

Science around us

A news service provided by BASF



The Chemical Company

Flexible covering protects imperiled dikes

The elastic composite of crushed stones and BASF's polyurethane Elastocoast® withstands even harsh storms

About 800 kilometers of dike systems protect the German North Sea Coast against the onslaught of the forces of nature. The North Sea coastal states Schleswig-Holstein and Lower Saxony already invest almost €100 million every year in coastal protection measures for flood disaster prevention. And these efforts will have to be increased even further in future: during the coming century, scientists predict that global warming will cause a rise in the sea level of up to 70 centimeters. The regions at greatest risk are therefore already raising the height of many of their dike systems to as much as 9 meters.

More than ever before, innovative solutions are needed to provide effective and stable coastal protection. One of them is a specially developed elastomer polyurethane system from BASF's subsidiary Elastogran: under the name Elastocoast®, the company is offering a novel plastic for reinforcing stone ballast revetments for dikes. These coverings represent the first line of defense in the fight against the sea, protect the dike by absorbing the force of the breaking waves and slow down the water masses. "Elastomer revetments utilize the property of polyurethanes of creating permanent and elastic bonds with stone surfaces", explains Professor Erik Pasche of the Institute of Hydraulic Engineering of Hamburg-Harburg University of Technology, Elastogran's partner in developing Elastocoast®, the adhesive for stabilizing sea defenses. "This creates sturdy, porous but at the same time very resistant revetments."

Elastic and porous – these two properties are the secret of Elastocoast®: the ability to yield slightly protects the revetment against the brute force of the water masses crashing down upon them; the interconnecting cavities between the stones absorb their energy. Rigid and solid revetments made from the conventional "adhesives" concrete or asphalt, on the other hand, are often broken down by the pounding force of the waves: starting from an initial, tiny defect, the breakers gradually make deeper and deeper inroads into the revetment.

The philosophy of yielding slightly to these thundering masses of water in order to contain them has paid off. The same principle is applied in the construction of

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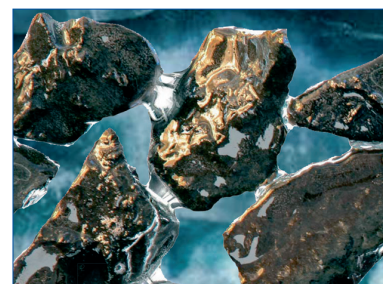
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The Story



Pilot project in the north of the island of Sylt: since September 2005, a revetment with Elastocoast® is undergoing trials at this particularly exposed coastal area.



Reinforcing stone ballast with Elastocoast® creates a porous stone structure (schematic diagram).

Text, photography and illustration are available at:
www.basf.de/science_around_us

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modern dike systems which rise with a very gradual incline on the side facing the sea. This allows the breakers to gradually expend their force without causing damage, instead of explosively releasing their pent-up force on immediate impact. But the dikes also need a protective layer against the insidious erosion which is reaching dramatic proportions along exposed sections of coastline, as for example in Sylt, and is even threatening the integrity of whole islands. Preventing this from happening is the job of Elastocoast®.

It could hardly be easier to use: the liquid two-component special plastic polyurethane is stirred on site and then mixed – for example in a concrete mixer – with the crushed stone which it envelops like a thin, transparent film. With relatively little effort, the finished mix of materials, which remains ready to use for about 20 minutes, can be applied in covering layers about 15 to 30 centimeters thick. The mixture even hardens underwater. Alternatively, the environmentally friendly Elastocoast® can also be sprayed onto a loose layer of stone ballast using a high-pressure technique.

Following its successful use in the redevelopment of a jetty on the bank of the river Elbe in Hamburg, Elastocoast® is now facing its biggest challenge on the island of Sylt. Especially in winter, the North Sea gnaws away at the island: last year, flashing eroded coastline sections with sand cost at least €3.5 million. In September 2005, a revetment made of Elastocoast® has been protecting part of the particularly exposed northern part of the island. A similar pilot project has also been completed on Hamburger Hallig to the north of Husum. Dr. Marcus Leberfinger, project manager for maritime applications at Elastogran, is very satisfied with the results achieved in the first winter: "Even in the breaker zone of the open coast of Sylt, the revetment reliably withstood the high dynamic stresses caused by wave impact, salt water and the effects of frost."

The research results speak for themselves, but is coastal protection with Elastocoast® affordable as well? "Cost control was given high priority from the outset in developing the product", says Leberfinger. "Elastocoast® is easy to apply, and because of the reduced thickness of the revetment and the lower cost of the smaller-sized ballast stones, at the end of the day the costs are even somewhat less than those for conventional structures."

Elastocoast® with its ecological properties also provides benefits for nature: flora and fauna could find new habitats in the porous structure of the cover layers – and so shore crabs, limpets and beach grass would also stand to gain from this innovation.

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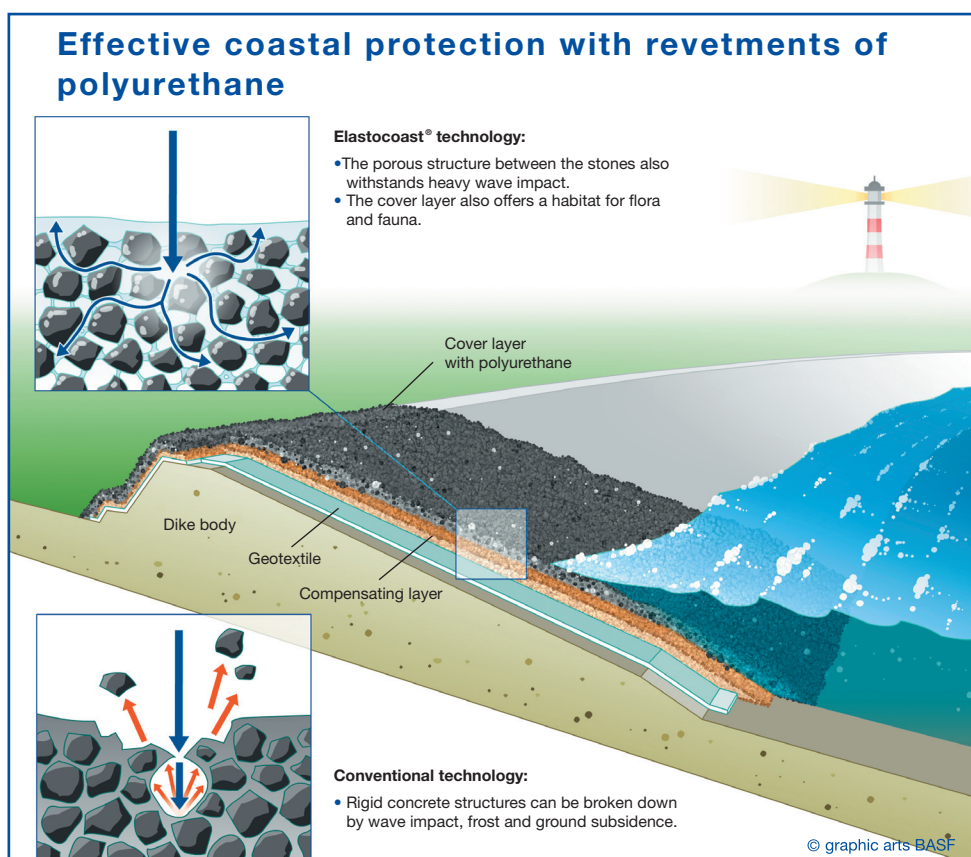
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The idea of bonding stone ballast together using polyurethane plastics to give it permanent cohesion was first put into effect with outstanding success in railroad construction. With Elastocoast®, the great stability and durability of these stone ballast embankments can now be transferred to a maritime context. Dike systems like those on Sylt or the Hamburger Hallig, are only one of many possible application sites for revetments of crushed stone and Elastocoast®. Along the coastlines, they can also protect harbor installations, flood barrages and riverbank promenades. The forces of nature also do not spare the banks of inland waterways, which can similarly be protected by revetments with Elastocoast®. The potential is vast: Bavaria alone has almost 1200 kilometers of flood barriers. For its recently published "Action Plan 2020", the Free State intends to provide funding amounting to €2.3 billion for flood protection, almost €500 million of which will be devoted to redeveloping and extending dike systems.

The Prospects



The Graphics

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Polyurethanes for a thousand and one applications

Polyurethanes (PU or PUR for short) are to be found everywhere in our modern world. This is because of the **versatility** of PUR plastics which can be either rigid or soft and elastic depending on the manufacturing technique. And yet PUR basically consists only of the two components isocyanate and polyol derived from crude oil. The huge variety of PUR products obtained from these simple basic ingredients is evident from the details of the approximately 3500 formulations offered by Elastogran.

- PUR is easy to **foam**. This process produces either soft foam of the kind found in automobile seats, mattresses or soles of shoes, or rigid foam like that widely used in the construction sector, such as thermal insulation.
- Whether used for surfaces of running tracks, high jump mats, the World Cup football or downhill skis: PUR variants are present in **sport and leisure** products whenever flexibility and strength are needed. These properties also distinguish man-made fibers of PUR elastomer of the kind favored by the garment industry.
- Nine of ten **automobile** manufacturers use shock absorber systems of foamed PUR elastomer in their automobile suspensions, in which the stretchable and compressible material absorbs vibrations and noise. But innumerable other automobile components, for example steering wheels or door coverings, also benefit from the properties of polyurethane which comes into its own wherever stability and flexibility are required simultaneously.

The Info Box

Further information can be found at:

<http://www.elastogran.com>
http://www.tu-harburg.de/wb/english_site/
<http://en.wikipedia.org/wiki/dike>

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