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Nitrogen Inflation

Introduction

Nitrogen was discovered by the Scottish physician Daniel Rutherford in 1772. It is the fifth most abundant element in the universe. In the earth's atmosphere it is by far the most common element, making up about 78 percent, or an estimated 4,000 trillion tons, of the atmosphere. Nitrogen gets its name from a mineral known as "niter" (potassium nitrate), from which it can be made. Nitrogen is generally obtained from liquefied air through a process known as fractional distillation. The most common use of nitrogen is in ammonia, which is used for fertilizer production and to produce nitric acid. Nitrogen gas is used where an inert atmosphere (one without oxygen) is needed, such as in a light bulb or to help prevent the deterioration of documents by keeping them in an oxygen free environment. Liquid nitrogen is also used by the oil industry to build up pressure in wells to force crude oil upward.

Nitrogen exists as N_2 in gaseous form. As a single nitrogen molecule, it has a "free" electron, meaning it is very unstable, but in the form of N_2, the spare electrons each molecule has, bond and form the very stable N_2.

Nitrogen & Tyre Inflation

Nitrogen has been used with tyres fitted to trucks, aircraft, race cars and specialist vehicles for some time. These tyres were generally inflated using portable bottles, very similar to those used to store gases for welding equipment. Equipment has become available that can now generate large volumes of nitrogen suitable for inflating tyres with a general purity of between 90 – 99%. This equipment has the potential to reduce the cost of inflating tyres with nitrogen to a much lower level compared to using portable bottles. Some tyre retailers may now be using or considering using this technology and are promoting the filling of tyres on passenger cars, four-wheel-drives, vans, & light trucks.

There are advantages to inflating tyres with nitrogen rather than compressed air, but not all these advantages will apply in all applications. The argument that Nitrogen must be better because it is used in Aircraft Tyres for example is not really relevant in day-to-day vehicular applications. One of the main reasons that nitrogen is used in aircraft tyres is that they fly to heights where the temperature can reach –40 °C and condensation in the tyres will freeze and may not thaw completely before landing.

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If the frozen ice then settles in one spot there is the possibility of it causing an unbalance as the tyre spins when it contact the ground on landing. Tyres on motor vehicles do not undergo these extremes. It should also be noted that when you first fill up your tyres, they already have air in them, so they must be filled then evacuated, then filled again to remove the residual atmospheric air, and as an additional note If tyres are filled with Nitrogen, in order to retain any benefit, you will need to top up with Nitrogen as well. Topping up with Compressed air will negate any benefit.

The main arguments put forward by proponents of Nitrogen are:-

1) Slower rate of pressure loss:

The butyl rubber used for tubes & inner liners in tubeless tyres is not 100% impermeable; therefore some pressure loss can be expected over time. Due to its molecular structure, nitrogen bleeds through the inner liner or tube at a slower rate than compressed air. This advantage applies to all tyres filled with nitrogen. Although at a slower rate Nitrogen can still bleed through the inner liner so regular pressure checks are required. In addition tyres can lose pressure caused by slow leaks caused by punctures or through faulty valves. This is one area of concern because it could be thought that if a tyre is inflated with Nitrogen regular tyre maintenance is not required, poor maintenance and under inflation will have a far greater negative effect on tyre performance and durability than filling a tyre with compressed air rather than Nitrogen.

2) Cooler running leading to Improved tread wear and reduced incidents of tyre damage caused by heat:

It is true that tyres filled with Nitrogen will generally run cooler than a tyre filled with compressed air. The reduction in the tyres running temperatures when inflated with nitrogen as opposed to compressed air is due to the presence of water molecules in compressed air more than any other factor. As a tyre is run, the flexing of the sidewalls and tread, as well as the friction between the tread and the road surface produces heat regardless of what gas is used to inflate the tyre. The difference is that water molecules in the compressed air behave quite differently to nitrogen molecules when exposed to the heat produced by the running of a tyre. Water molecules become much more "excited" by the heat generated by the running of a tyre, creating more heat & pressure build-up compared to a nitrogen inflated tyre (See Casing Durability). This is the argument used that a Nitrogen filled tyre will give better mileage and also suffer from less heat damage than an equivalent air filled tyre.

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These benefits are difficult to quantify in a day-to-day road application as tyre performance comes from many factors including the correct choice of tyre for the load and speed etc, good maintenance of the tyres and vehicles, and particularly in fleet the correct tyre for the application and active monitoring of the fleet. In addition the biggest influence in tyre performance and durability is the driving style of the driver.

3) Improved Casing Durability

One of the main claims made by Nitrogen proponents is that compressed Nitrogen contains less moisture than compressed air, thereby reducing the incidence of this moisture migration effect. This applies primarily to truck and bus, and some light truck tyres where the tyre body ply is composed of steel. Passenger and most light truck tyres are not affected, as they are composed of textile body ply material (e.g. polyester, nylon, rayon, etc).When the tyre heats up, moisture in the tyre vaporizes and expands. In some circumstances, moisture in the compressed air can gradually migrate through the inner lining of a tubeless tyre and into the steel-cord body plies, resulting in rust, which ultimately causes casing degradation.

While this can sound like an impressive argument, moisture can be introduced into the tyre as a result of poor workshop practices and incorrect or inadequate tyre fitment procedures irrespective of the mix of gas used in tyre inflation. Proper selection of compressor equipment, air-line routing, the use of air dryers, and other sound workshop and equipment maintenance practices to minimise moisture introduction is likely to have a far greater effect on the levels of moisture in the tyre, remember air is comprised of nearly 80% Nitrogen. If proper practices and equipment are utilised, moisture migration is minimised. It does not matter so much whether Nitrogen or compressed air is the inflation medium.

Summary

Despite the advantages of using Nitrogen in specialised tyres that may be subject to extreme conditions, the benefits for users of tyres used primarily on ordinary highways are not clear. Nitrogen is not a “Set and Forget” option and if nitrogen inflated tyres are topped up with air, any potential advantages nitrogen may offer, will be negated.

Maintaining tyre pressures correctly and adopting a smooth driving style can achieve far greater performance and safety.

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