

## Tire Sealants - A Bomb Looking for an Ignition Source

Consumers generally do not pay attention to the contents of consumer products; they assume that if an item is sold for a purpose, the item is safe when used for that purpose. Unfortunately, this is not true, and what you don't know can hurt you.

Would you inflate your tires with propane? Although most people would answer, "are you crazy, of course not", these same people are routinely inflating their tires with so-called "tire sealants" that are nothing but propane and perhaps a little isobutane. There are two kinds of tire sealants sold in aerosol cans: those \$5 to \$10 brands that are likely to be non-flammable and contain latex sealant, and those \$1 to \$2 brands that contain propane, are flammable and contain no real sealant.

Injuries have occurred from the use of these inexpensive "sealants." Two injuries we are aware of resulted from tire repairmen attempting on-the-wheel plug repairs. In each case a reamer was inserted into the tire puncture, and the tire exploded. The tire obviously contained an explosive mixture and only needed an ignition source. It is likely that sparks resulting from the reamer contacting steel belts provided the ignition source.

A scientific look at such a tire explosion provides some interesting and surprising revelations; but first, we need to understand the concept of flammable limits:

Flammability Limits (Explosive Limits) are the minimum and maximum concentrations (in air) of a flammable gas or vapor between which ignition can occur. Concentrations below the lower explosive limit (LEL) are too lean to burn, while concentrations above the upper explosive limit (UEL) are too rich. All concentrations between the LEL and UEL are in the explosive range, and special precautions are required to prevent explosion or ignition. The LEL and UEL are also known as LFL and UFL (lower and upper flammable limits.) The UEL for both propane and isobutane is 9.5 volume %. The LEL for propane is 2.1% and for isobutane is 1.4%. If we had 100 cubic feet of an air/propane/isobutane mixture, there would be 9.5 cubic feet of propane/isobutane at the UEL.

If your automobile tire was at 15 pounds pressure (psig) and you repressured the tire to 30 psig with propane (the case is identical with isobutane), the mixture in the tire would be about 33% propane. As you can see, this is well above the UEL for propane. This case likely illustrates why there aren't daily incidents and injuries involving propane/isobutane based "tire sealants." In most cases, when the tire is inflated with the sealant, the concentration of flammable gas is significantly above the UEL. If the tire was completely flat and inflated to 30 psig, the propane concentration would be about 66%.

Now let's look at the case where the tire is slightly low and filled to the desired pressure with "tire sealant." Assume the initial tire pressure is 26 psig and the desired 30 psig is attained by adding "sealant". The propane concentration would be 8.8%!!! Oops, we now have a flammable mixture.

So, with the flammable tire sealants, more sealant is better than less sealant. If the mixture in the tire is above the UEL and is vented into the air so that it can mix with more air, it will burn if ignited. But, the mixture in the tire will not explode.

A more likely and quite insidious case is when a tire contains flammable "sealant" above the UEL; the tire continues to leak; and the tire is then reinflated with air. If a tire at 15 psig is inflated to 30 psig with "sealant", the propane concentration would be 33% (this is the first case discussed). Now assume the tire leaks to 15 psig and is reinflated with air. The propane concentration would then be 22%. If the tire leaks to 15 psig and again is inflated to 30 psig with air, the propane concentration would be 14.8%. A third, similar, repressure with air would result in a propane concentration of 9.8%, essentially the UEL of propane. A fourth, similar, repressure with air would

result in a propane concentration of 6.6%, still in the flammable range. A fifth repressure would result in 4.4% propane, still within the flammable range. A sixth repressure would result in 2.9% propane, still in the flammable range. A seventh repressure would finally decrease the propane concentration below the LEL.

## Conclusion

1. Flammable tire sealants are dangerous.
2. Never attempt an on-the-wheel tire repair.
3. Never put a small amount of flammable sealant in a tire. More is better than less.
4. Always inform the tire repair technician when a tire contains a "tire sealant."
5. Never use air to reinflate a tire that contains a "tire sealant". It is safer to use more sealant.
6. Have leaking tires repaired immediately.
7. Realize that a flammable gas concentration between the UEL and LEL is a bomb looking for an ignition source.

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*Update: 2/19/99*

The Houston Chronicle reported that Houston-based Pennzoil-Quaker State Co. issued a voluntary recall of all its Fix-A-Flat tire inflator products, saying unsafe repair practices could cause explosions. According to the article, there have been six explosions involving welding of rims holding tires believed to contain Fix-A-Flat propellant. Some 30 million cans have been sold since 1996 alone. The incidents resulted in five injuries and one death.