

**Study Title**

The Efficacy of BromMax™ in Controlling  
Algae, Slime and Bacteria in  
Open Recirculating Cooling Water

**Data Requirement**

Efficacy Data Observing Bacterial, Slime and Algae Control Using BromMax™  
(EPA registration #63838-3) as a Recirculating Water Microbiocide

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**Study Completion Date**

27<sup>th</sup> July 2005

**Report I.D. #**

BromMax 07-27-05-CA

### Introduction

BromMax is a product that recently received registration with the USEPA as an agent for controlling microbiological growth in open, recirculating cooling waters and related uses. BromMax contains sodium bromide and sodium hypochlorite as the active ingredients present in the product, which are each independently recognized as effective biocides.

Although the situation is under review, CDPR requires that the registrant supplies efficacy data for every pesticidal product sold in California. For products designed to control microbiological growth in cooling water, CDPR has previously accepted a month trial during which time efficacy data is obtained. This report documents the efficacy results obtained during a more than one-month trial of BromMax in the recirculating cooling water of a California manufacturing facility.

### Description of the Cooling System

Company in Madera, CA. Operations were 24 hrs/day.

Two Baltimore Air Coil galvanized package towers

Superenhanced copper tubes in the condenser. These are 40% thinner than normal and have rifling on the inside and outside making these tubes prone to debris and foulants.

Heat load: 80% process cooling; 20% comfort cooling

Delta T: 18-20 °F

Total system contained volume: 6000 gallons

Circulation Rate: 800 gpm

Sand filtration: automatic backwash 2 x per day based on delta P across filter

### Water Chemistry

pH 8.5-8.6 maintained by sulfuric acid addition

Conductivity recirculating water 2650  $\mu\text{S cm}^{-1}$

Conductivity make-up water: 800-1000  $\mu\text{S cm}^{-1}$

Number of cycles: 2.5-3 limited by silica deposition

### Previous Biocide Program

Bromine (BCDMH) tablets continuous feed

Consumption 40 lb/week

Frequency of filling feeder 2 x per week

Isothiazolone slimicide: 2 x per week for 1 hour (16 lbs/week)

### BromMax Biocide Program

Continuous low level addition 0.1-0.5 ppm (as total chlorine)

Consumption: 8.2 lbs per day (56 lbs/week)

Frequency of replacing drum: Once every 74 days

Isothiazolone slimicide: discontinued

Objectives:

Perform aerobic plate counts to confirm bacterial control  
Visually observe for changes in algae or slime growth

Length of Trial:

May 1-July 1, 2005

Results and Discussion

Upon discontinuing the previous biocide program, a 55 gallon drum of BromMax was placed in position. A LMI diaphragm pump was used to continuously dose the cooling water at the manifold to the recirculating pumps feeding cold water from the basins to the hot side.

The original target dose was less than 0.5 ppm as total chlorine but this would be lowered to improve the economics of the program provided adequate microbiological control was maintained. All sampling was performed on the hot return side prior to entering the cooling tower.

The plant was visited at least once per week for the next six weeks. At each visit, the recirculating water was sampled and immediately analyzed for halogen using DPD (using total chlorine pillow packs) methodology in conjunction with a Hach 46700 pocket colorimeter for total chlorine.

Immediately after sampling, the test solution was neutralized with sodium metabisulfite by adding 0.5 ml per 99.5 ml of sample using a freshly prepared 10% stock solution of sodium metabisulfite. Subsequently we performed direct plating or a serial dilution at 10-1 with sterile Butterfield's buffer using sterile 1 and 10 ml pipettes as necessary. Samples and controls were plated in duplicate, and the average of each set was reported. If a duplicate set varied by more than 20% the results were discounted. A duplicate set of plates was performed at each dilution range, one with and one without the neutralizing solution.

The plates for the general aerobic bacteria were plated in duplicate in 2 ways: both as-is, and using a 10-1 dilution in Butterfield's buffer. All samples that were undiluted were pH adjusted prior to plating with sterile 1N HCl<sub>2</sub> to a pH of 6.6-7.2. All plates were inoculated with 1 ml of test solution and the results are expressed as colony forming units per milliliter (CFU/ml). All samples were plated onto 3M Petrifilm 'AC' for aerobic bacteria. Upon returning to the laboratory a couple of hours later, the Petrifilms were placed in an incubator set to 35 °C and then enumerated 48 hours later using a standard colony counter.

Table I summarizes the results of these measurements on cooling water samples obtained on the dates listed in the table.

Table I

Date	Log <sub>10</sub> CFU/ml	Total Cl <sub>2</sub> /ppm
5/9/05	3.6 (Discontinue bromine tabs)	1.05
5/16/05	3.0	0.46
5/20/05	< 2.0	0.16
6/2/05	< 2.0	0.55
6/6/05	3.1	0.40
6/13/05	2.6	0.10
6/20/05	N.M	0.10
6/27/05	2.3	0.11

N.M. = Not Measured

Cl<sub>2</sub> reading x 2.25 = total bromine

Many water treatment companies do aerobic plate count measurements on the bulk recirculating water to gauge the microbiological effectiveness of the chemical treatment programs they are using. A widely used rule of thumb in these circles, is that provided the aerobic plate counts are at less than 4-log<sub>10</sub> CFU/ml, then the water is considered to be under satisfactory microbiological control. The data in Table I would indicate that the water was under excellent microbiological control at all times during the BromMax trial because the aerobic plate counts never exceeded 3-log<sub>10</sub> CFU/ml, and in most cases were around 2-log<sub>10</sub> CFU/ml and lower.

Conclusion:

- When used in a continuous low-level dose, BromMax affords more than adequate control of aerobic bacteria in open recirculating cooling water.
- No obvious increase in algae growth or slime in or on any of the surfaces was observed during the trial period.
- No increases in recirculating temperatures or back pressures were observed during the length of the trial.
- No objections or negative observations from the customer or field personnel were noted during the trial.
- BromMax performed equivalent to the BCDMH/Iso program with equal or less cost (based on estimated retail prices).