Bulk bag discharger and flexible screw conveyor feed rough ground particles and rubber buffings to cracker mill. The bulk bag is loaded into the discharger frame by electric hoist and trolley suspended from a cantilevered I-beam. The wide frame accomodates open-bottom design bags.

Scrap Tires Reduced to Crumb Rubber with Help of Bulk Bag Dischargers

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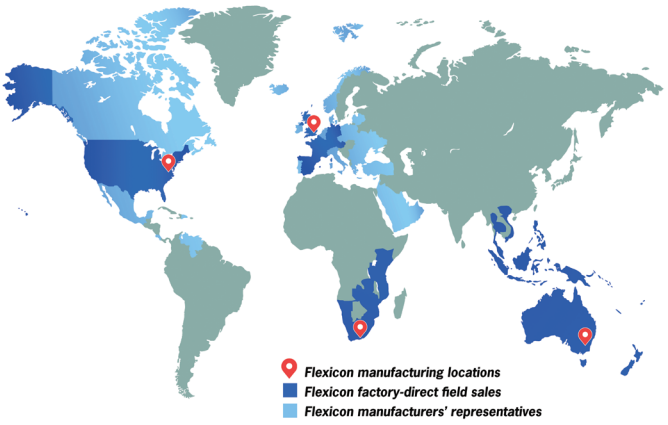

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Scrap Tires Reduced to Crumb Rubber with Help of Bulk Bag Dischargers

CHAMBERSBURG, PENNSYLVANIA — According to the U.S. Environmental Protection Agency, approximately 290 million scrap tires are generated in the United States each year. As recently as 1990, most of these scrap tires took up space in landfills or were dumped illegally. Today, many of them are recycled by companies such as Edge Rubber (www.edgerubber.com) into various grades of ground rubber, also known as fine mesh crumb rubber.

Markets now exist for 233 million (80%) of all scrap tires. Some 130 million (56%) of these scrap tires are burned as fuel. Another 56 million (24%) are used in civil engineering projects such as artificial reefs, while 30 million (13%) are recycled into ground rubber. Another 16.5 million (7%) scrap tires are retreaded.

Of the 30 million scrap tires recycled into ground rubber, some 6 million (20%) find their way to the Edge Rubber plant in Chambersburg, PA, the oldest and most successful facility producing fine mesh crumb rubber in the United States. One of the most efficient scrap rubber plants in the country, much of the plant's efficiency is attributable to its bulk raw material handling system utilizing six Flexicon bulk bag dischargers.

"On receiving the scrap tires, we first shred them into approximately 1/2 in. (1.3 cm) particles, which are gravity fed into 2,000 lb (907 kg) bulk bags," says Sam Kauffman, Vice President and Chief Operating Officer of Edge Rubber. "These rough ground particles make up 80% of the raw material that we process into fine mesh crumb rubber."

The other 20% arrives in small bags from tire retreaders that grind a portion of the tread from used tires prior to applying new tread to the carcasses, generating "buffings" that measure approximately 3/16 in. (0.5 cm).

Because Edge Rubber has eliminated manual dumping of small bags from its production process, it first transfers the contents of small bags into bulk bags which are stored, or discharged to feed ground rubber particles, along with rough shredded particles, to a cracker milling process to further reduce particle size.

Moving the rubber particles from the bulk bags to the cracker mills are six automated BULK-OUT® BFC Bulk Bag discharger systems with integral flexible screw conveyors from Flexicon. An operator loads a bulk bag onto the discharger frame by electric hoist and trolley on a cantilevered I-beam; the discharger unloads the particles into a 20 cu ft (0.56 cu m) capacity floor hopper from which a 15 ft (4.57 m) long flexible screw conveyor transports them into one of six cracker mills. Kauffman explains, "Four of these discharger systems are identical, one has a larger diameter flexible screw conveyor for faster feeding capacity, and one is a double discharge unit with two flexible screw conveyors that feed material to two cracker mills."

Once the bag is in place, the operator pulls the tied end through an iris valve, which prevents material flow while the bulk bag is being untied and allows controlled discharge of the material into the hopper once the bag has been opened.

Rough ground particles from shredded scrap tires comprise 80% of Edge Rubber's raw material.

Retread buffings from tire retreaders comprise 20% of Edge Rubber's raw material.

Crumb rubber particles that have been ground in the cracker mills are packaged for shipment to customers or conveyed to the micro milling process for reduction to the finest powders.

Due to the nature of the rubber particles, material flow from the bag can be inconsistent. In order to ensure continuous and efficient operation, FLOW-FLEXER® bag activation devices positioned on the frame continually compress and release opposite sides of the bulk bag to promote flow through the bag spout into the floor hopper.

The rubber particles flow from the discharge port of the floor hopper and charging adapter into the 15 ft (4.57 m) long Model 1450 flexible screw conveyor, designed to handle difficult materials and consisting of a flexible steel screw rotating inside a 4.5 in. (11.4 cm) diameter carbon steel outer tube. The screw is driven by an electric motor located at the discharge end of the conveyor, which feeds the rubber particles through a transition adapter into the cracker mill.

High and low level sensors in the floor hopper signal a PLC to activate the conveyor on reaching high level, and turn off the conveyor on reaching low level.

From the large hopper, two flexible screw conveyors transport ground rubber particles from the cracker mills to wet grind mills for the finest size reduction. Discharge chute (black) deposits the cracker mill grindings into the hopper.

Ambient grinding produces high quality powder

A typical tire shredded by Edge Rubber contains, by weight, approximately 70% recoverable rubber, 15% steel, 3% fiber and 12% extraneous material such as inert fillers. On average, one passenger tire yields 10 to 12 lb (4.5 to 5.4 kg) of crumb rubber.

The rough shredded particles and retread buffings are first ground in the cracker mills (ambient grinding) — the first of two size reduction processes that produce nine particle sizes ranging from 10 mesh (2.00 mm, 0.8 in.) to as fine as 200 mesh (0.074 mm, 0.003 in.). The cracker mills produce particles from 10 mesh (2.00 mm, 0.8 in.) to 30 mesh (0.60 mm, 0.02 in.).

A cracker mill tears apart scrap rubber by passing it between rotating serrated steel drums, reducing it to various sizes by adjusting the gap between the grinding rolls. The resulting long and narrow shaped particles have a large surface area and are suitable for applications including automotive, asphalt, and molded goods such as rubber mats and solid rubber wheels for carts and lawn mowers.

Crumb rubber particles discharged from the cracker mills are classified by sifting screens. Oversize particles are reintroduced to the cracker mills while the rest convey to the packaging line or to the next process, micro milling, for reduction to the finest powders. Magnets remove wire and other metal contaminants. Fabric is removed by aspiration and screening.

At the discharge end of the flexible screw conveyor, forward of the electric motor, ground particles gravity feed through a transition adapter and downspouting into the micro mill.

Micro milling produces the smallest, cleanest particles

Wet grinding, or micro milling, produces cleaner, finer mesh particles. “While it produces particles as coarse as 40 mesh (0.40 mm, 0.016 in.), the majority of the particles are 60 mesh (0.25 mm, 0.01 in.) and finer. A percentage of the overall throughput, in fact, is finer than 200 mesh (0.074 mm, 0.003 in.),” says Kauffman.

In wet grinding, the crumb rubber particles are mixed with water to create a slurry, and proceed through micro mills. When the desired size is achieved,

Edge Rubber’s micro milled, cleanest and finest particles have a unique shape for maximum surface area, yielding performance advantage in applications requiring strong bonding or high tensile strength.

the water is evaporated from the slurry and the particles are dried and classified. An advantage of wet grinding is the cleanliness and consistency of the fine crumb rubber produced, as the process “washes” the crumb rubber to remove the last traces of fiber.

These particles have a unique morphology, or surface structure, and are often sold as additives to improve the performance of injection molded and extruded plastics. Although most wet milling processes produce particles with a smooth surface, Edge Rubber’s proprietary technique yields particles with a rough surface and unique shape for maximum surface area. They offer superior performance for applications requiring strong bonding or high tensile strength in industries such as automotive, sealants, specialty coatings and custom compounding.

Most of Edge Rubber’s wet milled particles are packaged in pre-measured batch-inclusion bags that are placed directly into the customer’s molding process and then disintegrate by melting at a low temperature. The rest of the wet milled particles, along with the larger particles produced by the cracker mills, are shipped in various size bags to customers in the United States and internationally.

“Thanks in large part to our bulk bag discharging equipment, we are one of the most efficient scrap rubber recycling plants in the United States,” concludes Kauffman.

Micro milled particles are packaged in pre-measured batch inclusion bags to be placed directly into the customer’s process.

Finished powder ships to customers.

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