Trelleborg uses TANIQ's reinforcement technology on dredge hoses

"This new technology enhances our offering, providing added value to our customers in terms of light-weighting and a superior component that can give outstanding performance with incomparable consistency." — Peter Stello, MD of Trelleborg Infrastructure, pictured (left) with Siebe Nooij, MD of TANIQ

A unique, science-based fibre winding system is helping Trelleborg Infrastructure to improve reliability and repeatability in heavy-duty hoses, while permitting the company to develop new products and investing in state of the art production technology in Western-Europe.

By David Shaw, ERJ Staff, dshaw@crain.com

Dredging hoses are multi-layer constructions, which have to perform in the cold, in the heat and keep going while they suck up rocks, scrap and abrasive sand from the sea bed. Trelleborg is using a high-tech manufacturing technique to ensure the products last longer and to innovate new products which cannot be made by any other technique.

ERJ has previously written about the TANIQ approach to fibre winding. The company has developed the system further and one of its first commercial applications is going to be in the manufacture of heavy duty hoses at Trelleborg in the Netherlands.

The companies have successfully applied the fibre reinforcement methods in expansion joints and pipe plugs (to form temporary seals while repairs are carried out in drains and sewers). For this, the production is about to start. Simultaneously Trelleborg plans to use the same approach to manufacture other products based around fibre-reinforced rubber. Examples of this are dredging hoses, oil sand hoses and lifting bags.

TANIQ's approach is to use sophisticated numerical analysis to calculate the stresses throughout a flexible, fibre-reinforced envelope. The system looks at the plane stresses across the surfaces, and throughout each layer within the construction, so that they can optimise the distribution of stresses and hence fibre reinforcement layers though the thickness of the product.

Once the stress pattern has been calculated and the fibre layout designed, TANIQ uses a robotic manufacturing cell to apply the fibres and the rubber compound over a mandrel so as to ensure perfect repeatability from component to component. The same robotic approach applies tapes used to apply pressure to the component during curing.

Historically, these components have been hand-built. This introduces three areas of production risk – first is that the operator varies the amount and orientation of the sheets placed on the component, and second that the fibres can not correctly be aligned with the stresses. Third, the tapes are not always applied with the same tension.

All these risks are eliminated using the TANIQ approach. The result is a component which uses the fibres more efficiently and can therefore be thinner and lighter than conventional designs. Furthermore, since the lay-up process is fully automated, every aspect of production is repeatable, even when there is an interval of months or years between production cycles.

Trelleborg makes large-scale components

As a result, said Ruud Bokhout, Business Development Director for Trelleborg Infrastructure, Trelleborg continues to manufacture its more complex dredging hoses for the EU market in the Netherlands.

In the next few months, said Bokhout, TANIQ will install one manufacturing cell at the Trelleborg facility in Ridderkerk, the Netherlands and has already planned a second, larger unit to make a variety of fibre-reinforced rubber components up to 14 metres in length at the site. ■

New products for the oil sands market

Apart from dredging hoses, Trelleborg expects to use the technique in hoses for the oil sands market in Northern Canada. The oil-bearing rocks are processed in large extraction facilities. Abrasive material is sent down pipes and hoses. Trelleborg supplies these hoses, and expects to use the TANIQ approach in their manufacture in due course.

The technique opens up new opportunities. Currently the common way to make elbows in the pipes is to use steel fabrications, but these can wear out after just 3 months. Trelleborg want so make these elbows in rubber, as this offers improved wear life and is more flexible. These elbows cannot be made using conventional techniques.

Manufacturing cells for robotic assembly

To make a components around 2m in size, the first manufacturing cell requires a floor area of 100 m^2. This comprises two robotic work stations. While one station is performing all the assembly operations, the other is available for an operator to add any finishing markings to the product and perform other ancillary work and then replace the mandrel for the next production cycle

Once wrapping operations are completed on the active station, the robot switches stations and begins work on the newly-prepared mandrel.

And you thought all you needed to know about hoses was 54.7 degrees?

Those in the hose industry may think that sophisticated stress analysis is not needed to analyse a hose. Long ago, engineers worked out that the neutral angle in a simple hose is 54.7 degrees. The reinforcement needs to be applied at that angle, in order to deliver optimum fibre performance.

However, this is not the whole story, especially in multi-layer hoses. Inefficient transfer of stresses within the hose wall means that the inner layer of reinforcement will carry most of the load. To optimise the efficiency, not every layer should be assembled at the neutral angle.

Siebe Nooij, CEO and founder at TANIQ, said that in a multilayer hose made with high modulus fibres (e.g. aramid), if both reinforcement layers are the same, then the second layer might only carry 50 percent of its maximum load capacity, while the inner layer is on the point of failure. The more layers are used, the further this efficiency is reduced if no action is taken. This, he said, points to inefficiencies in the system. TANIQ's mathematical model of the hose wall allows engineers to optimize for the most efficient use of fibre reinforcement, even for dredging hoses which carry eight or more layers of reinforcement. This also prevents over-designing the hose.