FEATURE I

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Why "New" Greens Fail

Cubs or Soxs; Bears or Packers; Bud or Miller; conservative or liberal; blonds or…well you get it. There are many easy ways to split a room and begin a debate. In the horticulture industry there's no easier way to divide a room than to spark a conversation about container or field grown nursery stock or which is better, dry or liquid nutrition.

Turf is no different. Debates will always rage about old grass varieties vs. new; new chemistries vs. old; or green vs. red. But perhaps the best way to split a room is to crank up the debate over sand vs. soil. And, like any good debate, each side will have their positive and negative points. Over time, most superintendents will experience both sides of this debate and favor the environment that they like to manage the most.

Logic tells us that it is highly unlikely that we will ever build 'new' soil greens again, which means that someday we will all find ourselves on the same side of this debate. So, since most of us will deal with sand based greens in our careers, let's look at 3 typical construction pitfalls.

Compatibility of Construction Materials

The first and least likely pitfall to occur has to do with material compatibility. More precisely, the compatibility of the sand used in the greens mix and the gravel used for drainage. (The USGA has developed recommendations for each which can be found on the Green Section website and thus will not be duplicated here.) This first picture shows what happens when proper procedures are not followed.

In this photo you can see that the greens mix has infiltrated the drainage gravel and created a layer that is difficult for water to penetrate. This is much like making a pot of coffee with one filter….no problem. Add a second or third filter and you can still make coffee, but chances are the water will overflow out the top since it will be coming in faster than the finished coffee can permeate multiple filters. In a golf green, this will result in the lower portion of the profile staying full of water and eventually going anaerobic. Gases will form, roots will come to the top in search of oxygen and decline will set in.

The sand used in this construction falls well within the USGA recommendation and the ruler photo shows that the mix, after about an inch of topdressing, was used at the proper 12" depth.

The gravel however is a different story. This course is in an area where bridging gravel is very scarce and expensive to haul. So, instead of adding an 'intermediate layer' with a choker sand/gravel that would have separated the mix from the drainage gravel, the builder simply placed the mix on the locally

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available gravel. I am sure the greens functioned pretty well for a period, but 10 years worth of moving water, freezing and thawing, and aerification have finally migrated enough sand into the gravel that the layer is no longer permeable.

Several superintendents failed on this course before the problem was identified. And unfortunately, there is no quick or cheap fix for this problem. New 2" drainage lines laid above the gravel in the worst areas, along with smile drains, will alleviate some of the symptoms but will not correct the problem. The profile will drain, but much like the double coffee filter, it will take some time. Venting aerification following every major rain event is a must here as is the monitoring of soluble salts, since flushing is near impossible.

Mat (360 deg C ash)		0.71	
ıd Fractions			
ve Size mm		% Retained	
- 2.0	Fine Gravel	0.61	2.0mm <= 3.0%
- 1.0	Very Coarse Sand	1.19	2.0mm + 1.0mm <= 10%
- .500	Coarse Sand	12.01	
- .250	Medium Sand	53.53	0.5mm + 0.25mm >= 60%
- .150	Fine Sand	22.30	0.15mm <= 20%
- .106	Very Fine Sand	5.87	0.106mm + 0.053mm <= 5.0%
- .053	Very Fine Sand	1.61	
ıl Moisture Measurements			
ırated Conductivity in/hr		3.0	
ıl Density			
k Density	g/cc	1.58	
:icle Density	g/cc	2.60	

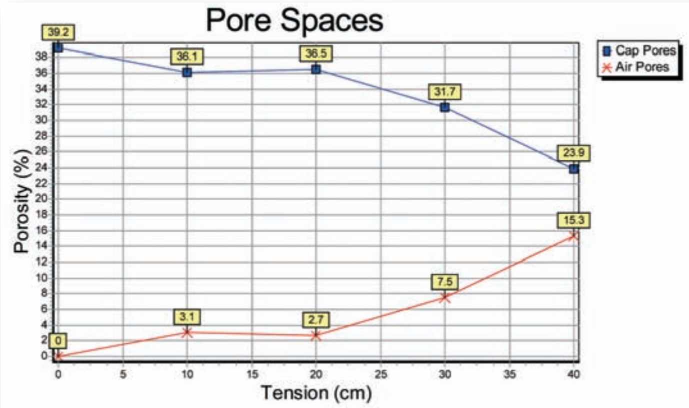
Wrong Construction Sand

Improper selection of construction sand is the 2nd most popular reason for failures in sand greens. Again, the USGA Green Section publishes recommendations for construction sands, but that doesn't mean the standards are always followed.

This lab report is from a green that was supposed to be built according to USGA recommendations. The percent of sand classified as fine to very fine is well above the 20% threshold allowed. Therein, the saturated conductivity is also below the minimum allowance of 6"/hour.

To see what this means in a more visual sense we need to look at a moisture curve of this mix.

A moisture curve is developed by measuring the capillary and air-filled pore spaces at various tensions. The ideal graph would have equal amounts of capillary and air-filled pore spaces at the 30cm level, which is the depth of a 12" green. When the mix is used at the left side of **where the lines cross**, then the mix will carry too much capillary water and remain too wet. When the mix is used at a depth to the right of where the lines cross then the mix will have too much air and be classified as droughty. You can see by this graph that the lines don't even to cross at 40 cm (16") tension which would suggest that this mix will hold a great deal of water.



A moisture curve is developed by measuring the capillary and air-filled pore spaces at various tensions.

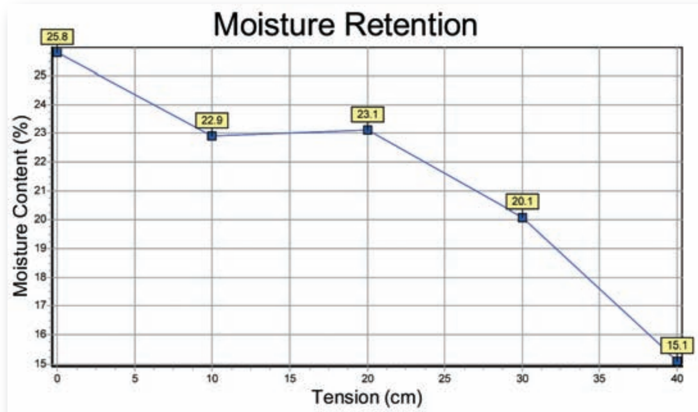
The profile picture indicates that this green has 14″ of mix even after 10 years of topdressing, which suggests that it was built at around 12″ in depth. The result is that the mix is constantly wet, there is no oxygen for root development, and thus a heavy matt is developing on the surface since this is the only place where roots can survive.

The fix for this superintendent is lots and lots of holes and lots and lots of topdressing. Since there will be no way to correct the lower half of the profile, the superintendent should concentrate on diluting and removing as much of the matt that has developed and provide a more fitting sand to fill aerification holes. Over time this method will alter the moisture curve in the top 6″ and form a suitable surface media.

Improper Mix Depth

Above all else, using greens mixes at depths that are in accurate is by far the #1 pitfall we see in sand based greens construction. This is slightly different than the use of the wrong sand, but many of the physical principles are the same. Two scenarios are most common, but before we get to them it is important to understand the basic principle of capillary and air-filled pore space. Over simplified, capillary water is the water that is held on the surface of the media particles being either sand or organic matter. A simple illustration is to roll up a paper towel and submerge one end into a glass of water. The water climbing up the roll is capillary water. In a sand based, perched water table green, we would hope that the capillary water would 'wick' back up the profile to provide hydration to the turf. When capillary pore space and water is lacking, greens are droughty and additional surface water will be required. Again, this is vastly over simplified but a necessary understanding before we move on. (I would suggest that it should also be fodder for future study.)

The first mix depth pitfall is the use of sand based mixes at the depth of 12″ when the physical properties dictate otherwise. In other words, when a moisture curve (illustrated earlier) shows that capillary pore space will raise water 14″, then the mix should either be redesigned or used at the 14″ depth. If the mix is used at 12″ as called for in the USGA recommendations, then the excess 'pull' or 'wick' of water will result in water filling pore space that should be occupied by air. The result of this mismatch will be very shallow rooting and/or black layer. Tension table moisture content readings should also be taken to further determine if adequate moisture holding capacity exists to support germination.



The second, and perhaps the most common mistake on sand based greens, is using the mix to shape the green surface. Recently a client took the time to probe a few of their greens to measure the depths of mix. The most consistent green measured, averaged between 15″ and 20″ in depth. The least consistent green measured, varied from 10″ to as much as 24″. Again, employing the principles we have thus far discussed, it is easy to see how parts of these greens will stay far too wet, while others will be continuously droughty. Wetting agents may help some, but the reality is that the irrigation heads need to be turned off and all moisture controlled by hand watering. This long-term expense and management nightmare is avoided by making sure that the gravel bed is properly shaped and accepted prior to adding the greens mix. Suffice it to say that those who shape greens out of mix have never had to manage a sand based environment.

Yes, someday most of us will deal with sand based greens and it is nice to know that when we do, we have some tools to work with. While superintendents may not choose to understand all of the physics that are involved with construction materials, (and only a few have been discussed) they should gain familiarity with the construction and testing methods that are available. I would further suggest that when looking at job opportunities, growers get detailed information about the methods and material testing that was employed during construction. It might keep them from making a terrible mistake.

Lastly; definitely Cubs, Bears and Bud! The rest is up for discussion. **-OC**