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If a tire's not sick, why must it be "cured"?

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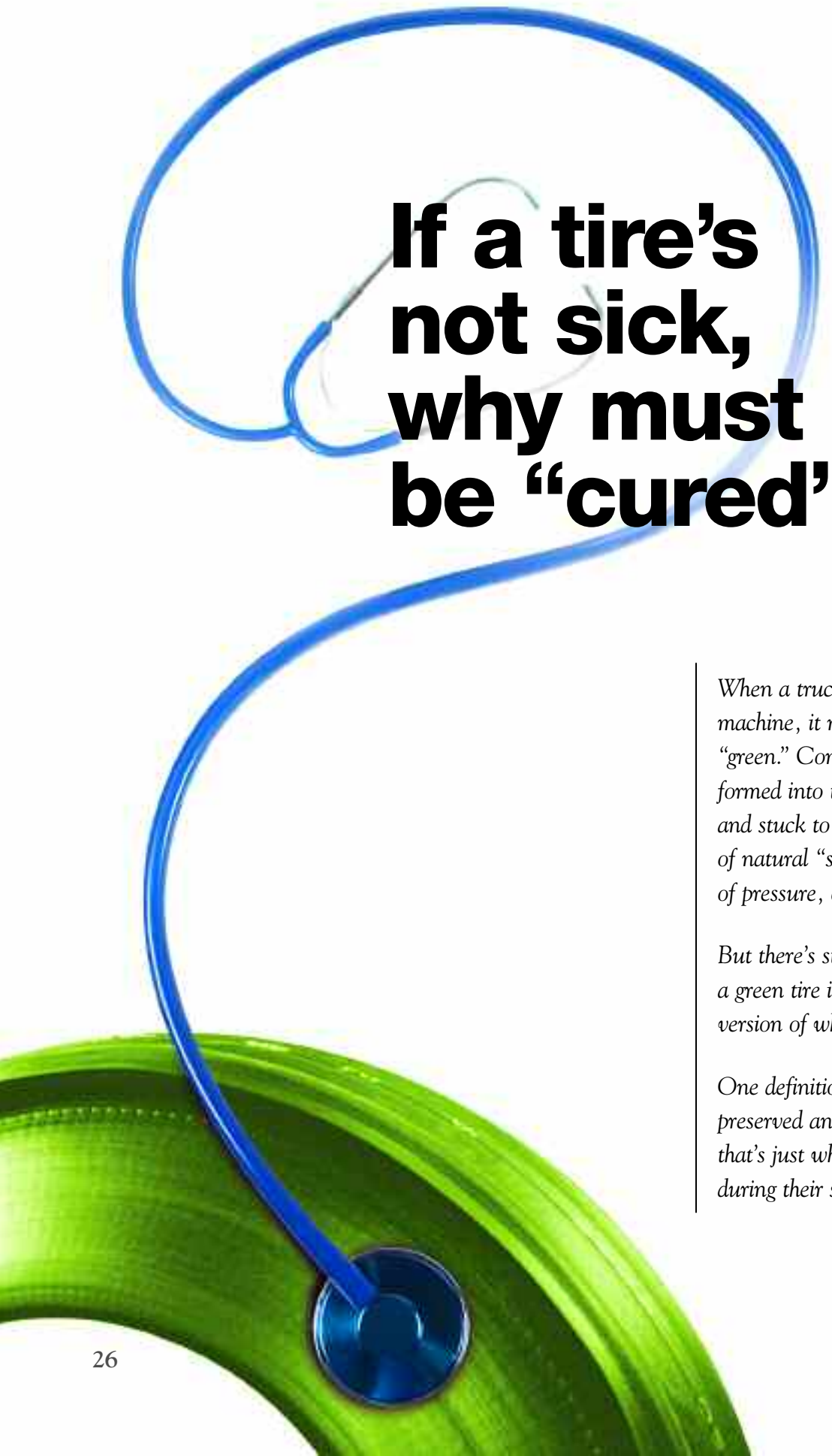
If a tire's not sick, why must it be "cured"



When a truck tire leaves the tire assembly machine, it may not be sick, but it still is "green." Components have been assembled, formed into their approximate shapes, and stuck to each other by a combination of natural "stickiness" and the application of pressure, called "stitching."

But there's still no tread pattern, and overall, a green tire is a sort of Pillsbury Doughboy version of what you use on your vehicles.

One definition of "cured" is "prepared, preserved and finished." As we'll see, that's just what happens to green tires during their stay in the curing room.

Why is it called a "green" tire?

Probably because, like a green piece of fruit, the just-assembled tire isn't quite ready. It needs, as we said, to be prepared, preserved and finished.

What does the curing process do?

Curing employs both mechanical and chemical processes. Overall, the tire has a sort of "tire" shape, but it has no tread pattern, and the shapes of its other components are nowhere near their final form.

How are those shapes created?

That's the job of the mold. And, like most everything else we've discovered along the way in looking at how tires are made, molds aren't as simple as we might think they could be.

It's probably no surprise that molds are very precisely made. After all, every detail you see on the outside of the tire – from tiny stress-relief sipes to large tread blocks – has to be made by the mold.

And, like the tire itself, the molds have lots of parts.

Why is that?

Even when it's green, a tire is a pretty large, pretty stiff thing. So, rather than trying to force it into a mold, tire manufacturers divide the mold into two large halves, and these halves into segments.

The segments can move apart to allow the green tire to fit inside, and then move apart again, once the process is over, to allow the cured tire to be removed.

Are molds expensive?

Remember that you have to have a separate mold for every tread pattern and every size of tire you make. And then, consider that each of these molds may easily cost 60 to 80 thousand dollars, depending on the mold's size and complexity.

With dozens of sizes and dozens of patterns, just managing your mold inventory is a huge job.

How does the molding process work?

The segments around the outside of the tread are pushed inward by the curing press to form the outside shape of the tread.

At the same time, a large rubber bladder, sort of like an innertube, inflates inside the green tire, to push the tire against the mold from the inside.

Between the segments moving in and the bladder pushing out, the green tire is forced to fill the mold, creating the tread pattern.

What else is going on?

Remember that one of the definitions of curing is preserving. You need more than just the right shapes.

Periodically, technicians clean, maintain and repair each of dozens of different molds.

Tire molds are heated, usually either by electricity or high-pressure steam. Besides helping to form the rubber into the mold shape, heat also changes the rubber chemically, a process called vulcanization.

In an earlier article in this series, we went into the chemistry of vulcanization, but for our purposes here, we'll say that vulcanization changes the properties of the rubber and bonds all the tire components to each other.

How are the rubber properties changed?

Vulcanizing converts rubber from a substance whose properties tend to vary a lot with temperature, going from soft and sticky when hot to stiff and brittle when cold, into a substance with remarkably similar properties over a wide range of temperatures.

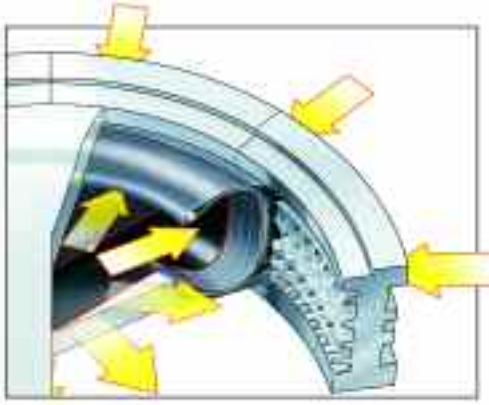
Vulcanization changes the chemical structure, giving rubber enormous strength and resilience – just what you need in a tire.

And the "bonding" process?

Vulcanization creates strength and resilience by connecting, or "cross-linking" individual rubber molecules together.

Remember that we said a tire is constructed of many different types of rubber compounds and many different components? Here, in the curing process, cross-linking strengthens the individual rubber components.

And, the cross-linking process bonds different components to each other. Tread rubber



Inside the tire mold, as the mold segments push in to form the tread, a rubber bladder inflates to push the tire itself firmly against the inside of the mold.

"Vent" holes in each mold help the rubber to fill it completely. A small amount escapes, forming new tire "hairs."

isn't just adhered to undertread and sidewall rubber. Chemical bonds link the various components to each other.

The result is that the many individual parts of the tire are so powerfully linked to each other that it's almost impossible to pull them apart. That truly makes all of the tire components work together.

How long does it take to cure a tire?

For most sizes, a bit less than an hour. Obviously, very small tires may take less time and giant, off-road tires more. Times are carefully calculated and controlled.

In Bridgestone's curing room, the presses that contain the molds are loaded and unloaded automatically, with robot carts delivering green tires at the right time for each curing cycle. Computers control curing times, temperatures and pressures.

Does the same press always make the same tires?

Curing room management is a specialized job in itself. Because you need different types and sizes of tires at different times, crews have to change the molds in a given press continually.

Molds are hot, heavy, complex and easily damaged, so changing them takes time and care. Molds also have to be maintained on a regular basis.

In the mold shop, technicians clean and repair any damage, to keep molds ready for production. And, occasionally, a new mold has to be made to replace an old one. Molds are stored and retrieved from giant shelving units in the mold shop.

As a result, scheduling and planning are critical to productivity and supply. Presses are too expensive to have a dedicated one for every mold, and you can't just swap molds into and out of presses in a couple of minutes. Plus, as we've said, maintenance and repair must be done regularly.

What are those tiny hair-like things we see on new tires?

In order to make the tire completely fill the mold, the segments, as we said, push in from outside while the bladder pushes out from the inside.

As all this pressure forces the rubber into the mold, air could be trapped, preventing the rubber from completely filling in each mold detail.

To prevent this, molds have tiny holes in them that allow the air to escape. As the rubber fills the mold, some of it is forced into these air holes, and that is what creates those hair-like projections.

Incidentally, the technical term for them is "vent spews."

You'll also see "flashing," that thin line or flap of rubber that occurs where the mold segments touch each other.

Are the tires ready for use once they're cured?

Not quite. Next, they have to receive a final quality inspection, undergo some finishing steps, be sorted, labeled and warehoused. We'll talk about those steps next time. TA