Racing Surfaces Testing Laboratory
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The Durability of Sand Constituents in Dirt Racetrack Surface Materials

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Introduction

Amending and replacing racing surface material are necessary parts of track maintenance. Documentation of this process is often limited and material types differ between racetracks based on climate and local conditions. Therefore having improved data regarding the constituents of the surface material can help track superintendents better justify materials needed for track maintenance.

The mechanics of dirt racing surfaces are dependent on the moisture content and the composition of the material. Sand mixtures with smaller pores behave differently than sand mixtures with larger pores, retaining more moisture between grains. As a surface material changes due to wear, the moisture content necessary to maintain shear strength and compaction also changes. The sand becomes smaller and the fine material from the wear process can fill the pores. The change in the mechanical properties of the surface materials is critical to providing the required biomechanical properties for the horse.

The rate at which changes in the sand occur depends on mineral content and the shape of the sand grains. Sand with a high percentage of silica, typically in the form of quartz, is much more resistant to weathering and abrasion due to the level of hardness of quartz. More rounded sand will also tend to be more durable. With the frequent harrowing and heavy traffic on a racetrack, the changes to the sand grains from abrasion can occur quickly depending on the type of sand. The selection of more durable sand, if available, is usually the preferred method of avoiding these issues. However, if more durable sand is not available, frequent amendment of material and management of lost fine material is critical to the maintenance of a consistent racing surface.

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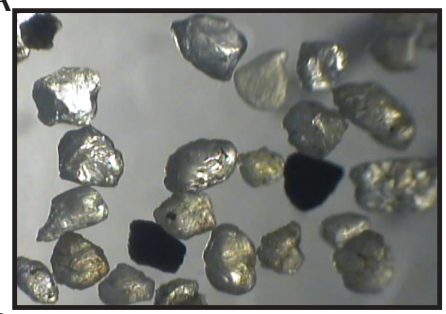

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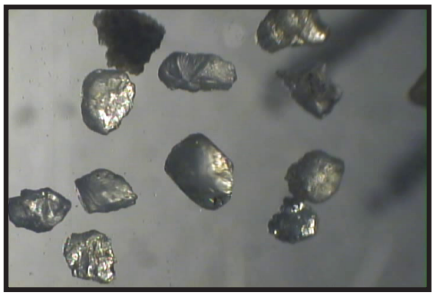

Figure 1: Sand with high percentage of quartz (~80%). A) Before abrasion resistance test and B) after.

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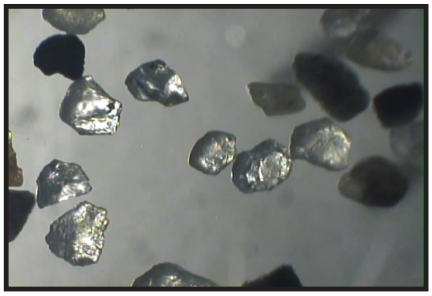

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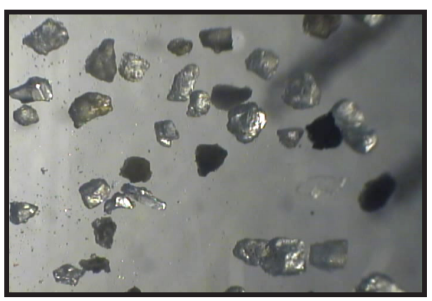

Figure 2: Sand with low percentage of quartz (~3%). A) Before abrasion resistance test and B) after.

Abrasion Resistance Testing

The selection of more durable and consistent sand can dramatically reduce changes to a track surface. Racing Surfaces Testing Laboratory (RSTL) has adopted and revised a sand durability test using a Micro-Deval apparatus, commonly used by the Department of Transportation. This abrasion resistance test allows for quantification of the durability of dirt track surface materials.

Abrasion resistance testing measures the abrasion resistance and durability of the sand used in a track surface. The quality of the sand is determined by the abrasion loss when a material is combined with water and an abrasive force. Track material undergoes mechanical abrasion using calibrated steel balls in the Micro-Deval apparatus. This allows for calculation of the percentage of material lost by comparing the weight of the sample before and after abrasion. Like the wear processes of the sand on the racetrack, the metal balls wear in the test apparatus and lose material in the same way that the harrow teeth and horse shoes wear. This

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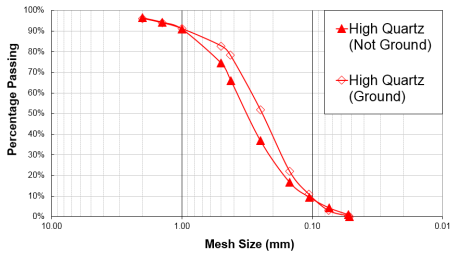

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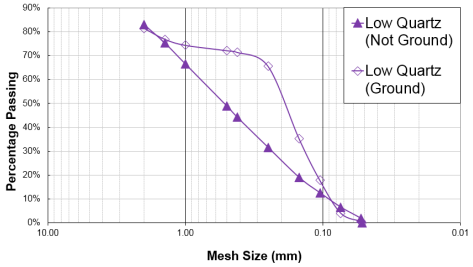

FIGURE 3: The amount of change in a track material as a result of abrasion resistance testing. A) Sediment with a high percentage of quartz (approximately 80%), and B) low percentage of quartz (approximately 3%).

This Racing Surfaces Testing Laboratory Technical Bulletin for Track Surface Education is one 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

The Racing Surfaces Testing Laboratory is a product of efforts by The Racing Surfaces Committee that was formed at the inaugural Welfare and Safety of the Racehorse Summit in 2006.

wear is addressed by weighing the balls before and after each test.

These test results are useful when evaluating the hardness of a material like the sand on a track which is worn by abrasive processes such as harrowing and horse traffic. By measuring changes in the size and the type of material created from the wear, it is possible to determine if the material used on a track will require frequent amendments. Abrasion resistance testing also reveals some interesting information on the effects of abrasion when looking at mineral shape and grain size. In the scientific literature, it has been demonstrated for samples of the same mineralogy, flat or angular particles will have more material loss due to abrasion. Wear of the particles is due to chipping of corners.

Mineralogy

Test results indicate the mineralogy of a sample as a key component to the abrasion resistance of a track surface material. The mineralogy is determined using x-ray diffraction (XRD). Quartz is one of the hardest minerals in sand, and therefore resists abrasion. Sand with a high percentage of quartz is less likely to lose material due to abrasion than those with low percentages of quartz. The particle size distribution before and after abrasion testing for two track materials is shown in Figures 1 and 2. Figure 3 compares percentages of quartz and the amount of changes to the sediment sample as the result of testing. Sand with a higher percentage of quartz is clearly more durable and results in less generation of fine materials.

Conclusion

Dirt tracks with higher percentages of quartz and sub-rounded sand grains are more resistant to abrasion and therefore resist degradation of the track surface. Conversely, track surfaces with lower percentages of quartz or angular grains will require replacement of the surface material more frequently and may generate fine material that leads to compaction of the surface. XRD and abrasion resistance testing, in combination with sieve and hydrometer testing, provides highly valuable data as to how readily a track surface material degrades. Dirt tracks in North America have a wide range of quartz content (40-90%). Quantifying the durability of the sand used for the tracks can help determine the proper maintenance and required monitoring of the surface. The result can help to improve the consistency of the surface and provide trainers, riders and jockeys a fair and consistent surface for racing and training.

Acknowledgements

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