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Study of accelerated thermal aging of transformer oil-based ferrofluid

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Transformer oil-based ferrofluids are promising alternative dielectric liquids for retrofilling of distribution transformers. They have been reported to exhibit improved thermal and dielectric properties under certain conditions. Despite increasing interest in ferrofluids for transformer applications, their behaviour under accelerated thermal aging remains insufficiently explored. In this paper, we experimentally investigate the thermal aging of a ferrofluid based on biodegradable transformer oil and iron oxide nanoparticles (0.15 % w/V) coated with a single layer of oleic acid. The ferrofluid was divided into five samples and placed in separate bottles, which were exposed to a temperature of 90 °C. The samples were aged under these conditions for controlled time intervals ranging from 72 to 504 hours. The effects of thermal aging were systematically assessed using dielectric measurement techniques, namely DC resistivity and measurements of temperature-dependent dissipation factor and permittivity at power frequency (50 Hz). It is found that DC resistivity of transformer oil increased by one order of magnitude due to thermal aging, while ferrofluid's resistivity remained relatively stable, indicating only a weak effect of thermal aging. A nearly linear decrease in permittivity with increasing temperature is observed for both the oil and the ferrofluid. A slight decrease in the dissipation factor of oil and ferrofluid is ascribed to the decreased moisture content, as documented experimentally. Overall, the ferrofluid exhibits increased dissipation factor and permittivity, but these properties remain more stable during thermal aging compared to those of the base oil.

Type:

Poster