Long-term follow-up:
how well did that soil amendment work?

Above: "WOW!" is what most turf professionals say when shown these pictures of a soccer field built in 1997. Big Finn Hill Park, Soccer Field, King County Parks, Juanita, WA, designed by The Berger Partnership. Constructed in 1997 with 10% CDE tilled into the top 6 inches of USGA sand blended with organic.
9 Years After Construction – 2006
12 Years After Construction - 2009

Below: BOTHELL HIGH SCHOOL, Baseball & Softball Fields, Bothell, WA, designed by D.A. Hogan & Associates. Constructed in 1998 with 5% CDE blended offsite with USGA sand and organic 6 inches deep over 6 inches of sand mix.
8 Years Past Construction – 2006
11 Years Past Construction - 2009
Healthy root systems are evident here in not just root length, but in root density, which again, for the turfgrass manager translates into better wear resistance.

Editor's note: This article was written by the vice president of EnviroTech Soil Solutions, which makes soil amendment products.

LIKE ANYTHING ELSE OVER TIME, natural grass sports fields can deteriorate into poor playing surfaces. It is also true that sports fields have a better chance of holding up over time if they are constructed well. One way to improve long-term performance is to improve the rootzone with porous amendments that work long-term.

In an exercise to provide post-construction feedback to some prominent physical engineers and landscape architects in the Pacific Northwest, who specified our calcined diatomaceous earth (CDE) soil amendment (AXIS), we created a pictorial history to show how several sand-based fields are holding up as many as 12 years after installation.

Sports turf managers understand that healthy roots are a good measure of plant health and are essential for stable playing surfaces and good wear resistance. All of the fields pictured were originally seeded with cool-season blends of rye, blue, and fescue. There may be some added significance to these extensive root systems since they are inevitably susceptible to *poa annua*, which is notoriously shallow rooted.

According to Mike Crandell, Natural Resource Coordinator for King County Parks, who manages Big Finn Hill Park, "This field holds up particularly well compared to the other fields we have in our system, especially when you consider the volume of scheduled uses this field receives vs. the amount of maintenance that we can perform. This field is generally aerated only once per year, with three applications of fertilizer and one overseed application every year."

Healthy root systems are evident here in not just root length but in root density, which translates into better wear resistance. Significant rooting is the result of an environment with adequate air, air exchange and hydraulic conductivity. In other words, good rootzone mixes have the capacity to move more air and more water into, out of, and throughout the soil. Plants don't compensate for good or bad soil environments, they reflect their environments. These are rich root environments, and the currency is efficient air and water movement and availability, along with good nutrition and proper maintenance practices. These roots are consistent with original research by Dr. Ed McCoy of Ohio State where dry weight rootmass was found to be 4 times greater with CDE than the control in USGA sand.

Spin Martin, former head groundskeeper of the Indianapolis

Colts, claimed phenomenal rooting in the practice field he rebuilt last year for the Colts with CDE. "I had 14-inch roots in 6 weeks, and after 12 solid weeks of NFL players practicing on my fields I noticed less compaction, and not a single bare spot at the end of the season. This was the best field I ever installed or worked on, and my irrigation was reduced by about 60%, according to irrigation records.

» **Above:** Redmond High School, Baseball & Softball Fields, Redmond, WA, designed by The Berger Partnership. Constructed with 10% CDE tilled into the top 6 inches of USGA sand and organic in 2002.
4 Years After Construction, 2006
7 Years After Construction, 2009

» **Below:** PCC Rock Creek/ Tualatin Hills Park & Recreation District Athletic Fields, designed by WHPacific. Constructed in 2006 with 10% CDE with USGA sand and organic. Infield mixes contain 10% CDE Play Ball!
1 Year After Construction, 2007
2 Years After Construction, 2008

"There's also a healthy increase in oxygen content all the way down to the roots. I did the lab comparisons, due diligence, and my own bench tests. Every step of the process confirmed this was the best material to use and made it a no-brainer," Martin said.

It is widely recognized that soil should be about 25% air space, and 25% water pore space. What may not be as readily recognized is that porosity influences everything else. It reduces compaction while increasing infiltration, air and water pore space, water holding capacity and plant available water. Studies show that CDE increases water holding capacity and plant available water significantly enough to reduce irrigation. As water is released from their structures it is replaced with air, and likely contains residual air permanently.

When comparing porous inorganics, pore size matters, as larger pores absorb and *release* more water per wetting and drying cycle. As these cycles repeat within the soil, the cumulative difference of air and water availability over time is substantially greater with CDE. Testing by Micromeritics Instrument Corporation reported median pore size for CDE is 9 times larger than calcined clay (CC)—(.36 microns vs. .045). The impact of this is that CDE requires approximately 4 times less energy to release water than CC.

Using university water savings research and irrigation data, it is possible to estimate the water conserved, the water cost savings, an estimated return on your investment, and the time required for CDE to pay for itself. Depending on your location, water resources can be limited by cost, or a simple lack of available resources for sufficient irrigation. Water resource stewardship is less of a choice now than a necessity. For Big Finn Hill Park's soccer field, the original cost of the CDE averaged over 12 years of service is $2,500 per year, or less than three cents a square foot per year.

Any conversation of the long-term contribution of porous amendments needs to include what we know about their life expectancy. There are two forms of breakdown concern, weathering and crushing. The USGA recommends a sulfate soundness test of under 12 to determine suitable resistance to weathering. Sulfate soundness tests for CDE are 3.1 and calcined clay (CC) are 2.9. From this test, two manufacturers of CDE and CC, EP Minerals and Profile Products respectively, both estimate a 3% breakdown from weathering over 20 years.

While calcined diatomaceous earth can crush at slightly lower pressures than calcined clays, when the products have been satu-

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rated, they crush within 7 psi of each other. Crushing potential barely exists on grass fields where grass blades, plant crowns, and thatch can insulate these products from wear, and since soil pressures reduce quadratically with soil depth. Crushing potential is higher on infield surfaces and can crush all but the hardest (and abrasive) products. Essentially, in turf and landscape applications, these products are marketed as permanent amendments.

One surprising observation common among all the fields pictured was the degree to which the original grades were preserved. The grades are almost identical to original condition even after several years of use in the Northwest's frequently rainy weather due to increased drainage, less puddling, and increased rootmass. Because the fields are saturated less, they have increased wear resistance and are less vulnerable to that bad combination of aggressive cleat traffic, shallow roots, and saturated conditions.

Sports turf managers are not always afforded proper resources and time to properly manage their facilities. In many areas, there are not enough athletic fields to accommodate the scheduled uses. This field use pressure amplifies the importance of "hardwiring in" the best opportunity for resilient and productive service. To the extent these fields require less work to maintain, there may also be some maintenance cost savings in addition to improved soil and turf quality.

Designing in healthy, proven, soil performance from construction resources is less expensive, more effective, and requires less effort than engaging in soil modification after construction. For soil modification of existing turf, topdressing porous amendments with sand after aerifying is much more effective than sand alone, but requires repeat applications to reach recommended rates and best results.

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