Prescription soils cure turf ills

'Designer soils" — soils or root zone mixes blended with certain desired properties — are used to improve site conditions such as drainage, aeration and water retention.

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Last year, a major university had to replace two athletic fields that were little more than two years old. The school's new fields didn't drain, they were extremely hard, and the turf on these fields had very poor rooting.

The architects failed to properly design the soil or root zone mix for these fields, resulting in their failure. Unfortunately, this scenario plays itself out quite often on both athletic fields and golf course greens.

The physical properties of golf course greens and natural turf sports fields profoundly impact the performance of the turf growing on them. High performance turfgrass areas such as greens and sports fields demand free draining root zone mixes that have good compaction resistance and good aeration. In addition, sports fields have a special need for surface stability; an area where many very high sand media fail.

Designing soils to have certain properties is not new in the golf industry. Since the USGA specifications were first published in 1960, laboratory testing has been used to design root zone mixes or soils. The purpose of this testing is to design a mix that has desirable physical properties, such as good drainage, aeration and water retention.

The design process

The first step in designing a soil or root zone mix for an athletic field or green is to select your raw materials. Sands should be of the particle size shown in Table 1. There is not much room for compromise. Research has consistently shown that sand sized between 0.25 and 1.0 mm in diameter is most desirable for a free draining growing medium. Coarser, uniform sands are acceptable for athletic fields, and are desirable where soil will be in the mix.

Peats and compost vary immensely in quality. You should employ the services of a competent soil physical testing laboratory to test the quality of your organic matter source. The USGA recommends that a peat have a minimum organic matter content of 85 percent, which is a good guideline. We recommend that composts have a minimum organic matter content of 60 percent, are screened to ¼ inches, and are proven to be non-toxic to plants.

Soils are often added to sports field mixes, and occasionally to greens mixes. A small amount of soil can help stabilize an otherwise soft sand. Soils in the textural classes loam and sandy loams are preferred, but soils of other textures can be considered as well. An ample supply of a screened soil of the same texture is probably more important than the texture itself.

Different ratios of the raw materials are blended into different mixes for testing. The mix ratios tested are often based on the gradation of the sand, and the experience of the lab or soils consultant.

Using ASTM (American Society of Testing and Materials) test methods, a series of tests are run on the mixes to determine their physical properties. First, cores containing the mixes are compacted to a standard level. One of the first tests run on the compacted cores is the infiltration rate. Again, one of the goals of this testing is to design a mix that will drain, even under compacted conditions.

The total porosity is the percentage of a volume of soil that is the pores or voids between the sand grains or soil. Some of these pores are large in diameter, and conduct water under saturated conditions. When drained, these pores fill with air and provide oxygen necessary for root growth. These are called the aeration porosity.

Field capacity is the point where all gravitational water is removed from the soil by free drainage. The lab simulates field capacity by pulling water out of the cores at a known suction. Since the soil profile depth will effect the water retention characteristics of the soil, it is important that you tell the lab of the intended profile depth so that it can be better simulated. It is at this point that we determine the aeration and capillary (water filled) porosities. A nearly even distribution of air and water filled pore space after free drainage is ideal.

Table 2 lists the target ranges for the physical properties tested. These values can be further refined to reflect the climate and environment where the turf will be grown. The mix ratio that produces the most desirable physical properties should be duplicated in the field.

Quality control

The mix design is only the first step to a successful construction project. It is extremely important that steps be taken in the field to duplicate the best mix.

Recheck your sand to make sure that the particle size is consistent with what was sent to the lab. You don't want to pay $6 to $10 per ton of mix for organic matter and blending, only to find out later that the sand had changed. Once blending begins it is important that the organic content of the mix is consistent with the approved lab-designed mix. We recommend that quality control checks be made every 500 to 1000 tons.

On site modification?

It sounds right: "if you add sand to a soil it should improve drainage, compaction resistance, and the aeration of the soil." Why is it then, that some of the worst fields we have tested or visited are where sand was incorporated into a soil?

The best explanation for these failures was offered by Dr. Art Spomer of the University of Illinois in articles published in 1980. In those articles, Dr. Spomer explains that when small amounts of sand are added to a soil, the sand grains 'float' in the soil and do not produce the large pores characteristic of sands. The sand provides no benefit in these small volume additions.

As more sand is added, the total porosity of the soil will decrease until you reach a threshold proportion. At this point, there is sufficient sand for there to be sand to sand contact. Unfortunately, there is also enough soil in the mix to completely fill the voids between the sand grains. It is at this point that the soil would probably be best for the base of a road or parking lot, because it will pack very tightly. It is not a soil that would be suitable for an athletic field or green. You must get well beyond this threshold proportion to see improvement in the physical properties..

The amount of sand required to bring about this improvement will depend on the sand used and the texture and structure of the soil. A competent laboratory can identify this threshold proportion, and make sure that the designed soil is well beyond it.

Maintaining greens and athletic fields is difficult enough with today's expectations for quality and high demand for use. A properly designed soil or root zone mix will make it an easier job for you to meet these expectations. The testing of a soil or mix will not guarantee that your greens or athletic fields will succeed, but it will greatly minimize the risk for failure. **LM**

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TABLE 1. RECOMMENDED SAND PARTICLE SIZE FOR GOLF GREEN AND ATHLETIC FIELD ROOT ZONE MIXES

Size class	Sieve No.	Particle diameter	Athletic fields % retained	Golf Greens
fine gravel	No. 10	2.0	<5%	≤3%
very coarse sand	No. 18	1.0	5-20%	≤ 10% combined
coarse sand	No. 35	0.5	>60%	≥ 60% combined
medium sand	No. 60	0.25	combined	
fine sand	No. 100	0.15	0-15%	0-20%
very fine sand	No. 270	0.05	0-3%	0-3% 0-5%
silt and clay		<0.05	0-3%	0-8%

TABLE 2. PHYSICAL PROPERTIES FOR DESIGNED ROOT ZONE MIXES

Physical property	Recommended range
Total porosity	35-50%
Aeration porosity	15-30%
Capillary porosity	20-30%
Infiltration rate	6-24 inches/hour
Bulk density	1.35 to 1.60 g/cc

A properly designed soil or root zone mix will make it an easier job for you to meet the expectations of your customers.