divorced!



Picture 2

The air pulses are fed into the domestic installation via the distribution battery

completely. The result is rapid recontamination, as the biofilm will build up again (regenerate).

Biofilm is therefore the direct cause of the legionella problem. Biofilm growth is in turn promoted by faulty installation or incorrect operation. The priority should therefore always be to eliminate all defects. All too often, however, an important measure is forgotten in the renovation plan. The installation is changed, the operating mode is improved, sufficient water flow is ensured, circulation pipes are hydraulically adjusted as well as possible, hot water temperatures are set correctly, etc., but hardly anyone thinks about the inside of the pipes. It is extremely important that the drinking water pipes are mechanically cleaned of all biofilms and corrosion residues.

Often only parts of the
the deficiencies. It is therefore perfectly legitimate to compensate for the remaining inaccessibility by means of a stationary disinfection system. The basic prerequisite for their success is mechanical cleaning of the drinking water system. The Comprex pulse flushing process is ideal for this.

Thorough mechanical cleaning using Comprex

The Comprex pulse flushing process is based on a controlled, pulse-like addition of compressed, pure air within a defined flushing section (**Fig. 1**). The important thing here is that precisely metered blocks of air are forced into the throttled water flow. These correspond to the diameter of the pipe. Very strong turbulent flows of approx. 10-15 m/s are generated around them, which are capable of destroying the laminar sub-layer of the water flow. In combination with cavitation shear, shear and drag forces, they cause all mobilizable deposits to detach from the pipe walls. The air pigs, the water and the deposits discharged through the tapping points are released and discharged by cyclone separators. Solid cover layers are not attacked and remain in the system. To prevent damage to pipe systems, some of which are quite old, the impulse pressure always remains below the resting pressure of the pipe network.

A practical case should illustrate that only the cleaning of the installation
The success of the stationary disinfection system was made possible.

Hotel in the greater Frankfurt/Main area

In a 4-star hotel in the greater Frankfurt/Main area, the local health authority detected legionella in the order of 5,000 CFU/100 ml during a routine inspection. These are due to defects that have been known for some time. These include the generally widespread installation, an improperly functioning circulation system, stagnation due to seasonally low bed occupancy, a fire extinguishing pipe integrated into the cold water system, a pressure booster system that is switched off but still integrated into the system, etc. An engineering firm was commissioned some time ago to bring the drinking water installation up to the latest state of the art. As part of the renovation plan, for example, the water heating system and the direct connection to the network have been updated. The engineering office also recommended that the hotel managers carry out a thorough cleaning using Comprex as a further important measure.

A site inspection by an in
Hammann's engineer calculated a workload of approx. 70 hours, including shock disinfection. The

Picture 3

A long-lasting turbidity was observed during rinsing

Picture 4

Added tap extension. The particles that were discharged were up to 2 mm in size

The hotel has around 80 rooms, a kitchen with its own hot water supply, a restaurant with sanitary facilities, offices and a swimming pool with corresponding taps. A total of 374 cold water taps and 224 hot water taps including all pipes, including the fire extinguishing pipe, had to be cleaned and disinfected. The sanitary installation did not allow for section-by-section cleaning. However, this would have meant that water could not be taken from any taps. Of course, this is almost impossible to implement in a hotel. However, the company vacations at the turn of the year were a good time to carry out the cleaning and disinfection work. In order to keep the hotel running until this time, a permanent disinfection system was installed to significantly reduce the legionella concentration in the drinking water. Samples showed that although the legionella levels had fallen slightly, there was no sign of a germ-free situation. High levels were sampled, especially at distant taps. This indicated a high consumption of the disinfectant. Thorough cleaning was all the more necessary.

The work to clean the drinking water

The work on the cold water system began on schedule after Christmas. Before the actual flushing measure, it was necessary to carry out various conversion measures, but above all to prepare the two cold water distributors for feeding in the air (**Fig. 2**). In addition, the existing kitchen line had to be

pressure reducer and the water meter must be removed. To clean the circulation pipes, it is always necessary to remove the circulation pump(s) and install drain hoses in their place. These first direct the rinsing water into a sight glass, with which it is possible to check the turbidity, in order to then relax it in the cyclone separator. The hotel's water distribution system is divided into a large number of lines, each of which had a line aerator. In order to achieve excellent flushing hydraulics, all 36 aerators were replaced with flushing valves.

After completion of the preparatory

The actual cleaning work could then begin. A systematic approach is always taken. In this example, the taps and pipes were cleaned from the upper floor to the basement. The flushing fittings on the end pipes were now used to remove all deposits and biofilms from the basement distributions and risers, which were removed using the Comprex process, from the system. This was carried out in both the cold water and hot water systems. During flushing, a long-lasting turbidity was observed in conjunction with the discharge of particles up to 2 mm in size (**Figures 3** and **4**).

Is the main water distribution system clean, the cleaning of the individual supply lines to the respective tapping points can begin. Manual cyclone separators are installed at each discharge point for this purpose. Here, too

to severe turbidity. A subsequent shock disinfection of the entire drinking water system completed the cleaning work. During the implementation of the project, particular emphasis was placed on absolute hygiene. The drinking water installation, all sanitary facilities and the hotel rooms were returned to the hotel in perfect condition. Normal hotel operations were able to resume the day after the cleaning work was completed.

Subsequent investigations have resulted in

legionella values of 0 CFU/100 ml at most sampling points. At very few taps, values below 50 CFU/100 ml. There was a considerable improvement, particularly at the distant taps (upper floors). Here we can speak of sterility. This clearly shows that the Com- prex process has succeeded in removing deposits from the pipes. Chlorine measurements have shown that this is now also detected at the last tapping points without being consumed.

What is important now is the further refurbishment

of the drinking water installation. This allows the concentration of chlorine dioxide to be reduced.

Conclusion: Cleaning is essential for hygiene

Hygienically safe water can only come from clean pipes. However, this requires a drinking water network that is constructed and operated according to the rules of technology. Unfortunately, this ideal case is far too rare in practice. In many cases, the result is legionella levels far in excess of 100 CFU/100 ml. Hasty, supposedly inexpensive solutions only rarely lead to success, and then only in the short term. It is always advisable to renovate the drinking water system if defects are known. If this cannot be carried out promptly, the use of a permanent disinfection system makes perfect sense. However, the example above shows that the sole use of such a system does not lead to 100% success. As deposits and biofilms can always be found in faulty pipes, the consumption of the disinfectant is too high. Only a consistent and thorough cleaning of the system using Comprex can remedy this.