Racing Surfaces Testing Laboratory
Orono Maine USA

The Role of Clay in Racing Surfaces

Christie A. Mahaffey, M.Phil. and Michael "Mick" Peterson, Ph.D.

The risks to horses and riders are the result of many factors. Racing surfaces are only one aspect and likely are not the most critical factor. However, surfaces impact every horse on a day at the track and should be managed to ensure that they help improve the safety of racing.

Introduction

The amount of clay in a dirt racing surface is perhaps the most important composition issue and impacts performance of horse and rider. The effects of clay influence a wide range of performance attributes, including the amount of slide in a surface, the tendency of the surface to compact and get hard, the formation of clods that can fly up at the riders, and the sensitivity of the track to small variations in the moisture content. While the importance of clay is well accepted, the challenge arises in getting an accurate measurement of the amount of clay in a racing surface and in determining what the correct amount of clay should be for a particular surface and its geographic location.

How Clay Works

To understand the function of clay in a material, it is important to realize that while a particle of sand is rounded like a small rock, a particle of clay is typically flat like a sheet of paper. Clay particles can be folded like the image shown in Figure 1. These particle surfaces have very specific characteristics that distinguish them from sand or silt. In fact, while it is possible to create clay from sand and silt, the process takes thousands of years (Targulian 2007).[1] Therefore, the amount of clay in the surface can only be changed by physically adding or removing clay; the sand itself will not turn into clay. Furthermore, the addition or loss of clay is dependent on the local materials interacting with the surface, the maintenance methods used on the surface, and the climate and weather that the surface endures.

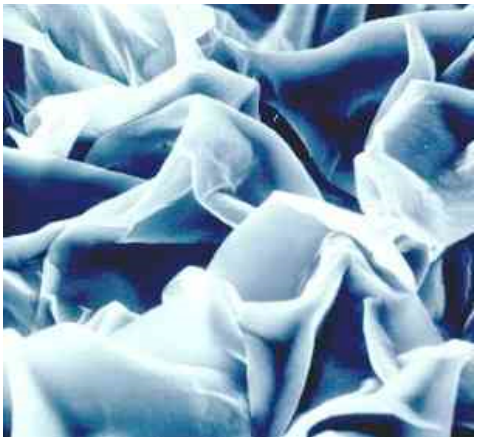

Figure 1 The folding of flat clay particles.

The Laboratory Measurement of Clay

To understand data of clay in a racetrack, it is useful to understand the most common methods for testing clay in soils.

Wet sieve

The simplest, least expensive, most common soils test used in civil engineering is called a **wet sieve test**. In this test, the material is soaked and a dispersant (typically the chemical-equivalent of Calgon) may be added to separate the clay particles. The wet material is then washed on a fine mesh with holes of approximately 0.5 mm diameter. The starting weight of the soil minus the weight remaining on the sieve equals the weight of fine particulates that pass through the sieve, thus revealing the percentage of the soil sample that is not sand. Fine particles that pass through the sieve are the very smallest rounded particles (silt), along with the flat clay particles. While this information is useful, the wet sieve test does not distinguish the individual amounts of silt and clay in this finer particulate.

[1] Targulian, V. O. P. V. K. (2007). "Soil system and pedogenic processes: Self-organization, time scales, and environmental significance." Catena 71:373-381.

Hydrometer

The hydrometer test is significantly more complex and less reliable than the wet sieve test. The hydrometer requires a large amount of time to perform properly (approximately 4 days), and repeatability is dependent upon precise temperature control. However, it does have the advantage of being able to grade the finer particles. Like the wet sieve test, the hydrometer test cannot distinguish the shape of the particle, but by making use of the settling rate of fine particles in a cylinder of water, particles as fine as .002 mm can be separated. The hydrometer is the most common method of measuring the amount of clay material in a soil sample. However, the test does not precisely distinguish between clay and silt and the test is influenced by factors other than the mineralogy of the track material. Reliability of this test can be established by repeating the test of a sample material or by comparing the test results to historical, regular test data.

X-ray Diffraction

rently, the only truly effective approach to knowing the amount of clay in a soil sample is the use of **X-ray diffraction**. Details about this technique will be discussed in a later technical bulletin, but it is important to understand that through x-ray diffraction it is possible to know both the percentage and the particular type of clay that exists in a surface. Clay types can differ dramatically in their response to water and loading. Consequently, it is clear that with the safety of the horses and riders at stake, these more sophisticated tools are required for correctly planning and maintaining the properties of a track surface.

Correct Clay Percentage for a Track

Once we have measured the amount of clay in a surface, the next question is, "How much is the correct amount?" Research has demonstrated that the answer depends on a number of factors. For example, if the climate at a particular track is sufficiently dry, more clay may be required to hold the track together during a period of drought. On the other hand, areas with high rainfall need a fast-draining track with less clay. However, two things are clear:

1) If the percentage of clay changes over time, watering and other maintenance must be adapted, and
2) The percentage of clay throughout the surface material should be consistent around the track.

Making every track the same would be a mistake given the impact of differences in climate at each location. Understanding the type and amount of clay in a surface is the fundamental basis for the development of the best maintenance strategy for a track. To gauge and respond to surface material changes appropriately, regular wet sieve and hydrometer tests provide timely and cost-effective monitoring, while scheduled X-ray diffraction tests provide more detailed information to observe changes. Systematic examination of the clay surface provides the opportunity to respond to changes in the material in order to successfully reduce risk and improve the safety of racing.

This informational report is based on the white paper "Racing Surfaces," available at the Racing Surfaces Testing Laboratory website: racingsurfaces.org/white_papers

and at the Jockey Club website: grayson-jockeyclub.org/resources/White_Paper_final.pdf

*The white paper and report are the result of efforts by The Racing Surfaces Committee that was formed at the inaugural **Welfare and Safety of the Racehorse Summit** in 2006.*

This Racing Surfaces Testing Laboratory Technical Bulletin for Track Surface Education is the first in a series of papers directed toward a general audience with a common interest in developing consistent and reliable track surfaces. This and subsequent bulletins can be found at the Racing Surfaces Testing Laboratory website: racingsurfaces.org/bulletins

Racing Surfaces Testing Laboratory encourages the distribution and use of these bulletins. For further information, contact:

Michael "Mick" Peterson, Ph.D.
Racing Surfaces Testing Laboratory, 2 Summer Street, #1, Orono, Maine 04473
Ph: 207-409-6872 racingsurfaces.org mlpeterson23@gmail.com