TIRE RESEARCH

The following is an excerpt from a research paper prepared by Lawrence Sperberg concerning the use of nitrogen gas for tire inflation.

Million Mile Truck Tires - Available Today

"Oxygen and Moisture - the Killer of Tires"

by Lawrence R. Sperberg

All pneumatic tires have suffered from a deterioration starting the day that tires were invented. That deterioration is chemical oxidation masquerading under the name of "tire fatigue".

THE ENEMY - OXIDATION

Causing the deterioration are oxygen molecules contained in the inflating air which is a mixture of gases - nitrogen 78%, oxygen 21%, argon 0.9%, and miscellaneous O.1%. Tires are designed to be protected from this deterioration by their liners which are supposed to keep air from percolating through them into the tire body, which they never do, and by chemicals called antioxidants or age resisters whose job is to intercept and neutralize any invading oxygen - which they do until they are themselves used up, which occurs too soon after a tire enters into service.

So the deterioration spreads. It starts within the tire interior and moves outward. it first invades and consumes the tire liner. It then ravages the insulation rubber adjacent the liner. It marches inexorably outward - because of the pressure differential of the tire inflation on the inside and the atmospheric pressure on the outside. As the decay moves ever outward - the oxygen molecules react chemically with the unsaturated double valence bonds present in all rubbers, causing the rubber molecules to lose their strength and their elasticity, so that they no longer act as rubbers, but instead take on the characteristics of a non rigid plastic. The decay is constantly being fueled by the fresh all too often moist air being injected into the air chamber to maintain the desired inflation pressure.

How do you get a truck tire to go a million miles? It's simple. **TAKE THE OXYGEN OUT OF THE AIR!**

TRUCK TIRE TESTS

A total of 175 truck tires were tested until they were worn down to the tread wear indicators (TWI). About 125 of these tires wore out without failing at mileages ranging from 125,000 to 225,000. About 50 of the tires failed physically at varying mileages generally on the low side. All the tires had been carefully monitored, measured for tread loss etc., and inspected at 10,000 mile intervals, a lot of them at 2000 to 3000 mile intervals. Tire sizes were mostly 11R24.5 & 11-24.5 with a very few 10R20 and 10-20's. About half of the tires had operated over the eastern part of the United States while the other half had run mostly in the southwestern part of the U.S.

When the tires were removed from service small samples of tread rubber were taken from the shoulders of the unfailed tires and from the actual failed areas of the destructed tires. These specimens were then subjected to the electron microprobe examination that has been described previously. The examination was specifically directed at determining oxygen and sulfur levels which was best accomplished by using IOKV (10000 electron volts) electron beam And an exposure of 30 seconds.

Both of the figures tell the same story. When a tire lives to wear out, the oxygen slowly migrates and permeates its way into and through the tire cord body and finally into the under tread and then into the tread itself. It takes a long time for an appreciable amount of oxygen to reach the tread since most of the oxygen gets waylaid along the way by the liner, and then the cord arid cord insulation compound.

One reason that truck tires can run 250,000 miles with the original tread while passenger tires can only go 50 to 60,000 miles lies in the relative bulk of the 2 different tire bodies. The bulkier the body the longer it takes for the oxygen to work its way into the tread. Unfortunately the bulkier the body the higher is the heat buildup and the faster is the rate of oxidation of the available double bonds. Once the tire body is all oxidized the tire is dead no matter how much tread remains on it. The thinner the tire body the lower the running temperature and the slower the rate of oxidation with a correspondingly longer life.

Practically all tire engineers throughout this century attribute the gradual loss in tire strength to be the result of "fatigue" when in reality this "fatigue" is nothing more than a slow inexorable oxidation taking place at the available double bonds of the rubber molecules.

IMPROVED TIRE LIFE

In one experiment involving 54 new 10.00-20 truck tires, 33 were inflated with nitrogen and 21 were inflated with air. These tires were run side by side on the same tractor units until they failed or until they wore to the tread wear indicators. In this case the 54 new truck tires, nitrogen inflation resulted in 26% more miles being run before tires had to be removed when wear reached the tread wear indicators.

In the case of the failed tires a smaller percent of nitrogen tires failed physically (30% vs. 57%) and they gave 48% more miles before failing than did the air tires. This 48% improvement is due to the tire bodies lasting longer and not the better wearing properties of the tread which is the situation with the tires that lived to wear out.

The experiments involving 54 new and 44 used tires running some 7,345,497 tire miles in drive axle service, when viewed in light of the election microprobe experimental findings presented earlier, depict a clear cut picture of what nitrogen inflation can do for the transportation industry - cost wise as well as safety wise.

HOLDING PRESSURE BETTER

Today probably 99% of all tires are tubeless - truck, passenger, giant - and these tires are inflated with air, and all too frequently with wet air, i.e. air where the water has not been drained from the compressor tank as it should be. This moisture laden air (oxygen catalyzed by water) attacks the paint in the wheel well ultimately penetrating the paint and oxidizing the iron below it to form iron oxide or rust. Even aluminum is not immune from rusting, forming aluminum hydroxide, that gives an extremely fine dust that is difficult to even see inside the tire. The iron oxide rust is present within the tire in varying sizes ranging from coarse to extremely fine. Aluminum hydroxide dust is never coarse only extremely fine.

Whenever a tire is checked for its inflation pressure the pressure gauge requires a small gulp of air to activate the gauge. When the small gulp of air escapes from the tire the turbulence created picks up the finely divided rust and the dust enriched gulp of air passes around the open valve core which has been opened by the tire gauge. When the valve core drops backward into place after the gauge is removed some of the tiny rust particles get trapped between the rubber or plastic seal and the metal housing surrounding the seal.

This results in an extremely slow air leak that all too often escapes detection by the person gauging the tire and unless a metal valve cap which has another sealing surface in it is screwed onto the valve stem the tire will continue to lose air, albeit very slowly. When a larger rust particle is trapped between the core and housing, the escaping air is easily recognized so that proper action can then be taken immediately to correct the problem.

The perennial problem of low tire inflation can be effectively solved by the simple expedient of using nitrogen to inflate tires. Nitrogen is dry and contains no moisture. Nitrogen is inert so rust cannot form since there is neither oxygen nor moisture present to cause oxidation of the wheel.