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Identifying the Stages of Oil Oxidation

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Lubricants age and alter chemically by a process called oxidation. In fact, oxidation is the primary way a lubricant degrades over time from normal service. It typically results in impaired chemical and physical properties of the base oil and additives. Understanding why a lubricant oxidizes is essential to prevent, delay and monitor the process.

As oil is used in a machine over time, the oxidation process occurs, typically starting with the degradation of antioxidant additives. If the driving conditions that stress the oil remain unchanged, these additives will deplete at a near linear rate. This is sometimes called the induction period. When the oxidation inhibitors are largely depleted, the breakpoint of the lubricant is reached, at which time the base oil has lost its first line of defense against oxidation.

Some base oils are extremely robust and resist oxidation naturally. Examples include most synthetics. However, if exposures to pro-oxidants such as high temperature, moisture, metal particles, agitation and oxygen are severe enough, even the most robust synthetics will give way to oxidize.

This oxidation process has the potential to begin almost spontaneously for even oil sitting dormant in a storage container. However, the rate of additive depletion and base oil oxidation generally correlates to the intensity of pro-oxidants existing within the oil. Ultimately, the consequences of this chemical process will include increased oil viscosity and organic acids; the formation of sludge, varnish and deposits; additive depletion (including anti-wear additives, dispersants, corrosion inhibitors, etc.); and the loss of other vital base oil performance properties. Once these undesirable lubricant conditions exist, the machine no longer will be protected effectively against friction, wear and corrosion.

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