

## Industrial Uses for Synthetic Oils and Fire Resistant Lubricants

There are many uses for fluorochemicals and organic halocarbon compounds in industry and commerce. Sometimes fluoro-chemicals are the safer alternative to chemicals that were designed to use chlorine instead. There are many medical applications of halocarbon chemicals, too, such as a wide range of anaesthetic compounds. However, the most directly industrial use is as the wide range of synthetic, inert oils available today. Perhaps most notably, these oils are entirely synthetic - using no hydrocarbon constituents - these synthetic oils are totally inert and able to be used in applications with pure high pressure oxygen or chlorine. They are also unusually resistant to degradation, even under extreme conditions such as those encountered at a foundry, as in the case of metalworking fluids. Of course, fluorine is a remarkable and dangerous substance. Utterly toxic in its native form, it tightly bonds with other atoms. Its reactions are intense and unique. In the case of inert oils or lubricants, the hydrogens of a typical petrochemical lubricant are all removed, leaving only fluorine and chlorine tightly in their place. It is no wonder that the use of fluorochemical lubricants has been so widespread in industry. Possibly, the only thing keeping synthetic oil from being far more widely adopted is the price associated with them. This is a consequence of the danger and complexity inherent with fluorochemical manufacture. Some industries have a choice and prefer to stick with other options, though recycling halocarbon oils can make the cost of their use lower. However, at the turn of the 21st century, there are plenty of industries and trades where fully synthetic lubricants are absolutely necessary, such as the machining of zirconium, tungsten, tantalum or niobium. These exotic metals have become far more widespread since the widespread adoption of metalworking fluids. At this time, they cannot be reliably fabricated in the same manner without high temperature, inert oils. Synthetic oils are also used in high temperature and high performance automobile applications, though their major use in transportation is with aerospace. Bearings and gears are especially likely to use inert lubricants because of high temperatures and oxygen. Many such synthetic lubricants have been inspected and approved by NASA, among others. That said, there are some instances where the usual benefits of using a synthetic lubricant are negated by an unfortunate reaction. As is typical for a fluorochemical compound, when something doesn't work, it is readily or painfully obvious. There are several metals (sodium and potassium) and other compounds (liquid fluorine and chlorine trifluoride) that don't play well with these synthetic oils. Other industrial uses for fluorochemical lubricants involve those with the longest chains - synthetic waxes. These are very often used in conjunction with the metals industry as coatings. While waxes are most often used with finished products, oils are sometimes used to coat the inside of pumps that may be used with highly reactive substances. Many industries that routinely use dangerous chemicals rely upon inert oils and lubricants. The bleaching of wood pulp for paper and (ironically perhaps) the treatment of water sources with chlorine and are two examples of industries that are dependent upon halocarbon oils to keep safe. Many chemical firms rely upon such inert oils as inert solvents. There are several "aggressive" substances that require equipment to be coated or lubricated with a substance that will stand up to chemical attack. Fluorochemicals are especially good at resisting chemicals such as full-strength hydrogen peroxide, chlorine and liquid oxygen. Many labs choose to use inert lubricants as high temperature grease to lubricate lab equipment. Just as synthetic lubricants are suitable for high temperature applications, they are also ideally suited to very low temperature applications because the viscosity can be very finely tailored to the job. As you might expect from the same element that is at the core of non-stick coatings for frying pans, these inert lubricants remain quite slippery even under adverse conditions. Because fluorinated synthetic lubricants are fully oxygen compatible, they are safe to use in even the most intense applications, such as situations where pure oxygen is kept under high pressure and when other lubricants and sealants would have been oxidized away. Anyone who has ever worked with compressed or liquid oxygen knows that practicing oxygen safety is the first and foremost concern working with such systems. Having inert lubricants you can rely upon is a relief for professionals that didn't enjoy such a degree of safety in the past. In addition to its use as a synthetic lubricant, fluorochemical oils and compounds can also be used to repel water and soil and is often used on high traffic fabrics as a repellent. The use of inert oils as synthetic lubricants and metalworking fluids, suitable for high or low temperature use with some of the most reactive chemicals on Earth make fluorochemical oils a very important part of several important industries.

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