Legionella Control with solutions by automatically control systems to solve Legionella in Drinking Water

Drinking water in Germany may not be chlorinated, except with special permits and in the case of epidemics.

Definition of Drinking Water in Standards

- **PWC** – Portable Water Cold
- **PWH** – Portable Water Hot
- **PWHc** – Portable Water Hot Circulation

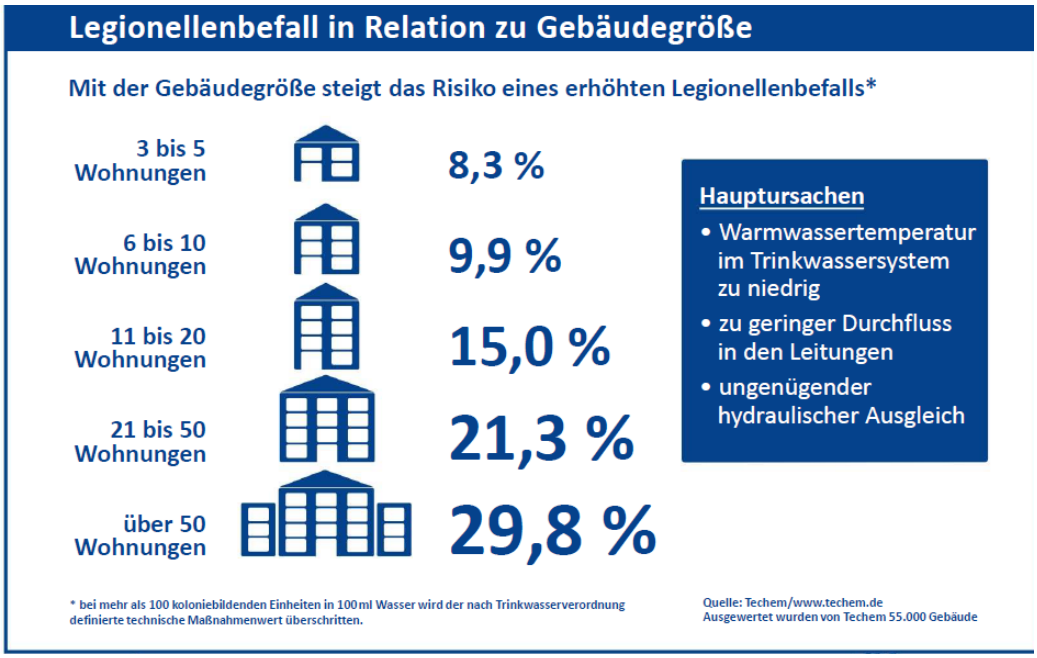
What are Legionellas in Drinking Water?

Legionella are bacteria found in drinking water that multiply exponentially under certain conditions. When they exceed a certain concentration of colony-forming units (CFU), they can cause lung diseases through the inhalation of water vapor and aerosols, such as during showering or filling a bathtub. In Germany, the limit is 100 CFU per 100 mL of water. Once this "technical action threshold" is exceeded, countermeasures must be implemented in specified technical steps.

Where Do They Develop, and How is Their Growth Promoted?

Centralized hot water systems, consisting of central hot water storage tanks, supply pipes, and circulation lines, are often affected by Legionella contamination.

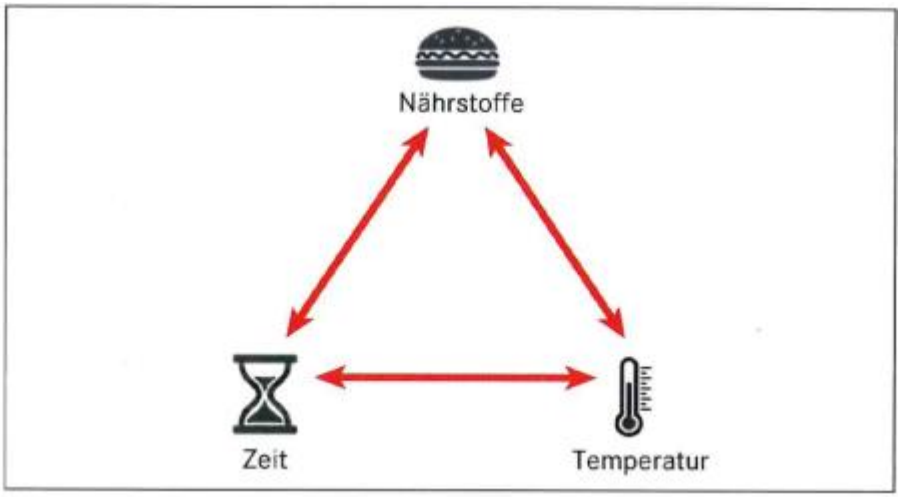
Figure 1: Increase in apartment buildings and probability of Legionella contamination. With the numbers of flats in one building the risk increases to get Legionella contamination. The picture shows 3 to 5 flats risk 8,3% of alle buildings but mor than 50 flats the risk is about 30%



There are three critical factors that promote Legionella growth:

- **Water temperatures between 30°C and 45°C (86°F – 113°F)**
- **Stagnation**, meaning little or no use, leading to a lack of flow in pipes and fixtures, as well as laminar flow, i.e., calm areas with minimal pipe flow
- **Nutrients** provided by biofilm and incrustations in the pipes where Legionella multiply and feed.

Figure 2: Critical factors for Legionella growth.



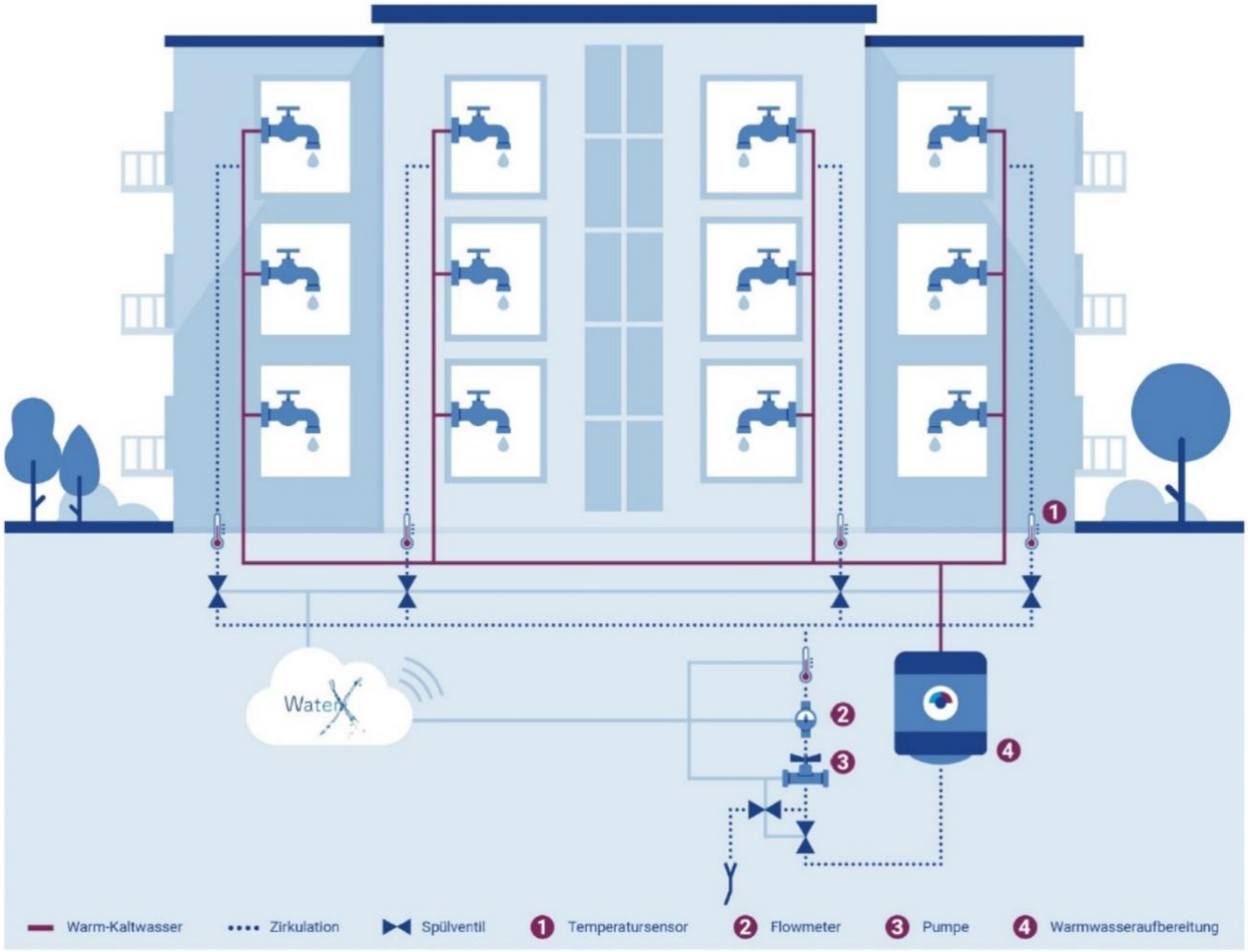
Controlling Legionella

1. **Temperatures**: The domestic water system must be operated so that for hot water (PWH = Portable Water Hot), the temperature at the outlet of the storage tank is maintained at 60°C (140°F), and at the return of the circulation water (PWHc = Portable Water Hot Circulation), the temperature must be 55°C (131°F) before the circulation pump. The return flow of each circulation line that comes back to the basement area must have a minimum of 55°C (131°F) This is achieved through the hydraulic balancing of the individual loops of the circulation system. However, it is not enough for the mixed temperature at the pump to reach 55°C (131°F) ; every loop of the system must reach 55°C.
2. **Time - Stagnation**: To deprive Legionella of the basis for their growth, it is crucial that the water is in constant use, ensuring flow through the pipes. In Germany, technical regulations stipulate that a complete exchange of the water volume in a pipe must occur at least every 72 hours. This must be ensured by the resident. In case of prolonged absence, someone must be tasked with flushing the system, or automatic flushing fixtures should be installed to ensure regular water usage.
3. **Nutrients**: Older pipes often develop corrosion residues with biofilm, or even without corrosion residues, a biofilm in the pipes, which provides nutrients for Legionella. This biofilm must be regularly flushed out, or in the case of commissioning (new construction), kept to a minimum.

To meet these three factors, maintenance according to European standard EN 806 is required. (EN 806 Specifications for installations inside buildings conveying water for human consumption)

As a technical aid, both for existing and new systems, we recommend the automatic monitoring of temperatures and flows in the hot water network by installing appropriate control valves and a data-based monitoring system in a central control center.

Figure 3: Here you can find System overview of a possible control system.



System Components from the Diagram:

1. **Temperature sensor with an associated regulating valve** (ball valve)
2. **Flow meter** – Monitors flow combined with a dirt filter*
3. **Circulation pump** – Adequately sized for water volume and pressure
4. **Hot water storage tank** – 60°C at the outlet for PWH
5. **Shut-off valve and backwash valve** – Opens only during backwashing, depending on flow measured by the flow meter ("2").

Hydraulic Balancing Through Control of Balancing Valves

Figure 4: Shows the fittings from the diagram labeled "1." By opening and closing, the flow in the circulation line is influenced and regulated so that, ideally, 55°C (131°F) is ensured in all loops! The ball valve was chosen to allow residues in the pipe system to pass through, which are caught by the central dirt filter. The dirt filter must be checked and maintained.

Figure 5: Shows the temperature profile in the circulation line of hot water systems when using the Water-X system. On the left is the learning phase at startup, the middle shows the regulation phase, and on the right, the optimization phase. If there is a heating failure, an alert is immediately sent to the system, allowing external intervention.

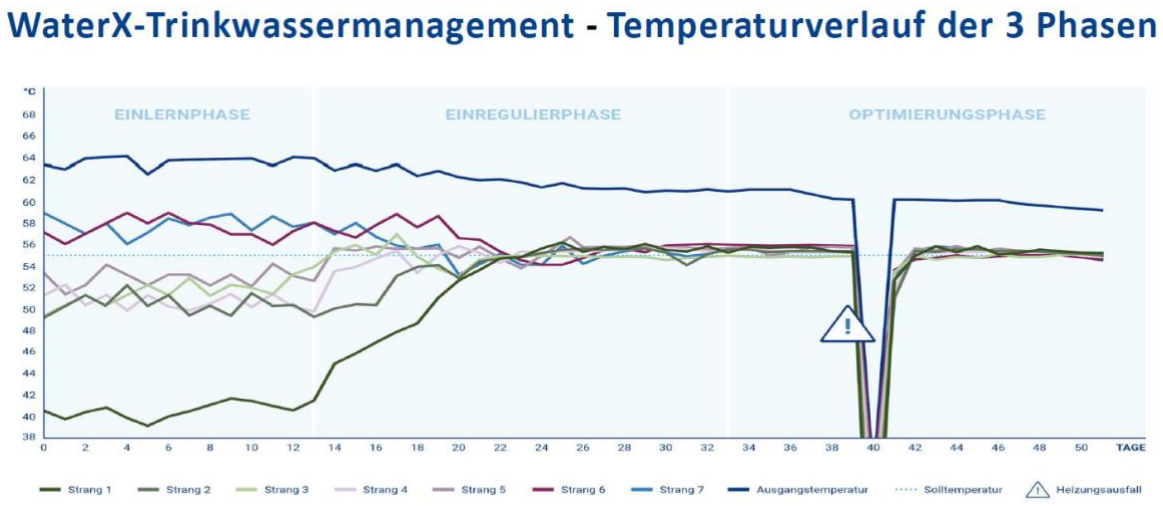


Figure 6: Shows the contamination in the pipes and the need for backwashing and cleaning of the dirt filters.

If you are interested, I can give you more information about solution in the German industry. And I hope if you face similar problems, we find appropriate solutions in your country.

Summary

Drinking Water Management in Existing Buildings:

- Ideal analysis tool for pinpointing weaknesses in the installation
- Ability to create renovation plans based on analysis data
- Long-term prevention of Legionella in the hot water system
- Documentation of temperature and flow every 15 minutes
- Reminder of operator obligations according to German law
- Continuous remote monitoring of technical systems

Drinking Water Management in New Buildings:

- From commissioning, permanent hydraulic balancing of the water system is ensured
- Partial fulfillment of maintenance steps according to DIN EN 806-5
- Heating system check including optimization recommendations
- Documentation of temperature and flow every 15 minutes
- Operator liability as mentioned above
- Increased efficiency and reduced energy consumption
- Continuous remote monitoring

I can offer you the expertise, the components to be installed, as well as the training and education of technicians who will assess the issues on-site, install the components, and take over the maintenance of the hot water supply system. The control center is located at the company headquarters, and the local measurement sensors are connected to the control center via the internet. At the ISH 2025 in March in Frankfurt, Germany, we will present the product and technology to you at the WPC booth.

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