RECYCLING RUBBER PRODUCTS
Who We Are?

Bee’ah is the leading and award-winning fully integrated environmental company in the Middle East. Headquartered in Sharjah, in the United Arab Emirates, the company is a Public Private Partnership company (PPP) and was founded in 2007 under an Emiri Decree as Sharjah Environment Company (Beeah) LLC with a mandate to tackle and resolve the environmental and waste challenges across the Middle East region.

Through its waste management divisions and adopting international best practices, Bee’ah is providing a full range of environmental services to its customers with a “promise” to contribute and make a positive difference to Sharjah and the UAE’s environment. The company is steadfast to investing in innovative technology and servicing its clients, ensuring expertise is utilized within the waste management industry.

With a clear vision, a commitment to performance, excellence and a passion for the future, Bee’ah is committed to building partnerships with key entities who share the common goal of preserving the environment, and creating what is an essential step forward to grow and achieve sustainability excellence.
Bee‘ah offers a diverse portfolio of recycled rubber products, manufactured completely in the UAE by Bee‘ah, for various uses and applications without sacrificing the health of the environment. Each year, Bee‘ah recycles millions of pounds of scrap tyres, thus saving millions in raw materials and ensuring that these tyres are kept out of the landfill. Supplying sustainable and responsible selections to the industry has been a way forward for the organization, making it easy to design and apply responsibly.
World leading technology

Bee’ah’s world-class Tyre Recycling Facility uses state of the art environmentally-friendly cryogenic processes to recycle used tyres into crumb rubber and crumb rubber tiles which can be used for different applications and flooring products.

The cryogenic process uses liquid nitrogen to flash freeze the tyres at minus -196 degrees Celsius, which become brittle and broken down like glass, by cracker mills, into crumb granules varying between less than 0.5 and 4 mm. The average process time is 40 minutes, from the start with a whole tyre to the finished product.

Mega tyres used in industrial and construction vehicles can be processed at the TRF by employing an oversize tyre reduction system (OTR) to take the very large tyres and break them down so that they can be fed into the shredder. Steel-belt radial tyres have the steel threads removed and the latter is sold as recycled material – the tyre then goes through the breakdown process as any other tyre.

When applied to running tracks, the rubber-modified surface absorbs most of the impact thus preventing strain on the body. Rubber tiles are suitable for both indoor and outdoor application, where impact reduction, proper access and safety are required.
While the majority of the competition uses a loose and spongy all ambient rubber system, Bee’ah only incorporates a patented and premium cryogenic rubber recycling process to guarantee its customers that the highest quality materials are used in order to assure consistent and reliable results.

Cryogenic rubber is the highest and rarest grade of rubber granule that is when a rubber tyre is ground up, approximately only 4% of that tyre is suitable for cryogenic rubber processing while the remaining 96% is set aside for ambient processing. Due to the limited supply of cryogenic rubber the product is not easily obtainable. Bee’ah however, has gone to great lengths in order to secure large quantities of this rare, high quality product.

The process

During the grinding phase ambient rubber is simply processed through a high powered rubber cracker mill. The result is a jagged inconsistent rubber granule which has the tendency to degrade rapidly over time. When used as an infill component, ambient rubber has the propensity to float and scatter as the air bubbles located within the rubber facilitate simple infill migration. The process of grinding the rubber is referred to as ambient because all size reduction steps take place at or near ambient temperatures, i.e. no cooling is applied to make the rubber brittle before grinding.

First, a rubber tyre is grinded through a mill, then the smooth clean particles are separated from the dirty jagged ambient ones. Once separated, the rubber is then frozen to a temperature of below –80 degrees Celsius (-112 degrees Fahrenheit). Cryogenically freezing the rubber allows for a cleaner more glass-like partition of the rubber. While the rubber is still frozen it is placed through a specialized mill which then carefully and cleanly cuts the frozen rubber into small, smooth and rounded particles. The cryogenic freezing process also helps to prevent the formation of any loose or stray rubber strands which reduce the overall quality of the rubber.
Drainage qualities

When it comes to the topic of drainage, Cryogenic rubber works to promote effective and consistent drainage by eliminating the potential for migration caused by water. The cryogenic rubber’s smooth and rounded shape facilitates a consistent flow of water without raising and displacing any rubber. The loose and jagged rubber strands found in ambient rubber make it highly vulnerable to migration and floatation caused by the air bubbles in water. Even though the specific gravity of ground rubber is about 1.14 (slightly heavier than water) if there are enough air bubbles attached to the rubber, it will float. As the ambient system drains, the rubber floats and is easily dispersed. As a result, empty pockets may form which can be extremely hazardous.

Ambient rubber (on the left) compared to Cryogenic rubber (on the right) as it responds to water.
Cleanliness

When it comes to cleanliness and safety Bee’ah only uses cryogenic recycled rubber throughout its products. There is a substantial difference in the cleanliness levels of cryogenic rubber versus ambient rubber. Ambient rubber is mass produced and does not require a great deal of manipulation to create.

As a result the granules of ambient rubber which have been torn and shredded from a rubber tyre contain many particles besides rubber. While cryogenic rubber consists of rounded, smooth pieces of rubber, ambient rubber contains traces of dirt, steel and other metals which were not removed in the grinding process.

On the left - Ambient rubber with jagged edges. On the right - Cryogenic rubber is smooth and rounded.
# Characteristics of Ambient and Cryogenic Processes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ambient</th>
<th>Cryogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>Max. 120° C</td>
<td>Below - 80° C</td>
</tr>
<tr>
<td>Size reduction principle</td>
<td>Cutting, tearing, shearing</td>
<td>Braking cryogenically ambrittled rubber pieces</td>
</tr>
<tr>
<td>Particle morphology</td>
<td>Spongy and rough, high specific surface</td>
<td>Even and smooth, low specific surface</td>
</tr>
<tr>
<td>Particle size distribution</td>
<td>Relatively narrow particle size distribution only limited size reduction per grinding step</td>
<td>Wide particle size distribution (ranging 10mm to 0.2 mm) in just one processing step</td>
</tr>
<tr>
<td>Maintenance cost</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Electricity consumption</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>LN2 consumption</td>
<td>N/A</td>
<td>1.0 - 0.5 kg LN2 per kg tyre input</td>
</tr>
</tbody>
</table>
Rubber Recycling
Products
Recycled tyres

Recycled tyres have many uses and applications, and at Bee’ah, we make it our responsibility to turn them into valuable products for re-use in our economy. This has always been our priority and we are constantly finding new and exciting ways to use recycled tyres through creative thinking and proper waste management.

Discarded and scrap tyres consume valuable land space, act as a fire hazard, and when co-mingled with garbage, provide a habitat for mosquitoes, rats and other vermin. Thus, we invested in a state-of-the-art tyre recycling facility which turns used and worn out tyres into a sustainable rubber product which can positively serve the community.

Products

Products derived from recycled tyres include crumb rubber, rubber mulch, crumb rubber tiles and pavers (manufactured from the crumb rubber), molded rubber products and rubberised asphalt.

These can be used in flooring applications such as running tracks, grass-surfaced playing areas, stadium playing areas, miniature golf courses and in artificial turf infill in local schools, parks, athletic facilities and equestrian arenas.

Recycled rubber may also be used in landscaping and gardens, interior decorations and even for urban infrastructure and communities in new roads, signs and car parks.
Facts & Figures

- 1 Recycled tyre can be converted into 3 flooring tiles.

- 1 scrap tyre delivers around 6.5 kg of steel-free crumb rubber.

- To cover an area of 1 square meter, requires 22 hexagonal tiles, 36 F shape tiles or 4 square shaped tiles. This means at least 7 recycled tires are required to cover 1 square meter.

- 1 tonne of crumb rubber (around 145 tyres) produces around 500 tiles, covering an area of 23 square metres.

- About 7 tonnes of crumb rubber are required for a 1km-long, 50 mm thick, single lane asphalt rubber road – thus around 1050 tyres are needed for a 1km-long single lane driving surface.
Other benefits of this product are:

- Safer playing surface
- Reduces mud spots
- Prevents bare spots
- Extends lawn growing season
- Reduces soil compaction
- Metal free
- Environmentally friendly
- Fiber free

Use / Applications

Crumb rubber is used mainly in running tracks, grass-surfaced playing areas, stadium playing areas, miniature golf courses and in artificial turf infill.

Benefits

Adding crumb rubber to sports surfaces provides two main benefits: Increased safety and performance enhancement. When applied to running tracks, the rubber modified surface absorbs most of the impact thus preventing strain on the body.
### Chemical and physical properties of Bee’ah crumb rubber:

<table>
<thead>
<tr>
<th>Appearance and odor</th>
<th>Black granules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity</td>
<td>0.03 -/+ 1.14</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>700° F</td>
</tr>
<tr>
<td>Flashpoint (COC)</td>
<td>475° F</td>
</tr>
<tr>
<td>Stability</td>
<td>Stable</td>
</tr>
<tr>
<td>Solubility in water</td>
<td>Nil</td>
</tr>
<tr>
<td>Wt. % volatile</td>
<td>&lt; 1% primarily water</td>
</tr>
<tr>
<td>Hazardous polymerization: (PVC)</td>
<td>Poly vinyly chloride</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
</tbody>
</table>
Tests conducted on crumb rubber products prove an improved ergonomic support system on personal safety and health, with decreased injuries and enhanced risk management.

<table>
<thead>
<tr>
<th>Crumb rubber sizes</th>
<th>5-10 mesh</th>
<th>2mm-4mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14 mesh</td>
<td></td>
<td>1mm-2mm</td>
</tr>
<tr>
<td>10-30 mesh</td>
<td></td>
<td>0.5mm-2mm</td>
</tr>
<tr>
<td>14-30 mesh</td>
<td></td>
<td>0.5mm-0.8 mm</td>
</tr>
<tr>
<td>Minus 30 mesh</td>
<td></td>
<td>less than 0.5 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>Recycled product</th>
<th>Wheelchair Acceddible</th>
<th>Maintenance needed</th>
<th>Choking hazard</th>
<th>Cast effective</th>
<th>Long term cast</th>
<th>Installation cast</th>
<th>Manuf. Warranty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bee’ah safety Surfacing</td>
<td>Yes</td>
<td>Yes</td>
<td>Very low</td>
<td>No</td>
<td>High</td>
<td>Very low</td>
<td>Low</td>
<td>5 years</td>
</tr>
<tr>
<td>Pea Gravel</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Wood Fiber</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>Yes</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Yes</td>
</tr>
<tr>
<td>Poured in Place</td>
<td>Maybe</td>
<td>Yes</td>
<td>Medium</td>
<td>Yes</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
</tr>
<tr>
<td>Rubber Mats</td>
<td>Maybe</td>
<td>Yes</td>
<td>Low</td>
<td>No</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
</tr>
<tr>
<td>Sand</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>No</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Shredded Rubber</td>
<td>Yes</td>
<td>No</td>
<td>High</td>
<td>Yes</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Conditional</td>
</tr>
<tr>
<td>Wood Chips</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>Yes</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>
With these most comparative ratings, Bee’ah’s products and designs provide a cushioned and resilient support system that ensures superior durability and physical comfort.

The advantages of crumb rubber

Good for the environment:
Made of 100% recycled rubber from used vehicle tyres. It is estimated that in the emirate of Sharjah 1.4 million tyres are thrown out in a single year, thus Bee’ah recycles all types of tyres, from motorcycles through to tractor tyres. The main purpose for recycling used tyres is to alleviate the landfill from its large volumes and space.

Exceeds normal product standards:
Due to its resilience and durability as a material, crumb rubber is used in various flooring applications such as jogging tracks, athletic fields and golf courses. The drive behind using this material in athletic arenas is the fact that it has many benefits for athletes, namely increased safety and enhanced performance.
Jogging Track Surfaces & Fitness Trails

Bee’ah’s recycled rubber can be adapted into the creation of walking and jogging tracks for indoor or outdoor use in parks, gymnasiums, athletic fields and sports centers. The 100% recycled crumb rubber is mixed with 100% polyurethane binder to create an athletic surface. The rubber jogging surface allows for an incredibly comfortable «cushion like» surface that’s easier on the legs and knees which makes it more preferred by all players and athletes.
Benefits:

- Seamless
- Drains Quick
- Easy to Maintain
- Proven Durability
- Materials are made from 100% recycled rubber in the UAE
- Free of steel and fiber.
Football Fields
The new generation of artificial turf athletic fields often contains crumb rubber infill made from recycled tires. Crumb rubber infill serves as an artificial soil, supporting the artificial blades of grass, softening the surface, improving drainage, and helping to provide a high-quality playing surface for a variety of sports. However, tyre rubber is a complex material, containing many naturally-occurring and man-made chemicals. Crumb rubber made from recycled tyres has the potential to release a variety of chemicals and particles into the air. It also represents a potential site of bacterial growth and transmission to athletes using the fields (including methicillin-resistant Staphylococcus aureus, MRSA). Therefore, OEHHA has evaluated the following aspects of artificial turf safety for fields constructed with recycled crumb rubber infill.

**Introduction**

**Turf advantages**

**Excellent playability**

synthetic turf does not inhibit or deflect the bounce or roll of balls. Traction, rotation and slip resistance, surface abrasion and stability meet the rigorous requirements of the most respected sports leagues and federations.

**All-weather availability**

synthetic turf can be used within hours of installation, in all types of weather. No significant downtime is required in case of rain, drought or other climate conditions. Increased availability equates to higher return on investment for owners, and more practice and skill development for players. Additional questions to be answered are: whether artificial turf can be utilized more per year without the rest that grass fields require, and what the maximum hour of playing time is for the two field types.
Increased playing hours
In most climates, synthetic turf fields can be used 3,000 hours per year over a four-season window, with no damage to the turf. Natural turf fields become unplayable after 680 to 816 hours per year, and are typically available only for three seasons.

Reduced maintenance
Natural turf fields require approximately 70,000 gallons of irrigation water each week, approximately 15 to 20 pounds of fertilizer each year per 1,000 square feet of turf, plus herbicides and pesticides. Synthetic turf maintenance costs are two to three times less than natural turf. No mowing, irrigation or chemicals are required.

Cost-effective investment
Synthetic turf fields are typically warranted for about 3,000 hours of play per year, with no rest required. For schools with sufficient land, it would take three or four natural fields to withstand the usage of one synthetic turf field. Because of its consistent availability, a synthetic turf field is also a reliable source of rental revenue for schools and communities. In addition, the total cost of ownership for fields will be explored, including all of the maintenance resources (water, fertilizer, pesticides, labor, and equipment) needed to upkep a field.

Generally safe application
For most common and typical uses, the materials (e.g. crumb rubber) is a safe alternative to natural materials and landscaping. While the general public is exposed to articles suggesting the need to further assess the material, no conclusive study has proven these materials as unhealthy, nor have high incidences of physical harm occurred from approved and proper uses. Recent issues that have surfaced relate to Carbon Black and Lead, however, for the vast majority of applications, serious physical harm has not occurred from these particulates.

Fewer Injuries
Synthetic turf fields are far more uniform and consistent than the natural turf fields most schools and communities are able to maintain. Also, they are made of resilient materials that provide a level of impact attenuation that is difficult to obtain on hard, over-used natural turf fields. An NCAA study comparing injury rates during the 2003-2004 academic year showed that the injury rate during practice was 4.4% on natural turf and 3.5% on synthetic turf.

Environmentally friendly
Using synthetic turf eliminates the need for water, pesticides, herbicides and fertilizers. The used auto tyre rubber used as infill recycles 25 million used auto tires per year that would otherwise end up in U.S. landfills. The EPA encourages the use of recycled auto tyres for playgrounds, running tracks and sports fields.
Maintenance

The maintenance required, along with the number of playing hours a surface can provide, are key factors in assessing the value that a certain turf type provides. Reduced maintenance is often cited as one of the major benefits for synthetic turf. However, artificial turf does require a minimum level of upkeep. The savings in maintenance are apparent when considering the useful hours that are returned on the cost and time required for maintenance.

Why use cryogenic rubber

There are several factors which contribute to the safety and performance characteristics of an artificial turf field. None of which are more important than the composition and quality of the infill. The infill is the athlete’s source for cutting, planting, shock absorption and energy restitution.

While the majority of the competition uses a loose and spongy all ambient rubber system, Field Turf only incorporates a patented layered infill system that is comprised of silica sand and premium cryogenic rubber. When it comes to a field’s infill, Field Turf goes to great lengths to guarantee its customers that nothing but the highest quality materials are used in order to assure consistent and reliable results. Cryogenic rubber is the highest and rarest grade of rubber granule.

When you grind up a rubber tyre approximately only 4% of that tyre is suitable for cryogenic rubber processing while the remaining 96% is set aside for ambient processing. Due to the limited supply of cryogenic rubber the product is not easily obtainable. Field Turf however, has gone to great lengths in order to secure large quantities of this rare, high quality product. During the grinding phase ambient rubber is simply processed through a high powered rubber cracker mill. The result is a jagged inconsistent rubber granule which has the tendency to degrade rapidly over time. When used as an infill component, ambient rubber has the propensity to float and scatter as the air bubbles located within the rubber facilitate simple infill migration. The process of grinding the rubber is referred to as ambient because all size reduction steps take place at or near ambient temperatures, i.e. no cooling is applied to make the rubber brittle before grinding.

The process of creating a cryogenic rubber granule requires a substantial amount of time and technical manipulation. First, a rubber tyre is grinded through a mill. Then the smooth clean particles are separated from the dirty jagged ambient ones. Once separated, the rubber is then frozen to a temperature of below –80 degrees Celsius (–112 degrees Fahrenheit). Cryogenically freezing the rubber allows for a cleaner more glass-like.

While the rubber is still frozen it is placed through a specialized mill which then carefully and cleanly cuts the frozen rubber into small, smooth and rounded particles.
The cryogenic freezing process also helps to prevent the formation of any loose or stray rubber strands which reduce the overall quality of the rubber. When it comes to the topic of drainage, Cryogenic rubber works to promote effective and consistent drainage by eliminating the potential for migration caused by water. The cryogenic rubber’s smooth and rounded shape facilitates a consistent flow of water through the infill without raising and displacing any rubber. The loose and jagged rubber strands found in ambient rubber make it highly vulnerable to migration and floatation caused by the air bubbles in water. Even though the specific Gravity of ground rubber is about 1.14 (slightly heavier than water) if there are enough air bubbles attached to the rubber, it will float. As the ambient system drains, the rubber floats and is easily dispersed. As a result, empty pockets may form which can be extremely hazardous to the athlete. More clearly depicts the difference and discrepancy between ambient and cryogenic rubber as it reacts to water. The glass on the left consists of ambient rubber while the glass on the right consists of cryogenic

When mixed with water the ambient rubber proved to be highly susceptible to migration as it floated easily to the surface of the glass. The cryogenic rubber on the other hand, was able to maintain its composure and position even in the presence of water. Another benefit of cryogenic rubber revolves around its ability to effectively combine with silica sand. Sand is an integral component to the infill mix as it facilitates proper energy restitution. Without sand the infill tends to be overly soft to the point where excessive amounts of energy are needlessly expended. Using the analogy of running on the beach, an all rubber system can be compared to running in the loose and tiring soft sand, whereas FieldTurf’s sand and cryogenic rubber system can be compared to running along the shore line. The round and consistent shape of the cryogenic rubber assures that the silica sand and cryogenic rubber synthesize in a way that promotes consistency within the infill. By essentially playing off one another, the silica sand and cryogenic rubber come together to form a solid bond. It is that bond which holds the field’s fibers firmly in place while offering a safe cushion for the athlete’s body, joints and muscles. Ambient rubber’s largely inconsistent size does not allow it to smoothly combine with sand. As a result, the sand and rubber which may be situated within the field can easily shift and disperse when played on.

When it comes to cleanliness and safety FieldTurf doesn’t take chances, which is why FieldTurf fields are only installed with cryogenic rubber. There is a substantial difference in the cleanliness levels of cryogenic rubber

Ambient rubber is mass produced and doesn’t require a great deal of manipulation to create. As a result the granules of ambient rubber which have been torn and shredded from a rubber tyre contain many particles besides rubber. While cryogenic rubber consists of rounded, smooth pieces of rubber, ambient rubber contains traces of dirt, steel and other metals which were not removed in the grinding process. The following images are of ambient and cryogenic rubber as seen through a microscope.
Bee’ah produces recycled rubber mulch in a variety of sizes (between 10mm to 32mm) and colours for use in landscaping around shrubs, walkways etc. as well as a landscape paver system for manufacturing complete pavers for walkways, garden patios, and driveways. Also available as a chip, providing highly realistic and longer lasting alternative to organic bark or woodchip, and can be laid loose or bonded.
Equine applications:

Mixed with sand, rubber mulch gives horse arenas optimum traction and shock absorption, hence reduces strain on horses.

Benefits:

• Strong, secure and dust free
• Minimizes injuries
• Reduces dirt and dust in outdoor and indoor arenas
• Reduces maintenance
• Environmentally friendly

Available Rubber Mulch Colours:

- Black
- Terra Cotta Red
- Brown
- Blue
- Green
Landscaping applications:
Can be used for decorative purposes in private gardens, parks and playgrounds.

Playgrounds:
Playground areas can be made safe with rubber mulch flooring. With its advanced shock absorption capacity playgrounds can become a safer and cleaner place for children.

Gardens:
Rubber mulch can be placed in gardens to prevent it from termite and carpenter ant attacks. The rubber mulch also holds an advantage over other materials, as it does not get washed away in the rain.

Landscaping:
Rubber mulches come in different colors and shapes. They can be used to beautify interiors and even outdoor areas. The average depth of rubber mulch in landscaping and gardens varies between 2 to 3 inches.

Athletic arenas:
Being considered as the safest and sturdiest flooring material, crumb rubber mulch is used in flooring of the athletic areas so that not much injury is caused to the athletes.

Benefits:
- Ideal alternative to decorative gravel.
- Can be used for indoor or outdoor applications.
- Ensures and retains moisture for live plants, and protects erosion of the soil.
- Reduces fungus growth.
- Will not rot or blow away. No need for annual replacement.
- Does not absorb water, does not attract animals and insects.
- Dries quickly yet retains soil moisture during dry weather.
- Resists compaction in high wear areas.
- Odor less.
Bee’ah has acquired a colored rubber mulch production system, this system takes the 2 inch shreds and reduces them to a mulch size of 10 mm to 32 mm. There are five main operations in the recycled rubber mulch system; these are:

**Granulation:**
The shreds are processed through a large granulator that reduces them in size and at the same time removes most of the steel contained in the rubber shreds.

**Steel rubber removal:**
The granules that come out of the large granulator are processed through two over-belt magnets that remove any rubber that still contains steel.

**Coloring:**
The mulch sized rubber pass through a coloring system in batches (A multitude of colors can be used). It is important to note that nontoxic paint is used in this process.

**Drying:**
The colored rubber mulch goes through a dryer to dry the paint and to avoid the mulch sticking together when bagged.

**Bagging:**
The final product is bagged in 10 kg sized bags or in jumbo bags (1 tonne bags). This system is electrically powered and is capable of generating 6,000 pounds of colored rubber mulch per hour.

The following table shows the results of testing that were conducted by RMD Americas in regards to safety when it comes to the use of rubber mulch in playgrounds:

### Loose mulch performance characteristics

<table>
<thead>
<tr>
<th>Critical Fall Height*</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 feet</td>
<td>Rubber Mulch</td>
</tr>
<tr>
<td>12-10 feet</td>
<td>Shredded Tires</td>
</tr>
<tr>
<td>07 feet</td>
<td>Wood Chips</td>
</tr>
<tr>
<td>06 feet</td>
<td>Double Shredded Bark Mulch</td>
</tr>
<tr>
<td>06 feet</td>
<td>Engineered Wood Fibers</td>
</tr>
<tr>
<td>06 feet</td>
<td>Fine Gravel</td>
</tr>
<tr>
<td>05 feet</td>
<td>Course Sand</td>
</tr>
<tr>
<td>05 feet</td>
<td>Medium Gravel</td>
</tr>
</tbody>
</table>
Installation

Landscaping installation

Landscaping is a simple process that almost anyone can manage:

• It is advised to apply a weed barrier first that will secure the best weed prevention results.
• Rinse final applied area with hose at the end of installation to remove any dust accrued during the installation in storage and shipping.
• Install 2” to 4” of rubber mulch that according to the area that needs to be covered.

Playground installation

It is suggested to follow the below recommendations in order to undertake the installation of rubber mulch in playgrounds:

• Install 4” to 6” of rubber mulch based on the area to be covered. Particular attention needs to be paid under swings, slides and elevated play structures. Standards from CPSC and ASTM define these zones as extending six feet around all equipment and two times the height of the top rail of a swing set, in front and to the rear of swings.
• Mulch under swings, slides, and other wear areas must be adjusted periodically to ensure that it stays at the required depth. It is a good idea to have required depth markers on playground equipment supports in high use areas, and to check depth at least weekly.
• A retaining barrier is recommended around the area where rubber mulch is used to contain it.
• Rubber mulch should not be installed over existing hard surfaces like asphalt and concrete.
Horse arena installation

Horse Arena owners regularly mix in rubber mulch with sand or dirt, to ease the stress on horses’ joints and is virtually dust free. The recommended depth that needs to be placed in horse arenas is 1/2 inch of rubber mixed with a 1/2 inch of sand.

Athletic arena installation

The installation of the rubber crumb in sport tracks is a technical process that should be follow:

- The black crumb rubber and polyurethane binding agent are blended together in a suitable mixer for a period of 2 to 3 minutes. The blended materials are then spread onto the asphalt/concrete base by means of a mechanical tandem leveler at a rate of 16 to 16.5 pounds per square yard. The tandem leveler shall have a heated oscillating screed bar to obtain both smoothness and compaction. The heated screed bar normally works at a temperature of 158 to 176 degrees F.

The laying procedure shall be bay-to-bay and limiting the length of the passes so as not to have any cold (cured) joints between the bays. At the beginning of each new day’s work, the traverse joint from the previous day’s work shall be tack coated to ensure a good bond. Small irregularities remaining in the surface after the tandem leveler has passed may be removed using a light polyethylene or Teflon roller.

The surface hardens through the reaction of the binding agent with humidity. The speed of the reaction depends on temperature and relative humidity. Usually the surface may be walked upon the next day.

- After the black mat has properly cured, apply a thixotropic mixture, using red 1-c spray and red EPDM granules*, mixed in a suitable container using a drill and mixing paddle and spray applied using approved air spray equipment designed to handle this heavy rubber mixture.

The structural spray coating is applied in applications utilizing 1.80-pounds per square yard for each application.

*EPDM Granules are rubber granules for the structural spray wearing coats that shall be EPDM peroxide cured, man-made rubber containing a minimum of 20% EPDM and having a specific gravity of 1.5 +/-0.1. The EPDM rubber will be 0.5mm to 1.5mm EPDM granules. EPDM granules shall be of the same color as chosen by the owner for the track surface.
Recycled Rubber Tiles & Pavers

An environmentally-friendly product made from clean recycled rubber, available in a variety of colours, upon orders and can be used in many applications, both indoor and outdoor, such as playgrounds, walkways, sports complex, golf clubs, health-care centers, day care centers, nursing homes, malls, basement floors, horse stables, or can be used for dressing borders and pathways.

Tiles and pavers are laid down according to our client’s needs and designs, by our team of professionals in a number of patterns. Tiles and pavers are provided in two different thicknesses 25mm and 45mm, in the following shapes:

**Shapes and dimensions of recycled rubber tiles**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexagon rubber tile</td>
<td>230x230mm</td>
</tr>
<tr>
<td>Square rubber tile</td>
<td>500x500mm</td>
</tr>
<tr>
<td>Rubber brick</td>
<td>220x110mm</td>
</tr>
<tr>
<td>Toothed rubber brick</td>
<td>220x110mm</td>
</tr>
<tr>
<td>Toothed rubber tile</td>
<td>220x220mm</td>
</tr>
<tr>
<td>Square interlocking tile</td>
<td>500x500mm</td>
</tr>
<tr>
<td>I-shaped interlocking</td>
<td>200x160mm</td>
</tr>
</tbody>
</table>
**Eco-Friendly**

Made from clean recycled rubber. Non-toxic and latex free.

**Exclusive drainage design**

Water drains easily. Children can play right after the rain.

**Color Sample**

- Gray
- Black
- Red
- Green
The advantages of Rubber Tiles & Pavers

Safety
Superior slip resistance and shock absorption qualities, make them the safest alternative flooring product for any high traffic areas, especially in playgrounds, fitness centers, parks and gymnasiums.

Designed for disassembly
Can be installed over a variety of surfaces and if one becomes damaged, there is no need to replace the entire surface, unlike concrete tiles.

Low Maintenance
The crumb rubber tiles are non-toxic and latex-free. They have an exclusive drainage design, allowing for rain water to drain easily, so running tracks and playgrounds can be used right after, without having to wait for the water to dry up; and easily eliminates dirt and mud.

Durability
In the warm climate of the UAE, concrete tiles or wood flooring tend to crack and come apart. However, rubber tiles last longer, are prone to warm weather and can easily be changed, without having to remove the entire flooring system.

Density
Comes in high and bio density, as required by the application.

Warranty
Bee’ah rubber tiles are warrented to be free from manufacturing defects for a periods of 3 years from the date of instalation.
Technical Data

Applicable Testing Standards – American Society for Testing Materials (ASTM)

ASTM F-1951-99 - Determination of Accessibility of Surface Systems under and around Playground Equipment

The average work force per Lbf-in values measured lower when propelling a wheelchair across the rubber tiles, than when propelling it over a flat surface with a grade of 7.1%. The material met the requirements of the ASTM F-1951-99.


- ASTM D395-97 - Compression Set Test: Average Percentage of Compression Set: 7.65%
- ASTM C67-94 - Compressive Strength: Average Compressive Strength: 86 psi
- ASTM D2240-86 – Hardness: Average Hardness (Shore “A” Durometer): 48
- ASTM D2632-88 – Resilience By Vertical Rebound: Average Value: 33

<table>
<thead>
<tr>
<th>Drop Height (at 23°C)</th>
<th>G-Max</th>
<th>HIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ft</td>
<td>128</td>
<td>525</td>
</tr>
<tr>
<td>4 ft</td>
<td>156</td>
<td>799</td>
</tr>
<tr>
<td>5 ft</td>
<td>189</td>
<td>1205</td>
</tr>
</tbody>
</table>

Note: The G-Max and HIC (Head Impact Criteria) for proper Impact Attenuation of Surface Systems under and around Playground Equipment should be below 200 for g-Max and below 1000 for HIC.
Installation

The Bee’ah rubber tiles can be installed on existing surfaces such as concrete or asphalt. In addition, the rubber tiles can be installed over aggregate material as per the manufacturer’s instructions. Their installation is very easy because of the way they are designed; they do not need skilled labor for that purpose. Any contractor who worked with the conventional clay interlocking tiles can easily do the job.

The recommended installation procedure is as follows:

1. Start by excavating the topsoil 7” to 9” below the finished walkway or playground level.
2. Fill in 4” of clean stone or sub base (1/4” to 3/4” size) and compact till level is flat. Wet compaction is recommended.
3. Cover the sub base with 1” to 3” of sand for the tiles to be placed on.
4. It is recommended that the center of the area which needs to be covered by the tiles is where the first tile is placed.
5. Tiles need to be carefully laid around the center until the edge. Then the tiles need to be cut to size to fill in the remainder of the area. Tiles can be cut in halves either point-to-point or flat-to-flat. These halves can be used to make straight edges. (See Figure 2) Tiles may be cut with a slow-revolution band saw for the cut pieces necessary to close the edges and fill in remainder areas

Maintenance and surface recoating

The following coatings can be used for surface maintenance:

- Pittsburgh Paints 3-510 Series (Urethane Modified)
- Sherwin-Williams Armorseal Tread-Plex SW6094
Rubberized Asphalt

In partnership with leading contractors, Bee’ah also offers rubberized asphalt and recycled green roads, which help improve safety, enhance driving and reduce maintenance costs.

Rubberized asphalt is comprised of crumb rubber mixed with asphalt and applied in new roads. This technology is currently used in a number of countries around the world, and has many benefits over existing asphalt – the return on investment alone has resulted in ongoing savings to the cities who have implemented the technology.

Another advantage of asphalt rubber over conventional asphalt is that it creates a safer and longer lasting road system. It decreases the cost of building roads, increases the lifespan to almost double of road surfaces, enhances fraction for cars on road surface and reduces noise generated from passing vehicles. Recycled green roads are useful in the maintenance of roads and are remodeled on-site; whereby a state-of-the-art machine removes the existing road asphalt and road base, mixes it with cement and water, and then reapplies the road in a matter of minutes. This not only saves time in remodeling but also cuts maintenance expenses.
For more information & pricing, please contact us:

By calling
800 BEEAH (800 23324)
or 0097165729000

By email:
sales@beeah.ae