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OXIDATION INHIBITORS FOR INSULATING OILS

Natural Inhibitors

New insulating oil as normally refined contains small amounts of certain chemical compounds that act as oxidation inhibitors. These naturally occurring materials retard oil oxidation until such time as they are expended. The rate at which the inhibitors in the oil are used up is dependent upon the amount of oxygen available, soluble contaminants in the oil, catalytic agents in the oil, and the temperature of the oil. In modern transformers, either sealed to exclude air and moisture or protected by an inert atmosphere, the benefits of the inhibitors can be extended over many years. As the inhibitors are exhausted, the rate of oxidation and the deterioration of the oil increases. Reclaiming processes, such as acid refining or clay treating, can restore the oil so that it has most of its original characteristics, but this has no effect upon restoring the usefulness of the natural inhibitors occurring in the oil. In fact, both Fuller's earth and activated alumina remove the natural inhibitors and the reclaimed oil has no resistance to oxidation. To overcome this undesirable condition, synthetic oxidation inhibitors should be used to extend the life of the reclaimed oil.

Inhibitor Action

A number of organic chemical compounds are known to slow down the oxidation when added to lubricating or insulating oils. Such additives are known as antioxidants or oxidation inhibitors. Unfortunately, all known oxidation inhibitors become depleted with time. When all of the inhibitor has been used up, the oil starts to deteriorate again, and deterioration proceeds in the same way at the same (or greater) rate as in the uninhibited oil. The useful life of the oil is extended by the amount of time the inhibitor remains effective, before it becomes depleted, usually a few years.

The DBPC Inhibitor

An inhibitor material that has found almost universal approval is known, chemically, as 2,6-ditertiary-butyl-para-cresol, but is generally referred to as DBPC. This material is a very desirable inhibitor and has outstanding properties which, even in small concentrations, is a stable and effective oil antioxidant. Since the natural inhibitors are consumed by oil in service and are completely removed by Fuller's earth; it is important that, following the reclaiming process, an inhibitor, such as DBPC, be added to the oil. Reclaimed oil should be tested for DBPC content, DBPC is commercially available in a concentrated oil solution or in dry-flake form which must be dissolved in hot transformer oil before using. A concentration of 0.3 percent DBPC by weight is recommended. Since DBPC is insoluble in water, it is not removed from the oil by Fuller's earth treatment if the temperature is kept below 75C (167F).

The Test Method

The test method, ASTM D-2668, covers the determination of the weight percent of 2,6-ditertiary-butyl para cresol (DBPC) and 2,6-ditertiary-butyl phenol (DBP) in new or used electrical insulating oil in concentrations up to 0.5% by recording the infrared spectrum of the oil at certain specific bands.

Significance of Test

The quantitative determination of 2,6-ditertiary-butyl para-cresol and 2,6-ditertiary-butyl phenol in a new electrical insulating oil measures the amount of this material that has been added to the oil as protection against oxidation. In a used oil, it measures the amount remaining after oxidation products have reduced its concentration. The test is also suitable for manufacturing control and specification acceptance.