FILTRATION SYSTEM TECHNICAL REPORT

AQUA PLANET LIMITED

worting house basingstoke RG23 8PY

tel 01256 345537 fax 01256 478479 email info@aquaplanet.co.uk

www.aquaplanet.co.uk

THE IMPORTANCE OF WATER RESEARCH COUNCIL APPROVAL

All equipment fitted to the mains water supply must comply with water byelaws.

Since 1983, the Water Research Council (WRC) has been responsible for the Water Byelaws Scheme. This has now been updated to the Water Regulations Advisory Scheme (WRAS)

The scheme operates in the UK on behalf of all the water companies and provides a service to examine and test water products to ascertain whether they comply with the byelaws for prevention of waste, due consumption, misuse or contamination of the water supply.

Once found to comply, the water fitting can then be marketed and fitted anywhere in the country without further testing by individual water companies.

The advantages are many :-

- for the manufacturer, once the product has been approved it can be sold anywhere in the country in compliance with byelaws and without further testing. This is now applicable throughout the EU as the WRC/WRAS is recognised under EU directives.
- for the water authority, there is no longer the need to test every new fitting appearing in their area
- the user can rest assured the product does meet water byelaws and can check from the schemeís list of fittings that the intended purchase is indeed approved.

Fitting equipment not complying with the Water Bylaws regulations can lead to a large fine and removal of the equipment by the local water authority.

Because of the importance of WRC/WRAS approval many companies marketing water treatment products claim the components used to manufacture their products are approved.
This is not good enough.
A particular component may be quite harmless on its own but when placed in contact or close proximity to another may create a chemical reaction and thus cause contamination of the water supply.

If the company cannot produce a certificate, they do not have WRC/WRAS approval for their product.

(see end of report)

TECHNICAL INFORMATION - MEDIA

GRANULATED ACTIVATED CARBON

Grade - 207a pyrolised.
Derived from coal.
Surface area - 1100-1200 square metres per gram.
Density - 0.49-0.53gm/cc.
Silver impregnated at 0.105% to maintain bacteriostasis.
Pyrolised to minimise leaching of silver and to help maintain bacteriostasis throughout filter life.

Activated carbons catalyse chlorine to chloride which, at the concentrations found in drinking water, will be totally non-toxic and undetectable to taste. Activated carbons are the preferred technology for the adsorption of organic molecules and effectively deal with those contaminants that give rise to problems of colour, odour & taste as well as a wide spectrum of organic contaminants such as industrial solvents, pesticides and biological break-down products eg ammonia, amines etc.

REDOX ALLOY

Alloy of high purity electrolytic copper and zinc.
Colour - gold.
Form - granulated.
Apparent density - 2.6gm/cc.

This alloy has a reduction/oxidation (REDOX) potential of contaminants and allows spontaneous REDOX reactions of contaminants to occur in a fluid medium i.e. electrons are transferred between the REDOX alloy and the contaminant. When a metallic contaminant is present in the influent water, an electrical potential is created between itself and the copper/zinc alloy. The further apart in the electromotive force series the metals are, the greater the difference in electrical potential and thus the greater rate of corrosion (the REDOX alloy exploits corrosion principles). The contaminant metallic ion is effectively removed by electroplating itself against the REDOX alloy in exchange for copper or zinc. The release of copper and zinc falls well within the relevant E.U. limits for potable water.

Due to its strong REDOX potential the REDOX alloy effectively kills algae and fungi and will control bacterial growth, especially during standstill periods when conditions for bacterial growth are most favourable. It complements and enhances the properties of carbon when used in conjunction with G.A.C.

TESTING

To ensure the quality of our products, our filters have been extensively tested by a major British university, to verify performance and safety. As the REDOX alloy is a relatively new concept in water filtration in the UK, special emphasis was placed on the testing of the heavy metal reduction filters employing this media.

The test report clearly shows that water treated by the heavy metal reduction filters conforms in all respects to the statutory requirements specified by the E.U. directives on drinking water quality and World Health Organisation standards.

Contaminants tested included:

Ag	SILVER
Al	ALUMINIUM
As	ARSENIC
Cd	CADMIUM
Cr	CHROMIUM
Cu	COPPER
Fe	IRON
Hg	MERCURY
Mn	MANGANESE
Ni	NICKEL
Pb	LEAD
Zn	ZINC
Ca	CALCIUM
Mg	MAGNESIUM
	TRICHLOROETHANE
	LINDANE
	CHLOROFORM
	CHLORINE
	NITRATES
	NITRITES
	FLUORIDE
	TDS

The filters tested showed the ability to remove a wide range of chemical compounds from the water even after 15,000 litres had been passed through. The efficiency of the KDF/GAC unit under test appeared to decline only very slightly compared to its performance when new. Reductions were maintained.

Comparable systems using specialised activated carbons (notably bone charcoal) would be approaching the end of their effective life span with respect to metallic compounds at this throughput. Performance on nitrates was particularly impressive since reductions in these compounds are not usually associated with activated carbons.

Levels of calcium and magnesium salts, generally regarded as beneficial for healthy nutrition, remain constant.

THE PRODUCT HAS DEMONSTRATED ITS ABILITY TO PRODUCE TREATED WATER OF HIGHLY ACCEPTABLE QUALITY, EVEN WHEN CHALLENGED WITH CONTAMINANT LEVELS AT UP TO TWICE THE MAXIMUM ALLOWED CONCENTRATIONS.

INVESTIGATION OF KDF/CARBON WATER FILTERS

PROJECT 1693AB

CONSULTANT Dr S T Sparkes
Dept of Environmental Sciences
University of Plymouth
Drake Circus
Plymouth
PL4 8AA

Poly Enterprises Plymouth Ltd
Charles Cross
Constantine Street
Plymouth
PL4 8DE

July 1991

P E P
Consultancy
Training
Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

SUMMARY REPORT

The chemical purification characteristics of a KDF/carbon filter unit have been examined. The filter was installed on to a mains water supply and flushed for 1½ hours. Samples of influent and effluent water were examined for a range of analyses. Samples of tap water were spiked with a range of potential contaminants and the efficacy of the filter unit at removing these species assessed. This testing was performed at start-up and after approximately 15,000 litres of water had passed.

The results of the analyses show that the filters are able to remove a range of metals, anions and organic species from an influent water supply. The units are clearly able to remove the elements As, Cd, Cr, Cu, Fe, Hg, Mn, Ni and Pb from solution. The filters are also able to remove organochlorine compounds, pesticide, nitrite and fluoride from the water as well as substantially reduce the level of nitrate and chlorine. The filters appear to add small amounts of silver and zinc to the effluent water, but at levels well below maximum permissible concentrations.

P E P
Consultancy
Training
Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

EXPERIMENTAL DETAILS

Preparation of spiked water samples

At both stages of testing (start-up and 15,000 litres) a series of 20 litre water samples spiked with a range of potential contaminant species were prepared. The species and levels of spiking are listed in Table 1 (2)

Three separate spiked samples were prepared:

(a) Containing nitrate, nitrite, fluoride (as sodium salts) and chlorine (from sodium hypochlorite solution). Prepared in plastic and used immediately to avoid losses of Cl_2 to minimise risk of conversion of NO_3 and NO_2.

(b) Containing metals prepared from standard solutions of nitrate salts (unless otherwise specified) and stored in plastic before use. Chromium prepared from Cr (VI) oxide, and aluminium added as separate spike prepared from aluminium sulphate. It was not possible to confirm the chemical form of these species in the solution before use.

(c) Containing organic species (prepared from dilution of original compound in hexane). Prepared in glass to avoid loss to container.

The spiked samples were sampled prior to analysis and then pumped at 2 litres/min through the unit. Post filter samples were taken after approximately 15 litres of water had passed through the unit. The samples were run in order (a), (b), (c) and flushed for 15 to 30 minutes with tap water between spiked samples. Samples of water were collected for analysis using either plastic or glass containers.

P E P Consultancy Training Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

TABLE 1 DETERMINANDS AND SPIKING LEVELS

DETERMINAND	SPIKE LEVEL	EC MAX
Nitrate	100 mg/l	50 mg/l
Nitrite	1 mg/l	0.1 mg/l
Fluoride	3 mg/l	1.5 mg/l
Chlorine	2 mg/l	-
Ag	Not Spiked	10 (80) µg/l
As	100 µg/l	50 µg/l
Cd	100 µg/l	10 µg/l
Pb	100 µg/l	50 µg/l
Mn	100 µg/l	50 µg/l
Cr	100 µg/l	50 µg/l
Ni	100 µg/l	50 µg/l
Hg	100 µg/l	1 µg/l
Al	400 µg/l	200 _g/l
Fe	400 µg/l	200 µg/l
Zn	Not Spiked	5 mg/l
Ca	40 mg/l	-
Mg	15 mg/l	-
Cu	3 mg/l	3 mg/l
Chloroform	50 µg/l	0.1 µg/l
Trichloroethane	50 µg/l	0.1 µg/l
Lindane	50 µg/l	0.1 µg/l

P E P
Consultancy
Training
Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

SUMMARY OF ANALYTICAL METHODS

Nitrate, Nitrite, Fluoride
The above species were determined directly by ion chromatography with conductivity detection (3). Samples were analysed immediately after collection.

Metals
Metals were determined by Inductively Coupled Plasma-Mass Spectrometry. Where levels present were found to be greater than 0.2µg/l, the elements were determined by Direct Current Plasma-Atomic Emission Spectrometry (Al, Fe, Cu, Mg, Ca).

Organic Compounds
The three organochlorine compounds used in this investigation were determined using gas chromatography with electron capture detection. Approximately 2 litres of sample were collected and extracted with pentane (15 cm3, x2). The pentane extract was reduced to approximately 1 cm3 using a nitrogen jet and then transferred to a vial. The volume of extract in the vial was carefully reduced using a nitrogen jet and then transferred to a vial. The volume of extract in the vial was carefully reduced using a nitrogen jet with the vial cooled in a small ice bath to avoid losses of analyte.

Other parameters
Chlorine was determined using a proprietary test kit (BDH Chemicals Ltd) according to the manufacturers instructions, pH was determined using a pH meter and temperature using a mercury thermometer. Total dissolved solids were determined gravimetrically on a 500 cc sample of water.

P E P Consultancy Training Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

TABLE S1 Filter = KDF/GAC Volume = Startup (0) Trace Element Data

	Spiked water before filter	Spiked water after filter	% reduction
Chlorine	2.2	< 0.01	> 99.5
Nitrate	105	1.5	98.6
Nitrite	0.98	< 0.005	< 99.4
Fluoride	3.2	< 0.01	> 99.6
Ag	< 0.5	4.7	-
Al	440	140	68.2
As	98	< 2	> 98
Cd	98	< 0.5	> 99.5
Cr	103	0.7	99.3
Cu	3100	50	98.4
Fe	570	150	73.7
Hg	98	< 0.5	> 99.5
Mn	101	1.5	98.5
Ni	97	1.4	98.6
Pb	105	< 0.5	> 99.5
Zn	58	78	-
Ca	86.1	42.5	50.6
Mg	31.1	17.1	45.0
Chloroform	48	< 0.1	> 99.8
Trichloroethane	47	< 0.1	> 99.8
Lindane	51	< 0.1	> 99.8
pH	7.8	8.1	-
Temp (•C)	12	12	
Flow rate (l/min)	static	2	
TDS (mg/litre)	59	51	13.6

P E P Consultancy Training Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

TABLE S2 Filter = KDF/GAC Volume = 15250 litres Trace Element Data

	Spiked water before filter	Spiked water after filter	% reduction
Chlorine	2.1	< 0.01	> 99.5
Nitrate	98	2.3	97.7
Nitrite	1.1	< 0.005	> 99.5
Fluoride	3.1	< 0.05	> 98.4
Ag	1	4.1	-
Al	410	97	76.3
As	93	< 2	> 97.8
Cd	102	1.3	98.7
Cr	97	1.5	98.5
Cu	2980	73	97.5
Fe	530	210	60.4
Hg	103	3.2	96.9
Mn	106	7.3	93.1
Ni	95	15	84.2
Pb	98	2.1	97.9
Zn	65	170	-
Ca	90	45.2	49.8
Mg	32	23.3	27.2
Chloroform	51	< 0.1	> 99.8
Trichloroethane	49	< 0.1	> 99.8
Lindane	52	< 0.1	> 99.8
pH	7.8	8.0	-
Temp (•C)	12	13	
Flow rate (l/min)	static	2.1	
TDS (mg/litre)	53.5	51	4.7

P E P Consultancy Training Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

FILTER MICROBIOLOGICAL TESTING

SUPPLEMENTARY REPORT

EVALUATION OF WATER FILTER (MICROBIOLOGICAL TESTING)

The initial tests examined the microbial content of water passing through a single carbon/KDF filter supplied at 15,000 litres of water throughput. Supplementary tests continued on this filter up to 40,000 litres of water throughput.

SUPPLEMENTARY TESTS

The flow rate of the filter was set at approximately 6 litres per minute. The filter was run during the day but left to stagnate overnight and over one weekend. Samples of influent and effluent water were examined using membrane filtration and total aerobic plate counts at 3°C.

RESULTS

Approx. cumulative water throughput (litres)	Microbial count (c.f.u./100ml)	
	Influent	Effluent
22,880	39	40
31,310	39	37
40,008	39	42

From the data it appears that there is no significant increase or decrease in the microbial quality of the effluent water up to 40,000 litres

P E P Consultancy Training Research

Poly Enterprises Plymouth Ltd
Charles Cross Centre, Constantine Street
Plymouth, Devon PL4 8DE
Tel: 0752-225999/223424
Fax: 0752-222943

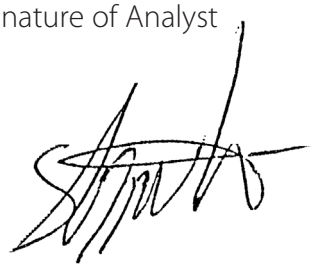
REFERENCES

1. G. Smith, Cambrian Water Consultants, Personal Comm., 23 April 1991

2. G. Smith, Cambrian Water Consultants, Report, 8 March 1991

3. The Determination of Anions and Cations, Transition Metals, Other Complex Ions and Organic Acids and Bases in Water by Chromatography 1990, HMSO

Signature of Analyst



Dr S T Sparkes BSc, PhD, MIEnc. Sci.

TAKEN FROM A REPORT BY
LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY CIVIL ENGINEERING

KDF FILTER

SHORT TERM REST RESULTS **FLOW RATE 1.51/MIN**

(1A) TOTAL COLIFORMS INFLOW CONCENTRATION 12 X 10^4/100ML 12 X 10^5/1L

Volume passed in mls	*Total Coliform In*	*Total Coliform Out*	*% Retained*
2,000	24 x 105 (2,400,000)	2 x 102 (200)	99.99
10,000	12 x 106 (12,000,000)	Zero	100.00

(1B) FAECAL COLIFORMS INFLOW CONCENTRATION 4 X 10^4/100ML 4 X 10^5/1L

Volume passed in mls	*Faecal Coliforms In*	*Faecal Coliforms Out*	*% Retained*
2,000	8 x 106 (8,000,000)	Zero	100.00
10,000	4 x 106 (4,000,000)	Zero	100.00

(1C) FAECAL STREPTOCOCCI INFLOW CONCENTRATION 13 X 10^3 PER 100ML 13 X 10^4/1L

Volume passed in mls	*Faecal Streps In*	*Faecal Streps Out*	*% Retained*
2,000	26 x 104 (260,000)	2 x 104 (20,000)	92.31
10,000	13 x 105 (1,300,000)	1 x 105 (100,000)	92.31

(2A) METALS

Metal	*Vol passed in mls*	*Metal Cone In (mg/L)*	*Metal Cone Out (mg/L)*	*% Retained*
Manganese	2,000	5.88	3.42	41.84
	10,000	5.88	3.48	40.82
Copper	2,000	5.2	0.1	98.08
	10,000	5.2	0.1	98.08
Lead	2,000	2.10	< 0.1	> 95.24
	10,000	2.10	< 0.1	> 95.24
Aluminium	2,000	1.5	< 0.1	> 93.33
	10,000	1.5	< 0.1	> 93.33
Iron	2,000	5.4	0.24	95.56
	10,000	5.4	0.32	94.07

(2B) NON-METALS

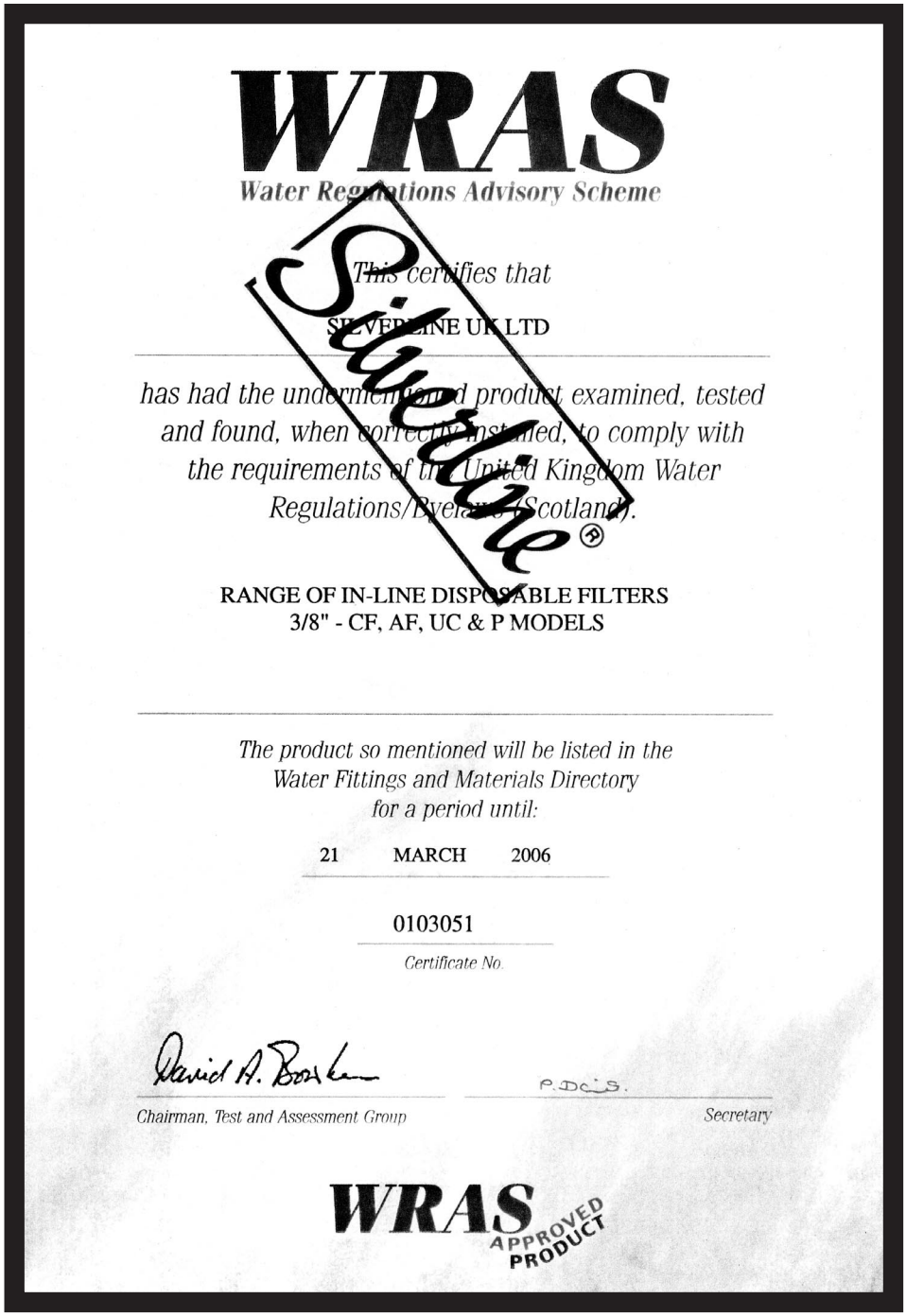
Metal	*Vol passed in mls*	*Metal Cone In (mg/L)*	*Metal Cone Out (mg/L)*	*% Retained*
Nitrates	2,000	55.1	1.9	96.55
	10,000	55.1	11.6	78.95
Chlorine	2,000	0.27	0.02	92.59
	10,000	0.24	0.00	100.00

CERTIFICATIONS

FILTERS

ALL AQUA PLANET FILTERS ARE WATER REGULATIONS ADVISORY SCHEME APPROVED.

LISTING NUMBER: 0103051



WRAS

Water Regulations Advisory Scheme

Silverline

This certifies that

SILVERLINE UK LTD

has had the undermentioned product examined, tested and found, when correctly installed, to comply with the requirements of the United Kingdom Water Regulations/Byelaws (Scotland).

RANGE OF IN-LINE DISPOSABLE FILTERS
3/8" - CF, AF, UC & P MODELS

The product so mentioned will be listed in the Water Fittings and Materials Directory for a period until:

21 MARCH 2006

0103051

Certificate No.

David A. Bowden — P. Davis.

Chairman, Test and Assessment Group — *Secretary*

WRAS APPROVED PRODUCT

COMPONENTS	ALL COMPONENTS CONFORM TO BS6920
MEDIA	REDOX ALLOY - APPROVED BY THE DRINKING WATER INSPECTORATE AND WATER REGULATIONS ADVISORY SCHEME
CARBON	APPROVED BY THE DRINKING WATER INSPECTORATE.
SAFETY	PRESSURE TESTS WERE PERFORMED ON THE 1.5, 2, 3 & 4 INCH OUTSIDE DIAMETER PIPES AND ALL WITHSTOOD COMFORTABLY THE SPECIFIED 100psi. COPY OF THE REPORT AVAILABLE ON REQUEST

AQUA PLANET LIMITED

worting house basingstoke RG23 8PY

tel 01256 345537 fax 01256 478479 email info@aquaplanet.co.uk

www.aquaplanet.co.uk