

Long pile artificial turf systems, also referred to as 'third generation' have made themselves a truly viable reality for a variety of sports, including soccer and rugby — it is essential that these systems provide good shock absorption and energy restitution.



Today's users of modern artificial turf systems are more demanding than ever, with the attributes and characteristics required having evolved with the uses and roles it is expected to fulfil.

Long pile artificial turf systems, also referred to as 'third generation' have made themselves a truly viable reality for a variety of new sports, including soccer and rugby, despite their differing requirements. Where artificial turf for hockey, an early adopter of the system, used to focus on the flatness of the field and reduced maintenance costs, third generation artificial turf systems deal with a new and much more complicated issue; the health and well-being of the players. Good shock absorption and energy restitution of the field is therefore essential.

Greater Need for Comfort

Tackles, jumping and diving are part and parcel of both soccer and rugby, unlike in the cases of hockey, tennis or golf. Tackles are surprise events that do not allow a player to brace or prepare for direct and sudden contact with the playing surface, meaning that impact can be devastating, with injuries or chronic pain being responsible for keeping players on the sidelines. This can cause teams to lose championships in the case of the professional game and companies to be temporarily deprived of an employee in the case of amateur sport.

Several European studies, such as the 2002 study entitled "Economic impact of injuries", which was

The Dow Chemical Company discusses the importance of shock absorbency in Artificial Turf systems.

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published by Linköping University Sweden, have estimated the impact of injured athletes on the economy is worth billions of euro annually. This is supported by Jiri Dvorak, FIFA chief medical officer and chair person of the FIFA medical assessment and research centre, who said at a recent press event: "Every weekend there are probably millions and millions of people playing football. The impact is enormous. Preventing injuries is crucial. Reducing football injuries by just 10% would save astronomical amounts — enough money to fund the FIFA World Cup structure every year."

Infill material and shock-pads (or e-layers) are increasingly used to contribute to the performance of the shock absorption and energy restitution on a field. This is of particular importance, as Jill Martin, a Senior Development Engineer at The Dow Chemical Company, outlined: "A field that has a shock absorption and energy restitution that are not well-balanced can cause discomfort for the player. These fields might be characterised as 'dead', with players having the impression they are playing on a field that consists of wet sand. At the end of the game they might feel tired and their legs can hurt."

A Different Approach

The concept of shock absorption can be considered from two angles; the first is the ability of the shock absorbing layer to be compressed such that the players' joints are not negatively impacted. The second is the

Right & next page: Specially manufactured infill materials — i.e. TPEs and TPVs — for artificial turf systems can be accomplished using extrusion and compounding processes. However, it is the screening of the final material that requires a connection between the end-use performance requirements and the attributes, which can be tailored, including the formulation and resin design. Additives, such as anti-static agents for example, can be included to supply material in different colours for aesthetic and climatic reasons or to make them flame retardant.

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spring-back or energy restitution that prevents the feeling associated with playing on wet sand. Although a system that is too soft can result in early leg fatigue and slower ball play.

Making the correct decision when selecting the components for a field is therefore essential, as Martin advised: "Efficient shock absorption and energy restitution requires the selection of the correct type of infill and a balanced amount of infill used. In addition to that, it can be balanced with the use of a shock pad."

One-Stop Shop

Dow manufactures various materials for use as infill material or as a shock pad. The company has in fact been developing elastomers for a wide variety of markets for almost twenty years. Quite often, the implementation of these materials depends upon their elastic performance, which is measured by hysteresis, compression set, and recovery.

"For use in third generation artificial turf fields, we produce thermoplastic elastomers (TPEs) and thermoplastic vulcanisates (TPVs) and an elastomer-coated sand," Martin confirmed.

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which can be tailored, including the formulation and resin design. Additives, such as anti-static agents for example, can be included to supply material in different colours for aesthetic and climatic reasons or to make them flame retardant. Anti-statics can also be added to facilitate the installation of the materials by reducing the tendencies to cling to other surfaces.

Specially manufactured infill material maintain their flexibility better over the long term, as Martin explained: "These rubbers are composed of molecular networks which act very much like springs. The amount of resiliency is directly related to the amount of 'springs' or networks in the material. Because the connections between the molecules can be permanent, the infill materials are thermally more stable, which adds to their durability and abrasion resistance."

“Eventually an artificial turf field needs to be replaced, something today's systems require every eight to ten years, depending on the intensity of use and maintenance. But shock pads could be used in two or even three installations, making their lifespan between twenty-five and thirty years...”

— Jill Martin, The Dow Chemical Company.

The fact that TPEs and TPVs are specially produced also allows for the development of specific dimensions and shapes, something that should contribute to the performance and durability of the field.

Hidden but Important

A second element that contributes to the shock absorption and energy restitution of a field is the shock pad. As this layer lies underneath all of the visible layers of the field, selecting the best option here is even more essential, as it is impossible to have it replaced cheaply should a field not perform.

“The transference of the force from players walking or running across the field to the shock pad is significant and depends on a number of factors, including pile height and density, and infill height and composition. Based on the number of design variables, it is clear that an understanding of the component performance and

contribution is critical to achieving a high-performing field,” Martin confirmed.

Polyurethane binders and polyolefin solutions are central to Dow's shock absorption materials, which can be blended and adjusted to help provide the right amount of ‘give’ to address the specific needs of the players. Shock pads must also be weather resistant, should not rot, should not become brittle or harden over time, should be reusable when the artificial turf material must be replaced, provide uniformity in density, provide shock attenuation, and have a high level of elasticity for additional cushioning comfort. These attributes need to be maintained in all conditions of play for the lifetime of the field.

Martin further advised: “Eventually an artificial turf field needs to be replaced, something today's systems require every eight to ten years, depending on the intensity of use and maintenance. But shock pads could

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The increase in the use of a shock pad or e-layer has led to an increase in the number of available options. In the early days of turf, polyurethane foam was attached directly to the back of the carpet during manufacture. Today this embodiment is still used but is primarily found in the field hockey market, where shorter piles are used and infill cannot be added for improving shock absorbency. Additional alternatives include: an in-situ

pad, which is made from SBR (Styrene-Butadiene Rubber) and a polyurethane binder; a modular pad, which is manufactured in small sheets and then assembled on the field; or a roll pad, which is usually the same width as the turf carpet and can be unrolled on the field.

Lab Testing for Performance Predictions

With soccer being one of the biggest global sports, its international governing body Fédération Internationale de Football Association (FIFA) has developed quality standards that an artificial turf system for the professional game must meet. These criteria are described in the FIFA Quality Concept handbook and they are set ➤

Perfect Balance between Performance and Environment

Historically non-recyclable infill was a significant deterrent for the use of artificial pitches due to environmental concerns, particularly in regions such as Scandinavia, however since the enhanced infill technology of late, which has led to the ever increasing acceptance of artificial turf, some fifteen soccer pitches free of ground-used tyre rubber have been installed in the Nordic region, and orders for nine more have been placed.

Recyclable thermoplastic elastomers (TPE) infill solutions are increasingly gaining

market acceptance and the trend towards eco-friendly pitches is set to continue. It is expected that 50% of artificial turf installations in this region will be without used tyre rubber infill within two years.

With its complementary and closely integrated portfolio of materials and technologies, Dow's Artificial Turf Solutions is well positioned to help its partners develop sustainable solutions, using prime raw materials that are recyclable and strike a balance between price and performance. Working with infill manufacturer GoldenPlast and pitch installer Unisport has resulted in the delivery of a new, environmentally-friendly, state-of-the-art artificial pitch for the municipality of Sölvesborg, in Sweden. This latest installation is being used as a training pitch by two local teams, Mjällby AIF and

Sölvesborgs GIF Football Club, both of whom currently play in the first and second divisions of the Swedish Football League respectively.

Meeting the Challenge

The challenge facing the municipality of Sölvesborg was threefold. Firstly, to replace its sand pitch with a surface that would allow winter training on surfaces similar to the one used in the summer and still increase its usage rate in the warmer months without compromising performance. Secondly, to install an environmentally-friendly pitch, given the trend in Sweden towards solutions free of ground used tyre rubber. Thirdly, the new pitch needed to be very cost effective. These were the challenges that market leading installer Unisport did not hesitate to take on, confident of delivering a suitable solution.

With more than fifteen years' experience in installing artificial turf surfaces in Scandinavia, Swedish-based Unisport realised that Sölvesborg's all-season playing requirements meant they would have to propose a pitch offering excellent

Runplast® offers excellent characteristics for use as infill material on artificial sports surfaces: it delivers good shock absorption and ball roll behaviour; is dust and odour free; has a highly uniform round granule shape; offers attractive colour options; is durable, UV and ozone stable; is non-toxic and non-allergenic; and is inert and non-reactive in close contact with polypropylene (PP) and polyethylene (PE).

performance in terms of temperature resistance (in both the summer and winter), as well as softness, elasticity and shock absorption. Operating in one of the most environmentally-friendly regions in the world, Unisport also knew that an environmentally compliant infill would be a crucial aspect. With this in mind, they turned to GoldenPlast.

GoldenPlast is a young and dynamic company that produces thermoplastic compounds primarily used in applications for footwear and infill for artificial sports surfaces. The company's flagship infill product, Runplast®, offers high performance at a competitive price and is based on the ENGAGE™ Polyolefin Elastomers produced by Dow. GoldenPlast was able to engineer the product's exceptional mechanical and physical properties by taking advantage of the high molecular weight, processing ease and elasticity offered by the ENGAGE™ Polyolefin Elastomers. The result is that Runplast® offers excellent characteristics for use as infill material on artificial sports surfaces: it delivers good shock absorption and ball roll behaviour; is dust and odour free (increasing player comfort); has a highly uniform round granule shape (making it very safe for players to slide and tackle on); offers attractive colour options (a key attribute for being compatible with the needs of broadcasters and spectators); is durable, UV and ozone stable; is non-toxic and non-allergenic; and is inert and non-reactive in close contact with polypropylene (PP) and polyethylene (PE).

Standard Bearer

In testing carried out by independent sports institutes and universities (see box: 'ISA Sport's Conclusions' on p112), Runplast® TPE granules demonstrated exceptional resistance to extreme temperatures, severe weather conditions and aging. Most importantly, Runplast® meets environmental requirements according to official DIN standards, is compliant with FIFA 2-Star guidelines, and can be recycled after use. On the strength of these characteristics, Unisport has used Runplast® on numerous pitches installed in

Scandinavia this season, and the company's cooperation with GoldenPlast is set to continue over the coming years.

Gianni Perozzi, Technical Manager at GoldenPlast Spa, advised: "TPE infill materials have been in development for five years and we have experimented with EPDM, SEBS and Polyolefin as the elastomer carrier. However, it was when we combined ENGAGE™ Polyolefin Elastomers from Dow that we really achieved the required results. It has the benefit of providing the required temperature resistance, while remaining a thermoplastic material that is fully recyclable. We feel we now have the perfect balance between performance and cost necessary to gain market acceptance versus our competitors."

This feeling is echoed by GoldenPlast's key customer, Joachim Gabriellsson, Sales Director for Unisport: "The development of Runplast® is good news for installers as we have already found it to have extremely good mechanical and physical properties, as well as having low weight, and round granule size. We have found the drainage of the material to be excellent and the fact it is non-compacting means that it also stays in place in the monofilament, which in turn equals better playing characteristics for the players. Overall in terms of quality and price, it is very competitive."

Enrique Torres of R&D at Dow concurred: "Runplast® represents a technological evolution and performance improvement compared to other infills available today. The density of Runplast® TPE infill means it is less easily lifted from the surface during play; its softness and uniform roundness makes sliding safer for players; it does not have an unpleasant odour; and its range of colours means it can be used in any type of sports surface. And the fact that it is recyclable makes it an excellent choice in the context of increasing environmental pressure on suppliers."

The benefits are also clear for the municipality of Sölvesborg. The maintenance costs compared with natural turf are considerably lower: fewer labour hours, fewer machine hours, less use of chemicals and dressing materials. Lasse

Wahlqvist, Field Maintenance Manager, confirmed: "In the summer, you only have to dress the surface once or twice a week, check the levels of infill in the pitch a couple of times a year. You may need to blow or brush the pitch to remove snow or leaves, but all in all it's very little work compared to a natural pitch. As we had problems making extensive use of our natural turf, we had a sand pitch for use during the winter season before Unisport installed our new artificial surface. Now, we can use the pitch all year around and are able to offer more training to more teams than we could ever imagine before. The pitch is now being used an average of four hours per day, all year round."



The Municipality of Sölvesborg wanted a cost-effective, environmentally-friendly, artificial turf field that they could use all year round — thanks to Unisport, GoldenPlast and Dow, they now have this.

TM: TRADEMARK OF THE DOW CHEMICAL COMPANY ("DOW") OR AN AFFILIATED COMPANY OF DOW.

®: RUNPLAST IS A REGISTERED TRADEMARK OF GOLDENPLAST S.P.A.



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ISA Sport's Conclusions

GoldenPlast S.p.a. asked ISA Sport to test the suitability of the Runplast® rubber granulates infill for use on artificial soccer pitches. The following characteristics were examined: specific weight, granulate size, granulate composition, resistance to continuous load, abrasion resistance, colour, flammability, smell and environmental compatibility. Runplast® was subjected to a climatic simulation including exposure to UV light, moisture and temperature changes to simulate a period of five years of use of the infill material. After the simulation resistance to abrasion, continuous load and colour were examined again.

ISA Sport concluded that Runplast® is suitable for use as infill material in artificial turf constructions. Measurements after the climatic simulation showed no significant changes in the infill, demonstrating good climatic resistance, and the infill met all requirements for toxicity and heavy metals content, thus showing environmental compatibility.

Runplast® passed the ISA Sport tests with flying colours — a clear endorsement for this technology, jointly developed by GoldenPlast and Dow. For further information, please visit: www.isa-sport.com

ISA Sport — the Institute for Sports Facilities — carries out continuous research and testing into all aspects of sports facilities to ensure that they are of good quality, durable and safe. The ISA Sport materials testing laboratory has been approved by FIFA and UEFA to carry out lab testing of artificial surfaces used in soccer.

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out to protect clubs from having poor quality fields installed or installations that do not meet the standards in the longer term. The Union of European Football Associations (UEFA) has also adopted the same standards, as has the International Rugby Board (IRB) for artificial turf systems for rugby.

The key performance measure of the field is the shock absorption, as determined by the methods described in the FIFA Quality Concept handbook. Typical specifications for infill installed on a field speak to the particle size and size distribution, but the actual performance of the infill is not covered by a standard, despite the fact it is critical to the foot traction. If the infill has very high elasticity, the force of the shoe causes it to 'pop' from the playing surface. Conversely, a low elasticity will result in player discomfort since there is no energy restitution, or recovery.

Dow uses a procedure common for the solids handling industry to better understand not only the effects of particle size and particle size distribution on performance but also the composition. This technique is known as a ring-shear tester (RST), which calculates the flowability of bulk solids, as well as other properties, such as internal angles of friction, bulk density, attrition properties, and time consolidation.

Predicting Long Term Performance

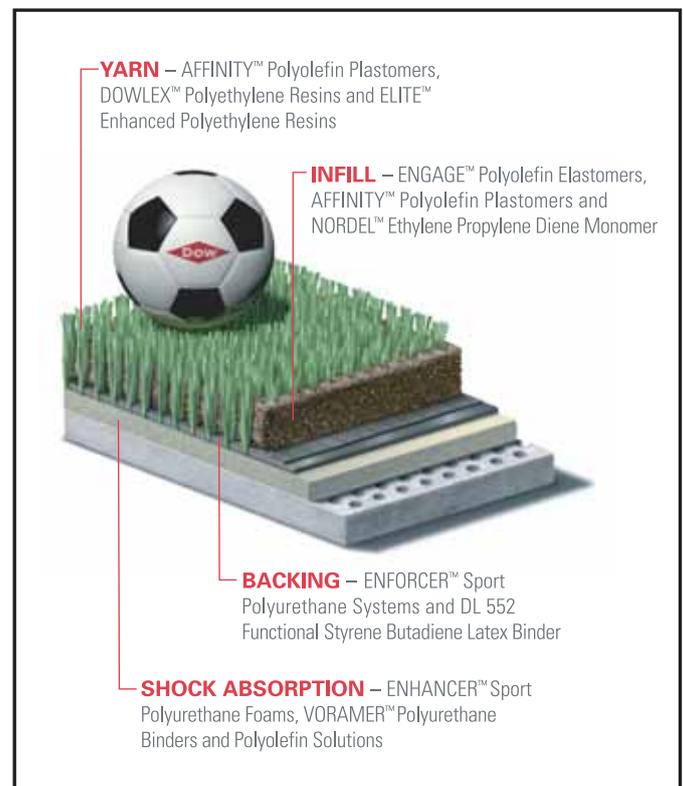
Few of the standards take into account the long-term effects of temperature cycling, the combination of heat and humidity, and the amount of use that the field endures. Therefore, it is necessary to take into account how the individual components' long-term behaviour can affect the system's behaviour. Dow uses cyclic loading or fatigue testing procedures to explore new materials for shock pads and to test the effects of temperature and relative humidity. Current formulations using bound SBR, and recycled polyurethane and polyethylene foams have shown distinct attributes. The long-term performance of these incumbent materials, as well as those based on other polyolefin materials, continue to be explored by these test methods.

Dow has been active in test development methods for elastomers to cover a broad range of applications — many of these can be leveraged for artificial turf to provide screening of new shock absorbent materials, whether it is infill or a shock pad. This helps both the raw material supplier and the builder to better correlate the field performance with the materials used in the manufacturing of the various components. The long-term prediction of this important property, i.e. shock absorption, will eventually lead to the broader acceptance of artificial turf at both community and professional levels. 🌱

References to 'Dow' or the 'Company' mean The Dow Chemical Company and its consolidated subsidiaries unless otherwise expressly noted.



Score big with Dow turf solutions — whether you choose one or all four artificial turf components. Dow's turf team is supporting the development of high-performance products (yarn, infill, backing and shock absorption) that have the end-users in mind. Stay one step ahead of the game with turf solutions from Dow.



■ From one to four, choose the Dow turf solutions that meet your needs.

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