

DON'T LET
ALGAE RUIN
YOUR DAY



TAKE THE ALGAL CHALLENGE TEST

applied biochemists

Quality Products for Water Quality

TECHNICAL SERVICE REPORT

New Considerations and Opportunities for Controlling Algae and Cyanobacteria in Lakes, Potable Water Reservoirs, Irrigation Systems, Wastewater Retention Ponds and Other Industrial Process Surface Water Systems

Background

Copper-based algaecides have been used since the early 1900's as a primary active ingredient for controlling algae blooms and problems in a wide variety of use sites. Despite considerable research and attempts to find organic and "natural-based" alternatives, copper products continue to be used on a widespread basis. Over the years, a number of refinements have been made in copper formulations to overcome some of the drawbacks experienced when using straight copper sulfate. This has included development of liquid chelates and complexes designed to increase contact time of the soluble copper, reduce toxicity to non-target organisms, improve treatment accuracy and efficiency, and increase efficacy. More recently, adjuvants have been formulated into these compounds to enhance their performance, thus offering a wider choice of products to meet varying algae control needs. These inert additives serve to improve uptake of copper into algal cells by functioning as penetrants and wetting agents. Sodium Carbonate Peroxyhydrate (SCP), has also been added to the list of EPA registered pesticides. It offers a non-copper based alternative for more selective control of sensitive species (primarily blue-green / cyanobacteria) or for use in conjunction with copper products where alternating treatments of these actives have shown promise.

Over 30,000 species of algae and cyanobacteria have been identified throughout the world. Experience and studies have shown considerable variability exists in the toxicity of copper and other active ingredients to this wide range of organisms. Typical treatments involve application of "average" dosage rates, providing copper concentrations between 0.2 and 1.0 mg/l known to be algicidal to a broad-range of species. SCP is applied in the range of 0.3 to 1.7 mg/l (as hydrogen peroxide) for more specific control of blue-green algae.

Problems and concerns have been encountered by those who find a need for controlling algae in industrial, wastewater and potable water sites, but are equally responsible for meeting limits on copper levels and other water quality criteria in discharge, process and finished water. The need to control these organisms to reduce TSS, lower pH, reduce filter clogging, and/or control taste and odor problems associated with MIB's or geosmin can sometime become critical to

avoid fines, public complaints and/or operation shut-downs. In these industrial and potable water sites, however, use of copper algaecides is closely monitored or restricted within the confines of copper concentrations allowed under site specific NPDES permits or the Safe Drinking Water Act.

Recreational waters can experience unsightly algal blooms. In extreme cases, these blooms might contain varying levels of potentially toxic algal species threatening fish, wildlife, pets and even humans with illness or even death. Monitoring programs have been instituted in a number of states on specific water bodies where such blooms have been identified. There are currently no set federal or state guidelines on “safe” exposure levels (cell counts or toxin concentrations). Management programs calling for large-scale algaecide treatments have been implemented cautiously due to concerns over the fate of the toxins.

Technology Development

Since 2000, Applied Biochemists has teamed with Clemson University’s Institute of Environmental Toxicology and more recently the Dept. of Forestry and Natural Resources to conduct research on the differences in toxicity and efficacy between various algaecide formulations. Additional cooperators became involved to assess control issues at site-specific locations. Under the direction of Dr. John Rodgers and his research staff, studies have included:

- Efficacy work on numerous algae and cyanobacteria species
- Variability of cell counts and biomass density.
- Toxicity to standard, non-target benthic and planktonic organisms.
- Copper monitoring to evaluate time associated with loss from the water column.
- “Leaky Cell” research to determine the effects of different formulations and rates of algaecides on cell membrane integrity with respect to production and release of cellular contents (toxins, MIB’s & geosmin).
- Evaluation of state-of-the-art fluorometer equipment for on-site assessment of chlorophyll *a* and phycobilin pigment concentrations.

Five of Applied Biochemists’ algaecide formulations have been assessed including some comparisons with Copper Sulfate:

- Cutrine-Plus
- Cutrine-Ultra
- Clearigate
- Algimycin PWF (NSF Certified to ANSI-NSF 60)
- Phycomyacin SCP* (NSF Certified to ANSI-NSF 60)

*Sodium Carbonate Peroxyhydrate

As an outcome of this research, technical papers have been published (or are under peer review) in pertinent journals including the Archives of Environmental Contamination and Toxicology. Several significant findings have been verified:

- There are considerable differences between efficacy, non-target toxicity and residence times of the various copper formulations. This

has lead to the conclusion that “**all copper algaecides are not chelated equal**”.

- The total amount of copper required to control an algal infestation is a direct function of the species and amount of biomass present. The authors have referred to this as “**critical burden**”.
- Treatment rates should be based upon the algae concentration, not the water volume. “**Treat the algae, not the water.**”
- Residence time of soluble and/or free copper from the water column can be pre-determined by duplicating species, biomass/cell count and water quality conditions under laboratory conditions as a part of the efficacy testing.
- Based upon preliminary observations and evaluations, treatment impacts to cell membrane integrity can vary. Product formulation and concentration exposure affect the cells’ ability to produce and release extra-cellular products (MIB’s, Geosmin & toxins). It appears feasible to adjust dosage and choice of formulation to **prevent toxin production and/or release**. (Research in progress).
- Recent availability of field test kits for microcystin (toxin) detection for the drinking water industry coupled with our Clemson research on methodologies to rapidly detect pigment concentrations are aimed at developing criteria for more **rapid response** to managing algal blooms.

Application of Technology

The protocol developed by Clemson for screening algaecide efficacy and toxicity has already had several real world applications.. This has included:

- Treatment and control of cyanobacteria (blue-green algae) blooms in four IN and MO drinking water reservoirs with Cutrine-Plus and Cutrine-Ultra.
- *Lyngbya* sp. control in a southern paper mill pond with Clearigate.
- Irrigation canal water treatment for filamentous algae with Cutrine-Ultra in a California water reclaim project.
- Evaluations on sediments from WI and IN lakes determined copper levels were not toxic to benthic invertebrates in standard (EPA) biosassays.
- Development of a treatment regimen for bloom control in a GA rendering plant retention pond with Cutrine-Ultra.
- Development of a treatment regimen for bloom control in an AZ power plant reservoir with Cutrine-Plus and Cutrine-Ultra.
- An algae control program in power plant ash ponds in NC to meet NPDES and operational water quality criteria.
- Development and implementation of a treatment program for giant *Lyngbya* control in AL Power reservoir systems utilizing multiple products to optimize effectiveness.
- Efficacy and cellular effects of AB product formulations on toxin producing algal species from Nebraska reservoirs (work in process).

More specific information on the above applications in the form of case studies for these sites may become available in the future if permission is secured from the end-users. Otherwise, we will maintain confidentiality and have promised not to release names and locations of use sites.

The Algal Challenge Test

Applied Biochemists in conjunction with Clemson University's toxicology labs within the Dept. of Forestry and Natural Resources under the direction of Dr. John Rodgers, Jr., offers selective access to these services to potential product end-users. Laboratory evaluations are performed directly on client's water samples utilizing subcultures of the algae species present. Testing requires ten days to two weeks following receipt of water samples. Recommendations, based upon test data, will include the following:

- Algae identification and enumeration.
- Algaecide formulation recommendation.
- Dosage rate based upon cell count or biomass.
- Expected residence time in water to meet water quality standards.

To secure these services, contact an Applied Biochemists Technical Representative at 1-800-558-5106. We will provide packing and shipping information. Costs for a standard Algal Challenge Test is \$1,500.

Information provided on the Algal Challenge Test Site Data sheet will be used in determining treatment recommendations for your location. Please provide information pertinent to your site.

ALGAL CHALLENGE TEST SITE DATA SHEET

General Use

(Please complete applicable and/or known information concerning your site)

Company/Agency _____

Contact Person _____ Title _____

Address _____

City _____ State _____ Zip _____

Phone _____ Fax _____

e-mail _____

Water Use(s) _____

Size: Surface Acres _____ Avg. Depth _____ Volume _____

Retention Time (if applicable) _____ Days Outflow or Consumption _____ MGD

Hardness _____ Alkalinity _____ pH _____ D.O. _____ Total P _____

Other Water Quality Parameters _____

Algae/Cyanobacteria _____

Provide Ranges for the Following

Cell/Trichome Count _____ Chlorophyll a _____

TSS _____ Secchi Disk _____ Geosmin _____

MIB's _____ Algal Toxins _____

Reporting or Permit Requirements & Concerns _____

Describe Water Quality/Use Problems Associated with Algae Growth (e.g. Taste & Odor, Toxins, TSS, pH, filter operation, color, process interferences, regulatory, environmental etc)

Describe Current Algae Treatment Methods (if any) _____

Additional Comments _____

(Fax this information to Applied Biochemists at 262-255-4268 or provide it directly to your Applied Biochemists Technical Representative. We will provide a quotation for your Algal Challenge Test(s) and provide an ACT sample kit for your algae and water samples to be sent to Clemson University Dept. of Forestry and Natural Resources for analysis.)