

*TRIAL CONDUCTED BY CAIRNS WATER QUALITY LABORATORY UNDER
DIRECTION FROM ECOSMARTE OBSERVING THE EFFECTIVENESS OF
COPPER IONISATION IN REDUCING BACTERIAL DENSITIES IN A NUMBER
OF SAMPLE MATRICIES.*

INTRODUCTION

A number of samples were subjected to copper ionisation with the equipment as supplied by EcoSmarte (See Appendix 1). Matrices under test were, raw water, effluent and laboratory broths of *Escherichia coli* and *Pseudomonas aeruginosa*. Laboratory reports are attached in Appendix 2.

For each sample type, the analyte under test was tested *prior to treatment* to determine the initial bacterial load under test. These are shown as *no treatment*.

Prior to each trial the column was filled with diluent water and analysed for the analyte under test to ensure no cross contamination.

The heterotrophic plate count procedure used in this trial is based on the Australian Standard AS 4276.3.1-1995. The heterotrophic plate count (formerly known as the standard plate count) attempts to provide a standardised means of determining the density of aerobic and facultative anaerobic heterotrophic bacteria in water containing no growth inhibiting additives. The heterotrophic plate count results are expressed as CFU/mL.

The faecal coliforms procedure used in this trial is based on Australian Standard AS 4276.7-1995. Faecal coliforms analysed by the membrane filtration methodology are expressed as CFU/100mL.

The *Escherichia coli* procedure used in this trial is based on the Australian Standard AS 4276.7-1995. *E.coli* analysed by the membrane filtration methodology are expressed as CFU/100mL.

The *Pseudomonas aeruginosa* procedure used in this trial is based on the Australian Standard AS 4276.6 13-1995. *Pseudomonas aeruginosa* analysed by the membrane filtration methodology are expressed as CFU/100mL.

TRIAL #1

Trial conducted 06.06.05

Sample Type: Raw Water**METHOD:**

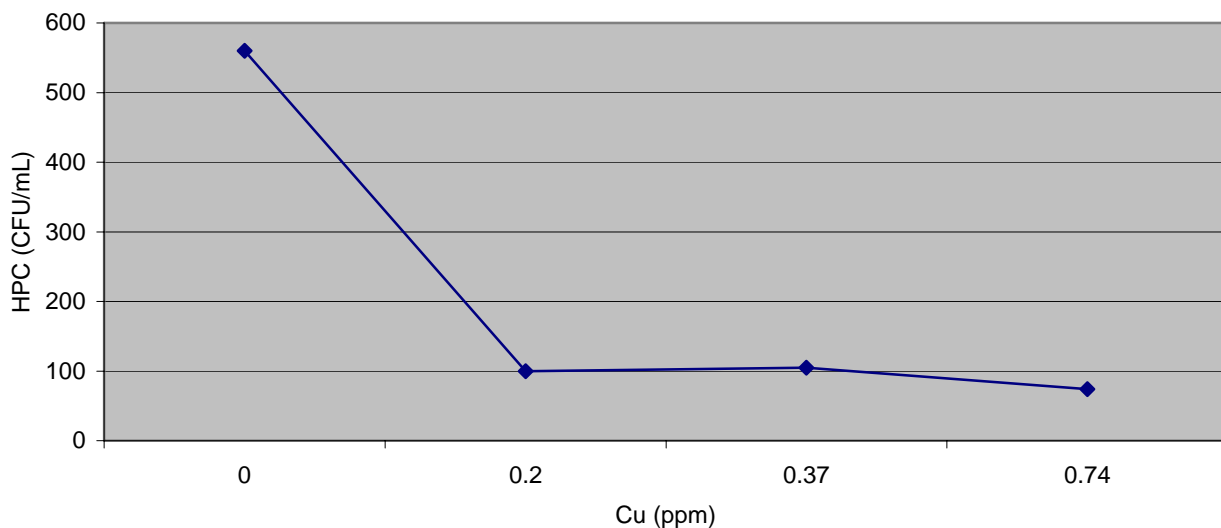
Ionisation column was filled with raw water and ionised for 10 seconds to give a copper level of 0.2ppm, 20 seconds 0.37ppm and 35 seconds 0.74ppm. A heterotrophic plate count was performed using 1mL of the sample and pour plated with heterotrophic plate count agar as per method TPB030. Samples were plated immediately after ionisation. See Table 1 and Chart 1 for results. The raw water had an initial heterotrophic plate count of 560 CFU/mL

RESULTS:**Table 1 : Effect of Copper Ionisation on Raw water heterotrophic plate count**

Ionise Time (secs)	Cu (ppm)	pH	EC $\mu\text{s}/\text{cm}^*$	CFU/mL [#]
No Ionisation	<0.1	7.6	44	560
10 seconds	0.2	7.4	44	100
20 seconds	0.37	7.4	44	105
35 seconds	0.74	7.3	45	74
Blank	na	na	na	<1

CFU – Colony Forming Units

- EC – Electrical conductivity (micro siemens)
- ppm – part per million

Chart 1: Effect of copper concentrations on heterotrophic plate count in raw water.**CONCLUSIONS:**

It is obvious from the chart above that copper does have some effect on the heterotrophic plate count in raw water. The total count was reduced from 560 to 70 CFU/mL. It was determined that some contact time may be needed to further reduce the heterotrophic plate count. Trial #2 explores this.

TRIAL #2

Trial Conducted 8/06/05.

Sample Type: Raw Water**METHOD:**

Ionisation column was filled with raw water and ionised for 10 seconds to give a copper level of 0.22ppm, 20 seconds 0.44ppm and 35 seconds 0.7ppm. A heterotrophic plate count was performed using 1mL of the sample and pour plated with heterotrophic plate count agar as per method TPB030. Samples were plated immediately after ionisation. See Table 2 and Chart 2 for results. The raw water had an initial heterotrophic plate count of 610 CFU/mL

RESULTS:

Table 2 : Effect of Copper Ionisation on Raw water heterotrophic plate count after contact time.

No Treatment 610 CFU/mL

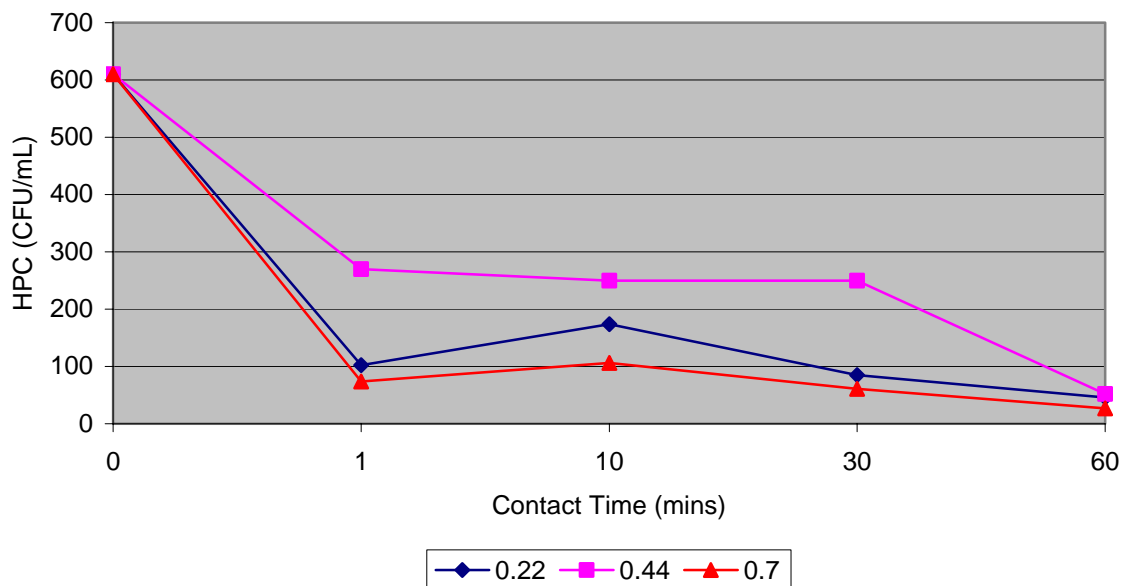
Blank <1 CFU/mL

Contact Time (mins)	Copper Level (ppm)		
	0.2ppm	0.44ppm	0.7ppm
	Heterotrophic Plate Count (CFU/mL)		
1	102	270	74
10	174	250	106
30	85	250	61
60	46	52	27

CFU – Colony Forming Units

- ppm – parts per million

Chart 2: Effect of Copper Concentrations on heterotrophic plate count in raw water over time.



CONCLUSIONS:

From Chart 2 above it can be observed that copper does have an effect on heterotrophic plate count and this is further reduced by some exposure or contact time with the copper. 0.7ppm copper appeared to have the greatest effect. After 30 minutes the effect seems to have been at its greatest with minimal further reduction after 60 minutes.

TRIAL #3

Trial Conducted 8/06/05.

Sample Type: Untreated Effluent.**METHOD:**

Final effluent was collected from wastewater treatment plant. Final effluent is effluent that has been processed and is ready for discharge into the receiving water. Ionisation column was filled with raw effluent and ionised for 4 seconds to give a copper level of 0.22ppm, 8 seconds 0.44ppm and 12 seconds 0.70ppm. A heterotrophic plate count was performed using 1mL of the sample and pour plated with heterotrophic plate count agar as per method TPB030. Samples were plated immediately after ionisation. See Table 2 and Chart 2 for results. Final effluent had an initial heterotrophic plate count of CFU/mL

RESULTS:**Table 3 : Effect of Copper Ionisation on heterotrophic plate count after contact time in final effluent.**

No Treatment 117000 CFU/mL

Blank <1 CFU/mL

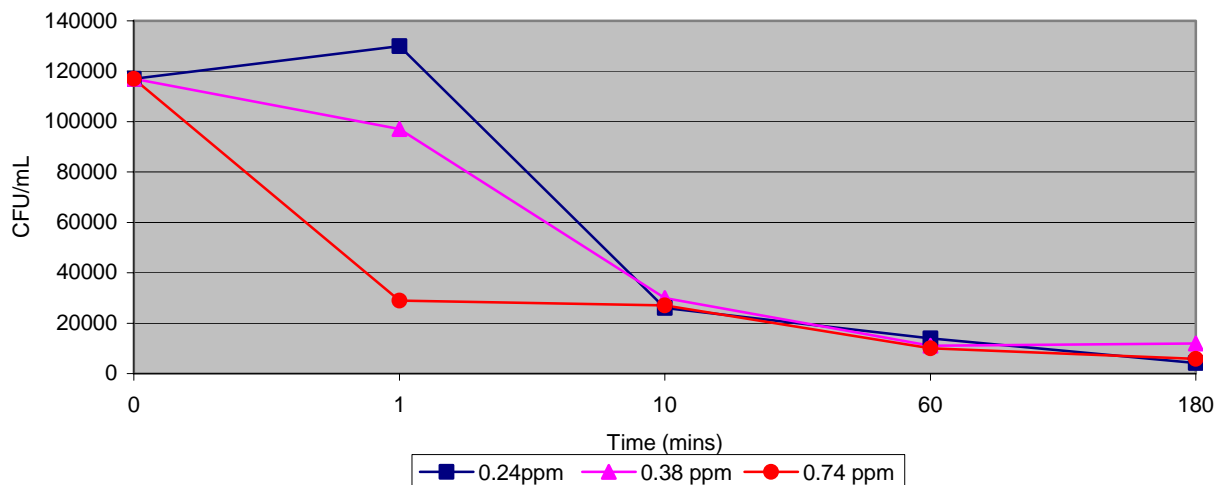
EC : 430 μ S/cm

pH: 7.6

Contact Time (mins)	Copper Level (ppm)		
	0.24ppm	0.38ppm	0.74ppm
	Heterotrophic Plate Count (CFU/mL)		
1	130000	97000	29000
10	26000	30000	27000
60	14000	11000	10000
180	4200	12000	5900

CFU – Colony Forming Units

- ppm – parts per million

Chart 3: Effect of copper ionisation on final effluent over time.

CONCLUSIONS:

From Chart 3 above it can be observed that copper does have an effect on heterotrophic plate count. There appears to be little residual effect of the copper on heterotrophic plate count after 25 minutes and little difference between the 3 levels of copper concentrations. The preceding trial, number 4 looks again at final effluent and heterotrophic plate count but will concentrate on 0.4ppm copper levels up to 60 minute contact time.

TRIAL #4

Trial Conducted 27/07/05

Sample Type: Untreated Effluent.**METHOD:**

Final effluent was collected from wastewater treatment plant.

Ionisation column was filled with raw effluent and ionised for 8 seconds to give a copper level of 0.40ppm. A heterotrophic plate count was performed using 1mL of the sample and pour plated with heterotrophic plate count agar as per method TPB030. Samples were plated immediately after ionisation and after 30 and 60-minute contact time. See Table 4 and Chart 4 for results. Final effluent had an initial heterotrophic plate count of 150000CFU/mL

RESULTS:

Table 4: Effect of 0.4ppm copper concentration on heterotrophic plate count after contact time in final effluent

No Treatment 150000 CFU/mL

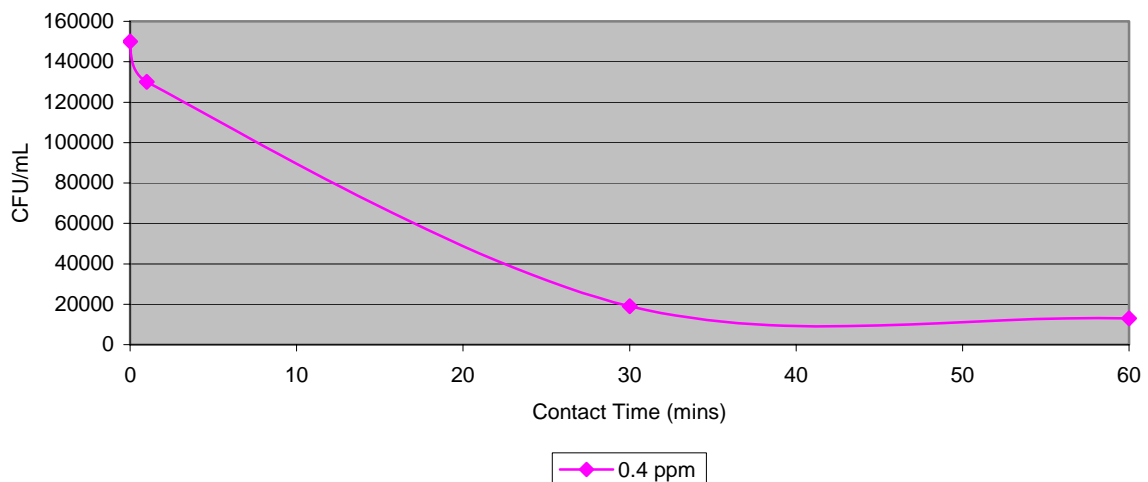
Blank <1 CFU/mL

EC : 515 μ S/cm

pH: 6.92

Contact Time (mins)	Heterotrophic plate count (CFU/mL)
1	130000
30	19000
60	13000

Chart 4: Effect of 0.4ppm copper on final effluent over time.



CONCLUSIONS:

The heterotrophic plate count was reduced from the initial density of 150,000 CFU/mL to 19,000 CFU/mL after 60 minutes of contact time. As faecal coliforms dominate effluent, it was decided to repeat this trial and enumerate only faecal coliforms using a copper concentration of 0.4ppm and contact times of 10, 20 and 40 minutes. Results for this are displayed in Trial 5.

TRIAL #5

Trial Conducted 3/08/2005

Sample Type: Untreated Effluent.**METHOD:**

Final effluent was collected from wastewater treatment plant.

Ionisation column was filled with raw effluent and ionised for 8 seconds to give a copper level of 0.40ppm. The sample was diluted and a faecal coliform count was performed using membrane filtration as per method TPB070. Samples were filtered immediately after ionisation and after 10, 20 and 40 minute contact time. See Table 5 and Chart 5 for results. Final effluent had an initial heterotrophic plate count of 580000 CFU/100mL.

Table 5: Effect of 0.4ppm copper concentration on faecal coliforms after contact time in final effluent

No Treatment 580000CFU/100 mL

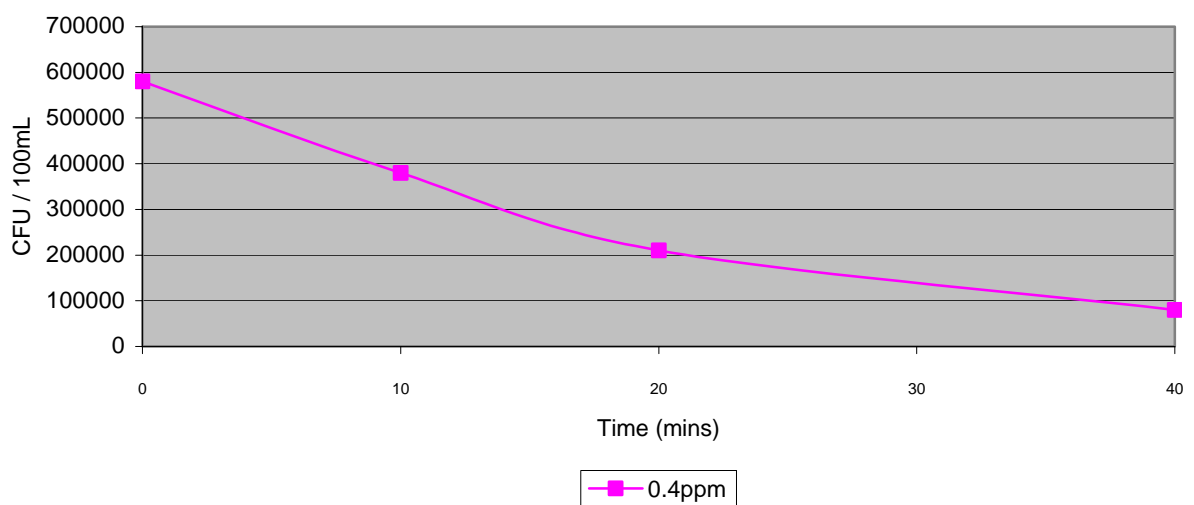
Blank <1 CFU/mL

EC : 420 μ S/cm

pH: 7.1

Contact Time (mins)	Faecal coliforms (CFU/100mL)
10	380000
20	210000
40	80000

Chart 5: Effect of 0.4ppm copper concentration on faecal coliforms in final effluent.

**CONCLUSIONS:**

The faecal coliforms were reduced from the initial density of 580000 CFU/100mL to 80,000 CFU/100mL after 60 minutes of contact time.

TRIAL #6

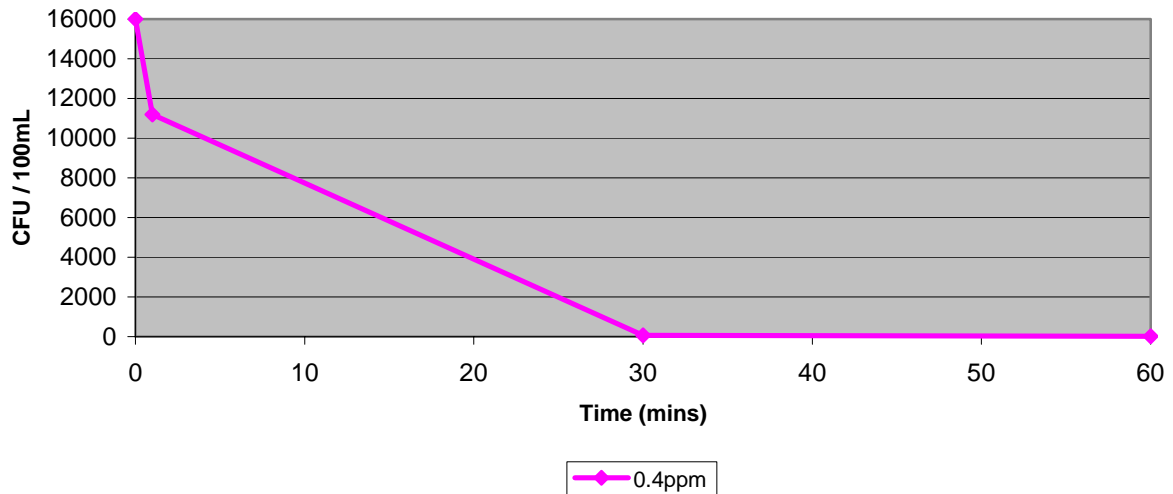
Trial Conducted 3/08/2005

Sample Type: Pure Laboratory Culture *Escherichia coli*.**METHOD:**

A laboratory broth was prepared using *Escherichia coli* (ACM 1803). The broth was prepared by preparing a 10mL broth sample to a 0.5 McFarland standard. The broth was then diluted to yield a final *e.coli* count of 160 CFU/mL. The broth was prepared using sterilised tap water with 0.05g of calcium chloride to raise electrical conductivity to 120 μ S/cm.

Table 6: Effect of 0.4ppm copper concentration on *E.coli* over time.

Contact Time (mins)	<i>E.coli</i> (CFU/100mL)
1	11200
30	70
60	10

Effect of 0.4ppm copper on *E.coli* over time.**CONCLUSIONS:**

Escherichia coli was reduced from an initial density of 16000 CFU/100mL to less than 10 CFU/100mL after 60 minutes of contact time with copper concentration of 0.4ppm.

TRIAL #7

Trial Conducted 3/08/2005

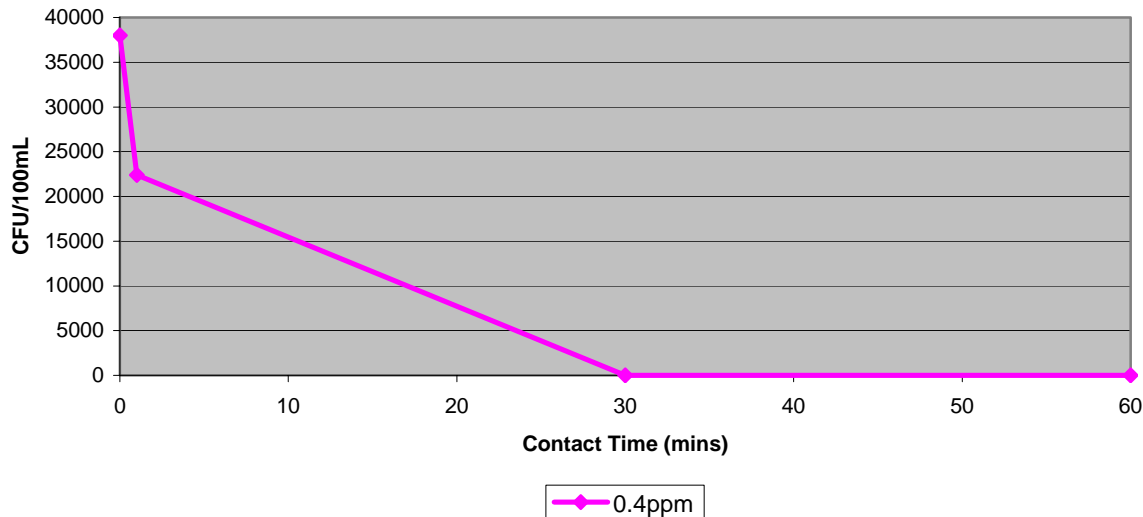
Sample Type: Pure Laboratory Culture *pseudomonas aeruginosa***METHOD:**

A laboratory broth was prepared using *pseudomonas aeruginosa* (ACM 495). The broth was prepared by preparing a 10mL broth sample to a 0.5 McFarland standard. The broth was then diluted to yield a final *pseudomonas aeruginosa* count of 380 CFU/mL. The broth was prepared using sterilised tap water with 0.05g of calcium chloride to raise electrical conductivity to 120 μ S/cm.

Table 7: Effect of 0.4ppm copper concentration on *pseudomonas aeruginosa* over time.

Contact Time (mins)	<i>Pseudomonas aeruginosa</i> (CFU/100mL)
1	22400
30	<1
60	<1

Effect of 0.4ppm copper concentration on *pseudomonas aeruginosa*



Pseudomonas aeruginosa was reduced from an initial density of 38000 CFU/100mL to less than 1 CFU/100mL after 30 minutes of contact time with copper concentration of 0.4ppm.

APPENDICES

APPENDIX ONE: *This information has been compiled by EcoSmarte and in no way does it reflect the views or opinions of Cairns Water laboratory personnel. Cairns Water Quality Laboratory makes no guarantee of the validity or accuracy of the information provided in this appendix.*

Objectives

ECOsmarte Planet Friendly Inc, Minneapolis, USA manufactures and markets products for the water treatment industry. Noted products include the ECOsmarte chemical free swimming pool systems, potable water upgrade systems, golf course irrigation and chemical free cooling tower sanitation. The product range in these different applications ranges from consumer to commercial models.

The core technology used by ECOsmarte is based on proprietary processes involving

1. ionisation
2. oxidation

Electronic ionisation

Ionisation has been used for over 30 years in many different applications.

It was developed by Honeywell Corp. in the sixties for the NASA space program and was sold for over \$1 million per lunar mission. It is for instance an accepted sanitizer for cooling towers by the World Health Organization for controlling Legionella viruses.

ECOsmarte® uses conventional copper ionisation (without silver) in its technology (110 CU grade or better.): ECOsmarte® copper electrodes are manufactured in a water soluble, non-chemical or machine oil process.

Electronic oxidation

ECOsmarte uses electrolysis by means of titanium electrodes with proprietary noble metal coatings and low voltage DC to produce multiple form of oxygen directly from the treated water.

Effectiveness in microbiological control

Micro-organisms vary greatly in form, colour, and habits, as well as in size. The variety is enormous. In one classification alone, the Diatomacea, it is estimated there are over 10,000 species, each of which has its own distinctive shape, pattern or design. Some microorganisms live only in sunlight, others thrive in the dark: some are aerobic requiring oxygen for their existence, others are anaerobic and grow in the absence air. They may be mobile or non mobile. Microorganisms grow, in cold or hot water and even under ice. Microorganisms when introduced in water supplies, cause a variety of problems, many form coatings on piping, reducing flow and restricting valves, pumps, nozzles, or parts of the water distribution system. Filters and water softener media may be contaminated and operation impaired.

The objective of the following tests is to get a feel for the effectiveness of low-level ionisation on a range of micro-organisms encountered in water treatment processes, and to determine which parameters are important in the control of these organisms.

Apparatus

The equipment used consisted of an ionisation column and an electronic control box. The column used in these experiments is a standard 2inch flow cell with a clear plastic tube and ECOsmarte copper electrodes. The control box controls the ionisation process. A timer has been used to set the time parameters / duration of ionisation.

APPENDIX TWO: Laboratory reports for EcoSmarte trial.



Certificate of Analysis

CAIRNS WATER
Laboratory Services
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Cairns 4870

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Lionel Glendenning
Laboratory Commercial Manager
direct phone: (07) 4044 8344
direct fax: (07) 4044 8333

P911 EcoSmarte
Shop 6/19 Condoo St
KURANDA QLD

4881

Attn : Sarva
Phone : (07) 4093 8160
Faxes :

Client Reference :

Sampled : 6/06/2005 8:00:00 AM Depth (m):
Received at Lab : 6/06/2005 8:16:21 AM

Raw Water

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
<u>105/09077</u>				
Electrical Conductance	44 μ S/cm		6/06/2005	TPP030
Miscellaneous	0.06		6/06/2005	
pH	7.6		6/06/2005	TPP050
Standard Plate Count (undisinfected)	560 CFU/mL		6/06/2005	TPB030
<i>Raw water as received. Copper ppm.</i>				
<u>105/09078</u>				
Electrical Conductance	44 μ S/cm		6/06/2005	TPP030
Miscellaneous	0.2		6/06/2005	
pH	7.4		6/06/2005	TPP050
Standard Plate Count (undisinfected)	100 CFU/mL		6/06/2005	TPB030
<i>0.2ppm Cu. Copper ppm.</i>				
<u>105/09079</u>				
Electrical Conductance	44 μ S/cm		6/06/2005	TPP030
Miscellaneous	0.37		6/06/2005	
pH	7.4		6/06/2005	TPP050
Standard Plate Count (undisinfected)	110 CFU/mL		6/06/2005	TPB030
<i>0.4ppm Cu. Copper ppm.</i>				
<u>105/09080</u>				
Electrical Conductance	45 μ S/cm		6/06/2005	TPP030
Miscellaneous	0.74		6/06/2005	
pH	7.3		6/06/2005	TPP050
Standard Plate Count (undisinfected)	74 CFU/mL		6/06/2005	TPB030
<i>0.7ppm Cu. Copper ppm.</i>				

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Report Number : 27808

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Report Issued : 22/06/2005

Client Reference :

Sampled : 6/06/2005 8:00:00 AM Depth (m):

Blank

Received at Lab : 6/06/2005 8:16:21 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/09076</u>			
Standard Plate Count (disinfected)	< 1 CFU/mL		6/06/2005	TPB030
<i>Diluent water through column prior to raw water analyses.</i>				

Client Reference :

Sampled : 8/06/2005 Depth (m):

Blank

Received at Lab : 8/06/2005 10:35:42 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/09314</u>			
Standard Plate Count (disinfected)	< 1 CFU/mL		8/06/2005	TPB030
<i>Diluent water run through ionisation column prior to effluent analysis.</i>				

Client Reference :

Sampled : 20/06/2005 Depth (m):

Blank

Received at Lab : 20/06/2005 8:31:24 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/09713</u>			
Standard Plate Count (undisinfected)	30 CFU/mL		20/06/2005	TPB030
<i>Diluent water run through column prior to Raw Water Trial #2.</i>				

Client Reference :

Sampled : 8/06/2005

Depth (m):

Final Effluent

Received at Lab : 8/06/2005 10:35:42 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
<u>105/09315</u>				
Electrical Conductance	440 µS/cm		8/06/2005	TPP030
pH	7.4		8/06/2005	TPP050
Standard Plate Count (disinfected)	117000 CFU/mL		8/06/2005	TPB030
<i>Pre-Treatment.</i>				
<u>105/09316</u>				
Electrical Conductance	430 µS/cm		8/06/2005	TPP030
pH	7.8		8/06/2005	TPP050
Standard Plate Count	130000 CFU/mL		8/06/2005	TPB090
<i>0.2ppm, immediate.</i>				
<u>105/09317</u>				
Standard Plate Count	26000 CFU/mL		8/06/2005	TPB090
<i>0.2ppm, 10 minutes contact time.</i>				
<u>105/09318</u>				
Standard Plate Count	14000 CFU/mL		8/06/2005	TPB090
<i>0.2ppm, 60 minutes contact time.</i>				
<u>105/09319</u>				
Standard Plate Count	4200 CFU/mL		8/06/2005	TPB090
<i>0.2ppm, 4 hour contact time.</i>				
<u>105/09320</u>				
Electrical Conductance	430 µS/cm		8/06/2005	TPP030
pH	7.7		8/06/2005	TPP050
Standard Plate Count	97000 CFU/mL		8/06/2005	TPB090
<i>0.4ppm, immediate.</i>				
<u>105/09321</u>				
Standard Plate Count	30000 CFU/mL		8/06/2005	TPB090
<i>0.4ppm, 10 minute contact time.</i>				
<u>105/09322</u>				
Standard Plate Count	11000 CFU/mL		8/06/2005	TPB090
<i>0.4ppm, 60 minutes contact time.</i>				
<u>105/09323</u>				
Standard Plate Count	12000 CFU/mL		8/06/2005	TPB090
<i>0.4ppm, 4 hour contact time.</i>				
<u>105/09324</u>				
Electrical Conductance	430 µS/cm		8/06/2005	TPP030
pH	7.7		8/06/2005	TPP050
Standard Plate Count	29000 CFU/mL		8/06/2005	TPB090
<i>0.7ppm immediate.</i>				
<u>105/09325</u>				
Standard Plate Count	27000 CFU/mL		8/06/2005	TPB090
<i>0.7ppm, 10 minutes contact time.</i>				
<u>105/09326</u>				
Standard Plate Count	10000 CFU/mL		8/06/2005	TPB090
<i>0.7ppm, 60 minutes contact time.</i>				
<u>105/09327</u>				
Standard Plate Count	5900 CFU/mL		8/06/2005	TPB090
<i>0.7ppm, 4 hour contact time.</i>				

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Client Reference :

Sampled : 20/06/2005

Depth (m):

Raw Water Trial #2

Received at Lab : 20/06/2005 8:31:24 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/09699</u>			
Standard Plate Count (undisinfected)	100 CFU/mL		20/06/2005	TPB030
	<i>0.2ppm Cu, Immediate.</i>			
	<u>105/09700</u>			
Standard Plate Count (undisinfected)	170 CFU/mL		20/06/2005	TPB030
	<i>0.2ppm, 10 minute contact time.</i>			
	<u>105/09701</u>			
Standard Plate Count (undisinfected)	85 CFU/mL		20/06/2005	TPB030
	<i>0.2ppm, 30 minute contact time.</i>			
	<u>105/09702</u>			
Standard Plate Count (undisinfected)	46 CFU/mL		20/06/2005	TPB030
	<i>0.2ppm, 60 minute contact time.</i>			
	<u>105/09703</u>			
Standard Plate Count (undisinfected)	270 CFU/mL		20/06/2005	TPB030
	<i>0.4ppm, Immediate.</i>			
	<u>105/09704</u>			
Standard Plate Count (undisinfected)	> 250 CFU/mL		20/06/2005	TPB030
	<i>0.4ppm, 10 minute contact time.</i>			
	<u>105/09705</u>			
Standard Plate Count (undisinfected)	> 250 CFU/mL		20/06/2005	TPB030
	<i>0.4ppm, 30 minute contact time.</i>			
	<u>105/09706</u>			
Standard Plate Count (undisinfected)	52 CFU/mL		20/06/2005	TPB030
	<i>0.4ppm, 60 minute contact time.</i>			
	<u>105/09707</u>			
Standard Plate Count (undisinfected)	240 CFU/mL		20/06/2005	TPB030
	<i>0.4ppm, Reionise after 30min to 0.7ppm. Contact Time 30mins.</i>			
	<u>105/09708</u>			
Standard Plate Count (undisinfected)	74 CFU/mL		20/06/2005	TPB030
	<i>0.7ppm, Immediate.</i>			
	<u>105/09709</u>			
Standard Plate Count (undisinfected)	110 CFU/mL		20/06/2005	TPB030
	<i>0.7ppm, 10 minute contact time.</i>			
	<u>105/09710</u>			
Standard Plate Count (undisinfected)	61 CFU/mL		20/06/2005	TPB030
	<i>0.7ppm, 30 minute contact time.</i>			
	<u>105/09711</u>			
Standard Plate Count (undisinfected)	27 CFU/mL		20/06/2005	TPB030
	<i>0.7ppm, 60 minute contact time.</i>			
	<u>105/09712</u>			
Standard Plate Count (undisinfected)	97 CFU/mL		20/06/2005	TPB030
	<i>0.7ppm, Reionise after 30min to <1ppm Cu. Contact Time 30mins.</i>			
	<u>105/09714</u>			
Standard Plate Count (undisinfected)	610 CFU/mL		20/06/2005	TPB030
	<i>Pre-Treatment</i>			

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Explanatory Notes for this Report

Unless otherwise indicated, responsibility for sampling lies with the client. Samples analysed as received.

A number in parentheses () indicates a presumptive result.

Unless otherwise specified, results for solids and semi-solid samples are reported on a dry-weight basis.

'-' in the NATA Accredited column indicates that the analysis was performed in the field, either by the client or by laboratory staff, or that the analysis was subcontracted to another laboratory (as indicated), or that the result is calculated.

Authorisation

Chemical Testing

Robyn Lale *B.App.Sci., MBA*

Chemist

Françoise Peltain *Ing.Agr., Ph.D.*

Laboratory Technician

Biological Testing

Janet Tyson *B.App.Sci.*

Microbiologist



Certificate of Analysis

CAIRNS WATER
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4881

Attn : Sarva
Phone : (07) 4093 8160
Faxes :

Client Reference :

Blank

Sampled : 27/06/2005 Depth (m):
Received at Lab : 27/06/2005 7:50:03 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
E. coli	<u>105/09993</u> < 1 CFU/100mL		27/06/2005	TPB008

Diluent run through column prior to sample treatment.

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Client Reference :

Sampled : 27/06/2005

Depth (m):

E.coli ACM 1803 Lab Broth

Received at Lab : 27/06/2005 7:50:03 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/09994</u>			
E. coli	9400 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.000001		28/06/2005	
	<i>Pre-treatment.</i>			
	<u>105/09995</u>			
E. coli	7500 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.27		28/06/2005	
	<i>0.2ppm immediate.</i>			
	<u>105/09996</u>			
E. coli	7300 CFU/100mL		27/06/2005	TPB008
	<i>0.2ppm, 10 minutes.</i>			
	<u>105/09997</u>			
E. coli	8800 CFU/100mL		27/06/2005	TPB008
	<i>0.2ppm, 30 minutes.</i>			
	<u>105/09998</u>			
E. coli	9400 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.37		28/06/2005	
	<i>0.2ppm, 60 minutes.</i>			
	<u>105/09999</u>			
E. coli	7500 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.44		28/06/2005	
	<i>0.4ppm, immediate.</i>			
	<u>105/10000</u>			
E. coli	8400 CFU/100mL		27/06/2005	TPB008
	<i>0.4ppm, 10 minutes.</i>			
	<u>105/10001</u>			
E. coli	7600 CFU/100mL		27/06/2005	TPB008
	<i>0.4ppm, 30 minutes.</i>			
	<u>105/10002</u>			
E. coli	8200 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.59		28/06/2005	
	<i>0.4ppm, 60 minutes.</i>			
	<u>105/10003</u>			
E. coli	6500 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.69		28/06/2005	
	<i>0.7ppm, immediate.</i>			
	<u>105/10004</u>			
E. coli	9100 CFU/100mL		27/06/2005	TPB008
	<i>0.7ppm, 10 minutes.</i>			
	<u>105/10005</u>			
E. coli	8100 CFU/100mL		27/06/2005	TPB008
	<i>0.7ppm, 30 minutes.</i>			
	<u>105/10006</u>			
E. coli	6500 CFU/100mL		27/06/2005	TPB008
Miscellaneous	0.69		28/06/2005	
	<i>0.7ppm, 60 minutes.</i>			

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Sodium Thiosulphate appears to have had an effect on the copper readings, repeat test without thiosulphate addition.

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Authorisation

Chemical Testing

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Chemist

Françoise Peltain *Ing.Agr., Ph.D.*
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Biological Testing

Janet Tyson *B.App.Sci.*
Microbiologist



Certificate of Analysis

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P911 EcoSmarte
Shop 6/19 Condo St
KURANDA QLD

4881

Attn : Sarva
Phone : (07) 4093 8160
Faxes :

Client Reference :

Blank

Sampled : 28/06/2005 Depth (m):
Received at Lab : 28/06/2005 10:48:16 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
E. coli	<u>105/10159</u> < 1 CFU/100mL		28/06/2005	TPB008

Diluent run through column prior to sample treatment.

This report should not be reproduced except in full

Client Reference :

Sampled : 28/06/2005

Depth (m):

E.coli ACM 1803 Lab Broth

Received at Lab : 28/06/2005 10:48:16 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
E. coli	<u>105/10160</u> 27600 CFU/100mL		28/06/2005	TPB008
	<i>Pre-treatment.</i>			
E. coli	<u>105/10161</u> 36000 CFU/100mL		28/06/2005	TPB008
	<i>0.2ppm, immediate.</i>			
E. coli	<u>105/10162</u> 26800 CFU/100mL		28/06/2005	TPB008
	<i>0.2ppm, 10 minutes.</i>			
E. coli	<u>105/10163</u> 6400 CFU/100mL		28/06/2005	TPB008
	<i>0.2ppm, 30 minutes.</i>			
E. coli	<u>105/10164</u> 230 CFU/100mL		28/06/2005	TPB008
	<i>0.2ppm, 60 minutes.</i>			
E. coli	<u>105/10165</u> 22400 CFU/100mL		28/06/2005	TPB008
	<i>0.4ppm, immediate.</i>			
E. coli	<u>105/10166</u> 23200 CFU/100mL		28/06/2005	TPB008
	<i>0.4ppm, 10 minutes.</i>			
E. coli	<u>105/10167</u> 13600 CFU/100mL		28/06/2005	TPB008
	<i>0.4ppm, 30 minutes.</i>			
E. coli	<u>105/10168</u> 6500 CFU/100mL		28/06/2005	TPB008
	<i>0.4ppm, 60 minutes.</i>			
E. coli	<u>105/10169</u> 27200 CFU/100mL		28/06/2005	TPB008
	<i>0.7ppm, immediate.</i>			
E. coli	<u>105/10170</u> 22000 CFU/100mL		28/06/2005	TPB008
	<i>0.7ppm, 10 minutes.</i>			
E. coli	<u>105/10171</u> 18000 CFU/100mL		28/06/2005	TPB008
	<i>0.7ppm, 30 minutes.</i>			
E. coli	<u>105/10172</u> 16800 CFU/100mL		28/06/2005	TPB008
	<i>0.7ppm, 60 minutes.</i>			
E. coli	<u>105/10173</u> 18000 CFU/100mL		28/06/2005	TPB008
	<i>No treatment, initial sample after 1 hour holding period.</i>			

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Sampled : 7/07/2005 Depth (m):
Received at Lab : 7/07/2005 12:21:19 PM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/10695</u>			
E. coli	< 1 CFU/100mL		8/07/2005	TPB008
Pseudomonas aeruginosa	< 1 CFU/100mL		8/07/2005	TPB110
<i>Water run through column.</i>				

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Report Number : 28147

Page 1 of 3

Report Issued :

Client Reference :

Sampled : 7/07/2005

Depth (m):

E.coli ACM 1803 Lab Broth

Received at Lab : 7/07/2005 12:21:19 PM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/10696</u>			
E. coli	> 16000 CFU/100mL		8/07/2005	TPB008
	<i>Pretreatment. EC - 110 µs/cm.</i>			
	<u>105/10697</u>			
E. coli	11200 CFU/100mL		8/07/2005	TPB008
	<i>0.4ppm Immediate.</i>			
	<u>105/10698</u>			
E. coli	70 CFU/100mL		8/07/2005	TPB008
	<i>0.4ppm 30 minutes.</i>			
	<u>105/10699</u>			
E. coli	10 CFU/100mL		8/07/2005	TPB008
	<i>0.4ppm 60 minutes.</i>			

Client Reference :

Sampled : 8/07/2005

Depth (m):

E.coli ACM 1803 Lab Broth

Received at Lab : 8/07/2005 11:46:49 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/10757</u>			
E. coli	> 16000 CFU/100mL		8/07/2005	TPB008
	<i>No treatment end count after 60 minutes.</i>			

Client Reference :

Sampled : 8/07/2005

Depth (m):

Ps Auruginosa Lab Broth

Received at Lab : 8/07/2005 11:46:49 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/10752</u>			
Pseudomonas aeruginosa	38000 CFU/100mL		8/07/2005	TPB110
	<i>Pretreatment.</i>			
	<u>105/10753</u>			
Pseudomonas aeruginosa	22400 CFU/100mL		8/07/2005	TPB110
	<i>0.4ppm Cu Immediate. EC - 120µs/cm.</i>			
	<u>105/10754</u>			
Pseudomonas aeruginosa	< 1 CFU/100mL		8/07/2005	TPB110
	<i>0.4ppm 30 minutes.</i>			
	<u>105/10755</u>			
Pseudomonas aeruginosa	< 1 CFU/100mL		8/07/2005	TPB110
	<i>0.4ppm Cu 60 minutes.</i>			
	<u>105/10756</u>			
Pseudomonas aeruginosa	38000 CFU/100mL		8/07/2005	TPB110
	<i>No treatment end count after 60 minutes.</i>			

De-Ionised water used, EC adjusted with Calcium Chloride to final EC of 110-150µs/cm.

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Authorisation

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Client Reference :

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Sampled : 27/07/2005 Depth (m):
Received at Lab : 27/07/2005 12:48:14 PM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/11680</u>			
Standard Plate Count (disinfected)	< 1 CFU/mL		27/07/2005	TPB030

Client Reference :

Final Effluent

Sampled : 27/07/2005 Depth (m):
Received at Lab : 27/07/2005 12:48:14 PM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/11681</u>			
Standard Plate Count	150000 CFU/mL		27/07/2005	TPB090
	<i>Start - Pretreatment. pH Effluent - 6.92. EC 515µs/cm.</i>			
	<u>105/11682</u>			
Standard Plate Count	160000 CFU/mL		27/07/2005	TPB090
	<i>End - Pretreatment. pH Effluent - 6.92.</i>			
	<u>105/11683</u>			
Standard Plate Count	130000 CFU/mL		27/07/2005	TPB090
	<i>0.4ppm. Immediate.</i>			
	<u>105/11684</u>			
Standard Plate Count	19000 CFU/mL		27/07/2005	TPB090
	<i>0.4ppm. 30 minutes.</i>			
	<u>105/11685</u>			
Standard Plate Count	13000 CFU/mL		27/07/2005	TPB090
	<i>0.4ppm. 60 minutes.</i>			

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Authorisation

for Biological Testing



Janet Tyson *B. App Sci. (Hons)*
Scientist (Microbiologist)



Certificate of Analysis

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Client Reference :

Blank

Sampled : 3/08/2005 Depth (m):
Received at Lab : 3/08/2005 10:43:08 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/12032</u>			
Faecal coliform	< 1 CFU/100mL		3/08/2005	TPB070
<i>Diluent water run through column, pre trial.</i>				

Client Reference :

Final Effluent - Unchlorinated

Sampled : 3/08/2005 Depth (m):
Received at Lab : 3/08/2005 10:43:08 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
	<u>105/12033</u>			
Faecal coliform	(580000) CFU/100mL		3/08/2005	TPB070
<i>Pre- Treatment. pH - EC - µs/cm.</i>				
	<u>105/12034</u>			
Faecal coliform	(380000) CFU/100mL		3/08/2005	TPB070
<i>0.4ppm Cu, 10 minutes.</i>				
	<u>105/12035</u>			
Faecal coliform	(210000) CFU/100mL		3/08/2005	TPB070
<i>0.4ppm Cu, 20 minutes.</i>				
	<u>105/12036</u>			
Faecal coliform	(80000) CFU/100mL		3/08/2005	TPB070
<i>0.4ppm Cu, 40 minutes.</i>				
	<u>105/12037</u>			
Faecal coliform	(510000) CFU/100mL		3/08/2005	TPB070
<i>No treatment. End of trial.</i>				

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Report Number : 28426

Page 1 of 2

Report Issued : 4/08/2005

Client Reference :

Sampled : 3/08/2005

Depth (m):

Effluent - Chlorinated

Received at Lab : 3/08/2005 10:43:08 AM

	Analysis Result	Guideline	Analysis Commenced	Analysis Method
Faecal coliform	<u>105/12038</u> (76) CFU/100mL		3/08/2005	TPB070

Chlorinated effluent. No Ionisation.

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