Synthetic Turf Technology Clinic

TTNA Technical Textiles & Nonwoven Association | International Fibre Centre – Supporting Training & Education in Textiles | STA Synthetic Turf Australasia

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Synthetic turf – an Australian manufactured "advanced material" delivering environmental outcomes

On 8th March a broad group of representatives from Australia's synthetic turf and technical textiles industries came together to deliberate a body of research on the specific materials and designs currently used in synthetic turf products to enable more comprehensive information to be distributed to end users and the Australian public.

As part of the Australian Advanced Materials manufacturing sector, the industries recognise the benefits of focussing on strategies and devising improved communications channels within the industry itself, and with external industries, interest groups, government and the broader public specifically on the technical properties of the materials used in manufacturing.

This event was initiated by Ms Kerryn Caulfield, CEO of the Technical Textiles and Nonwoven Association, and speakers included leading composites scientist Dr Floreana Coman and strategy consultant Dr Martin Schlegel, Director of Chemneera Pty Ltd, along with a discussion panel that included Mr David Carpenter, Research & Development Manager for Tapex Pty Ltd; Mr Grant Humphreys, Managing Director of Acousto-Scan Pty Ltd and Dr Schlegel.

Figure 1: Mr David Carpenter, Dr Martin Schlegel and Mr Grant Humphreys

Australia is fortunate to have a sophisticated synthetic turf manufacturing industry and associated supply chain of suppliers and installers; all of which have developed a collective understanding the UV and performances challenges of the Australian climate. David Carpenter said: "The Australian synthetic turf industry produces advanced materials manufactured to provide profound environmental benefits."

To address some of the questions and negative inferences raised by certain media articles in the last few years, Dr Coman presented on the fundamentals of the synthetic turf product - clarifying the actual science that is involved, the manufacturing process and providing an account of the historical development of synthetic turf.

Dr Coman likened this product to a composite, describing it as a Polymer Loose Matrix Composite and an 'advanced material'. 'Composite' refers to a product made up of a mix of materials with particular qualities, made more consistent when a supporting matrix material is added and an intimate to perfect bonding between the elements is created. In the traditional Polymer Matrix Composite (PMC) the reinforcement, in the form of fibres or fabrics, plays the key role as it provides key properties such as strength, stiffness and fatigue resistance.

By association, synthetic turf is made up of similar layers of reinforcement and supporting matrix, but more loosely connected (when compared to traditional composite products). In the case of Polymer Loose Matrix Composites the blades play the role of reinforcement, providing strength, stiffness and fatigue resistance as traditional reinforcement does.

Dr Coman said the “mechanical, physical and thermal properties are anisotropic - or dependent on fibre direction, as well as dependent on the type and amount of the fibres/reinforcement and the type and amount of matrix/backing material”. The basic terms used to describe components of synthetic turf are the: Blades; in-fill; backing mat; shock pad; engineered base (and the lower base of sand/soil).

The blades are made of polyethylene (PE). Polyethylene plastic is an inert material up until 120 degrees Celsius. It will not change form. At the molecular level it is quite simple, made up of six basic atoms of two carbon and four hydrogen (C_2H_4) which link in long chains by polymerisation. Dr Coman said “chains make it very difficult to conduct heat. Lower density PE conducts very little heat, and higher density conducts more”.

“Polyethylene was created in a laboratory ‘accident’ in 1933 when two chemicals were placed together under pressure. Because it is a poor conductor of heat it was first used as an insulator in 1942,” she said. It also has good chemical resistance against basic acids and bases, and is resistant to gentle oxidants and reducing agents. It does not give off any types of gas. These blades are an “inert” substance.

To protect the blades from UV rays an additive is included during extrusion, along with colour pigment. Australia produces and purchases high-grade encapsulated colour pigment, which contains no heavy metals.

“In over 40 years there has never been an instance of human illness or environmental damage caused by synthetic turf. Although it is an inert substance, as a precautionary measure very cheap imported turf should be tested to check for any trace of metals.” Dr Coman said.

Also in the past, certain manufacturers overseas provided no UV additives, and extruded at temperatures in excess of 200 degrees Celsius, ensuring the product would rapidly perish. Polyethylene is a safe recyclable plastic (1) that is also used in food handling and for medical applications/storage.

The proliferation of the blades improves the product, and is measured in Denier (or Tex) for yarn linear density. (Denier is grams / 9,000m of the yarn, and Tex is grams / 1,000m of the yarn.) Blade extruders understand all the scientific properties of: Molecular weight; melt rheological characterisation; thermal analysis (shape change); density determination, cross-linking analysis and mechanical properties.

Polypropylene is currently used for the backing (matrix), as the density, or weight, is slightly lower, and it has a higher melting point. Polypropylene goes underground and is therefore not affected by UV rays. Polypropylene exhibits good strength and no water absorption directly into the material. “No emissions can come out of these atoms,” Dr Coman said.

Where parts of the backing might contain recycled rubber tyres this is unlikely to give off any emissions, due to the late stage in its life-cycle. This is often coated a lighter colour, which is simply to reduce heat absorption. No public health concerns have been confirmed in any international research.

Australia produces a very high quality modern synthetic turf. It evolved from “Generation 1” in 1962, when the US Government commissioned Monsanto Corporation to carry out research. The first version was physically very hard on users. The second generation came in 1980 using a textile technology tufting machine for polypropylene. In 1993 “Generation 3” renounced polypropylene and introduced ‘polyethylene’, to be followed with “Generation 4” with much softer blades for users.

An important aspect of this product concerns actual planning and installation, as presented by Dr Martin Schlegel . Dr Schlegel believes that all organisations in Australia should ensure that this is a priority area.

There was a disturbing media report recently in which a football club’s expansion had not been anticipated in the planning of a new synthetic turf complex. What might be perceived as successful - from seven-day activity in the area and increased parking - should have been realised during the planning stage, on behalf of all residents.

“When there are any doubts or there is any inconvenience caused to the surrounding community,” Dr Schlegel said “ … even when there are no scientific examples to support their claims, emotive methods are used to fight a project”.

Dr Schlegel highlighted yet further consequences of neglecting any areas of planning that could even result in “a proposed national moratorium from a political leader, which can threaten the livelihood of industry members”.

Dr Schlegel has developed a model ‘Project/Process Cycle’ which plots the milestones and key areas. “We must basically find out how is the place being prepared before installation, how is it managed afterwards, and what do we expect in terms of required maintenance? … And stakeholders must all work together,” he said.
“Initially, discuss the existing facility with the client - its change-rooms and various items such as parking - and then look further, at the surrounding neighbourhood.”

Consider all of the following: Planning, procurement of appropriate turf system from source (may involve testing), place management (whether it is a club or sporting facility, for example), participation (or who will be included among the users, and what is the break-down), feasibility study (consider the infrastructure available, future local and state plans), develop specifications (involves engineers and additional testing), and, finally, decide on the project management method (and who should be involved). Also important, is to consider how the existing infrastructure will be managed during installation works, so as not to impact negatively on those using the

area. And to be forward-thinking with regards to how the area will be maintained in future, for early inclusion of necessary access areas.

Some difficulties stem from a lack of industry created standards/specifications, which could potentially cover many of the more basic aspects of installation. Even actual sand grains are checked for their appropriate size. Engineers focus predominantly on the local soil type, but have a limited knowledge of the total turf system being installed. Many diverse solutions are also explored with clients to align with their proposed budget, which adds to the complexity.

Particular challenges also arise during the design of sporting facilities (i.e. for rugby). A hard, fast-running ground will create a faster game - a three to eight millimetre deformation creates a much harder surface. A friction detection machine could be used to measure co-efficient friction. The possible alternatives should be communicated to the client. A friction detection machine also assists in estimating the impact upon the health of players.

Whereas the synthetic turf is a highly controlled environment, natural grass poses far greater risk to players' safety, as a result of gradient changes/undulations and much wetter areas, caused by sprinklers or rain, while other parts of the same field may be quite hard.

While the AFL is continually working on standards for all ovals, another issue is the need for intermittent testing for the presence of toxins and fertilisers used on natural turf ovals and how this could impact user health.

Belinda Crane's organisation, TEAM sports has carried out a carbon footprint assessment using a basic comparison of natural to synthetic turf. Over a ten year life-span the synthetic turf was responsible for less carbon emissions, provided greater cost efficiencies, and a significant reduction in the use of water.

There have also been no negative findings in relation to coverage over underlying roots, and the synthetic turf can assist with moisture retention.

Mr Michael Coates founder of the Victorian based manufacturing firm I.N.C. believes there are many untapped opportunities in areas of sustainability and recycling, for this industry. Mr Coates is milling unused end-of-production runs further reducing the environmental footprint of synthetic turf.

"Who knows what new developments are yet to come, but the research must go on to continually build on the science underlying Australia's most recent generation of synthetic turf and to support advanced materials manufacturers," Dr Coman concluded.

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