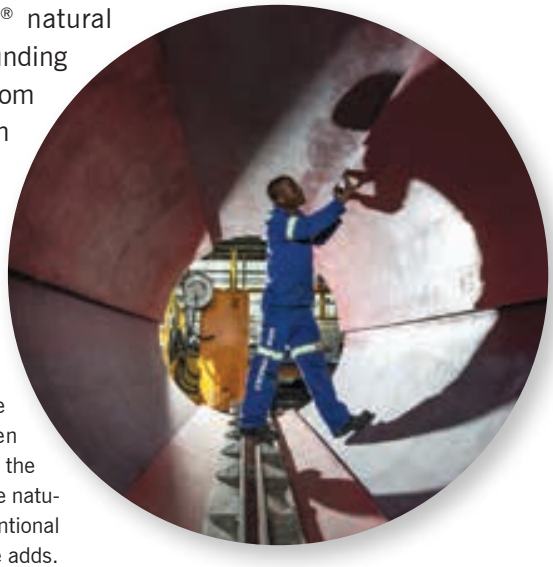
Wear resistant products: a blend

Weir Minerals, the global OEM for Linatex® natural rubber using proprietary liquid-phased compounding methodology, has a state-of-the-art custom hose and equipment lining facility in Alrode, South Africa. *MechTech* visits the facility and talks to Yatheen Budhu (left), the business' product manager for Rubber Products in Africa.



Weir Minerals Africa offers Linatex® premium rubber lining for equipment such as mills, pumps, cyclones and valves.

Weir Minerals' rubber hose products are used all over the world as a preferred slurry transportation solution. The company's advanced manufacturing techniques and proprietary rubber compounds, most notably, Linatex® premium rubber, provide a high-quality product that is consistent, robust, reliable and exhibits outstanding wear life.

"We provide tailored engineered solutions, regardless of application and conditions and, here in this facility, we have world-class hose manufacturing expertise and wear lining capability that stems from the combination of automation and the craftsmanship," Budhu tells *MechTech*.

At the heart of its premium offering is Linatex, its proprietary range of natural rubber compounds. "Conventional rubber blending processes rely on high temperature processing. Natural rubber bales are granulated and then heated to above 130 °C, which breaks down the molecular chains of the polymer. Chemical additives are then dispersed into the blend at high temperature. Property enhancing additives are then incorporated to promote new polymerisation with improved performance characteristics," he explains.

"Our unique process for Linatex rubber, however, is a liquid phase process that retains the original properties of the natural rubber. Chemicals are dispersed into the liquid latex at low temperature, which prevents any structural changes from occurring while creating the improved compound. The liquid process also improves dispersion and avoids having to destroy the natural structure when blending," he says.

Linatex premium rubber offers outstanding abrasion resistance when handling wet and fine slurries. "Natural rubber has long chain molecules and high molecular weights. These properties are preserved when processing Linatex rubber, while the heat, shearing and breaking of the natural rubber associated with conventional compounding destroys these," he adds.

Linatex premium rubber sheet is imported into South Africa from Weir Minerals' processing plant in Malaysia. The starting point of the manufacturing process is the slitting and buffing of the rubber. "We bring in rubber sheets at 30 mm thickness and slit them down to the thickness we need: 3.0 mm being the minimum. The automatic machine we use slits off one thickness at a time to ensure consistency and thickness accuracy to a tolerance of 10% – 0.6 mm on the thinnest sections.

"Once slit, the sheet is passed through a buffing machine, which roughens one or both surfaces for better adhesion after bonding," Budhu explains.

"From a capability perspective, this gives better flexibility with respect to the liner thicknesses and allows us to process bigger orders more quickly. We don't have to rely on our Malaysian facility for non-standard rubber thicknesses. We can manufacture what we need from standard 30 mm stock," he explains.

"In addition to Linatex premium rubber sheet, we also have a range of other products to cater for various applications. The Linard® rubber range was developed for applications where larger particles and materials resistant to cutting are required and the Linagard® rubber range can handle the acid, oils, higher temperature and food applications."

Hose manufacture

For manufacturing straight lengths of Linatex hard-walled, cut-end mining hose, soft-wall and gimble ring hose for slurry suction and discharge applications, Weir Minerals' manufacturing plant in Alrode has six custom-built hose manufacturing lines. "Four of the lines are used for our standard range of hose, which goes up to a diameter of 600 mm (ID). We also have a further two lines for manufacturing hose of up to 1.1 m in diameter – and all of these lines can handle lengths of up to 10 m," he informs *MechTech*.

Describing the manufacturing process, Budhu says the lines are all semi-automated. In principle, the process starts with uncured Linatex rubber sheeting being wrapped around a pre-lubricated mandrel. "While the craftsman is there to set up the machine and start the process accurately, the automated wrapper ensures exact tension and placement of each applied layer," he says.

Depending on the pressure and application requirements, the hoses are reinforced by several layers of SBR rubber-embedded fabric with spring steel spiral wire or gimble rings. End flanges can also be incorporated into the manufacturing process on either side of the hose to give excellent and repeatable length accuracy and with rubber-lined mating surfaces to act as gaskets for the coupling. The hose is finally wrapped in a layer of ozone and weather-resistant rubber.

"Since the hose is manufactured from uncured rubber, it needs to be cured in one of our autoclaves. Depending on hose size, thickness and blend composition of

# of craftsmanship and automation

Left: *Weir Minerals Africa's state-of-the-art hose manufacturing bay in Alrode, South Africa.* ***Right:*** *Weir Minerals Africa has installed six custom-built manufacturing lines for semi-automated hose manufacture.*

Left: *To improve the accuracy, consistency and safety of liner cutting, Weir Minerals uses a CNC AquaCut water jet cutting system to cut Linatex sheet into the rubber shapes required.* ***Right:*** *Linatex premium rubber sheeting is passed through a buffing machine to roughen the surfaces.*

the rubber, this can take anything from one hour to six hours," Budhu explains.

The process involves holding the component in a steam atmosphere at a maximum temperature of 140 °C at a pressure of 350 kPA above atmospheric. "We have three autoclaves in use on this site, sized at: 1.2×13 m; 1.2×11 m; and 3.7×7.0 m," he tells *MechTech*.

In addition to manufacturing straight hose, Weir Minerals in South Africa has developed a novel process for manufacturing hose bends. The company operates two additional machines for manufacturing customised hose bends to suit the diameters and radii required on site. "We can accommodate most commonly used hose diameters with typical curvatures of three, five or six times the hose diameter.

"Via accurate placement of the end flange on the mandrel, different angles and curved lengths can be manufactured," he says, adding, "the CNC controller is programmed for the length and the machine automatically wraps each layer working from the centre. The exact length required will be produced and the distance between flanges will be a perfect match for the section being replaced on site."

Budhu continues: "On a straight hose, it is relatively easy to remove the mandrel once the hose has been constructed: using a simple hydraulic winch, we hold the hose and pull the mandrel out. It is much harder to remove a curved hose from a curved mandrel. We have developed a proprietary way of doing this, which enables us to construct customised hose bends to the same complexity as our straight section hoses," he says.

Equipment lining

In addition to hose manufacture and the supply of rubber sheeting, Weir Minerals' Alrode plant also undertakes the rubber lining of equipment. "We apply cured and uncured rubber to metal surfaces of equipment such as mills, pumps, cyclones and valves. By starting with uncured rubber and curing it in one of our autoclaves, very high bond strengths can be achieved. We can also reline equipment on site using pre-cured rubber and the cold vulcanisation process," he explains.

To improve the accuracy, consistency and safety of liner cutting, Weir Minerals uses a CNC AquaCut water jet cutting system to cut Linatex sheet into the rubber shapes required. "In terms of cost efficiency and minimising wastage, we use nesting software to enable us to cut as many shapes as possible off a single sheet. And we have a full team of skilled artisans to apply the rubber linings to the equipment.

"The steel is first shot blasted, then 'grey-primed' with a bonding agent. The surface of the liner is also primed with a rubber adhesive before the craftsman begins to 'stitch' the rubber to the steel surface using rollers and purpose designed corner and edge tools. This is our

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own proprietary adhesive system, which results in an excellent bond strength and a sealed rubber lining over the metal," Budhu informs *MechTech*. He adds: "if uncured rubber is used, then the finished product must also spend some time in an autoclave."

A common use of the cold vulcanisation process is for mills for the platinum industry. "In the case of mills, which are often too big to go into an autoclave, we developed a bladder-based stitching process. This applies an even pressure to the liner, ensuring proper adhesion," he explains.

"These particular liners also have a coloured indicator layer on the inner surface of the mill. When the red liner wears to the coloured layer, the operator knows that the mill needs to be stopped for a liner replacement. This prevents costly damage to the mill shell," Yatheen Budhu says.

"In this application, our Linatex rubber lasts between 12 to 14 months in ideal operating conditions – versus some competitor offerings that lasted only six months in this application," he notes.

One of three autoclaves at Weir Minerals Africa's Alrode plant used to cure rubber hoses as part of the manufacturing process.

Outside the workshop, Budhu shows *MechTech* a completed length of hose ready for delivery. It reads: 'Manufactured in RSA by Geoffrey'. "We stamp the craftsman's name onto each hose he produces. We have skilled people who are proud of their work and this stamp focuses their minds on maintaining high quality standards, a key goal throughout Weir Minerals.

"Our customised hose and lining facility combines the experience, skill and craftsmanship of our people with innovation and automation, so that the specific product and service quality requirements of all our different customers can be met," he concludes. ❑