Managing Rubber Infill Fields

BY **DR. A. J. POWELL, JR., AND MIKE ANDRESEN, CSFM**

Athletic facilities around the world are converting natural grass fields to the new generation of artificial turf. This can be a positive step especially if it solves an overuse issue on grass fields. But hastily trying to solve all sports turf management problems with an artificial fix is not a good idea. There is no easy answer to field overuse and there is no "cure-all." This article will focus on maintenance and management issues that turf managers have identified or experienced to date with the new generation artificial fields.

The new synthetic infill systems are sold as an alternative to overused natural grass fields. The infill systems are not inexpensive nor are they being installed because players prefer synthetic turf. (A 2002 survey of NFL players showed 88 percent of the players still prefer natural grass.)

No audience is more aware than you that many natural grass fields being replaced with these alternatives have not been properly maintained nor funded. Although little money can be appropriated for turfgrass maintenance, it appears in some cases that a large capital investment is easy to come by.

Also, it is less hassle to buy a quality-looking surface than it is to grow one. In many areas of our society, the natural "look" or "feel" is no longer important. Another factor seems to be that area school competitiveness is so great that if one school gets the "latest" then all the rest need the "latest." It is not necessarily better, but it is in vogue.

Though many sports turf managers feel threatened by the introduction and acceptance of this new technology it remains a fact that Synthetic Infill surfaces are here to stay and professional sports turf managers need to become well versed in this new technology.

Some of the causes for consideration of alternative outdoor surfaces include:

More outdoor sports, for girls and boys, have greatly increased traffic pressure. Also, more and more campus buildings have been constructed upon space that could be used for sports fields, thus placing more traffic pressure upon the remaining fields.

The demand continues for very aesthetic, almost perfect game fields. Even if a high quality field is maintained, there is always enough pressure for additional teams or games so that the fields show severe wear by the end of a playing season. Because of fan and parent pressure for perfection, the old way of playing on thin turf, with a little mud, is no longer an acceptable option.

The cost of new or renovated, natural soil fields has not increased substantially. However, the cost of natural grass sand-based fields that allow all-weather use may now cost upwards of $500,000 to $1,000,000 for a single field. These sand-based fields that have been used recently by colleges, professional teams, and some high schools, have set a new high standard—for cost.

Failures related to severe sod shearing with sand based fields have certainly placed the wisdom of constructing new sand based fields in question. Also, these fields have often been over-sold as the cure-all for increased traffic, when in fact traffic usually cannot be increased without severe wear.

Expensive repair of worn sand based fields, using thick cut sod, again makes one question the selection of sand in the first place. Also, there have been many expensive cure-alls developed for these field problems and most have not been successful.

Construction and Maintenance Cost Comparisons

To make cost comparisons between grass and infill systems, many assumptions must be made. Obviously it is much more costly to maintain grass in some climatic regions, some grasses are more expensive to maintain than others, generally it is more expensive to maintain college fields than high school, and more expensive to maintain game fields than practice fields.

	Current Sand-Based Field Maintenance	New Sand-Based Field	New Synthetic Infill [A]
Initial Construction	—	$1,000,000[B]	$600,000
Maintenance cost - 1st year	$40,000	$40,000[C]	$3,500[D]
10 year maintenance cost [E]	$458,600	$458,600	$40,120
10 year total cost	$458,600	$1,458,600	$640,120
Average cost/ year	$45,860	$145,860	$64,012

[A] Approximate cost estimate presented at 2004 STMA Annual Conference.

[B] Conversion to sand base usually requires excavation of the old field, utilization of sod for quick conversion and hiring of a professional consultant for specification and site inspections.

[C] Cost average given by several active Sports Turf Managers. Includes labor, equipment depreciation, irrigation, fuel, water, all maintenance activities and products, line paint, etc.

[D] Includes sweeping and brushing every few weeks and equipment depreciation. This may be an excessive estimate for some fields that have no preventative maintenance. On the other hand, it is a gross underestimate for most college and professional fields.

[E] The 10 year maintenance estimates are adjusted for 3% annual inflation.

Conclusions:

–The Synthetic Infills are less expensive to construct and much less expensive to maintain than sand-based fields.

–However, if you already have a sand-based field and compare its maintenance cost to a new synthetic field, the average cost per year is much less expensive with your current field.

– Certainly the Infills can take infinitely more traffic than grass fields and if you calculated the cost per event, assuming the field is heavily used, the prices are heavily skewed in favor of the Infill system.

Most "Infills" include:

1. 2.5-inch long, vertical polyethylene, polypropylene or nylon fibers attached to a porous polyethylene backing.

2. 2-inch infill of crumb rubber placed within the fibers. Some only use crumb rubber, others use a segregated layer of crumb rubber and sand, and others use a specific mixture of sand and rubber. Mainly because of this infill material, the surface performs much better than the old artificial turf.

3. Some also include a polyurethane pad, placed just under the backing. This gives extra cushion and surface resiliency.

4. For drainage, most use an 8-12 inch gravel/sand sub-base and sideline drains.

Cost comparisons

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From an economic standpoint, it is obvious that soil based fields are much less expensive than the Infills. However, the soil based grass field will likely become worn between the hash marks, look somewhat unsightly, require extensive "use" discipline, and will require management expertise and manual labor. (Normally these worn grass fields are safe to the athlete.)

Quality expectations and wear tolerance could be realized if only a portion of the $42,000 to $56,000 savings per year as calculated for the soil vs. infill, could be spent on improving grass maintenance. However, wear tolerance for grass can never compare with the Infill. The increased cost for the Infill is further exaggerated when the synthetic carpet must be replaced.

Evaluating Infills

There are more than a dozen companies manufacturing and/or installing different versions of the synthetic Infills. Their warranties and construction methods vary considerably. Since this is recent technology no one can really predict future performance. Although Infills are often sold as almost maintenance free and permanent, there are concerns that must be addressed before purchasing, including:

DRAINAGE SYSTEM. Many Infill systems have been laid over a

gravel blanket with no slotted drain piping except on the sidelines. Water is expected to drain through the synthetic backing and drain laterally through the gravel to the sidelines. The addition of perforated pipe within the gravel blanket increases the rate that water can drain from the field but it is a more expensive installation. A surface slope (crown) of 1/2 to 1.5 percent should be installed, falling toward the sidelines, to help get more rapid runoff. If a very heavy rainfall enters the gravel layer faster than it can move laterally to the sideline, then the entire carpet will tend to float. This may cause delay in field usage and cause some lateral movement of the crumb rubber and/or crumb rubber/sand mix.

WARRANTY. It is extremely important to understand up-front what is covered in the warranty. Warranties are normally prorated and settlement requires considerable judgement. Certainly it is more than just knowing that the infill is covered for the normal 8-10 years or so. Also consider:

- How financially stable are the manufacturer and/or installer? The warranty is only as good as the financial condition of the companies providing it.
- Do the manufacturer and installer have separate warranties?
- Does the warranty cover the entire system or just the carpet? Some warranties only cover the synthetic carpet, infill material and/or synthetic pad. They do not cover the drainage system. If water infiltration is so slow that water accumulates or ponds on the surface following a rainfall, who is responsible for the drainage system repair?
- Is there any recourse if the synthetic grass fibers fade in color?
- With heavy wear, especially in goalmouths, between football hash marks and bench areas, who is responsible for the shredding of the tips of the synthetic grass fibers, especially if it causes extra surface slickness?
- With heavy wear, especially in goalmouths or where repetitive cuts or kicks occur during football or soccer practice, who is responsible for replacing the crumb rubber mix to the surface? More importantly, who is responsible for any underlayment repair where the gravel or sand is displaced, causing a dangerous, but not so obvious hole that is just below the surface?
- Who is responsible for line repairs where the permanently fixed lines become stretched, making them somewhat wavy in appearance?
- Who is responsible for line or hash mark repairs when they become unglued or ripped loose?
- Is the warranty good, regardless of how many times you rake the surface to fluff the crumb rubber? Obviously the more you do it, the quicker the fibers will wear, fade, and actually be removed by the equipment. With regard to the fibers, what constitutes a warranty repair? Is a loss of density, tip shredding, loss of fiber rigidity, or color fade (to include lines), covered?
- In what time frame will warranty repairs be made? Obviously damage that creates safety hazards must be repaired immediately.
- If irrigation sprinklers are installed into the carpet after installation, does this

Comparing Soil-Based Grass Field with Synthetic Infill

Approximately 2 acre field, no sub-surface drainage system added to grass

	Using Current Soil Field Contract [A]	DIY [B]	Newly Constructed Soil-Based Field	Synthetic Infill
Initial Construction	-	-	$50,000 [C]	$600,000
Maintenance Cost – 1st year	$20,000	$7,000	$15,000	$3,500 [D]
10 year Maintenance Cost [E]	$229,358	$80,275	$172,018	$40,120
10 year Total Cost	$229,358	$80,275	$222,018	$640,120
Average cost/yr	$22,936	$8,028	$22,202	$64,012

A Contract maintenance including labor, equipment depreciation, fuel, irrigation water, line paint and all maintenance activities and products.

B Do It Yourself (DIY) maintenance is the norm for most school and private league fields, and includes fertilizers, herbicides, paint, equipment depreciation, aerification, annual renovation and minimum labor and water cost.

C Includes minimum site work, new irrigation system, seed and minimum top soil hauled; maintenance is higher because of needed equipment and quality expectations.

D Includes sweeping and brushing every few weeks and equipment depreciation.

E The 10 year maintenance estimates are adjusted for 3% annual inflation.

Conclusions:

– From an economic stand point, it is obvious that soil based fields are much less expensive than the synthetic Infills.

– However, the soil based grass field will likely become worn between the hash marks, look somewhat unsightly, require extensive "use" discipline and will require management expertise and manual labor. (Normally these worn grass fields are safe to the athlete and it is not unusual to hear football players praise the 'muddy' field.)

– Quality expectations and wear tolerance could be realized if only a portion of the $42,000 to $56,000 savings per year as calculated for the soil vs. infill, could be spent on improving grass maintenance. However, wear tolerance for grass can never compare with the Infill.

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affect the overall warranty?

FIELD HARDNESS. Most companies guarantee a surface hardness range and provide annual testing. Hardness is measured using either a Clegg Impact Soil Tester (commonly used for natural grass fields) or measured with the F355 (commonly used for synthetic turf surfaces). With both methods, a weighted missile is dropped on the surface and the Gmax is measured as the ratio of maximum negative acceleration on impact to the acceleration due to gravity. When measured with the F355, the hardness is usually guaranteed between hardness no greater than a G-max of 200 and softness no less than 50. However, a Gmax no greater than 150 would most often be preferred.

Consider the following when getting these measurements:

(1) Use an independent company with a proven reputation for measuring hardness. Don't just depend upon the one suggested by the installation contractor. The cost of this testing may be $2000 plus, depending upon how far they travel and how much equipment they must carry. Who will pay for this testing?

(2) Every hardness measurement above the guaranteed limit is a safety problem, i.e. hardness is not just an average measurement to be made at random over the entire field. A single

hard spot (or soft spot) is most dangerous because it affects footing, and is not obvious to the athlete until he/she stumbles across or falls upon it.

(3) Brushing and scarifying just before measuring Gmax will alleviate considerable compaction and hardness. However, you need to always have the measurement taken on a field under your playing conditions, i.e. with a delay in brushing, as you would normally use the field.

HEAT. On hot days the increased heat on a synthetic field can be a major problem that many times is left out of the discussion during the decision making process. (See "Q&A" p. 38, for more on this topic.) High surface temperature can be very dangerous to the athlete because it increases heat stress, causes blisters or discomfort and certainly dehydration. Surface temperatures of an infill have been measured up to 200F when air temperature reached 98F. Surface temperatures of 160F have been measured on a 92F day as compared to an adjoining, well-irrigated grass field surface measured at 89F (because of natural evaporative cooling). In another situation, the surface of an infill was measured at 180F, an adjacent grass field measured 80F, and the air temperature measured 86F. The problem is most severe when black crumb rubber is exposed to sunlight and not shaded by the plastic grass.

Skin burn can occur in seconds when the surface temperature is 140F and is very uncomfortable at 120F. Obviously this is mainly a problem when games or practices occur during bright sunny days. One would only expect a moderate increase in latent heat on the surface after the sun goes down.

For maximum safety however, it would be best to remove play or cool the field with irrigation when the temperature reaches 120F. Large radius turf sprinklers or sideline irrigation guns can be used to irrigate the entire field to lower the temperature and/or add humidity to the dry air. Because the temperature reduction with irrigation may only last 5-10 minutes on a bright, hot day it may require several irrigations and the use of an underground irrigation system. After irrigation, the temperature can rebound as much as 80F in less than one half-hour. Controlling humidity levels is a serious consideration and adding humidity to an already humid environment may contribute to an even more dangerous situation for field users. More research is needed, and is being conducted presently, to define the synergy between heat and humidity on athletes.

Other considerations

•Do you have the equipment necessary to mechanically rake the crumb rubber to uniformly maintain a smooth surface?

• Do you have the expertise, time and ability to extract/remove chewing gum, tape, cigarette burns, blood, vomit, spit, tobacco juice and other possible fluids? Certainly a wet/dry vac will be an important tool, but after each use some infill will likely need replacing.

• Do you have a pressurized mainline with available quick couplers for instant water access?

• To repair a small or large area, do you have the expertise, time and ability to remove the crumb rubber, cut through the backing, replace the damaged piece, re-glue the damaged piece to another piece that can be placed below the original carpet, refill with crumb rubber, etc.?

• If a disinfectant is needed for the entire surface, do you have money budgeted and a boom sprayer that can be used to uniformly apply a disinfectant?

• If used for multiple sports, do you have money budgeted and equipment for temporary line painting, painting over permanent lines that are in the way, and then scrubbing the temporary paint from the surface so that the original lines appear normal? To paint temporary lines, paint over some permanent lines and then remove the paint can cost upwards of $6,000 plus labor. Walk-behind equipment with mounted brushes can increase that cost by 2 times per painting.

• Also, it is almost impossible to completely remove the temporary paint from the plastic grass and certainly from the black crumb rubber. This is not an infringement upon the Infill quality that you would want to often repeat.

• Renting the field for other teams or local events is often suggested as a way of justifying/paying for the new Infill. But beware:

1. Rental fees most likely are used solely for after-use clean up, operating lights, etc. Little is left for "paying" for the field.

2. If multiple sports are anticipated, expensive line painting and after-use scrubbing will be necessary between events.

3. For events such as concerts, field days and graduation ceremonies or any events that place chairs upon the infill system or have aggressive traffic, you must protect the field much the same as with natural grass. There will always be a load bearing weight limit for the field. Just the material cost for a commercial field cover or plywood would be expensive. If equipment ruts penetrate into the sub-base, the entire rut area must be remove, repaired, and replaced.

• When replacement becomes necessary, will equipment be available to remove, clean and re-use the crumb rubber? Or, will the crumb rubber and synthetic carpet require costly landfilling?

• Even with a new infill, you must be prepared to continue maintaining one or more practice, natural grass fields. Consider the following:

1. Coaches prefer to practice on the game field because they get the 'feel' for wind, sun aspect, acoustics, lighting, etc. But, they do not like to be confined to only one field. Wear is a major concern for natural grass and it may also be true with excessive use of the Infills.

2. Practices often conflict with games when other sports are involved or when the Infill is being used for intramurals, community leagues etc.

3. Practices on the Infill may have to be postponed during hot, sunny days. High surface temperatures increases fatigue and injury risk. Most coaches prefer to practice off site and on naturally cooler grass surfaces and some choose to practice at night, especially during the summer months.

Although these Infill fields can be used 24 hrs/day, they will not be used as such. It is unlikely that games or practices will ever be scheduled from midnight to noon. Also, over scheduling increases excessive wear upon the plastic fibers. Excessive scheduling will require excessive maintenance to ensure safe levels of playability.

• Static electricity may have to be confronted by spraying the field with a static inhibitor or fabric softener. Static electricity causes the crumb rubber to cling to the fiber blades, causing the infill fibers to look black in color. It also causes the crumb rubber to cling to uniforms, arms, legs, etc. Static electricity is minimized by rainfall or irrigation. Unfortunately regardless of how static electricity is reduced, it always returns quickly.

• A first aid kit with eyewash should always be available. Crumb rubber, like any other particle, can be an eye irritant. It also can contaminate abrasions.

• Normal sweat also attracts crumb rubber. This must be continually removed from the skin, and possibly even from a wet ball. It is also an irritant in shoes and on clothes.

• Although it is rather easy to push snow off an Infill, one has to be extra careful

to not damage the carpet and not apply so much down force as to dislodge the rubber or fibers. Permanent damage can be easily done. It is not uncommon to have a large pile of fibers to remove from the melted snow.

• Skin abrasions are much less of a problem on the Infills than on the older synthetic surfaces. But they can still occur. However, because of a concern for infections, it may be necessary to spray periodically with a disinfectant.

• Increased security is necessary with synthetic Infill. Random access must be prohibited. Vandalism by fire, paint or graffiti is very costly to repair or replace. The Synthetic Infill will not 'grow out of it'.

Just as natural grass fields are scrutinized concerning pesticides used for weed control, there is increasing concern relative to the chemical safety of crumb rubber and silica sand amendments. Certainly there is a rubber odor, especially on hot days, and there will always be some inhaled dust that is associated with infill wear. The bagged silica sand, used to blend with crumb rubber, carries a silica dust WARNING; suggesting that breathing silica dust can cause silicosis and cancer. Hopefully future research will conclude that there is no risk.

Some grass shear in natural grass is important and safe for the athlete. A surface that does not absorb energy of a cut or stop by shearing can be very hard on joints and muscles, and may be very difficult for some athletes to get comfortable with. Also on some of the soft Infills, the foot tends to slightly shift sideways, just like it does on a thatchy zoysiagrass surface.

Turf problems

In no way do we want to highlight problems with synthetic Infills without also reminding the reader of long experienced problems with natural grass fields. The most obvious problems with grass has always been excessive wear, sod shear on sand based fields, irrigation needs, maintaining management expertise, marking/painting the field mostly before every major game, laborious use of rain or grow tarps, year-a-round maintenance, the constant need to rotate practice areas, etc.

It certainly makes sense to consider the Infills for:

• Landlocked campuses that must transport classes and teams off site.

• Municipal stadiums that are forced to use the game field for numerous teams, little league events, band days, concerts, etc.

• Campuses that hold numerous summer camps, exhibition games, etc.

• Campuses that need an all-weather practice field and for practice when preparing to play an away game on a similar field.

It makes little sense to consider the synthetic Infills for:

*Replacement of a grass field that only gets center of field wear by season's end. (Grass field wear is usually non-consequential as related to player performance or safety. It mainly becomes an aesthetic issue, even if the field becomes totally worn out.)

(continued on page 34)

HERE'S A LAUGH

This is a copy of the photo that currently is running in consumer magazines as part of an advertisement for West Coast Turf. That's Arizona Diamondbacks' turf manager Grant Trenbeath and his dog, Mattingly, enjoying a blanket of turf.

(continued from page 31) • Replacing a soil based grass field because the maintenance cost for the Infill would be less. It would take dozens of years to make up the difference between an increased maintenance cost and the initial cost of a synthetic infill; but you will also have an added replacement cost of the synthetic infill in a few years.

As the infill system becomes more competitive many of the problems mentioned in this article will or already have been corrected. Many new companies are already manufacturing and/ or installing these systems, measuring surface hardness, and supplying infill maintenance equipment.

Synthetic Infills are here to stay and they are serving an important clientele, our kids. As pointed out in this article, there are many unanswered questions that need justification and scrutiny. There is little to no research and few evaluations reported by independent testing companies/consultants. Decision-makers, along with sports turf managers, need to ask all of these questions before signing the bottom line.

Just as we need more research to improve sand-based grass fields, more research is needed with these 'new' Infill systems. The Sports Turf Managers Association (STMA) has endorsed independent research of Synthetic Infill products. As new research results become available the STMA is committed to publishing or otherwise reproducing the findings to its members and the public. **ST**

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