



# Targeted Management of Taste and Odor producing Cyanobacteria and resulting water quality improvements in Lake John Hay Reservoir, Salem, IN

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## THE PROBLEM

“Water Superintendent Russell Brown said his department is continuing work to address the taste and odor issues that many customers have been complaining about for the past several months.”

“Algae bloom is believed to be the root of the taste and odor issue. Brown noted algae was very bad this summer and many other water departments in the region are dealing with similar issues. He said there are some forms of algae that bloom during cold weather. Both Brown and Mayor David Bower said the city is committed to getting to the root of the problem and correcting it permanently. ‘We know people expect good, clean water with no taste or odor,’ Brown said.”

*Excerpt taken from “Water taste and odor issues continue”, written by Stephanie Taylor Ferriell as published by The Salem Leader on December 4, 2009*

## THE FACTS

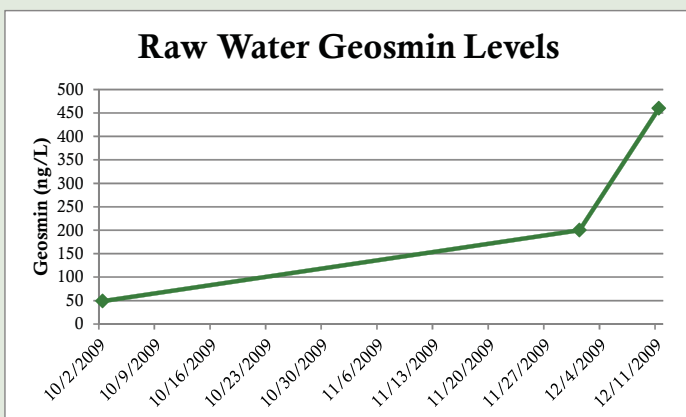
### Lake John Hay

- Six miles northwest of Salem, Indiana
- 210 acre impoundment
- Has experienced persistent, recurring algae blooms causing taste and odor problems
- Used for drinking water and tournament and recreational fishing
- Average depth of ~14-15 feet, (much of Lake John Hay is within the photic zone, ideal for algae and plant growth)
- Frequent complaints led to officials seeking an action plan



*Planktothrix Filament*

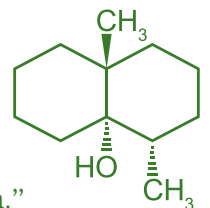
*Water samples showed two primary planktonic taste and odor producers - Planktothrix and Chrysochromulina. Geosmin concentrations in excess of the human detection threshold were also measured at several locations within the reservoir as well as in sediment samples.*



## GEOSMIN

Produced by several classes of microbes, including Cyanobacteria (blue-green algae)

“Geosmin, an organic compound whose name literally translates to ‘earth smell’, is detectable by the human nose in concentrations as low as five parts per trillion.”



*Excerpt taken from “Geosmin levels below detectable threshold”, written by Chad Fleetwood as published by The Salem Leader on June 22, 2010*

# Targeted Algal Management Plan to Address Taste and Odor Problem

- 1.) Conduct Algal Challenge Test (A.C.T.)
- 2.) Apply A.C.T. Cyano specific treatment plan
- 3.) Monitor Algae, Pre- and Post-treatment
- 4.) Record Geosmin and MIB levels Pre- and Post-treatment
- 5.) Analyze Costs for Potable Water Treatment and Customer Complaints, Pre- and Post-treatment

## ALGAL CHALLENGE TEST sent to and tested at Clemson University

### METHODS

#### Laboratory Experiment

- Three candidate algaecides (2 copper, 1 peroxide)
- *Planktothrix* and *Chrysochromulina* exposed to five treatment concentrations of each algaecide
- Measured algal cell density, chlorophyll *a*, geosmin, and methyl isoborneol

**Out of 3 algaecides, Algimycin® PWF Algaecide/Cyanobactericide was effective, at a treatment rate of 1.06 gal./acre-ft (0.2 mg Cu/L).**

**Algimycin Algaecide/Cyanobactericide is certified by the National Sanitation Foundation for use in drinking water.**

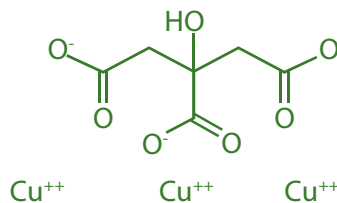


## ALGIMYCIN® PWF

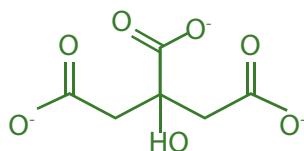
ALGAECIDE / CYANOBACTERIOCIDE

### Copper Citrate

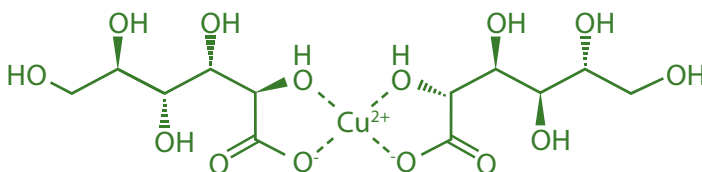
Active Ingredient Copper.....5.0%  
(in the form of copper citrate and copper gluconate chelates)



Certified by NSF



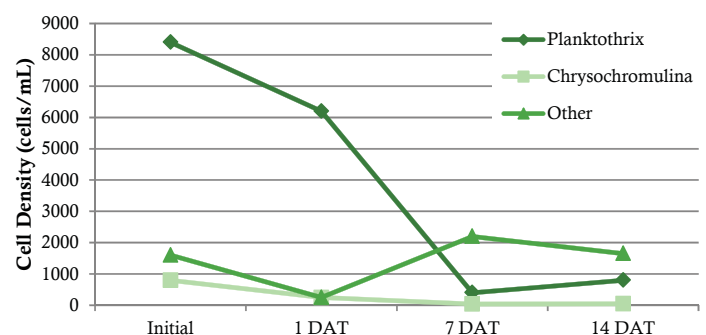
### Copper Gluconate



Algimycin Laboratory Test Treatment	Results Four Days After Treatment			
	Avg. Cell Density (cells of blue-green algae/mL)	Avg. Chlorophyll-a (µg chl-a/L)	Avg. Turbidity (NTU)	Avg. Total Suspended Solids (mg/L)
Untreated Control	9,000	13.3	3.5	3.3
0.05 mg Cu/L (0.27 gallons/acre-ft)	2,800	0.75	3.1	2.1
0.1 mg Cu/L (0.53 gallons/acre-ft)	1,700	<0.5	2.4	0.8
0.2 mg Cu/L (1.06 gallons/acre-ft)	850	<0.5	2.2	0.1
0.4 mg Cu/L (2.12 gallons/acre-ft)	700	<0.5	1.9	<0.1
0.6 mg Cu/L (3.19 gallons/acre-ft)	<500	<0.5	1.7	<0.1

### Laboratory ACT Cell Densities

Algimycin 1.06 gal./acre-ft (0.2 mg Cu/L)



Algimycin is registered trademark of Arch Chemicals, Inc.

The Algal Challenge Test (A.C.T.) is a proprietary procedure developed by Arch Chemicals, Inc. in conjunction with Clemson University.

# TARGETED TREATMENTS

## Data Collection Survey Stations -



## Target Treatment Area - Identified Area for May Application



**May 4, 2010**

First treatment made to 1/3 of the surface area of the reservoir using calibrated delivery pumps

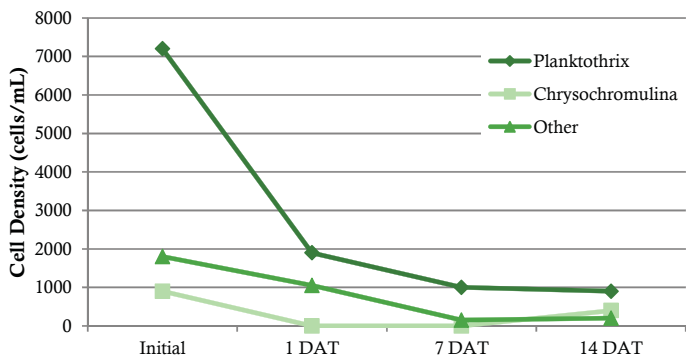
## Treatment Area and Track



Aerial photograph © 2011 DeLorme

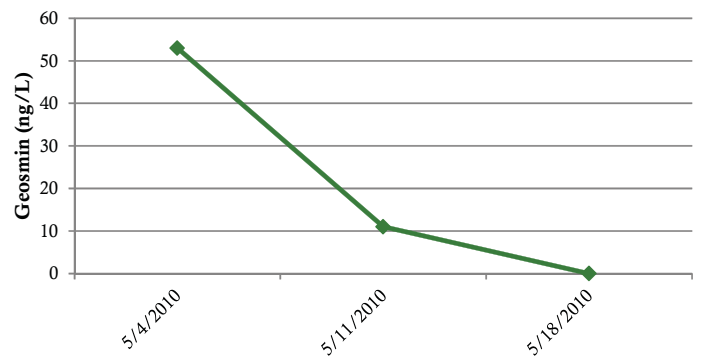


## May Station 4 Cell Densities (Pre/Post)



Post-treatment, cell densities of *Planktothrix* and *Chrysochromulina* declined significantly one day after treatment.

## May Raw Water Geosmin Levels

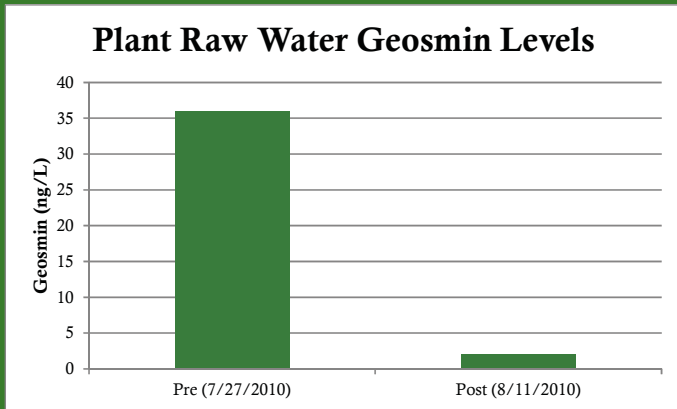


Geosmin concentration in the vicinity of the water intake structure declined from about 50 ng/L to non-detectable (detection limit <5 ng/L) two weeks after treatment.

*Treat the algae, not the water.*

July 27, 2010

Second treatment made using drop hoses to inject the algaecide at deeper depth where geosmin and Cyanophytes were higher

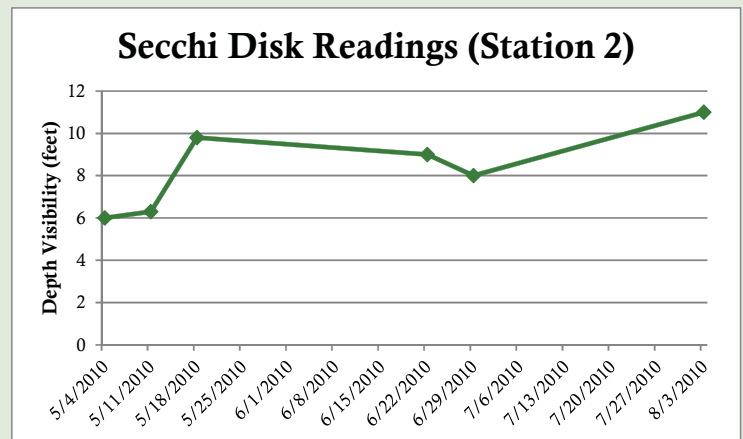


Prior to the July treatment, algal cell densities were approaching 50,000 cells/mL at the 12 ft depth and the geosmin concentrations were >35 ng/L in the treatment plant raw water.

After this second algaecide application, post-treatment geosmin concentrations were <2 ng/L in the treatment plant raw water.

## SUMMARY OF RESULTS

- Use of Lake John Hay was restored.
- The algaecide treatment was effective, as predicted by the Algal Challenge Test.
- Geosmin and methyl isoborneol concentrations declined post-treatment.
- Water clarity improved (Secchi Disk Readings).
- Cost of water treatment for potable water declined post-treatment an estimated 21%.
- **97% reduction** in customer taste and odor complaints - replaced with compliments for a job well done.



*“Russell Brown [Superintendent of Water Treatment] said that since geosmin levels have fallen, the amount of chemicals needed to treat the water have dropped as well. He estimated that the Lake John Hay treatment facility has cut the amount of carbon needed to filter out organic compounds, as well as the amount of coagulant used, by roughly 50 percent. This has also reduced the amount of sludge byproducts generated. Mike Cook, a member of the water oversight committee, agreed with Bower. ‘I had the opportunity to be on the lake last week,’ he said. ‘I had visibility of three to six feet and the water looked great.’”*

*Excerpt taken from “Geosmin levels below detectable threshold”, written by Chad Fleetwood as published by The Salem Leader on June 22, 2010*



## 2011 MONITORING AND TARGETED MANAGEMENT STRATEGY

- Monitor algal densities, geosmin levels, water temperature and dissolved oxygen
- Analyze phytoplankton population at sample sites
- Timed treatment based on monitoring
- Schedule treatment before problem develops

*This information has been prepared and compiled by Applied Biochemists, a business of Arch Chemicals, Inc.*

*We thank and acknowledge the assistance and cooperation from Aquatic Control (Seymour, IN), Clemson University (Clemson, SC), and the Salem Water Department (Salem, IN) in providing technical and operational support for this project.*