The water quality
An essential parameter

Reduced energy costs
due to online monitoring of
Water Quality

in accordance with VDI 2035 / WÜ 100 (TRD 611) / DIN EN 12952-7

Monitoring the water quality is an important first step towards reducing energy costs in any facility that operates with hot water and steam boilers.

Modern steam boilers benefit from water quality monitoring

Recent surveys have shown that improved control of parameters, such as water hardness, carbonate hardness and conductivity, carried out by online monitoring can save water quality facilities several thousand euros annually in energy and plant downtime.

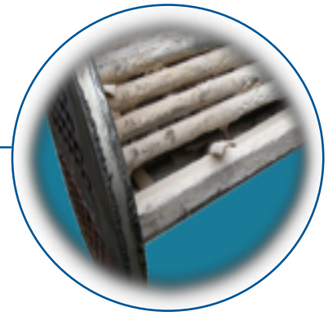
Monitoring water quality can also significantly increase the service life of a hot water or steam boiler, which in turn leads to major savings in assets and investments.

Virtually any facility that is operated with energy-related heat generation (e.g. hot water or steam boiler plants, as well as open or closed cooling towers) is very susceptible to higher operating costs caused by to limescale.

How does limescale originate ?

The alkaline earth metals found in water (calcium, magnesium) as well as the carbon dioxide bound to the alkaline earth metals dissolve with increasing water temperature. Consequently, leading to severe limestone, particularly in hot water systems.

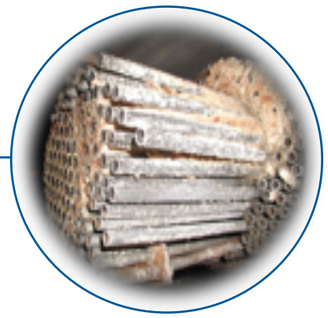
Lime in the chemical sense is calcium carbonate. The carbonic acid, which keeps the salts dissolved, is expelled by the heating of the water – the lime/carbonic acid equilibrium no longer exists. Lime precipitation occurs.



What are the consequences of limescale ?

Even the slightest amount of limescale reduces the heat transfer. This alone is an important factor for increasing energy costs. Severe limescale can even lead to local overheating of the metal, resulting in the formation of cracks.

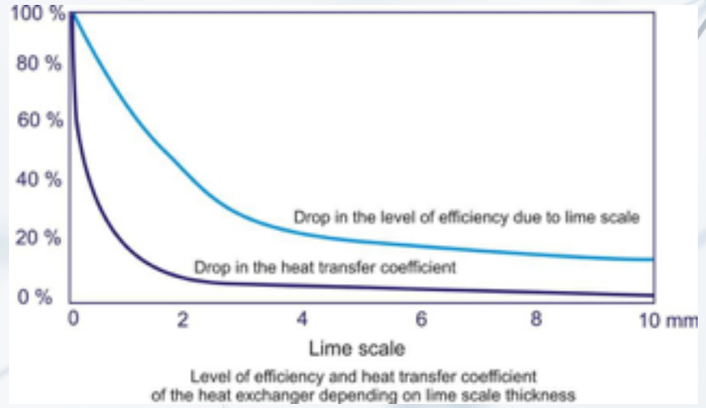
Furthermore, aggregates such as pumps are also overburdened. The cross–sectional constrictions of pipes cause increased flow resistance within the pipe network (the kvs values rise), leading to increasing energy consumption and follow-up costs.



In order to illustrate this case, we present the following example :

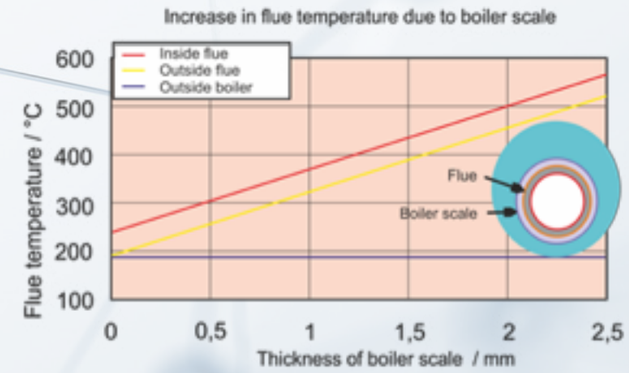
A limescale coating of 1.0 mm thickness reduces heat transfer coefficients of plate heat exchangers or tubular heat exchangers, by up to 80%. This leads to a reduction in heat transfer of up to 30%. Even a seemingly insignificant limescale coating of only 0.1 mm thickness can ultimately result in higher energy costs of up to 12%.

Graphic 1 :
Energy loss due
to limescale



Level of efficiency and heat transfer coefficient
of the heat exchanger depending on lime scale thickness

Graphic 2 :
Energy loss due
to limescale



Boundary conditions of the upper calculation	
Wall thickness of the flue	12 mm
Length of the flue	4000 mm
Thermal conductivity of the flue	50 W/mK
Diameter of the flue	1200 mm
Thermal output of the boiler	6 MW
Thermal conductivity of boiler scale	1,5 W/mK
Water temperature	180°C
Heat flux density	approx. 200 kW/m²
Proportion of transmitted thermal output in the flue	50 %

Scale formation in steam boiler plants without monitoring the boiler water and feed water

Utilising the operating parameters listed below and a constant feed water hardness of only 0.1°dH = 1.8 g/m3 CaCO3, approximately 90 kg of CaCO3 (lime) is deposited on a boiler heating surface of 300 m², per year. A lime coating of approximately 0.12 mm can start to form in its first year of operation.

Even this low amount will already lead to significant heat transfer and energy losses. This corresponds to about 2% additional energy expenditure in relation to the total energy outlay costs.

Example of a 15 t/h steam boiler	
Condensate recovery (45%)	6.75 m3/h
Replenishment of feed water (55%)	8.25 m3/h [total 49,500 m3 per year]
Operating hours	6000 hours per year
Water hardness	0.1°dH = 1.8 g/m3 CaCO3
Heating surface	300 m3

Hardness ruptures with higher values lead to significantly increasing energy costs		
Water hardness	Limescale per year	Additional energy expenditure*
0.1°dH	0.12 mm	€3,880 per year
0.5°dH	0.5 mm	€9,700 per year
1.0°dH	1.0 mm	€19,400 per year

*with a gas/oil price of 4 cents/kWh

Feed water monitoring for hot water and steam boiler plants using the **Testomat 2000®** (certified in accordance with the new TÜV standard WÜ 100 for steam boiler plants), prevents this additional energy consumption.

The purchase of a **Testomat 2000®** pays for itself after only one year

The acquisition of a limit device, **Testomat 808®** (certified in accordance with DIN EN 12952-7) for small steam generators, pays for itself even faster !

Are there any other effects on the performance of hot water and steam boiler plants ?

Water hardness not only causes additional energy costs, due to limescale, it can also lead to even more harmful scaling resulting from various factors.

Silicates, sulphates and calcium phosphate in feed water all lead to deposits on heat exchange surfaces. The existence of an increased amount of any of these substances in feed water of energy-related heat generators can result in costs of up to €15,000 per year. If, in addition to the lime, deposits are caused by the occurrence of these substances, the costs can be very high due to energy loss, descaling and further potential damage to the boilers and other equipment.

Energy losses due to deposits of calcium carbonate, sulphate and calcium phosphate		
Coating of 1 mm	Energy loss	Oil or Gas consumption
Calcium carbonate	~ 11.00%	533 m3/a
Sulphate	~ 9.00%	436 m3/a
Calcium phosphate	~ 4.50%	218 m3/a

What are the effects of hot water and steam boiler plants downtime on normal operating costs ?

Plant Downtime is an important cost factor and plays a crucial role when deciding in favour of a better water quality monitoring, utilising an online analysis instrument. Plants or facilities must be switched off for necessary boiler cleaning. This occurs frequently if the water hardness has increased in limescale levels. Plant engineers and operators can have these costs reduced significantly by monitoring the water hardness with a Testomat 2000® in boiler houses or with a Testomat 808® for small steam generator plants.

Downtime	Frequency	Days per year	Loss of production*
Without hardness monitoring	About 2-3 times per year	About 8- 12	Approx. €10,000–€70,000
With hardness monitoring	Once per year	About 4	Approx. €5,300

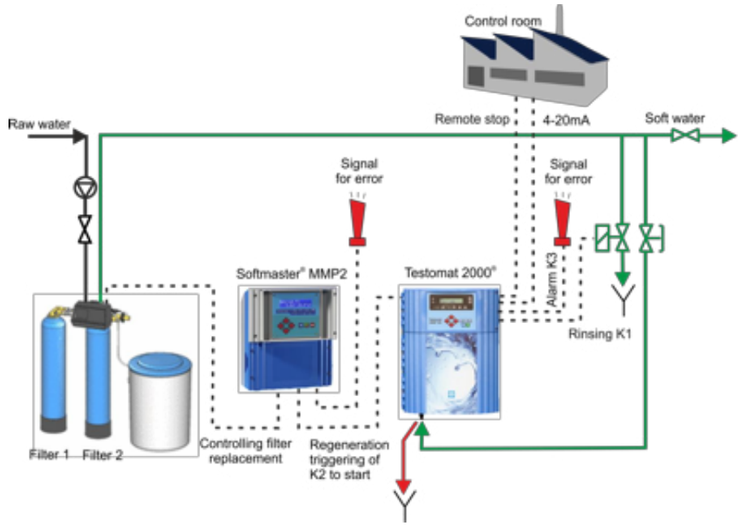
* Based on a 15 t saturated steam boiler for commercial use

Our Testomat 2000® monitors your feed and condensate water (in accordance with current TÜV WÜ 100 regulations) for water hardness, in your hot water and steam boiler plants assisting you in maximising your plant's efficiency levels.

Are there other factors that are important for the maintenance of hot water and steam boiler plants and should therefore be monitored ?

Dissolved salts remain in the water during the generation of steam and increase the concentration of salt in the boiler water.

The increased concentration of salt results in a more rapid formation of solid deposits, thus weakening heat transfer; this leads to boiler corrosion and also the formation of foam. This foam can be removed with steam and consequently affect downstream plant components.

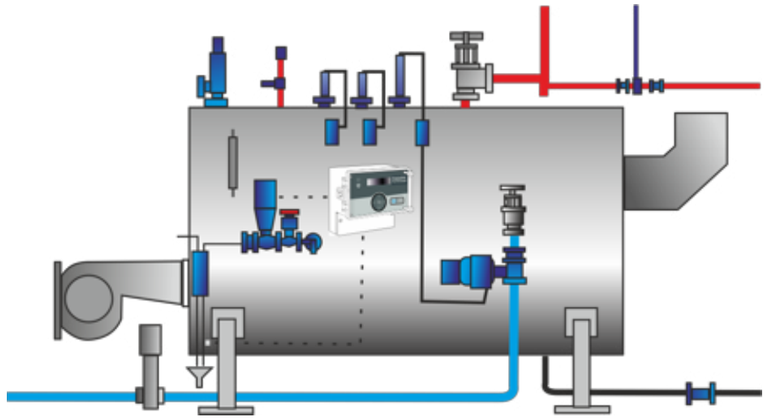


Graphic 3 :
Online monitoring
of water quality with
instruments from Heyl

How can Heyl Analysis Technologies instruments help you in controlling the quality of your hot water and steam boiler plants?

The Testomat 2000® analyses the hardness of the feed water in a quantity or time-controlled manner. If the maximum hardness is exceeded, the Testomat 2000® sends a signal to our Softmaster® MMP controller. The Softmaster® MMP2 then controls the filter replacement and triggers the regeneration of the exhausted filter. Both instruments have alarm signal outputs, for unforeseen events (e.g. low water pressure, low filter capacity, limit exceeded). They can send these signals at the same time, via a 4-20 mA interface, to a main control unit or to a central control system.

To prevent salt corrosion, the conductivity of the feed water is controlled with the monitoring instrument EcoControl EC Dos Desalt. The EcoControl EC Dos Desalt controls the flushing of boiler water, with a high concentration of salt and the supply of water if necessary, to maintain the correct salinity.



Graphic 4: Monitoring the boiler water with EcoControl EC Dos Desalt

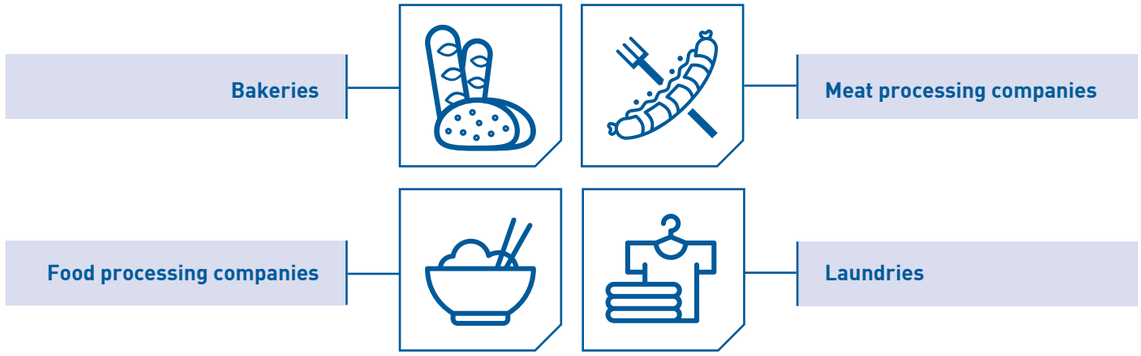
How can the water treatment process be improved by online analysis instruments ?

Plant operators and plant engineers can increase the efficiency of the process for softening the boiler water through constant monitoring of water quality. The water quality monitoring enables operators to detect whether the regeneration process runs correctly, the resin quality is sufficient and whether the regeneration conditioning agents are sufficient and available in the correct consistency.

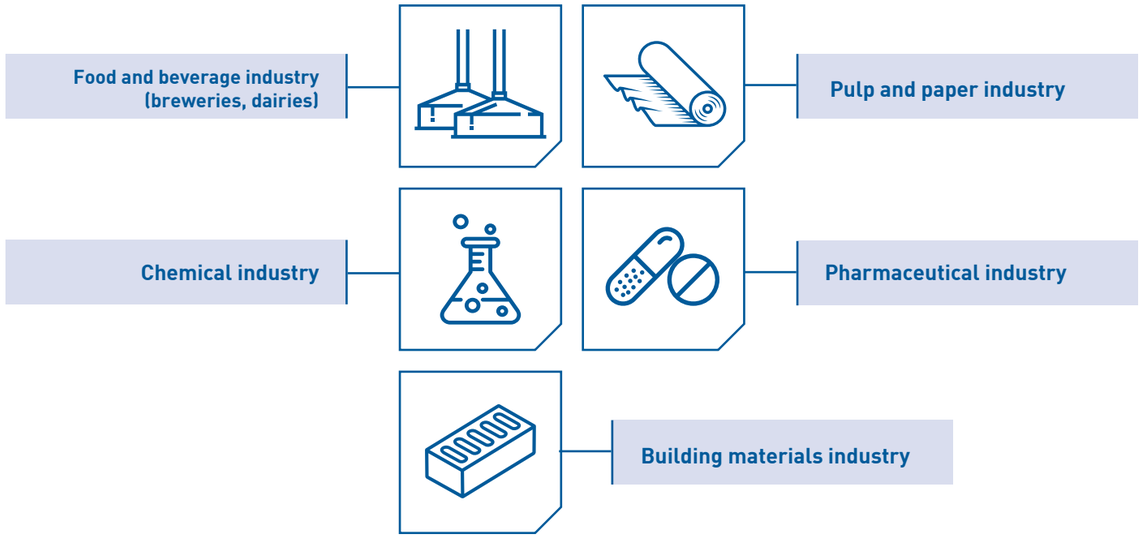
The combination of Testomat 2000®, Softmaster®MMP2 and EcoControl EC Dos Desalt results in less wastewater, lower salt consumption and cost savings due to lower energy requirements.

What companies can save energy costs by monitoring the water quality with online analysis instruments?

Companies using low pressure boilers, such as:



High pressure boilers are manufactured as high-capacity boilers with a permitted operating pressure of 1 to 25 bars. Companies operating in the following sectors use this technology:



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