# Why Oil Goes Bad

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I decided to write on this topic because I continually hear people say that oil doesn't go bad, it just gets dirty. This implies that if you keep the oil clean, it will last forever. This is not true. I am frequently dismayed to see how many people simply don't change the oil in certain machines.

In general, all in-service lubricants will fail at some point. That being said, there are numerous ways to manage the condition of a lubricating oil and extend its life significantly. There are three primary causes that necessitate an oil change: degradation of the base oil, depletion of additives and contamination. Some of these conditions can be remediated, yet others cannot.

Base Oil Degradation

Base oil degradation may be the most common reason for oil failure. The most common type of base oil failure is likely oxidation. When oil oxidizes, the primary by-products are acid and insoluble materials, which can lead to serious surface deposits and corrosive wear. To address this problem, most lubricants are formulated with antioxidants, but they don't last forever.

Like many lubricant additives, oxidation inhibitors are used up as they perform their intended function. Once these additives are consumed, the base oil begins to oxidize. Many factors contribute to oxidation including heat, contaminants and base oil quality. Oil temperature plays a large role in the rate of oxidation. For every 10-degree Celsius increase in oil temperature, the rate of oxidation doubles.

Contaminants also cause significant changes to the rate of oxidation, acting as catalysts for the reaction or, in the case of air, providing one of the reagents. Certain wear metals can dramatically increase the rate of this reaction, especially in the presence of water.

The quality of the base oil used in the lubricant plays a role as well. Lower quality base oils tend to contain more inherently unstable constituents such as aromatics and other unsaturated hydrocarbons which more readily react with oxygen.

In addition to oxidation, base oils can fail due to thermal degradation, hydrolysis and various chemical reactions with contaminants. While mineral base oils and polyalphaolefins (PAO) have good hydrolytic stability, several types of synthetics are prone to reacting with water, which forms corrosive acids.

While it may be impractical to forever prevent base oil from failing, we can dramatically impact the oil's life by managing the influencing factors. Managing the oil's temperature, selecting a good-quality base oil, monitoring antioxidant concentration, and preventing or removing contamination goes a long way toward extending the lubricant's service life.

## Additive Depletion

Although many additives such as antioxidants enhance the properties of the base oil, other additives perform functions the base oil cannot. Antiwear, extreme pressure, detergents and dispersants are examples of such additives. Even if a lubricant's base oil is in good condition, the lubricant can no longer perform all of its duties when certain additives are depleted and, therefore, must be changed.

Additives are depleted by a number of different mechanisms. Water can react with certain additives (hydrolysis), and also can attract and remove others (water washing). Some additives are removed by particle contaminants (particle scrubbing), and others are simply used up when performing their intended functions.

Once again, these processes cannot always be eliminated, but they can be minimized. By using a well-chosen lubricant, maintaining proper oil temperature and controlling contamination, we can prevent any unnecessary additive loss, thereby extending the useful life of the lubricant.

It is possible to replace additives by draining and replacing a portion of the sump's volume. This is typically referred to as sweetening the oil. Otherwise, concentrated additives may be added to in-service oil under controlled conditions. However, this type of re-additization requires a significant level of expertise and may be cost-prohibitive for most systems.

## Contamination

Many types of contaminants contribute to the degradation of lubricating oils, but that's not the worst of it. Of course, we all know that contaminants such as particles are responsible for the majority of mechanical wear in many machine components. Because of this, we often change oil before it fails, simply to remove the contamination.

For systems with no means of contamination removal, such as mechanical filters, this is the only way to control contaminants and ensure proper lubricating conditions. However, changing oil to remove contamination will be only partially effective, at best. When the oil is changed in most machines, a significant portion of the old contaminated oil is left behind.

Additionally, the new oil is likely to be contaminated already, unless it was properly filtered before application. It is, therefore, more effective to prevent contamination and/or have the means to remove it from the machine through the use of good filtration, contamination exclusion and proper handling methods for new oil.

Extending the life of your lubricants, for the most part, is a worthwhile endeavor. If you examine the cost of changing the oil in the average machine, you might be shocked to see what you spend. The keys to achieving maximum life from lubricants are proper selection, temperature management, good oil analysis and contamination control.

Just remember to keep the oil clean, cool and dry.