

# A Higher Purpose For Scrap Rubber

Surface treatments and devulcanizing agents promise to vault crumb rubber into higher-end products, but some processors and engineers have doubts.



**T**

he history of the processing and selling of rubber and other material from scrap tires is one of unfavorable economics and heartbreak for processors who bet on the success of a certain technology or on markets for end products. Today, recyclers, industry and academia are trying to buoy the market for scrap rubber by moving beyond low-tech end uses and creating higher-end markets for the material.

At the forefront of this movement are high-tech binders, special surface treatments and even proclaimed devulcanizing agents. But engineers in the tire industry have their doubts about some of these methods.

## THE DEVULC DEBATE

The feasibility of devulcanization has been the source of much debate in the rubber industry ever since a company called STI-K, based in Malaysia and with an office in Washington, announced more than a year ago that it could break the sulfur bonds in cured rubber. The company promised to turn recycled rubber into rubber with "virgin-like qualities" with its De-Link chemical process.

STI-K has set up a devulcanizing operation in South Bend, Ind., that produces several million pounds of crumb rubber from whole tires annually. The company has sold the process to American Tire Recyclers, Jacksonville, Fla., which will be starting its own devulcanizing plant soon. STI-K has also licensed Custom Cryogenics, Simcoe, Ontario, to toll process factory scrap using its devulcanizing method. Finally, STI-K officials say that they have about a dozen rubber product manufacturers that buy the De-Link chemical to treat rubber scrap.

"Currently, De-Link adds about 3 to 10 cents a pound, plus associated factory costs," says Fred Siesseger, president of STI-K America.

Another devulcanizing technology that uses ultrasound was developed by a pro-

*By Mark Phillips*

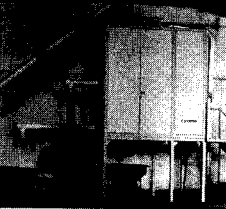
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fessor at Akron University, Akron, Ohio. However, there are currently no known companies using this method.

While some companies are touting devulcanization as the savior of crumb, there are many others in the industry that have doubts. One scrap tire processor who has been associated with the tire and scrap tire industry for decades does not believe in devulcanization.

"I have talked to chemists and compounders in the tire industry and they say devulcanization is impossible," he says. "I have watched the demonstrations at shows and all these companies are doing is adding natural rubber and sulfur to fine recycled crumb. They also add a magic potion, but I think it's really the natural rubber that they are adding that makes it work because natural rubber has such good properties."

Engineers at Goodyear Tire & Rubber, Akron, Ohio, are also highly skeptical. "Rubber is a thermoset material and you can't change that," says Jack Zimmer, a business and technology analyst who has more than 40 years in the tire industry. "I'll never say never, but to date we feel that there aren't any treatments out there that can devulcanize rubber or change its state."

Crumb rubber can only be used as a filler, claims Zimmer, and this limits its use to lower-end applications like mats. "It's not like a metal that can be remelted and its chemistry adjusted," he says. "Rubber is totally different."

Part of the problem also revolves around the many different kinds of compounds and rubber blends in tires, not to mention the different compounding methods between tire manufacturers.

Although Michelin is currently road testing new tires with about 10 percent by rubber weight of recycled crumb, Zimmer is cautious about the results reported so far. "I understand that those tires still are not quite where they need to be to deliver the performance of a tire made from virgin materials," he says. Michelin would not comment fur-

ther from a previous statement, but would say that the tires are currently being tested by taxi cab fleets.

"Every good chemist was taught that devulcanization is impossible, so we understand the initial disbelief," counters STI-K's Siessesger. "The only market barrier we face is the mindset of the industry. Devulcanized rubber is currently being included in tread rubber used on retreads overseas, in shoe soles, and in a wide range of other products including automotive applications."

### SURFACE TREATMENTS

Surface treatments are another way companies claim they can reconfigure recycled rubber to make it more receptive to binding. These treatments involve adding certain chemicals or oils or subjecting the rubber to a gas that makes the surface of the crumb more reactive and receptive to binding with other polymers. Once again, though, some in the industry are skeptical about these methods.

## PRICE STABILIZATION FOR CRUMB RUBBER

While some processors say they are battling a soft pricing structure for crumb rubber, others see a silver lining on the horizon and say that pricing has leveled. "The price for crumb rubber has stabilized and may even be gaining some momentum," says Victor Sibilia, president of EnviroTire, Lillington, N.C. "End users are finding out that the lower priced crumb carries with it some unwanted baggage, meaning there are too many contaminants. Those crumb producers that adhere to making a high-quality product will get high-quality prices."

Mike Rouse, president of Rouse Rubber Industries Inc., Vicksburg, Miss., agrees. "Overall, the market for crumb is strengthening as more manufacturers are finding out how to use more recycled crumb and processors are pushing their products into these new markets."

Crumb rubber pricing seems to be in the 8 to 30 cent range a pound, depending on crumb size. "Right now, we are getting 8 to 10 cents for 10 mesh; 10 to 12 cents for 20 mesh; 13 to 15 cents for 30 mesh; 15 to 18 cents for 40 mesh; and 28 to 32 cents for 60 mesh," says one processor. Another processor is getting 10 to 12 cents for 4 to 6 mesh, 11 to 13 cents for 10 to 20 mesh, and 15 to 18 cents for 40 mesh, while another is getting 12.5 cent for 10 mesh, 17.5 cents for 40 mesh and 27.5 cents for 80 mesh.

One company, Tyreplex Corp., Downingtown, Pa., claims it can convert crumb rubber from a thermoset into a thermoplastic material using its surface treatment process. "We have proprietary additives and equipment," says John Kuc of Tyreplex. "The beauty of our system is that once the crumb has been treated you can use it in extrusion molding operations."

To date, Tyreplex has licensed its technology to two processors, and has three more licenses pending in Europe. The process costs about 6 cents to treat one pound of crumb.

Surface treatments also include exposing the reclaim to a fluoride, bromide or other gas to activate the surface of the crumb.

Other companies that have developed surface treatments include National Rubber Baker Materials Inc., Toronto; Composite Particles Inc., Allentown, Pa.; Rouse Rubber Industries Inc., Vicksburg, Miss.; Rubber Research Elastomerics Inc., Minneapolis; and Urethane Technology Inc., Santa Ana, Calif. Some of these companies

have had their surface treatments on the market for more than a decade.

Alex Chin, a rubber industry consultant with a doctorate degree in chemical engineering, combines a reactive plastisizer surface treatment with devulcanized rubber to make a super rubber that he claims has nearly the same tensile strength as virgin material. Chen has about 20 corporate clients, with his biggest one being Rubbercraft Inc., Orlando.

Composite Particles uses a reactive gas to treat crumb rubber, and is using treated rubber in products such as wheelchair wheels, the drive rollers of escalators, anti-slip and latex coatings, boot soles, and carpet underlayment.

"It's unfortunate that surface treatments are not widely accepted in the United States," says one manufacturer. "That's why we have plants overseas."

Another maker of surface treatments is tired of negative comments from companies like Goodyear. "They obviously have their own agenda, and that involves using tires as fuel. Overall, the tire manufacturers don't want to

admit that they can reuse scrap rubber in tires because then it becomes an albatross around their necks in the form of producer responsibility."

### THE BEAUTY OF BINDING

Another area related to crumb rubber usage in higher-end products involves binders - specially formulated "glues" that hold recycled crumb together. In this area, there seems to be no controversy in the industry. There are several companies with binders on the market, including Futura Coatings Inc., St. Louis, and Uniroyal Chemical, Elmira, Ontario, which sells a binder called Royalbond.

Since binders only hold crumb together, the crumb does not need any special treatments, according to Terry Drudge, worldwide marketing specialist of urethane binders for Uniroyal Chemical. "Plus, processing times are two to three times faster than devulcanizing methods," he says, "and products made with a binder can be recycled over and over again."

Most of the products made with a

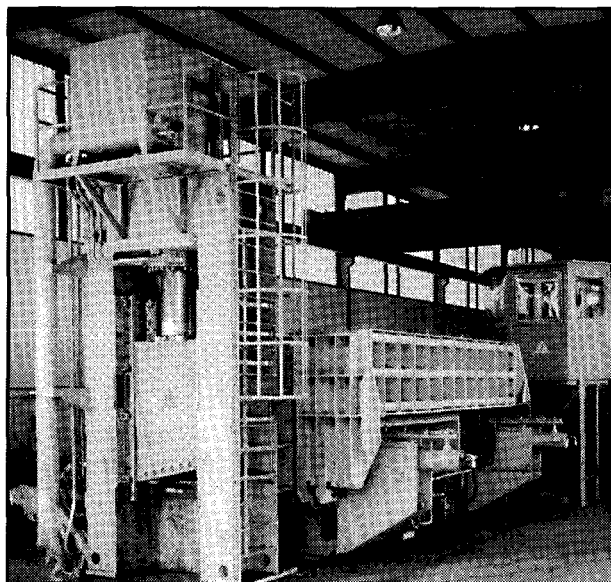


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binder are compression molded, and include mats, bumpers, railroad ties, patio bricks and curb stops. "I have a list of more than 70 products that are made with our binder," says Drudge. Overall, Drudge says that molded products from crumb seem to be growing at about 20 percent a year.

Binders sell between \$1 and \$1.60 a pound, and typically add about 3 percent to 8 percent by weight to a molded product.

### PUSHING PRODUCTS

While the debate rages on concerning crumb rubber treatment methods, processors and manufacturers are busy pushing the envelop to make higher-end products out of crumb rubber.

"Nike's Indestruct tennis shoe is made with recycled rubber, and if you have ever played tennis, you'll know the beating a shoe can take," says Victor Sibilgia, president of EnviroTire, Lillington, N.C., a producer of recycled crumb.

Sibilgia is traveling to China to meet with manufacturers of bicycle tires to discuss the use of recycled crumb in their products. He also says his company has used crumb in the tread rubber of retreads. "Our tire, which contained 25 percent recycled crumb in the tread, was tested by an independent lab and it was found to be just as good as one using virgin feedstock. Now all we need is a tire company to help us take the next step."

Another processor, Larry Sehman, of Sehman Tire, Franklin, Pa., says he believes that companies are experimenting with higher-end products that use a high percentage of recycled crumb, but says it would be difficult to find out exactly what these products are because companies guard their research closely.

"I don't think we really know what the limits of recycled crumb usage are right now in higher-end products," says Sehman. "There needs to be more performance-based testing to determine the upper limits, and those tests need to be published."

There is also ongoing research to try and combine recycled crumb rubber with plastics to produce products with the rigidity and strength of plastic, but the elasticity of rubber. One company working with rubber/plastic blends is Creative Chemical Co., London, Ontario. "We have developed several new formulations in blending rubber and plastics," says P. Raja, president of Creative Chemical. "In the case of crumb rubber-plastic blends we are us-

## CRYO VS. AMBIENT

There are currently two main types of grinding methods available to crumb rubber producers - ambient and cryogenic. In an ambient system, mechanical shredders, grinders, high-speed granulators and slow-speed crackermills reduce the tire to crumb; while in a cryogenic system, the tire is frozen, usually with dry liquid nitrogen, and then pulverized by a hammermill to achieve crumb.

Proponents of cryogenics claim that this method allows them to achieve a smoother crumb particle that flows better and can be made as fine as 100 mesh.

Advocates of the ambient method say that they don't have to worry about handling liquid nitrogen and its associated costs. They also claim that an ambient system can make crumb that is of equal quality to cryogenic-made crumb, and that ambient crumb actually has more surface area for binding.

"Overall, the differences between ambient and cryogenic crumb are not as black and white as one might expect," says one processor.

ing different types of coupling agents that can chemically react with both crumb rubber and matrix polymers. In some cases we have used a reactive alloying concept, where the additives co-react at the interface between the crumb rubber particles and the matrix polymers."

Overall, there has been a lot of hype with surface treatments and devulcanizing, according to Rouse, and it's hard to sort out all the facts concerning what is happening in this industry. "The important thing is to preserve the rubber molecule as best you can for its properties," he says. "This is done by making the crumb clean and uniform with no fiber or steel, and the same size through sieving; having a consistent chemistry; understanding the compound you are dealing with; and adjusting the formula to fit the need.

"We have to get crumb rubber into higher-end applications," continues Rouse. "All you have to do is look at our world of diminishing resources - that will eventually drive crumb rubber into more products." **RT**

*The author is managing editor of Recycling Today.*