Everything You've Always Wanted to Know About Putting Green Soil Mixes But Didn't Know Whom to Ask

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WITH 25 YEARS of experience with USGA Green Section Specifications for Putting Green Construction successfully behind us, many wonder why certain basic questions still persist. But persist they do, and I've been asked to clarify these issues:

Why is a physical soil analysis really necessary for putting green construction?

What quantities of the basic materials are needed by a laboratory for testing?

Why does it take so long to achieve and receive laboratory results?

Why do the final numbers vary from one lab to another?

Why is straight mechanical analysis not sufficient?

Why is a soil mix better than straight sand construction for greens?

Why is it essential to off-site mix?

Why laboratory work does not always produce magical results.

Most of you are aware of the Specifications for Putting Green Construction and the techniques for physical soil testing for greens. The original research was done to correlate the findings of research studies, the soil sciences, and the practical solutions arrived at by superintendents trying to solve real-world problems. To this was added exhaustive laboratory analysis of hundreds of cores from all sorts of golf course greens all over the country. The research was conceived and conducted by Dr. Marvin H. Ferguson, then National Director of the USGA Green Section.

The conclusion of this work led to the understanding that by constructing greens in a specific fashion and using a pre-tested blend of construction materials, consistently desirable conditions could be provided for optimum turf growth, economical maintenance, and maximum playability of putting green surfaces.

Simply stated, the method recommends that the green be constructed with the subgrade finished to the final contours of the green; that the subgrade be adequately trenched for drainage tile; that the tile be covered with gravel; and that a gravel blanket about four inches deep be placed over the entire subgrade. The gravel is to be topped by at least two inches of coarse sand with roughly a 14-inch layer of prepared seedbed mix placed over the surface.

THIS METHOD is designed to take advantage of a peculiar interaction of soil and water, a condition called the perched water table effect.

The other part of this system is the mixture used for the seedbed; although this has evolved over the years, its function has not changed. The actual seedbed or top mixture is put together after a physical analysis of the materials (sand, soil and / or organic matter) available and an assessment of their suitability when combined with each other.

If you could get a worm's eye view of a good soil mixture, you would see a variety of particle sizes bridging each other, combined with an organic material chosen to fit the characteristics of the sand. There would be a small quantity of silt and clay present to increase nutrient retention, and the mixture would be stable. It would not shift under traffic, and the fine particles would remain in place.

Judith Ferguson Gockel

To go about achieving this mixture, we begin by analyzing the sands that have been submitted to us.

We report the particle breakdowns in millimeters; we also provide U.S. sieve sizes for comparison with suppliers' specifications. We prefer very little material above the 2mm range.

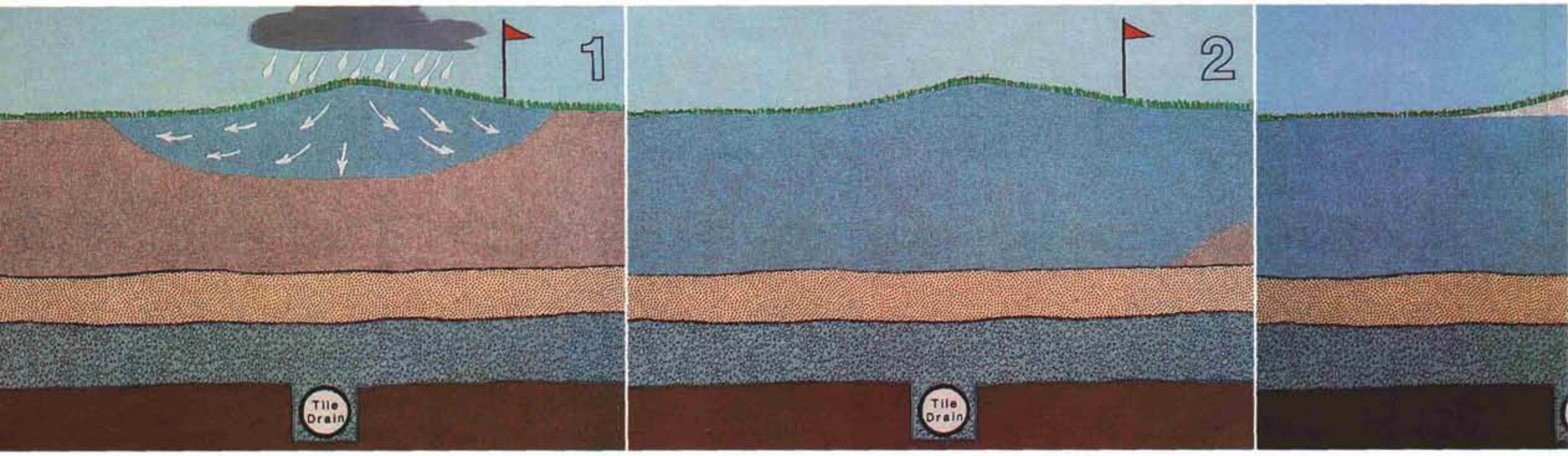
Sands with a predictable curve of particle size distribution have proven over the years to be the most desirable for seedbed construction. The details can change, but the overall curve is a good guideline for selection.

We also run a hydrometer analysis on virtually every material that comes into the lab.

At this point, we go into the realm of "feel" — which is a brief way of saying that we apply the experience gathered in testing thousands of materials over the years to the specific materials we are looking at.

This is the point at which a selection of organic materials is made. We know that a fine sand with a fair amount of silt and clay may develop dangerously low infiltration rates if we combine it with a reed-sedge, or bog or muck peat. We know that a clean, relatively coarse sand combined with a long-fibered sphagnum peat will be droughty. There is almost no way to record the variables, which are literally endless. We call this accumulation of experience "feel," and we don't have any shame in doing so.

We are asked far too often why we use organic matter at all. The answer is we use peat to improve water retention, to



cushion the roots of the turfgrasses during their early development stages, and to increase porosity. Peat is not an optional ingredient; its absence cuts your margin for error to almost nothing. One mistake, one problem, and you can lose the green.

WHEN WE HAVE chosen the best materials from what we have been sent, we make up mixtures and test them for these factors. Capillary porosity is the water present in the soil which is not available to the plant. Non-capillary porosity measures the water that is available to the plant. Bulk density measures the weight of solids present in a given volume of soil. Water retention measures the capability of the mix to retain adequate moisture. Permeability measures the quantity of water that will penetrate a known volume of soil in a given period of time; this is also referred to as the infiltration rate. There is a good deal of controversy and confusion concerning the infiltration rate. It is necessary to figure in the finished depth of the green mix in the field in order to make accurate predictions of field infiltration.

While there are guidelines for acceptable figures in these categories, no one set of numbers within these guidelines is necessarily better than any others. Selecting the best mix must take into consideration what is available in the way of material, the climate, the altitude, the budget of the course, the distinctive nature of soils in any given area, and a host of other variables.

In spite of our testing background, in spite of our experience, we can only help you if you give us adequate information. And I say "us" referring to any laboratory you work with. There are at least three physical soil testing laboratories in the country today, and we all do good work. But none of us can do our best work without your input.

We need adequate, separate samples of the materials you propose using. We prefer to receive one gallon of each material to be tested (i.e., sand, soil and/or organic matter). We need to have the materials labeled on the outside of the package. We need to know what course we are working for. We like to know which materials are most convenient or least expensive, since we are willing to help you build economically. Give us a complete return address and a telephone number. It helps to receive a letter detailing as much information as possible about what you are doing and what you would like us to do. If you have a rush job, advance notification is vital.

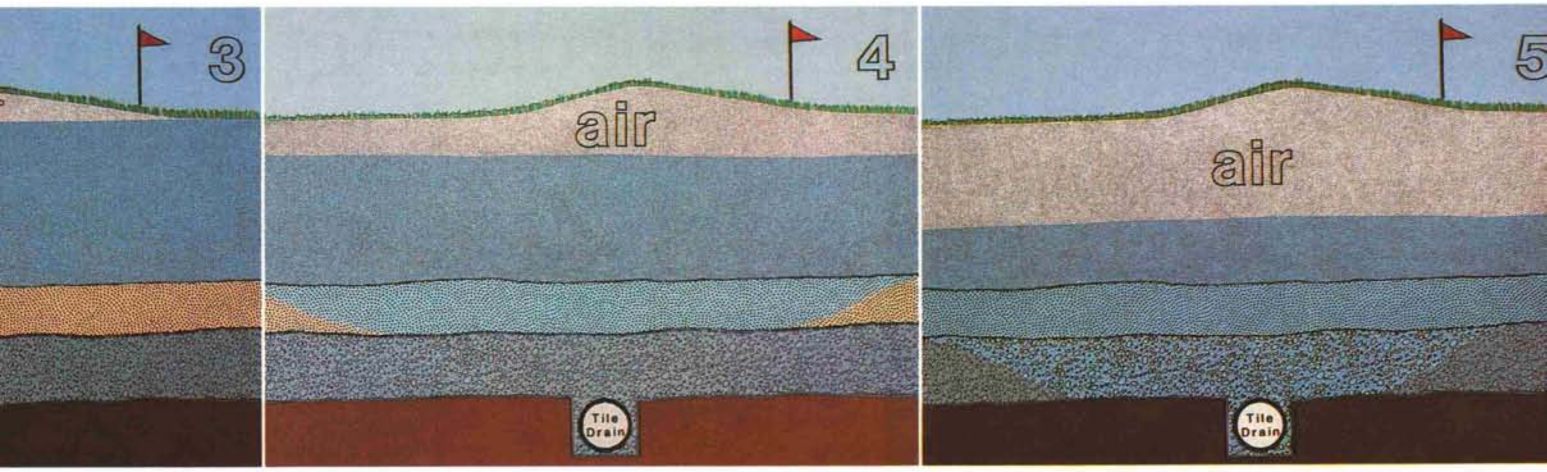
ONE of the major problems between field conditions and laboratory results is in sampling error. We usually get no more than one cubic foot of material in a single sample. If you are building one green with a 7,000-square-foot surface area, you are going to be working with 7,000 times as much material as we do. In order for there to be a reasonable degree of correlation between laboratory and field results, you will need to take great care in your sampling procedures.

Take your own samples. You will find it useful to see the materials and the production facilities of your supplier. You will get an idea of how carefully the supplier handles the materials, and you will know what the product looks like in volume. This can keep you from accepting a load from the wrong stockpile. In taking the samples, take several from different areas of the stockpile. Take your samples from the interior of the pile, and go in at chest height or higher.

When you have accumulated several samples, mix them together thoroughly, and send us half of what you have. Keep the rest, well labeled, for your own reference when delivery starts. Ask the supplier for several screening records. Most commercial suppliers make regular tests of the particle sizes in their products and will be happy to give you an example.

When selecting an organic material, have the supplier provide you with a bag, bale, or a representative quantity of bulk material. Here again, retain part of the sample for your own reference, and cross check it against the delivered materials. By acquainting yourself and whoever will receive incoming materials with the look, feel, and general characteristics of the materials, you will save a great deal of trouble in case of a delivery error.

Perhaps you should be aware that, after being something of a stepchild in many areas of the country for years, golf courses have become a hot new market for many suppliers of construction materials. You will find they are willing to meet your needs and live up to your standards. They are willing to work with you. Give them the right information and you can have superior materials delivered for the same cost of the merely adequate.



THIS SEEMS to be the proper place to mention a thorny problem. TIME. We all have a tendency to see our own work as the only important thing going on at any given time. Having just mentioned the new interest of sand and gravel suppliers to golf courses, it is appropriate to mention that more golf courses are being built today than at any time in history. Our laboratory has been swamped with an almost double work load during the past year. In the best of times, a physical soil analysis takes one working week to complete. Shipping your materials can take up to three weeks, and there is a finite amount of lab equipment available to do the work. Since we have no prior notice of the arrival of most of our samples (and they refuse to arrive tidily, at regular intervals, but often come in huge batches), we must sometimes arbitrarily assign a processing order to what we receive and work through the accumulation as efficiently as possible. We do our very best to turn out the work as rapidly as possible.

New construction is rarely a last-minute decision. There is seldom a need to start choosing the materials for construction six days before you begin getting the loads. If you will plan in advance and notify us that your work is coming in, we can better schedule our time and produce your results much faster.

One of my remaining topics is the importance of off-site mixing. To boil this one down to the essence, if you mix on-site, you will probably have undesirable greens for several reasons. On-site mixing rarely produces an even distribution of the materials. The usual effect is the creation of an additional perched water table with a tremendous water retention factor right at the root zone. It is almost impossible to achieve the recommended uniform ratios of materials by on-site mixing. The overall behavior of the green will be totally unpredictable. In short, on-site mixing is a potential disaster.

THE FINAL point I must mention is why laboratories do not always produce magical results. That isn't too difficult. We aren't magic. Nor are we psychic. All of us, individually and collectively, do the best possible job, and I speak for my competitors as well as myself. Sometimes clients will send materials to two or more labs and then compare results. The reported lab numbers will often vary substantially from one to another. This does not necessarily mean Lab A disagrees with Lab B. Lab techniques and equipment can vary considerably. The material samples sent may not have been exactly alike. Interpretation and analysis of results will also vary from one individual to another. There are many explanations and many possibilities. There are ranges of interpretations in a science that is not and cannot be exact.

Science is a wonderful thing, yet without meaningful information from you and practical field application of all of the USGA specifications, a good greens mixture won't solve your problems. Remember that you are dealing with a method, and a quarter-of-a-century of experience indicates that it is a good method. We, along with all the other professionals in this field, keep working to make it even better.

Figure 1. In this instance, water is being added. Notice that although this is a sand-peat mixture, the water moves horizontally as well as vertically.

Figure 2. Here, the seedbed is almost saturated, but no water has yet penetrated into the sand layer, although it is the coarser of the two.

Figure 3. This illustrates why droughty spots occur on some greens: the subgrade does not have the same contour as the finished green. It also shows the seedbed layer saturated, but with no breakthrough to the sand below.

Figure 4. The water has penetrated to the sand layer, but not to the gravel.

Figure 5. This is the completed cycle, with the green draining normally into the tile lines, re-admitting air to the roots, having completed the cycle necessary for plant growth.