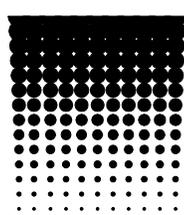
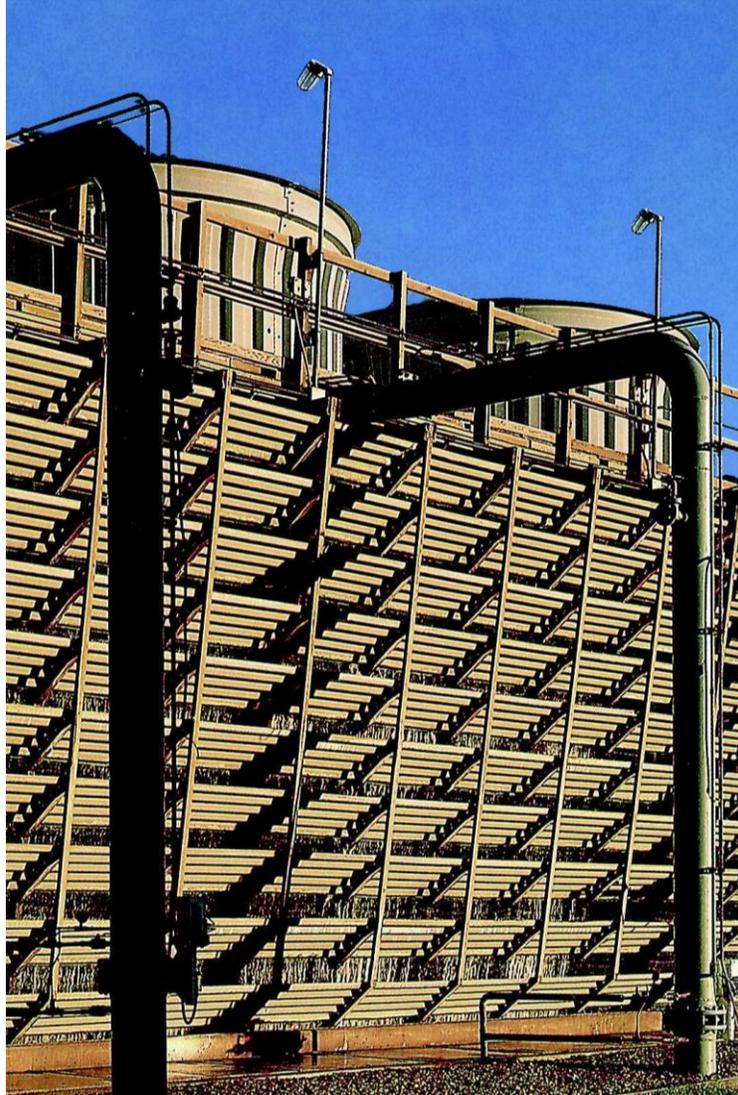


OxyChem[®]



Towerbrom[®]

Microbicides By OxyChem[®]

**MICROBICIDES FOR
COOLING WATER SYSTEMS**

Towerbrom[®] microbicides were developed to address the increasing demands of industrial water treatment professionals. These halogenated isocyanurate compositions generate available bromine for the control of biofouling in cooling waters, for either continuous feed or shock feed treatment methods.

The Towerbrom Advantage

Towerbrom microbicides are halogenated isocyanurate compositions that generate available bromine for the control of biofouling in cooling waters.

The Towerbrom products are available in either a quick dissolving granular form, Towerbrom 60M Granules, or a sustained release tablet form, Towerbrom 90M Tablets. Towerbrom provides the broadest range of dosing practices of the solid bromine oxidizing microbicides.

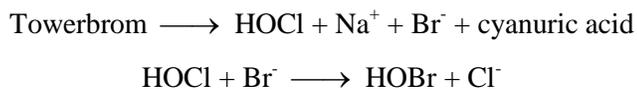
The effectiveness of the Towerbrom microbicides as a bactericide and slimicide in recirculating water systems has been demonstrated by over twenty five years of use in a wide variety of water systems.



Bactericidal Action of Towerbrom

Towerbrom microbicides were developed to address the increasing demands on a microbicide in industrial water treatment. Water in a cooling tower is continually contaminated by impurities in fresh water sources and by atmospheric air drawn through the tower to effect cooling. These contaminants contribute to scaling, corrosion, and biofouling problems that adversely affect the proper operation of the heat exchange equipment. Also, aerosols from the tower's exhaust have been identified as a source of microorganisms that can cause public health risks.

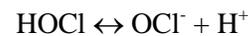
The Towerbrom products release hypochlorous acid (HOCl) and bromide ions when it dissolves. These react to produce hypobromous acid (HOBr).



The hypobromous acid sanitizes the cooling water by killing a wide variety of bacteria, algae, and fungi, and oxidizes organic materials. When this occurs, bromide ions are formed which are regenerated into hypobromous acid by

these products. This process makes the most effective use of the bromide in the cooling water system, giving you the highest performance of any solid oxidizing microbicide.

The pH of most cooling water is typically maintained in the range of 8 to 9 for alkaline corrosion protection. Chlorine microbicides are less effective at pH > 7.5 because the hypochlorous acid concentration is reduced. As the pH rises above 7.5, the chemical reaction equilibrium shifts from hypochlorous acid, the predominant chlorine species, to hypochlorite ions:



The hypochlorite ion cannot easily penetrate the bacterial cell membrane. However, the uncharged hypochlorous acid can rapidly diffuse into the cell to kill or control growth. A similar phenomenon occurs with bromine microbicides.

The Bromine Advantage

Although hypobromous acid has nearly the same microbicidal properties as hypochlorous acid, bromine is more effective than chlorine in the pH range of 7.5 to 9 because of hypobromous acid's higher pK_a value (8.7). As shown in Table 1, the hypobromous acid concentration will be higher than hypochlorous acid at any given pH.

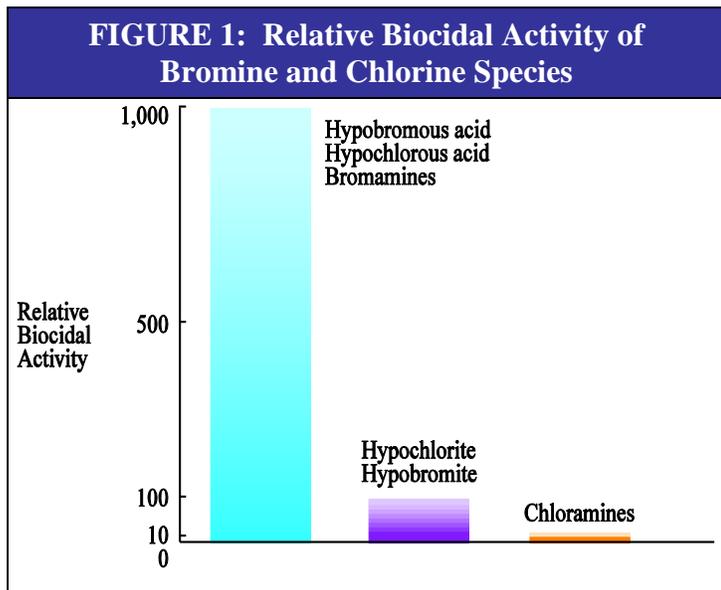
Table 1: Bromine vs. Chlorine

Effect of pH on Hypobromous and Hypochlorous Acid Concentrations		
pH	%HOCl	%HOBr
6	97	100
7	78	98
8	26	83
9	3	33

Bromine is the product of choice in water systems that are contaminated with nitrogenous materials, such as ammonia. Bromine and chlorine react with these contaminants to form bromamines and chloramines, respectively.

The sanitizing power of chlorine is reduced dramatically with chloramine formation. Chlorine is strongly bonded in the chloramine molecules and is not readily available to form the active biocidal species (HOCl). Conversely, bromine's sanitizing power declines only slightly because the bromine is weakly bonded in the bromamines and is readily released to form the active bromine species (HOBr).

Figure 1 compares the relative sanitizing power of bromine and chlorine species.



OxyChem also markets chlorine-based tablets and granules. For more details see OxyChem's Towerchlor® bulletin.

Choice of Towerbrom Product

OxyChem markets two Towerbrom products, Towerbrom 60M Granules and Towerbrom 90M Tablets.

Towerbrom 60M Granules are a quick dissolving form that is ideal for shock feeding. Dispensed by hand, Towerbrom 60M Granules dissolve almost immediately for quick release of the available halogen.

Towerbrom 60M solutions are nearly pH neutral, so Towerbrom 60M Granules have virtually no effect on the pH of the treated water.

Towerbrom 90M Tablets are sold as solid, easy-to-use three inch or one inch diameter tablets. Towerbrom 90M Tablets work well in either continuous or shock treatments. Towerbrom 90M Tablets dissolve slowly for sustained release. However, they dissolve more rapidly than hydantoin and can respond faster to changes in demand.

Both Towerbrom products are completely soluble and contain no metal ions, like calcium, which can contribute to the scaling potential of the cooling water.

Methods of Use

Current biofouling control techniques include periodic shock treatments with microbicides and low level continuous application of microbicides. Towerbrom microbicides can be easily applied to both methods of treatment.

For continuous bromination,

Towerbrom 90M Tablets have the highest available halogen content (84% as chlorine) of any solid bromine microbicide. This means that you can use smaller, less expensive feeders and refill them less often. Towerbrom 90M Tablets are also ideally suited to other types of dispensers, such as buckets or bags.

Many of the feeders currently in use provide excellent results. Contact us for feed rate data and recommendations. OxyChem also offers two inexpensive tablet feeders which are ideal for small water systems. See our feeder brochure for more information.

For shock feeding,

If a shock feed program is desired, consider using Towerbrom 60M Granules. Their fast dissolution rate allows the full dose to be attained in a matter of minutes. Broadcast Towerbrom 60M Granules by hand since this product dissolves too quickly for use in feeders.

If Towerbrom 90M Tablets are used for shock feeding, certain steps must be taken to ensure safety. Wet tablets under stagnant conditions will slowly generate nitrogen trichloride (NCl₃), which can be hazardous if formed in sufficient quantities. Therefore, Towerbrom 90M Tablets should not sit in stagnant water after the feeder shuts off. A feeder must be purged to remove NCl₃ as it is formed. Modify a feeder used for shocking to either: 1) completely drain out the water when the feeder shuts off, or 2) maintain a minimal water flow between shocks. Consult our application bulletin for more information.

More Sanitizing Power Than Other Dry Bromines

Because the Towerbrom products are based on the chlorinated isocyanurates, they differ in important ways from hydantoin based microbicides. Towerbrom's available halogen is released faster, resulting in more sanitizing power. Table 2 illustrates how Towerbrom is more effective than hydantoin at the same free halogen concentration.

Product	Free Halogen Residual mg/L	pH	Microorganism Population CFU/ml
Towerbrom 90M	0.5	8.5	2,000
Bromochlorohydantoin	0.5	8.5	25,000
Chlorine	0.5	8.5	13,000

* These data are based upon samples tested in the laboratory and are not guaranteed for all samples.

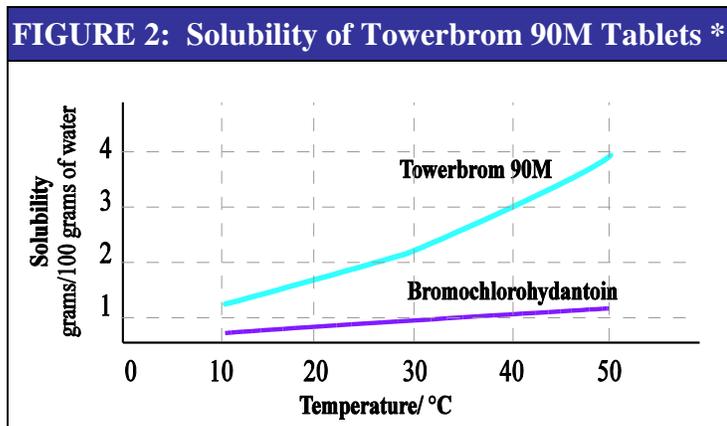
More Available Halogen Than Hydantoin

Towerbrom 90M Tablets have a higher available halogen content than the hydantoin products (Table 3). Therefore, the amount of Towerbrom 90M Tablets required to obtain the same bromine level is considerable less than that of the hydantoin microbicides. Field trials have confirmed that Towerbrom microbicides perform as well as or better than hydantoin at lower usage rates.

TABLE 3: Towerbrom vs. Hydantoin*		
Microbicide	Available Halogen (Cl ₂ Basis)	Relative Use Rates For Control
Towerbrom 90M Tablets	84	1.0
Towerbrom 60M Granules	57	1.5
Bromochlorohydantoin	51-57	1.5-1.6

Faster Delivery of Available Halogen

The solubility of Towerbrom 90M Tablets is 2.5 to 5 times that of the hydantoin bromine microbicides (Figure 2). Towerbrom 90M's higher solubility and more concentrated form combine to provide faster microbicide delivery. This makes design and operation of tablet feeders simpler.



* These data are based on samples tested in the laboratory and are not guaranteed for all samples. This does not constitute an express warranty. See the sales specifications.

Packaging

Towerbrom microbicides are packaged in convenient, resealable 50 lb. all-plastic pails with screw-on lids. There are 24 pails (1200 lb.) to a pallet. They are also available from several distributors.

Registrations

Towerbrom microbicides are classified as pesticides and require registration with the U. S. Environmental Protection

Agency and with each state where they will be sold. You can buy the Towerbrom products with OxyChem labels and avoid paying any registration costs. Alternatively, OxyChem offers supplemental registrations and will apply your approved label to the package before shipment. You avoid the cost of relabeling and pay only the state registration fees where you sell the Towerbrom products.

Towerbrom microbicides are approved for a variety of uses besides cooling towers. Other uses include air washers, ornamental ponds and aquaria, industrial scrubbing systems, auxiliary or process water, pasteurizers, pulp and paper mill water systems, and once-through cooling systems.

Precautions

These products are strong oxidizing agents which require proper handling and storage. Improper handling may cause a reaction leading to fire or explosion. Consult the Safety Data Sheet (SDS) for details. In particular:

- Never block-in a feeder containing Towerbrom 90M Tablets.
- Never add any other chemical to a feeder containing Towerbrom 90M Tablets.
- Never add Towerbrom 60M Granules to a tablet feeder, always add directly to the water system.
- Read the label and SDS carefully before using.

TABLE 4: Towerbrom Typical Properties		
	Towerbrom 90M Tablets	Towerbrom 60M Granules
Total Available Halogen (as Cl ₂), %	84	57
Bulk Density, lb/ft ³	63	63
pH, 1% Solution	3	6
Color	white to off-white	white to off-white
Form	180 gm, 2.75" tablets or 14 gm, 1" tablets	Free-flowing granules

Key Advantages

- ▶ **Highest sanitizing power (Towerbrom 90M Tablets) of all solid bromine oxidizers**
- ▶ **Fastest dissolving (Towerbrom 60M Granules) of all solid bromine oxidizers**
- ▶ **Simpler, smaller feeders**
- ▶ **Easy and safe to store and use**
- ▶ **No calcium**
- ▶ **Cost effective**
- ▶ **Supplemental registrations available**
- ▶ **Registered in 50 states and Canada**

Highly Effective, Cost-Competitive Microbicides

- ▶ Designed specifically for industrial and commercial water recirculation systems.
- ▶ Controls microorganisms via shock feed and continuous feed methods.
- ▶ Available in durable and non-dusting tablets to provide a more uniform dissolving rate (Towerbrom[®] 90M Tablets). Also available in granular form for shock treatment (Towerbrom[®] 60M Granules).
- ▶ Tablets can be used with conventional feeder equipment without major cost and/or equipment modifications.





Towerbrom[®]/Towerchlor[®] Microbicides

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