

FUNCTIONAL TESTING OF A "SCALEWATCHER"

Report No TRA9192472

Anglesea Building
Anglesea Road
Portsmouth PO1 3DJ
Switchboard (0705) 827681

Introduction.

"Scalewatcher" is a mains operated electronic device designed to create a variable magnetic field around the cold water inlet pipe of a domestic hot water system. The output from the device is a square wave, with continuous frequency modulation in the lower frequency band. The purpose being to prevent scale build up on the heating surfaces within the indirect cylinder.

A further claim for the device is that once fitted, an already scaled system will gradually descale, improving heat transfer and thus providing economic benefits to the user.

The requirement was to build a laboratory test rig, which simulates a domestic hot water system, and would allow scaled indirect cylinders to be subject to accelerated testing for scale removal.

Method.

A scaled indirect cylinder was fed with mains cold water via a 10 gallon header tank and ball valve. The Scalewatcher magnetic coil was initially installed around the 22mm cold water pipe from the header to the cylinder by staff from Etcetera Marketing.

The outlet from the cylinder was piped to drain through a Honeywell motorised valve (energise to open). The cylinder indirect coil was supplied with hot water from a direct domestic cylinder with twin immersion heaters set to 80°C. A circulating pump operated constantly between the domestic cylinder and the test cylinder heating coil.

A thermostat was fitted to the test cylinder, wired to open the motorised valve when the water in the test cylinder reached 60°C. A Kent Instruments water meter was fitted in the 15mm line to the test cylinder header tank.

In order to check for the descaling effect of the Scalewatcher, a 100mm square "window" was cut in the side of the test cylinder, opposite the heating coil. The thickness of scale on the heating coil was measured at one point with a depth micrometer. Every few days the test cylinder was drained, the window opened and scale thickness measured. See Appendix 1 and 2.

Operation.

The Scalewatcher was switched on and water allowed to fill the fortic and test cylinders. The immersion heaters in the fortic cylinder were switched on. On reaching 80°C the circulating pump was started.

When the water in the test cylinder reached 60°C the thermostat opened the motorised valve and dumped hot water to drain. Cold treated water entered the test cylinder from the header tank until the cylinder thermostat closed the motorised valve. This was found to occur at 40°C.

Once the cycle had steadied, it was found that the test cylinder was heated from 40°C to 60°C in 25 minutes, after which 65 litres of hot water was dumped to drain in 4 minutes with the cycle repeating continuously.

At various intervals during the investigation, the test cylinder was drained and the scale on the indirect heating coil measured through the access panel. One readily accessible point was chosen for measurement each time. The anvil of a depth micrometer was placed on the scale and a measurement taken to the bare metal beneath.

Appendix 3 shows the indirect coil at the start of the test. Appendix 4 shows the same coil after 65058 litres flow with the scalewatcher installed and initial scale thickness reduced by half.

Appendix 5 shows the coil after three weeks operation without scalewatcher, at 125080 litres, and appendix 6 at the end of the test after the Scalewatcher had been refitted, at 173000 litres.

Results.

Thickness of scale on heating coil. Test started 10-3-92
 Test terminated 8-5-92 with 59 days of operation 14.00 HRS

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* * * * *
* DAY * WATER METER * SCALE THICKNESS (INCHES) *
* * * * * litres * ON INDIRECT COIL *
* * * * *
* 0 * - * 0.020 *
* 2 * 3760 * 0.015 *
* 6 * 12803 * 0.012 *
* 13 * 34917 * 0.012 *
* 17 * 46552 * 0.010 *
* 23 * 65058 * 0.010 scalewatcher *
* * * * * removed *
* * * * *
* * * * *
* 43 * 125080 * 0.015 scalewatcher *
* * * * * refitted *
* 59 * 173269 * 0.010 *
* * * * *
* * * * *
  
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Initial results indicated that the scale on the heating coil was reducing in thickness, but the rate of reduction soon slowed and by day 23 was no longer measurable.

It was then decided to remove the Scalewatcher and run the system to check that scale would actually form with the temperatures and flows in the test rig. After 20 days without Scalewatcher it was found that scale had formed all over the heating coil, and had built up at the measuring point to 0.015 inches.

On the advice of Etcetera Marketing, the Scalewatcher was repositioned on the inlet to the header tank and the test continued. Within 7 days the extra scale added during the 20 days without Scalewatcher had been removed, and scale thickness of 0.010 remained until the end of the test. The results are summarised in Appendix 7.

Comments.

1. Average water usage per person in a domestic household is estimated to be 136 litres/day. (Reference 1)

Taking hot water to be that used for bath/shower (17%) plus half the washing machine usage (6%) plus half the miscellaneous usage (17%), gives 40% of total usage which equals 54 litres per day per person.

Based on these assumptions, a 4 person household would use approximately 200 litres a day of hot water, thus the 173000 litres used in the test represents approximately 2 years 4 months of typical domestic operation.

2. The literature indicates that the mechanism by which the magnetic device prevents scale build up relies on the CaCO_3 in the water coagulating under the influence of the magnetic field and forming a sludge. This sludge is unable to adhere to a heat exchange surface, and either remains at the bottom of the cylinder or is flushed through if there is sufficient flow velocity.

After 173000 litres of water were heated in the test cylinder, no signs of sludge were visible during inspection. The inference being that any sludge formed had been flushed through the system.

3. The test cylinder had been removed from a domestic system some weeks before the test started, and had dried out during this time. It is possible that such dried scale does not readily desolve in treated water, and could be an explanation for the inability of the Scalewatcher to remove all the initial scale from the heat exchanger.

Conclusions.

1. While Scalewatcher was fitted to the test rig no additional scale formed on the heating coil.
2. The device removed some of the initial scale that was surrounding the heating coil, but after 46000 litres no further scale removal was observed.
3. The final results indicate that Scalewatcher is capable of removing freshly built up scale from the heating coil of an indirect domestic cylinder.



27/5/92