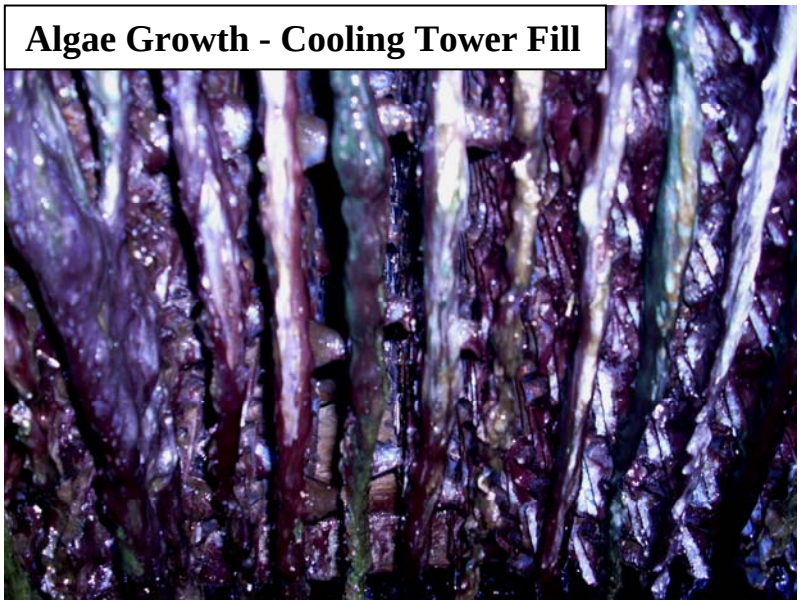
Technology Application Bulletin
MiniBrom™ Electrolytic Bromine Unit

Algae Growth - Cooling Tower Fill



Cooling towers require use of toxic chemicals, biocides, to control growth of microorganisms which cause accelerated corrosion, system plugging, and harbor disease causing bacteria like Legionella. Biocides, while often quite effective, present their own problems as they are costly; dangerous to ship, store, and handle; and can do significant environmental damage when spilled or discharged.

Eliminate Biocide Use With The
MiniBrom Electrolytic Bromine Unit

Patented **MiniBrom** technology was developed by ProChemTech to be a cost effective means to control growth of microorganisms in cooling water that is **totally non-hazardous**. A solution of common table salt and sodium bromide is converted into electrolytic bromine, a very effective biocide, via electrolysis at the point of use. **No costly, hazardous chemical transport, storage, and handling!** A side benefit is that operation cost for a **MiniBrom** system is much less than traditional biocides while equipment cost is comparable to many competing biocide delivery systems.

MiniBrom units are supplied as a complete "drop in" component package, shown to right, which easily replaces biocide chemical feed pumps, or as skidded units complete with mix tank.

Precursors used in the **MiniBrom,** PCT 3023 and 3024, and our manufacturing plants, are registered with the USEPA as required by law.

MiniBrom Model MB-2.5

US Patent 7,927,470

Technical Information

The following tables provide toxicity and cost comparison data on commonly used hazardous chemical biocides, efficacy information, and specification data on **MiniBrom** units.

Toxicity Comparison Table – Typical Hazardous Biocides to MiniBrom

Product	CAS	acute oral toxicity, rat LD 50
glutaraldehyde	111-30-8	134 mg/kg
isothiazolin	26172-55-4	57.2 mg/kg
dithiocarbamate	142-59-6	395 mg/kg
hydantoin	32718-18-6	877 mg/kg
MiniBrom 3024	mixture	> 3500 mg/kg

As shown in the preceding table, the feedstock for the **MiniBrom** is substantially less toxic than any other biocide. To put this information in prospective, common table salt has an oral toxicity value of 3000 mg/kg!

Aquatic Toxicity Table – Typical Commonly Used Persistent Hazardous Biocides

Product	CAS	96 hr LC 50 aquatic toxicity	
glutaraldehyde 25%	111-30-8	rainbow trout	56.2 ppm
isothiazolin 1.5%	26172-55-4	rainbow trout	0.14 ppm
dithiocarbamate 30%	142-59-6	rainbow trout	0.10 ppm
polyquat 10%	7173-51-5	bluegill sunfish	3.2 ppm
MiniBrom 3024	mixture	rainbow trout	> 1000 ppm

Many commonly used biocides do not degrade and are thus persistent, toxic pollutants when discharged in cooling tower blowdown. In contrast, the bromine produced by the **MiniBrom** does its job and then degrades back to harmless bromide ion, found in sea water at 65 mg/l.

Economic Use Cost Comparison Table – Typical hazardous biocides to MiniBrom

Product	Dose mg/l	lb/1000 gal	$/lb	$/1000 gal
10% polyquat	100	0.83	1.95	1.62
16% quat	65	0.54	2.40	1.30
30% carbamate	50	0.42	3.15	1.32
98% hydantoin	24	0.20	5.20	1.04
20% DBNPA	38	0.32	4.80	1.54
1.5% isothiazolin	127	1.06	3.65	3.87
15% glutaraldehyde	228	1.90	2.80	5.32
MiniBrom 3024	28	0.23	1.30	0.30

The **MiniBrom** is clearly the **most cost effective biocide for typical cooling tower applications on the market.** It is especially cost competitive against the very toxic isothiazolin and glutaraldehyde biocides favored by such firms as Ecolab-Nalco and GE Betz. The purchase cost of a **MiniBrom** is generally comparable to, or less than, the cost of a traditional biocide feed installation when the costs of chemical pumps, double containment (not needed with the **MiniBrom**!!), safety equipment, and special feeders (for dry products) are accounted for.

The costs of an accident or environmental incident can far exceed any costs related to normal operations, especially when bad publicity and the potential for litigation are considered. Replacement of toxic biocides with a **MiniBrom** eliminates these potential problems.

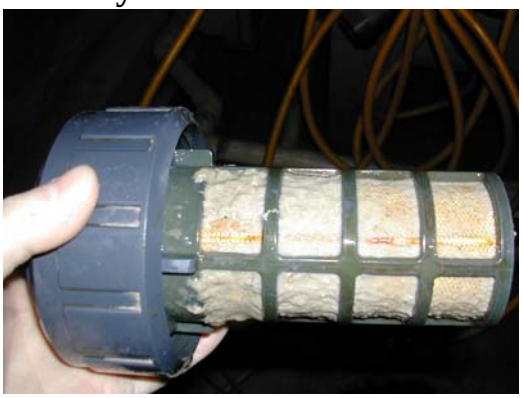
A quick comparison between **MiniBrom** and a traditional program using alternating glutaraldehyde and isothiazolin for a 1000 ton cooling tower operating 30 weeks a year gave the following annual costs:

Traditional Program - $4,134 **MiniBrom - $410**

The cost savings here, with a MiniBrom Model MB 5 priced at $3,077, pays for the MiniBrom purchase in less than one cooling season!

Power cost to operate a **MiniBrom** system is insignificant. For example, an MB 5 operating at three doses per week treating a 1000 ton cooling system for 30 weeks with power at $0.10/kwh would use $7.31 worth of electrical power. The only other cost to operate the **MiniBrom** MB 5 is a replacement electrolysis cell on a typical three year life cycle at $315.00

Efficacy



Traditional biocide programs generally require use of an oxidizing and non-oxidizing biocide to prevent long term development of a resistant biota in a treated system. Due to the fact that resistance cannot be developed to a strong oxidizer, like the electrolytic bromine produced by the **MiniBrom,** it replaces two products with one product.

Shown is a biofouled filter from a cooling system using not just two, but four, traditional biocides with poor results. Installation of a **MiniBrom** system permanently eliminated this major biofouling problem.

The **MiniBrom** is much more effective in high pH cooling waters than traditional chlorine based biocides as shown in the following table:

pH of water	% available chlorine	% available bromine
6.5	95	100
7.0	90	100
7.5	50	94
8.0	24	83
8.5	9	60
9.0	3	33
9.5	0	11

Oxidizing biocides, like electrolytic bromine produced by the **MiniBrom,** are recognized to be effective against the bacteria that cause Legionnaire's Disease by both OSHA and CDC; many traditional, commonly specified biocides are not recognized as being effective. As the **MiniBrom** produces a bromine residual in the cooling water, it is effective against both planktonic and sessile microorganisms throughout the entire cooling system. This is in contrast to UV and ultrasonic devices, which can kill only the planktonic organisms that pass through the device. Sessile (including algae) organisms are responsible for most under deposit corrosion and commonly harbor legionella bacteria. Note that the residual bromine can be easily measured in the field for control purposes to ensure control of sessile organisms throughout the cooling system.

Algae and Biofilm Control

We have found that electrolytic bromine is a more effective biocide for control of algae and biofilm than chlorine or the hypobromite produced by mixture of hypochlorite and sodium bromide. This effect is believed to be due to the fact that electrolytic bromine is a mixture of elemental bromine, hypobromous acid, and hypobromite. It is also very effective in systems which have some ammonia present, such as cooling tower systems using reclaimed wastewater for makeup as the resulting bromoamines are very effective biocides.

Typical **MiniBrom** Treated HVAC Cooling Tower

MiniBrom Specifications

MiniBrom units are self contained units housed in a 14.5” X 12” X 6.5” NEMA 12 steel panel box with the patented **MiniBrom** electrode assembly mounted in a plastic housing that is 10” X 10” X 8” located near the panel box and supplied with an appropriate solution pump. Construction is to NEC specifications, input voltage is 110 v ac, with a maximum electrode voltage of 12 volt dc. Units can be controlled using any stand alone timer, an optional timer supplied with the unit, or any existing time based biocide feed controller. Existing day tanks can be used for solution makedown, or an optional solution tank, in various capacities, can be purchased with the unit. Two **MiniBrom** units are offered with the following specifications:

Model	Output as Br lb/hr	Amp Output	Power use kw-hr	3024 use lb/hr	3023 use lb/hr	diluted solution use gal/hr	number of cell plates
MB 2.5	0.10	25	0.15	1.0	0.5	2.3	2
MB 5	0.21	30	0.36	2.0	1.0	4.5	3

ProChemTech International, Inc.

“Innovation in Water Management”

Apache Junction, AZ, and Brockway, PA

814-265-0959 **www.prochemtech.com**

MiniBrom Electrolytic Cells