# The impact of water quality on climate control systems

TECHNICAL GUIDE FOR PROJECT MANAGERS AND DESIGN OFFICES

econeaulogis
ingénierie environnementale du bâtiment

bwt.fr

# Editorial

Water is everywhere and, now more than ever, poses major challenges for our societies. Whether it is water for human consumption, process water, or water used in climate control systems, its quality plays a fundamental role and has repercussions on our health, our standard of living, our expenditure and our environment.

As a water treatment expert, BWT continuously monitors the information that flows into its research and development department, and that allows it to offer the most efficient water treatment solutions, irrespective of the challenge.

Today, we wanted to learn more about water in climate control systems. For this reason, we contacted the Econeaulogis design office to conduct a study on the impact of scale and sludge on the performance of heating plants and domestic hot water systems.

This study highlighted the importance of water quality for the energy efficiency of buildings, the comfort of occupants, the maintenance of equipment and the appreciation of assets.

An overview of the study is presented in this guide.
By identifying the repercussions of water imbalances on climate control systems, this document also highlights the importance of ensuring that your installations are properly protected.

Enjoy !

# CONTENTS



# 1 ENERGY PERFORMANCE



## THE ROLE OF HVAC WATER CIRCUITS IN ENERGY PERFORMANCE

Energy performance is at the heart of the directives implemented in Europe. Their objective: to improve building energy consumption while maintaining at least an equivalent level of user comfort. The various thermal regulations that have succeeded each other from the 1st oil crisis until today, with the French RE2020, are moving in this direction.

Many elements contribute to building energy performance: the quality of the building's insulation, the choice of joinery, ventilation, heating and domestic hot water systems.

And because water is the main calorie vector in heating and hot water circuits, it has an essential role in the proper functioning of installations.

Where do we stand on energy performance today and in what regulatory context are we?

# THE WORLD ENERGY SITUATION

*Although energy efficiency has improved worldwide over the last decades, there is a risk of backsliding in the coming years.*

## AN IMPROVEMENT ON A GLOBAL SCALE

Over the past three decades, most countries have significantly reduced their total primary energy consumption. There are two main reasons for this: changes in equipment manufacture, making it more efficient and less energy hungry, along with the implementation of political programmes, measures and standards in every region of the world.

## A WORRYING OUTLOOK

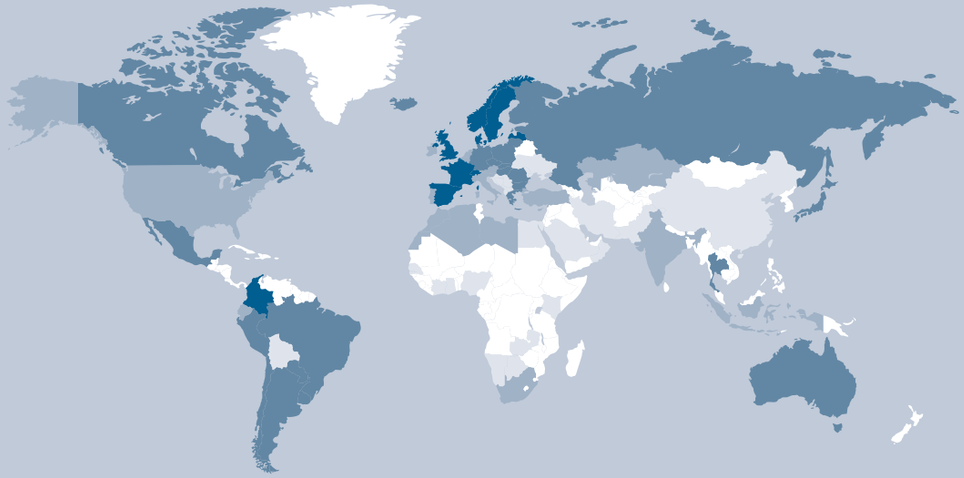
Despite these improvements, there is a concern that the global energy demand will increase between 2010 and 2035*. China and India alone would account for nearly a third of this growth, even if China's energy consumption were to remain below half that of the United States or Australia.

## DISPARITIES WITHIN EUROPE

Europe in general, and Western Europe in particular, is the region of the world with the lowest energy intensity even though it is made up of highly consumerist countries.
This low intensity is mainly explained by the implementation of numerous laws and directives intended to promote energy efficiency, as well as financial incentive policies mainly focused on improving the energy efficiency of buildings.
However, there are significant differences in energy efficiency between countries in the north and south, with northern Europe generally being more virtuous in this respect than the south. There are, however, a few exceptions, such as Portugal and Romania, both of which benefit from a proactive energy-saving policy.

* According to a World Energy Council study

The energy performance index measures energy system strengths and weaknesses in countries, taking into account economic, environmental and energy security aspects.



**The 3 top performing countries: Norway, Sweden and France**

High performance — Poor performance

## KEY FIGURES

**+33 %**

World energy consumption is expected to rise by one third by 2040

**+1 %**

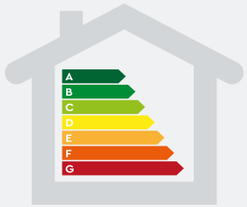
This is the evolution of the building sector's average annual share in global energy consumption

*In 2017, $236 billion was invested in energy efficiency*

Source : World Energy Council and ADEME report with the technical support of ENERDATA.

# WHAT DO REGULATIONS SAY?

*Reduce our consumption of energy, this has been the ambition of the public policy since the 2000s. An ambition manifested by numerous investments and regulations.*




## THE BUILDING SECTOR AT THE HEART OF MEASURES TO REDUCE ENERGY CONSUMPTION

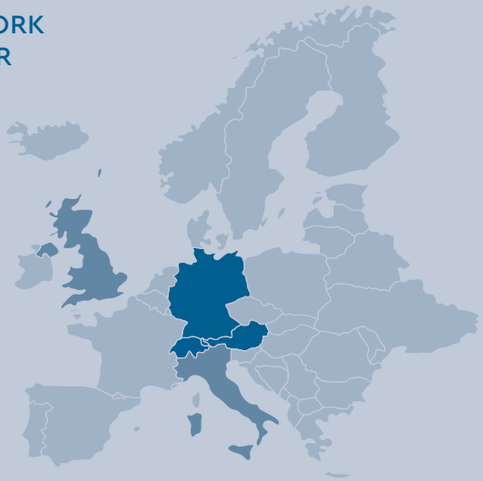
The reduction of energy consumption requires, above all, an upgrade of energy efficiency of the existing building stock. In the wake of COP 21 and under the aegis of the European Energy Transition Law, the French State undertook the implementation of a wide reaching thermal renovation plan, governed by a range of regulations, from the RT 2005 (French Thermal Regulation) to the RE2020 (French environmental regulation), and including the E+C- label and BEPOS (Batiment à énergie positive, energy-plus building).
New builds have also benefited from the various thermal regulations, but new builds account for only 1% of the renewal of the French real estate stock per year.

## THE EUROPEAN LEGISLATIVE FRAMEWORK GOVERNING THE TREATMENT OF WATER IN CLIMATE CONTROL SYSTEMS

**DE, AT, CH**
Strong legislation that favours the use of demineralised water

**UK, IT**
Strong legislation that favours the injection of formulated products

**Other countries FR, ES, BE**
No legislation, but a market more oriented towards the use of formulated products



## CURRENT REFERENCES CONCERNING WATER IN CLIMATE CONTROL SYSTEM

There are many texts, decrees, regulations and guides on this subject. These seem to be the most interesting.

**Regulations**

» Circular dated March 2nd 1987 updating the list of fluids and additives used for the thermal treatment of water intended for human consumption (currently being amended with the assistance of SIPRODEAU)

**Guides and practices**

» Guide to network pathologies (AQC – 2014)
» Collective heating and hot water installations (ADEME – 2008)
» Water treatment processes (CSTB – 2011)

## ENERGY TRANSITION FOR GREEN growth

# ENERGY PERFORMANCE AND HVAC CIRCUITS

*When discussing building energy performances, we often think of insulation and capital assets but rarely about closed circuits. Even so, they too play an essential energy performance role!*

## WHAT IS A CLOSED CIRCUIT?

A closed circuit is one in which the distributed fluid flows in a loop without any contact with the atmosphere. Hot water heating circuits and iced water air conditioning circuits are part of what are usually considered to be closed circuits.

## HOW THEY WORK

Whether for hot or chilled water production, the principle is the same! In both cases there is a generator which consumes energy (electricity, gas...), which supplies transmitters. Cooling generators are connected to air conditioning systems or technical circuits.

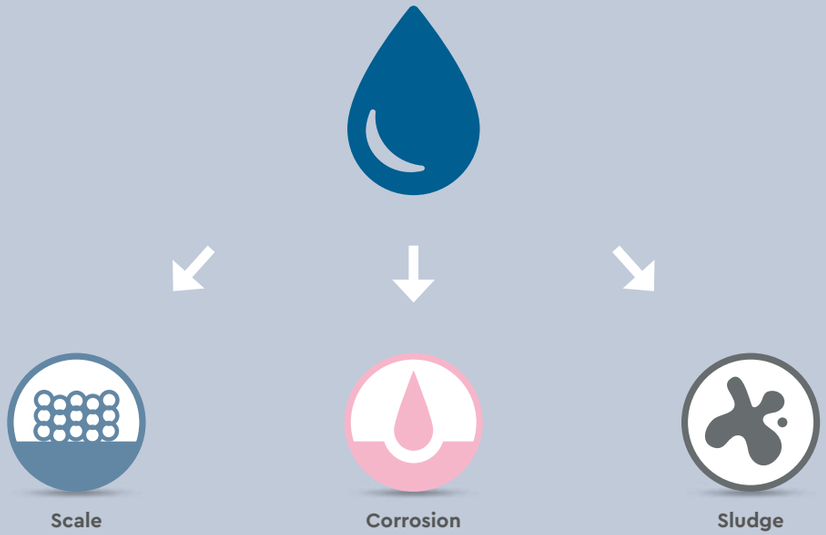
Like heating systems, cooling circuits are also faced with water related disorders that lead to loss of energy performance.

## THE CLOSED CIRCUIT

**Water: your network heat transport fluid**

» Water = calorie vector

» Water = **efficiency drive belt**




## KEY FIGURES
### ENERGY, THE BIGGEST SPENDING ITEM

**7 %**
for individual housing

**12 %**
for collective housing

**15 to 20 %**
for industry

*Generators, emitters, circulators, piping... The entire circuit is involved!*

# 2 WATER AND HEATING

## WATER AND HEATING

Heating and domestic hot water production are at the core of a building's energy efficiency. In addition, their characteristics will determine our living comfort and the amount of our energy bills.

Renewable energies, which are booming, offer solutions that are less energy hungry and that are compatible with most types of buildings. The water that supplies these systems also contributes significantly to the efficiency of the installations.

This chapter provides an overview of current heating solutions.

# HEATING AS A LEVER FOR ENERGY PERFORMANCE

*Heating is one of the main sources of energy savings in the building sector, even though there are significant differences from one region to another.*

## AN END TO THERMAL SIEVES: A NATIONAL PRIORITY

The elimination of thermal sieves within 10 years is a priority for the public authorities. To achieve this, an investment plan of 9 billion euro has been allocated to the renovation of thermally inefficient housing with a target of 75,000 homes renovated each year. In the same vein, the French Energy Transition Tax Credit (CITE) has just been converted into a bonus conditional on the completion of work to insulate walls, attics or to replace boilers with more efficient solutions.

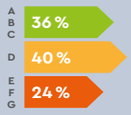
## ECODESIGN AND MANDATORY LABELLING

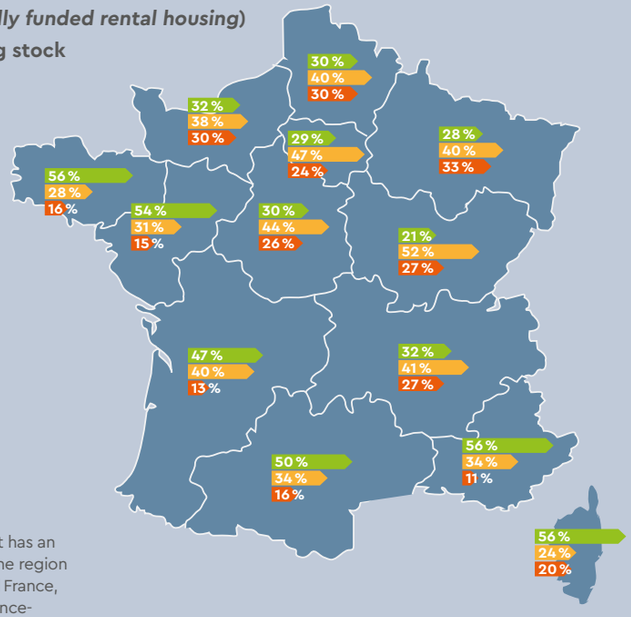
In 2013, the European Union published mandatory eco-design and energy labelling regulations for heating systems and domestic hot water production and storage systems. These regulations set energy performance requirements that ban the least efficient products.

## DISTRIBUTION OF THE SOCIAL HOUSING STOCK ACCORDING TO ENERGY LABELS

**RPLS 2016, (*French list of socially funded rental housing*)**
**mainland France, social housing stock**

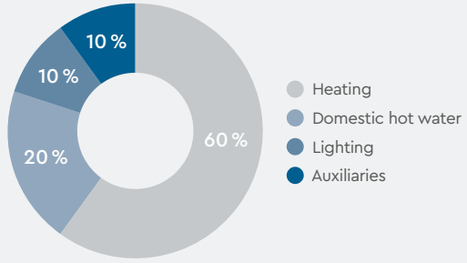
**In mainland France**




The proportion of the housing stock that has an energy consumption label varies from one region to another: usually over 75% in mainland France, it is lower in the Île-de-France and Provence-Alpes-Côte d'Azur regions.

## TYPICAL DISTRIBUTION OF A BUILDING'S ENERGY CONSUMPTION




The heating of existing homes accounts for over 20% of final energy consumption.

## KEY FIGURES

Only **14 %** of individual homes are considered to be energy efficient

**36 %** of social housing stock is classified as label A, B or C

# HEATING AT THE HEART OF COMFORT

*The malfunction, or even shutdown, or a heating system has a significant impact on our quality of life. This is why thermal comfort remains a priority today, and why it is one of the main drivers of this work.*

## THERMAL DISCOMFORT, THE LEADING SOURCE OF DISSATISFACTION

According to a Qualitel-Ipsos survey, thermal discomfort is the leading reason for dissatisfaction, ahead of noise and ventilation problems. Dissatisfaction is more pronounced among apartment dwellers (41% are dissatisfied compared to 26% in single-family homes) especially in housing built before 1980.

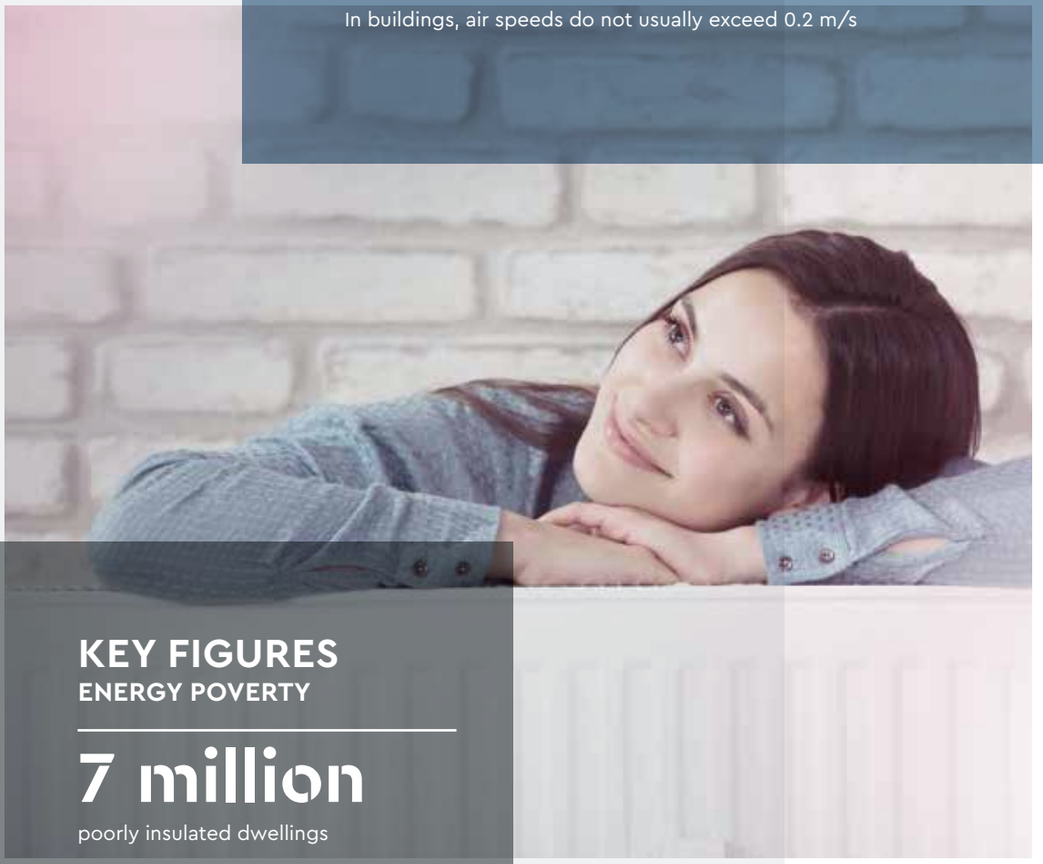
## HEATING MALFUNCTIONS: MULTIPLE REASONS

Many factors can cause a home to feel cold: defective or inefficient heating systems, poor insulation with high heat loss, or heating system malfunctions. This last problem manifests in several ways: noisy boilers or radiators, heat poorly distributed over the heating systems, muddy or coloured water during bleeds, etc. If these problems that are related to sludge in the boiler are not dealt with, you can still feel cold even when the heating is running at full throttle!

## WHAT IS THERMAL COMFORT?

6 parameters define thermal comfort:

- Metabolism, in other words our ability to generate human warmth
- Clothing, which is a thermal barrier to heat exchange between the skin and the environment
- The ambient air temperature (aT)
- The average wall temperature (wT)
- Relative humidity of the air (RH)
- Air speed influences heat exchange by convection. In buildings, air speeds do not usually exceed 0.2 m/s



## KEY FIGURES
### ENERGY POVERTY

**7 million**
poorly insulated dwellings

**3,8 million**
households in energy poverty

**14 %** of households are cold in their homes in winter

# THE DIFFERENT TYPES OF HEATING

*Choosing the right heating solution means finding the right balance between indoor comfort and heat loss. This is an overview of the many existing heating systems by building type.*

## WHAT ABOUT COOLING SYSTEMS?

Whether for hot or chilled water production, the principle is the same! In both cases there is a generator which consumes energy (electricity, gas...), which supplies transmitters. Cooling generators are connected to air conditioning systems or technical circuits. Like heating systems, cooling circuits are also faced with water disorder related problems.

| | WOOD | ELECTRIC | GAS | FUEL | SOLAR |
|---|---|---|---|---|---|
| Individual heating | ✓ Inserts, boilers | ✓ Convectors, towel dryers, radiant panels, underfloor heating | ✓ Boilers | ✓ Boilers | ✓ Boilers |
| Collective heating | ✓ Boilers | ✓ Convectors, towel dryers, radiant panels, underfloor heating | ✓ Boilers / central heating | ✓ Boilers / central heating | ✓ Boilers / central heating |
| Urban heating | ✗ | ✗ | ✓* Heating networks, substations, high-power boilers | ✗ | ✗ |

* Natural gas / coal mine methane

| | THERMO-DYNAMIC | GEO-THERMAL | BIOGAS | BIOMASS | THERMAL DISCHARGES | COAL |
|---|---|---|---|---|---|---|
| Individual heating | ✓ Boilers | ✓ Boilers | ✗ | ✗ | ✗ | ✗ |
| Collective heating | ✓ Boilers / central heating | ✓ Boilers / central heating | ✗ | ✗ | ✗ | ✗ |
| Urban heating | ✗ | ✓ Heating networks, substations, high-power boilers | ✓ Heating networks, substations, high-power boilers | ✓ Heating networks, substations, high-power boilers | ✓ Heating networks, substations, high-power boilers | ✓ Heating networks, substations, high-power boilers |

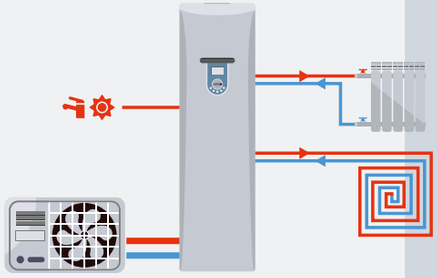
# HEATING & RENEWABLE ENERGIES

*The emergence of renewable energies has given rise to new heating and DHW production technologies. Here are a few examples.*

These multi-energy installations usually have a generator that can be used to back up another. Their principle: to exploit the best yield of each energy source at all times (depending on the amount of sunlight, the cost of gas, etc.).
Here are 3 new heating systems and domestic hot water production systems that are becoming increasingly popular.

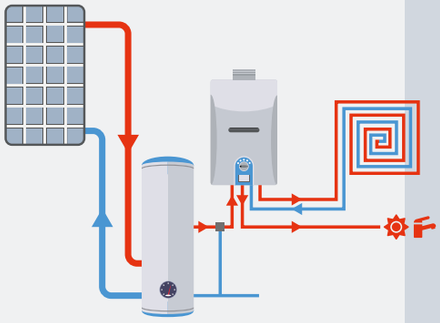
## HEAT PUMPS

Usually comprised of 2 units (one outdoors and one indoors), this system captures calories from the outside air to heat or cool a home and/or supply it with domestic hot water.



## SOLAR SYSTEMS

Horizontal or vertical solar collectors, conventionally mounted on the roof, are connected to a boiler and/or hot water tank to meet the heating and domestic hot water needs of occupants of single family houses or apartments.



## FOCUS ON THE CONDENSING BOILER

Whereas standard boilers transform water into steam, condensing boilers transform water into steam and then cool the steam back into liquid form.

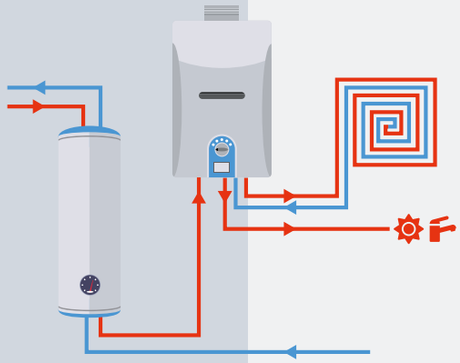
**The result:**
**combustion yield + yield from calories recovered from steam in the exhaust gases = +14 % heat gain**

**CONVENTIONAL BOILER**

**EVAPORATION**
= energy loss

**CONDENSING BOILER**

**CONDENSATION**
= energy saving



## THERMODYNAMIC WATER HEATERS

Thermodynamic water heaters trap heat calories present in the outside or ambient air, store them and then transfer them to the domestic hot water in the tank.

# 3 WATER AND ITS DISORDERS



## WATER AND ITS DISORDERS

Because it supplies circuits for heating and domestic hot water production equipment, water also plays a central role in building energy performance, the well-being of its occupants, the energy bill and the durability of installations.

Thus, water disorders, that generate scale and sludge, can impact several components of the system, from the generator to the emitters and circulators.

What are these disorders and where do they come from? What impacts can they have? Discover all the answers through actual cases and the in-depth results of our study on each system component.

# ORIGINS AND THEIR CONSEQUENCES

*Whether it comes from rain, snow or melting ice, from run-off, reservoirs or evaporation, water is not always the pure element we imagine. It often contains substances that cause problems, particularly in climate control systems.*

## SCALE OR LIMESCALE

Calcium carbonate in water results from the precipitation of dissolved ions. This precipitation can be due to the pH of the water, its temperature, its pressure. It is characterised by a whitish deposit, generally hard and adherent, and sometimes porous.

**Its consequences for heating and domestic hot water systems:**

- It clogs the components of climate control systems resulting in a loss of efficiency
- It causes pumps and valves to malfunction
- It weakens the system environment making it more vulnerable to the growth of germs

## CORROSION

Some mineral salts contained in water, but also water temperature or the presence of oxygen, can have a corrosive effect on non-stainless steels. This manifests as brown deposits on the steel elements.

**Its consequences for heating and domestic hot water systems:**

- Corrosion weakens materials, creating holes and therefore leaks
- It enables the build up of sludge
- It releases gases that create noise and cold zones in emitters
- It causes galvanic corrosion of dissimilar metals

## SLUDGE

The origins of sludge vary. It can be formed from the residues of work (solder, etc.), oxides (corrosion, abrasion, etc.), carbon deposits (on new systems that were cleaned or renovated systems that were not cleared of sludge) or bacteria / algae. Sludge is characterised by yellowish water.

**Its consequences for heating and domestic hot water systems:**

- Sludge can abrade and then pierce the components of climate control systems
- It can clog various system components such as valves, radiators, underfloor heating loops and heating elements
- Elles fragilisent les équipements de production (condenseurs, échangeurs...)
- It prematurely ages equipment

# - CASE STUDY -
# INDIVIDUAL HOUSE

## SPECIFICATIONS

» **Boiler:** 25 kW – Yield up to 109 %
» **Specific flow rate at Δt:** 30K : 20 l/min
» **Type of emitter:** 90 m² underfloor heating system (6 loops)

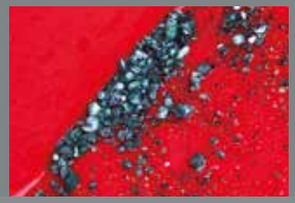
## WATER

» **Water hardness: 380 ppm**
» **No water treatment**

## ISSUE

After 2 years of use, there is sludge at several levels of the heating system

Cross section of a corroded heating unit body



Heating unit body particles

## APPEARANCE OF THE DEPOSIT

Grey powder and gravel

## ANALYSES

| THERMOGRAVIMETRY | PERCENTAGE |
|---|---|
| Humidity at 105 °C | 24,4 |
| Loss on ignition at 550 °C (/105 °C) estimation of organic matter | 20,3 |
| Loss at 840 °C (/105 °C) | 25,5 |
| Fraction of the loss at 840 °C due to loss of $CO_2$ | 5,2 |

| ANALYSE DU MINERALISAT ACIDE | PERCENTAGE OF THE DRY MASS (105 °C) (Ranking of the elements in descending order) |
|---|---|
| Al | 28,8 |
| $PO_4$ | 8,5 |
| Insolubles | 4,6 |
| Ca | 4,2 |
| Cu | 0,9 |
| Silica expressed in $SiO_2$ | 0,8 |
| Fe | 0,7 |
| Zn | 0,7 |
| Mg | 0,2 |

## COMMENTS

The boiler was clogged mainly with sludge residue (quantified by the loss on ignition) and aluminium compounds resulting from the corrosion of the heating element. The presence of phosphates is due to multiple de-sludging operations.

## CONSEQUENCES FOR THE INSTALLER

» 9 interventions by the plumbing company
» Complete de-sludging
» A heating element to be replaced
» Analysis followed by injection of water treatment products
» Impact on the reputation of the boiler brand (online reviews)

**TOTAL COST OF THE OPERATION: € 3 500 EXCL. VAT**

# - CASE STUDY -
# COLLECTIVE HOUSING

## SPECIFICATIONS

» **A 250 apartment unit in a region east of Paris**
» **Winter refurbishment**

## WATER

» **Water hardness: 370 ppm**
» **No water treatment**

## ISSUE

» No heating in 127 apartments upon restarting the heating

The thermostatic valve Y-strainer clogged on the distribution

Sludge and initial signs of corrosion on the circuit

## CONSEQUENCES

» Installation of 300 electric radiators
» Removal and mechanical unclogging of each strainer
» Removal of meters and installation of full flow sleeves
» Removal of the accelerators
» Removal and mechanical unclogging of the strainers on each radiator valve
» Injection of de-sludging reagent, fluidification of the sludge to create a suspension
» Hydropneumatic rinsing, column by column, floor by floor, apartment by apartment
» Conditioning and protection of de-sludged networks
» Installation of an auxiliary softener, a degasser and a clarifier

**TOTAL COST OF THE OPERATION: € 37 120 EXCL. VAT**

# THEIR EFFECTS ON THE HEATING ELEMENT

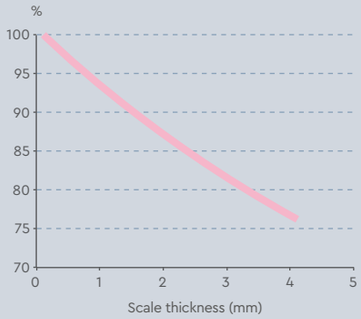
*The generator is the part of the system where thermal fluctuations and temperatures are the highest; they are therefore especially vulnerable to scale deposits.*

Scale deposits and sludge have a low thermal conductivity coefficient (0.85 W/(m.K)). They are insulators and will have a significant impact on the thermal conductivity of the heating element of a stainless steel boiler because they reduce heat transfer through the heating element wall. This implies:

» Longer heating time to reach the same setpoint temperature.

» An additional amount of primary energy to obtain the same amount of heat in the heat transfer fluid (water in the heating loop).

## REDUCTION OF THE BOILER THERMAL CONDUCTIVITY




Heat transfer as a function of the thickness of the scale deposit or sludge

**1 mm**
scale deposit or sludge

**= -7 %**
heat transfer



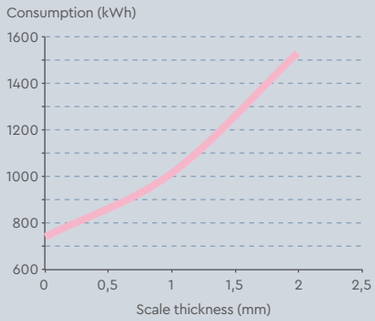


# THEIR CONSEQUENCES ON CIRCULATION PUMPS

*Scaling of pipes increases the load loss, this impacts the energy consumption of the circulation pump.*

As the results of our study show, the presence of scale or sludge leads to the over-consumption of energy by the circulation pumps. This data should be put into perspective, taking into account the number of circulators in the installation. For example: Collective dwellings with individual heating systems with one circulating pump per dwelling.

## CIRCULATING PUMP CONSUMPTION AS A FUNCTION OF SCALE THICKNESS




| Scale thickness (mm) | Load loss (mCE) | Power (W) | Consumption (kWh) | Consumption difference | Annual cost |
|---|---|---|---|---|---|
| 0 | 4,11 | 135 | 746 | 0 % | 109,81 € |
| 1 | 5,45 | 184 | 1 014 | 36 % | 149,26 € |
| 2 | 7,78 | 276 | 1 525 | 104 % | 224,48 € |

# THEIR ACTIONS ON RADIATORS

*The build up of sludge in radiators has a collateral impact on the rated power and the increase of heat transfer fluid temperature.*

The results of our study revealed the 2 main repercussions of sludge deposits in radiators, namely:

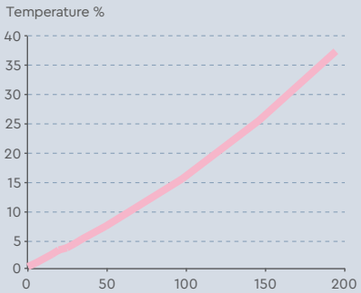
» The heat exchange surface area with the ambient air is decreased leading to a drop in the rated power.

» The heat transfer fluid temperature is increased to compensate the drop in rated power caused by the smaller heat exchange surface area.

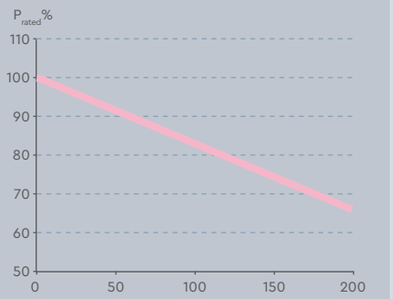
**5 mm**
sludge deposit

**= -10 %**
of the rated power of a radiator

## INCREASE IN THE HEAT TRANSFER FLUID TEMPERATURE




## RATED POWER REDUCTION





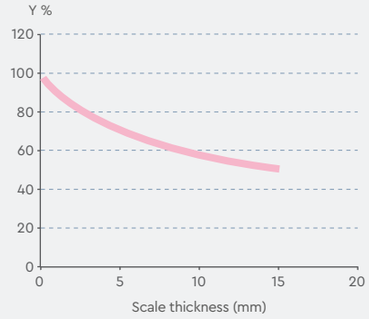


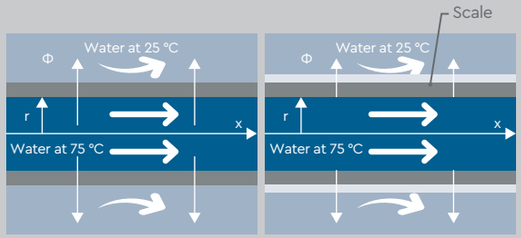

# THEIR IMPACT ON COILS

*Scale can also be deposited on the external part of coil exchangers located in domestic hot water tanks, leading to a drop in the system's energy performance.*

The presence of scale has a significant impact on the heat transfer coefficient, and therefore the quantity of heat passing through the wall. This decrease of the thermal transmission coefficient leads to an increase in the heating time, and therefore an increase in energy consumption.

## THERMAL TRANSFER COEFFICIENT




Coil of a hot water tank without any scale (left) then with a deposit on the external wall (right).

**2 mm**
scale deposit

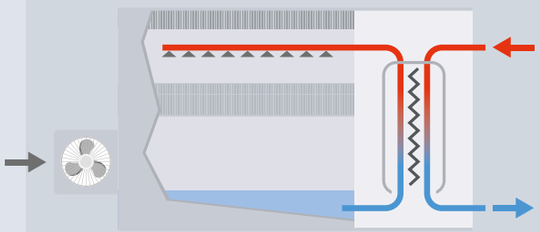
**= -15 %**
thermal transfer coefficient

# THEIR EFFECTS ON THE ELEMENTS OF A COOLING TOWER

*Real life example of the consequences of scale in cooling tower circuits.*

**Example of a cooling tower with the following specifications:**

- T° difference : 10 °C
- Power: 560 kW
- Flow rate: 56 m³/h
- Running time: 10h/day all year
- TH: 25 °f



**5 500 m³**
of annual water consumption

**= 10 000 €**
per year of electricity

**5 500 m³**
of water

**= 500 g**
of scale entering the tower every day

Similarly, for 1 mm of scale on the exchanger and packing side, 10 % kW more will need to be evacuated to obtain the same T° difference.

**This will generate considerable extra costs.**

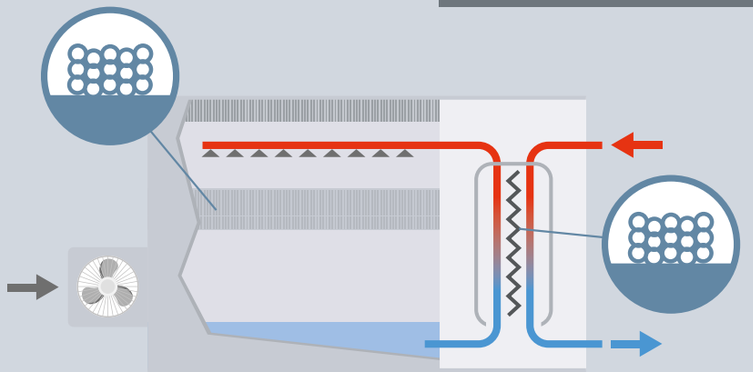
**Annual extra overhead:**

Water:
**+ 550 m³**

Cleaning:
**+ € 500** / year

Electricity:
**+ € 1000** / year

**Total annual extra overhead:**
**+ € 2000**



**For an investment of about € 1,500 per year (based on 350 kg/year), the use of a scale prevention product prevents the premature deterioration of the equipment. Considering the € 2,000 extra overhead due to the presence of scale on the system components, this means that the investment is profitable from the very 1st year!**

# THEIR IMPACTS ON THE ELEMENTS OF A CHILLER UNIT

*Example of the effects of sludge deposited on cooling unit elements.*

**Example of a cooling unit with the following specifications:**

» T° difference: 15 – 10 °C
» Power: 500 kW unit
» Volume: 20 m³
» Running time: 50 %

**Operation:**

» Water: 0 m³
» Conditioning: € 0
» Electricity (90 kW): 25 K€

The presence of sludge not only has a financial impact, it also has a direct impact on the appliance's loss of energy efficiency:

» Corrosion under the sludge deposit
» Bacterial growth
» Damage to public image (leaks or incorrect temperatures in hotels, hospitals, etc.)
» Noisy installations
» Shortened equipment service life

Similarly, a 1 mm sludge deposit on the cooling unit tubes will generate significant extra annual overheads.

**Annual extra overheads:**

Water:

**+ € 0**

Cleaning:

**+ € 800** / year

Electricity:

**+ € 2500** / year

**Total annual extra overhead:**

**+ € 3300**

**Preventive action using a scale prevention product (based on 100 kg) or the installation of an SoluTECH clarifying filter represent an investment of € 1,500 € (scale prevention product) the 1st year, meaning a payback time of less than 6 months.**

# WATER, THE KEY TO CUSTOMER COMFORT

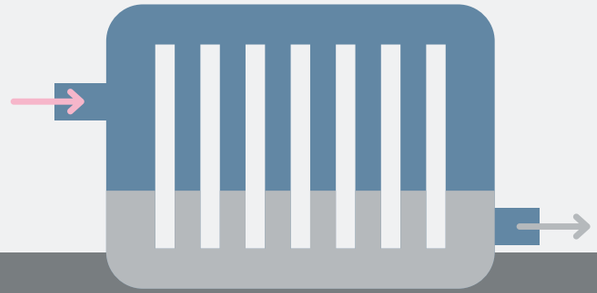
*What could be more unpleasant than feeling cold in your home or having an inadequate flow of water? The solution to this unpleasantness could lie in correcting water imbalances.*

## SLUDGE

**Radiators**

» Drop in rated power
= reduction of the heat exchanged with the ambient environment

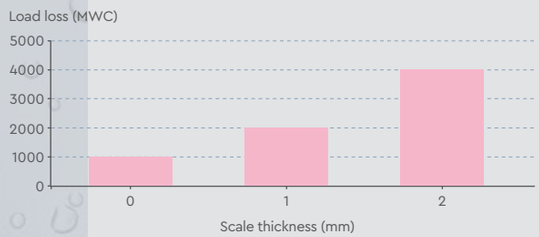
» Increase in heat transfer fluid
= lower thermal surface area
**→ more uneven heat distribution**



## SCALE

**Circulators**

» Inadequate flow (if the circulators are not powerful enough to compensate the load loss)
**→ Drop in temperatures or increase in starting temperatures, i.e. increased energy consumption**



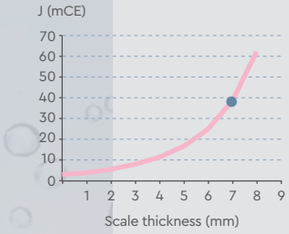

Changes in load loss in a single family heating circuit, type T3, Ø 16/18 (pipes only)

**Domestic hot water networks**

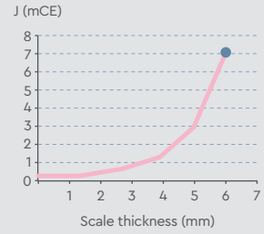
» 4 mm scale on pipes with a diameter of 16/18 mm
= load loss multiplied by 8

» Load loss increases exponentially with increasing scale thickness

» If the scale is thicker than than 5/6 mm **→ poor water circulation → inadequate water flow at the taps**




Changes in regular load loss during the drawing process




Changes in regular load loss on the loop

## IN SUMMARY

SCALE OR SLUDGE
= DROP IN INDOOR TEMPERATURES
+ LOW WATER FLOW

# WATER, THE KEY TO ENERGY PERFORMANCE

*Due to the impact of scale and sludge on the generator, circulators and emitters, the energy efficiency of the entire system can be compromised.*

## SLUDGE

**Radiators**

Power loss (the lower section no longer emits heat).
To reach the set point temperature:

» Either the radiator flow rate is increased (opening of the valve / thermostat)

» Or the temperature of the heat transfer fluid is increased

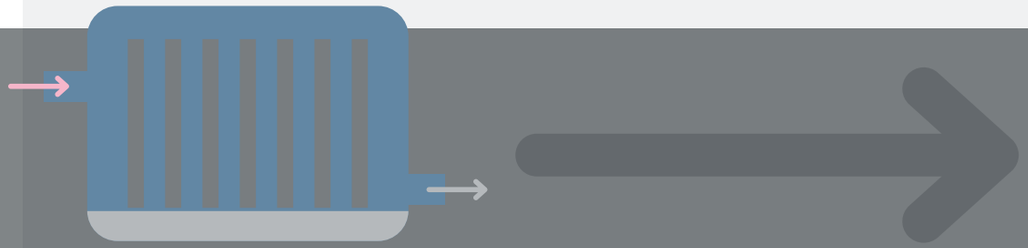
**→ In either case, this leads to an over-consumption of energy.**

**Collateral effect on the boiler**

» Higher loop output temperature = higher loop return temperature (even though condensation is optimised when the temperature of the return loop is low)

**→ deterioration of boiler efficiency. Consequences:**

- The temperature must be increased by 7% with a sludge height of 50 mm and a radiator height of 600 mm to compensate for the loss of heat exchange surface area
- Without water treatment, de-sludging will be needed every 4 years (65 €/radiator)



## SLUDGE + SCALE

**Heating element**

» Drop in heat transfer from the wall

**→ longer heating time**

**→ increased energy consumption**

**(as of 1 mm of scale or sludge)**

**Circulators**

» Increased load loss

**→ increase in energy consumption**

## SCALE

**Coils**

» Drop in the thermal transmission coefficient

**→ increased heating time**

**→ additional energy consumption**


## IN SUMMARY

SCALE OR SLUDGE
= DROP IN EQUIPMENT EFFIENCY
+ INCREASE IN ENERGY CONSUMPTION

# WATER, THE KEY TO INSTALLATION DURABILITY

*The presence of sludge and scale also has repercussions on the service life of system components and even the entire system, the financial impact could be significant.*

## SLUDGE

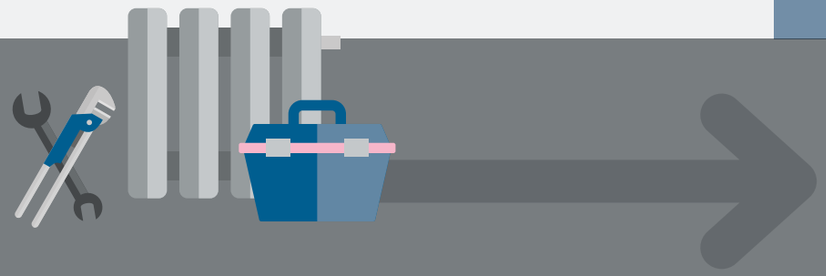
**Circulators**

» Solid particles in the pumped fluid = abrasion of the equipment
**→ destruction of pump components such as the impeller**

## SCALE

**Circulators**

» Alteration of heating pipe cross-sections = increased load loss
**→ cavitation phenomenon (formation of steam bubbles that implode on the impeller or phenomenon due to a lack of head at the intake, both of which are damaging to the pump)**



## SLUDGE + SCALE

**Heating element**

» Water quality problems (hard water, top-ups that are too frequent or too large, sludge, etc.)
**→ Equipment damage (deformation, pierced tubes or exchanger elements, etc.)**

» 2 mm of scale or sludge deposit = increase in the heating element skin temperature
**→ breakage of the heating element (one of the main issues encountered in the field)**

## IMPACT OF SLUDGE AND SCALE ON CIRCUIT MAINTENANCE

[ CASE STUDY: DE-SLUDGING OF A HEATING CIRCUIT ]

**Description of the installations to be treated (8-storey office building, heating substation)**

» 1 Plate heat exchanger
» 1 main Primary circuit supplying 1 plate heat exchanger
» 1 Reversible underfloor circuit 1 060 liters
» 1 AHU circuit (18)
» 1 Secondary circuit (radiant panels) 9 610 liters

**Estimated volume:** about 10 m³

**DE-SLUDGING METHOD**

» Curative treatment
» Hydropneumatic rinsing
» 9 day technical shut down
» Preventive treatment

**TOTAL AMOUNT: € 9 000 EXCL. VAT**

**The annual budget for a preventive programme, had one been implemented, would have been € 3 000.**

## IN SUMMARY

SCALE OR SLUDGE
= REDUCTION IN BOILER SERVICE LIFE
+ INCREASE IN MAINTENANCE COSTS
(repairs and technician call out fees)

# 4 CONCLUSION



## THE IMPACT OF WATER DISORDERS ON CLIMATE CONTROL SYSTEMS

Water imbalances impact user comfort, energy efficiency and the service life of equipment. Even with the most innovative installations, they can bring an entire system to a stop and drive up a building's energy bill and maintenance costs. There is only one solution to avoid this: continuously monitor and maintain good quality water in climate control systems.

Water also plays a role in the Life Cycle Assessment of a system, with the LCA becoming a reference in anticipation of the future application of the RE2020 in France. Thus, with the technology injected into buildings, maintenance and operation will soon be a major issue.

# THE IMPACT OF WATER DISORDERS ON HEATING AND HOT WATER NETWORKS

*This does not mean that water imbalances are inevitable. Whatever the water quality or the use to which it is put, there are numerous solutions to treat it.*

## IN SUMMARY

Water imbalances in climate control systems lead to:

» **DIMINISHED** user **COMFORT**
» **INCREASED** energy **CONSUMPTION**
» **SHORTER SERVICE LIFE OF** equipment

**As the results of this study have shown, sludge and scale have many repercussions on the operation of heating equipment:**

» damage to the heat exchangers
» risk of clogged valves
» slowing of circulators and risk of breakdowns
» noise pollution in the piping system
» energy over-consumption
» diminished customer comfort

**To alleviate these problems, suitable water treatment will protect installations and offer:**

» optimum heating system operation
» adequate flow rate at apartment drawing points
» the reduction of equipment failures and the risk of boiler shut downs
» a feeling of well-being in the homes
» control of energy costs associated with users

**This treatment also significantly reduces maintenance costs. This is an example of what a sludge or scale damaged installation can cost compared to the annual cost of water treatment.**

| Estimated financial impact of 1 mm of scale or sludge on the collective heating of a jointly owned building with 30 RT 2005 housing units (in Haute Savoie) per year | |
|---|---|
| Generator: heating element | € 1320 |
| 4 circulation pumps | 4 × 40 = € 160 |
| 1 de-sludging operation every 4 years (65 €/radiator) | € 2500 |
| **ANNUAL COST** | **€ 3980** |

| CATALOGUE PRICE cost for water treatment for the collective heating of a jointly owned building with 30 RT 2005 housing units (in Haute Savoie) | |
|---|---|
| Filling water softener + meter | € 1200 |
| Solutech Protection product | € 600 |
| Clarifying filter | € 900 |
| | **€ 2700** |

i.e. an **annual cost of € 270** for an average water treatment system service life of 10 years


# THE WATER TREATMENT EXPERT

*Everywhere, in all our activities, let us enjoy the pleasures and benefits of BWT water.*

BWT (Best Water Technology) develops the best treatment products, equipment, technology and services. Every day, the group guarantees the safety, hygiene and health of millions of consumers all over the world.

BWT has an extensive product and service portfolio: filtration systems, water softeners, disinfection (UV, ozone, chlorine dioxide), scale protection, seawater desalination, reverse osmosis systems, production of purified water for the pharmaceutical industry, etc.

All BWT products and processes are effective, economic and environmentally friendly.

## WATER, OUR ELEMENT, OUR EXPERTISE

For decades we have undertaken research and development in the water sector covering the entire water treatment spectrum. Almost everywhere there is water you will find innovative BWT solutions. We are continuously working on the development of processes and products that create optimum water quality for a wide range of applications. Thus, we offer a wide range of products and services for filtration, softening, disinfection (UV, ozone, chlorine dioxide), scale protection, seawater desalination, reverse osmosis, etc.

## SOME KEY FIGURES

**N° 1** in water treatment in Europe

**25** countries of operation

**3 900** employees worldwide, including 580 in France

**4** R&D centres

**7** factories

**700** million euro turnover

# WATER IS OUR MISSION

*Water, essential to humankind and the planet*

The European leader in water treatment, the BWT group places its know-how at your service, whether you are a design office, an installer, an industrial sector professional, in charge of community level infrastructure, or simply a private individual. Our technology and innovations provide you with the water treatment solution best suited to your needs while improving hygiene, safety and control over energy consumption, in service to public health and our environment.

## FOR YOU AND PLANET BLUE

Our strap line, "For you and Planet Blue", is the expression of the essence of BWT's mission: to act responsibly, to satisfy the needs of the individual and to preserve the Earth as a unique habitat.

Fully aware of the importance of its role, BWT uses environmentally sound techniques to purify, mobilise and preserve our irreplaceable water resources all over the world.

*For You and Planet Blue.*

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