
Contribution ID: **912** Type: **Poster**

# 2P77 - Investigation of impulsive breakdown of interfaces formed by ester insulating liquids and solid dielectrics

*Tuesday 25 June 2019 13:00 (1h 30m)*

As naphthenic mineral oils are classified as a Class 1 water hazard, both the power and pulsed power industries are actively investigating suitable replacement liquid insulation. Natural and synthetic ester liquids present a possible alternative to these naphthenic mineral oils, primarily due to their comparable dielectric properties. Furthermore, ester liquids offer a number of additional benefits over conventional naphthenic oils such as improved biodegradability, reduced toxicity, increased flash point and the ability to absorb large amounts of moisture, as a consequence of the higher saturation point of ester liquids. For these reasons, significant research efforts have focused on the suitability of esters in the replacement of naphthenic mineral oils. However, most published research has examined ester liquids as the insulating medium within bulk insulating systems, with little known of the performance of liquid-solid interfaces formed between esters and solid polymers used in practical high voltage power and pulsed power systems.

This paper will present and discuss the breakdown performance of liquid-solid interfaces formed by MIDEL 7131 synthetic ester, FR3 natural ester and different solid dielectric materials, Nylon 66, Perspex and PVDF. These interfaces will be stressed with standard lightning impulse voltages of both positive and negative polarity, following the IEC 60897 methodology. This standard uses a point sphere geometry generating a highly divergent field. Key breakdown characteristics, such as breakdown voltage and time to breakdown will be obtained and compared with those for liquid-solid interfaces formed between the same chosen solid dielectric materials and a naphthenic mineral oil. The results of the study will provide data for designers and operators of power and pulsed power systems, helping to determine whether naphthenic oils can be directly replaced with esters in existing high voltage designs, and informing the clearances in new designs.

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**Session Classification:** Poster - Microwave Generation and Plasma Interactions and Pulsed Power Switches and Components

**Track Classification:** 5.5 Insulation and Dielectric Breakdown