TO: **Kevin Connors, Alliant Energy Center**

FROM: **Harry L. Gibbons, Jr., Ph.D.**

DATE: **June 30, 2022**

SUBJECT: **Analysis and Recommendations for Alum Treatment of Alliant Energy Center Ponds**

This report was produced at your request, working in cooperation with David Marshall and Richard Wedepohl, to look at use of alum for controlling nuisance growths of algae that limit the beneficial uses of two ponds that surround Willow Island at the Alliant Energy Center.

Figure 1. East and West Ponds at Alliant Energy Center

Basic water quality samples and morphological data were collected by Dave Marshall and Richard Wedepohl on April 24, 2022 to define pond conditions.

TABLE 1. Pond Conditions on 04/24/2022

Parameter	**East Pond**	West Pond
Conductivity	**555 uS/cm**	**537 uS/cm**
pH	**7.85 SU**	**8.13 SU**
Alkalinity	**161 mg/l**	**145 mg/l**
TP	**0.044 mg/l**	**0.098 mg/l**
DRP	ND	ND
TOC	7.4 mg/l	-
Area	3.34 acres	2.04 acres
Volume	14.5 acre-feet	8.4 acre-feet
Max Depth	6 feet	5.5 feet
Secchi	6 feet (bottom)	2.5 feet
Near shore fish species	Green sunfish, bullheads, pumkinseeds	Goldfish, common carp, green sunfish, golden shiner, pumpkinseeds
Macrophytes	White water lily	Eurasian milfoil, coontail

Alum Use Strategies

P Stripping: Alum is applied to a lake or pond surface to strip P from the water column.

P Inactivation: Alum is applied to inactivate sediment P and reduce internal P recycling

P Interception: Alum is used to intercept incoming P from streams or pipes before or as it enters a lake or pond.

Maintenance Dosing: Multiple, frequent or continuous alum additions at low doses designed as incremental P controls by water column phosphorus stripping and partial sediment phosphorus inactivation (bound to aluminum).

Recommended Strategy for Alliant Energy Ponds –Maintenance Dosing Applied Periodically

For small ponds such as these a simple maintenance dosing strategy is recommended. The ponds at the Alliant Energy Center are well suited to use of this strategy. There is easy access for applying alum and treatment that can be routinely completed by grounds maintenance staff.

To achieve long term benefits that require only limited follow-up treatments, experience with similar ponds has been that the goal over the first year is to get the ponds dosed with a total of 40 mg/l of aluminum depending upon pond response.

Aluminum sulfate is a salt of an acid and to maintain pH levels above 6, only a limited amount of alum can be added, dependent upon the ponds ability to buffer the acidification that occurs when alum is hydrated by pond water.

Rather than using a buffer such as sodium aluminate, which is expensive and more difficult to handle, it is recommended that several periodic applications be made based upon the ponds ability to neutralize the ponds alkalinity reduction by alum addition. The ponds alkalinity will naturally rebound, often in a period of days to several weeks, which will then allow subsequent applications to be made to meet the first-year goal of 40 mg/l of aluminum. Future annual treatments will be needed, but frequency and dose may decrease over time as sediment phosphorus is deactivated. In the long-term, periodic low dose alum treatments may still be needed to inactivate the external loading of phosphorus to the ponds to maintain pond water quality and beneficial uses.

Planktonic algae production will be reduced with an enhancement of phosphorus inactivation from an initial, lower dose, application. The noxious filamentous algae production in these ponds will also be reduced as the aluminum captures available phosphorus in the sediments that contributes to its initial growth.

Given that these ponds will continue to receive phosphorus from precipitation and runoff, experience has demonstrated that just a single application in future years will be needed to

maintain desirable conditions once the phosphorus in the water/sediment is sufficiently inactivated by the aluminum.

Initial and Subsequent Application Rates

Bench testing of alum doses (Attachment) was conducted by Dennis Crow and Richard Wedepohl at Water Compliance Specialists, Inc. in Lodi Wisconsin to determine dose rates that will maintain pH levels above 6. Based upon this information it is recommended that an initial application rate of 6 mg/l be applied to both ponds. Liquid or dry alum may be used but in situations like this, dry alum is recommended. Unlike liquid alum, dry alum can be easily stored and handled and only requires use of good industrial hygiene procedures when handled and applied. To achieve the 6 mg/l concentration, dry alum, which is 9% aluminum, it would be applied at a rate of 180# per acre-foot of volume.

For East Pond, which has a volume of 14.5 acre-feet, 2600 pounds of dry alum would be applied to achieve a dose of 6 mg/l of aluminum.

For West Pond, which has a volume of 8.4 acre-feet, 1500 pounds of dry alum would need to be initially applied.

Subsequent applications of 6 mg/l would be made until the first year goal of 40 mg/l is achieved. Timing between these applications, which could be somewhere between several days to weeks, will be dependent upon the rate of alkalinity rebound. Routine alkalinity measurements will provide this information as could additional bench testing.

On a longer-term basis, possibly annually dependent upon future loadings, applications of 6 mg/l of aluminum should be sufficient to ensure that total phosphorus concentrations in the ponds does not exceed 0.020 mg/l to 0.025 mg/l.

Application Methodology

For low tech applications a simple water container, e.g. 250 or 300 gallons, mounted on a vehicle or trailer along with a pump and spray nozzle is needed. Typically, a 5 hp motor is usually sufficient to spray alum out across a pond like these.

Dry alum would be placed into the water tank and then pond water is pumped into the tank. Agitation is necessary to ensure the alum is dissolved before applying. Periodic mixing with a paddle may also be necessary. Typically, 80 to 100 gallons of water is enough to dissolve a 50# bag of alum. Once dissolved, the pump is reversed and the alum mixture is then sprayed over the surface of the pond. The alum should be sprayed as evenly as possible over the pond but precise application is not critical given that normal wind mixing will distribute the aluminum throughout the pond and into the pond sediments.

Since alum is an acid a stainless steel pump is recommended. Whether or not the pump and connection fittings are stainless they must be flushed out immediately following use with tap water to prevent corrosion.

Pre-Treatment with Hydrogen Peroxide is Beneficial

Much of the phosphorus in these ponds is now tied up within the extensive algae growths. Alum can still be applied but much of the phosphorus in the system will not be initially tied up by the first application. Natural senescence of these plants will release bound phosphorus and the alum in the system will eventually capture the phosphorus from these plants. However, it will take longer to achieve visible control.

To capture more phosphorus with the initial alum treatments, application of sodium carbonate peroxyhydrate (SCP) has been shown to be beneficial. This herbicide, licensed in Wisconsin, immediately breaks down the cell walls of the cyanobacteria and filamentous algae and can also inhibit the growth of coontail which is present in the ponds. There is some evidence that it slows growth of algae in the future. The waste product of algae decay by this chemical is dissolved oxygen.

Monitoring

Typically permits for use of alum require pH monitoring during application. If pH is found to drop below 6.5 application of additional alum should be delayed.

As for when ponds can be re-treated to achieve the initial desirable aluminum level, periodic alkalinity testing should be done. Typically, the alkalinity in ponds like this will recover so that the ponds can be retreated after a few weeks to a month or so. Doing an additional bench test to determine maximum dosage rates for future applications can also be done.

Experience has shown that, on the longer term after enough sediment phosphorus becomes bound, the ponds will tell you by its productivity when another treatment is desirable. Oftentimes ponds like this will exhibit excellent water quality for a year or more, again dependent upon the watershed loading rates experience.

ATTACHMENT

WILLOW ISLAND POND ALUM DOSING BENCH TESTING

Conducted at Water Compliance Specialists, Inc., Lodi Wisconsin, by Dennis Crow and Richard Wedepohl

FIRST TESTING ON 5/23/2022 Note: These tests were conducted to develop methodology and were completed using food grade alum purchased locally.

West Pond initial pH = 8.8, Alkalinity = 170 mg/l; East Pond Initial pH = 8.4, Alkalinity = 183 mg/l

Aluminum Dose	5 minute pH	20 minute pH	1 hour pH	Alkalinity
2 mg/l as Al	8.2	7.6	7.7	
3 mg/l	8.0	7.6	7.7	
4 mg/l	7.8	7.4	7.4	
6 mg/l	7.6	7.3	7.3	138 mg/l

***No testing was done on the East Pond**

SECOND TESTING ON 6/09/2022 Note**:** These tests were run using a ground dry alum sample provided by Hawkins Inc., Water Group.

West Pond initial pH = 9.0; Alkalinity = 129 mg/l

East Pond initial pH = 8.0; Alkalinity = 129 mg/l

WEST POND

Aluminum Dose	5 minute pH	20 minute pH	1 hour pH	Alkalinity
4 mg/l as Al	7.6	7.2	7.2	
6 mg/l as Al	7.3	7.1	7.1	
8 mg/l as Al	7.1	6.9	6.9	89 mg/l
10 mg/l as Al	6.7	(pH after 14 hours was 7.0. Alkalinity 76 mg/l)		

EAST POND

Aluminum Dose	5 minute pH	20 minute pH	1 hour pH
6 mg/l as Al	7.0	6.9	6.9

Methods: Formulation of the store purchased alum was unknown although product label had "Aluminum Sulfate" listed as the only ingredient. Alum for testing came from Thunder Bay Chemicals (for Hawkins, Inc.) The solid ground aluminum sulfate had a chemical formulation of $Al_2(S0_4)*N\ H_20$.

For testing, pond water was placed into 1 liter beakers. Dry alum contains 9% aluminum" so the amount of alum used for this test was weighed out to show application rates as "As Aluminum". For example, to achieve a dose of 2 mg/l Al, 22 mg of dry alum was measured and added to the 1 liter beaker (2/.09=22mg), etc.

After addition of the alum the beakers were stirred for two minutes. pH measurements were taken at 5 minutes, 20 minutes and 1 hour after addition. Alkalinity was measured prior to testing and after 1 hour following dry alum addition.

pH measurements were made with Hach Pocket Pro meter. Alkalinity was measured using a Hanna H1775 Freshwater Alkalinity Colorimeter.