Racing Surfaces Testing Laboratory
Orono Maine USA

RACING SURFACES TESTING LABORATORY
Technical Bulletin #2 for Track Surface Education

Synthetic Racetrack Surfaces Temperature Changes

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Introduction

Changing temperatures of synthetic racetracks have been shown to have a marked effect on horse racing performance. In Figure 1, the effect of sunlight on the track is shown for the Del Mar racing surface in California. Over the course of six days in August, the temperature of the track at a 1-inch depth (the blue line) varied between 70ºF (21ºC) and 125ºF (52ºC) when the track was not cooled with water. Figure 2 shows that on the same track the 6-furlong Thoroughbred race/work times vary from morning to afternoon with times trending slower with higher temperatures. Clearly, something significant happens with temperature changes on a synthetic racing surface.

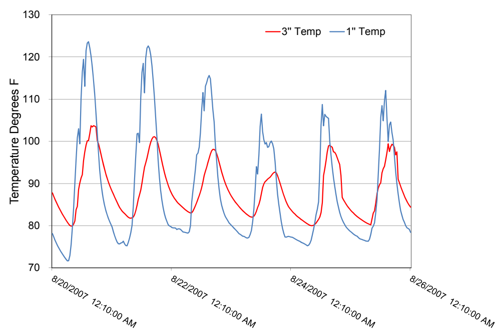

Figure 1 Temperature of a synthetic racetrack surface over a six day period.

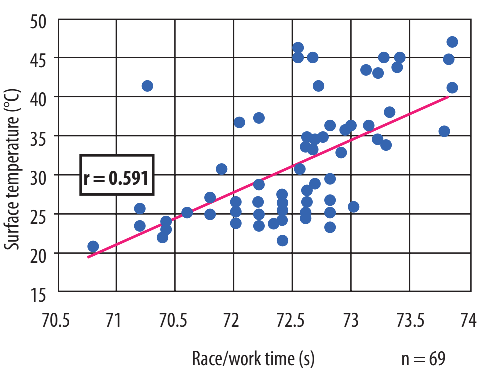

Figure 2 Race and work times are influenced by temperature.

Peterson, M. L., Reiser II, R. F., Kuo, P. H, Radford, D. W. and McIlwraith, C. W. (2010). "The Effect of Temperature on Race Times on a Synthetic Surface", Equine Vet. J. 42 (4), 351-357.

The Role of Wax in Racing Surfaces

The function of the wax is to coat and bind together the sand, polymer fiber, and rubber particulate that make up the other components of a synthetic track material. The wax coating makes up between 4% and 9% of the total track mass. The wax consistency and the ability of the wax to coat the sand are influenced by the relative amounts of paraffin and microcrystalline wax solids and the amount of oil present in the wax. Unlike paraffin wax used in candles, these waxes melt over a wide range of temperatures that may include the operational temperatures seen at many racetracks.

Wax Thermal Effects on Mechanical Properties

Wax, in many ways, acts like clay in a dirt track. As with high clay content, wax can lead to clods of material known as "balling up", but also like clay, a desirable proportion of wax is needed to help hold the material together to support the hoof of the horse. Wax has a second very important role in synthetic racing surfaces; the wax coats the sand and other materials and repels water, making the track hydrophobic. This effect is seen most clearly during a period of heavy rain. Initially the rain may pool on the synthetic track due to surface tension, but often a single pass with a harrow will lead to quick drainage of the water from the top of the track. The key is to use a mixture of wax that does not ball up under the hooves of the horse or result in kickback during races, while at the same time, ensuring that the water-repelling characteristics of the surface are retained.

Good Wax

Just as clay must be carefully controlled in a dirt track, wax must be controlled in a synthetic track. The challenge with a synthetic track is that unlike clay, which can only be added or removed by mechanical means, some of the lighter wax components simply evaporate over time. Environmental effects can also change the wax over time.

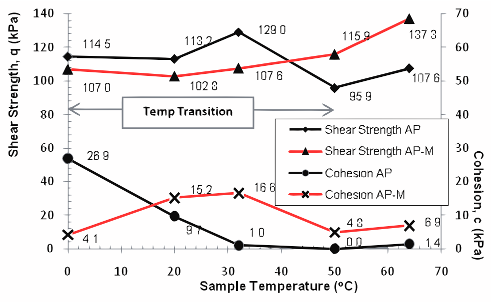

Figure 3 Triaxial shear strength of a synthetic track surface as a function of temperature.

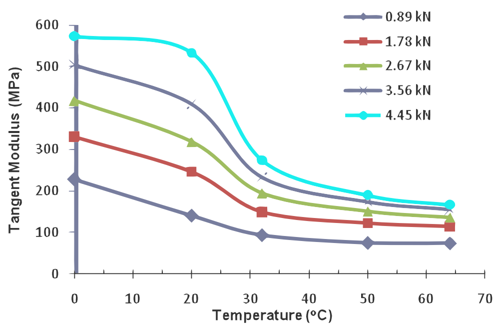

Figure 4 The effect of temperature on the tangent modulus at a range of loads.

This technical bulletin is based on the white paper "Racing Surfaces," available at the Racing Surfaces Testing Laboratory website: racingsurfaces.org/bulletins

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

*The white paper and bulletin 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 one of a series of papers directed toward a general audience with a common interest in developing consistent and reliable track surfaces. This and other bulletins can be found at the Racing Surfaces Testing Laboratory website: racingsurfaces.org/bulletins

Ideally, a wax surface would experience minimal and gradual changes in properties throughout the operational temperature range. A pure wax would have a distinct change in properties over a very narrow temperature range. However, wax modifiers can be added to the surface to help make the changes more gradual over a wider range of temperatures. Additionally, oil can be added to the wax to reduce stickiness. Two standard laboratory tests used for synthetic racing materials are the tangent modulus, which represents the hardness of the surface, and the triaxial shear, which determines the resistance of the surface to slide. Figure 3 shows the effect of temperature on shear strength and cohesion before and after the addition of a wax modifier. In Figure 3, the shear strength (top black line) initially increases as the track wax is melting, but then decreases as the temperature continues to rise. The cohesion or "stickiness" (bottom black line) simply decreases as the temperature increases. The result is a track that is more prone to balling up at lower temperatures. In Figure 3 the red lines show the effect of adding a wax modifier to the track to improve consistency through temperature changes. In Figure 4, the hardness of the track rapidly decreases after the predominant melting temperature is reached at five different loads. Most racing surfaces warm through a couple of common critical temperatures, such as 25°C (77°F), in which potentially significant changes in mechanical properties can occur.

Good Maintenance

While modification of waxes is one way to avoid these sorts of changes, almost any track can be managed with regular monitoring and proper maintenance. Simply watering the track to avoid reaching the temperature at which the changes occur will keep the track more consistent. Similarly, a deep harrowing or a cultivator in the morning can soften the track during the cooler morning hours. Water can also be used to help manage the stickiness that can be a problem on cold winter mornings.

While changes to the wax in synthetic surfaces present challenges, the temperature of the surface is generally the same on the entire surface. In contrast, moisture content of a dirt track can vary between locations. This important distinction makes synthetic surfaces an appealing option for some tracks.

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

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