BY **PHIL BROWN AND DR. BERT MCCARTY**

Understanding and minimizing soil compaction

Soil compaction is becoming an ever more prevalent problem within the turf world. With the surge of athletic events and practice on a limited number of fields, unhealthy turf and playing conditions are emerging. Facilities wishing to attract additional revenue are facing the situation where the more customers they attract, the greater the traffic on the turf and thus, the greater the amount of soil compaction.

Soil compaction is the pressing together of soil particles, resulting in a more dense soil mass with less pore space. When the soil particles push together, they occupy a smaller space, thus, are considered compact.

Compaction occurs in areas receiving the most traffic. Athletic training fields are a high compaction risk due to the near daily usage and the evolution of larger and stronger participants. Other areas at risk are recreational fields open to almost unlimited play and practice. It is not just foot traffic causing compaction, but also vehicular traffic. Daily mowing, periodic topdressing, and fertilizing require heavy machinery to perform, thus, additional sources of compaction.

Soil compaction can occur at any time, however it is most acute when the soil is wet. This is from the water in the soil acting as a lubricant, more easily allowing the soil particles to slide past each other with less resistance than when they are dry. This is amplified when soil high in silt or clay is used during construction. These soils remain wet longer following rain and the smaller size of these soil particles allows them to press closer together.

A marching band's practice field—talk about compaction!

Problems caused

Compaction can also cause a number of soil problems, including an increase in bulk density, an increase in soil strength or firmness, a reduced aeration porosity, and an altered pore size distribution when soils are highly pressed together.

Bulk density is a measure of mass or weight per unit area. In compacted situations, due to the increase in number of soil particles in the area, the mass will increase. This also contributes to the reduction in aeration porosity, as the closer soil particles are to one another, less pore space exists. Sufficient pore space allows air, water, and other nutrients to enter the soil, a reduction in this eventually leads to poor turf. Non-uniform pore size distribution also can contribute to this, causing soil particles to move closer to one another, reducing pore space.

These physical changes can have detrimental effects on turfgrass growth such as decreased root growth, decreased shoot growth, reduced carbohydrate reserves, and decline in overall quality. Destruction of the soil structure also may occur. The resulting soil often becomes "hard as a brick" when dry and a "mud hole" when wet. The turf eventually thins, potholes develop, and the resulting hard surfaces can cause player injury.

Prevention

Constructing fields with sands that do not compact is the first step in preventing soil compaction. This involves replacing the existing soil with a pre-approved sand-based rootzone mix that balances good water management and compaction prevention. Unfortunately sand-based athletic fields are more expensive to build.

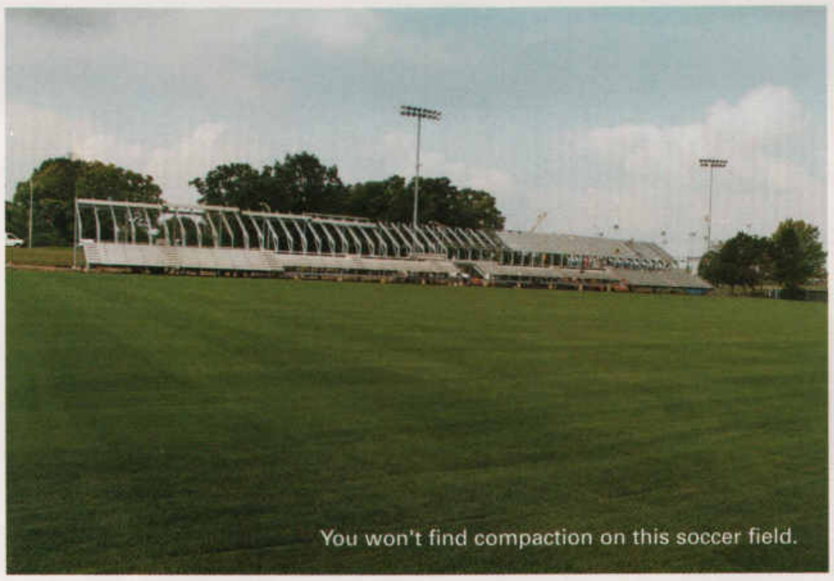
The most common way of reducing compaction of existing soil is through the use of soil cultivation techniques. Most of these techniques operate by physically altering the soil profile in some way, be it by removing parts of the soil or by altering the structure of the soil. A great deal of diversity exists among the cultivation techniques available.

The most popular method of reducing existing soil compaction is hollow tine aerification. Hollow tine aerifiers are hollow tubes 1/2 to 3/4-inch in diameter and 3 to 12-inches long, designed to pull plugs out of the soil, thus, reduce the amount of soil per unit area. They operate on the principle that if less soil is present then a lower mass per unit area (or bulk density) results. Note that hollow tine aerification can disrupt the surface considerably, the equipment can be expensive, and generally requires a medium sized tractor.

The disruption cause by hollow tines has increased the popularity of solid tine aerification. Solid tines are designed to enter the soil vertically and shatter (disrupt) the structure of the soil as they are retracted from it. Since solid tines do not pull out plugs of soil like hollow tines, they require very little clean up, saving on labor costs, and helping keep the playing surface smoother. However, there is a question over the effectiveness of solid tines since they do not remove any soil material and therefore might not be reducing the bulk density of the soil.

Adaptations to hollow and solid tine aerification include both deep tine aerification and spiking. Deep tine aerifiers are hollow and solid tine aerifiers able to penetrate to depths of up to 12 inches. Spiking is similar to solid tine aerification except the tines are thinner and shorter. Spiking is designed where the surface of the turf requires as little disturbance as possible.

The hydroject operates on a similar principle to solid tine aerification but instead of a tine, high-pressured jets of water are used. The water is pushed into the soil under pressures of 2000 psi enabling it to reach a depth of roughly 8 inches. The water not only aids in the relief of compaction but helps water penetrate to the lower parts of the soil profile, redistributes organic matter in the soil, and wet hydrophobic (excessively dry) soil.


You won't find compaction on this soccer field.

Another technique that operates in a similar way to the original solid and hollow tine aerifiers is "drill-n-fill." Drilling involves using a piece of machinery with drill bits attached to it. The bits are drilled into the ground, creating deep holes. As is the nature of a drill, some soil from the hole is brought up to the surface, lowering bulk density. This, however, is not in the same quantities as conventional hollow tine aerification. Some machines allow the hole to be filled with sand and tend to cause less surface disruption than conventional aerifiers. Unfortunately these machines are relatively slow when compared to other aerifiers but do not disrupt the surface as much as deep-tine aerification.

Other techniques use a horizontal motion. Slicing, for example, is using a rolling blade to cut slits into the soil. The slicer helps break up the soil surface, reducing surface compaction as it does so. Slicing also helps soil water and air exchange and slices algae and turfgrass runners. Slicing blades can be continuous or a series of teeth set on a rotating blade.

Similar to slicing is grooming. Grooming operates in a similar manner but the blades are attached to a walk-behind mower. The blades used in grooming are much smaller and thinner than those used in slicing as the technique is generally used in the prevention of mat and grain formation on turfgrass. The blades are powered to revolve against the direction of machine movement. Due to the shallow blades, grooming is unlikely to have a great deal of effect on deep compact areas but helps in alleviating or preventing compaction in the upper soil profile.

Supplements to the use of machinery include reducing or altering the traffic pattern on the turf, especially when the soil is excessively wet. On football and soccer fields concentrated practices should be performed or rotated on different parts of the field. Using only lightweight machinery and minimizing its use and practice when soils are saturated also help prevent soil compaction.

Soil compaction is a serious issue among the turfgrass community and one that has possible legal ramifications. It can cause the deterioration of turf quality and be a danger to participants. Take steps to relieve this problem or eventually undesirable turf and soil conditions will develop.

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Keep softball maintenance costs in the ballpark

BY **MARK NOVAK AND PATRICK MAGUIRE**

As the days grow longer, the first signs of spring bring with it the excitement of a new season. Yet, whatever opportunities the season may bring for athletes, athletic fields bring their own set of management challenges: how to increase usage and improve field conditions on limited budgets. With the unique combination of skinned infields, turf areas and other facility elements, softball fields are some of the most difficult athletic facilities to properly maintain. Attention to detail and creative athletic field design can help to reduce scheduling headaches and keep annual maintenance costs in the ballpark. Following are several cost-effective techniques that will help to improve playing conditions and increase the life span of softball facilities:

Customize the infield mix. Composed primarily of sand, silt and clay, the "skinned" area of a softball field might be the most delicate and maintenance intense component of all athletic field surfaces. In fact, many high-level facilities have staff dedicated solely to the upkeep of softball (and baseball) facilities.

Determining the composition of an infield mix directly influences both the playability of the field, and how well it will respond to various weather conditions. Across the country there is an enormous variety in climatic conditions and just as many variations in infield mix design. In New England, weather ranges from cold and wet months in the spring and fall, to hot and dry during the summer. A typical ratio for an infield mix in the northeastern portion of the country also reflects the area's climatic conditions: 60-75% sand, 9-25% silt and 16-25% clay. The high percentage of sand helps keep the infield mix playable in the spring and fall while the percentage of clay helps maintain the skinned area's moisture during the dry summer months. Each softball field is unique and the design of the infield mix should be considered the same.

Water efficiently. Watering the skinned areas is necessary to maintain a consistent infield mix. Water is the glue that holds the components of the infield mix together. During the softball season and the hot, dry months of summer, skinned areas can require water up to three to four times daily.

Springfield College in Springfield, MA, last year experienced an extremely dusty softball infield. The college's president called in a design consultant to assess

and recommend renovation methods for the softball facility. Tests of the infield mix at the softball field showed a high percentage of silt. Dusty conditions on an infield can often be attributed to an infield mix that is high in silt and is not watered enough.

Many natural grass athletic complexes have in-ground, head-to-head irrigation systems. Instead of hand watering the field three to four times per day, consider installing a separate irrigation zone that waters the infield mix at a different time and rate than the turf areas. High-speed irrigation heads should be used in this type of application. Standard irrigation heads provide a slower, more thorough watering which is required for turf areas. The high-speed heads allow sports turf managers to initiate a quick irrigation cycle that will moisten the infield mix without saturating the skinned areas. The incorporation of a high pressure water hook-up near the infield is also advisable to aid in the lip removal process at the border of the infield surfaces and turf areas. Watering efficiently will save time and dollars.

Cover up and support high-use areas. Keep maintenance at a minimum by purchasing a cover. Watering and then covering the skinned areas of a field when the field is not in use will help the infield mix retain its moisture and thereby prevent it from drying up and becoming concrete-like. Once an infield mix is allowed to dry up, it requires a significant amount of man-hours and dollars to return it to a playable condition. Also consider installing clay bricks underneath the infield mix to fortify batters boxes and pitcher's mounds.

Think about the following: What is the first thing a batter does when he/she steps into the batter's box? What is the first thing a pitcher does when he/she takes the mound? They dig themselves a firm foothold. Clay bricks are installed approximately 2 inches underneath the top layer of infield mix and prevent deep ruts that will require repair after every game or practice.

Test the infield mix. Infield mix tests are an essential component in the renovation and maintenance of skinned athletic surfaces. Consider the constantly evolving nature of the natural grass portions of softball (and baseball) fields. Soil tests should be conducted a few times a year to analyze the chemical and physical properties of the turf's rootzone. Much like natural grass, the composition of infield mixes evolves over time and should be tested annually. Annual maintenance of skinned infield areas typically requires the addition of amendments such as calcined clay. Play on the infield, water and wind born erosion, and amendments will change the properties of the infield mix. Annual tests help determine what the skinned areas need to keep their composition in synch with the properties of the original design mix.

Improve drainage. Under perfect conditions, skinned infields with quality infield mixes are exceptional playing surfaces. Unfortunately, perfect conditions cannot be guaranteed over the course of a softball season. Poor surface drainage is usually the primary reason why a skinned infield area fails. Internal drainage is poor even in the best-designed infield mixes. Considering subsurface drainage has little or no effect under skinned infield surfaces, facilities are better suited spending money and time during design and construction to maintain positive surface drainage away from the infield.

When possible, design swales to intercept water from surrounding areas before it has a chance to cross the infield mix or any of the playing surfaces. Insufficient drainage will only create additional maintenance headaches for athletic and facility departments. If an infield does not drain properly, the condition of the field will deteriorate immediately when used during or shortly after inclement weather. Use of drying agents can help to keep a field playable during a light rain but proper design, intricate grading of the infield during construction and regular maintenance is the best way to ensure your field will be suitable for play in a short period of time after inclement weather.


Poor surface drainage leads to puddles and unplayable conditions in the infield. Photos courtesy Geller Sport

Make the grade. How the infield is graded (the way the ball rolls) significantly affects the playability of the field and thus the potential safety of the athletes. The NCAA provides recommendations and guidelines on how fields should be graded with emphasis on consistency throughout the entire field (www.ncaa.org). Other softball organizations, such as the ASA, also provide design standards that all fields should strive to at least meet. Working with a design consultant to meet and exceed standards will avoid jeopardizing player safety and enhance field playability.

Involve the team. The maintenance required for softball (and baseball) infields can be staggering, especially for understaffed maintenance crews. Consider involving the teams that use your field. Teams taking an active role in maintenance can unload a considerable burden from the staff. Involving the athletes in weeding, raking, watering down, and covering the field can help them get to know the field better, as well as instill a sense of pride in the facility.

Softball fields are dynamic facilities that will always require the attention of a skillful and creative maintenance staff. For programs working with limited funds, good design decisions can improve playing conditions and reduce the chances for serious renovations in the near future.

Patrick Maguire is the president and Mark Novak is a project manager of Geller Sport, a division of Geller DeVellis Inc., a Boston-based landscape

Preventing winterkill with data loggers

Over the past few winters, turf in the northeast United States have been subjected to some of the most extreme weather conditions seen in decades. Steve Thys, superintendent of the Worcester Country Club in Massachusetts, says that two winters ago, he did a routine check of one of his greens after snowfall on an already covered ground. According to Thys, "Everything looked as lush green as it had in November because it had not hardened off by the time the first snowfall fell." Just a little over a week later, he checked the green again, only to find winterkill.

"Something happened during those ten days, but it was impossible for us to pinpoint any specific weather occurrence," Thys says. "Nevertheless, we had a big problem on our hands, and it was a race against time to get the damage repaired since our members flock to the course the minute the snow melts."

Thys' story is so common in the Northeast that that he and other superintendents are beginning to monitor greens in the off-seasons with battery-powered data loggers.

Data loggers are compact instruments that incorporate built-in micro processing, high-accuracy temperature sensing, and battery power in an enclosure designed for long-term deployment outdoors. Loggers can be placed under turf covers during the winter months, where they will collect temperature data at user-defined intervals (e.g., every 10 minutes) and store it digitally into logger memory.

Data loggers are perhaps one of the simplest and most straightforward of PC-based technologies. Using them involves four basic steps: logger set-up, deployment, data retrieval, and analysis.

Setting up a logger is typically done by connecting the device to a PC and using accompanying logger software to make a number of point-and-click selections. These include how often the logger should take a turf temperature measurement, and the specific date and time the logger should start recording. Deployment involves determining optimal placement of the logger on the green and physically installing the logger under its covering. Data retrieval can be accomplished manually, where the turf manager offloads the collected data onto a PC, laptop or data shuttle, or, in certain cases, automatically, where the logger transmits the data to a PC via wireless communications.

Analysis of the data is typically performed using the accompanying data logger software to translate the data into time/date-stamped graphs that show spikes and drops in turf canopy temperature over the given data collection period.

Peter Hasak, superintendent of Tedesco Country Club in Marblehead, MA, has been experimenting with data loggers and various types of greens covers to understand the differential temperatures above and below the cover surfaces and to correlate that data with potential damage to the greens.

"While we've typically been using translucent covers that let a lot of sunlight in, we are looking at making the change to solid white covers in some areas," he says. "The idea of bringing solid white covers into this part of New England is relatively new, but it's an idea worth considering in certain situations." ST

This article was supplied by Onset Computer Corp., www.onsetcomp.com.

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