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WATER REGULATIONS ADVISORY SCHEME (WRAS).

TESTING OF NON-METALLIC MATERIALS FOR USE WITH DRINKING WATER (BS 6920 : 2000)

TEST REPORT

Product : Hydrotite CJ-0725-3K
Report Reference : M 103076B/M 103174B
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Thoron (Hong Kong) Limited
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HONG KONG

Report Date : 15th July 2003

Executive Summary - this product has met the requirements of the Water Regulations Advisory Scheme (WRAS) Tests of Effect on Water Quality/BS 6920:2000 Cold Water Use.

NOTES.
1. The results given in this report relate only to the items tested, and not necessarily to the bulk from which they were taken.
2. This test work was undertaken in the UKAS accredited Spencer House laboratory of Thames Water Utilities Ltd., UKAS registration number 0677, unless otherwise stated.
3. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
4. This test report shall not be reproduced, except in full, without our prior written approval.

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TESTING OF NON-METALLIC MATERIALS FOR USE WITH DRINKING WATER. WATER REGULATIONS ADVISORY SCHEME TESTS OF EFFECT ON WATER QUALITY (BS 6920).

0. INTRODUCTION.

The samples of the product referred to in this report have been tested in accordance with the methods of the Water Regulations Advisory Scheme (WRAS) Tests of Effect on Water Quality/BS 6920-2:2000 "Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water : Methods of Test".

1. TEST SAMPLES.

General composition of product	**Chloroprene Rubber**
Trade name/designation	**Hydrotite CJ-0725-3K**
Material manufacturer	C. I. Kasei Co. Ltd
Date of manufacture/production	Not Supplied
Production batch numbers	Not Supplied
Submitting organisation	Thoron (Hong Kong) Limited
Date of receipt of test samples	(1) 22nd April 2003 (2) 5th September 2003
Method of packaging	(1) Plastic bag (2) Paper envelope
Condition on receipt	Satisfactory
Laboratory storage before test	Ambient temperature (21±4)°C

Description	test article	Cut section of strip
	shape	Rectangular
	dimensions	25mm x 12mm x 7mm
Appearance of article	colour	Green/Blue/Black
	surface finish	Matt
	opacity	Opaque
Surface area of one article (mm^2)		~1000
Number of articles to give a surface area of 1000mm^2		1
Calibration mark of the test vessel/container in litres		1
Extraction temperature used for tests 2, 3, 5 & 6		(23±2)°C

SUPPLEMENTARY TESTING - fresh samples were submitted for Duplicate Odour & Flavour of Water re-testing. No changes in formulation/method of manufacture have been made.

2. SUPPLEMENTARY ODOUR & FLAVOUR OF WATER TEST (In duplicate).
Temperature of extraction : 23°C Date test started : 09.09/03.

The extracts detailed below were compared with the procedural blank test waters by a panel of 3 testers. The following results were obtained for the test extracts.

Extract	Test water	Test	Descriptors	Threshold dilutions
First	Chlorine free	Odour	None	[redacted]
		Flavour	None	<1
	Chlorinated	Odour	Rubber/None/None	[redacted]
		Flavour	--	--
Final	Chlorine free	Odour	--	[redacted]
		Flavour	--	--
	Chlorinated	Odour	None	[redacted]
		Flavour	None-	<1

Extract	Test water	Test	Descriptors	Threshold dilutions
First	Chlorine free	Odour	None	[redacted]
		Flavour	None	<1
	Chlorinated	Odour	Rubber/None/None	[redacted]
		Flavour	--	--
Final	Chlorine free	Odour	--	[redacted]
		Flavour	--	--
	Chlorinated	Odour	None	[redacted]
		Flavour	None-	<1

COMMENT. On the basis of these results the samples of this product have been found ***to conform*** with the requirements of BS 6920-1 : Clause 4 when extracted in duplicate at 23°C.

3. APPEARANCE OF WATER.

Temperature of extraction : 23°C

Date test started : 29/04/03.

	Colour (Hazen Units)*		Turbidity (Formazine Nephelometric Units)*	
	First Extract	*Final Extract*	*First Extract*	*Final Extract*
Test sample extract	**<1.0**	--	**<0.10**	--
Reagent blank	<1.0	--	<0.10	--
Test sample effect	***<1.0***	--	***<0.10***	--

[* - method code 321]

COMMENT. On the basis of these results the sample of this product has been found ***to conform*** with the requirements of BS 6920-1 : Clause 5 when extracted at 23°C.

4. GROWTH OF AQUATIC MICROORGANISMS.

Temperature of test : 30°C.

Date test started : 29/04/03.

Container	Mean Dissolved Oxygen Difference (MDOD) in mg/L
Test product (weeks 5 to 7)	1.5
Negative reference (glass) (weeks 5 to 7)	0.1
Positive reference (wax) (weeks 5 to 7)	7.4
Special positive reference	n/a
Negative control - Mean dissolved oxygen concentration (weeks 5 to 7)	8.0

COMMENT. On the basis of these results the sample of this product has been found ***to conform*** with the requirements of BS 6920-1 : Clause 6.

At the end of this test the test pieces showed no changes in colour and appearance.

5. THE EXTRACTION OF SUBSTANCES THAT MAY BE OF CONCERN TO PUBLIC HEALTH.

Temperature of extraction : 23°C

Date test started : 29/04/03.

The extracts from the product and the blank were used to prepare culture media for use with a monkey kidney cell line (VERO ATCC CCL 81) - [method code 256].

Attribute	**Test sample extract**	Reagent blank	Zinc sulfate solution
Cell morphology (Microscopy)	**Satisfactory**	Satisfactory	Cell death
Culture medium (colour)	Normal	Normal	Abnormal (alkaline)
Monolayer confluence (approx %)	100%	100%	0%

COMMENT. On the basis of these test results the extract of this product has been found to give a non-cytotoxic response, and therefore it has been found ***to conform*** with the requirements of BS 6920-1 : Clause 7 when extracted at 23°C.

6. EXTRACTION OF METALS.

Temperature of extraction : 23°C

Date test started : 29/04/03.

The results obtained for the first extract are given below -

Element		Unit	MAC	Reporting limit	Sample 1	Sample 2	Reagent blank
Aluminium	Al	µg/L	200	14.0	<14.0	<14.0	<14.0
Antimony	Sb	µg/L	10	0.8	<0.8	<0.8	<0.8
Arsenic	As	µg/L	50	0.8	<0.8	<0.8	<0.8
Barium	Ba	µg/L	1000	3.0	<3.0	<3.0	<3.0
Cadmium	Cd	µg/L	5	0.5	<0.5	<0.5	<0.5
Chromium	Cr	µg/L	50	5.0	<5.0	<5.0	<5.0
Iron	Fe	µg/L	200	12.0	<12.0	<12.0	<12.0
Lead	Pb	µg/L	50	0.5	<0.5	0.6	<0.5
Manganese	Mn	µg/L	50	3.0	<3.0	<3.0	<3.0
Mercury	Hg	µg/L	1	0.05	<0.05	<0.05	<0.05
Nickel	Ni	µg/L	50	2.0	<2.0	<2.0	<2.0
Selenium	Se	µg/L	10	0.5	<0.5	<0.5	<0.5
Silver	Ag	µg/L	10	1.0	<1.0	<1.0	<1.0

Extract Analytical.

The analysis of the extracts for these metals was undertaken in the Millharbour Laboratories of Thames Water, UKAS registration number 1258.

Mercury, arsenic, selenium, antimony, silver and lead - inductively coupled plasma mass spectrometry [method code 407].
Aluminium, barium, cadmium, chromium, iron, manganese, and nickel - inductively coupled plasma optical emission spectrometry [method code 385].

Analytical Control Data - these two techniques are in continuous use for analysis of drinking water metals; all of these techniques are fully validated to the requirements of "A Manual on Analytical Quality Control for the Water Industry" (NS 30) and the requirements laid down by the Drinking Water Inspectorate. Each technique has a comprehensive AQC protocol including control solutions and spike recovery testing with each batch of samples for analysis; full details available upon request.

COMMENT. On the basis of these results the samples of this product have been found *to conform* with the requirements of BS 6920-1 : Clause 8 when extracted at 23°C.

CONCLUSIONS.

The samples of this product have been tested at the reduced surface area of 1000mm² in 1 Litre of test water, and under these conditions of test the samples meet the test criteria of BS 6920-1:2000 ("Specification") and thus DO conform with the requirements of the Water Regulations Advisory Scheme (WRAS) Tests of Effect on Water Quality, for use with cold water.

NOTES :
(1) It has not been assessed for compliance with these test requirements at the normal surface area of 15 000mm² in 1 Litre of test water.
(2) On this basis and in light of the review of Water Industry Specification 4-31-02 (Specification for Plasticised PVC Waterstops for use in Construction, Contraction and Expansion Joints in Concrete Water Retaining Structures) this product is satisfactory, in terms of its effect on water quality, for use in reservoirs constructed in accordance with BS 8007:1987 design criteria with respect to nommal frequency of joints, provided that the PVC waterstops are not used in direct contact with potable water and are of the "Cast-in" type.
(3) materials and products intended for use by a public water supply company in the preparation or conveyance of water may need to satisfy more comprehensive toxicological requirements as set specified by the Drinking Water Inspectorate. These additional requirements are necessary to ensure legal compliance with Regulation 25 of the Water Supply (Water Quality) Regulations 1989.

NOTES -
1. The results specified in this report relate to the samples submitted for evaluation and not necessarily to the bulk from which they were taken. Any changes in the nature or source of ingredients and the process of manufacture or application could affect the suitability of the product for use in contact with drinking water.
2. We would draw to your attention that reports issued by the accredited test laboratories do not of themselves constitute approval by the Water Regulations Advisory Scheme (WRAS) or the test laboratory. Only a letter from the Scheme, citing a Directory Reference Number, can be regarded as indicating approval.

C. Stokell

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WATER REGULATIONS ADVISORY SCHEME (WRAS) TESTS OF EFFECT ON WATER QUALITY : TEST CRITERIA (BS 6920:2000).

The following test criteria are used to determine whether your product(s) complies with the requirements of the Water Regulations Advisory Scheme (WRAS) Tests of Effect on Water Quality.

1. ODOUR & FLAVOUR OF WATER. (BS 6920-1 : Clause 4)
Off-odours and off-flavours of water are the most usual causes of customer complaints about water quality. On test the material is exposed, under controlled conditions (surface area to volume (S/V) test ratio, duration, temperature) to the test water (with and without free-chlorine); it is subsequently diluted twice on a 1 to 1 basis and assessed by a test panel.

The test sample leachates must be free from odour and, after dilution, free from flavour in the first 1:1 dilutions of them. If, after 7 sequential leaching periods, any odour is detected in the sample leachates or any flavour detected in the first dilution of these leachates by any of the three panellists, then the product fails to meet this test criterion *unless* two further sets of test samples are assessed and no odour is reported in the leachates and no flavour is reported in the first dilutions of the final (i.e. seventh) leachates from these additional test samples.
Materials meeting these test criteria do not usually give rise to off-odours and off-flavours in-service.

2. APPEARANCE OF WATER. (BS 6920-1 : Clause 5)
Any increase in the colour and turbidity of the final (i.e. seventh) leachate from the sample of the product must be less than 5 Hazen units and 0.5 FNU respectively. If any colour or turbidity is detected in the final extract, then the product fails to meet the test criteria *unless* two further samples are tested and the mean of the colour and turbidity measurements of the final extracts of *all* of the samples meet the test criteria.
Materials meeting these test criteria do not usually give rise to in-service changes in the appearance of water.

3. GROWTH OF AQUATIC MICROORGANISMS. (BS 6920-1 : Clause 6)
The original methods were based on microbiological counting techniques and the test took a longer time period and cost considerably more (in real terms) than the present test. In an attempt to improve the performance of the test, including duration, other techniques were evaluated for assessing materials for the supports of biofilms and overall growth in water. Work using dissolved oxygen depletion measurements as a surrogate measure of microbial growth in water showed improved reproducibility and repeatability compared with bacterial counts. The mean dissolved oxygen difference (MDOD) value obtained for the product is a surrogate measure of its ability to support the growth of microorganisms - as the growth of the organisms increases oxygen is removed from the test system; thus the greater the loss of dissolved oxygen caused by the product, the greater the MDOD value. This work was subsequently published (Colbourne and Brown, 1979) and incorporated into BS 6920 : Section 2.4:1988.

The mean dissolved oxygen difference between the water in contact with the sample of the product and the negative control system must be less than 2.4 mg/l; two further test samples of products giving a value in the range 1.7 to 2.9 mg/L are tested and the mean of the three readings used to show conformity with the test requirement s(<2.4 mg/l).
The pass/fail criterion was set after consideration of results obtained from materials using microbial counts and evaluation of materials associated with biofilm development and/or microbial deterioration in water quality in-service.

4. THE EXTRACTION OF SUBSTANCES.... (CYTOTOXICITY TEST) (BS 6920-1 : Clause 7)
If the first aqueous extract from the sample of the product is free from toxicity to the test cell line, it can be regarded as suitable for use in contact with potable water in relation to this particular test. If any toxicity is detected in this extract, then the product fails to meet the test criteria *unless* two further samples are tested and found to be free from any toxic response.
A failure in this test is indicative only of a possible public health issue and NOT necessarily of a real concern.

5. THE EXTRACTION OF METALS. (BS 6920-1 : Clause 8)
Any metal present in the final duplicate extracts obtained from the samples of the product must be at levels less than Maximum Admissible Levels (MACs) based on both the first and subsequent EU Drinking Water Directives If the MACs of any metal is exceeded in either of the final extracts from the samples of the product then the product fails to meet this test criterion *unless* three further samples of the product are tested and the levels of the specified metals in the extracts from all of these additional samples do not exceed the MACs.
Materials meeting these test criteria do not usually give rise to significant in-service changes in the concentrations of metals in water.