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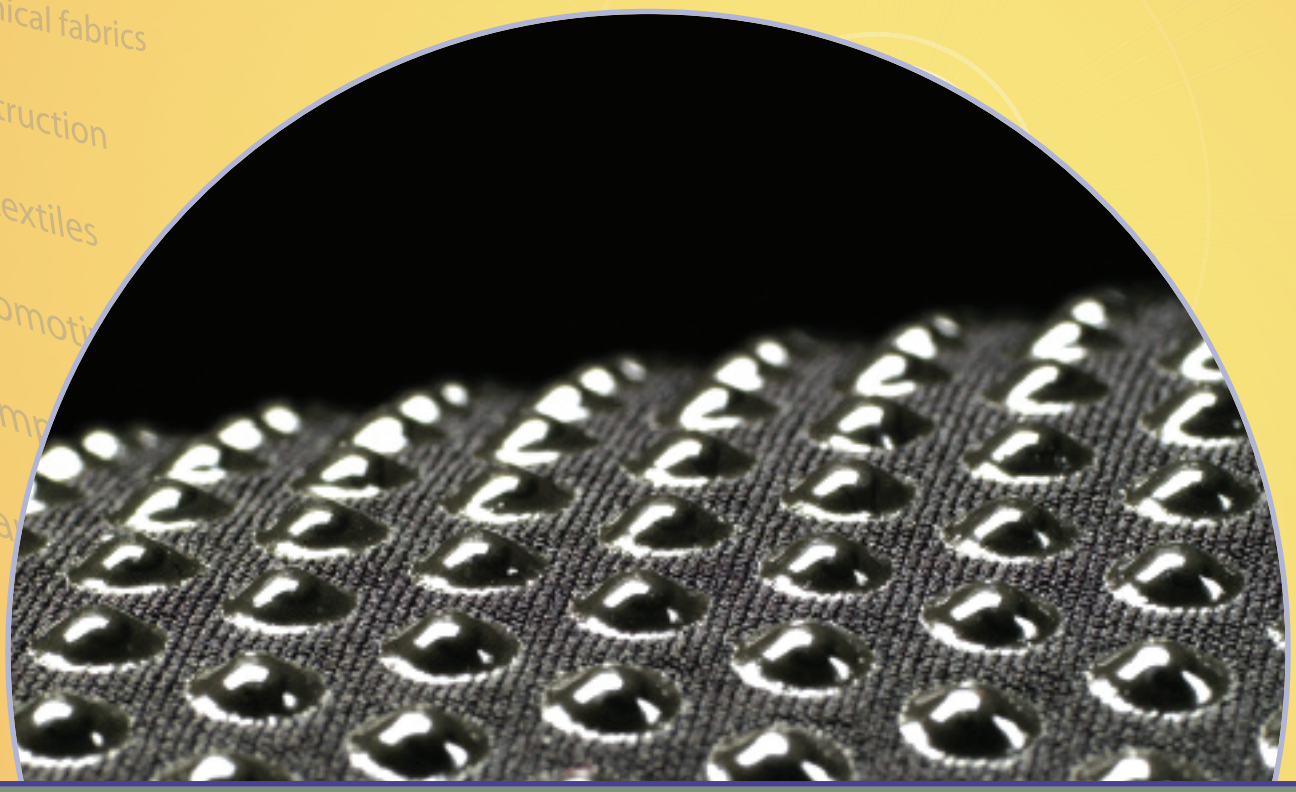

"Challenges of the environment drive innovation in coating"

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Challenges of the environment drive innovation in coating

Manufacturers gathered in Orlando, Florida, USA, for the *International Conference on Textile Coating and Laminating (TCL) 2011,* held on 17–18 November, where one of the recurring themes was the importance of environmental issues, reports Nick Butler.

Challenges facing the world today represent commercial opportunities to those seeking to develop novel technologies, products and services. In his keynote address to *the International Conference on Textile Coating and Laminating (TCL) 2011* held in Orlando, Florida, USA, on 17–18 November, Commercial Director of Sioen Industries of Ardooie, Belgium, Jan Mortier set out what he and his colleagues believe the main challenges are: demographics—a growing and ageing population will create specific needs for infrastructure, including sufficient food and drinking water; safety and protection—a growing desire to safeguard people and objects; climate, energy and ecology—addressing changes to the world's weather systems, searching for renewable and sustainable sources of energy, and the design of products to minimize the damage their manufacture, use and disposal does to the environment.

Coated and laminated textiles offer solutions to all of these problems, he explained.

Demographic changes

Coated textiles are integral to products such as tents, textile membranes, semi-permanent structures, water tanks, basins and covers (ranging from tarpaulins for trucks to the covers for landfill sites). To be successful, however, in these saturated commodity markets the coater/laminator needs to create added value; for instance, tarpaulins that are lighter, cheaper, stronger and more resistant to heat. To create value, increasingly it is necessary to combine several functions into one product, and it is vital to discover the specific needs of a market, such as addressing the growing problem of graffiti and vandalism to truck covers, among others.

Growing populations are also creating increasing demands for food and drinking water. Coated fabrics can be the basis of products in which to transport and/or store food, clothing to protect workers and/or the food from process chemicals, and garments to keep the wearer warm in such as cold storage facilities.

From Sioen Industries, Jan Mortier helped set the agenda of the conference by summarizing the main challenges faced by industry, many of which relate to the environment. Solving these problems will lead to commercial opportunities for innovators.

Safety and protection

There is now a growing awareness around the world of the possibilities that textiles, especially coated textiles, afford towards offering previously unconsidered levels of protection, to both people and their belongings. Moreover, as the proportion of the elderly increases within the total population, there is more demand for products in the medical market, such as antibacterial bedding and surgical garments.

Climate, energy and ecology

Coated-textile products that have been developed to meet the challenges of the changing climate include hurricane shelters, sun shades, mats to absorb oil spills, and tents that can be deployed rapidly at the location of disasters. Outdoor workers need more protection from the weather, leading to developments in workwear, such as better protection from ultraviolet (UV) radiation.

Containers for biogas, including reactors and digestion tanks, can be made using coated fabrics, and value is added, for instance, by creating products that biodegrade after use. Indeed, the wider concern for the effects of products that

Information from the presentations was bolstered by several lively question-and-answer forums. In the first, Ed Gregor, at the podium, chaired a forum involving, seated left to right, Jan Mortier, Karel Lansu page 35), Kari White of the University of Massachusetts and Sean Hsu from King-Tech Industry.

Sustainable alternative to flexible PVC

Addressing in more detail one of the issues raised by Mortier, Managing Director of Ed Gregor Associates LLC from Charlotte, North Carolina, USA, Ed Gregor, told the conference about a material developed as an alternative to the flexible polymers, notably PVC, that has been developed for coating fibres, yarns and fabrics used in a wide range of applications.

have reached the end of their useful lives presents opportunities to add value by designing the material for recycling and/or re-use, as does careful consideration of the effective substitution of the growing number of chemicals deemed unsafe to the environment and human health. Manufacturers need to be aware of the growing amount of legislation – such as Europe's registration, evaluation, authorization and restriction of chemicals (REACH) regulations – as well as the trend in perception among consumers. Particular issues facing the coating and laminating industry include the needs to:

- move away from the use of solvents to water-based coating and/or UV curing technologies;
- avoid the use of heavy metals;
- create plasticizer-free polyvinyl chloride (PVC);
- use phthalate-free materials;
- develop flame-retardant (FR) chemicals that contain no halogens.

Sioen Industries also makes sure that its manufacturing is undertaken with the aim of minimizing the company's environmental impact, investing in appropriate sources of energy, such as solar panels for its production plants, and developing its policies to save on energy consumption and reduce waste.

In conclusion, Mortier said that in order to meet these many challenges, Sioen Industries places great emphasis on its research and development (R&D) efforts, and sets ambitious targets for the proportion of its turnover that is generated from new products.

Gregor described flexible PVC as one of the most useful and versatile plastics in use. In terms of volume, it is currently the third most used plastic in the world. Coated-textile applications include cross-head extruded yarns (for such as roller blinds and shades) and coated fabrics for advertising hoardings, banners, tents, wallcoverings, flooring, vehicle interiors, liners for ponds and swimming pools, shower curtains, bedding and toys. However, the material often contains many of the chemicals Mortier earlier identified as being unwanted: phthalates, heavy metals, vinyl chloride, halogens and dioxins.

Arguably, therefore, it is also one of the most toxic materials. A campaign group based in New York, USA, the US Center for Health, Environment and Justice has called PVC "the poison plastic", he said. Moreover, the US Government's Consumer Product Safety Commission has banned six of the most important (by volume of use) plasticizers used to make flexible PVC for children's bedding and cots (cribs), and car seats, effective since 2010, and restrictions are in place in Europe too.

In response, Dynamic Modifiers LLC of Atlanta, Georgia, USA, has developed an alternative with the trade name of pal (formerly FlexOlé). The company says its material meets all of the technical, functional and aesthetic properties of flexible PVC, but eliminates the issues associated with the toxic chemicals (including the toxic gases released from burning PVC). No phthalates are added to make the polymer flexible, no heavy metals are used and the material is non-toxic. It can be fully recycled after use.

Its burning behaviour is good as well: there are no detectable levels of halogen gas released and it does not generate excessive amounts of smoke. It is also possible to tailor the material's properties to suit the needs of a particular application; for instance, for outdoor applications pal can be made with high resistance to UV radiation. Based on this performance, the US publication, R&D Magazine awarded pal one of its *2009 R&D 100 Awards*, which recognize the 100 most technologically significant products of the year.

Property	ASTM test method	Low	High
Density	D 792	0.87	1.50
Melt flow rate (g.10 min^{-1})	D 1238	4.00	40.00
Tensile strength (MPa)	D 638	2.80	25.00
Tensile elongation (%)	D 638	25.00	600.00
Flexural modulus, 1% secant (MPa)	D 790	10.00	75.00
Notched Izod impact at 23°C	D 256	N/A	no break
Hardness (Shore A)	D 2240	67.00	95.00

A range of mechanical properties can be achieved for the polymer called pal, the conference learned, allowing its developer, Dynamic Modifiers to tailor it to suit various applications.

Gregor, who worked on the project to develop pal, expanded on the material's properties (see also, Table 1), saying that it passes a number of standards: in accelerated weathering tests involving exposure to UV radiation (340 nm) for 3000 h, the polymer shows minimal discoloration and cracking; it passes standards set by US bodies such as the National Fire Protection Association (NFPA) and the Federal Aviation Administration (FAA) with respect to flame-retardance.

In addition, printers can apply colours to the material and it can be coloured by adding pigments during compounding. Mechanical properties, flexibility and hand are all similar to PVC and even, in most cases, thermoplastic polyurethane (TPU); its surface hardness is 60–90+ on the Shore A scale (for the FR grades this is 70 to 90+). The polymer can be used in cold weather.

The cost of pal is similar to PVC in applications involving high-volume production. Moreover, because it has a low specific gravity (comparing FR grades, pal is 0.9, TPU is 1.1–1.30 and flexible PVC is 1.35–1.65), pal's lower weight per unit coverage makes it cost-competitive for coatings.

The polymer is also available in film form (blown, cast or extruded, with calendar grades under development). Films can be coloured, including deep shades, welded (with heat or radiofrequency radiation) and are supplied in a range of flexibilities. The smoke and toxicity behaviour of the films leave them suitable for use in the interiors of commercial aircraft.

The material is also suitable as a replacement for TPU.

Finally, Gregor gave details of a patent-pending grade, pal-PCA 70, developed for carpet-tile backings. This contains up to 70% of Dynamic Modifiers' proprietary additive system, which is derived from post-consumer products. This readily flows and extrudes, adheres well to various substrates, is dark brown or black, and has a Shore A hardness in excess of 80.

Environmentally conscious laminating

While Gregor focused on materials, Director Marketing & Sales, Klieverik Heli, Oldenzaal, The Netherlands, Karel Lansu described his company's efforts to develop machinery that allows its customers to make laminates an an environmentally conscious manner. Wet coatings and the lamination of carpets with wet latex, for instance, require energy to evaporate the moisture.

Alternative methods (such as coating thermoplastics on fabrics, and laminating nonwovens to mattress ticking and upholstery) do not require this drying step, and so reduce the energy (and associated costs) needed.

Traditional lamination techniques each have their own disadvantages, according to Lansu:

- flame-bonding creates volatile fumes;
- flat-bed techniques need lots of energy;
- slot-dye and roller-coating methods are not flexible;
- spraying is imprecise.

As an alternative, Klieverik offers lamination via a drum calendar. This is applicable to a wide variety of thermoplastics in the form of powders, webs, foils and multi-layer films. Further, the equipment allows the user to change the material quickly, leading to versatile use of both materials and machinery.

From an environmental perspective, such machinery has advantages too: it operates cleanly and efficiently; it uses a low amount of energy. Finally, calendar machines are economical: the compact design takes up little floor space; capital costs are lower than for traditional equipment; low energy consumption is increasingly important as energy prices rise; it is possible to make multi-layer products in a single pass; the possibility of coating and laminating on a single machine further reduces capital investments.

Lansu also discussed the advantages of power scattering techniques. Working with all types of adhesive, users can instantly adjust the width to which the adhesive is applied, up to a maximum of 6 m. Adjustment of the powder flow is also instantaneous, up to 2 $kg.min^{-1}$ for each metre in width of the fabric, and this degree of control is economical in terms of the use of raw materials, good for both the environment and the manufacturer's costs.

A third alternative technology described was that of carpet fusing and laminating, for which Klieverik has applied for patents around the world. Here, as an alternative to applying a latex backing to hold the pile, the machine fuses the pile fibres together at their bases. The absence of the latex backing reduces the costs of raw materials and removes the need for a drying stage, lowering energy use and costs. Overall, Lansu estimated production costs are reduced by 10% compared with the traditional approach.

Further, the absence of the latex backing considerably simplifies recycling the product at the end of its useful life, as well as reducing the burden of pollution compared with that from a traditional carpet from which this extra layer needs to be burned off before the pile can be reclaimed. Finally, the carpets produced by this new technique take up less space, so more can be transported at a time, saving fuel costs in shipping, and they are 15–20% lighter in weight, leading to less fuel consumption when used in aircraft or cars.

Such machines are already in use for the dedicated production of automotive carpets, he told the conference.

Further information

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The next event in this series, *International Conference on Textile Coating and Laminating (TCL) 2012*, will take place in Europe towards the end of the year. Full details will be available shortly. In addition, the full Proceedings of the 2011 event, including each of the presentations, and audio recordings of the question-and-answer sessions, will also be available in the near future.

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