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Insulating liquids – Quantitative determination of methanol and ethanol in insulating liquids

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INSULATING LIQUIDS – QUANTITATIVE DETERMINATION OF METHANOL AND ETHANOL IN INSULATING LIQUIDS

FOREWORD

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IEC TR 63025 has been prepared by IEC technical committee 10: Fluids for electrotechnical applications. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
10/1112/DTR	10/1131/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

It has been demonstrated over several years that the ageing of impregnated paper in insulating liquid, which results in cellulose degradation, produces molecules of light alcohols, methanol (MeOH) and ethanol (EtOH). In laboratory experiments, a good correlation has been established between the increase of the methanol content in insulating liquid and the decrease of the degree of polymerization of the cellulose, irrespective of the type of paper, standard kraft or thermally upgraded. Further, at the early stages of paper ageing, i.e. of cellulose degradation, the methanol content is always higher than that of furanic compounds (mainly 2-furfural), so this behaviour suggests that methanol could be a relevant in-oil marker to detect early paper ageing in transformers and to assess its evolution (see Figure 1).

Ethanol is a second light alcohol of interest that these methods would be able to detect.

It should be emphasized that in a real transformer the situation is much more complicated than in laboratory setups, so the relationship between in situ paper degradation and tracer concentration (MeOH, EtOH, as well as 2-FAL) is much more complex and hard to establish.

In order to address the growing interest of industry in using these alcohols as tracers of cellulosic material ageing in operating equipment, there is a need for the development of a document describing analytical methods to quantify methanol and ethanol in the different types of insulating liquids. The objective is for one of these methods to remain as simple and affordable as possible, and for the other to be more sophisticated and more accurate.

The principle of this Technical Report was brought up and discussed during the IEC TC 10 plenary meeting held in Vienna in November 2013. A project team was set up to prepare test methods for the unambiguous quantitative determination of methanol and ethanol in unused and used insulating liquids.

WARNING – Health and safety

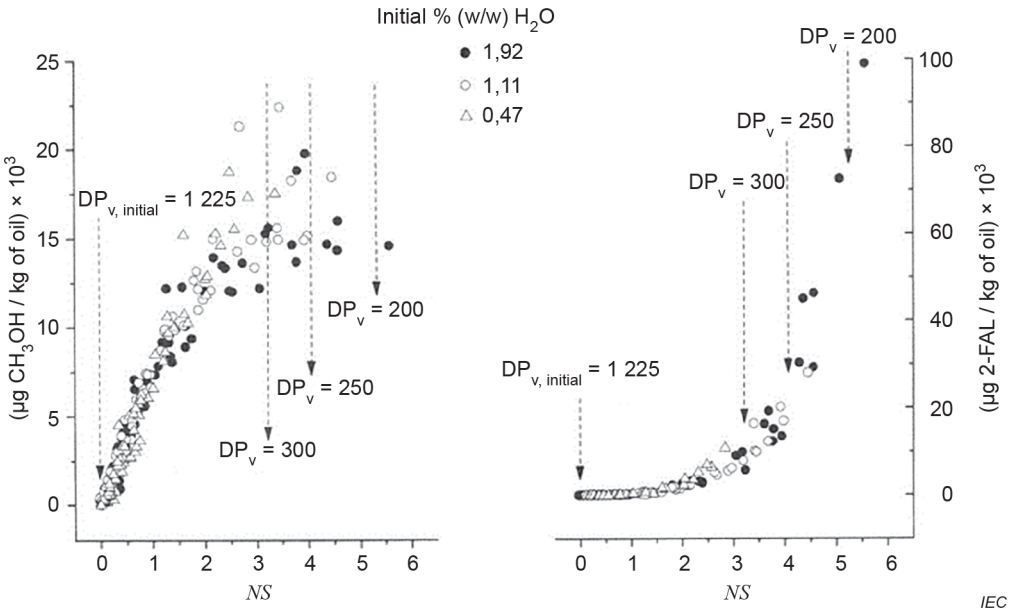
This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

The insulating liquids which are the subject of this document should be handled with due regard to personal hygiene. Direct contact with eyes may cause slight irritation. In the case of eye contact, irrigation with copious quantities of clean running water should be carried out and medical advice sought.

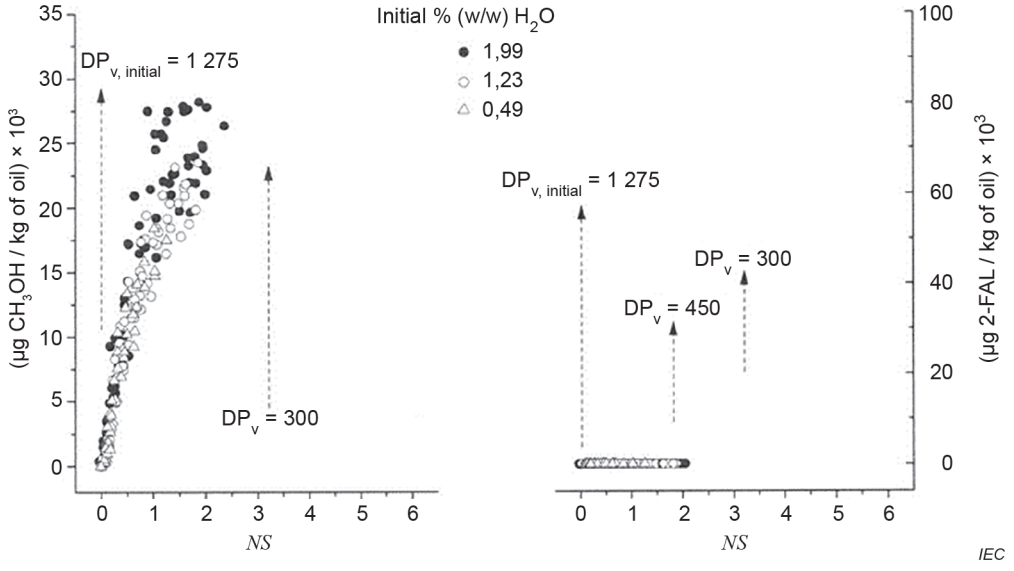
Some of the tests specified in this document involve the use of processes that could lead to a hazardous situation. Attention is drawn to the relevant standard for guidance.

WARNING – Environment

This document involves mineral oils, ester liquids, chemicals and used sample containers. The disposal of these items should be carried out in accordance with current national legislation with regard to their impacts on the environment. Every precaution should be taken to prevent the release into the environment of the chemicals used during the test.



a) Clupak HD75 specimens



b) Manning 220 mannitherm D specimens

Key

NS: number of scissions, inversely proportional to the polymerization degree (DPv)

a): standard kraft paper

b): thermally upgraded paper

NOTE See Jalbert J., Gilbert R., Tétreault P., Morin B. and Lessard-Déziel D. (2007) in the Bibliography.

Figure 1 – Comparison of methanol and 2-furfural production in mineral oil versus cellulose scission number

INSULATING LIQUIDS – QUANTITATIVE DETERMINATION OF METHANOL AND ETHANOL IN INSULATING LIQUIDS

1 Scope

This document specifies two test methods for methanol and ethanol determination in insulating liquids.

Methanol (MeOH) and ethanol (EtOH) are two light alcohols generated during the degradation process of cellulosic materials. They are soluble in insulating liquids so they can be regarded as ageing tracers whose concentrations in oil reflect the degradation of insulating cellulosic materials in liquid-impregnated transformers.

2 Normative references

There are no normative references in this document.