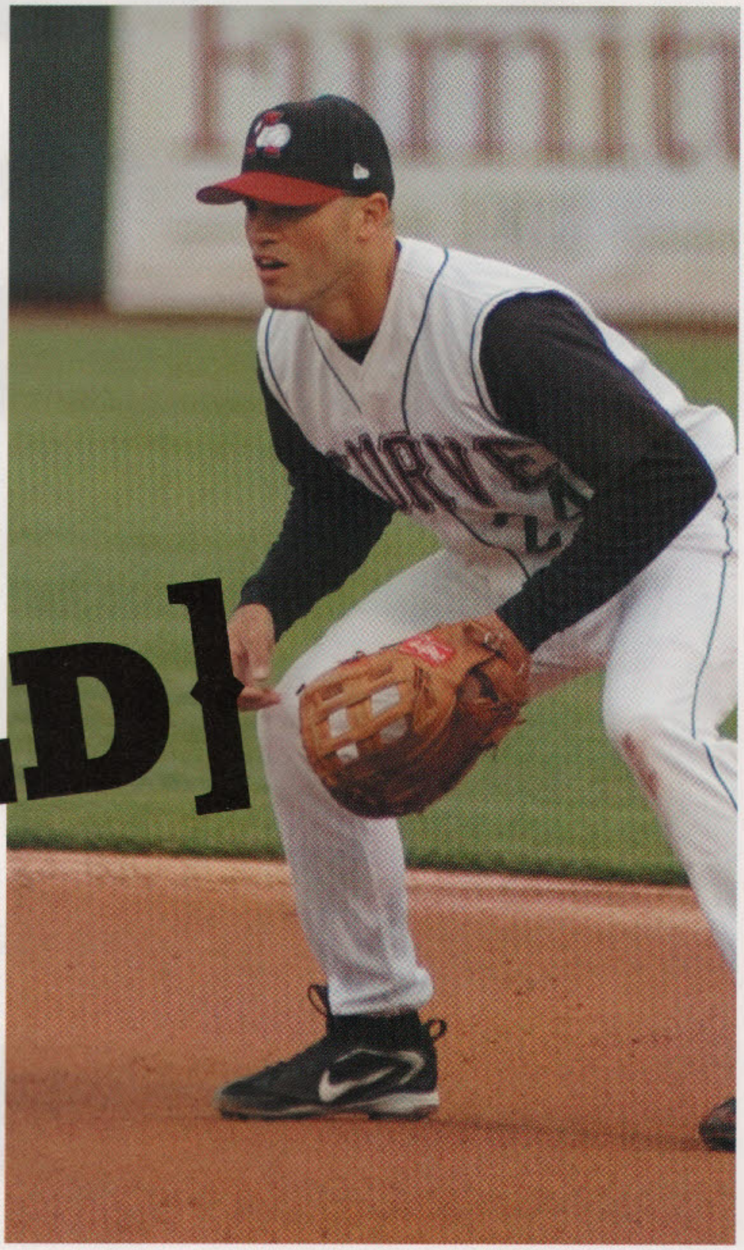
Take better care of your {INFIELD} *skin*



By Jim Brosnan and Dr. Andy McNitt

Baseball field maintenance is unique, and many of the maintenance practices used to prepare baseball fields for play are rooted more in tradition than science.

Maintenance programs often evolve out of simply having a feel for what techniques have worked in the past. Field managers agree that maintaining the skinned area is really an art form.

We conducted a research study at Penn State in 2006 to take a closer look at some of the most common skinned infield maintenance procedures. We had three main reasons:

First, injuries are common in sports. The National Youth Sports Safety Foundation reports that over 3.5 million children under the age of 14 are injured annually competing in athletics. Not all of these injuries are surface related, but such staggering numbers warrant taking a closer look at how we prepare fields for play, and how these practices affect athletes.

Second, not all baseball field managers are lucky enough to have been trained by one of the great "artists." Those managers that have not been exposed to the tricks of the trade may benefit from documentation of proven maintenance techniques.

Above: Simon Pond readies himself on the award-winning infield of the Class AA Altoona Curve (see p. 42).

Cleat used during traction testing.

Pennbounce apparatus used to measure the speed of skinned infields.

Thirdly, field managers do admit that a large portion of their skinned maintenance is done by "feel." Through experience, the veteran field manager knows how to prepare the skinned area for play during various weather conditions. It would be useful to know the actual affect of the various maintenance procedures they employ.

Research plots were constructed at the Joseph Valentine Turfgrass Research Center using an infield mix comprised of approximately 75% coarse particles (gravel + sand) and 25% fine particles (silt + clay). After construction, plots were differentially rolled to create areas of high, medium, and low compaction. Within each area of compaction, calcined clay was applied at four rates: 0, 0.5, 1.0, and 1.5 tons per 10,000 sq. ft. These treatments are similar to the amount of calcined clay applied to professional skinned infields as topdressing before play. Plots were then groomed to four depths with a nail drag: 0, 0.25, 0.50, and 0.75 inches.

We investigated how these factors affected 1) the safety of the infield, 2) the speed of the infield, and 3) moisture management.

To measure skinned infield safety we evaluated two properties, surface hardness and traction. The hardness of a playing surface determines the amount of energy that the surface can absorb when a player falls on it during competition. A survey, conducted by the Penn State Center for Turfgrass Science, found many skinned infields to be above the surface hardness threshold (200 Gmax) set by the U.S. Consumer Product Safety Commission. Traction is a measure of how players' cleats interact with the surface. Surfaces high in traction are said to "grip" the cleat, resisting either linear or rotational motion. Both surface hardness and traction have been linked to anterior cruciate ligament (ACL) injury, one of the most debilitating injuries an athlete can suffer.

Skinned areas are heavily compacted at construction to ensure proper grade and surface drainage. Player traffic on the skinned area will compact the surface even more. Our research found this compaction to be directly linked to unsafe playing conditions (hardness + traction). What can be done? Periodically try grooming the skinned area deeper than usual. This will prevent a heavily compacted layer from forming near the soil surface, reducing both the surface hardness and traction of the skinned area.

It is important to note that we evaluated traction using a baseball cleat that contained metal spikes. The cleat used during testing contained 8 flat, metal studs approximately 0.5 x 0.5 in. Research has found that the shape of the studs on a cleat and their location on the sole of the shoe can change the traction characteristics of a playing surface. Future research needs to evaluate the traction of skinned infield surfaces using different types of baseball cleats, especially cleats with molded rubber studs.

Speed of the infield

We can determine how fast an infield plays using an instrument termed Pennbounce, which calculates the velocity of baseballs propelled at the playing surface before and after impact. Our findings indicate that speed of a skinned infield is determined by the characteristics of the sub-surface soil, which is the soil below the material loosened during the grooming (scarifying) process. Sub-surface soils on skinned areas are often highly compacted at construction. We have found that as this soil becomes more compacted, the speed of the infield will increase.

Surface treatments, such as applying calcined clay at rates as high as 1.5 tons per 10,000 sq. ft. and grooming up to 0.75 inches, did not change the speed of the infield in this study. Thus, if the goal is to change how fast the infield plays, one must do something to change this sub-surface soil. Relieving this compaction will slow down an infield that plays too fast.

Baseball field managers agree that the most important task in maintaining skinned areas is managing soil moisture content. The moisture content of the skinned area affects how both the ball and players react with the surface. On the game-day, field managers often apply water up to five times. This process takes a lot of time. Part of this research project was to investigate skinned infield irrigation practices in order to find the most efficient method of irrigation.

We have found that the time required to re-wet skinned infield soils is related to compaction as well. Infiltration into compacted skinned areas is very slow for two reasons; these soils lack permeability and are often crowned.

Most skinned infield soils contain at least 25% silt and clay particles. Some non-commercial skinned infield mixes are much higher in silt and clay. Therefore under compaction, there is very little internal porosity (permeability) through these soils, and pores that are present are smaller in size (micropores). There is very little internal drainage through skinned infield soils.

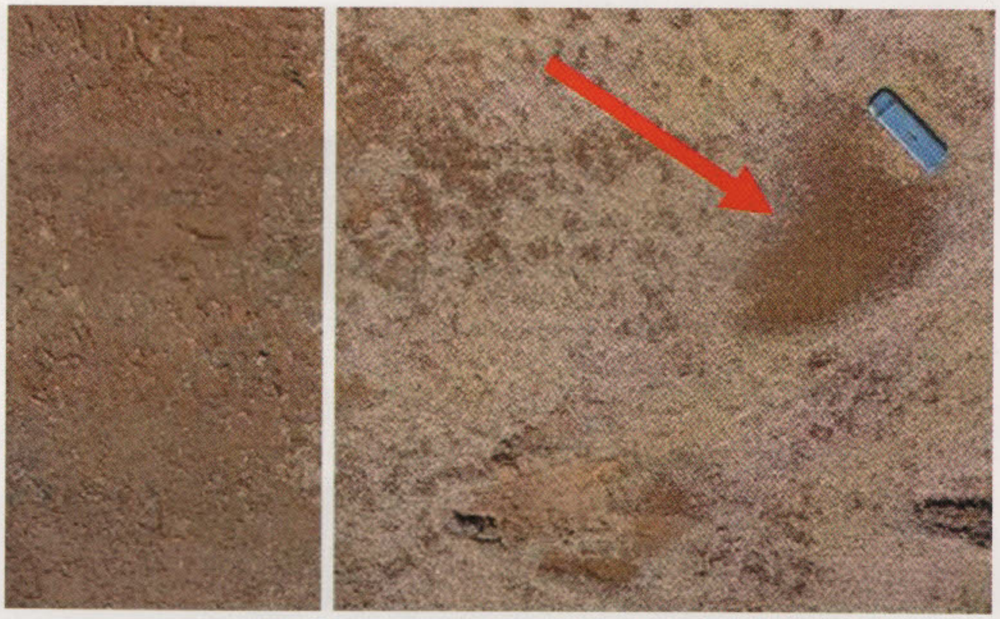
The fact that skinned infield soils lack internal drainage is not news to most of us. Skinned areas are often constructed with a crown of at least 1/2%. This crown is designed to move rainwater off the field of play. We know that if we have a prolonged rain on the skinned area the moisture will be retained in that soil for a long time, often rendering the surface unplayable. Thus, we rely on that crown to move water off the field via surface drainage.

Applied irrigation water works the same as rainwater. When we irrigate these skinned areas water wants to move with that crown to the foul line. Thus, it is going to take longer to introduce water into the underlying soil. To combat this problem, many field managers flood their infields during the day. They irrigate to the point that there is standing water on the skinned area, and then simply allow that water to slowly infiltrate into the soil below.

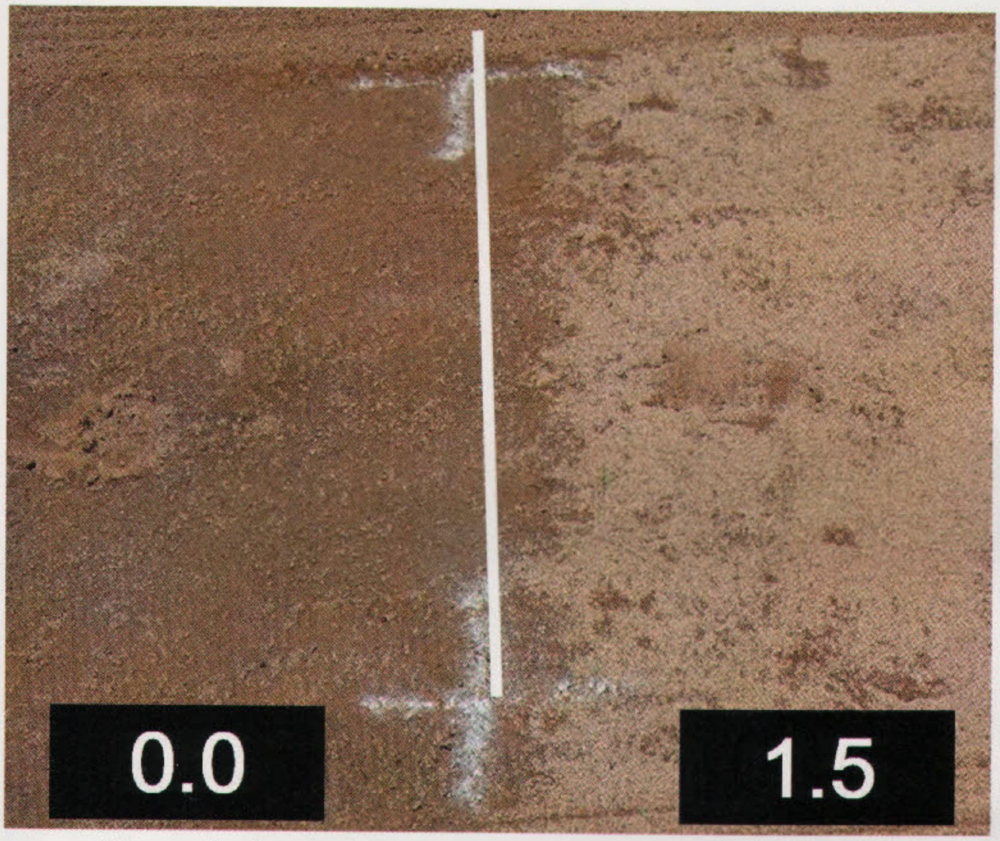
We flooded our infield plots by applying 2 inches of irrigation 14 hours before data collection. We then measured volumetric soil moisture content twice in a 3-hour period. This would be synonymous to flooding the infield the night before a game and taking a pre- and post-game moisture content reading. Following this irrigation schedule, we found no differences in pre- and post-game volumetric soil moisture content. This phenomenon was observed in cooler weather during April and hot and humid weather during June and July. Water introduced into this skinned infield soil was retained throughout the day. Even though at times a color change was noticeable, there was no appreciable soil moisture content change.

Calcined clay

When studying skinned infield management it is necessary to discuss the effects of conditioners like calcined clay. In this study calcined clay, applied as topdressing, had no effect on playing quality. The conditioner had no effect on the safety (hardness and traction), speed, or soil moisture retention of the skinned area.



Soil below calcined clay topdressing is similar in color to soil found on a plot receiving no calcined clay.



Plots receiving lowest and highest rates of calcined clay 17 hours after irrigation.

It is important to note that calcined clay products are used for reasons other than what was evaluated in this study. Calcined clay is often used to improve the aesthetics of the surface and to make the area easier to groom (scarify). Neither effect was measured in this study. Calcined clay products are also often used as drying agents to remove standing water from the infield and to keep the surface playable during an in-game rainstorm. Neither of these effects was measured in this study.

Our research also found calcined clay, applied as topdressing, to have no effect on the amount of moisture the skinned infield could hold at a 3-inch depth. When used as topdressing, there was only a thin layer of material on top of the soil surface. We know that the underlying soil maintains consistent moisture content over time, regardless of the surface application of calcined clay. A 0.25-inch of calcined clay on the surface will not change the amount of water that can be retained in a 3-inch deep soil profile. Moisture retention is a function of the amount of silt and clay in the soil, not the amount of conditioner on the soil surface.

This calcined clay material did change color during the data collection process. After irrigation, the material exhibited a dark brown color (Munsell notation, 7.5YR 4/4). Over a 3-hour time period, the material lightened to very light brown color (Munsell notation, 10 YR 7/4). This color change presents an illusion that the area is drying out and needs additional irrigation, but the soil moisture content did not change during this period.

For example, the photo on this page was taken 17 hours after irrigation. One plot had no calcined clay applied to it while the other had calcined clay applied at a rate 1.5 tons per 10,000 sq. ft. The plot with calcined clay topdressing appears much drier than the plot without topdressing. Many field managers would apply additional irrigation to their skinned areas if they had this appearance. If we remove the calcined clay topdressing, it is apparent that the soils of these plots are very similar in color, and moisture content data shows that they do not differ in soil moisture content.

Thus, there is not a need to irrigate multiple times a day in response to this calcined clay color change. A single heavy application of water to the skinned area will allow for slow infiltration into the underlying soil. Once this water is in the soil, it will be retained for an extended period of time because these soils exhibit very little internal drainage.

The soil below the material loosened during the grooming process (sub-soil) affects the safety of the skinned area. As this soil becomes more compacted, both surface hardness and traction increase. Grooming excessively compacted skinned infields to greater depths will reduce both surface hardness and traction.

The sub-soil affects not only the hardness and traction of the infield, but the speed of the infield as well. As this sub-surface soil becomes increasingly compact, the speed of the infield will increase. Management efforts to change the speed of the infield should be directed towards the sub-soil, as grooming and calcined clay applications do not alter the speed of the infield.

Calcined clay topdressing did not change the playing characteristics of skinned areas in this study. Increasing the amount of calcined clay on the surface did not alter the safety or speed of the infield, nor did it affect the amount of moisture the skinned area could retain. Volumetric soil moisture content on skinned areas appears to be a function of the amount of silt and clay in the soil, not the amount of conditioner on the surface.

A deep, infrequent irrigation program (similar to what is often practiced on turfgrass surfaces) appears to be the most efficient method of managing moisture on skinned areas. Water slowly infiltrates into skinned infield soils, and once it enters the soil profile it is retained for a considerable amount of time in varying weather conditions. Often calcined clay on the soil surface may present an illusion that the skinned area is drying out, but this is not the case.

We have learned a great deal about skinned infield maintenance from this research, but there is more work to be done. Future research needs to evaluate different skinned infield mixes varying not only in sand content, but sand shape and size as well. Additionally, the effect of blending conditioners into skinned infield soils during construction needs to be evaluated.

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