LAW ENFORCEMENT TECHNOLOGY

By Sam Simon

Cooling the aging process

Aging is where the rubber hits the road, when it comes to the life of a tire. By replacing the compressed air used to fill tires with nitrogen, the aging of tires can be slowed and tire life can be dramatically extended.

Police cruisers are prime candidates for nitrogen-inflated tires, according to Nick Verini, president of Nitronics Systems, based in Lafayette, Colorado. According to Verini, cars in a high-mileage driving environment would benefit the most.

"It certainly helps with a vehicle that's putting on a lot of miles per year," says Verini. "When the tire pressure is maintained better, the tire runs cooler, so the tire lasts longer."

"The biggest part of a tire program is maintaining the proper tire pressure,"

— Tom Vasko,
City of Wichita, Kansas

The National Highway Traffic Safety Administration (NHTSA) describes the better-known process of mechanical aging as "physical stresses and strains of steering, driving and carrying the weight of a vehicle over rough and uneven surfaces, causing tires to wear and weaken." The lesser-known chemical aging is defined as "changes in tire rubber due to heat and oxygen interactions." This type of wear has been found to be the most crucial.

Chemical aging

Proper tire inflation is one item checked during routine inspections of patrol cars. The problem is the air used to inflate tires, the same air all people breathe and which consists of mostly oxygen and nitrogen, is actually deteriorating the tire through a process of oxidation. Literature from Parker Hannifin, a manufacturer of nitrogen filtration systems in Haverhill, Massachusetts, states that as oxygen permeates through the tire wall, it reacts with the double bonds in the tire's rubber causing the tire to break down over time. The oxidized rubber causes premature tire wear and in some cases, blowouts.

Oxygen also attacks the rims of cars. The water present in air will rust steel rims or cause aluminum oxide, a white powder, in aluminum rims. This leads to rim leaks and tire valve stem leaks.

Filling tires with oxygen causes the rubber to deteriorate. Using nitrogen to inflate tires will negate the process of oxidation and extend tire life.

Essentially oxygen attacks tires from the inside out. The oxygen passes through rubber, intermingling with the rubber molecules and steel belts on the tire. As it passes through the wall of the tire, oxygen alters the rubber and prematurely ages the tire.

In a 2003 study brought about by the Ford/Firestone tire debate, NHTSA reports chemical aging is due to oxygen diffusing through the tire composite and reacting with the internal components. If the rate at which air diffuses through the tire is slowed, the rate of chemical aging will be similarly slowed. Typical results of chemical aging, according to NHTSA, include belt-edge failure (which may lead to tread separation) and bead cracking (which results in more rapid air loss), and less frequently, tread chunking and sidewall failure, better known as a blowout.

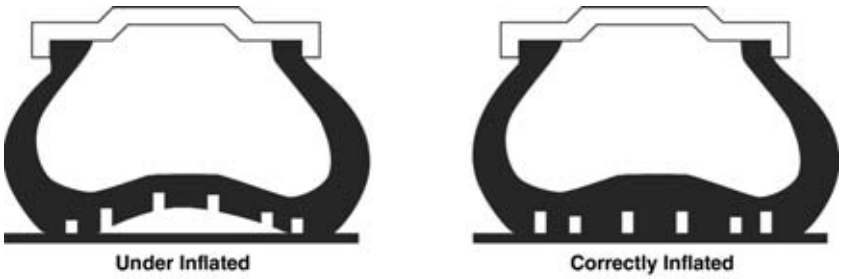
As a result of research into mechanical and chemical aging, NHTSA concludes that:

- High ambient temperatures result in an increase in tire failures;
- High ambient temperatures accelerate the rate of chemical aging;
- Tire failures don't begin to manifest until about two to three years of use; and
- Testing new tires from the factory may not identify defective designs.

Top 'em off

Tires must be kept properly inflated to their recommended pounds per square inch (PSI) measurement in order to live their expected life. A tire 20 percent under inflated will have a 15 percent shorter tire life. An under-inflated tire will also speed the chemical aging process as flexing causes the air in it to heat, speeding chemical aging. The rubber prematurely breaks down and a catastrophic failure due to under inflation and the weakness of the rubber may take place.

A Goodyear bulletin reports the service life of a tire, under inflated by 10 percent, will decrease by 7 percent. Pirelli Tyres Ltd. reports 20 percent under inflation equals 15-percent-shorter tire life. According to a survey from NHTSA, it is reported that 27 percent of passenger cars are driven with one or more substantially under-inflated tires. In addition, the survey found 33 percent of light trucks are driven with one or more substantially under-inflated tires.



Tire life and performance depends on correct inflation. Under inflation cannot always be detected by simply looking at a tire. Under inflation results in an over-loaded tire, which causes mechanical flexing, heat build up and leads to tire failure.

Tire inflation determines a tire's load capacity and an under-inflated tire may overload the tire. Gas mileage, tire wear, sluggish handling and excessive mechanical flexing causing heat build up are all tire-related problems due to improper inflation.

Keeping tires properly inflated is being stressed by the automobile industry to ensure safety and extended tire life. In fact, NHTSA requires vehicle manufacturers to equip light vehicles (those with a gross vehicle weight rating of 10,000 pounds or less) with tire pressure monitoring systems (TPMS). The TPMS alerts the driver when a tire or combination of tires has become substantially under inflated through an illuminated telltale.

The solution

To avoid these problems, oxygen is being taken out of the equation and tires are being filled with nitrogen. Because nitrogen is an inert and dry gas, when inflating car tires, the process of oxidation (rusting and corrosion) is practically eliminated. Nitrogen also permeates out of tires at a much slower rate than air. Bridgestone reports that air-inflated tires lose 2.7 PSI per month while nitrogen-inflated tires lose approximately 0.7 PSI per month.

Loss of tire pressure between scheduled check-ups was one problem Tom Vasko, fleet services director for the City of Wichita, Kansas, was having with its police patrol cars. Changes in the tire's temperature caused the tire pressure to fluctuate and activated the TPMS, requiring an officer to leave the street to check the vehicle's tire pressure.

After learning that nitrogen held a much more constant tire temperature, Vasko contacted Parker Hannifin to participate in a prototype test program that allowed the police department to test running nitrogen in patrol car tires. Vasko quickly noticed the difference. "It was nice because none of the low pressure alarms came on in the vehicles," says Vasko. "I think it's normal to lose 1 to 2 pounds a month (with air), and we weren't even losing that anymore."

Low tire pressure was leading to uneven tire wear for the Raymond (New Hampshire) Police Department, especially with its winter tires. Despite providing excellent traction and performance, the tires tended to prematurely wear in the center of the tread, according to Police Chief David Salois. The department also worked with Parker Hannifin to test the nitrogen system for just under a year. After putting nitrogen in one of its cruisers and testing without problems, the other eight department cruisers were filled as well.

"On the Goodyear winter version of the RSAs, we noticed that there was a center wear problem," Salois reports.

"We adjusted the tire pressure on numerous occasions to eliminate the center of the tire wearing prematurely. We noticed the nitrogen helped alleviate most of the problem."

In addition, after driving vehicles with nitrogen-filled tires some drivers reported better-handling cars. Technicians also saw that tire pressures remained more consistent over time.

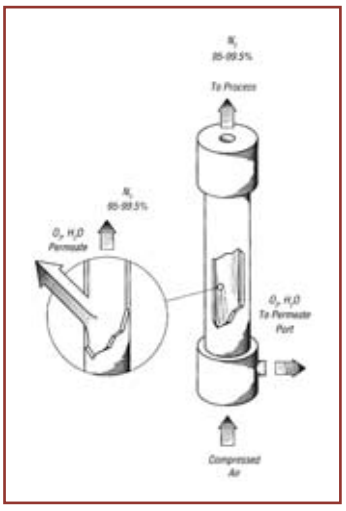
Even with heavy idling, Salois notes there was an increase in gas mileage that ranged from 1 mile-per-gallon to several miles-per-gallon in his fleet's fuel economy. In many studies, gas mileage has been found to increase 2 to 4 percent when nitrogen is used. However, due to high idling time, police cruisers may see lower gas mileage improvements.

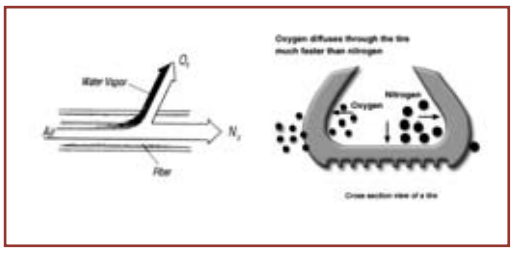
Throughout the tests, only one difficulty arose. Vasko found that drawing the nitrogen from the ambient air kept the generator constantly running, and he was unable to build up enough pressure to fill truck tires with the prototype Parker Hannifin generator model being used. Vasko's solution to this problem was to only fill the department's light duty vehicles with nitrogen. Since then Parker Hannifin has added an automatic shutoff valve to the device that shuts down the generator when it is not in use.

Setting up the nitrogen system

It is fairly simple to set up a nitrogen system for tire inflation. An air compressor feeds ambient air to the generator, which extracts the nitrogen from the pressurized air, and fills the tires through a conventional air hose connection.

The compressor is connected to the nitrogen generator through inlets. The compressed air then passes through a hose into the generator. As the air passes through Parker Hannifin's TireSaver nitrogen generator, it filters through four stages that remove oil, dirt and water. A charcoal bed removes oil vapor from the compressed air,





The technology for a convenient, reliable, economic means of providing nitrogen to inflate tires has recently become available. In the past few years, membrane technology has been developed where a high purity of nitrogen can be made. The nitrogen benefits tires because it permeates through the walls of a tire at a significantly slower rate than oxygen.

increasing the system's reliability. That air, a mixture of oxygen and nitrogen, flows into a hollow fiber membrane. The membrane works similar to a tire, allowing oxygen and water vapor to permeate the wall of the membrane, separating the nitrogen which then moves into a receiver tank where it sits until it's needed to fill tires.

"The beauty of this is that no electricity or moving parts are involved," says David Connaughton, strategic account manager for Parker Hannifin, regarding it's TireSaver nitrogen generators. "It generates nitrogen on demand, so the generator can be placed anywhere in a shop and doesn't need to be near an electrical line."

Cost/benefit of nitrogen systems

Each city tested the nitrogen systems for just under a year, and both departments have returned to using air in their tires despite the benefits they experienced. A lack of funds was cited as the primary reason for not making the switch.

"We were looking at it, but with the budget crunch, it wasn't one of the things that was our top priority," Vasko says. "When the economy gets a little better, it's something I'd like to get going right away, because it was really part of the tire maintenance program. The biggest part of a tire program is maintaining the proper tire pressure. If you can do that with the nitrogen, and not have to check the tire's air pressure or lose pressure as often, that's a tremendous benefit."

Adding a nitrogen system may even help departments save money in the long run. A basic nitrogen generator from Parker Hannifin costs approximately $5,000. Assuming a typical tire costs $100 and a department sees a 10-percent increase in tire life by using nitrogen, a savings of $10 per tire or $40 per car is recorded. If the tires are being replaced about every 10 months, a 10-percent increase in life extends the tire life to just under one year. So every year, each car saves approximately $40. If there are 100 vehicles in a department's fleet, it would save approximately $4,000 each year.

Considering many police department vehicles are serviced by a station in charge of fire trucks,

Vehicles running high miles on their tires are replacing oxygen with nitrogen — generated from systems such as the Nitrogen Station from Nitronics Systems — to fill tires.

plows, city vehicles and many other automobiles, savings could be further increased.

Patrol car tires are not the only tires in the department that would benefit from nitrogen inflation. This cool gas would extend the life of tires on vehicles not used every day or stored for extended periods of time. Since the nitrogen is permeating at a slower rate, the pressure in the tires would be more sustained than if filled with air.

Trailer, ATV, mobile speed display and mobile command center tires also would have extended tire lives since air would not be deteriorating the rubber and they would be maintaining proper inflation.

"Any vehicles put away for a period of time or not on the road every single day will see a noticeable difference in terms of maintaining tire inflation pressure with nitrogen," says Connaughton. "Losing all of that oxygen, that's just rotting the tire from the inside. On a tire that's not used very much, (with air) there actually will be plenty of tread life left, but the rubber will be totally rotted."

The chemical aging that rots tires is the same thing that happens to rubber bands. Stretching a rubber band that has been in a drawer for a long time and having it break is chemical aging. The rubber has deteriorated. The same thing is happening to tires.

Other types of nitrogen use

While the use of nitrogen in passenger-type cars is relatively new, heavy-duty machines have been using nitrogen-inflated tires for some time. They use nitrogen to combat the problem of auto-ignition, caused by a rim, brake or some part of the truck that heats and in turn heats the tire.

Heavy-duty trucks can have a brake failure that goes unnoticed. As the failed brake rubs the rim, it heats up. The heated rim then starts to affect the tire. The organic compounds of the tire begin breaking down and mixing with the air inside the tire. The presence of a flame, like a welding torch for repairing a rim, could ignite the tire, causing a massive explosion with the ability to throw the truck's rim 100 yards.

A benefit nitrogen provides for the aviation industry is the ability to maintain tire pressure. When an airplane is at altitude, the pressure on the tire is very low. The force from inside the cavity of the tire is greatly increased, driving oxygen from the tire to the outside. Because nitrogen does not permeate at the rate oxygen does, it helps to maintain air pressure.

A second reason for inflating airplane tires with nitrogen is increased safety in an aircraft fire. If a tire inflated with air bursts, it will increase the fire's intensity. When a nitrogen-filled tire bursts, the gas actually helps to douse the flames.

Truck fleets get much longer life out of their tires with the use of nitrogen. A typical passenger tire has a life of approximately 50,000 miles and a fleet truck tire can go over 250,000 miles using the practice of retreading. Nitrogen slows down the aging process allowing for more retreads due to a fresher tire.

Tires also keep a higher tire pressure, which saves on wear and shortened tire life. The Technology and Maintenance Council recently did a study on fleet tire blowouts. Of all blowouts, 90 percent were caused by under inflation. As the tires run all those miles, the tire heats and prematurely ages. This causes a catastrophic failure, mostly due to under inflation and the weakness of the rubber.

Generally tires have been overlooked when it comes to maintenance for a variety of reasons. By switching to a cool gas to inflate the tires of a fleet, the maintenance and cost savings are greatly improved. "I think typically people want to spend the least amount of money as they can on tires," says Connaughton. "I think they see it as an unexpected expense and don't fully realize the value, technology and the importance of today's radial tire. Without a tire, you're in trouble." ■

A generator from Parker Hannifin supplies the cool nitrogen gas to a storage tank.