The effects of infrared coatings on the surface temperature of artificial turf

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Introduction

Before the invention of artificial turf, natural grass was the only option for groundcover, whether it was for a sporting complex or a residential lawn (Apallas, 2005). Today, many high schools, parks and recreation councils, and homeowners are replacing their natural grass surfaces with more durable and aesthetically pleasing artificial counterparts (Adamson & Frensenburg, 2005; Sports Turf Managers Association [STMA], 2006).

Since the invention of artificial turf, there have been numerous advancements and modifications that have improved both the appearance and safety of these surfaces (Apallas, 2005). Today, artificial turf surfaces are complex systems made up of several different layers (Figure 1). Despite these advancements, there still remains to be room for improvement in the field of artificial turf technology.

Today, the two greatest downsides/problems with artificial surfaces are high surface temperature and the increased risk of skin abrasion (Barton, 2006). Rather than neglect the safety hazards that artificial turf surfaces pose to this day, it is in the best interest for those athletes who play on such surfaces that a solution to these problems be found.

Therefore, the purpose of this study was to investigate those characteristics which cause artificial turf surfaces to reach dangerous surface temperatures and develop, evaluate, and present a plausible solution.

After the conclusion of preliminary control experiments, it was hypothesized that an infrared reflective coating when applied to the crumb rubber infill of turf, poses the greatest potential to reduce the surface temperature of artificial turf on a significant level.

Materials and Methods

Testing and evaluation was conducted in two stages. Stage one consisted of several control experiments designed to determine the effects of isolated regions, in the electromagnetic spectrum, on the build-up of surface temperature in the crumb rubber infill. The isolated wavelength regions included in the control testing were: infrared, ultra-violet, and intensified visible. In addition, experiments were also conducted to determine the effects of exposure to increased air temperature.

Stage two consisted of the development and evaluation of two infrared reflective coatings. First, a master mix of an 56% solid epoxy based primer was created to serve as the coating solution. Next two different infrared reflective coatings were created, each of which consisted of a different loading of the infrared reflective pigment Yellow 10C112. One primer was loaded with 30% reflective pigment and the other 50% reflective pigment.

Finally, each of the two infrared reflective coatings were sprayed evenly across the surface of separate rubber sheets. Following the completion of spray coating each rubber sheet was re-evaluated according to the established procedure of the infrared control testing.

Results

The control experiments clearly indicate that the greatest factor in the build-up of dangerous surface temperatures of artificial turf is infrared radiation, as shown in Graph 2. The next highest factor accounting for surface temperature increase was that of 3x visible light, which accounted for an average increase in surface temperature of only 18°F on the artificial turf and 16°F on the rubber sheets (Graph 2).

Discussion

In order to coat the very fine and irregular shaped granules of the crumb rubber infill (as seen in Figures 2-3), it would require a system of tumbling and mist application. Due to the lack of those resources, the infrared reflective coatings were applied via spray to thin rubber sheets instead. However, as seen in Graph 1, this was not an issue as the rubber sheets were an excellent model in the behavior of artificial turf heat-pick up from infrared radiation. In Graph 1 it is also very important to note that a white cardstock control gained only 21°F when exposed to the same amount of infrared radiation.

The data collected for the two infrared reflective coatings clearly shows a directly proportional relationship between coating thickness and loading percentage on the reduction of surface temperature. The greater the loading percent and the greater the thickness the larger the reduction in surface temperature. Accordingly, the 50% pigment loaded coating with even greater thickness out performed that of its 30% pigment loaded counterpart.

In conclusion, the infrared reflective coatings produced in this study show potential to reduce the surface temperature of artificial turf. Although the tested Yellow10C112 coatings did not reach the target reduction in temperature of 40% this study has validated and pinpointed the characteristics of heat build up for turf surfaces.

Future Work

• Research and test different infrared reflective pigments.
• Conduct strength and durability tests to determine life-span of coatings.
• Generate cost projections based on coating thickness and durability.
• Investigate a plausible industrial process to coat the turf infill.

References


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