Rubber to the Road

New laws push the addition of recycled tires to asphalt

By ELIZABETH PENNISI

What do you do with an old tire that's really too bald to drive on any longer? Why, grind it up, add it to the roadway and drive on it some more.

That seemingly silly notion is being taken quite seriously these days by engineers and legislators alike as a possible means of improving the nation's highways while reducing its ever-expanding — and potentially hazardous — stockpile of worn rubber tires.

Engineers have experimented with ground rubber in roadways for decades, but new laws are pushing transportation agencies to expand the use of this material, says Michael A. Heitzman, a pavement engineer with the Federal Highway Administration in Washington, D.C. The federal Intermodal Surface Transportation Efficiency Act, signed into law last December, requires that 5 percent of asphalt laid using federal aid in 1994 must contain scrap rubber from tires. That translates into more than 3,000 miles of rubberized roadway that year, and the law requires the percentage to increase over time. Also, at least 44 state legislatures have contemplated roadways as a means of getting rid of some of the 285 million vehicle tires discarded each year, according to Heitzman.

Two basic technologies exist for blending ground tire into roadways. In dry processes, engineers mix coarse rubber grains with stone and sand. They then bind this "aggregate" with asphalt cement, the gooey, petroleum-refinery waste that makes roads black and holds the stone, sand and, now, rubber together. In wet processes, engineers heat the rubber and asphalt cement together first to make an asphalt rubber, a thicker goo that replaces asphalt cement as a binder material. Ongoing research has made these processes more compatible with current highway construction and repair practices, says H. Barry Takallou, an engineer with BAS Engineering Consultants, Inc., in Irvine, Calif.

Old tires can serve several functions in roads. Many highway departments already use ground rubber on a limited basis in mixes for repairing cracks or treating road surfaces to make them stronger. More recently, engineers have tested rubberized asphalt in roadway construction in hopes of making the road more resilient and longer lasting.

Tire rubber contains antioxidants that can slow aging of asphalt pavement. In addition, asphalt rubber binder coats the aggregate more thickly, and thicker coatings retard aging, says Gale C. Page, state bituminous materials engineer for the Florida Department of Transportation in Gainesville.

Some states have already begun making the transition to rubberized roadways. While some experts worry about cost increases caused by this additive, others expect the improvements to outweigh the extra cost. However, questions remain about the long-term effects of adding rubber to the roads.

About 15 years ago, California was struggling to come up with roads that could better withstand freezing and thawing and the grinding of tire chains in the state's snowbelt. Transportation engineers decided to try rubber-modified asphalt cement. Success there has led the state to apply increasingly thinner — and consequently cheaper — paving layers, says Jack L. Van Kirk, a materials engineer with the California Department of Transportation in Sacramento. In California, workers can put down a rubberized top layer only half the thickness of a typical asphalt top layer; yet the thinner layer apparently works as well, Van Kirk reported in January at the annual meeting of the National Research Council's Transportation Research Board, held in Washington, D.C. Now the state is looking at whether a coat of rubberized asphalt can keep pavements in Southern California from developing the tiny cracks caused by the hot sun and the constant pounding by trucks, he adds.

For the past two years, many East Coast snowbirds have unwittingly served as volunteers in another rubberized-road project, this one in Florida. Drivers on Interstate 95 in northern Florida probably never realize that they travel over about a mile of pavement made with an asphalt rubber, says Florida's Page.

Page's department uses an asphalt that contains very finely ground rubber tires as part of the binder, "which is new to the technology," says Heitzman. The Florida group discovered that the finer rubber grains enabled them to use less rubber and lower mixing temperatures. Because the very fine grains blend faster, workers laying roadway do not have to delay construction to wait for the rubber to mix in with the asphalt, says Page. Also, by using less rubber, the engineers do not have to modify their procedures for assessing pavement quality to account for differences between rubber-containing and regular pavement, he adds. Overall, Page estimates that state, city and local highway departments could use up to half of Florida's waste tires this way.

There are drawbacks, however, to recycling tires for road use. Adding rubber increases the cost of the pavement by as much as 100 percent. "That's a hard pill for state agencies to swallow," says Heitzman. Aside from cost, engineers worry that they will not be able to recycle asphalt that contains tires. Currently, highway departments often reprocess and reuse asphalt that they have removed from roads.

Florida's experience seems to show that the extra cost presents no serious drawback. In one analysis, Page's group found that rubber asphalt pavement needs to last just three months longer than normal pavement to pay back the extra cost. "We feel that the additional cost of adding the rubber will be offset by the performance," says Page. California's engineers found they could make rubber asphalt more cost-effective by laying it in thinner layers, notes Van Kirk.

Not everyone agrees that the technology used in Florida is really that beneficial. "We've found that some of these so-called improvements haven't functioned as advertised," says Gary L. Cooper, a civil engineer with the Asphalt Rubber Producers Group.

Other researchers are looking at different ways to get rid of old tires. Chang-Yul Cha, a chemical engineer at the University of Wyoming in Laramie, melts pieces of old tires in a soup of waste motor oil to make a lighter oil that then can be refined into gasoline and diesel fuel. The residue from this refining process is a useful additive for slowing asphalt aging. This technology should cost much less than processes using ground-up rubber in asphalt, Cha told SCIENCE NEWS.

Taking a much different tack, scientists at the Georgia Institute of Technology use shredded tires to clean wastewater from food-processing plants. Other groups want to burn tires as fuel in power plants.

So, in time, whether with rubber in the road or tires in the fire, those mountainous stockpiles should diminish. □