Removal, Recovery, Reuse & Recycling

of Synthetic Turf and Its System Components

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Synthetic Turf End of Life

Introduction

What happens with synthetic turf once it reaches the end of its useful life? What options are available to avoid the landfill? One of the challenges the synthetic turf industry is working on is determining how best to manage the removal and disposition of synthetic turf once it has reached the end of its useful life, or "End of Life" (EOL).

As with any recovery and recycle effort, the diversity of component materials represents a technical and economic challenge. Synthetic turf includes a variety of polymers such as polyethylene, polypropylene, nylon, styrene butadiene rubber and polyurethane. Natural materials such as silica sand and calcium carbonate are also present. These materials must be separated in order to be recycled and the variety presents a unique challenge not seen in other recycled materials such as plastic bottles, carpet or plastic bags.

With this challenge there is an assortment of technologies and processes being developed to reduce landfill dependence. These include processes for removing and separating to the extent possible turf components into materials that can be recycled or reused. They also include development of new materials for turf construction that are more environmentally friendly.

This document addresses the issues with removal, reclamation and recycling of synthetic turf. The industry is working hard to identify the best and most economical approaches to remove and process synthetic turf materials that have reached their end of life.

When it is time to make the decision to reclaim or to landfill, what is involved? What are the options for reclaiming and recycling synthetic turf installations?

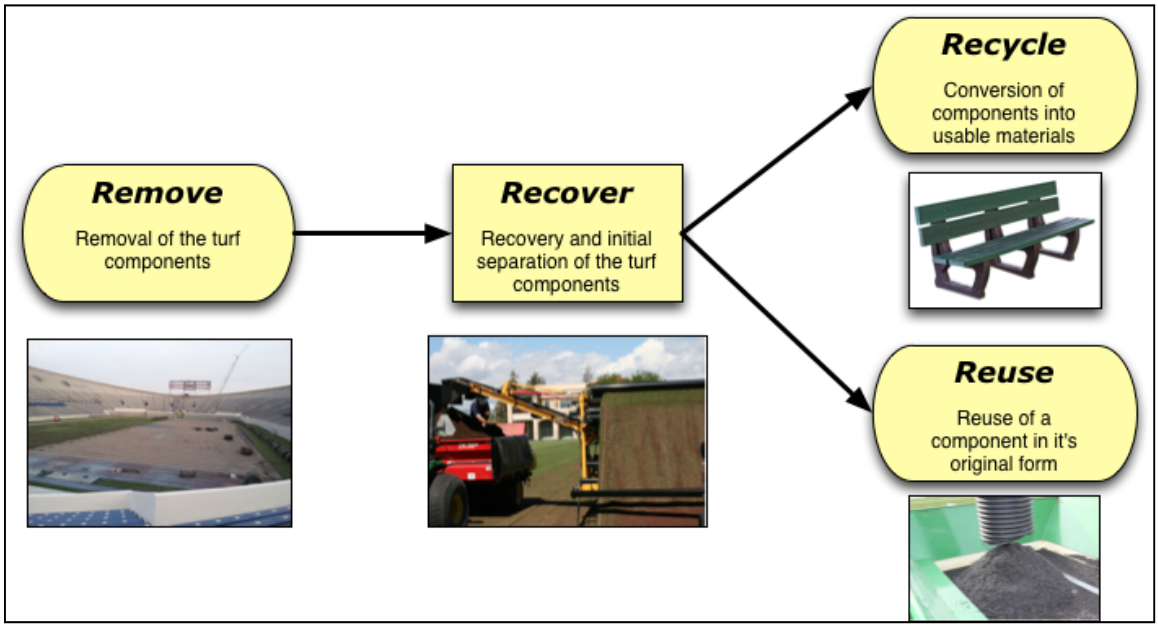
Converting Synthetic Turf to a Recyclable Material

The graphic on the next page is a simplified view of the decisions required and the options available for synthetic turf removal. It shows the steps required to convert the synthetic turf materials into a form that is useful for recycling. Unfortunately, converting synthetic turf to a recyclable material that is useable cannot be done at the point of removal. Material must be shipped to different processing locations. The cost of shipping is one of the biggest challenges associated with synthetic turf reclamation.

Once the decision has been made to reclaim the synthetic turf, the materials must be separated. Infill must be removed from the turf. Further separation may be required to separate sand and debris from the infill.

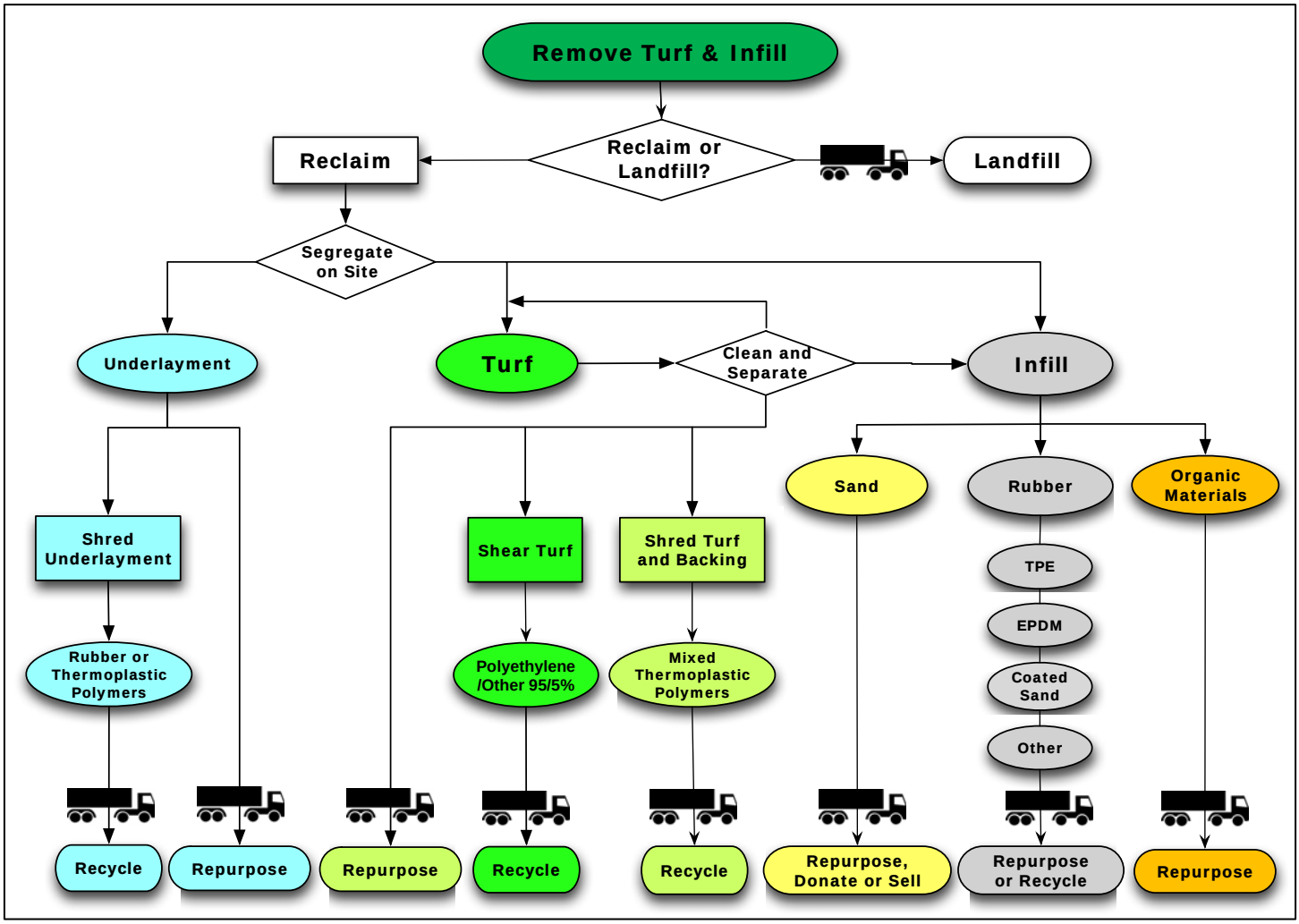
After the synthetic turf has been separated from the infill it can be broken down into materials suitable for post-consumer recycle content in the plastics industry. This can be accomplished in much the same way that carpet is reclaimed and recycled today. The industry is working to identify the most economical way to process turf plastics.

Keeping Synthetic Turf Out of the Landfill



Note: Other turf components such as infill and the underlayment pad may also need to be removed, reclaimed and recycled or reused.

End of Life—Synthetic Turf Material Flow Overview



Summary of Reclamation Options (as of January 2013)

	Removal Options	Reuse Options	Recycle Options*	Waste to Energy Options
Synthetic Turf				
Polyethylene	✓	✓	✓	**
Polypropylene	✓	✓	✓	**
Nylon	✓	✓	**	**
Infill				
Crumb Rubber	✓	✓	✓	✓
EPDM	✓	✓	✓	
TPE	✓	✓	✓	✓
Organic Infill	✓	✓		
Silica Sand	✓	✓		
Coated Silica Sand	✓	✓		
Coated Crumb Rubber	✓	✓		
Shock Pad Underlayments				
PVC/NBR foam	✓	✓	✓	✓
Polypropylene Composite	✓	✓	✓	
Polyurethane	✓	✓	✓	✓
Post Consumer Tire Rubber	✓		✓	
Elastic Layer Underlayments				
Post-Consumer Tire Rubber	✓	✓		**
Combination Drainage/Shock Pad Underlayments				
Expanded Polypropylene	✓	✓	✓	**
Cross-linked Polyethylene	✓	✓	✓	**
Drainage Mats and Strip Drains				
Polystyrene	✓			
Polypropylene	✓	✓	✓	**
TPO	✓		✓	

* Recycle options as defined here are commercially viable. No claims are made regarding logistical viability. Recycle options will vary by product, geographic location, and market.

** Technically feasible but not commercially practiced.

Synthetic Turf

Profile

A typical synthetic turf sports field is about 80,000 square feet (7,432 square meters). It comprises about 400,000 lbs. of infill and 40,000 lbs. of turf, or the equivalent of 15 to 20 30-yard dumpsters. Almost all fields installed in the U.S. include a silica sand/tire crumb rubber or all crumb rubber infill, each of which accounts for 2-3 lbs./sq. ft. weight of the synthetic turf system. Therefore, 1,000 deconstructed fields represent 80 million square feet of turf weighing 40 million pounds, and 400 million pounds of infill, including 250 million pounds of crumb rubber, and 150 million pounds of silica sand.*

The first infilled (or so-called 3rd Generation) synthetic turf sports field was installed in the U.S. in 1997. At the end of 2012, there were over 8,000 synthetic turf sports fields in use. Depending on its usage, exposure to intense sunlight, maintenance, and other factors, a synthetic turf sports field will last up to about 10 years before reaching the end of its useful life. It is estimated that by 2017, over 1,000 synthetic turf sports fields will be deconstructed annually: 365 in 2013; 571 in 2014; 768 in 2015; 941 in 2016 and 1,012 in 2017.*

During the past 10 years, synthetic turf has also become a popular option for residential and municipal landscape, roof gardens, pet parks, playgrounds, airport median strips, and other landscape and recreation uses. High quality synthetic turf used for landscape and recreation purposes can last years longer than synthetic turf sports fields because of the reduced usage.

Removal

The industry has developed special equipment to remove synthetic turf sports fields by cutting it, picking it up, rolling it into easily transportable bundles, and, in some cases, removing most of the infill. Synthetic turf for landscape and recreation use is not so easily removed and bundled because it is often irregularly shaped.

Once the synthetic turf is removed and the component materials are reclaimed, cost will be a prevailing factor in the decision of how to dispose of it. To consider available reuse and recycling options, the proximity of the synthetic turf to the removal, reuse, recycling or power generation site will be important in order to minimize and make affordable the transportation costs. In fact, when compared to the $30-60,000 cost of landfilling an 80,000 square foot sports field, it is unlikely that the cost of transporting the synthetic turf and/or infill farther than 200 miles will be considered feasible. Therefore, it will be important to investigate all of the reuse, recycling, and power generation options in the region. As the industry develops new technologies and options for the recovery of the synthetic turf, the economics will improve.

* Source: Turf Reclamation Services, LLC

Reuse and Recycling

Here are some of the uses to which old synthetic turf can be reused:

- Baseball: Batting cages, in front of dugouts, bullpens, indoor practice and hitting facilities
- Golf: Driving ranges, lining for sand traps for erosion control, tee lines, driving mats,
- Sports fields: grass field sidelines, running track protective strips, band practice field, indoor general use practice and play fields
- Landscape and Recreation: Play areas, small landscape areas, highway erosion control, dog runs, pet parks, equestrian stables, airports

Once the synthetic turf has been separated and processed it is useable for recycling. Synthetic turf is produced from several polymers. Even perfectly clean turf contains a mix of LLDPE (linear low density polyethylene), PP (polypropylene) and a coating of either polyurethane, hot melt polyolefin, or latex. Linear low density polyethylene is used to produce the majority of turf fibers, the largest component of turf. Nylon and polypropylene are also used, but to a much smaller degree. Polypropylene is typically used for the backing material, but backing is a smaller component than turf fiber. These materials can be melted together but may form a polymer mix with distinct phases. Heterogeneous polymer alloys can potentially be used as recycle content in some processes, but will have mechanical properties that are different and likely inferior to virgin or recycled polymers from single components.

Here are some of the ways used synthetic turf can be recycled:

Conversion to Energy

- Energy can be recovered from synthetic turf by incineration, pyrolysis or gasification.
- The calorific value (CV) of polyethylene is 40-45 MJ/kg.

Synthetic Lumber

- Boards
- Railroad ties

Molded Parts

- Injection molded parts
- Compression molded products

Crumb Rubber Infill

Profile

Crumb Rubber is derived from scrap auto and truck tires that are ground up and recycled. Two types of tire crumb rubber infill exist: ambient and cryogenic. Together these make up the most widely used infill in the synthetic sports field and landscape market.

Reuse and Recycling

Here is a list of viable reuse and recycling options for crumb rubber, sand, or the combination. In some cases, the extracted infill may be used As Is (AI) with minimal cleaning. In other cases, cleaning and separating (CS) the sand and crumb rubber may be required. It may be necessary to screen tire crumb rubber prior to reuse to remove unwanted fine particulates, e.g., fiber, metal, very small rubber particulate, or screen for a particular use, such as incorporation into asphalt.

Field/landscape Applications

- Reuse as infill on new synthetic turf sports field or landscape installations (AI) (CS)
- Natural turf soil amendments to improve wear tolerance and prolong playability of natural turf sports fields (AI) (CS)
- ADA-compliant playground surfacing (AI) (CS)

Road and Rail Applications

- Acoustic barriers (CS) (AI)
- Road base (CS)
- Portable traffic control devices (CS)
- Ripple strips and speed bumps (CS)
- Rail crossings, sleepers and buffers (CS)
- Asphalt

Construction & Industrial

- Industrial flooring (CS)
- Acoustic barriers (CS) (AI)
- Sprayed up roofing, insulation and Adhesive sealants (CS)
- Mounting pads and shock Absorbers (CS)

- Airfield runways (CS)
- Carpet underlay (CS)
- Children's playground surfacing (CS) (AI) (AIWP)

Marine

- Wharf buffers (CS) (AI)
- Floating docks (CS) (AI)
- Non slip flooring (CS) (AI)

Sporting

- Equestrian surfaces and workout areas (CS) (AI)

Landscaping

- Watering systems, rubber hosing & low pressure irrigation drip hoses (CS)
- Infill for Synthetic/Artificial Landscape Turf (CS) (AI)

Natural Turf Soil Amendment (to improve wear tolerance and prolong playability)

- Athletic Fields (AI) (CS)
- School Campus Areas (AI)
- Soil Compacted Walkway or Pathway Areas (AI)

Energy Recovery

- Energy can be recovered from crumb rubber infill by incineration, pyrolysis or gasification.
- The calorific value (CV) of tire rubber is 27.5 MJ/kg (14,000-16,000 BTU).

Infills Other Than Crumb Rubber

EPDM and TPE

EPDM (Ethylene Propylene Diene Monomer) and TPE (Thermo Plastic Elastomer) are polymeric elastomers with high resistance to abrasion and wear and will not change under high temperatures. Products are available in a variety of colors, and have proven durability in all types of climates. Excellent elasticity properties and resistance to atmospheric and chemical agents provide stable, high performance infill products.

Reuse and Recycling

Both EPDM and TPE infills are reusable as infill and recyclable into infill or other products. Energy can also be recovered from TPE where the calorific value (CV) can be up to 25-30 MJ/kg.

Organic Infill

Several organic infill materials are available in the North American market, all utilizing different organic components, such as natural cork and/or ground fibers from the outside shell of the coconut. These products can be utilized in professional sports applications as well as for landscaping.

Reuse and Recycling

At the end of its life cycle, organic infill can be recycled directly into the environment.

Pure Silica Sand

Pure Silica Sand is one of the original infill materials utilized in synthetic turf systems. This product is a natural infill that is non-toxic, chemically stable and fracture resistant. Silica sand infills are typically tan, off-tan or white in color and, depending upon plant location, may be round or sub-round in particle shape. Silica sand can be used in conjunction with many other infills on the market to provide a safe and realistic playing surface. It can be coated with different materials used as a standalone product, or used in combination with traditional crumb rubber infill systems.

Reuse and Recycling

Pure Silica Sand can be reused as infill on new synthetic turf sports fields or landscape installations. It can also be used in natural turf soil amendments to improve wear tolerance and prolong playability.

Coated Silica Sand

Coated Silica Sand consists of coated, high-purity silica sand with either a soft or rigid coating specifically engineered for synthetic turf. These coatings are either elastomeric or acrylic in nature and form a bond with the sand grain sealing it to provide excellent performance and durability over the life of a field. Coated sand is available in various sizes and colors to meet different needs.

Reuse and Recycling

In North America, the material can be returned to select manufacturers to be cleaned and recoated. The product can also be used as top-dressing on natural turf fields.

Select products can be recycled into new coated sand infill.

Coated Crumb Rubber

Ambient or cryogenic crumb rubber can be coated with colorants, sealers, or anti-microbial substances, if desired, to provide specific benefits.

Reuse and Recycling

Select products can be recovered, sanitized, and recoated for reuse as infill for synthetic turf sports systems, and can be recycled info rubberized asphalt or molded products.

Underlayments, Including Shock Pads, E-Layers, Integrated Drainage Systems, Drainage Mats & Strip Drains

Shock Pads

Shock attenuation pads offer an added level of protection and consistent playability to the playing surface and are designed to contribute to a safe *g*-max level throughout a synthetic turf field's life. Roll out or panel systems are available and can be permeable or impermeable. Some can replace all or portions of the stone base and provide both shock attenuation and drainage, while others are used in combination with a traditional stone and drainage base. Pads can be placed directly over asphalt or cement stabilized surfaces.

Various materials that are used include PVC/NBR (polyvinylchloride/nitrile butyl rubber) foam, polypropylene composite, polyurethane and post-consumer tire rubber.

Reuse and Recycling

Some shock pads last more than one turf lifecycle. Select pads can also be reused for other uses such as golf mats and farm animal mats.

Some pads are made from recycled materials, while others are made from virgin materials and may be recyclable. Certain manufacturers will accept recovered product for recycling. Energy recovery may also be an option.

Elastic Layers or E-Layers

Elastic layers (E-layers) are poured in-place (in situ). They are permeable and are typically comprised of rubber granulate with a polyurethane binder. E-layers can vary in thickness and do not have seams.

Materials include post-consumer tire rubber used in combination with a polyurethane binder.

Although E-layers are not able to be recycled at this time, they can be reused, or repaired and reused.

Integrated Drainage and Shock Pad Underlayment

Drainage pad underlayments are designed to replace the stone base and act as both a base support and drainage system for turf. Roll out or panel systems are utilized.

Materials used for the various product offerings include expanded polypropylene or cross-linked polyethylene.

Reuse and Recycling

Drainage pads can be used for multiple turf life cycles.

The product can be recycled and incorporated into a new drainage pad or other products. Cross-linked polyethylene can be a fuel source and has a caloric value of 45 MJ/kg.

Drainage Mats and Strip Drains

Drainage mats and strip drains are designed to act as both a base support and a single-sided drainage system for turf.

Materials used for the different products include polystyrene, polypropylene and TPO (thermoplastic olefin). Polypropylene products can be reused and recycled.

Reuse & Recycling Successes

STC member companies are working hard to develop reuse and recycling options for synthetic turf fields that have reached the end of their useful life. Several member companies will accept recovered synthetic turf. They provide assistance with removal and will clean and warehouse turf that is suitable for reuse. Assistance with transportation may also be available. Reuse options include arena football, tee mats, sand trap liners, landscape liner material, golf products and door mats.

Member companies are also developing removal technologies to make removal and recovery both quick and economical. Separation of infill from turf is particularly important to provide suitable materials for recycling processes.

Companies are developing processes to collect and separate materials so that turf can be processed into post-consumer recycle content products. Turf received in rolls can be processed into plastic pellets that are suitable for injection molding, rotational molding and profile extrusion. Products produced include carpet and turf backing, resilient flooring and infill.

Waste to energy is another viable option. Processes have been developed to utilize reclaimed turf as fuel to provide energy for manufacturing operations.

Looking Ahead

The uses for reclaimed turf are as vast as the new technologies being developed to allow for higher end uses than ever thought possible before. The members of the Synthetic Turf Council plan to lead in this effort to develop better and more environmentally friendly options for the second life of synthetic turf surfaces.

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