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Creating super-fine rubber powders

A company in Georgia in the US is using cryogenic preprocessing and centrifugal screening to create super-fine rubber powders that spawn new applications and dramatic energy savings.

Lehigh Technologies combines a patented cryogenic preprocessing technique and a Kason centrifugal screener to turn recycled tyre granules into the finest rubber powders on the market. The company's fine, 177 to 104 microns, and super-fine powders, 104 microns and above, are opening new applications in sealants and coatings and expanding rubber powder consumption in new tyres and recaps.

Recycled rubber particles have long been used as fillers and performance enhancers for more costly elastomers. Approximately 454 million kg will ship this year for use in carpet underlay, flooring material, belts, hoses, engine mounts and dampers, wire, cable, paints and adhesives. While the market has been growing at a robust 25 per cent per year, even greater growth is predicted.

"As we make powders finer, the market for them becomes almost unlimited," notes Bill Meckert, Lehigh's vice president of engineering.

A number of manufacturers ship rubber powders 420 microns and larger, and a few produce up to 149 microns, but no one matches Lehigh's 60 micron rubber powder. Ultra fine powders in the 74 to 60 micron range are essential for applications, such as sealants and automobile undercoatings. These materials are applied with fine orifice nozzles that would clog if larger particles were used.

The smaller the particle size, the more rubber powder can be added to tyres and recaps. Finer particles present a larger surface area for bonding and, therefore, lower the risk of delamination. Since recycled rubber powder costs about half
the price of virgin material, the higher the powder content the greater the cost benefits. One kilogram of recycled rubber added to a tyre saves almost 8.5 litres of crude oil, the amount required to produce an equal amount of virgin rubber.

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Producing fine and superfine
Lehigh's manufacturing site is one of the largest and most advanced rubber powder manufacturing facilities in the world. Here proprietary technology is combined with commercially available industrial equipment to produce consistently sized rubber particles 420 microns and smaller that are sold under Lehigh's Polydyne label.

The raw stock is 100 per cent recycle content, granulated rubber obtained from tyre processors in sizes ranging from 19.05 mm down to 2000 microns. Delivered in bulk bags or truckloads, the material is dumped into a hopper and shaken to classify the granules into sizes between 3560 microns and 1410 microns. Granules exceeding 3560 microns are ground down before the sized material is stored in bins.

Upon demand, stock is drawn from the bins and fed by insulated screw conveyor into the liquid-nitrogen-cooled cryogenic chamber where temperature, typically between -73°C to -90°C, is regulated based on the particle size desired. Freezing turns the rubber granules into a glass-like state that fractures easily during grinding in a high-speed attrition mill. After size-reducing, the material passes through a rotary drum magnet to remove steel belting freed during the grinding process.

Simultaneous jobs
At this stage, the powder exhibits an oily texture and is electrostatically charged, causing the particles to agglomerate and making them difficult to screen. A flow aid such as finely ground talc or fumed silica is metered in and the mixture screw-fed into a Kason Model MO-CS Centri-Sifter centrifugal screener that blends the two, causing the rubber particles to separate.

Inside the screeners' horizontally-oriented cylindrical chamber, rotating helical paddles break up soft agglomerates and continuously propel the material against a 840 to 589-micron woven nylon monofilament screen.

The centrifugal force accelerates the on-size particles through the apertures and scalps any fibre from the tyre cord. The fibres ball up like cotton and are discharged through the open end of the screen cylinder, along with any oversized rubber and residual steel.
“The Centri-Sifter screener does everything simultaneously, which is why we use this equipment,” declares Meckert.

The Centri-Sifter centrifugal screener’s ability to work efficiently within the demanding production environment contributes to the quality of powder processed on the line. Its heavy-duty construction makes it well suited for continuous inline operations. The unit is compact and operates quietly with vibration-free action. A large access door facilitates cleaning, and screens can be changed in under two minutes.

The final step
Following the Centri-Sifter screener, the powder is discharged into a proprietary tumbler screening process that classifies it. The line produces 1134 kg/h of powder in sizes ranging from 420 to 60 microns, depending on the application.

“Our growing production will ensure a good supply of powder for our customers and enable them to lower their production costs by increasing the amount of recycled material in their products,” remarks Meckert.

In the future, Lehigh foresees blending rubber with plastics to increase their durability and flexibility, as well as to improve their UV resistance so they are less susceptible to brittleness and cracking from sunlight. This application, which is still in the embryonic stage, will require even finer rubber powders than are now being produced and, according to Meckert, the company’s centrifugal screener will adapt to the new requirements with a simple change of screens.

Rubber powder fillers increase the flexibility and durability of rubber-based materials, while reducing manufacturing costs. Each kilogram of rubber powder added eliminates approximately 8.5 litres of crude oil that would be required to produce an equal amount of virgin rubber.

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