

Paris Session
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LIQUID TESTS IN SERVICE – SIMILARITIES AND DIFFERENCES

SC A2/P2

QUESTION 2.3 : Question 2.3: What maintenance challenges exist for alternative technologies, especially for demanding applications? Is there any significant difference from the maintenance challenges for conventional oil-immersed transformers

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Maintenance focus

- Maintenance of electrical equipment is focused on:
 - Keeping the equipment in service in a reliable shape
 - Preventing preliminary ageing
- For this purpose not single standards or guidances but a combination of those are to be utilized. This is common for all liquid insulated equipment.
 - e.g. no maintenance can be carried out only on gas-in-oil analysis or only on oil values, but on combination of both. Experience shows clearly that faults have similar manifestation in the gas-in-oil analysis although the chemical composition may be different
 - there are parameters, which are crucial for operation, e.g. breakdown voltage and others, which are important for early ageing recognition, e.g. acidity, DDF, interfacial tension

good

fair

poor

Differences between insulating liquids

- - Chemical composition
- - Biodegradability
- - Some electrical and dielectrical properties
- - Flammability
- - Environmental properties

Some specifications for new and used insulating liquids

	Mineral oil	Silicone liquids	Synthetic ester	Natural ester
New liquids	IEC 60296 ASTM D3487 IEEE 57.106 IEEE 57.121	IEC 60836 ASTM D4652 IEEE 57.111	IEC 61099	ASTM D6871 IEEE 57.147 IEC 62770
Liquids in service	IEC 60422 IEEE 57.106	IEC 60944 IEEE 57.111	IEC 61203	IEC 62975 IEEE 57.147
DGA	IEEE C57.104 IEC 60567 IEC 60599			

Similarities between maintenance approaches

Different parameters have different criticality

Property
Colour
Appearance
Breakdown voltage
Water content
Acidity (neutralization value)
Dielectric dissipation factor (DDF) and resistivity
Inhibitor content
Sediment
Interfacial tension (IFT) ^{b, c}
Particles (counting and sizing) ^b
Sludge
Flash point
Compatibility
Pour point
Density at 20 °C
Viscosity
Polychlorinated biphenyls (PCBs)
Corrosive sulphur ^b
Potentially corrosive sulphur ^b
Dibenzyl disulphide (DBDS) content
Passivator content

Breakdown voltage problem requires intermediate action. This is common for the maintenance of all types insulating liquids

	critical
	less critical

Additional parameters which help in maintenance of esters

- Some parameters which are of no real importance for mineral oil may be very important for the monitoring of natural esters, **e.g. viscosity. Fire point** may be important in case of esters for the identification of mixtures with mineral oils
- Some other simple parameters, like **refraction index**, not really used for mineral oil, can be very useful for this purpose as well