

Work Smarter Not Harder: Use Oxygen, Ozone, and Carbon Dioxide to Treat your Turf Instead of Chemicals and Surfactants

By Superintendent Glen Manly

I'm now finishing up my eighteenth year as Superintendent for Adobe Creek National Golf Course in Fruita, Colorado. I'd never seen our course come out of the winter looking better than it did in the spring of 2009. Every year since I've been here the course has emerged from the winter with a sodium cast, but this year was different. The course was greener, thicker, and healthier due to Mountain High Water's Oxygen, Ozone, and CO₂ Gas Diffusion System.

In March of 2008 I received a brochure in the mail from Mountain High Water about their Oxygen, Ozone, and CO₂ Gas Diffusion Systems. Among other information in the brochure, I was struck by the claim that their systems increase percolation rates and eliminate standing water.

As you can imagine by the name "Adobe" Creek National, our facility was built on and with adobe clay and thus had very poor percolation. We had issues with standing water and black algae growth because of it. In April of 2008, I set up a meeting with my staff and Mountain High Water. After an entire afternoon of responding to all of our questions with complete, scientifically accurate answers, Mountain High had satisfied us, and we decided to purchase one of their systems in May 2008.

There are many attractive things about the Mountain High's System; it enabled me to reduce and stop the use of some costly, dirty, and time-consuming chemicals and surfactants. Below is a list of areas where we saved, spent, and earned money.

Applications	Percent Saved
Wetting Agents	100%
Calcium Injection	100%
Acid Injection	100%
Organic Spread	100%
Fungicide	100%
Lake Treatment	100%
Poa Control	25%
Hand Watering	25%
Total Saved	\$127,000
\$ Spent on CO₂ Gas	\$7,000
Total Final Benefit	\$120,000

Wetting Agents – We almost completely reduced the use of wetting agents. Previously, we were injecting one 55 gallon barrel of wetting agents per month in June, July, and August. Now, I only use wetting agents to occasionally to spray isolated hard spots on a couple of greens, that's it. I attribute these remaining hard spots to a lack of sprinkler head coverage on those particular areas.

Calcium Injection – We completely eliminated calcium injection. Previously we were injecting one pallet of calcium each month, from May through September. This year we didn't use any calcium and the course stayed in great shape. We will be doing a soil test next year to make sure our soil's calcium level is correct.

Acid Injection – We completely eliminated all of our acid injection. Previously we were using one drum of acid each month from May through September to treat our greens. We were also using 75 gallons every three weeks from May to September to treat our fairways. The main reason for this acid use was pH control, which Mountain High Water's CO₂ Injection has completely replaced with a much better result. We now purchase CO₂ gas instead of acid; the cost is about the same but with a better result. We are now able to lower our pH from 8.8 to under 7.0 on a nightly basis.

Organic Spread – We completely eliminated our Organic Spread application this year. Our newest 9 hole usually gets a yearly organic spread, this year we forwent it, and still the turf remained healthy and thick. We will be conducting soil tests next year to make sure our soil and turf remain healthy in the absence of organic spread.

Poa Control – I have been battling Poa here for a while now. This year I was able to reduce my Poa control product by 25%. I believe this was directly related to Mountain High Water's Oxygen, Ozone, and CO₂ Injection System. With the increase in oxygen going into the turf and soil nightly, the turf is healthier and able to uptake treatments more easily. This next year we hope to conduct tests to see if a reduction in fertilizer is possible.

Fungicide – We almost completely eliminated the use of fungicides as well. We were using a liquid fungicide to treat every green once a month May to September. Now we only use granular fungicide on a few greens with isolated hot spots. Treating these isolated spots is a minor problem and a minimal expense compared to having to treat every green.

Hand Watering – I didn't keep exact records on hand watering but it is safe to say that we eliminated at least 25% this year. Cooler weather was a factor, but I believe the hand watering reduction was due to Mountain High Water's System.

Zebra Mussel Shells – We completely eliminated the Zebra Mussel shells in our irrigation lines because of the ozonated water. The ozone killed all the bacteria in the water that the shells feed on, hence eliminating them. We never had a real difficulty with them, nor did we spend money to treat them, it's just one additional benefit we noticed.

Budget Surplus – According to our General Manger, Paul Graebner we saw an increase of over \$100,000 in revenue in 2009. We believe it is directly due to Mountain High Water's System.

The system was installed in our pumping station and tied to our pump start, so when our system turns on, the Mountain High system turns on automatically. Also, the oxygen and ozone gas is created onsite from ambient air, so we don't pay anything for the gases used.

We also have a pH issue in our water that I've been battling for years, so I also wanted to use carbon dioxide because it lowers pH. The CO₂ is delivered weekly or bi-monthly depending on the time of year; it is clean and easy and I can lower my pH from mid to high 8's to under 7.

Before their system was installed we took percolation tests of our soil and tested our water for bacteria. These were our two biggest concerns, so we wanted to compare these initial results to later measurements after using the new system.

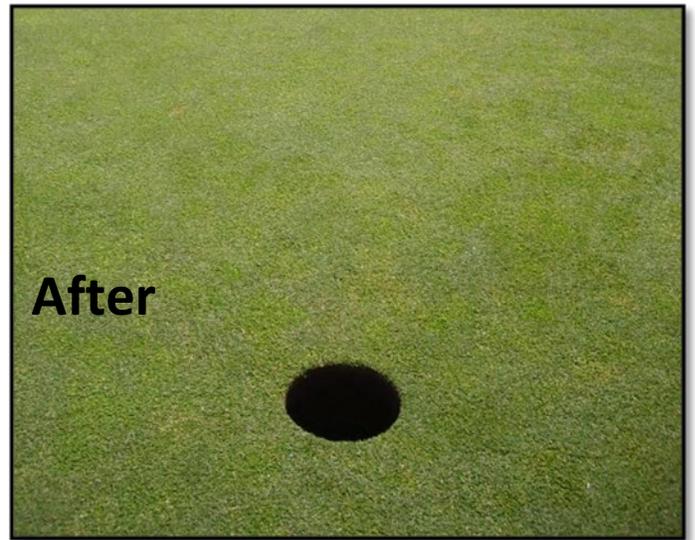
In the first month, we started to see the turf becoming a brighter cast of green and standing water starting to disappear. This was due to the ozone chelating the iron and calcium already in our soil. For those of you who don't know what chelating is, don't worry, I didn't know myself until last year. Chelating is a process that changes the molecules of light metals like iron, calcium, and magnesium to make them biologically available to plant life.

I'm sure that all you superintendents know that most of your soils and water are full of calcium and iron already, but bicarbonates are tying them up so your turf and soil can't use them. Well, this system allows the iron, calcium, and magnesium that already exist to be used in your soil and by your turf.



Above on the right is me, Glen Manley, and on the left, Don Lease of Mountain High Water. We are taking the first round of percolation tests.

After 68 days of having oxygen, ozone, and carbon dioxide injected into my irrigation water nightly we took another round of percolation tests. The result was that the percolation rate on our course increased by over 60%. We took another round of percolation tests 111 days after the system was installed and saw the percolation rate continue to increase. Meaning, we eliminated almost all of our standing water because the water penetrated the soil so much more effectively.



Above on the left, is one of my greens on May 15, 2008, on the right is the same green on July 22, 2008. The percolation rate increased, the black algae was gone, and the color was perfect.

Along with the percolation test a water test was taken for the purpose of determining bacteria levels in our irrigation water. Two water samples were taken on May 15, 2008, and sent to Colorado State University for Bacteria Coliform and Plate Count Tests. Another two samples were taken at the same location 68 days later.

The results were as-promised. Virtually all of the bacteria was eliminated from our irrigation water. Without bacteria algae cannot exist, and thus, we saw the algae in our sprinkler heads and on our turf disappear as well. We also saw the zebra mussels in our pipes eliminated. Below are the results from the tests.

#1: May 15, 2008 Water Test

Sample ID	Total Coliform / 100 ml	Aerobic Plate Count / ml
ACNGC Pump Lake	2	700
ACNGC #2 Mesa	4	280
ACNGC #5 Monument	9	1,600

The first water samples, in the table above, were taken from water around Adobe Creek National Golf Course to get a feel of the relationship between sample areas. Note the increases in the values from the pump lake to #2 and then to #5. The first water tests taken were before any ozone had been used.

#2: July 22, 2008 Water Test

Sample ID	Total Coliform / 100 ml	Aerobic Plate Count / ml
ACNGC Pump Lake	102	64,000
*ACNGC #2 Mesa	0	4,000
*ACNGC #5 Monument	0	1,000

*These samples have been treated with ozone

The second round of water samples taken show a drastic increase in bacteria levels from the pump lake which was not treated by oxygen and ozone. However, that untreated water was cycled through oxygen and ozone prior to arriving at the sprinkler heads #2 and #5. Note that the relationship between sample areas has changed. The water from the infected pump lake exhibits a zero coliform count once ozonated, and the aerobic plate counts decrease from the lake to #2 to #5 instead of increasing, as in the first table.

Many people don't know this, but ozone is a powerful oxidizer. According to the EPA, ozone is more effective than chlorine in destroying viruses and bacteria, and there are no harmful residuals that need to be removed after ozonation because ozone decomposes rapidly. Using ozone is a win-win situation.

Now, I want everyone out there to realize that using this system is not a cure-all for your turf and water issues, but it does help, SIGNIFICANTLY. I have saved considerably in my budget on chemicals, surfactants, fertilizer, and labor. The use of Mountain High Water's System has improved the look and quality of our course immensely. I'm glad we took a chance here at Adobe Creek National Golf Course on using this system.