

# Aquafacts No.11

The argument between the residential water treatment industry and boiler manufacturers about corrosion in aluminium boilers has remained unresolved for some while. Here are the facts as viewed by the UKWTA. This sheet was last updated in January 2010.

*The following remarks were published by the United Kingdom Water Treatment Association (UKWTA) from May 2006 to November 2009.*

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*The following statement was made by the UKWTA in May 2006*

## **Softened water and boilers / water heaters with aluminium heat exchangers**

Naturally soft waters of low alkalinity have a tendency to increase the corrosion of metals typically used in the construction of domestic boilers. This has led to the misconception that artificially softened water is corrosive and should not be used in domestic boilers and central heating systems under any circumstances. In fact, softening has been shown to be beneficial to most system metals when small amounts of dissolved heavy metal ions that are present in the water are removed by the softening process (these have a tendency to increase corrosion).

Soft to moderately soft water is supplied to approximately 35% of the country. Certain Water Utilities partially soften the water before it reaches customer premises.

The removal of dissolved calcium and magnesium ions by artificial softening, is an effective means of preventing limescale formation, which has been shown to have a dramatic effect on maintaining boiler efficiency. The Domestic Heating Compliance Guide, issued by the Office of the Deputy Prime Minister, which gives guidance on how to comply with Part L of the Building Regulations, specifies the use of some form of water treatment in hard water areas (>200ppm total hardness) to inhibit limescale formation to maintain boiler efficiency. The installation of an ion-exchange water softener provides an effective means of complying with this part of the regulations.

Although it is recognised that waters of high alkalinity (pH > 8.5) may be corrosive towards aluminium, the Water Supply (Water Quality) Regulations: 2000 (Statutory Instrument No. 3184) allow the supply of water with alkalinity of up to pH 10 in England and Wales.

Softening water with an ion-exchange softener does not significantly increase pH. Experts have now considered the effect of water quality on the materials used in the latest high efficiency boilers and systems and concluded the following:

### **Central Heating Systems**

Although waters of certain quality may be more

corrosive than others, water quality is largely determined by the supply to the premises - consumers often have no choice when filling a central heating system. British Standard 7593 : 2006 *Code of practice for treatment of water in domestic hot water central heating systems* has therefore been revised to allow the use of any supply waters, including artificially softened water, in central heating systems (including those with aluminium) provided an appropriate corrosion inhibitor is added. Installers are advised to consider hardness of the water being used to fill the system and to check suitability of the inhibitor product.

*Softener sales representatives and installation engineers are advised to refer boiler manufacturers and consumers to British Standard 7593: 2006, or the UKWTA, where there are objections to the use of artificially softened water in central heating systems, particularly those containing aluminium.*

### **Water Heaters and Combination Boilers**

Softening water may increase the potential for the corrosion of aluminium where the supply water exceeds pH 8.5 but many manufacturers of boilers with aluminium heat-exchangers are confident of the durability of their products across the entire range of water quality in the UK. (The UKWTA is in the process of compiling a list of boilers manufacturers who deem their products suitable for use with softened water and which should be avoided when using artificial softeners). None of the boiler manufacturers seem to consider variation in the pH of natural water a problem even though this may have been partially softened by the Water Utility!

*Softener sales representatives and installation engineers are advised to request that consumers insist on the installation of a high efficiency boiler with a stainless steel heat-exchanger where there are issues over the corrosion of aluminium and validity of the boiler warranty.*

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*The following statement was made by the UKWTA in December 2007.*

### **Softened water / aluminium corrosion debate goes on!**

Despite changes to British Standard BS7593:2006 *Code of practice for treatment of water in domestic hot water central heating systems*, which now allows the use of ion-exchanged softened water in central heating systems provided an inhibitor formulated for the purpose is added, there is still major reluctance of boiler manufacturers to reach accord with the revised protocol. Following letters to all boiler manufacturers, in the UK, requesting advice on the suitability of their boilers with

aluminium heat-exchangers with softened water, positive responses were only received from WarmWorld UK and MTS (GB) Ltd (Ariston). (For consumers wishing to have softened water the UKWTA now only recommends boilers with stainless steel heat exchangers or models from these two suppliers).

Argument as to why softened water is unsuitable usually derives from a perceived increase in pH due to the evolution of carbon dioxide when the water is heated in a open vessel and sodium from the resin column, exchanged for the calcium and magnesium ions in the water, bonding with the increased hydroxide concentration to form a caustic sodium hydroxide solution. (Corrosion of aluminium lifts off in aqueous solution with pH above 8.4). In reality, there appears to be very little (non-existent?) evidence for the catastrophic failure of systems which would result if systems were full with caustic solution.

To try and resolve the issue once and for all it is the intention of the UKWTA, during 2008/9, to carry out comparative tests on heating systems filled with hard and softened water to demonstrate that carbon dioxide evolution does not occur at typical heating system water pressures and that corrosion of aluminium is therefore not an issue. The UKWTA will work with an independent accredited laboratory. Tests will include results from customers' premises where trials have been undertaken.

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*The following statement was made by the UKWTA in November 2009.*

#### **Insure against softened water aluminium corrosion**

Following discussions with other Trade Associations and the various plumbing institutes, the issue of softened water in contact with aluminium heat exchangers still remains unresolved. Customers complain of being 'bullied' out of installing a water softener by 'threats' that this will invalidate the boiler warranty. (The Chemical Water Treatment Technology Group is attempting to develop a test procedure to demonstrate the performance of chemical inhibitors in softened water. However, boiler manufacturers have indicated that they will still have issues with corrosion on the hot water side) The UKWTA wrote to all 32 domestic boiler manufacturers in the UK last year, enquiring as to their position regarding the use of ion-exchange softened water in contact with heat exchangers in their boilers.

Only Ariston replied positively, stating that they were happy with softened water, having never experienced any problems. A few manufacturers expressed concern regarding the potential for increased corrosion with aluminum, but none had carried out testing or had evidence to substantiate problems.

For the SWET eczema field trial (see details in Aqua-Nouveau's latest newsletter), the UKWTA was able to obtain third-party insurance whereby participants in the trial were indemnified against 'all risks' from the

installation of a softener. For example, the householder was covered if it was found the softened water caused the corrosion of washing machine components.

Negotiations are now underway to obtain full warranty against the corrosion of aluminium heat-exchangers by softened water. The UKWTA is seeking to provide cover for installations of member companies' softener products, through an under writer such as Lloyds of London, with premiums paid from membership subscriptions. They will seek to extend the scope of cover to include all member company products, including water conditioners and filters.

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#### **Aqua-Nouveau's current assessment of the situation .**

We have many thousands of customers and as far as we know corrosion, through the use of softened water, has never occurred in any customer's heating system. We believe that softened water will not have any detrimental effect on any metal used in boiler systems. This is certainly the view of the industry and trade association. What may occur with aluminium in theory clearly does not occur in practice.

Scale is a costly concern and the enormity of the problem is clearly highlighted in AQUAFACT No.14. We believe boiler manufacturers should be emphasising this more to customers. Scale is likely to be far more damaging, in a very short time, than possible corrosion.

The technical committees involved in British Standards and the Building Regulations are totally clear on their approach to the subject. The publication of BS 6798, in January 2009, entitled '*Specification for installation and maintenance of gas fired boilers of rated input not exceeding 70kW net*', confirms the situation as previously stated in BS7593.

BS6798 states, '*Waters supplied via a base exchange resin softener have an increased potential for corrosion, especially in central heating systems containing aluminium components, and if they are to be used in any central heating system a corrosion inhibitor specifically formulated for the purpose should be added and properly maintained*'.

This indicates that aluminium boilers may be used in homes with water softeners as long as the correct inhibitor is used. Sentinel produce a chemical central heating product which meets this requirement. **Sentinel X100 Inhibitor** is designed to protect multi-metal boilers and those specifically with aluminium components by ensuring and maintaining neutral pH conditions. It will cope with all types of water including softened water.

We believe that the propensity for corrosion is still vastly overstated even by those supposedly 'in the know'. We are amazed by the approach that many boiler manufacturers are taking when not one of them can either provide an example of softened water corrosion, or adverse data that can be verified. Even British Gas Services have indicated that over 100,000 of the 3.5 million heating systems that they maintain under service contract, are filled with softened water. They state there is NO EVIDENCE that softened water has increased the risk of boiler damage or corrosion.