The development of DH over the past 50 years of development in building systems

– experiences from more than 12,000 controlled and fixed heating/cooling systems in commercial estates and public buildings.

1. QTF and the development of building systems
2. District Heating Today
3. District Heating in the Future
4. Consequences and New Problems Evolving
5. New solutions to New Problems

QTF degasses and cleans system fluid in heating and cooling systems in properties, industries and public facilities, to improve energy transfer and create corrosion-free systems. It ensures systems are energy-efficient and sustainable, and have a long life cycle.

Objectives

All relevant target groups should be aware that there are gases in system fluid, have an understanding of the problems this causes and what should be done to fix the problems*. We want property owners to set requirements for system fluid, and plumbing consultants to prescribe the fluid quality in new projects, among other things, by keeping the oxygen level below 0.5 mg of oxygen per litre of system fluid. This increases the need to control, measure and fix the system fluid.*

Vision

To make it generally accepted to measure and keep down oxygen levels in system fluid, so that Sweden's building stock can reduce energy use by several billion every year, and the systems' life span can be increased.

Areas of QTF's collaboration with the academic world, which has brought new knowledge and improved the performance of different systems.

Degree projects at Lund University of Technology and at Linnaeus University.

– Liquids in indirect energy transfer cooling systems and their potential impact on the environment
– Effects of heat transfer fluid from district heating networks on activated sludge
– Problems with gases in technical water systems
– Degassing of fresh cooling water systems for marine diesel engines

Luleå University of Technology

– Handling of gases in Xylem's energy wells.

Royal Institute of Technology

– For the Swedish Ice Hockey Association; Gases in ice rinks

Chalmers University of Technology

– Energy well project

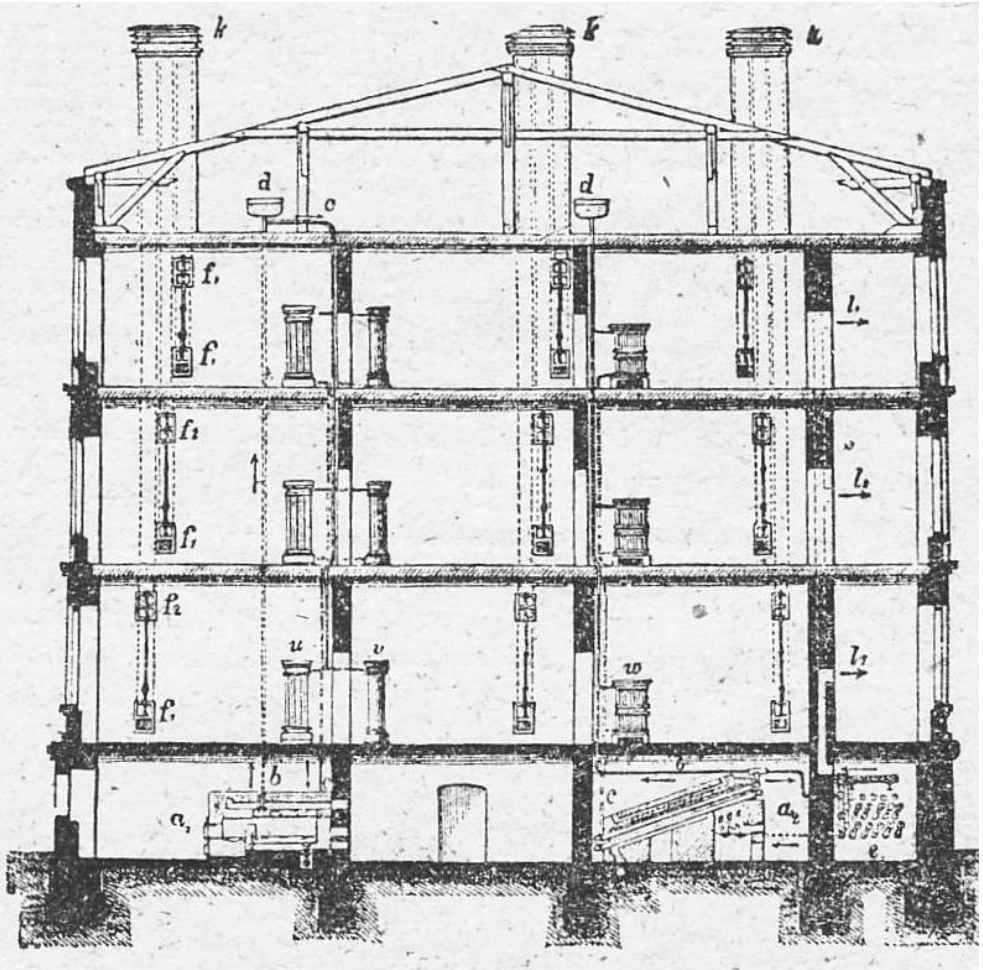


Fig. 68. Varmvattenlågtrycksuppvärmning.

Technology Book 7th Edition, 1878

300-year-old technology that has changed fundamentally in the last 40-50 years

Today's Status in District Heating (DH2/DH3)

- *Knowhow from DH2/DH3. Maintenance handbook from 2015.*
- *Modern research is not yet implemented in district heating.*
- *Large amount of chemicals is used.*
- *Small amount of preventive maintenance on relatively small grids.*
- *Service agreements not including energy efficiency in customer systems.*
- *Poor understanding of symbiosis in functionality with customer systems.*
- *Requirements of Lower Return Temperature.*

QTF report from small DH

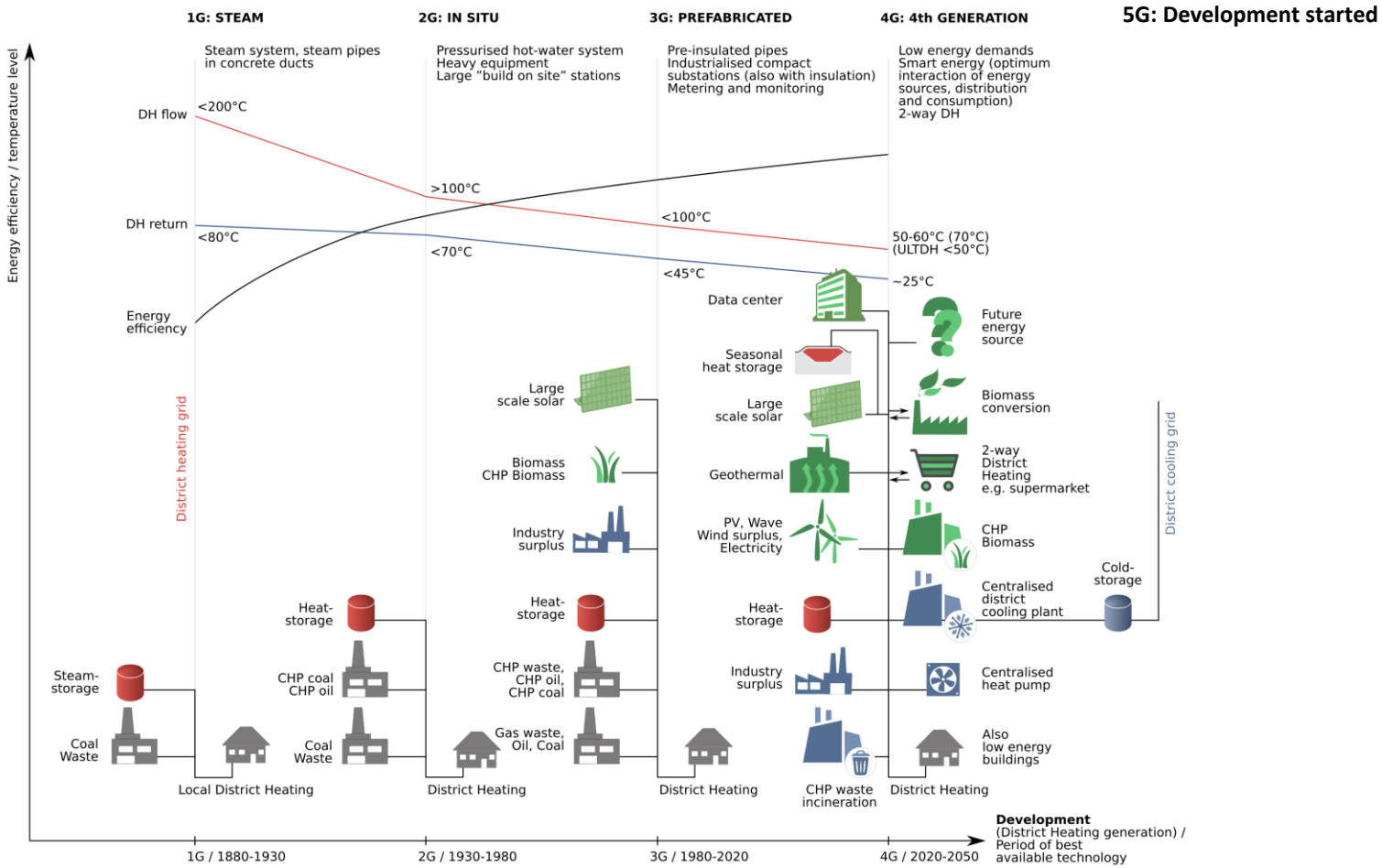
P0862 20161006			Primär	Sekundär	Primär	Sekundär	REVAQ
Järn mg/l	0,52	4,19	0,38	1,89	2,70	0,56	-
Koppar mg/l	0	0,02	0	0,04	0,08	0,05	<0,20
Krom mg/l	0,080	0,038	0,008	0,017	0	0,040	<0,05
* Syre mg/l/mättnad %	2,14/31,2	1,99/25,8	1,8/27	0,66/9,9	1,02/13,6	1,54/20,6	
Konduktivitet uS/cm	838	581	857	578	346	470	
pH	9,31	9,29	9,03	9,39	8,30	10,00	
Magnetit (0-10)	3	7	2	5	4	2	
CO2 mg/l	0,0	0,0	0,0	0,0	0,0	0,0	
Totalgas ml/l	2	12	6	8	0	8	

The glycol system for generator cooling and turbine house ventilation at a major combined heat and power plant. The total amount of gas was 45 ml/litre (4.5%), of which 7.72 mg/litre of oxygen.

- *The 2015 Maintenance Manual for district heating systems recommends*

< 0.02 mg/l

Development of District Heating



Source: Wikipedia

Development of heating/cooling systems in commercial estates and public buildings

- *Lower temperature*
- *Osmotic materials*
- *Mix of different metals*
- *Higher environmental requirements*
- *More complex systems*
- *Outsourcing of maintenance – lack of internal competence*
- *Low level of knowledge of water chemistry*
- *Longer warranty times*

Consequences and New Problems Evolving

District Heating will meet the same problems with gas in fluids as we have seen in commercial estates and public buildings in the past 40-50 years.

Increased oxygen volume requires more oxygen-eating chemicals or degassing.

Increased environmental requirements and a sustainability mindset will require reduced use of chemicals, especially when environmentally-friendly alternatives exist.

District Heating in the Future (DH4/DH5)

1. The change in DH faces a lower system temperature, a greater use of osmotic materials, and the need to achieve a lower return temperature in order to produce electric power more efficiently.

2. Increased environmental requirements and a sustainability mindset, in the lifespan of components and a good working environment, as well as efficiency in energy use.

3. Increased digitalisation in the control and monitoring of systems, including fluid.

4. More and smaller smart district heating grids

5. More complex installations and integration of different energy sources

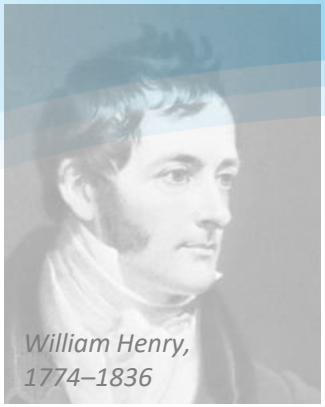
6. Increased need for more and educated maintenance personnel

Consequences and New Problems Evolving

Lower system temperature increases oxygen and other gases in the system fluid (Henry's Law).

Greater use of osmotic materials leads to more diffusion and oxygen penetration into the system.

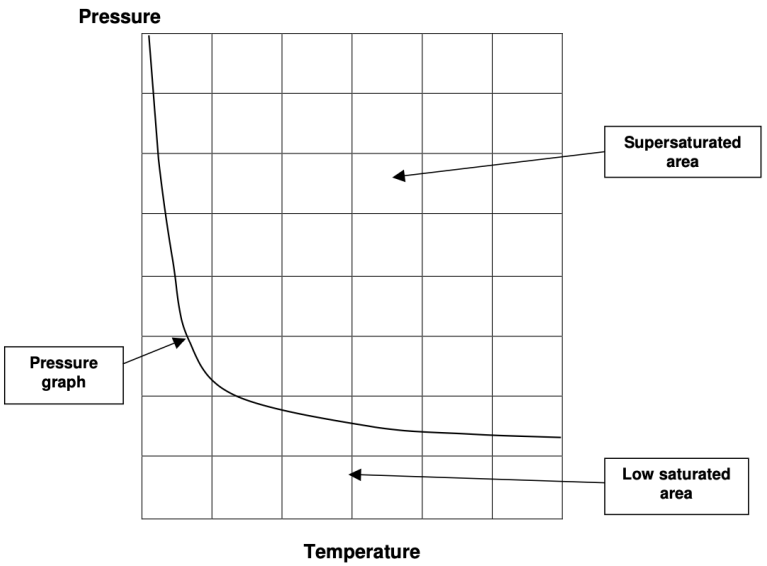
Increased digitalisation in the control and monitoring of systems, including the liquid, will offer opportunities to continuously monitor changes in gas levels and more effectively deploy prompt countermeasures.



Henry's Law was introduced in 1803

Water's ability to combine with gas

Ability to dissolve gas depends on temperature and pressure.



- *In the supersaturated area, the gas is dissolved as both liquid and bubbles. This is the area where exhausting is to be made.*
- *In the low-saturated area the gas is dissolved in the liquid, and affects the liquid flow and the heat transfer when temperature and pressure changes. Fouling occurs.*

Take a look at dissolved gases in water.

On Youtube: https://youtu.be/aLlynPx1r5M

Increased oxygen/gas levels impair energy transfer, and create corrosion that leads to leakage.

Increased use of (often hazardous, carcinogenic) chemicals leads to health and environmental problems.

The use of chemicals often produces uncontrollable residues that further impair systems, flow, conductivity, pH, etc.

Impaired energy transfer leads to higher return temperatures.

BeBo Report

Karin Lindström, eeot.se

- *Gains from reduced return temperatures in district heating systems*
- *Analysis of 8,600 DH Systems in Stockholm Exergi*
- *By lowering the return temperature by 5 degrees, Stockholm Exergi was able to increase profitability by 4-6%*

Link to the report:
https://www.bebostad.se/library/3653/rapport-vinster-med-saenkta-returtemperaturer-i-fjaerrvaermesystem_2019-10-31.pdf

Bella Center Copenhagen

QTF had already lowered the return temperature by 5 degrees for Bella Center back in 2008.

System size: 140 cubic metres. Degassed over three days from 15 mg/litre to below 1 mg of oxygen/litre of system fluid.

The Bella Center Copenhagen is Scandinavia's largest multifunctional event venue.

Need for increased knowledge

Water chemistry/water treatment

Gases impact on fluids

The reactions of added chemicals create different substances

Environmental consequences of emissions

E.g. Bachelor Project at Lnu: Effects of Heat Transfer Fluid from District Heating Networks on Activated Sludge

The QTF Method

One scientific and logical way to solve problems is to create a method. A method can be tested, changed and refined to perfection. The QTF Method and equipment is continuously refined and simplified, but the s steps remain.

1. INSPECTION

Inspection is always the first step. Without diagnosis no treatment. The inspection provides valuable knowledge and we never implement any measure without knowing exactly what is needed for your system to function optimally. Inspection should be performed regularly, especially if large changes have been made or a top-up carried out.

First, a visual inspection is carried out looking for weaknesses, rust-coloured leaks etc. We have seen most things and recognise early on the symptoms of fluid problems. The technical design is checked, we have sold knowledge of systems and are used to identifying weaknesses, even in the system design. Fluid samples are assessed regarding appearance, smell, particles etc. Finally, total gas level, pH value, oxygen gas level and conductivity are measured. The fluid should be as clean and clear as when it was poured into the system, anything else forebodes problems. The inspection concludes with the provision of a detailed inspection report, including recommendations.

"The fluid should be as clean and clear as when it was poured into the system, anything else forebodes problems."

2. SYSTEM CLEANING

If the inspection showed the system fluid contains particles, red rust, black rust, magnetite and/or environmentally hazardous substances, and is aggressive to the system, the fluid should be cleaned or, perhaps, even replaced.

Backwash

Backwashing is carried out alternately in both directions, to loosen particles that may have fastened. We do this using equipment we have developed, which reverses the direction of flow at intervals.

Filtration

The filter bags have a pore size of 1 µ, which is roughly equivalent to 40 times less than the visibility limit.

Additional filtration is carried out if needed, e.g.:

- Magnetic filtration to separate magnetite.
- Filtration for cleaning metal containing system fluid.
- Absorbent filtration to remove chemicals from a contaminated system fluid.

The filtration is only concluded once the fluid shows an acceptable conditions and fulfils REVAQ's regulations.

3. FLUID REPLACEMENT

QTF has a method for cleaning contaminated fluid during full operation. This cleaning process means that in many cases fluids do not need replacing and large amounts of money can be saved. The system is analysed to ensure the fluid meets REVAQ's requirements for fluids that can be released into the municipal sewer network. It is important to know the fluid's status, not least if a leak should occur.

If the fluid is a heating fluid or coolant mixture, e.g. glycol solution, all of the fluid is replaced. QTF takes care of the used fluid and sends it for destruction. The system is then refilled with new, clean fluid and degassed.

System fluids containing additives that lower the freezing point, e.g. glycol and saline solutions, are especially sensitive. The oxygen in the system fluid breaks down the inhibitor packet (corrosion protection substances) and then the glycol/saline solution. Such a system fluid becomes very aggressive to metals!

Environmentally friendly glycols are even more sensitive to oxygen-rich fluids. The glycol should decompose rapidly if it gets out into the natural world, where oxygen and humus bacteria do the job. The importance of an oxygen-free system fluid is obvious! In addition, cold fluid carries more oxygen than warm, and this is normal in cooling systems where glycol is used.

To remove precipitate residues that may remain from earlier flushing, the new coolant/heating solution needs post-filtration.

4. FAST DEGASSING

If gases are observed in the system fluid, fast degassing needs to be done. The sooner the liquid is treated the better. The oxygen in the liquid accelerates the corrosion process and the more the oxygen the faster the rate of corrosion. The best way to stop it is to remove the oxygen quickly. No oxygen, no corrosion!

At 6.0 mg/l oxygen, iron oxidises at a rate of 6.5 g/m² per day. High levels of oxygen gas are devastating for the service life of plumbing, heating and sanitation systems. The corrosion process starts immediately after filling. Low gas levels in the system fluid are also a condition for an efficient and lasting initial adjustment.

QTF fast degassers can reduce the gas level to acceptable levels in a very short time, i.e. less than 0.5 mg oxygen/litre for water and 0.8 mg oxygen/litre for glycol, saline solutions and ethanol. Carbon dioxide and other gases that take energy (nitrogen gas, hydrogen etc.) are evacuated. The unit continuously degases large flow volumes. A flow of up to 11 m³/h (larger flows, if needed) through the unit are subjected to 96 % vacuum across a 60 m² surface. QTF's fast degassers 300 times more effective than other common commercially available degassers.

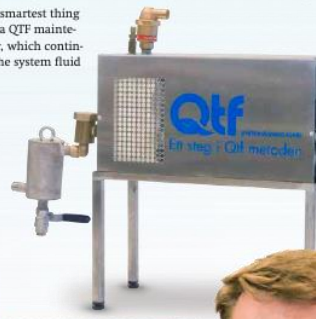
Filtration with 1 µ filter is performed as standard during fast degassing.

System fluids should be degassed no later than 7 – 10 days after filling.

5. MAINTENANCE DEGASSING

Once fast degassing has been completed, QTF maintenance degassers she be installed to guarantee continuing low gas levels in the energy carryin system fluid. Oxygen enters plumbing, heating and sanitation systems in different ways; dilution top-ups, valves, "diffusion-free" hoses, for examp in under floor heating systems, incorrectly placed automatic degassers o correctly adjusted expansion vessels, to name just a few we often bump i

The safest and smartest thing to do is install a QTF maintenance degasser, which continuously keeps the system fluid effective.



6. FOLLOW-UP INSPECTION

Once fast degassing is completed, the need for any maintenance degasser and routine follow-up inspection is assessed, as well as whether new adjustment/balancing of the system is required.

The gas levels should be checked within 6 month of completed fast degassing, or sooner if a change has been made to the system. Renovations, expansions etc. that require topping-up with new system fluid lead to a need for fast degassing or continuous maintenance degassing.

Sometimes, the gas levels may have risen due to external factors, even if maintenance degassing is installed. In which case, during the follow-up inspection, QTF can supplement the maintenance degasser with a turbo unit for a while, to regain the low level of oxygen gas. The turbo degasser reinforces the effect of the maintenance degasser by a factor of 7.
QTF offers agreements regarding fluids containing various levels, from regular control measurements to ensuring the quality of the fluid.

! On qtf.se, you can also watch films showing every step in the QTF Method.

"We transform water, from food to technical fluid for energy distribution"

The QTF Corrosion Technical Book can be downloaded from qtf.se

Questions and further contact

- The QTF Method brochure
– Technology book and references at qtf.se
– Videos on YouTube (also Eng and Ger)
– www.qtf.se
– Press releases and articles on Mynewsdesk
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