Quality Control Sampling Of Sand And Rootzone Mixture Stockpiles

One of the most important aspects of putting green construction is the rootzone. Whether the rootzone is composed of straight sand or a mixture of sand and amendments, quality control testing is recommended to ensure the rootzone material remains as consistent as possible. This is accomplished by removing samples from the stockpile and submitting those samples to an accredited physical soil-testing laboratory for analysis.

The goal of the sampling and testing procedure is to monitor changes in the rootzone material as it is produced. It is important to realize that some change is inevitable. As sand is mined from a pit or from a body of water, the physical make-up of the sand changes. Amendments may also vary slightly from bag to bag or lot to lot. And, when materials are blended, some variability is introduced through the operation of the blending equipment. Good suppliers of sand, amendments, and blending services can keep these variables to a minimum.

There is another major source of variability that can cause significant discrepancies in the quality control testing efforts. Improper and/or inconsistent sample collection procedures will introduce unwarranted errors in the test results. Poor sampling procedures can result in test results that make a good rootzone material appear to be inconsistent and therefore of poor quality.

When To Sample

There are two levels of sampling and testing that should be carried out. The first level should take place at the source where the sand and amendments are produced. Samples should be collected and sent to an accredited laboratory for analysis. The test results are then provided to the person responsible for approval of the materials.

Sampling and testing several candidate materials is the best means to identify the most appropriate and cost-effective products. The laboratory will determine if the sand meets the green construction criteria selected for the project. For example, if the USGA's Method of Putting Green Construction is to be followed, the lab will analyze the sand according to those criteria. Typically, the lab also will add amendments to the sand in varying ratios to identify the best mixture possible for the project. It is important to realize that such amendments are added by hand in the lab, often from small stocks they keep on hand. Later, when the rootzone mixture is produced in bulk, blending will be accomplished by machinery. As a result, when samples are collected from the blended stockpiles and compared to the preliminary testing, the numbers are almost certain to vary. The initial testing procedure should be used only to identify materials that fall within the project guidelines.

The second level of sampling should occur throughout the actual production of the rootzone materials so that mistakes due to handling the material during mixing and transportation are detected. Collect a sample from the first 200 tons produced and submit to the laboratory for complete analysis. If the lab determines the sample meets the requirements of the project (e.g. USGA Guidelines), the test results become the target for all subsequent quality control testing. The goal of all future rootzone material production is to match as closely as possible the material in the first 200-ton pile. After the initial 200 tons, collect a sample for every 1000 tons of rootzone mix produced. If less material is being used (for example, building only one green) or if the material is inconsistent in its composition as indicated by testing, sample every 500 tons or less.

How To Sample

Field sampling errors are almost certain to cause significant variability in laboratory test results and can cause confusion, delay, and unnecessary expense. It is imperative therefore, that stockpiles be sampled in a manner such that the composite sample removed from each pile represents the average properties of the entire pile. To do this, a sufficient volume of material should be taken with each sampling unit (a sampling unit is a core or auger of a given dimension) and all sampling units should be collected to make a composite sample (combining of sampling units) that are of equal volumes.

To better illustrate the importance of removing enough sampling units, consider the science of polling during an election. If a pollster queried only a few voters, there would not be a large enough sample of the population to reasonably predict the outcome. While the most accurate method would be to ask every single voter how he or she voted, this is not feasible or cost-effective. The pollsters utilize statistical analysis to determine how large a group of voters must be interviewed to determine the likely outcome of the election to a certain level of confidence. The greater the number of voters interviewed, the greater the level of confidence there will be in the poll. Similarly, the more samples that are removed from a stockpile, the more accurately the test results will reflect the actual make-up of the pile. This document recommends that at least 8 samples be collected from each 1000-ton stockpile to achieve good results.

Field sampling procedures should be standardized for the duration of the quality control testing program. ASTM D 75-97, Standard Practice for Sampling Aggregate, offers some guidance regarding the best method of sampling putting green rootzone mixture stockpiles. The standard states, "If circumstances make it necessary to obtain samples from a stockpile of coarse aggregate or a stockpile of combined coarse and fine aggregate, design a sampling plan that will give confidence in results therefrom that is agreed upon by all parties concerned to be acceptable for this particular situation." There are two very important statements in this quote from the standard. First, a sampling plan must be established. Secondly, all parties should agree to the plan.

The standard does not state exactly how the sampling procedure should be designed. To meet this need, the USGA utilized the expertise of university, industry and laboratory professionals to develop the following procedure. All samples should be collected as detailed in the following step-by-step procedure.

Produce a stockpile of approximately 1000 tons. The individual in the photo is standing in front of a recently produced, 1000-ton pile of rootzone sand. Assemble the necessary tools for sampling the stockpile. These include a:

- clean, 5-gallon bucket
- rubber hammer
- shovel
- permanent marker
- 1-gallon zip lock plastic bags

- mailing labels and
- a large, non-permeable plastic tarp

The sampling tool is made from a 4-foot long piece of 2-inch PVC pipe. To make sampling easier, one end of the pipe can be cut at a 45-degree angle. A PVC "T" can be placed on the other end to make it easier to push the pipe into the sand. Duct tape can be used to mark the 2-foot sampling depth.

Step By Step Procedure For Sampling A Stockpile

Collect a minimum of 8 samples to ensure an accurate representation of the pile. Take samples at four equidistant points around the pile, at ⅓ and ⅔ up the face of the pile, for a total of at least eight samples.

Dig a hole into the face of the pile to prevent collection of any of the sand from the surface of the pile. Expose an undisturbed face of the pile into which the collection tube can be inserted. When you first dig into the pile, material from above will usually flow down the face into the area you are clearing. Keep digging until the hole becomes stable. The shovel also works very well to expose an undisturbed face. Make a vertical cut down into the face just above the sampling point.

Insert the collection tube into the undisturbed face to a depth of two feet. The tube should be inserted at a slightly upward angle to prevent the sample from falling out when the pipe is removed. Mark the collection tube to ensure uniform depth insertion. The "T" fitting on the end of the two-inch, PVC pipe makes it easier to push the pipe into the pile. In most cases, the pipe can be pushed in by hand to the proper depth. In "tight" sand, a rubber hammer may be needed to drive the pipe to the 2-foot depth.

Carefully remove the collection tube from the face of the pile.

Empty the sample from the tube into a clean, 5-gallon bucket.

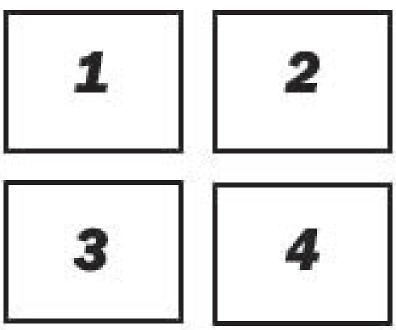
Improper sample collection procedures will result in problems. This sample is being collected incorrectly from the surface of the pile rather than from within the pile. When this sample is tested, the results will not represent the overall make-up of the stockpile. Samples collected in this manner will be highly inconsistent from test to test since the surface of the stockpile changes rapidly.

Samples collected from the surface of this pile can vary widely from those collected from within the pile. Notice how the surface of the pile has segregated due to wind and rain. As the finer materials erode, the coarser materials accumulate on the pile surface. Test results of a sample removed from this area would indicate a higher percentage of coarse materials than actually exists in the pile.

After the eight samples are collected from the 1000-ton pile, the 5-gallon bucket should be about ½ to ⅔ full. (If a stockpile larger than 1000 tons is sampled, the number of samples collected should be increased proportionately. Thus, at least 16 samples should be collected from a 20w00-ton pile.)

Empty the bucket onto a clean, non-permeable surface. Thoroughly mix the samples together by hand. The combined sample should now be reduced to approximately 1 gallon to be sent into the laboratory. This is accomplished by splitting the sample. The sample should be shaped into a square so that it can be divided into quarters.

Divide the sample into equal quarters. Opposite quarters will be removed from the sample and discarded. For example, if quarters 1 and 4 are removed and discarded, quarters 2 and 3 will be recombined and mixed again. Another square is then formed. The process is repeated until the sample is reduced to approximately 1 gallon



Place the 1-gallon sample into a plastic, zip-lock bag. Label the outside of the bag using a permanent marker. Record the pile number and date of collection. Print the same information on a mailing label and place the label on the outside of the bag. Place the sealed and labeled bag into another plastic bag and seal it with duct tape. This labeling and double-bagging procedure is important to ensure the lab receives the sample intact.

With assistance from university and labortory scientists, the USGA Green Section has identified the maximum amount of variation that should be tolerated for key test parameters measured during quality control testing. The following table details a variability percentage for each parameter. This variability percentage is more accurately referred to as the confidence interval and is used to establish plus or minus values for each measured parameter. For example, assume the laboratory test indicates a value for fine sand to be 10%. Using the confidence interval percentage for fine sand of 15%, the acceptable variance is 10% plus or minus 1.5% for an acceptable range for quality control testing of 8.5 to 11.5%.

Table 1—USGA Confidence Intervals For Quality Control Testing

Test Parameter	**USGA Confidence Intervals**
Fine Gravel	50%
Very Coarse Sand	50%
Coarse Sand	10%
Medium Sand	10%
Fine Sand	15%
Very Fine Sand	30%
Silt	25%
Clay	25%
Total Porosity	10%
Air-filled Porosity	10%
Capillary Porosity	10%
Saturated Conductivity	20%
Percent Organic Matter of Mix	0.2*

* The confidence interval for percent organic matter is not represented as a percentage. Thus, a reported value of 0.7% organic matter could range from 0.5 - 0.9%.