

*Anywhere that water collects - from a huge reservoir to a flat roof - is a prime candidate for a protective membrane*



# Protect and serve: latest in waterproof membranes

Waterproof membranes - whether for lining reservoirs or protecting a roof from leaking - takes many forms. Delegates at the recent *Waterproof Membranes* conference - organised by **AMI** and held in Dusseldorf, Germany - learnt about the range of solutions available - and an impression of the size of the market.

Industry consultant **Boyd Ramsey** told delegates that the global market for geomembranes was a shade over 1m tonnes per year.

These range from sophisticated 'A' and 'B' systems - which include double composite liners with leak detection and geomembranes with protective fabric. The consequences of these failing in service range from bad to severe, he said. Simpler systems (so-called 'C' and 'D' classes) will consist of the geomembrane only - of varying thickness. If these fail, the ramifications would be less (and in some cases, nothing at all).

The total accounts for anything up to 5.5% of global annual plastics production, he said.

## Colour changes

Geomembranes - whether of traditional bitumen-based design, or more modern plastic-based types

- are generally black in colour. For the plastic geomembranes, this creates no problem if they are lining a lake, for instance. However, the issue of 'green buildings' means that many builders - and regulations - are now looking to make roofing lighter in colour so that it can reflect more light.

With this in mind, many developers of roofing membranes are addressing the problem with roofing membranes in lighter shades.

**Lucobit** of Germany, for instance, has developed a range of thermochromic roofing membranes - which change colour depending on temperature, thanks to the use of special additives.

"The main driver is the view that a roofing membrane should not only be based on its sealing performance," said Harald Lehmann, head of R&D at the company. "Developers should also consider interactions with the environment."

The formulations use leuco dyes, which change colour between the colourless and coloured forms. For instance, leucoindigo changes from colourless to indigo at the correct temperature.

"They are commercially available - usually in the form of microcapsules with the mixture sealed inside," he said.

**Main image:**  
**Waterproof membranes are thought to account for up to 5% of global plastics production**

The idea is that a roofing membrane is light in summer – in order to reflect sunlight – and dark in winter, when it needs to absorb it. This has a positive effect on climate control within the building. In summer, it keeps the temperature of the membrane cooler – meaning that less heat stabiliser is needed in the formulation.

The concept can be applied to many different designs of waterproof sheet. In roofing, for instance, it could make a single change from grey to white at 25°C – or from dark grey to light grey at 10°C, then light grey to white at 25°C. Membranes for swimming pools could change from dark blue to light blue to white in a similar way.

Compounding thermochromic formulations is possible without a negative impact on processing parameters: at processing temperatures, the pigments are colourless and slowly become dark during cooling.

Organic pigments failed after less than 1000 hours of QUV exposure. Therefore, these membranes were equipped with a separate layer containing a defined ratio of UV absorbers.

“The effect on the number of colour changes was minimal,” he said.

Inorganic pigments have better light stability behaviour, and their limits are being investigated.

**Green roof**

Other producers are looking at similar areas. Udo Wagner, of **FDT** in Germany, told delegates that single-ply membranes can improve climate protection in cities.

He said that more than 260m sq m of synthetic roofing membranes are applied across Europe.



Most of this is in cities – where temperatures are typically 5°C higher than surrounding areas, he said.

Five cities in Germany are part of a pilot scheme called ‘Green City Masterplan’ to try and improve environmental performance. Early results from Mannheim show that roofing is an important factor in controlling temperature.

Single-ply membranes can help to reduce the Albedo ratio – and make a dark roof surface more reflective.

“Ideally, the roof should be white,” he said.

As well as reflecting away more light, it can also boost the effectiveness of solar panel system, he said.

**Above:**  
Light-coloured roof membranes can help to keep the interior of building cool

**White stuff**

The most widely used white pigment in plastics is titanium dioxide – and forms a key part of energy-efficient ‘cool roofing’ membranes.

**Chemours**, a leading producers of titanium



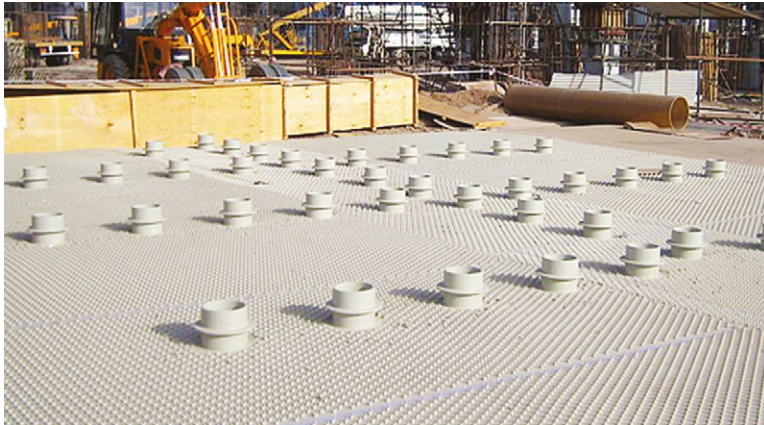
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**Above: Agru offers a series of concrete protection products**

dioxide, says the 'cool roof' concept works by reflecting the majority of sunlight back into the sky. While a typical black asphalt roof absorbs 80% of sunlight and reflects 5% (and reaches around 80°C), a white roof reflects 85% - and remains at around 40°C.

Part of its success is down to its ability to reflect near infrared light - which constitutes around half of sunlight. The material is ideal for roofing for several reasons according to Melis Arin, business development consultant at the company.

These include: longer service life of membranes

(due to inherent UV absorption that protects polymers); ease of processability; and superior optical properties. In addition, it can be used in different membranes, including both PVC and TPO.

The company's Ti-Pure has a particle size of around 25 microns. One particular grade, Ti-Pure R-105 has silica/alumina shells to prevent interaction between the titanium dioxide and UV energy. At the same time, the silica encapsulates the particles, physically separating them from water and oxygen.

In PVC formulations, it exhibited higher gloss retention than a typical titanium dioxide grade, he said, while retaining other physical properties.

In terms of processability, Arin claimed a 17% increase in throughput rate compared with standard grades, as well as a 7-14% decrease in torque. A roof coating formulation containing 7% of Ti-Pure R-105 had a total reflectance of 89%.

In terms of optics, he said R-105 had a more 'neutral' undertone - making the roof appear whiter - and the highest opacity of durable titanium dioxide grades.

"It gives the best value-in-use available from a durable titanium dioxide," he said.



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### Concrete benefits

Despite concrete's longevity, it is remarkably prone to damage - through corrosion, spalling and abrasion, for instance.

"They can also be affected by leaking - cause by root penetration or cracks from soil movement," said Rudolf Hummel of **Agru**.

For this reason, many geomembrane liners are designed specifically to protect concrete structures - ranging from sewage treatment plants to pipelines.

Agru offers a number of systems for this - including Sure Grip and Ultra Grip. These are produced on specialist equipment, and incorporate studs along their length - which anchor the system in place.

The products are made from HDPE, PP, PVDF and ECTFE, and have a wall thickness of 2-12mm. Various systems are available, in widths from 1500 to 5000mm. The material chosen will determine the temperature range: PE works from -40°C to +60°C, for instance, while ECTFE operates from -30°C to +140°C.

Some recent applications of the liners include: a biogas tank in Sweden; a sewage treatment plant in the Netherlands; precast pipes and manholes in New Zealand; and chemical storage tanks in Japan.

### Adopting polymers

Bitumen systems will continue to co-exist with newer polymer-based systems. One manufacturer in Saudi Arabia - which has traditionally made bitumen systems - recently began producing single-ply membranes in PVC and TPO.

**Bitumat**, based in Dammam, first began making bitumen membranes in 1985. In 2015, it installed a new PVC/TPO membrane line - and last year began commercial production of a new XPS2 production line.

The new line required a very different approach to that of its traditional business - mixing and rolling bitumen membranes. Now, using an Amut extrusion line, the company is making PVC/TPO membranes.

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