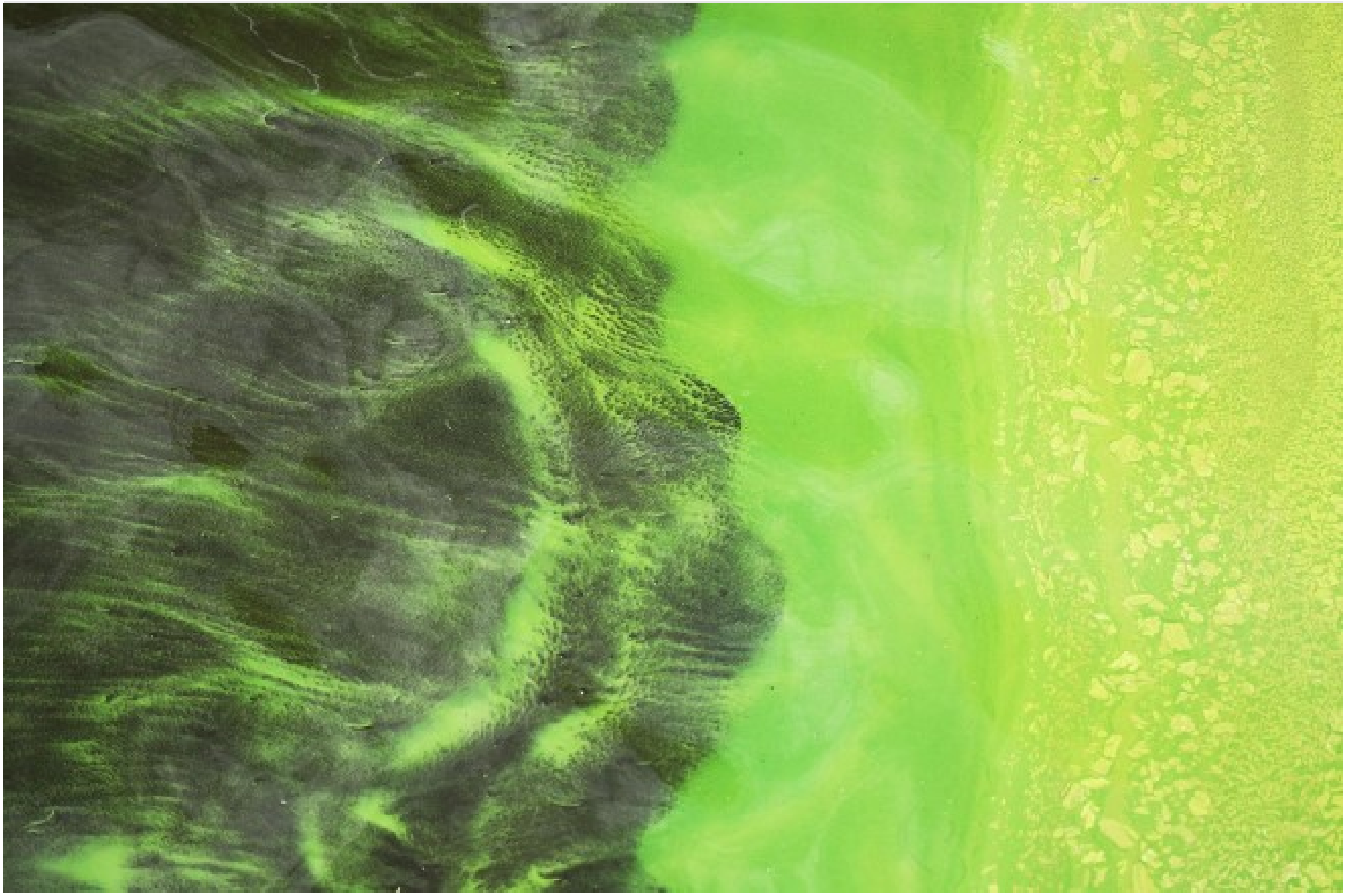

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ENVIRONMENT

This chemical turns polluted green lakes clear. Is it safe?

Aluminum sulfate, or alum, is increasingly being used to fight algae blooms spurred by an over abundance of phosphorus from human activity.

BY DANIEL ACKERMAN

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Autumn sunlight streams across Lotus Lake in southern Minnesota, animating a chattering kingfisher. The spunky bird flits among drooping willow branches, whose yellowing fingers tickle the water's surface. Behind this idyllic setting, however, something is amiss in Lotus Lake.

"It's pretty green," remarks local resident Greg Fletcher, backing his truck down the boat launch to haul out the family jetski for winter. Indeed, the sickly stained water evokes the cheeks of an acutely nauseous cartoon character. And Lotus Lake is not alone.

A history of pollution is sparking a colorfully devastating scourge in lakes across the country: algae blooms. These events can turn pristine waterways to pea soup, choking out wildlife and toxifying water. Increasingly, scientists are fighting back with chemical warfare, injecting aluminum sulfate into lakes to neutralize the pollutants that fuel the blooms. These "alum" treatments can be an ecological switch, flipping lakes from grimy to glorious almost instantly—but only if used in the right environmental context. When successful, alum is making swimming safer nationwide and could one day stem the red tide that plagues Florida's coast.

A murky legacy

A self-described "lake lover," John Holz spent 23 years at the University of Nebraska studying algae blooms. He explains that algae are simple aquatic organisms that thrive on sunlight and dissolved nutrients like phosphorus. Algae can "bloom," growing in high densities when nutrients are plentiful.

And Holz says humans have spiked phosphorus inputs to lakes by over-fertilizing crops and lawns. Rainwater plucks phosphorus-rich residue from these cultivated surfaces and trickles into waterways, serving up a treat for algae. The resulting blooms shade out native plants that anchor in the sediment and form fish habitat. Some algae, like cyanobacteria, can produce toxins that trigger rashes or flu-like symptoms for swimmers and have proven fatal to dogs.

Holz sought a solution to this cascade of algal agony. But he quickly found that dialing down phosphorus inputs to lakes, by culling fertilization and infiltrating stormwater into soil, was not enough to halt the blooms. The issue, he says, was hiding beneath the water itself.

Lake-bottom sediment can grow saturated with phosphorus over time. “As a society we’ve been overloading our lakes with phosphorus for decades,” says Holz, who is concerned that waterways have “reached a tipping point.” Even when new phosphorus is kept out of the lake, “legacy phosphorus” already banked in the sediment can rise back into the water under low-oxygen conditions, haunting the lake with algae blooms for years. At Nebraska, Holz learned about a possible fix—a chemical that lays the ghost of legacy phosphorus to rest in the sediment.

Aluminum sulfate, or alum, has an affinity for phosphorus. In water, alum assumes a cotton-candy-like form, “a nice fluffy floc,” according to Spokane-based environmental engineer Shannon Brattebo. This floc (short for flocculation) grabs phosphorus and other particles as it settles to the bottom of the lake, flipping the water from cloudy to clear.

"There is an immediate impact," says Brattebo. But quick clarity is just the beginning. Alum floc rests in the sediment and continues to bind phosphorus for years, even decades. Legacy phosphorus stays stuck in the sediment, starving potentially harmful algae in the lake above.

Holz seized on the predictable chemistry of alum, focusing his research on its ability to restore polluted lakes. He finetuned a process to deliver a precise amount of alum to the right part of the lake at the optimal time of year. Holz recalls that managers eager to flip their lakes "would contact us and say 'that sounds good. Let's do it.'" But there was a problem—nobody provided the rigorous, science-guided treatments that Holz was studying.

So in 2010 Holz scrapped the job security of his research post and dove into a risky fledgling industry, founding his own alum treatment company. "It was scary at first," he says. He purchased two barges customized with an array of hoses to dispense pre-calculated alum doses along GPS-controlled tracks. His investment paid off quickly. Demand for alum swelled, as did his fleet of customized barges.

"We've been fortunate," says Holz. "We've had steady growth over the eight years we've been doing this."

A clear future

Dosing lakes with alum is not a new practice—it was first tested in Sweden half a century ago. But it is gaining popularity as water managers battle the specter of legacy phosphorus fueling algae blooms. More than 250 alum-treated lakes worldwide support a growing body of evidence for the strategy's efficacy. The science of alum has “advanced substantially and continues to advance every year,” says Harvey Harper, a Florida-based environmental engineer with 60 treatments under his belt.

Like any method of ecosystem restoration, dumping thousands of gallons of alum into a lake is not risk-free. If pH plummets during an alum treatment, the usually benign chemical—often used to purify drinking water—can turn toxic for wildlife. After a parks department in Washington state shelled out a typical $100,000 for an alum treatment in 2008, a botched application killed hundreds of fish.

Brattebo also emphasizes that while alum smothers legacy phosphorus in the sediment, it cannot halt algae blooms feasting on new sources of phosphorus. A nutrient-laden stream flowing into a lake can carry plenty of algal nourishment no matter how much alum floc is resting in the lakebed below.

But under suitable environmental conditions, alum treatment holds key advantages compared to techniques like dredging. “You can get it done quickly and it’s safe,” says Brattebo. Plus, alum removes “more pounds of phosphorus per dollar,” she adds.

Most importantly, if applied properly alum works. Suppressing rampant algae growth “really opens up the lake for recreation,” says Brattebo. While it is difficult to quantify such benefits, experts estimate that alum treatments generally pay for themselves within a decade. Improved water clarity also allows native submerged plants to reestablish.

“That is super beneficial for fish habitat and the overall health of the water body,” she notes. Harper speculates that more alum use in Florida lakes could mitigate coastal red tide by slashing phosphorus flowing from land to sea.

At Lotus Lake, Holz’s team prepares to inject 100,000 gallons of alum solution during the next five days. Lotus marks the 76^{th} lake Holz has exorcized of legacy phosphorus—business is booming. Holz claims he has never had an unhappy customer.

Greg Fletcher looks forward to clearer water when he returns with the family jetski next spring. He also plans to swim across the lake with his two dogs, finally with a view of the fish and aquatic vegetation below.

“It’s been a battle,” Fletcher says of the lake’s struggle with algae. “It will be nice to be able to see better.”

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