



OXIDATION INHIBITOR

ASTM D 2668

Background:

Mineral oil insulating fluids undergo oxidative degradation in the presence of oxygen to give a number of oxidation products. The final products of oxidation are acidic materials that can affect the characteristics of the insulating fluid as well as cause damage to the components of the electrical unit. Oxygen is a diradical species and the reactions of the oxidative process are complex but they do involve free radical reactions. One way to prevent these types of reaction is to incorporate an oxidation inhibitor that will interrupt and terminate the free radical process of oxidation. Phenolic materials are quite good for this purpose and the two most commonly used inhibitors are 2,6-di-tertiary-butylphenol (DBP) and 2,6-di-tertiary-butyl-4-methylphenol or 2,6-di-tertiary-butyl-para-cresol (DBPC).

Procedure:

The entire details of the procedure for the determination of DBP and DBPC in mineral oil insulating fluids are given in the ASTM D 2668 method and are only briefly mentioned here. The method used for the determination of the amount of DBP and DBPC in mineral oil is by using infrared spectrometry. Both of the inhibitors exhibit infrared bands at about 3650 cm^{-1} due to the O-H stretching frequency of the phenol group. It is this band that is used to quantitate the amount present. In order to determine which inhibitor is present the spectrum is scanned in the region from about 900 to 700 cm^{-1} . The DBP exhibits a band at about 745 cm^{-1} due to the out-of-plane bending motion of the hydrogens attached to a 1,2,3-trisubstituted benzene ring. The DBPC exhibits a similar band at about 860 cm^{-1} due to the out-of-plane bending motion of the hydrogens attached to a 1,2,3,5-tetrasubstituted benzene ring.

Thus one can identify which inhibitor is present by scanning the low frequency range of the spectrum and then it can be quantitated by scanning the high frequency band at 3650 cm^{-1} . A series of standard solutions of the inhibitors in an uninhibited oil such as Diala A are made up and a calibration curve is determined for each inhibitor. The standards are covered over a range up to 0.5 % by weight.

Significance:

The presence of inhibitors in the oil will increase the useful life of the oil with respect to oxidative degradation in the presence of oxygen. As the oil is exposed to this type of oxidative degradation, the oil will be protected as long as there is inhibitor present. However, as the process proceeds the inhibitor will be used up and when it is gone the oil will degrade at a much higher rate. Thus the determination of the amount of inhibitor present can be used to estimate the useful life of the oil. It can also be used to determine whether or not new oil has been properly inhibited prior to its use. As the inhibitor is used up its concentration can be monitored and additional inhibitor added as needed to maintain a proper concentration in the unit. Typical values for fresh oil are in the range of 0.25 to 0.35 % DBP or DBPC by weight.