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TEST REPORT

Report Number: 2536-18002 **Project No.:** 29225

Report Issued: February 26, 2018.

Client: Aqua-Rex
3301 Spring Mountain Road Ste 18
Las Vegas, NV 89102 **Contact:** Jonny Seccombe

Source of Samples: The samples were shipped to IAPMO R&T Lab from Aqua-Rex, and received in good condition on October 11, 2017.

Date of Testing: October 25, 2017 through December 15, 2017.

Sample Description: Scale Prevention Device; model: Aqua-Rex WK1-E.

Scope of Testing: The purpose of the testing is to determine the efficacy of the Scale Prevention Device per section 5 of IAPMO IGC 335-2018, entitled "Rapid Scaling Test for Scale Prevention Devices".

CONCLUSION: When tested per Section 5 of IAPMO IGC 335-2018, Aqua-Rex WK1-E reduced scaling by 83% when applied to Las Vegas water heated to 180ºF.

Tested by,

Hanks Ninh, Project Engineer

Reviewed by,

Sean Vuu, P.E., Manager, Specialty Projects

Primary Standard: IAPMO IGC 335-2018, sections tested / evaluated:

5 Rapid Scaling Test

Sections of IAPMO IGC 335-2018 not listed above are considered not applicable to subject products.

Test Results: all tests and evaluations were conducted per the written procedures specified in the standard.

IAPMO IGC 335-2018:

5 Rapid Scaling Test

5.1 General Test – FOLLOWED.

The rapid scaling tests specified in Sections 5.3 to 5.4 shall be conducted using sample water supplied for the specific test. The sample water supplied shall be analyzed for total hardness.

The source of the water, provided by the manufacturer, was from Valley Vista Mobile Home Park, 3001 Cabana Drive, Las Vegas NV 89122. It was drawn off at about 14.15 PST on November 28th, 2017. The source was Las Vegas Valley Water District where 90% of the supply comes from Lake Mead.

Finding: the water hardness was measured (by Analytical methodology) at 300.1 ppm.

5.2 Test Rig, Components, Assembly and Setup

5.2.1 Test Rig Components – FOLLOWED

Procure the following components:

(a) One standard 1 L (0.3 gal) thermal glass flask with multi-socketed flanged lid having a spring clamp for securing onto the flask and a gasket to ensure the seal is waterproof.

(b) One standard electric cylindrical heating element (having 150 ± 10 W output) consisting of a heating element, sheath and PTFE or PEEK holder approximately12 mm (0.47 in) OD x approximately 300 mm (12 in) long for insertion into the glass flask.

(i) The heating element consists of stainless steel 240 volts AC, (150 ± 10 W output) cartridge heater, of 6.5 mm (0.25 in) diameter, heated length of 30 mm (1.2 in) at the bottom end and total length of 300 mm (12 in).

(ii) The alloy used to make the heater sheath shall be of 316 austenitic stainless steel. The heater sheath consists of a tube with a closed end and threaded at the other end, with dimensions as shown in Figure 1. The tube shall be formed by drilling to 6.4 mm (0.25 in) diameter and then reaming to 6.53 mm (0.257 in). The external surface shall be ground before each test with 400 grade silicon carbide (SiC) paper.

(iii) The heater sheath shall be attached to a PTFE or PEEK holder and the heating element is inserted through the PTFE holder and heater sheath until in contact with the closed end of the hole in the heater sheath (see Figure 2). A fluorocarbon 'O' ring, internal diameter 2.90 mm and thickness 1.78 mm shall be placed within the 'O' ring groove of the heater sheath. Before screwing the heater sheath into position on the holder, the heated length of the heating element shall be brushed with a heat release agent (e.g. Watlube Heater Release Agent from Watlow Ltd.).

(c) One standard 12.7 mm (0.50 in) OD copper tubing sufficiently long enough to
  (i) supply water;
  (ii) attach a scale prevention device; and,
  (iii) connected to the flask lid by an NPT connection.
  (iv) allow a section of clear plastic tube attached to the top (to observe the water level in the system).
(d) One standard thin cylindrical thermometer for insertion into the glass flask.
(e) One thin cylindrical thermocouple or platinum resistance thermometer
  (i) The thermocouple and the heating element shall be attached to a controller switch.
  (ii) The controller switch shall be capable of maintaining the required temperature of the water, 82 ± 2°C (180 ± 4 °F), during the entire test.
(f) One rigid clear plastic tube longer than the copper tube and with a shut off valve at the bottom connected to the flask by an NPT connection.
(g) One standard electrical magnetic stirrer for continuous mixing of the solution in the glass flask.

5.2.2 Test Rig Assembly - FOLLOWED

Assemble the components in above Section 5.2.1 and as indicated in Figure 3.

5.2.3 Test Setup - FOLLOWED

The device shall be installed in the test rig assembly if required in accordance with the manufacturer's installation instructions. The rapid scaling test shall be conducted at an ambient temperature of 20 ± 5°C (70 ± 8°F)

5.3 Control Test - FOLLOWED

The rapid scaling control test shall be conducted without use of a device as follows:

(a) Immediately prior to testing, the heater sheath shall be abraded with 400 grit SiC paper, rinsed with demineralized water, and dried.
(b) Reassemble the heater sheath onto bottom of PTFE or PEEK cylindrical tube and position the assembly so the bottom of the heater sheath is approximately 5 cm (2 in) from the glass flask bottom.
(c) Fill the glass flask with the sample water through the clear plastic pipe attached to the copper tube until the water level can be seen and maintained in the plastic tube during the entire test.
(d) Turn on the heating element, set the temperature control to maintain a continuous temperature at 82°C ± 2°C (180°F ± 5°F), and set the magnetic stirrer speed to rotate the stirrer bar in the flask at approximately 200 rpm.
(e) Operate step (d) above for 23 h. and
(f) No additional water should need to be introduced during the test. If additional water is required, then demineralized water may be added via the copper pipe.
(g) At the end of the 23 h test, remove the PTFE/PEEK cylindrical tube and heating element assembly and allow it to dry.
  (i) Carefully unscrew the heater sheath from the holder by holding it at the end with cotton or plastic gloves so that no scale is removed;
  (ii) Remove rubber 'O' ring, rinse in demineralized water and dry in warm air.
  (iii) Weigh the heater sheath and scale deposits using an analytical balance to the nearest 0.1 mg (3.5 μoz); and.
  (iv) Photograph heater sheath after test.
(h) Dissolve the scale formed on the heater sheath by immersing the sheath up to the threads in 4M (HCl). Rinse the sheath in demineralized water and dry in warm air. Weigh again to the nearest 0.1 mg (3.5 μoz) using the analytical balance.
(i) Determine the amount of scale deposited on the sheath by deducting the weight of the sheath

after cleaning in 4M HCl with the weight of the sheath after the test.

(j) The 316 stainless steel cylindrical heater sheath shall be completely cleaned to its bare metal and re-used.
   (i) grip (GENTLY) the threaded end in a drill or lathe chuck; and,
   (ii) abrade with 400 grit SiC paper.

(k) Repeat steps (a) to (j) 3 additional times and obtain the mean weight of scale deposited from the (4) tests (WSc).

5.4 Rapid Scaling Test with Device – FOLLOWED.

The rapid scaling test with use of a device shall be conducted as follows:

(a) Install and the device onto the copper tubing per the device manufacturer's installation instructions. Alternatively, take a sample of treated water from the device off line.
(b) If appropriate according to the device manufacturer's installation instructions turn on the device before filling the flask with water.
(c) Repeat above step 5.3.1 (a) through 5.3.1 (j) for a total of 4 separate tests.
(d) Determine the mean weight of scale deposited over the 4 tests (WSd).

5.5 Percent Efficacy Determination - FOLLOWED

Determine the percent efficacy (η) of the scale reducing device by using the:

(a) mean weight of scale deposited from the control tests (WSc);
(b) mean weight of scale deposited from the tests with device (WSd); and,
(c) The following formula (η%):

$$\eta\% = \left(\frac{WSc - WSd}{WSc}\right) \times 100$$

Finding:

- Control test*:

Heat Sheath weight (mg)		Scale deposit net weight
Before HCl	After HCl	WSc (mg)
38005.6	37994.4	11.2
37999.4	37989.0	10.4
37987.8	37977.2	10.6
38001.7	37991.6	10.1
	Mean:	10.6

*Note: Water sample was provided by client, indicated as Las Vegas water.

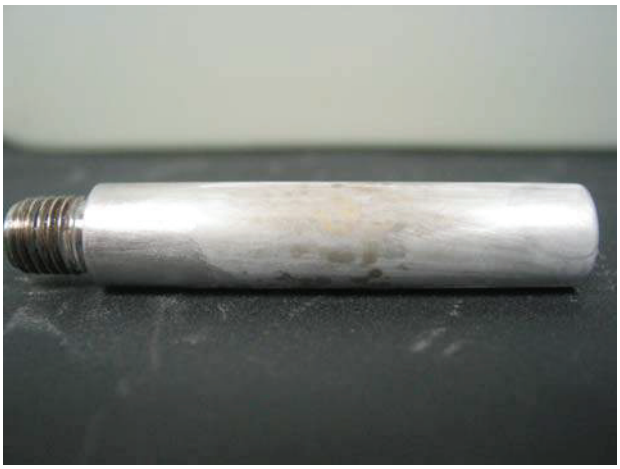
- Rapid scaling test with device:

Heat Sheath weight (mg)		Scale deposit net weight
Before HCl	After HCl	WSd (mg)
37999.6	37998.1	1.5
37992.6	37991.0	1.6
37999.6	37997.4	2.2
37966.1	37964.2	1.9
	Mean:	1.8

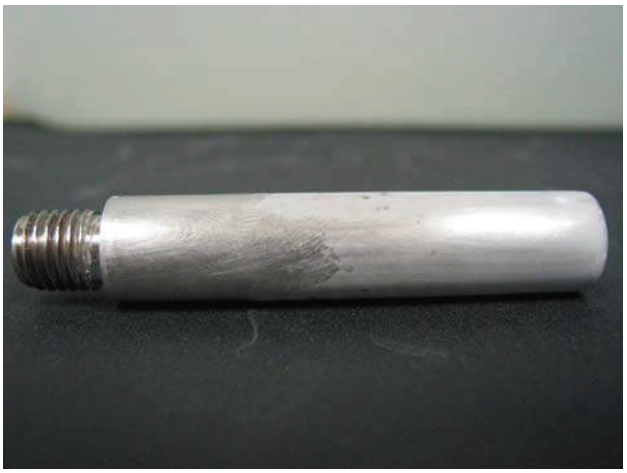
- Efficacy:

$$\eta\% = \frac{10.6 - 1.8}{10.6} \text{ x } 100 = 83\%.$$

Run # 1

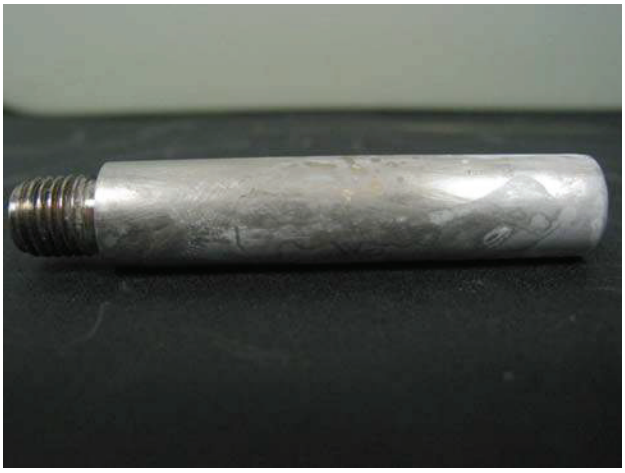


Control Test



Rapid Scale Test with Device

Run # 2



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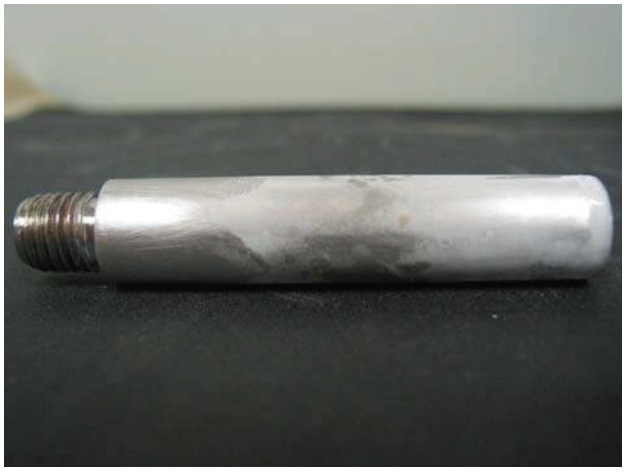

Rapid Scale Test with Device

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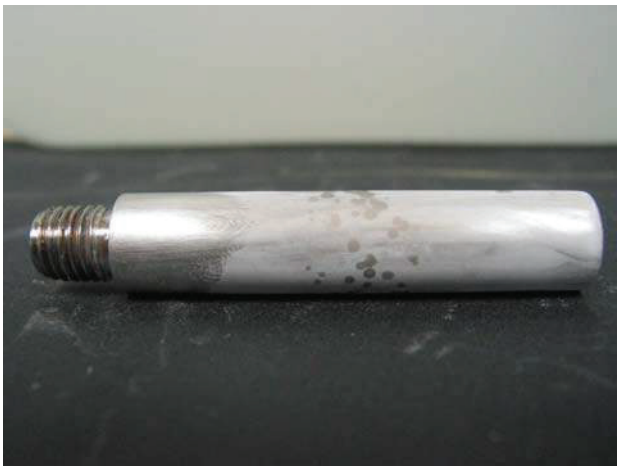
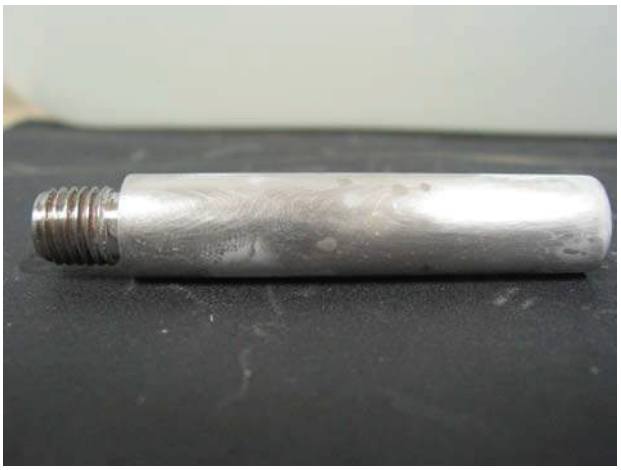


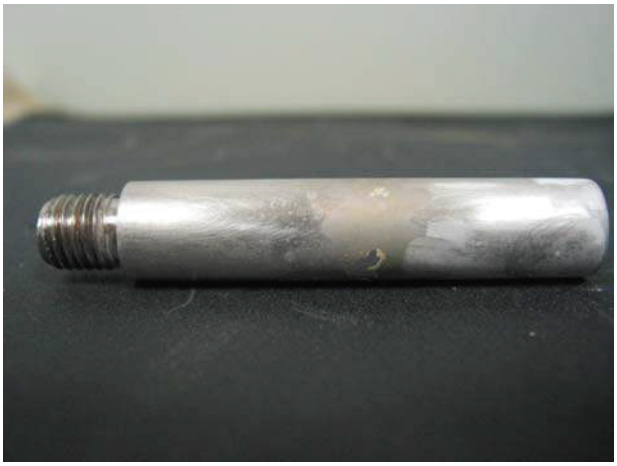
Control Test



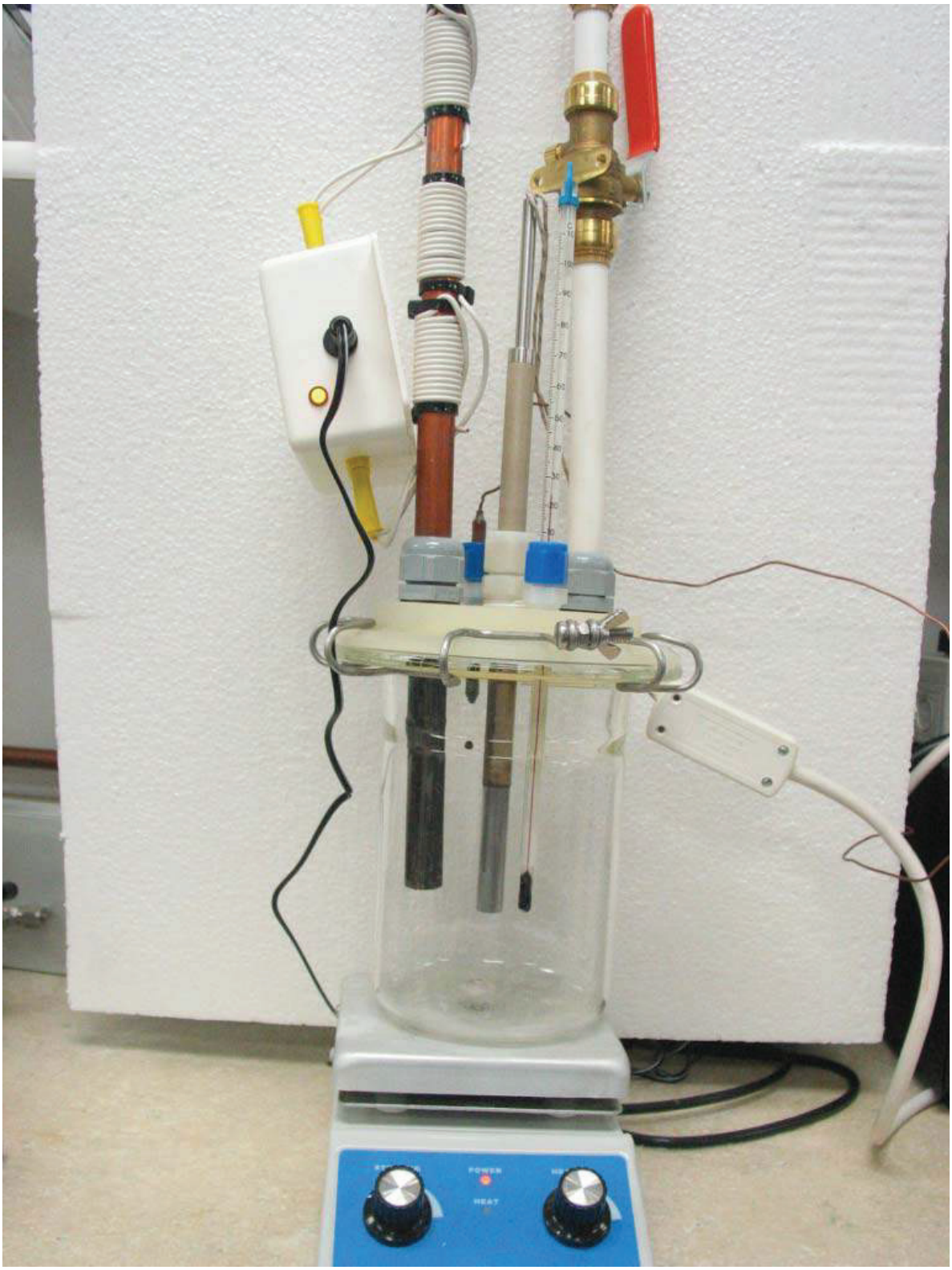
Rapid Scale Test with Device

Run # 4

Control Test



Rapid Scale Test with Device


POWER
HEAT

AQUA-REX® REPLACES WATER SOFTENERS AT THE PANORAMA TOWERS

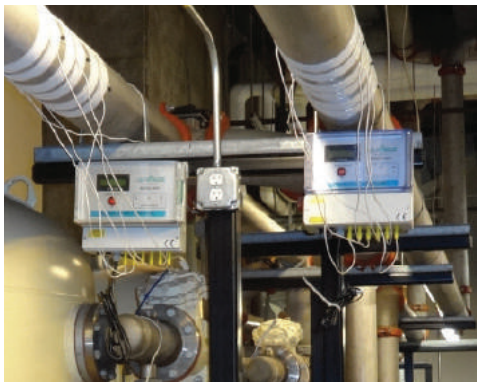
The Panorama Towers is a twin, 33 story, 635 unit luxury condominium high rise just off the Las Vegas strip which opened in 2006. At the time of construction a total of four conventional water softeners were installed on the ground floor and top floor of each tower to treat the hot water services.

In early 2013 one of the softeners required extensive repairs and the management company decided to investigate the use of Aqua-Rex. A total of four Aqua-Rex units were installed in place of one of the softeners and an extensive evaluation program was carried out over the next six months.

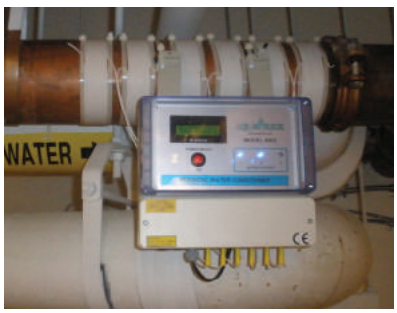
In December 2013 the HOA approved the purchase of additional Aqua-Rex units to treat both towers to replace the softeners entirely. As well as treating the hot water, these units also treat the previously unsoftened cold water services. This means that scaling is reduced in mixing valves, shower heads and faucets, whereas previously they all sufferd from this problem. The residents thus enjoy less scale problems than previously.

The cost of the installation was around $55,000 for both Towers using multiple Aqua-Rex in each pressure zone. The resultant savings in the first year of installation were calculated to be around $168,000 and over three years the savings are anticipated to be in excess of $500,000. No further expenditure for treating hard water is expected over the life of the building apart from electrical running costs of around $200 per annum.

The property management company, First Service Residential, has de-commissioned softeners and installed Aqua-Rex in four further Condominium properties in Las Vegas, The Martin, One Las Vegas, the Juhl and the Ogden.



WHAT IS AQUA-REX AND HOW DOES IT WORK?



First of all it is NOT a magnet nor an electro-magnet. It's actually a radio transmitter that puts ultra high frequency radio waves in the water that travel in the water in both directions, upstream and downstream. The radio waves change the structure of the iron (Fe) molecules to form nucleation seeds so the scale sticks to them instead of the surfaces where it would normally go. The scale forms as a non-adhesive powder in suspension instead of encrusting surfaces. The radio waves also create a resonance that breaks up existing scale so over a few weeks a plumbing system can be completely cleaned of old scale. The nucleation seeds also stimulate scale formation so there is less dissolved calcium in the hot water which is softer than it otherwise would be. The softer water is not slippery and slimey from the sodium dumped in it by a conventional softener.

All Aqua-Rex units have aerial wires that are wrapped around existing pipework. They are quick and simple to install, requiring no plumbing, no shut down or other disruptions. For further information download the Specifier Guide from our website www.aqua-rex.com. Remember Aqua-Rex comes with a no quibble, no condition money back guarantee. You have nothing to lose but your limescale!

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