



Report Number: 0478

Performance of Hydromx Inhibitor (BC1181)
as tested according to BuildCert Standard
Specification for the Performance of Chemical
Inhibitors for the Use in Domestic Hot Water
Central Heating Systems.

Prepared for:

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Date: 02/10/2013

1. Introduction

Midland Corrosion Services Ltd. has been certified by BuildCert Ltd. (under the Chemical Inhibitors Approval Scheme) as an approved laboratory for carrying out the DWTA industry standard performance test for chemical inhibitors for use in central heating systems.

BuildCert supplied a sample of Hydromx Inhibitor (BC1181) for evaluation of its performance according to the DWTA industry standard specification for the performance of chemical inhibitors for use in domestic hot water central heating systems (Revision 27). The requested in-use concentration was 500ml in 1000ml (50% v/v).

2. Tests Carried Out

2.1. Corrosion Rate Determination

The corrosion tests in both standard hard and standard soft water were carried out according to the DWTA test –section 1. Metal coupons were obtained from European Corrosion Supplies Ltd together with analysis certificates.

The DWTA standard hard water was made using Evian Spring Water together with added analytical grade reagents. The DWTA standard soft water was made using Aqua Pura together with added analytical grade reagents. The compositions of both waters were checked with ICP and titration method to make sure that they were within specification before test solutions were made up.

Monitoring of stirrer speeds (Vos 14 overhead stirrers), gas bubbling and cell temperatures was carried out regularly during the tests. No interruptions or deviations from the test method were noted during either of the 14 day tests.

The test was run in two stages: with 4 cells tested for 336 hours, 31/7/13 – 14/8/13 and 4 cells for 360 hours, 21/8/13 – 5/9/13, which are the minimum and maximum permissible times allowed in the standard.

2.2. Scaling Determination

A solution of 50% v/v HYDROMX was made up in DWTA standard hard water. Three glass cells were filled with 1 litre of this solution and a freshly prepared stainless steel heater sheath and assembly was fitted to each cell. The solutions were heated to 82°C +/- 2.0°C using the internal 150 W heating elements for 168 hours (1 week). The temperature control box and platinum resistance thermometers were calibrated using a reference thermometer immediately before the start of the test.

After the end of the test, the heater sheaths were rinsed in demin water and dried. The amount of scale deposited on each heater sheath was determined by weighing each sheath before and after cleaning with 4M HCl using a calibrated 5 figure Mettler Toledo balance. After allowing the solution to cool and settle for 30 minutes, a 50ml sample of water from each cell was drawn from the top of the solution and sent for ICP analysis together with a sample of the original solution before the test.

2.3. Compatibility with Non-Metallic Materials

Rubber test pieces were cut from certified test sheets obtained from Clywd Compounders Ltd. The volume of each rubber test piece was determined before and after immersion in the test solution by weighing the pieces in air and in demineralised water using the Mettler Toledo analytical balance.

The eight rubber test pieces (4 of each rubber) were immersed individually in glass bottles containing 100ml of 100% v/v HYDROMX (double the recommended concentration of 50% v/v). The bottles were placed in a calibrated Genlab recirculating oven at 82 +/- 1°C for 96 hours. At the end of the test, the rubbers were inspected for any signs of deterioration using a stereo zoom microscope.

3. Results

3.1. Corrosion Rate Determination

Each coupon was weighed after the test and after cleaning 4 times in the recommended acidic cleaning solutions using the 5-figure Mettler Toledo analytical balance. By plotting the results on a graph, corrected weight losses adjusting for any metal losses due to cleaning were obtained.

The corrosion rates derived from the corrected weight losses are shown in the appendices (adjusted for different test periods). The mean corrosion rates for all metals in 50% HYDROMX in both hard and soft waters were below the limits set in the DWTA test standard. The appearance of the coupons after testing is shown in the plates at the end of the report.

3.2. Scaling Tendency

Limescale deposition on the heater sheaths after testing was found to be 7.9mg, 3.0mg and 3.5mg for each of the 3 heater sheaths. The ICP analysis results (given in the appendix) for HYDROMX showed that the mean reduction in calcium levels was 8.7%, and hence below the 15% limit.

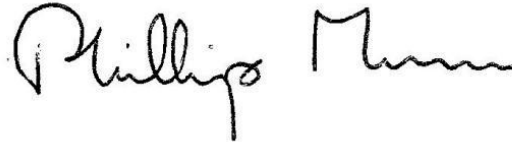
3.3. Compatibility with Non-Metallic Materials

The results given in the appendix show that the volume swells on all 3 EPDM rubbers and NBR rubber after immersion in 100% v/v HYDROMX in standard soft water were a maximum of 2.3% (for EPDM 70 resin cured). The difference in volume swells between those measured in the test solution above those measured in standard soft water were - 2.5% at most (with Hydromx giving a lower volume swell than in untreated water) and therefore were below the 5% limit set in the standard. No visible deterioration of the rubber specimens was apparent after testing when viewed at low magnification under the stereo zoom microscope.

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4. Conclusions

HYDROMX inhibitor, tested at the recommended in use strength of 50% v/v and at 2 x this concentration for rubber compatibility testing, comply with the DWTA industry standard specification for the performance of chemical inhibitors for use in domestic hot water central heating systems



Signed.....

Date.....2/10/13

Phillip Munn
Director

Appearance of Corrosion Coupons after Testing

Hydromx 30/07/13

50% v/v in Std Hard Water

Tested : Wed 31/07/2013 – Wed 14/08/2013



Bundle 1 = HW forced aeration



Bundle 2 = HW natural aeration

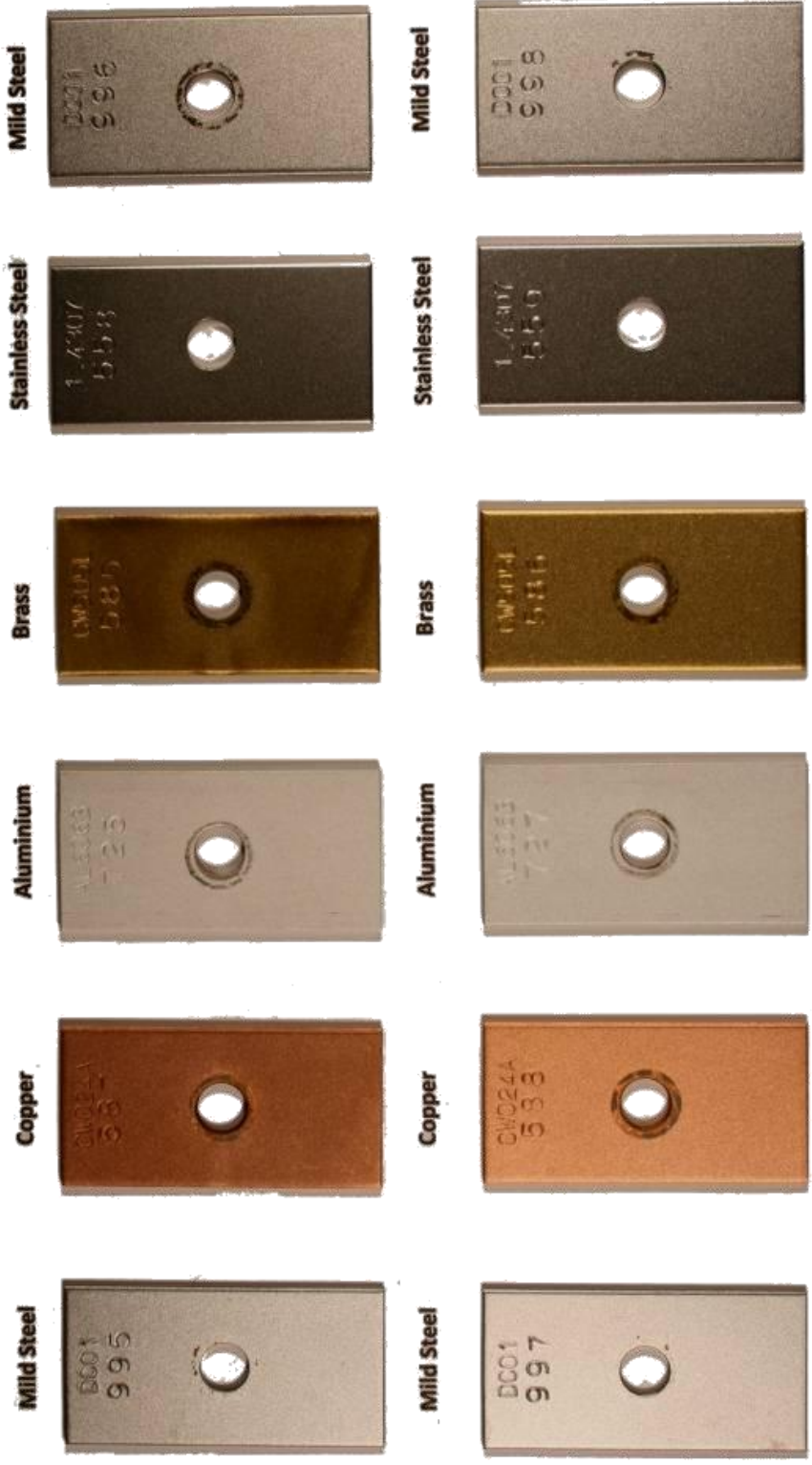


Inhibitor : Hydromx 30/07/13

Forced and natural aeration 50% v/v in Std HW

Tested: 21/08/13 – 05/09/13

Bundles 1 and 2



Hydromx 30/07/13

50% v/v in Std Soft Water

Tested : Wed 31/07/2013 -- Wed 14/08/2013



MCS
Midland Corrosion Services Ltd.

Bundle 3 = SW forced aeration

Mild Steel



Mild Steel



Copper



Aluminium



Brass



Stainless Steel



Bundle 4 = SW natural aeration

Mild Steel



Mild Steel



Copper



Aluminium



Brass



Stainless Steel



Inhibitor: Hydromx 30/07/13

Forced and natural aeration 50% v/v in Std SW

Tested: 21/08/13 -- 05/09/13

Bundles 3 and 4



Section 1. General Corrosion Rate

Batch Reference/Supplier of coupons

European Corrosion Supplies, HYDROMX

Water Analysis: Aquasolve/MCS

Water Source: Evian and Aquapura bottled water

Water Dilution: 50% v/v

Test Dates: 1) 31/7/13-14/8/13 (336 hours)

Test Dates: 2) 21/8/13-5/9/13 (360 hours)

Absolute corrosion rate

	Corrosion rate measured, mm/50ear							
	Hard water, air sparging		Hard water, natural aeration		Soft water, air sparging		Soft water, natural aeration	
Metal	Coupon bundle 1	Coupon bundle 2	Coupon bundle 1	Coupon bundle 2	Coupon bundle 1	Coupon bundle 2	Coupon bundle 1	Coupon bundle 2
Stainless steel	0.0010	0.0005	0.0010	0.0007	0.0009	0.0005	0.0008	0.0007
	Average: 0.0008		Average: 0.0009		Average: 0.0007		Average: 0.0008	
Copper	0.0038	0.0046	0.0047	0.0036	0.0048	0.0045	0.0049	0.0048
	Average: 0.0042		Average: 0.0042		Average: 0.0047		Average: 0.0049	
Extruded aluminium	0.095	0.087	0.0896	0.101	0.092	0.094	0.0997	0.090
	Average: 0.091		Average: 0.095		Average: 0.093		Average: 0.095	
Brass	0.0034	0.0046	0.0034	0.0033	0.0052	0.0043	0.0030	0.0039
	Average: 0.0040		Average: 0.0033		Average: 0.0048		Average: 0.0034	
Mild Steel	0.0040	0.0021	0.0044	0.0009	0.0021	0.0016	0.0018	0.0006
	0.0028	0.0010	0.0041	0.0012	0.0030	0.0011	0.0029	0.0024
	Average: 0.0025		Average: 0.0026		Average: 0.0020		Average: 0.0019	

Additional notes:	
Disruptions / equipment failure? None	Date:
Detail:	

Pitting Density

	Number of Pits: none							
	Hard water, air sparging		Hard water, natural aeration		Soft water, air sparging		Soft water, natural aeration	
Metal	Coupon bundle 1	Coupon bundle 2	Coupon bundle 3	Coupon bundle 4	Coupon bundle 1	Coupon bundle 2	Coupon bundle 3	Coupon bundle 4
Stainless steel	0	0	0	0	0	0	0	0
	Average: 0		Average: 0		Average: 0		Average: 0	
Copper	0	0	0	0	0	0	0	0
	Average: 0		Average: 0		Average: 0		Average: 0	
Extruded aluminium	0	0	0	0	0	0	0	0
	Average: 0		Average: 0		Average: 0		Average: 0	
Brass	0	0	0	0	0	0	0	0
	Average: 0		Average: 0		Average: 0		Average: 0	
Mild Steel	0	0	0	0	0	0	0	0
	Average: 0		Average: 0		Average: 0		Average: 0	

Section 2: Scaling tendency

Laboratory Reference of Heater Sheath Used:

Water Analysis: Aquasolve Report: 4101

Water Source: Evian Bottled, J16:03

Water Dilution Required: 50%

Test Start: Wed. 18/09/2013

Test End: Wed. 25/09/2013

	Reduction in calcium ion concentration (%)	Mean reduction in calcium ion concentration (%)
Test 1	9.3%	8.7%
Test 2	3.9%	
Test 3	13.2%	

Compatibility with non-metallic materials

Batch Reference and supplier of Rubber: Clydd Compounders, Ref HYDROMX

Water Analysis: Aquasolve /MCS HYDROMX

Test Start: 10/09/2013

Test End: 24/09/2013

Non-metallic material	% change in volume of samples in control test (synthetic soft water)		% change in volume of samples in test solution, with inhibitor		% age change in volume – control vs. inhibitor	Visual inspection notes
	Set 1	Set 2	Set 1	Set2		
EPDM 70, sulphur-cured	0.57	0.60	-.01	-0.14	-0.66	OK
	Average: 0.58		Average: -0.07			
EPDM 70, peroxide-cured	1.47	1.47	0.44	0.21	-1.14	OK
	Average: 1.47		Average: 0.32			
EPDM 70, resin- cured	2.67	2.82	2.33	2.22	-0.47	OK
	Average: 2.74		Average: 2.28			
NBR 70, peroxide-cured	3.63	3.78	1.24	1.19	-2.49	OK
	Average: 3.71		Average: 1.22			