Services

# **EVALUATION OF** TRANSFORMER SOLID INSULATION

## **DIRECT EVALUATION**

The mechanical properties of insulating paper can be established by direct measurement of its tensile strength or degree of polymerization (DP). These properties are used to evaluate the end of reliable life of paper insulation. It is generally suggested that DP values of 150-250 represent the lower limits for end-oflife criteria for paper insulation; for values below 150, the paper is without mechanical strength.

Analysis of paper insulation for its DP value requires removal of a few strips of paper from suspect sites. This procedure can conveniently be carried out during transformer repairs. The results of these tests will be a deciding factor in rebuilding or scrapping a transformer.

# FURALDEHYDE ANALYSIS

Direct measurement of these properties is not practical for in-service transformers. However, it has been shown that the amount of 2-furaldehyde in oil (usually the most prominent component of paper decomposition) is directly related to the DP of the paper inside the transformer.

Paper in a transformer does not age uniformly and variations are expected with temperature, moisture distribution, oxygen levels and other operating conditions. The levels of 2-furaldehyde in oil relate to the average deterioration of the insulating paper. Consequently, the extent of paper deterioration resulting from a "hot spot" will be greater than indicated by levels of 2-furaldehyde in the oil.

#### FOR MORE INFORMATION CONTACT:

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FURALDEHYDE CONTENT (PPM)	DP VALUE	SIGNIFICANCE
0-0.1	1200-700	Healthy Transformer
0.1-1.0	700-450	Moderate Deterioration
1-10	450-250	Extensive Deterioration
>10	<250	End of Life Criteria

### OTHER DIAGNOSTIC **COMPOUNDS**

The presence of phenols and cresols in concentrations greater than 1 ppm indicate that solid components containing phenolic resin (laminates, spacers, etc.) are involved in overheating.

#### RESEARCH

For more than 25 years, Powertech has performed research on solid insulation degradation used in electrical equipment. At the fundamental level, the remaining life of a transformer is determined by the condition of the paper. As a result, the emphasis of the solid insulation research at Powertech consists of studying new degradation products, rates of product formation, and the correlation of degradation products to fault types and the health of the paper. In particular, the development of new methods and instruments to non-invasively assess the condition of in-service solid insulation for life extension are the ongoing focus of the research. Powertech has both expertise and has performed research involving solid insulation by-products in several types of insulating mediums including, but not limited to, mineral oil, ester fluids and SF<sub>4</sub>.



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