WHITEPAPER

PRODUCT-BASED SYSTEMS VS INFILL-BASED SYSTEMS

SportsGrass by ForeverLawn

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INTRODUCTION

The benefits of synthetic turf against natural grass fields are widely recognized, as are the challenges associated with standard high infill turf systems (called infill-based systems). The purpose of this paper is to examine how product-based systems use modern technology to offer improvements in safety, performance, playing experience, and lifespan when compared against infill-based systems.

HISTORY

Since its creation in the 1960s, synthetic turf has undergone several evolutions.

The first synthetic turf systems consisted of 100% textured nylon fiber and resembled carpet more than grass. This is the type of system that still comes to mind for many when they hear the phrase "astro turf."

Despite its unrealistic performance and appearance, the benefits offered by synthetic sports surfaces were varied and invaluable — indoor fields, surfaces that were usable in all weather, drastically reduced maintenance, increased functionality, and more. However, challenges existed as well — unrealistically high traction caused joint injuries, firmness led to concussions, and abrasiveness was hard on players' skin. These obvious issues precipitated an evolution in how synthetic surfaces were designed and constructed.

The next generation of synthetic turf systems, known as infill-based systems, came to popularity in the 1980s and featured tall, straight polyethylene fibers and sand infill.

These systems solved many of the challenges posed by the previous generation. Taller fibers better replicated natural grass, straight fibers moderated traction to protect players' joints and decrease skin abrasion, and infill protected against impact-related injuries. While significant advancement was made in the synthetic turf industry, there were still areas for further improvement.

Future upgrades to turf systems — often considered the third generation — still utilized infill-based designs but introduced rubber infill (often blended with sand) for improved shock absorption and performance, padding for impact protection, and additional variety in fiber construction.

These systems excelled in replicating natural grass, but there were still challenges caused by the reliance on high infill levels. Players complained of infill fly-out, fields were prone to undulations and inconsistency due to infill migration, material constantly required leveling and replenishing, and leg fatigue was common due to lack of stability in the surfaces. Additionally, fields often appeared unsightly due to the amount of loose crumb rubber and were prone to accelerated wear due to their thin construction.

Still, these systems provided a great alternative to natural grass. Most of the industry accepted these challenges as the necessary trade offs of synthetic fields and stopped innovating. Many turf systems available today are still comparable to these over 20-year-old systems.

At ForeverLawn, we intentionally focus on innovation and strive to lead the industry with our synthetic turf solutions. We created SportsGrass with the goal of solving these challenges caused by over-reliance on infill. By deriving performance from the turf product itself with infill in a complementary role, we developed our signature product-based systems, installing our first SportsGrass system in New York City in 2005.

Product-based systems feature denser fiber construction, nylon thatch, and a three-layer backing weighing twice the industry standard. This higher-quality turf construction allows for less required infill than on other modern infilled synthetic fields.

These systems nearly eliminate infill fly-out and migration for a better playing experience and decreased maintenance, provide a more stable and consistent surface to prevent leg fatigue and improve athletic performance, last longer due to increased density, and offer visually appealing fields with crisp lines, markings, and logos.

COMPONENTS AND THEIR ROLES

There are three primary components to any synthetic turf field system: turf fibers, backing, and infill. Each plays a critical role, and the components must work together in a complementary way.

It is important to note that product-based and infill-based systems view and utilize these components differently.

Fibers

Fibers are the blades that comprise the surface of turf systems. There are two different varieties: primary and secondary. Primary (or face) fibers are the taller, straight fibers that are most visible. In field applications, these fibers are almost always made from polyethylene and may be either slit film or monofilament.

Secondary fibers are smaller textured fibers that sit lower than the primary fibers. These fibers are often made of either polypropylene or nylon, with the latter offering more durability and resilience but also increasing costs. Secondary fibers range from highly textured (called high-bulk) to loosely textured (low-bulk). It should be noted that not all turf systems use secondary fibers.

A typical infill-based system will use face fibers that are between 1.75" and 2.5" and may or may not have secondary fibers. The face weight (weight of fibers in a square yard) will usually be low to medium, ranging from 35 to 50 oz for an overall thin construction. When secondary fibers are present, they will usually be high-bulk, causing them to sit well below the face fibers and be buried by the infill.

A product-based system will use face fibers that are between 1.5" and 1.875" and will include secondary fibers. The face weight will be medium to high, ranging from 45 to 55 oz for an overall dense construction. The low-bulk nylon secondary fibers will sit just below the face fibers — allowing infill to drop into the blades — and will provide containment to greatly reduce infill fly-out and migration.

Backing

Any tufted turf product (the most common manufacturing style) will start with a primary backing. The primary backing is a lightweight, sometimes multi-component layer of material that turf fibers are tufted into. Weights on primary backing systems will typically range from 6 to 8 oz per yard.

Next, a secondary backing is applied. For infill-based systems, the secondary layer is usually urethane and is applied at a weight of 14 to 20 oz. This completes the backing of an infill-based system for a total backing weight of 20 to 28 oz.

Product-based systems also utilize a secondary backing. However, the weight of this layer is typically over 40 oz. It is also bulked via aeration, fully filling any voids between the tufts of turf.

Finally, a 6-oz tertiary layer is applied to complete the backing and fully encapsulate the tufts. This layer is typically made of a recycled polypropylene material.

The total backing weight of a product-based system is twice the industry standard, at 55 oz. This heavier premium backing system allows for reduced infill (as it is not required for ballast), adds shock-absorptive properties, ensures stability and straightness of lines and markings over time, and is compatible with reinforced adhesive systems, such as ForeverLawn's unique micromechanical seaming system.

Infill

Both product-based and infill-based systems utilize infill but in different capacities.

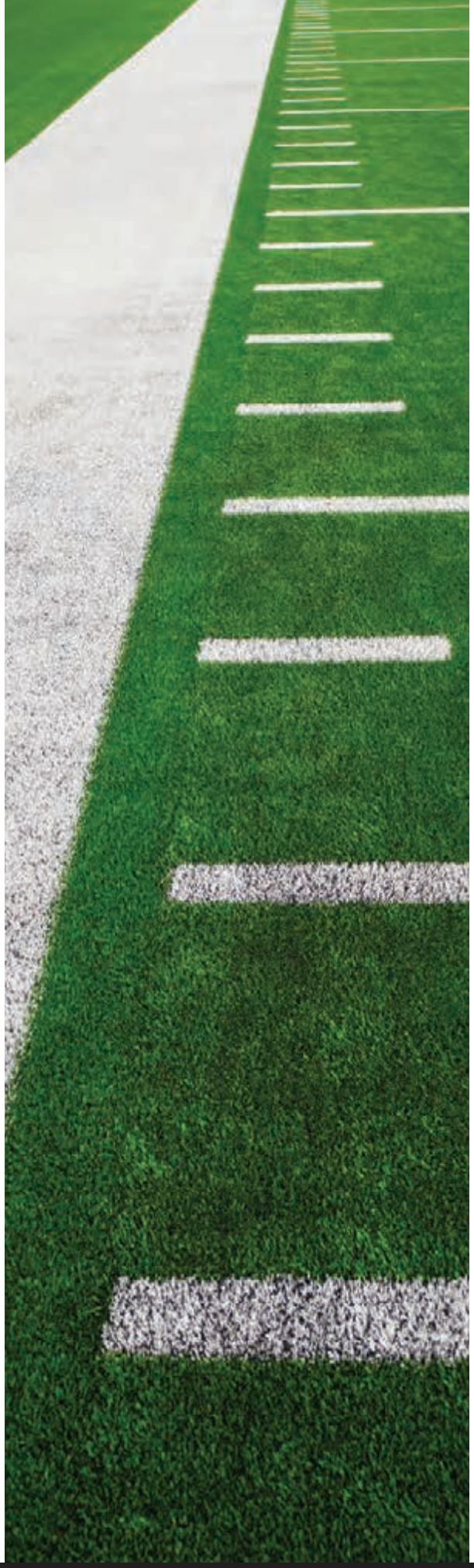
In infill-based systems, there is more reliance on infill for the performance of the surface. Infill-based systems will usually be filled to between 0.5" and 0.75" of the top of the fiber (called fiber reveal). Quantities will typically be around 3 lb/sf. for all-rubber systems while sand/rubber blends may be as high as 11lb/sf.

Product-based systems derive their performance primarily from the turf product, so while still requiring infill, quantities are much lower. Product-based systems usually have 0.75" to 1.0" of fiber reveal. All-rubber systems use 1.3 to 1.8 lb/sf. and sand/rubber blends use 4 to 5 lb/sf.

Overall, product-based systems will use roughly half the infill of comparable infill-based systems. These lower levels combined with the low-bulk nylon thatch nearly eliminate infill fly-out, the most common complaint of athletes who compete on synthetic turf, and infill migration, while also making fields more vibrant, more colorful, and easier to maintain.

Both product-based and infill-based systems are compatible with alternative infills, such as organic and cooling infill products.

INFILL-BASED SYSTEMS VS PRODUCT-BASED SYSTEMS BY THE NUMBERS		
Measurement	**Product-Based**	**Infill-Based**
Pile Height	1.5" – 1.875"	1.75" – 2.5"
Face Weight	45 – 55 oz	35 – 50 oz
Backing	55 oz three-layer	20 – 28 oz two-layer
Thatch	Low-bulk (usually nylon)	None or high-bulk (usually PP)
Infill	1.4 – 5 lb/sf.	3 – 11 lb/sf.



SAFETY AND PERFORMANCE

There is a dynamic relationship between safety and performance with synthetic turf fields. Safety focuses primarily on impact and joint protection while performance refers to the athletes' ability to perform at maximum athletic capacity.

There is a combination of factors that contribute to both the safety and performance of the surface, including impact absorption, traction, stability, and consistency.

The ability of the surface to absorb impact plays a direct role in the protection of athletes against impact-related industries. The common safety tests for impact include GMax and HIC.

Overall, impact scores between the two systems will generally be comparable, though the ways they achieve these differ. Infill-based systems absorb impact primarily through infill material while product-based systems absorb more impact through turf fibers and backing. Both systems are capable of sub-100 GMax scores and HIC scores of 1.4 and higher when used in conjunction with pads.

Regarding traction, rotational resistance is the leading testing metric. The standard acceptable range for rotational resistance is 25 to 50 Nm (newton-meters).

Infill-based systems usually test at the lower end of this range, with some systems even testing in the low 20s. The smaller ratio of fiber to loose-fill results in these lower scores and reduced traction levels.

Product-based systems usually test near the middle of this range, between 30 and 40 Nm. The higher ratio of fiber to loose-fill gives these surfaces more traction.

Traction is a massive factor in both athletic performance and safety. Higher traction is obviously better for performance, but traction that is too high increases injury risk by placing excessive levels of force (torque) on joints. At the same time, traction that is too low can also lead to injury due to risk of slipping.

By being near the middle of the acceptable range, product-based systems provide enough forgiveness to protect athletes without inhibiting athletic performance.

The standard test for surface stability is the vertical deformation test. The general acceptable range for vertical deformation is 4 to 11 mm. Vertical deformation that is too high indicates a surface is too spongy underfoot, while too low may be representative of a surface that is too firm. Both overly soft or firm surfaces pose significant challenges to performance and safety.

Both infill-based and product-based systems will test within the acceptable range with a wide range of pad and infill options, but product-based systems require much lower infill levels to achieve these scores.

Consistency is perhaps the single most important factor in both the safety and performance of synthetic turf fields. The most common way to measure surface consistency is through infill depth testing.

Highly consistent fields allow athletes to exert maximum effort with confidence that each step will be the same. They protect athletes from injury by eliminating changes in the underfoot feel and providing greater planarity. Conversely, surfaces that lack consistency not only inhibit athletic performance but also pose injury risk, as poor surface planarity results in unstable footing which can lead to joint injury.

Any properly installed synthetic turf field should have good infill depth consistency upon initial installation. However, with time and use, infill can displace resulting in more variance in infill depths and consistency.

In infill-based systems, the high infill levels and lack of thatch (or use of high-bulk thatch, which does little to contain infill), lead to significant infill fly-out and migration. This migration causes inconsistency in infill depths as fields receive use.

Because product-based systems use less infill and utilize low-bulk thatch to stabilize and contain infill, migration is greatly diminished. This reduced migration results in increased consistency of infill depth over time.

It is possible to correct migration by using brushing systems to level infill. Infill-based systems require more regular leveling maintenance than product-based systems do.

The ability of product-based systems to contain infill leads to higher surface consistency for improved athletic performance and safety, and decreased maintenance when weighed against comparable infill-based fields.

PLAYING EXPERIENCE

The largest complaint of athletes playing on synthetic turf is infill fly-out. Players often complain that it gets in their eyes, shoes, and just about everywhere else.

As previously mentioned, with product-based systems infill fly-out is nearly eliminated, resulting in a much more pleasant playing experience for athletes.

Another common complaint is leg fatigue. Leg fatigue is often caused by playing on an inconsistent or excessively soft surface, which forces athletes' lower leg muscles to constantly be active in stabilization, resulting in excessive fatigue.

The reduced infill levels of product-based systems result in excellent surface consistency and stability, greatly reducing leg fatigue.

COST

Any type of synthetic turf field represents a significant investment. It is normal for product-based systems to cost five to ten percent more than comparable infill-based systems. However, the cost of ownership over time is often lower for product-based systems.

Because product-based systems retain infill so well, maintenance efforts are reduced and the need to purchase additional infill over time (to top-dress fields) is minimal.

(For a more detailed breakdown of the cost comparison, see the chart provided at the end of this whitepaper).

LIFESPAN

Product-based systems also last longer than comparable infill-based systems. This is due to their increased density and more rugged construction. Most product-based systems, such as ForeverLawn's SportsGrass Edge and SportsGrass Max products, will receive a 10-year warranty, which is 25% longer than the industry standard 8-year warranty. This longer lifespan can more than offset the difference in initial investment.

SUMMARY

While they may seem similar at first glance, product-based and infill-based synthetic turf systems are significantly different. By deriving their performance primarily from the turf (fibers and backing), product-based systems provide enhanced performance, increased safety, and extended lifespans while also giving athletes a greatly improved playing experience and decreasing maintenance efforts.