The importance of water quality in laboratory testing

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A water softening system has recently been installed at the CATAS Surfaces Department.
In fact, with the increasing number of apparatus using tap water in various ways, the possibility of having a hardness close to 0 °HF (French degrees) significantly extends the life of the components and, consequently, reduces maintenance costs.

Picture 1. Softening plant

The new system will be mainly dedicated to treat the water used by the xenon tests to cool the xenon arc lamp, and a part of this softened water will be inlet in the osmosis water unit.

This 'double treated' water will be used in the ageing equipment (xenon test and UV test) for spraying the samples as required by the standards for outdoor materials.

When and how does 'limescale' form?

On its journey to our homes, water dissolves substances such as calcium and magnesium from the rocks, making it 'hard'. When a piece of equipment or appliance heats tap water up, some of these minerals are unable to remain in solution, but tend to crystallize, causing 'limescale precipitation'. This already occurs at temperatures of around 35 °C and becomes more and more pronounced as the temperature rises (especially above 55 °C).

A bit of chemistry...

In water, there is an equilibrium between the calcium bicarbonate and calcium carbonate dissolved in it. This equilibrium can be represented by the following equation, where the bicarbonate ion (HCO_3^-) is on the left and the carbonate ion CO_3^{2-} is on the right. In water, therefore, both these ions are present in certain concentrations together with the calcium ion (Ca^{2+}) and carbon dioxide.

$Ca^{2+} + 2HCO_3^- \rightleftharpoons Ca^{2+} + CO_3^{2-} + CO_2 + H_2O$

However, if the water is heated, the dissolved CO_2 will tend to evaporate and the equilibrium of the reaction will then shift to the right. However, this will increase the concentration of the carbonate ion, which precipitates in the form of calcium carbonate, as this salt is not very soluble in water:

$Ca^{2+} + CO_3^{2-} \rightleftharpoons CaCO_3$.

The same thing happens with the magnesium ion with the formation of $MgCO_3$.

The most common damages that can occur as a result of limescale formation in civil and industrial installations are:

- Scaling
- Ruined surfaces
- Pipes corrosion
- Pipelines occlusion

Softeners, such as the one at the disposal of CATAS, replace the calcium and magnesium ions with the sodium one, the salt of which (carbonate) is more soluble in water and therefore does not lead to scale formation.

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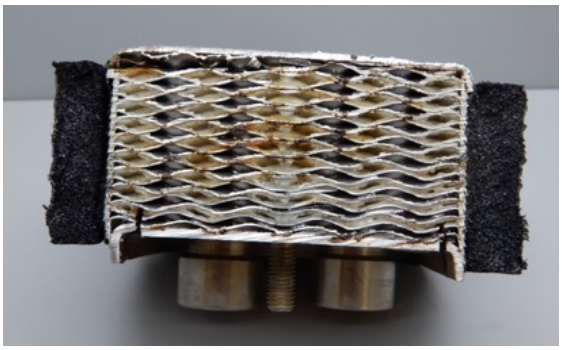
The adoption of 'double treated' water is one of those investments that are not widely adopted, but which demonstrate a laboratory's attention to the quality of its service.

Picture 2. Water coming from the aqueduct – hardness 26°HF

Picture 3. Water leaving the softening plant – hardness 0°HF

Picture 4. Xenon tester in use at CATAS



Picture 5. Limescale incrustations occurred in a heat exchanger at an operating temperature of 55°C

Water Classification

Water is generally classified according to its hardness as follows:

Types of water	Hardness in French degrees (°F)
very soft waters	0-4
soft waters	4-8
medium hard waters	8-12
moderately hard waters	12-18
hard waters	18-30
very hard waters	>30

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