# *Mineral Deposits in Sand Putting Greens*


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On Halloween of 2013, graduate student Glen Obear dressed up as a very busy guy and stood up in front of a fairly large audience to defend his Master's research in Soil Science. A few weeks later, he did the same thing for his Entomology degree under Dr. Chris Williamson. Many of you know Glen from his three years here as a graduate student in the UW-Madison turf program. Glen has given several talks at the UW Field Day and other educational events. He's also visited many golf courses around the state of Wisconsin to collect soil samples or evaluate on-course research trials.

Glen's work in Soils covered a wide range of topics revolving around the central theme of soil chemical problems in sand root zones. I won't attempt to summarize all of his findings, but will report on a few bits and pieces that I find very interesting.

The first time I met Glen, he was standing by my office door with a chunk of iron-cemented pea gravel from the bottom of a USGA green that he brought back from his internship in Hawaii. He wanted to know exactly what it was, how it formed, and how to get rid of it. He found answers from me and other professors unsatisfying, so I told him he might get the chance to research it himself as a graduate student. About two years later, that's exactly what he did. His graduate studies were largely funded by the

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At first, we figured this iron cementation was a rare problem that was specific to the tropics because the only other case that we knew of was from a club in Vietnam. However, after randomly sampling greens from all over the US, Glen estimates that 25% of all USGA greens will show


***Figure1. Red iron and black manganese accumulating at the pea gravel/ sand interface of a USGA putting green. (photo;Obear)***

some evidence of iron cementation at the pea gravel/sand interface. Glen selected five of the most developed iron layers for further study and found that the layers are indeed composed of iron and manganese oxides (Figure 1). The iron and manganese move down from the top layers of soil and horizontally from upslope areas. As a consequence, the iron layers are usually most severe at the lowest laying areas in putting greens.


***Figure 2. An iron layer is beginning to form at about four inches down because of textural discontinuity where fine topdressing sand sits on top of the original root zone mix. (image Obear)***

Glen also identified a handful of cases where the iron layer developed in the root zone around a depth of three or four inches (Figure 2). In these cases there always was a textural discontinuity where the layer formed. A textural discontinuity is just a fancy way of describing the place where finer particles sit on top of coarse particles, or vice versa. For example, we normally find the layer right where the sand sits on the pea gravel, but have also seen it where fine topdressing sand sits on top of the original, coarser root zone mix. This finding highlights the importance of matching your topdressing with your root zone mix.

There is still a lot of work that needs to be done to figure out why these layers form in some cases and not others. We don't know how much iron fertilizers contribute, but if it were me I'd be very conservative with iron applications on my USGA greens. Also, we do not know if anything can be done to reverse the layer formation that won't also kill the turf. I expect Glen will continue to investigate this throughout his career.

While studying the iron layer, Glen was also investigating the influence of high bicarbonate water on sand root zone quality. It is thought by some that bicarbonate is a problem because after entering the soil, it will react with calcium to form calcium carbonate. If this occurs, some fear that the calcium carbonate will clog soil pores. A few prominent turf scientists have written about high bicarbonate water having the potential to cause "surface sealing of pores" which will reduce air and water infiltration. The solution to the supposed problem is to treat the water to remove the bicarbonate, or treat the soil to dissolve the calcium carbonate. However, I am quite skeptical of this being a serious issue because irrigation water in southern and eastern WI has some of the highest bicarbonate levels in the country. If bicarbonate was such a problem, you'd think we'd all be in agreement about it and solutions would be in place. This doesn't seem

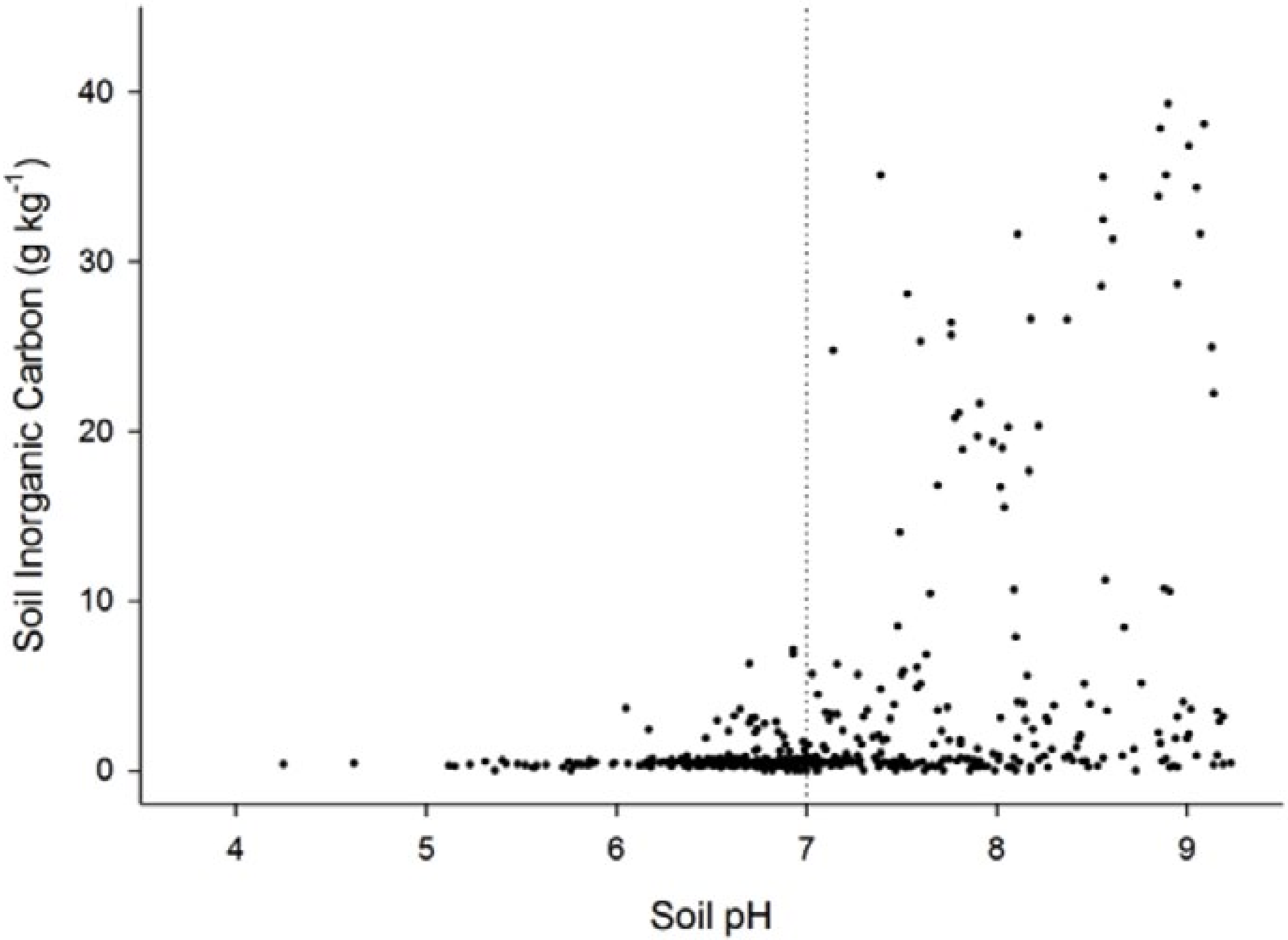


***Figure 3. Soil inorganic carbon (AKA calcium carbonate) is really only found in soils where the pH is above 7. If your pH is below 7, you'll never have to worry about bicarbonate from the irrigation water precipitating.***

to be the case. Some folks treat for high bicarbonate and swear by the results, others don't and are perfectly happy with conditions.

So Glen attacked the issue from two fronts. He sampled USGA greens and irrigation water from all over the US and analyzed and compared the results. The hypothesis was that areas water high in bicarbonate will have soils rich in calcium carbonate. But this turned out to be false. Instead Glen found that if soil pH was less than 7, there was little chance of finding calcium carbonate in the soil. If soil pH was >7, you may or may not find calcium carbonate in the soil. The implication here is that if you maintain soil pH below 7, there is no need to worry about bicarbonate in the water or the potential for pore clogging.

However, we really don't know if the high pH soils with calcium carbonate build up had a problem with reduced pore space. So Glen designed a greenhouse study where he irrigated bentgrass with pure water (no bicarbonate) and water nearly saturated with bicarbonate. After about three years' worth of evapotranspiration and no drainage, he found a small amount of calcium carbonate build up, but no evidence for clogging of pores. In fact, the pure water was found to have a higher degree of clogged pores. The exact reason for this is unknown, but we think it may have something to do with the pure water causing the peat moss in the soil to expand to a greater extent than happens with the bicarbonate water.

***Figure 4. A white crust of calcium carbonate is starting to form on top of the algal mat. (Image: Obear)***

Many of us have seen the white crust that develops on thin or dead spots on putting greens. Glen tested it at the O.J. Noer Research Facility and found that the white crust was indeed calcium carbonate. However, the calcium carbonate crusts we found were always associated with an algal crust. When the turf thins, the algae quickly fills in and forms a crust, and the high bicarbonate irrigation water reacts with the algae to form a white crust on top of the algal mat. So our hypothesis is that the white crust is often mistaken as the cause of the problem when it is simply an artifact of the algae and the water. The real problem is whatever caused the turf to thin so the algae could proliferate and form a mat (shade, compaction, scalping, heat stress, etc.). Like the iron issue, there is much more to learn about bicarbonate, but right now, we think you're much better off spending money to correct drainage and shade problems to prevent turf thinning rather than an acid injector to treat your irrigation water.

Last May, Glen packed up and moved to Lincoln, Nebraska with his wife, Lisa, their son Eli. There, Glen is pursuing his Ph.D. at the University of Nebraska with former Badger Dr. Bill Kreuser. I know Glen and Bill are doing some really great work together and making us proud.

***The editorial staff of the MGCSA publication Hole Notes gratefully appreciates the help we receive through articles contributed from the Wisconsin Grassroots Magazine, Editor David Brandonberg and the Agronomic Scientists, such as Dr. Doug Soldat, at UW, Madison.***

**Want more information on mineral deposits in putting greens? Attend the Advanced Agronomic Forum to be held December 3rd at Medina Golf and Country Club. Hear the latest information from Dr. Bill Krueser, University of Nebraska.**