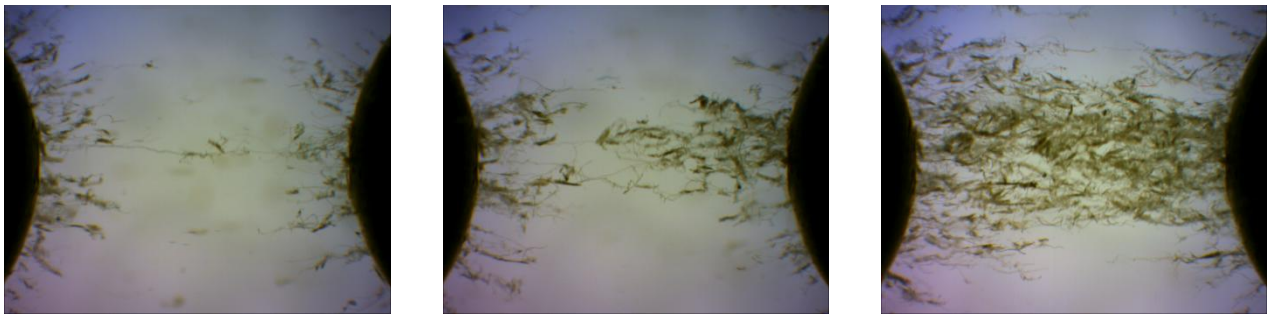
# Experimental Investigation on Bridge Formation in Contaminated Transformer Oil

S. Mahmud[*1], G. Chen[1], I. Golosnoy[1,] G. Wilson[2] and P. Jarman[2]
[1]University of Southampton, Southampton, SO17 1BJ, UK
[2]National Grid, UK
*E-mail: sm8e08@ecs.soton.ac.uk

Oil is an essential insulating and cooling medium used in a vast range of high voltage equipment from cables to transformers and switchgears. Analysis on power transformer failures has revealed that insulation/oil contamination is a major factor, accounting for nearly 30% of the total failures. As a result there is a great deal of research interest in understanding the composition, insulating performance, ageing processes and breakdown mechanisms in such oils. In this project we are focussing on the effect particle contamination of transformer oil on electrical performance of high voltage power transformers.

Transformer oil fulfils purpose both as electrical insulation and coolant. During the operation it contacts with metal, iron core and pressboard insulation inside a transformer. Contaminants such as metal filings or cellulosic residual can be formed in the oil, especially for transformers with aged paper insulation. During normal operation non-uniform fields are present within the transformer. These contaminants tend to move towards high field regions due to dielectrophoresis (DEP) forces and could form a bridge over a period of time. The bridge may potentially act as a conducting path between two different potentials within the transformer structure, leading to partial discharges or insulation failure. Initial experiment on pressboard cellulosic particles has demonstrated that pre-breakdown phenomena are closely related to the level of contamination [1].

Current work focuses on experiments with different sizes of pressboard particles under dc voltages. Three different levels of contaminants (0.0025, 0.0050 and 0.0075% by weight) have been used for the experiment. Current is also monitored whilst a dc voltage applied across a known contaminated oil sample. It has been found that at higher voltages the rate of bridge formation is increased along with an associated current increase.



7.5kV 60s | 7.5kV 90s | 7.5kV 300s

Figure 1: Photographs showing bridge formation in oil over time at 7.5kV. Contamination level 0.0025% by weight

[1] Chen, G. and M.H. Zuber. “Pre-breakdown characteristics of contaminated power transformer oil in Electrical Insulation and Dielectric Phenomena”, *Conference on Electrical Insulation and Dielectric Phenomena*, 2007.