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making Tracks

WISCONSIN GETS ROLLING ON TIRE RECYCLING

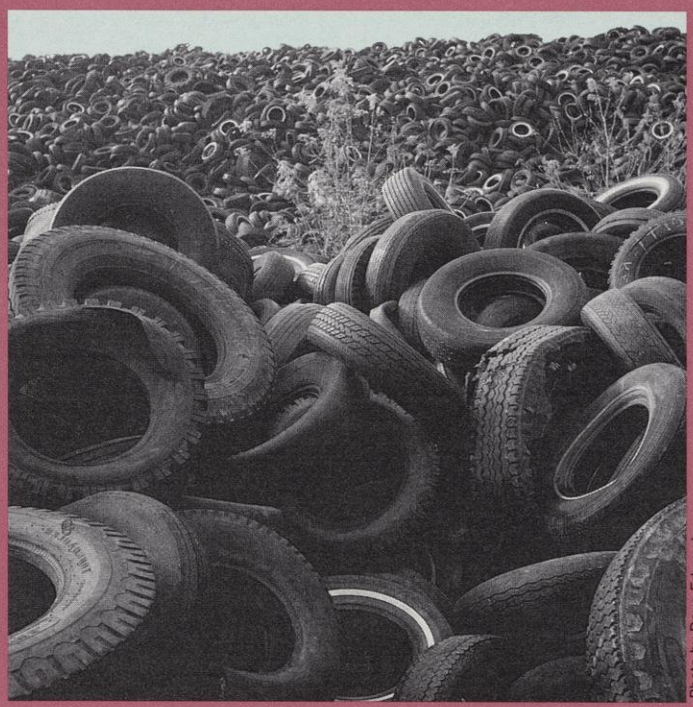
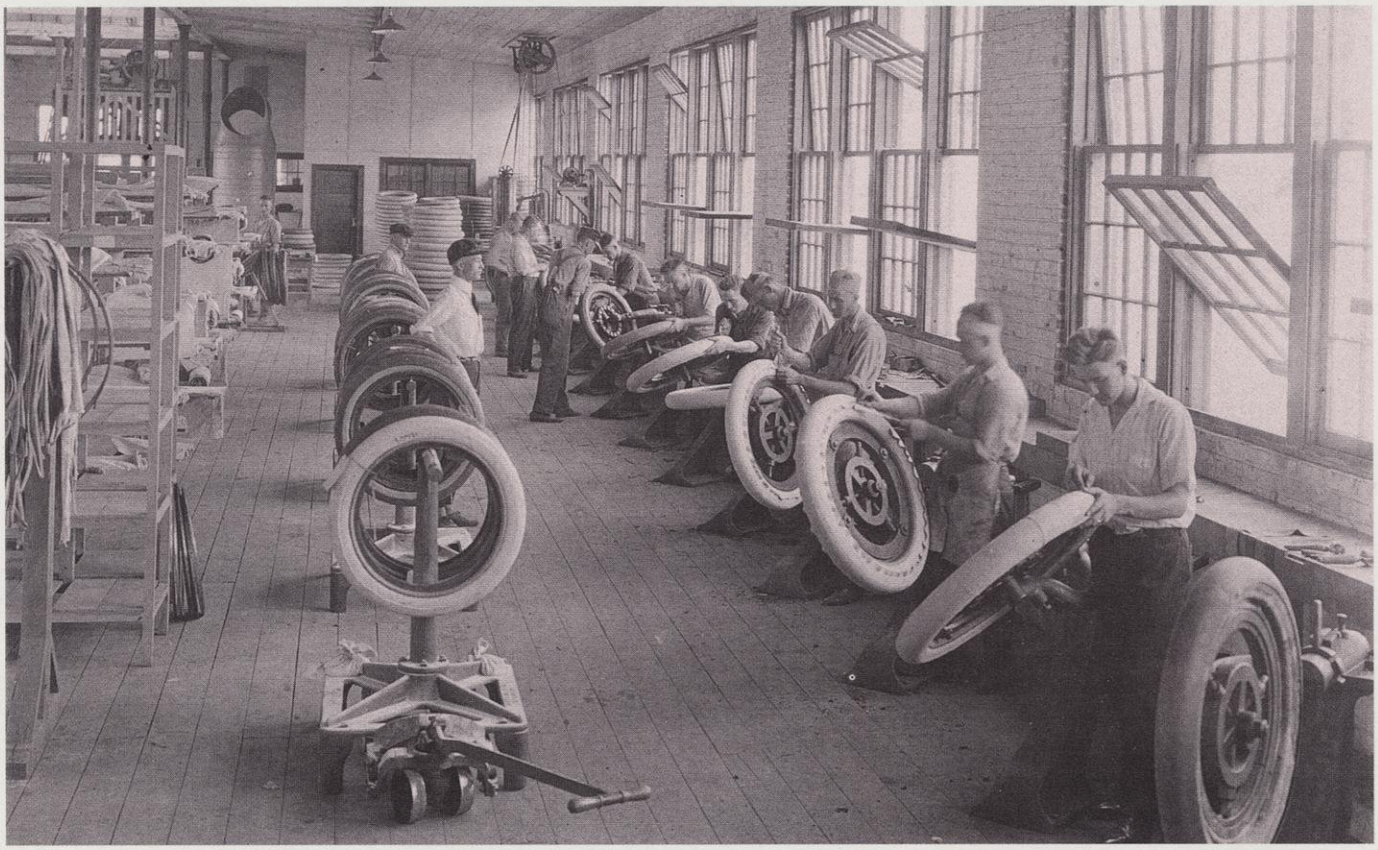


Photo by Dave Edwards

Coordinated and written by Maureen Mecozzi
Wisconsin Department of Natural Resources

Vulcan's children

A tale of inspiration, mythology and chemistry to start your tire education rolling.



It's 1919, and workers at the Boone Tire Factory, Chippewa Falls, roll 'em out. Canvas plies were hand-stitched to wooden rims to build "clinchers."
Photo by A.A. Bish courtesy of the Iconographic Collection, State Historical Society of Wisconsin

Charles Goodyear, the eccentric Connecticut inventor seduced by the charms of natural rubber early in the 1800s, might be surprised to find that a century later the precious substance he developed was primarily used to make something as mundane as tires. He'd be even more surprised to discover that the company now bearing his name (which he did not found) is the largest tire maker in the world.

Goodyear had other plans for caoutchouc — the sticky, milky liquid bled from *Hevea brasiliensis,* a rubber tree native to tropical Central and South America. He envisioned broad sails for clipper ships, air-inflated saddles and boxing gloves, imitation buffalo robes and waterproof "baptizing dresses" for clergymen. Without Goodyear's pioneering work in the lab, however, mass production of pneumatic (air-filled) tires might never have been possible.

In 1839, after years of experimentation, Goodyear developed a way to combat natural rubber's tendency to harden in cold weather and become soft and sticky in hot weather. By adding sulfur to caoutchouc and heating the mixture, he created a substance that was tough, nonadhesive and pliable across a wide range of temperatures; adding lead or other metallic oxides hastened the process. Goodyear dubbed the resulting product "metallic gum-elastic," but a British competitor with a flair for the dramatic crowned it "vulcanized India rubber," invoking the name of Vulcan, the ancient Roman god of fire. The process for manufacturing syn-

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thetic rubber has been called vulcanization ever since.

Tires today are a mixture of several ingredients: natural and synthetic rubber; carbon black, a pigment that helps resist scrapes and wear; sulfur; zinc oxide and stearic acid to promote faster chemical reaction and tire elasticity; benzoic acid to temper the chemical accelerators; antioxidants to slow tire aging and cracking; and oil to more easily mix the goo. Although the basic rubber ingredients may be similar, the exact tire recipe varies widely among tire manufacturers. Each blend directly affects tire performance. But we're getting ahead of the story.

Rubber can be made either hard or soft by varying the sulfur content added during vulcanization. Soft rubber has about two percent sulfur; hard, 35 percent.

Most carriages built after the 1840s featured solid, hard rubber tires; bicycles rolled on the same. Then an enterprising 23-year-old Englishman, Robert William Thomson, adapted Goodyear's concept of air-filled rubber items. He received a patent for the pneumatic soft rubber tire in 1845 and manufactured them for two years, but the tires were considered a novelty and never caught on. He went back to making solid tires, and when Thomson died in 1873, the pneumatic tire expired with him.

An 1880s biking surge resurrected the air-filled tire. John Boyd Dunlop, a Belfast veterinarian and cycling enthusiast, sought a way to make cycles faster and more comfortable. Dunlop fashioned a new pneumatic by replacing the heavy, solid rubber tires with a sheet of thin, soft rubber; a nipple from a baby bottle for a valve and a strip of old dress linen to protect the rubber from the wooden wheel rim. His air-filled bicycle tire was the foundation of the Dunlop Corporation, now the world's fourth largest tire manufacturer.

When horseless carriages sputtered on the scene in the 1890s, inflatable tires became a necessity. Solid rubber tires provided a teeth-rattling ride, and they overheated at auto speeds faster than 15 mph. The Michelin brothers, Edouard and Andre, made the first pneumatic tires for motor vehicles in Europe; the B.F. Goodrich Company snagged that honor in the United States. (In case you were wondering, the companies are currently second and seventh, respectively, in worldwide tire production.)

Tires 1, driver 0 — a blowout cripples an old touring sedan and an appointment.
Photo from the Iconographic Collection, State Historical Society of Wisconsin

The first widely used pneumatic automobile tires — canvas ply "clinchers" — were made of layered, rubber-coated canvas strips that encircled an air-filled tube. The bead, which maintains the shape and holds the tire tightly to the wheel rim, was also made of rubber. It was difficult to stretch over the rim when tires were mounted or changed.

Clinchers fell victim to new technology when the Goodyear Company embedded braided steel wire beads in the sidewall. The "straight-sider" led to the universal rim, precursor of today's wheel rims.

Building tires today

Surprisingly, tires are still made almost entirely by hand, using assembly methods similar to those from the turn of the century.

The tire builder begins on the inside and works outward, placing two circular rubber-coated wire beads on a revolving cylinder, slathering them with cement and layering on plies — strips of parallel, rubber-coated cords.

The first strip, the band ply, is cut wide enough to overlap the bead and long enough to fit the tire circumference. Originally, tire plies were made of cotton cord; after World War II, the natural fiber was replaced by rayon and nylon. Cords made of

Vulcanization — the elastic link in synthetic rubber

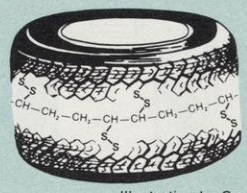
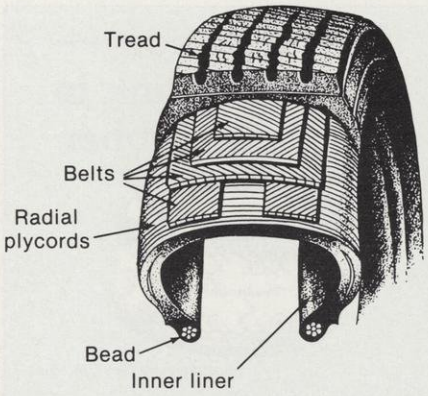


Illustration by Georgine Price

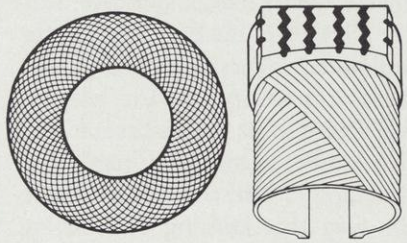
One must delve into a short chemistry lesson to appreciate the marvel of resilient, durable rubber. Rubber is a polymer — a chemical substance consisting of long chains of molecules made up of many smaller molecules. The small molecules (monomers) which are the building blocks of polymers, are linked by strong double bonds, which give rubber its elastic stretch. When rubber is heated with sulfur and various accelerators — that is, when it is **vulcanized** — some or nearly all of the double bonds are broken. The parallel chains of carbon-sulfur polymers are cross-linked, which makes synthetic rubber a little less elastic, but gives the individual layers of rubber molecules a "memory" so the material will return to its original shape after the rubbery material has been stretched or stressed. It's similar to the way that knitting or weaving thin strands of yarn can form a strong fabric that is stretchy while retaining its shape. Rubber can be vulcanized with a higher percentage of sulfur to form harder, less elastic compounds that need to be tough like rubber car bumpers.



Tires are still largely made by hand. Plies are laid in thin layers over the bead and a tough-wearing tread covers this flexible, durable core.

polyester, fiber glass, steel or aramid (aromatic polyamide fibers, better known to avid canoeists as Kevlar) are most commonly used today.

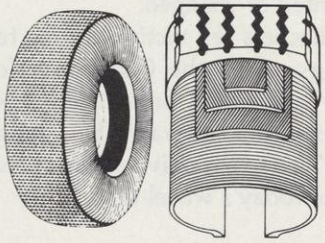
Passenger tires may have two, four or six plies of cord; tires made for large, off-road equipment may have 20 or more plies. In a **bias** ply tire, the ply cords run diagonally from bead to bead, each layer crisscrossing the other. In **radial** tires, however, plies run straight across the tire from bead to bead.



The bias ply tire with its crisscross alignment of ply cords helped millions of Americans "see the USA" by road through the late 1960s, when radials became favorites.

After the plies are built up, belts made of polyester, fiber glass, steel or aramid are layered over the tire circumference. The belts help to reduce tread motion when the rubber meets the road. Next, a length of rubber the circumference of the tire with thin, floppy sides and a thick top is wrapped over the belts. A water bag is fitted inside the casing, and the tire is placed in a tread mold ready for curing in a steam vulcanizer. The newly-formed tire is trimmed and inspected after curing and the water bag is removed. Tires were equipped with inner tubes until 1956, when the tubeless tire came on the scene.

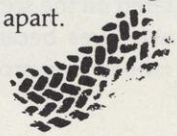
Bias construction lends rigidity to both the sidewall and the tread; it was the most common U.S. tire design for many years. Radial construction, popular in Europe since the 1940s, really didn't catch on here until the energy crisis of the 1970s.



Radial tires — the plies run straight across the tire from bead to bead. Radials deliver a more comfortable, fuel efficient ride than bias ply tires, and can handle heavier loads.

Radial construction provides more flexible sidewalls and less rolling resistance than stiffer bias plies. The resulting tire improves fuel efficiency. The flexing sidewall allows the tread to hug the road while the belts keep it flat, reducing wear. Road-hugging radials give more comfortable rides and can handle greater loads than their bias counterparts. Best of all, radials generate less heat than bias tires — and heat is the greatest single factor in tire deterioration. Consequently, a radial casing is usually in good condition even after the tread has worn away, and a casing that can be retreaded means one less tire must be made or discarded.

Now that you know how tires are put together, think about how tough they must be to take apart.



Tires of tomorrow

Back in the 1960s, a hot rodder seeking the ultimate "skins" would have purchased a set of Goodyear's translucent "glow tires" — each one lighted from within by 18 tiny bulbs. Future tire shoppers, however, will never stand for such frivolity. They'll be looking for high quality, long lasting "rugs" and, as tire technology improves, it's likely that shoppers will have no problem finding them.

Tires lasted an average of 3,000 miles in 1914. Today, a top-of-the-line tire will rack up at least 60,000 miles — more if you take good care of it.

"The tire manufacturers are making them tougher all the time," says Lloyd Stoyer, editor of *Modern Tire Dealer*, a trade magazine. "It's conceivable that someday that figure could reach 100,000." New substances such as aramid — the Kevlar of canoe fame — will continue to be incorporated into tires to add strength and increase longevity.

According to Stoyer, tire manufacturers are constantly experimenting to reinvent the rubber wheel. A German company, for instance, has developed a "run-flat" tire that keeps going even if it's punctured. Will consumers want it? Stoyer doesn't think so. "Flats aren't as common as they used to be," he observes. "That tire will probably be obsolete before it gets on the market."

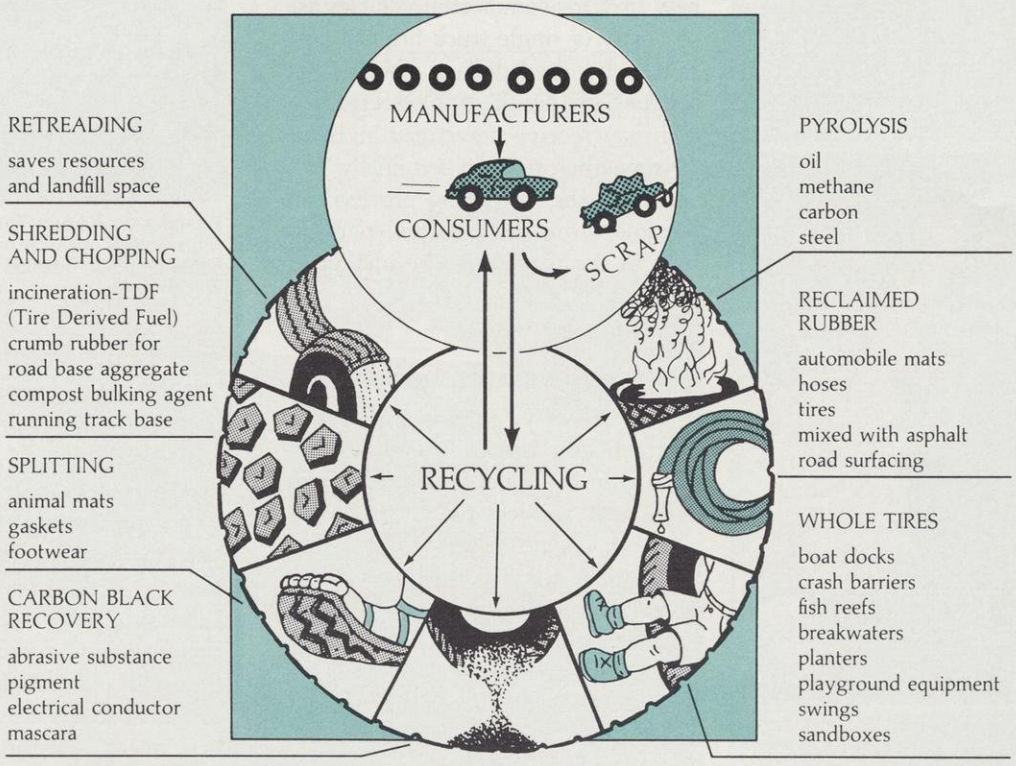
"Skinny spares" — the smaller, lighter, short-distance spare tires standard on most 1980s cars — may be shelved by a new, nonpneumatic spare Uniroyal is developing for General Motors. The new tire is solid polyurethane covered with rubber tread. It's lighter, smaller and even thinner than the skinny spare, and will probably be stored in a door panel or under a seat, leaving trunk room.

"It's noisy and rough-riding," Stoyer says of his ride on a nonpneumatic, "but it's stable. It will safely get you where you want to go."

Any chance that the tires of the future will be biodegradable? "I doubt it," says Stoyer. "Not unless they start making them out of cardboard."

Rubber soul

Sliced, diced, rewrapped or burned, there are lots of ways to rekindle the spirit of leftover tires.



Tires can be recycled many ways. Spent road warriors live on in other products.

Illustration by Georgine Price

2,000,000,000. Two billion. Look at those zeros closely. Imagine that they represent tires — scrap tires. The worn-out, useless tires stockpiled all around the United States. Try another figure: 240,000,000. That's the number of tires discarded in the country every year.

Look a little closer to home. You'll see 20,000,000 scrap tires cluttering the Wisconsin landscape. Each year, add another 4,000,000 to the pile — almost one for every man, woman and child in the state.

It's a rubber nightmare.

Methods of recycling scrap tires have been around almost as long as the tire itself. Yet no one anticipated that someday, waste tires would be discussed in figures normally heard in astronomy classes. There is no single best way to process all of Wisconsin's waste tires, but by employing a variety of recycling technologies, the scrap tire problem could be brought under control within a few years. And then, those "useless" tires would suddenly become a valuable commodity.

Here are a few ways to get more than just mileage from your tires:

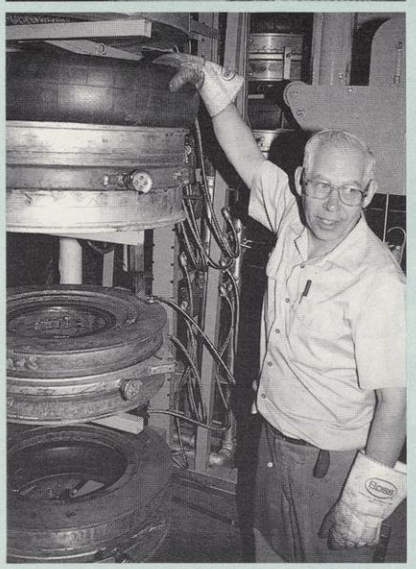
Retreading

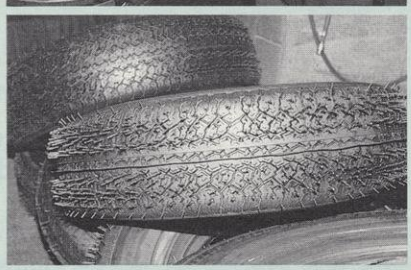
There's an axiom in the tire industry: a worn tire is a proven tire. Meaning if there's a weakness in a new tire, it will usually show up early in the tire's life. If the tire carcass is still good by the time the original tread has worn away, the casing can be successfully retreaded one or more times.

Each tire retreaded is one less tire that must be made or discarded. It takes five gallons of oil to produce a new tire, but only two to retread an old one. So why are only 10 percent of all passenger tires retreaded today, compared with 25 percent a decade ago?

Blame progress. When the radial tire was introduced in the United States in the early 1970s, tire recappers got caught with their tread down. The new radial casings — more flexible than their bias counterparts — were difficult to retread; often the final product was less than satisfactory. Passenger car retreads got a reputation for unreliability, which lingers today despite improvements in retreading techniques.

A retread, which generally costs about half as much as a new tire, usually lasts only half as long. According to Frank Ryan of the Rubber Manufacturers Association, the market for retreads traditionally has been among people in lower economic brackets, consumers who, perhaps, cannot af-





In the mold method of retreading (top three photos) a thick layer of rubber is wrapped around a tire casing. The prepared casing is set in a tread mold, heated and pressed. Rubbery nibs are trimmed and recycled after the fresh retread cools. (bottom photo) Using the precure method, a casing is buffed and preformed tread is bonded and vulcanized to the tire. Photos by Robert Queen

ford to buy new tires. Low-cost imported tires have also hurt the retread market.

However, passenger cars are not the sole retread market. About 40 percent of all truck, bus, airplane and off-road vehicle tires manufactured in the United States are retreaded. Since new tires for commercial vehicles are so costly (a single truck tire can cost several hundred dollars), the casings are specially designed to be retreaded and may receive new tread eight or 10 times before they are finally discarded. If the retreading process can become more competitive, particularly in the passenger tire market, it could help alleviate the scrap tire problem.

Reclaiming

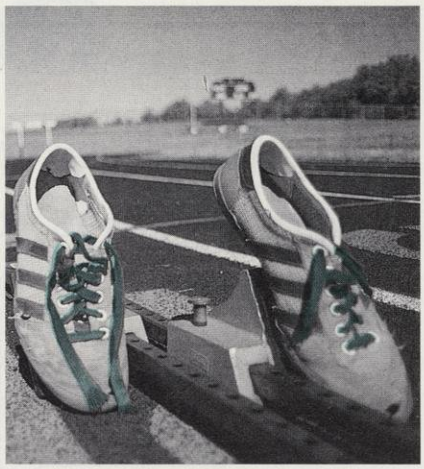
For 70 years, rubber reclaimers mechanically ripped the rubber in tires from the belts and beads, then used heat and chemicals to devulcanize it. The result was a pliable rubber suitable for making hoses, belts, tires, inner tubes, mats, shoe soles, toys and more. But the high energy costs of reclamation and competition from inexpensive synthetic rubbers and plastics have made the process uneconomical. Today, only five percent of the nation's scrap tires are reclaimed as rubber.

Split rubber

In this long established method of tire recycling, the tread is stripped from old tires, then flat rubber products are stamped out of the tread. Lining for muffler and exhaust pipe brackets, gaskets, door mats and shoe soles are just a few of the many items made from scrap tread.

Shredded rubber

Whole scrap tires go into the maw of a shredder — bead, belt and all — and come out as rough chips about two inches square. The chips are then used in other tire recycling processes. Tires can also be shredded cryogenically. First, they're frozen until they become brittle; then they're broken into small pieces by a hammermill. (Don't try this in your home freezer.)



Running on rubber: The track at Stoughton High School was surfaced with a product containing tire buffings from the retreading industry. Photo by Maureen Mecozzi

Chopped rubber

Old tires with the steel beads and belts removed can be ground into particles the size of small pebbles and used as a plant mulch, a bulking agent to compost sewage sludge, an aggregate in road construction, and a replacement for gravel and cinders in running tracks, road embankments and playground yards. Baker Rubber Inc., with plants in Indiana and Pennsylvania, chops close to four million tires every year for these uses.

Crumb rubber

After scrap tires are chopped, they can be ground into small particles (often the size of sand grains or smaller) and added to roof and road sealers, asphalt pavement and other rubber or plastic products. Rubber Research Elastomerics operates a plant in Minnesota where the crumbled product is combined with a polymer to produce a pliable rubber called "Tirecycle" that has many uses. If the plant were operating at 100 percent capacity, it could process three million tires per year; however, markets for Tirecycle are not well established, and the plant has been using fewer tires than originally anticipated.

Incineration for energy

Tires have a high energy value of approximately 30 million British Thermal Units (Btus) per ton — that's 50 percent more Btu value than coal,

or the equivalent of 200 gallons of oil. Tires can be burned whole in specially designed furnaces, or shredded into two-inch square chips and mixed with coal, wood or refuse-derived fuel in stoker-fired boilers. Because of the high Btu value of rubber, other combustible items burn more efficiently when mixed with tire chips. Of course, tire smoke must be filtered and scrubbed to collect carbon black and other emissions.

Nekoosa Packaging has been burning shredded tire chips combined with wood and coal at its Tomahawk plant for several years. Procurement Supervisor Derald Paszek says the boiler burns about 1,000-1,500 tons of rubber every month — about 150,000 tires. Currently, two other Wisconsin companies burn shredded rubber with other fuels, and other firms are considering burning rubber chips in their incinerators.

The Oxford Energy Company has built a $38 million tire disposal facility in Westly, CA at the nation's larg-

Tires on the road and in the road

Where the rubber meets the road — recycled rubber is ground and mixed with asphalt in a paving experiment on Highway 12 in Eau Claire County. Photo by Dave Lyford

Scrap tires becoming part of the roads they once traveled: There's a certain poetic justice to the concept. And the Department of Transportation (DOT) is experimenting with putting that poetry in motion.

Gary Whited, DOT chief of materials, says the jury is still out on 12 miles of test road his department set up using rubber from 25,000 waste tires.

In 1986, DOT laid test miles using the "interlayer technique" on State Highway 83 in Waukesha County and State Highway 142 (Washington Rd.) in Kenosha.

"Like making a sandwich," Gary says. "We laid down one layer of bituminous concrete (a combination of crushed stone and asphalt cement, a thick, tarry substance), then topped that with a thin layer of asphalt-rubber mix and covered it all with about an inch and a half of bituminous concrete." The rubber, ground from scrap tires into a coarse powder the texture of cornmeal, made up about 20 percent of the asphalt-rubber mix.

DOT headed west for two 1987 projects on State Highway 35 south of La Crosse in Vernon County and on U.S. Highway 12 near Eau Claire. The interlayer technique was used again; this time rubber was added to the asphalt in all three layers. There was another important difference.

"About two-thirds of the bituminous concrete on Wisconsin roads is recycled into new pavement," notes Whited, "and we wanted to see how the rubber would perform with some of that recycled pavement." The test miles were laid with approximately 40 percent recycled pavement, 60 percent new aggregate, asphalt and recycled rubber.

Whited estimates a single layer of asphalt-rubber mix uses 840 tires per mile of two-lane road; adding the rubber to all three layers makes good use of 3,600 tires per mile. And while there's no shortage of cheap scrap tires, using them in road building is a costly venture.

"No processor in Wisconsin produces the type of crumb rubber that must be used," he says, "so we have to 'import' it from other states. The asphalt-rubber mix requires specially modified pumps, mixers and spray nozzles; we have to bring those in from places like Nevada, Arizona, California and some of the East Coast states where more tire rubber is used. And it takes special expertise to lay tire rubber."

DOT will be watching the test miles for cracks and ruts and will take core samples to measure other signs of age and deterioration. Observers have already noticed some premature cracking in the test miles laid in 1987; Whited thinks the problem is probably caused by the extreme Wisconsin climate. "We're going to evaluate these miles carefully," says Whited. Only then will we know whether tire rubber will benefit Wisconsin's ecology and economy.

est pile — a whopping 40 million tires. The tires are burned whole at the rate of 800 per hour or about seven million per year. A similar but much smaller plant has been proposed for downtown Milwaukee.

Emissions from incinerated tires are comparable to those from coal; the air pollutants can be controlled with stack scrubbers and filters. Although incineration appears to be the quickest way to dispose of waste tires, it may not be the best since the opportunity to recover raw materials is lost.

Pyrolysis

Tires can be chemically decomposed by heating them at a high temperature without oxygen. You don't have to ship the tires to Mars to find an oxygen-free boiler. In fact, such a device is being tested this very moment in a demonstration project at the TecSon Company in Beloit. When a single car tire is shredded into two-inch chips and pyrolized, it yields one gallon of diesel fuel, 60 cubic feet of natural gas, eight pounds of carbon (formed into pellets for fuel), two pounds of steel and a half-pound of fabric.

TecSon currently operates a small module that can decompose 80 tires per day. In December, the company plans to install a large unit that can process 1,800 tires a day.

The answer to Wisconsin's waste tire problem will probably be found in a combination of these methods once we develop efficient, economical ways to transport and stockpile tires. Tires are bulky and costly to haul; both the state and private industry must plan how scrap tires will be moved from the places they are used into the recycling stream. And processors who need to keep a large inventory of scrap tires must maintain their stockpiles properly to avoid health and safety hazards.

Shredded tires tumble down a conveyer belt at Winnebago Tire in Kewaskum. Larger chunks will be chopped again into two-inch pieces. The chips are sold for fuel in stoker-fired boilers.
Photo by Maureen Mecozzi

Why tires are so tough to recycle

Ask landfill owners how they feel about scrap tires, and they'll probably answer with a gruff "Don't tread on me," and with good reason. Tires, the **waste *non grata*** of the garbage world, simply refuse to lay down and die like a bunch of old bananas.

Tires tossed on a landfill and covered with garbage won't stay covered for long. That's because a tire is difficult to compress: The buoyancy provided by the built-in air pocket causes a tire to "float" toward the surface of a landfill while the other waste settles. Many landfill operators claim that in time, tires will break through the top of the landfill, offering rubbery refuge to rats, mosquitoes and snakes. Once that happens, the tires must be covered — again — by the landfill owner. Big and bulky, tires are unwelcome at many landfills where space is at a premium.

Tires have other annoying habits. For instance, they resist natural decomposition. "Oh, a tire will biodegrade eventually," says Professor Bob Ham of the UW-Madison Civil Engineering Department, "but you've got to think of it in geologic time." Eras. Eons. Etcetera.

Shred them and be done with it, you say? The steel belts and beads in tires play hob with the cutting teeth of shredding machines. Those teeth are expensive to replace, and a shredder needs a tough, powerful motor to tame the natural springiness of tires.

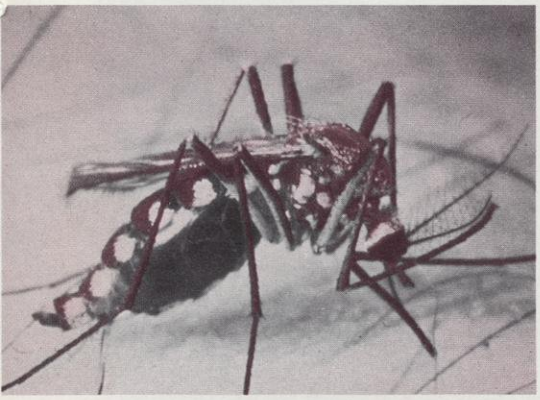
While shredded tires can be incinerated at high temperatures for their heat value, they are not an easy fuel to manage. Bits of steel or fiber embedded in the rubber can melt and gum up a furnace grate. The steel bead and belts can be removed, but the process is costly.

In fact, many tire processors won't accept steel-belted scrap tires for their shredding operations. That has strong implications for the future since 85 percent of all passenger tires produced in the United States in 1987 were steel-belted, and that percentage is expected to grow as consumers choose more durable, dependable tires.

Old tires never die, it seems. They don't even have the grace to fade away.

Squatters' rights

Scrap tires can be home to disease-carrying mosquitoes.



A happy resident of the nearest abandoned tire. The Eastern treehole mosquito would rather bite than switch to less hospitable digs. Photo by Jeff Beehler

An elegant, exclusive rubber condominium with all the amenities, including a pool and no mortgage.

That's how a scrap tire pile appears to *Aedes triseriatus* — the Eastern Treehole mosquito and carrier of the La Crosse encephalitis virus.

Tires make perfect homes for *triseriatus*, which dislikes bright light and prefers warm, undisturbed water. By holding the necessary warmth and moisture better than tree holes — the specie's natural habitat — tires become incubators that allow mosquitoes to reproduce continuously during the summer months when conditions are right.

Dave Geske, vector control officer for the La Crosse County Health Department, has done his share of treehole skeeter eviction and knows that controlling this prolific species is no easy task.

"In nature, it takes about three weeks for *triseriatus* to mature," says Geske, "in a tire, 10 to 14 days."

Mosquitoes in tires also begin reproducing sooner than normal. Generally, the hatch would start sometime in late May; near tire piles, mosquitoes can be sighted at the beginning of the month.

Once the treehole mosquito finds the perfect whitewall and moves into a tire pile, it's unlikely to move out.

"The species seldom travels beyond 50-100 yards of where it was hatched," Geske notes, "and in about 80 percent of the cases of La Crosse encephalitis, *triseriatus* habitat is found within 100 yards of the victim's home."

The virus was originally isolated from a girl who died of encephalitis in La Crosse. It attacks the central nervous system and causes fever, headache, drowsiness, vomiting and convulsions. Although people of all ages can contract the disease, children are especially susceptible.

To fend off the pesky creatures, use mosquito repellent and wear clothing that covers the arms and legs, particularly in the late afternoon — the peak biting period.

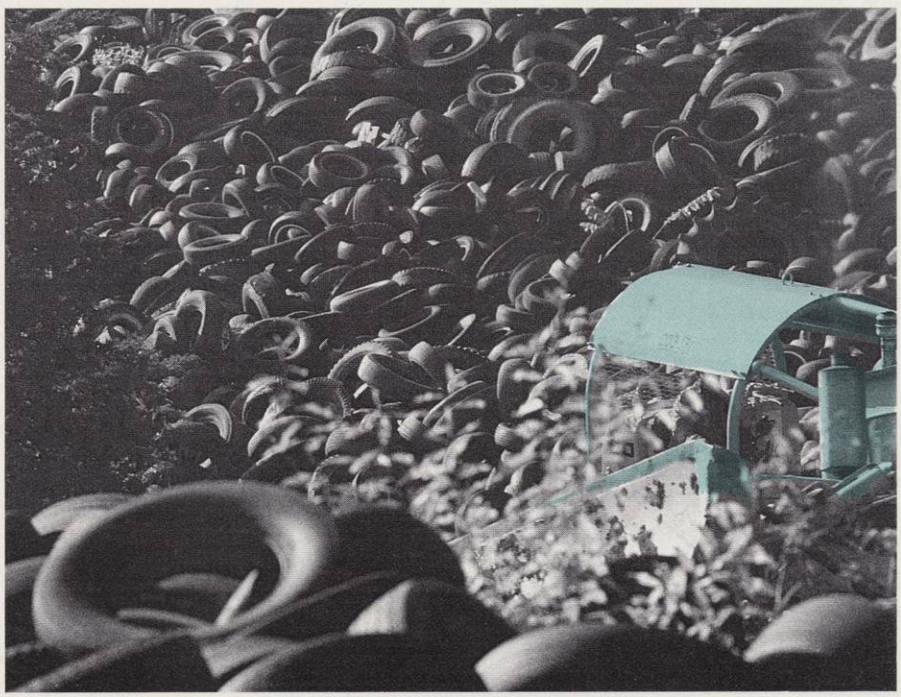
The best way to control the *triseriatus* population is to eliminate breeding sites. Geske recommends keeping scrap tires indoors or under cover, so they cannot collect water. Tire swings in trees — if they are used frequently — are exempt.

"*Triseriatus* doesn't like the motion," Geske says. If the tire swing is more picturesque than practical, drill a few 3/4-inch holes in the bottom for drainage.

Empty cans, bottles, buckets or any other items that can hold stagnant water should be disposed of or turned over. Tree holes should be filled with sand or soil.

With the help of the new waste tire cleanup and recovery law, the Department of Natural Resources will encourage "tire renewal" all around the state to eliminate *Aedes triseriatus* habitat. Soon, the species will be left without a synthetic home in which to hang its stingers.

Scrap tire piles are a favorite home. Photo by David L. Sperling



Night of the Living Tread: Five to eight million scrap tire skeletons lit up a rubber graveyard in an inferno Wisconsin will never forget. It prompted a new state program to promote tire recycling and set safety standards for storing tires. Photo by David L. Sperling

The tire fire that fueled action

The inferno blazed in the inky darkness, and then it blackened the morning sky. About 1:30 a.m. on October 18, 1986, a huge tire pile caught fire just north of Somerset, WI about 40 miles from the Twin Cities in northeastern St. Croix County. The salvage yard held 37 acres of discarded tires scattered a few feet to 10 feet deep: An estimated five million to eight million tires of solid fuel which could burn hot and persistently.

It takes a lot of heat to get tires burning, but once ignited, they are nearly impossible to extinguish. More than 150 firefighters learned the hard way that first morning that you can't fight burning tires with water and hoses. The intense heat and sickening, choking smoke kept all attempts to extinguish the blaze at bay. Burning tires melt into an oily fuel that blazes in furious flames.

Bulldozers slowly struggled to cut fire lanes that might separate stockpiled tires from the burning piles. The tough, resilient tires barely budged as the heavy machinery tried to cut swaths through the rubbery mountains.

Emergency crews were attempting to contain the fire and oily runoff to the salvage yard, keeping it away from neighboring pine plantations, farm fields and the Apple River. The river, a popular vacation spot for tubers, curves within 300 yards of the fire site. Crews dug out trenches and pond-like depressions to collect oily liquid residues.

The thick, black smoke rose several hundred feet in a black cloud that blotted out the sun for several miles north of Somerset.

Sooty, oily ash fell on homes, dairy herds and crops ready for the fall harvest. DNR professionals in air quality, waste management, law enforcement, spills and public information joined firefighters, health experts and agriculture officials to protect the local populace.

Fortunately, long-term health problems and crop damage from this environmental emergency were minimized. And legislators reacted swiftly to enact laws encouraging tire recycling and promoting fire prevention at tire piles in Wisconsin.

101 ways to recycle tires!

Could scrap tires be wheels of fortune? Enquiring minds want to know.

Is there life after 40,000 miles? Dave Geister of Prescott — a true believer in rubber reincarnation — never would have used "The Second Life of Tires" as his company slogan if there wasn't.

When Dave looks at scrap tires he sees opportunity. He sees berms for soil erosion, planters, signs, snow fence, field fence, animal stalls, mats and round hay bale protectors. He sees ways that the average person can successfully recycle a waste product with a minimum of tools and effort.

"If it works well for me," says Geister, who does a fair amount of his tire work with a utility knife, "it'll probably work well for somebody else."

Geister, the recipient of a DNR demonstration grant to develop low-tech ways to recycle tires, gets his raw materials from a gravel pit on the edge of town: it's filled with more than 450,000 scrap tires stacked nine feet deep.

Dave isn't daunted by the fact that he's only made a slight dent in that number. He's got a place — if only in his heart — for every last one of those rubber doughnuts.

Start with the simplest project of all — the tire planter. Dave, who professes to be in awe of the multitude of tire treads ("like snowflakes, no two alike"), trims off one sidewall of a tire, then paints the tread different colors. Set it on the ground, trimmed side up, fill with soil and plant those petunias.

The trimmed sidewalls don't go to waste. Clipped together at the top and spread out at the bottom by a stiff wire which has a circular panel inserted in the center, the sidewalls are transformed into "porta-signs." Leave out the panel, line up 20 or 30 of the "signs" and you've got a self-supporting snow fence that's easy to transport, set in place and able to withstand gusts of 60 mph.

Dave Geister astride a "kiss me quick" — a method of interlacing tires to prevent gully washers and farmland erosion.
Photo by Maureen Mecozzi

Got a soil erosion problem? Tires can take care of it, says Dave. His "porta-berms" — tires laid on one side with the top sidewalls sliced off, lashed together in a line with plastic banding straps and anchored to the ground with metal stakes — can prevent erosion on construction sites and at other places where the soil has been temporarily disturbed.

Washed-out gullies and shifting embankments need more than just a temporary solution. Quoth Dave: "If you want to make something permanent, use tires." Dig a trench about four inches deep and wide enough to accommodate three rows of tires. Lash those tires together (top sidewalls removed to eliminate the air pockets) and make a flat grid. Stake the assembly into the ground. Pile on the fill and level it off. Set more cut tires on top, overlapping the tires below. Lash together. Add more dirt. Make a third layer of tires. Lash 'em. Fill 'em up. Cover the whole thing with about four inches of good topsoil, seed with a quick-growing grass and voila! A man- (or woman-) made moraine!

Dave strips the tread from tires and weaves the lengths together to make fencing and mats for the farm. "Manure can't rot tread," he states emphatically. Two tread strips bolted together make a fine strap to hold

A tire embankment in Pierce County will be covered with soil and seeded with a quick-growing grass — voila, a berm! Photo by Dave Geister

down plastic tarps on round hay bales.

Can you do anything else with those scrap tires, Dave?

"Sure," he says with complete confidence. "I just haven't thought of it yet."

Surprising though it may seem, the Tire Man of Prescott does not have a

A tire planter with a southwestern motif near Kohlsville. Photo by Maureen Mecozzi.

corner on the scrap tire recycling market. Sandal soles are stamped out of tire tread. (Unfortunately, the sandals usually go out of style before the tread wears out). Welcome mats are woven from tire tread. In Massachusetts, nets for harvesting scallops are constructed from tread slabs. Keep a few long hunks of tread in your trunk this winter and use them for traction when you get stuck.

Make strawberry pyramids (or, since this is Wisconsin, potato pyramids) from scrap tires; they'll hold soil, heat and moisture. Bolt tires to your pier to protect your boats. (Depending on the way you drive, you might want to strap a few to your car.) Stick a tire halfway into the ground, tack on a reflector and use it for a driveway marker.

Or you could construct a little wave arrestor to keep down the whitecaps in your swimming pool.

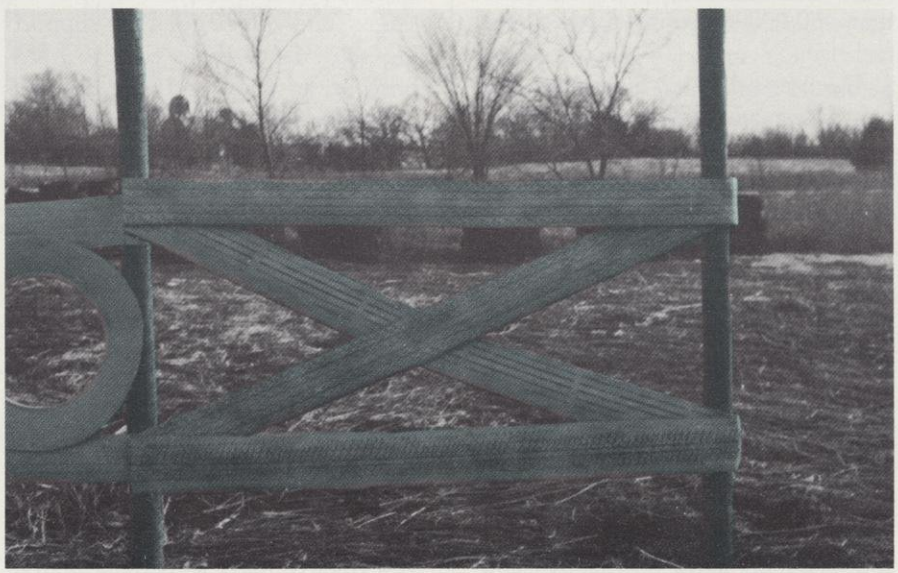
That's what DNR staffers did a few years ago at Lake Puckaway in Green Lake County. Carp were removed and the lake was reseeded with vegetation that game fish and waterfowl crave. Still, Puckaway is large and shallow, and when the wind gets to blowing, the waters become choppy. The powerful wave action was disturbing the plants and foiling the revegetation effort.

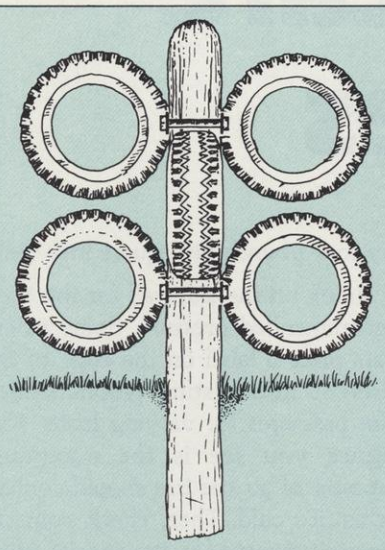
Instead of spinning their wheels, Horicon Area Fisheries Manager Jim Congdon and his staff put them to work. They took 3,000 scrap tires and strapped them together with used rubber belting from a conveyor into a flat chain 10 feet wide and about 1,500 feet long. The floating rubber necklace was anchored offshore in a bay of the lake where the vegetation was having trouble taking hold.

The temporary "radial reef," set in place for three summers, was a success. "The vegetation was well established downwind of the arrestor," said Congdon. "It really did help."

Tires tread water in other ways. Scrap tires have been used at several lakes to shelter fish like largemouth and smallmouth bass, black crappie, sunfish, pumpkinseeds, bluegills, black bass and walleyes that prefer open water. Who knows? There's a chance that the next lunker you reel in may have had a whitewall as a former address.

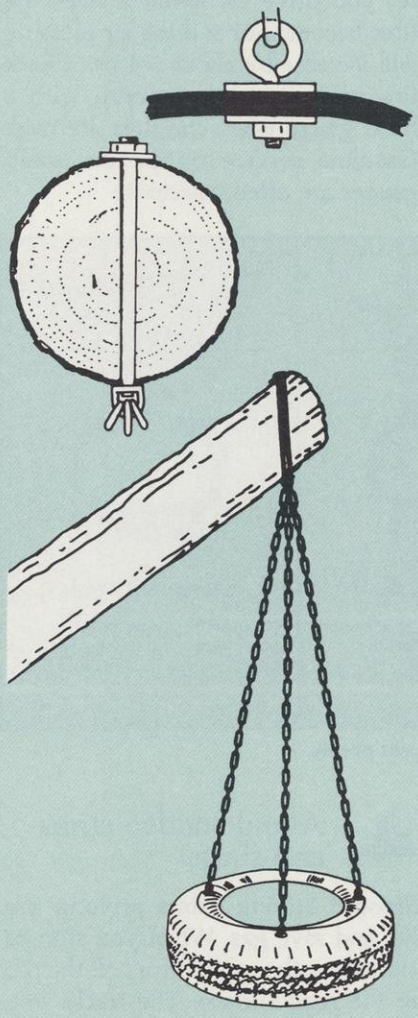
Dave, who says "barbed wire is for barbarians" prefers to construct his fences from tire sidewalls and tread. Photo by Dave Geister





Tire Tree — Sink a post at least four feet into the ground and seat it solidly. Attach tires to the post with 5/8″ galvanized bolts, large washers and nuts.

Illustrations by Maggie Payton



Cantilevered tire swing — Grab a spare 40-foot phone pole, quarter-inch chain, attaching hardware and an old tire and you can build a swing for four to five kids.

Scaling the tire tree. Photo by Robert Queen

Tires at play

"The first tire swing must have been invented about five minutes after the first blowout."

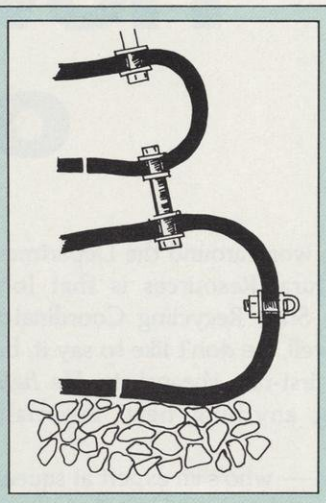
— *Paul Hogan*

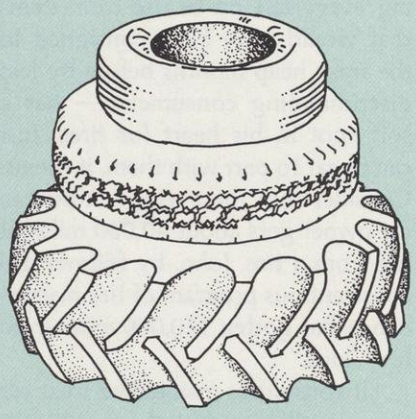
Contrary to what moms and dads think, all kids ought to have their own set of wheels by the age of 3. (The engine is optional; sandbox mandatory.)

Tires can be made into sturdy, safe, play equipment that kids love. Just follow a few guidelines before you begin to build:

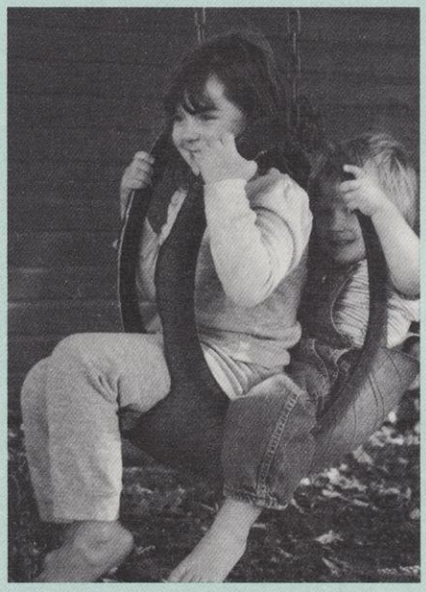
- Avoid using heavily worn steel-belted tires. The belts can pop through the tread and cause cuts.
- Trim the tire rims and gently smooth them with sandpaper to remove any rough edges.
- Drill a few 3/4-inch holes in the bottoms of the tires for drainage.

The following tire toys are described in Paul Hogan's book *Playgrounds for Free* (MIT Press, 1974).





Tire Teepee — Drill three to four holes in the base of stacked tires of different sizes. Drill three or four holes through the middle of the tread on the base tire. Insert 5/8″ × 6″ galvanized bolts with "D" heads, washers and nuts. (Used as steps and help anchor the teepee.) Place the second tire on top with a 5″ temporary spacer. These will be replaced by bolts, washers and 5″ steel sleeve spacers. Repeat with top layer. Top tire should be small so children can't accidentally slip through it.



A tire sling swing. Photo by Donna Frankenberg

How to take care of your tires

The word around the Department of Natural Resources is that John Reindl, State Recycling Coordinator, is . . . well, we don't like to say it, but he's a first-rate cheapskate. He *hates* buying anything new. Especially tires.

John — who's an expert at squeezing every last bit of use from items that would have been consigned to the trash heap months before by less discriminating consumers — has a soft spot in his heart for tires. Just can't bear to part with them, it seems. Consider this: the average American car owner gets about 40,000 miles of use from a tire. John, by following a conscientious program of tire maintenance, has gotten 110,000 miles from his "skins."

"If consumers maintained their car tires so all tires lasted for 100,000 miles," says the Man of Steel Belted Radials, "we would throw away less than half as many tires as we throw away now."

Another thing about John Reindl: He's lazy. He wants you to learn how to take care of your tires properly, so he'll have fewer rubber doughnuts to fret about. At the moment, there are about 20 million waste tires silently heckling John from piles located all over the state. Please, don't add your scrap tires to the chorus.

Here, then, are 12 tips to extend the life of your tires from a thoroughly treadful guy.

1. Pick the right tire type.

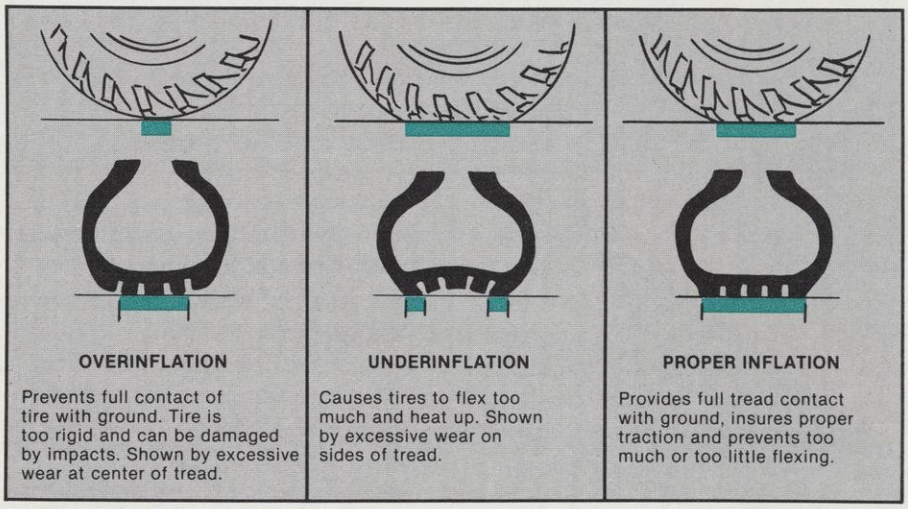
There are three basic types of tires — bias, belted bias and radials. Bias tires are the cheapest to buy but have the shortest life and mileage guarantee. Radials are the most expensive to buy but have the longest mileage guarantee. Radials also improve car handling and reduce gasoline consumption by 5-10 percent. In the long run, radials may prove to be your best value. (By the way, you should never use radials and bias or belted bias tires together on the same vehicle unless you're caught in an emergency situation. The combination will impair car handling.)

2. Use the correct tire size.

Tires are sized by diameter and width and are rated by their weight-carrying capacity. A tire that is too small for a vehicle, for instance, would carry too much weight and wear out faster. Overloading a tire by as little as 10 percent will significantly decrease its life. The size is marked on the tire sidewall — usually something like "FR78-14" or "205-75-13."

by four pounds per square inch (psi).

Look on the sidewall for the tire's recommended pressure. Some newer cars place a label on the edge of the driver's door listing recommended tire pressures for varying loads. The figure you see is the maximum amount of air the tire should contain when it's cold. Then, check your car owner's manual for any special situations that may require different inflation. For extended highway travel, for example, tire pressure should be about 4 psi higher. Remember that after you drive for about a mile, the tires become hot and the air pressure will increase by about 2-4 psi. Check tire pressure once a month with a hand gauge when the tires are cold. Gasoline service station air pump gauges are often inaccurate.



Tires should be properly inflated to last long and wear evenly.

3. Maintain proper air pressure.

Studies have shown that 80 percent of all automobile tires are improperly inflated. Too much or too little air pressure will shorten the life of a tire; underinflation is worse than overinflation. A 40,000-mile tire will lose 4,000 miles of life if it's underinflated

4. Avoid sudden stops and starts.

Smooth driving habits prolong tire life and save gas. When you stop or start abruptly, rubber tears off the tire at the road surface. The tracks you leave may look nifty to your fellow hot rodders, but they'll cost you in tires. Even normal stop-and-go traffic

The Patch Corps at Terry McCaughey's Car Care Center in Madison knows most auto tires only last 40,000 miles. You could get twice that wear by giving quality tires proper care.
Photo by Maureen Mecozzi

wears away tire tread seven times faster than steady driving. Glide gently up to stoplights and watch those jackrabbit starts!

5. Avoid excessive speeds.

A classic case of haste makes waste — high-speed driving builds up heat in a tire, which can more rapidly deteriorate rubber. A vehicle driven at 40 mph may have tire temperatures of 170 degrees; at 60 mph, the tire temperature will rise to over 190 degrees. A study of truck tires showed that a tire that would last 80,000 miles driven at 40 mph will last only 32,000 miles driven at 60 mph.

6. Avoid cornering at high speeds.

"Squealing" tires at corners drastically shortens their mileage life. It's also extremely dangerous to take a corner at a higher than recommended speed. You may end up with your wheels spinning in the air.

7. Rotate tires regularly.

It's important to rotate tires frequently (John says about once every 5,000 miles) because tires do not wear evenly on all four wheels. Tires on the rear axle generally wear down 30-100 percent faster than those on the front axle, unless your car has front- or four-wheel drive. If that's the case, the front tires will show more wear. Check your car owner's manual for the proper rotation sequence and timing.

8. Keep wheels aligned.

Improperly aligned wheels can increase tire wear tenfold over normal use. Have your alignment checked frequently if you drive often on rough roads. It's especially important to check alignment after a serious accident.

9. Keep wheels balanced.

An out-of-balance wheel will be literally pulled out of shape at high speeds, increasing tire wear. You'll experience a rough trip and so will your tires.

10. Check tires often for damage.

Inspect your tires at least once a month for punctures, cracks and signs of abnormal tread wear. To promote long tire life, have all tire repairs made on the inside of the tire.

11. Replace tires when there is 1/16" of tread left.

All new tires have "wear bars" that indicate when there is only 1/16" of tread left on the tire. When you can see the bars, the tires should be replaced or retreaded. Studies show that 90 percent of all tire trouble occurs in the last 10 percent of tread wear and that bald tires are 44 times more likely to have a flat or blowout than treaded tires. If you've followed proper maintenance procedures, it's possible that your old tires can be retreaded. That way, a new tire need not be manufactured and an old one disposed of. Contact a reputable retreader for advice.

12. Avoid rough roads and potholes.

Also, careful driving on rough roads can help reduce tire wear. Slow down and do your best to avoid hitting potholes or road obstructions.

There are many benefits of following these simple rules. By doubling your tires' life, you can save several hundred dollars. You'll get better gas mileage. Your car will handle better and you'll reduce the number of scrap tires in Wisconsin, which will make John Reindl a very happy man.

(For a "Tire Safety and Mileage Kit," including an air pressure gauge, a tread depth gauge, a set of four spare valve caps and a 16-page consumer tire guide, send a check or money order for $2.75 to the Tire Industry Safety Council, Box 1801, Washington, D.C. 20013.)

Don't tread on me

The gist of new plans for old tires.

New cars come with a lot of flashy standard features these days — cruise control, front-wheel drive, tinted glass and famous federal officials.

Yes, that's correct. Alexander Hamilton, first U.S. Secretary of the Treasury, is required by law to be a part of every new car transaction that takes place in Wisconsin.

You'll find Mr. Hamilton in your wallet on a $10 bill.

Photo by Maureen Mecozzi

Actually, Wisconsin's not that fussy. We're just as happy to make good use of two Lincolns, five Jeffersons, or 10 Washingtons, whatever you've got. But invest them we will, and you'll be glad we did.

Wisconsin's new waste tire cleanup and recovery program is funded by a $2 per tire fee on all new on-road vehicles registered for the first time. That's an additional $4 for a motorcycle, $10 for a car (we're not going to spare the spare tire) and if you buy a big 18-wheel rig... well, you can figure it out.

The money collected, close to $3 million each year, will be used to clean up unsightly, dangerous tire piles and to fund tire recycling projects.

The first item on the tire program agenda is the cleanup — or abatement, as they say in the solid waste industry — of stockpiles with more than a million tires. Tire dumps that present a threat to public health, such as those infested with mosquitoes or rats, and piles located in densely populated areas will be next in line for cleanup.

DNR solid waste investigators inventoried Wisconsin's waste tire piles and located some real whoppers in Fond du Lac, Iowa, Lafayette and Oneida counties. And there are still several million tires at a salvage yard in St. Croix County, in spite of the fact that five million tires burned there during "The Great Tire Fire" of October 1986.

Now, let's say it just so happened that you inherited the estate of your great-aunt Hortense. It came complete with a 26-bedroom, 12-bathroom mansion, a four-Mercedes garage and a pile of 60,000 scrap tires. The tires were "donated" to the estate from Fast Eddie's Friendly Garage. On a recent visit, a DNR solid waste investigator has deemed your pile to be a nuisance: "an unreasonable danger to public health, safety or welfare or the environment." Why? Because you don't have the tires stockpiled properly — stacked 20 feet high in blocks 100 × 100 feet square and surrounded by fire lanes at least 50 feet wide.

First, the Department of Natural Resources will try to locate Fast Eddie and ask him to clean up the pile since he brought the tires there in the first place. However, as is often the case with such irregular entrepreneurs, ol' Fast Eddie may be hard to find. DNR investigators will then ask you — the property owner — to get rid of the tires or to bring your pile up to snuff. The tire law states if the person who generated the tires cannot be found or refuses to comply with a cleanup request, the person who owns the property on which the tire pile is located may be held liable for cleanup costs. If you can't or won't, the department will have to do the job and possibly send you the bill.

Great, you say. I've got a 60,000-tire nuisance in my backyard, but I'm a good citizen. I want to do the right thing. How do I safely dispose of those tires?

There's no quick fix now, but we're working on it. Environmental managers know waste tires are a problem and an opportunity. Money collected from the tire recovery fee will be given as grants to private businesses, governmental agencies or nonprofit organizations that are developing ways to recycle tires or are already processing tires and need operating capital. An advisory committee is writing the guidelines to implement the law.

The tire law states that grants can fund recovery operations that receive at least 95 percent of their tires from Wisconsin tire dumps, retailers or residents. The law also encourages tire rubber reuse in highway surfacing and other road improvements.

If you have tires to dispose of, DNR's recycling program can put you in touch with a landfill or recovery plant that will put your tires to good use. In the meantime, you can ask tire dump owners in your area to maintain their stockpiles properly. Remember, your safety and the welfare of the environment are at stake, and we could never put a price on that.