Regulations and solutions to avoid the risk of legionella

COOL DH 1st European Technical Workshop

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“This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 76779”
What did we do?

We conducted a literature study with the aims to answer the following questions:

1. What is the legislation associated with legionella in domestic hot water systems? (In Sweden, Denmark, Finland, Norway, France and Germany)
2. What is the incidence of Legionnaires disease in the six included countries? How does this comply with the legislation?
3. What techniques could be used for legionella prevention in DHW systems?
4. How do the techniques comply with the legislation and the use of low temperature district heating?
Legionella

› *Legionellae* are common bacteria in freshwaters, seawater and soils
› Causes Legionnaires disease and Pontiac fever
› The bacteria thrives in:
  › Temperature levels of 32-42 °C
  › Stagnant water
  › Presence of biofilm and protozoa

Source: Brundrett, G. W. (1992)
Legislation
European working group for Legionella infections (EWGLI) – Technical specifications

1. Parts of the system should be kept at a temperature that does not promote microbial growth
2. The system should be designed in such a way that water stagnation does not occur
3. The components should be made in materials that do not promote microbial growth (e.g. by limiting the growth of biofilm)

EWGLI recommends that:
› hot water should be stored at a temperature no less than 60°C
› circulating water should be at a temperature that allows at least 50°C at the tap within one minute of opening the tap
# Regulations for DHW system temperatures in six countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Min. system T</th>
<th>Min. tank T</th>
<th>Min. tap T</th>
<th>Max. tap T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>50 °C</td>
<td>60 °C</td>
<td>50 °C</td>
<td>60 °C/ 38 °C*</td>
</tr>
<tr>
<td>Denmark</td>
<td>55 °C (45 °C)**</td>
<td>55 °C (up to 60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>65 °C (circulating)</td>
<td></td>
<td></td>
<td>55 °C/38 °C*</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td>55 °C</td>
<td></td>
<td>65 °C</td>
</tr>
<tr>
<td>Germany</td>
<td>50 °C, unless small system</td>
<td>60 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>50 °C, unless V &lt; 3 litres</td>
<td>55 °C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only for locations with increased risk of scalding

** Exceptions of temperature requirements are made at peak hours
Incidence
EWGLI statistic on cases of illness caused by Legionella

- Presented as reported incidence per 100,000 inhabitants.
Incidence of Legionellosis in the six countries

Diagram compiled from data obtained from ECDC (European Centre for Disease Prevention and Control, 2016).
Legionella pneumonia – not a diminishing problem...

Source: https://www.ssi.dk/Aktuelt/Nyhedsbreve/EPI-NYT/2018/Uge%2045%20-%202018.aspx

Sweden: Reported of Legionnaires disease 2009-2018

Source: Folkhälsomyndigheten (2019)
https://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/statistikdatabaser-och-visualisering/sjukdomsstatistik/legionellainfektion/
Techniques in DHW systems to prevent legionella
Techniques in DHW systems to prevent legionella

1. Mechanical treatment
2. Sterilization
3. Alternative system design
## Mechanical treatment

<table>
<thead>
<tr>
<th>Technique</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Fulfils temperature requirements in regulations?</th>
</tr>
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</table>
| Filters   | - Instant effect  
- Very effective | - Short lifetime; frequent maintenance required  
- High cost  
- Local effect, not residual | No |

### Filters

- Instant effect
- Very effective

- Short lifetime; frequent maintenance required
- High cost
- Local effect, not residual
## Sterilization

<table>
<thead>
<tr>
<th>Technique</th>
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</tr>
</thead>
</table>
| Chlorination  | • Mature technology  
• Residual control                                                      | • Less effective on protozoa  
• Local legislation  
• Potential health hazard, chemicals added  
• Can be corrosive for pipes | No                                            |
| UV-light      | • Instant effect  
• Mature technology                                                   | • Not sufficient on its own  
• Less effective on protozoa  
• Local effect, not residual | No                                            |
| Ozone         | • Highly oxidizing, effective in low concentrations                 | • Corrosive: pipe maintenance required  
• Local effect, partly residual                                         | No                                            |
| Ionization    | • High efficiency  
• Mature technology                                                   | • Can be prohibited by national legislation because of potential health hazard  
• Copper and Silver ions added                                           | No                                            |
| Photocatalysis | • Pilot studies show high efficiency                                 | • Not commercialized for residential properties  
• Local effect, not residual                                              | No                                            |
# Alternative system design

<table>
<thead>
<tr>
<th>Technique</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Fulfils temperature requirements in regulations?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decentralized substations</td>
<td>• No need for DHW circulation: reduces heat losses</td>
<td>• Investment cost</td>
<td>No</td>
</tr>
</tbody>
</table>

![Diagram showing the flow of water and energy in a decentralized substation system.](image)

**Notes:**
- DHW: Domestic Hot Water
- DCW: Domestic Cold Water
- DHs: District Heating Supply
- DHR: District Heating Return
- SIHs: Supply Heating Supply
- SHR: Supply Heating Return

**Legend:**
- Blue lines: Water flow
- Red lines: Energy flow

**Key:**
- DH: District Heating
- SIH: Supply Heating
- SHR: Supply Heating Return
- DCW: Domestic Cold Water
- DHW: Domestic Hot Water

**COOL DH WORKSHOP AND ANNUAL MEETING**

**NOVEMBER 15-16, 2018**
### Alternative system design

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<tbody>
<tr>
<td>Auxiliary heating devices:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electric heat tracing</strong></td>
<td>• No need for DHW circulation: reduces heat losses</td>
<td>• Only partly commercialized for residential properties</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="image">Diagram</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Micro heat pump</strong></td>
<td>• Energy efficient</td>
<td>• Higher investment costs</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="image">Diagram</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instantaneous electric heater</strong></td>
<td>• Compact installation</td>
<td>• High electric effect required at peak times: may need upgrade of main fuse</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="image">Diagram</a></td>
<td></td>
<td></td>
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</tr>
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Conclusions

› Legislation: temperature requirements not bacterial levels
› Different temperature requirements in different countries
  › Norway - 65 °C
  › Germany and France – 3-litre rule
  › Denmark - Exception for peak flows where a temperature of 45 °C at the tap is acceptable.
› In case of ULTDH
  › Sterilization techniques and filters are not possible to use as single methods
  › Decentralized substations only where 3-litre rule is applied
Conclusions

- Countries with higher temperature requirements also showed fewer cases of Legionella.
  - Causal relationship is not possible to establish in this study
  - Other factors could play a role: climate, number of detected cases, aging population, pattern of smoking and drinking