IEEE/PES Transformers Committee
Spring 2006 Meeting
Costa Mesa, California, USA

"Aging Rate of Kraft Paper Insulation Immersed in Natural Ester Based Dielectric Coolant"

-- Technical Presentation --
Tuesday, March 21; 4:45 to 6:00 p.m.

By C. Patrick McShane, Fredi Jacob, Don Duckett

1. Abstract

Accelerated insulation systems aging studies have been conducted following IEEE C57.100 methods, comparing aging rates of different cellulose papers immersed in mineral oil to those immersed in natural ester dielectric coolant. The studies have included thermally upgraded Kraft, non-thermally upgraded Kraft, and high cotton fiber insulating paper. All studies, both full scale (distribution class) and lab scale, have been reported in several IEEE Technical conferences. All have demonstrated a significantly slower aging rate for cellulose insulation in natural (vegetable oil) ester based dielectric fluid compared to the rate in conventional transformer oil.

This tutorial will review the summary data, analysis of chemistry behind the interactions of natural ester fluid and cellulose insulation, and the potential practical applications for this discovery.

2. Learning Objectives

Four areas will be covered:

- Scope of IEEE C57.100 and brief description of two distinct test methods for the thermal evaluation of the insulation system will be reviewed.
- Comparative data between an insulation system using natural ester based dielectric coolant vs. conventional mineral oil will be evaluated.
- Theories and confirming testing on mechanisms that point to the significant difference in aging rates will be reviewed.
- A model will be shown on how to use this information to extend the transformer life and/or increase its rating.

3. Learning Outcomes

Attendees at the presentation will gain:

- A better understanding of the basis for reduction in aging rates of insulation in natural ester fluids.
- Potential methods for reducing the aging rate of transformers using either thermally or non-thermally upgraded paper.
- Increased knowledge and tools for increasing transformer ratings and life.

4. Presenter's Biographies

Fredi Jacob, Ph.D.: Dr. Jakob received his Ph.D. at Rutgers, The State University of New Jersey, in 1961. He is professor emeritus of analytical chemistry at California State University, Sacramento and was the founder and Laboratory Director of Analytical ChemTech International, Inc. (ACTI), which is a wholly owned subsidiary of Weidmann Systems International. As a long-term member of ASTM and IEEE and author of over fifty published articles, Dr. Jakob is a traveling lecturer to private and governmental agencies. He has been invited to speak at Doble Conferences, NETA Meetings, AVO Conferences, American Public Power Meetings, ASTM Symposia as well as other industrial organizations.

C. Patrick McShane: C. Patrick McShane received his BS in Electrical Engineering from Marquette University in 1970, and an MS in Engineering Management from the Milwaukee School of Engineering in 1998. Currently the Product Line Manager for Dielectric Fluid at Cooper Power Systems Transformer Products, his employment experience includes International Area Manager for RTE Corp. (1977-1984) and Regional Technical Director for the State of Sao Paulo (Brazil) Rural Electrification Program 1970 - 1976). His professional activities have included USA Delegate International Electrical Commission (IEC) TC99, IEC TC99 Liaison to TC64, IEC TC89 Expert Delegate, Chair ASTM W.G. D-5222, and W.G. Chair IEEE TC Dielectric Fluids Subcommittee C57.121, and IEEE TC Task Force Chair for Ester Based Dielectric Coolants. Several of his proposals have been adopted by Codes and Standards (NEC, NESC, FM Global, IEC). He has presented papers at domestic and international engineering conferences including IEEE, EPRI, Doble, and CIRED. He is the principal inventor of six US patents relating to dielectric fluids. Projects managed by Mr. McShane have received regional and national recognition, including Governor's (WI) Environmental Product of the Year, Plant Engineering Magazine Electrical Product of the Year.

Don Duckett: Don Duckett received his B.S. in Electrical Engineering from the University of Texas, El Paso. He is currently the Technical Sales Engineer for Hughes Supply in Orlando, Florida. His responsibilities include technical sales support on Hughes Agency products and services which include reclosers, regulators, circuit breakers, and distribution and power transformers. His past experience includes development of a transformer application program for distribution and power transformers, participation in the 2005 Department of Energy Building Technologies peer review evaluation of energy efficiency standards, development of System Restoration Modeling software to determine impact from storms, and technical support to Florida and Carolinas on RFI issues. He received the 1985 GE Power Systems Sector Engineer Award and 1991 GE Industrial and Power Systems Engineering Award. Don has been a member of the IEEE Transformer Committee of the Power Engineering Society for more than 30 years. He currently holds a 1976 US patent for a Transformer Pallet Pad.