The Tony Davies High Voltage Laboratory

UNIVERSITY OF Southampton
School of Electronics and Computer Science

Influence of Thermal Aged Paper on Space Charge Dynamics in Oil-paper Insulation System

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Introduction

- Oil-paper insulation has been widely used in power transformers as the main insulation, including HVDC convertor transformer.
- One of the major issues associated with HVDC is the easy accumulation of space charge which can result in distortion of the electric field distribution, and lead to dielectric degradation.
- There are many factors that affect the space charge behaviour in the oil-paper insulation. The DC stress is mainly distributed in the solid part of oil-paper insulation. Therefore, the effects of paper property on space charge dynamic need to be investigated.

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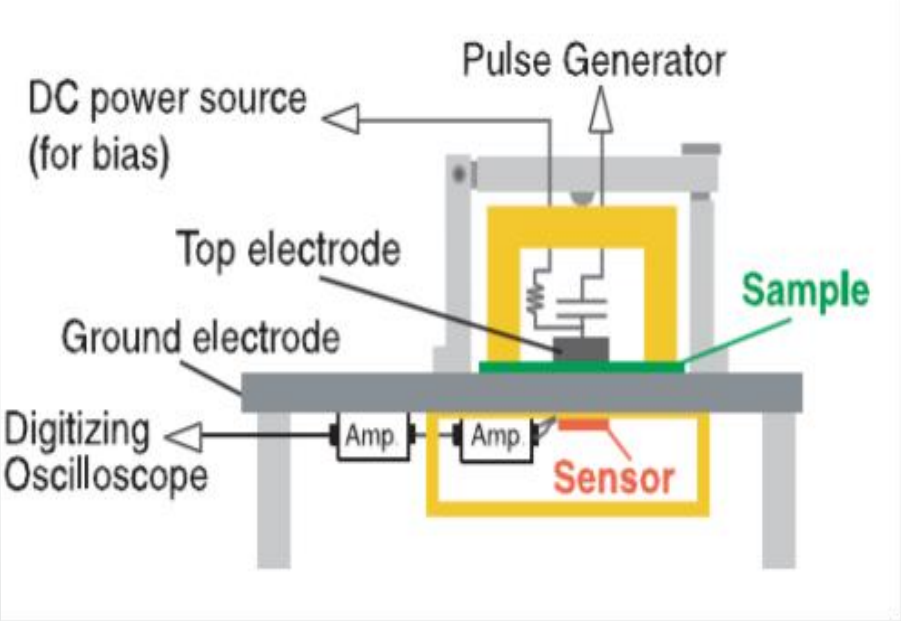
Experimental setup

- **PEA system:**



Pulse: 400Hz, 400V with 5ns pulse width;

Top electrode: semiconducting polymer;

Ground electrode: 10mm aluminium plate;

Sensor: 9μm PVDF film;

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Experimental setup

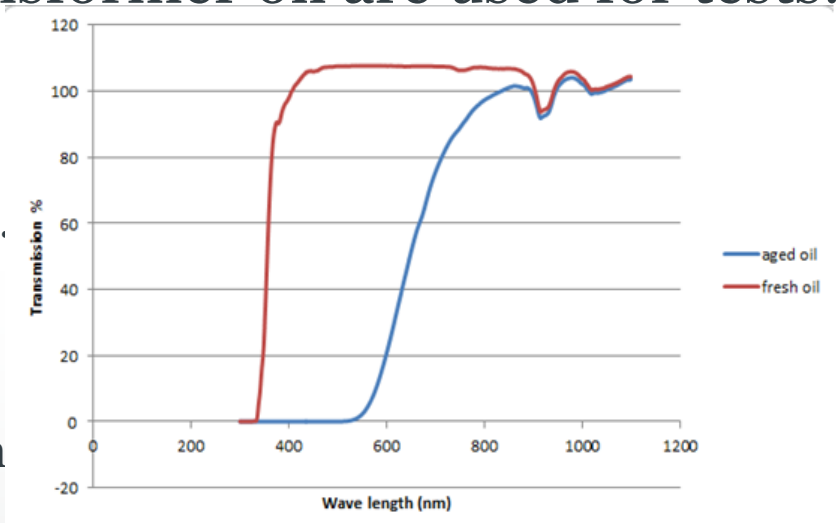
- Two different kinds of transformer oil are used for tests:

1. Fresh pure mineral oil

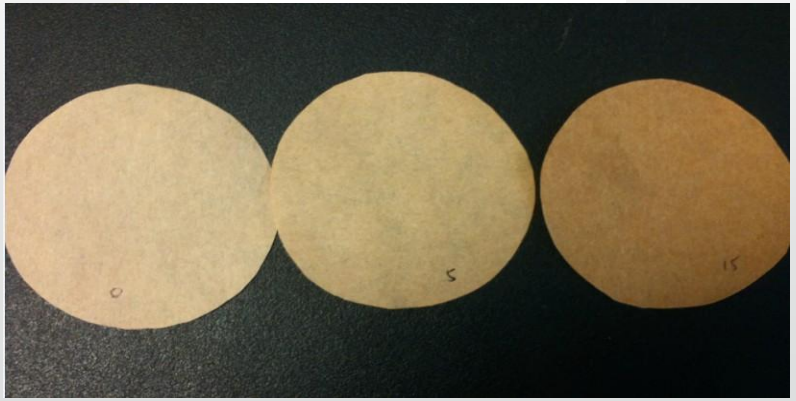
   the moisture content is about 12 ppm.

2. NG serviced aged oil

   the moisture content is about 30 ppm



UV/Vis spectra results



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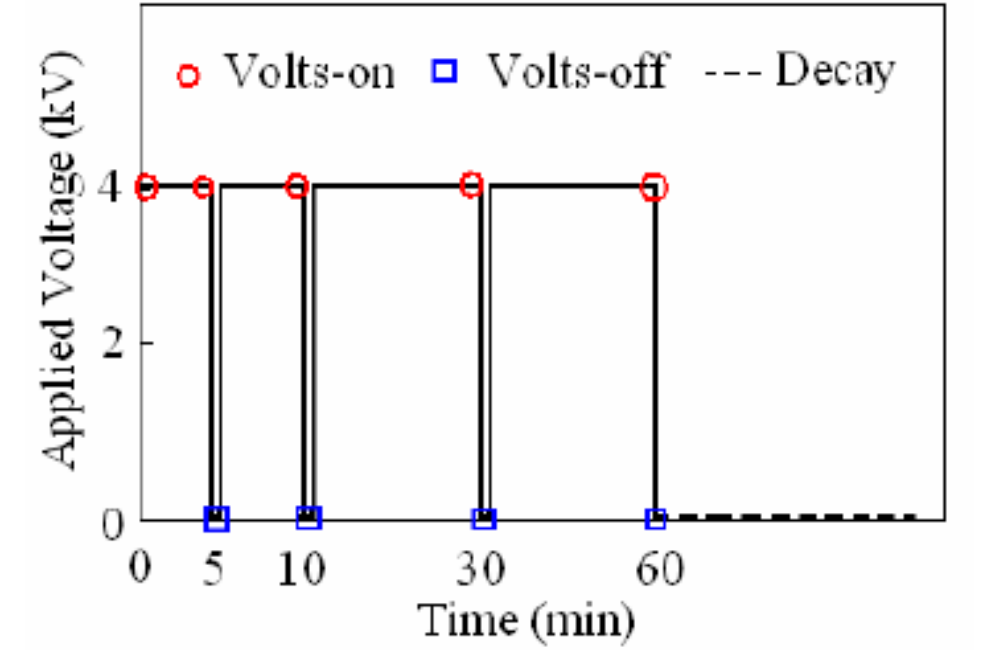
Experimental setup

- Illustration of experimental measurement points



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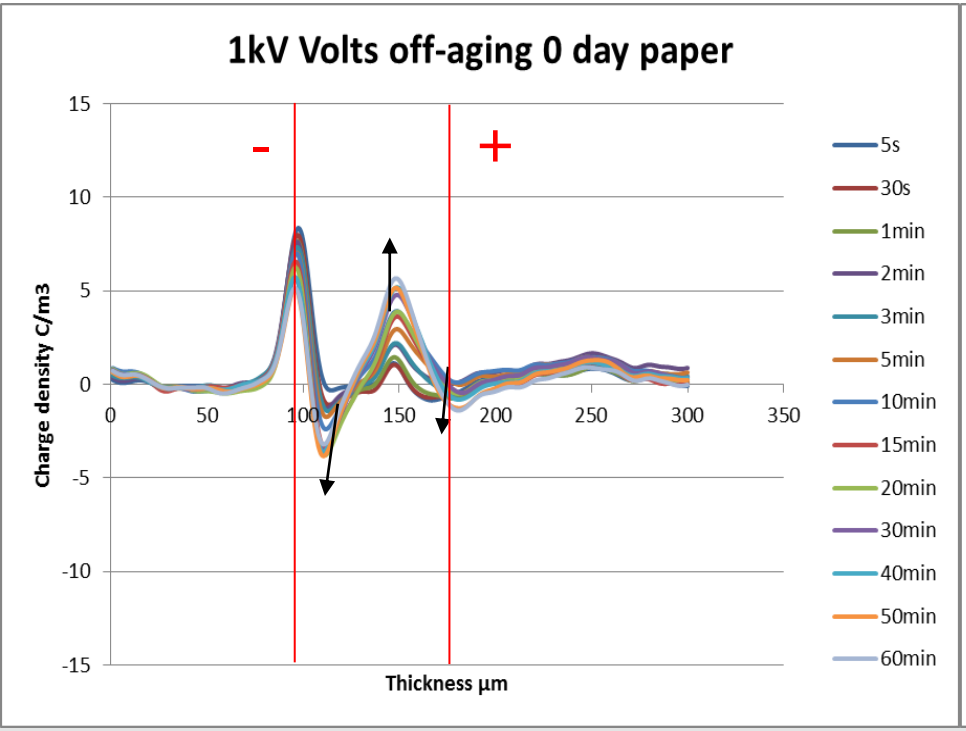
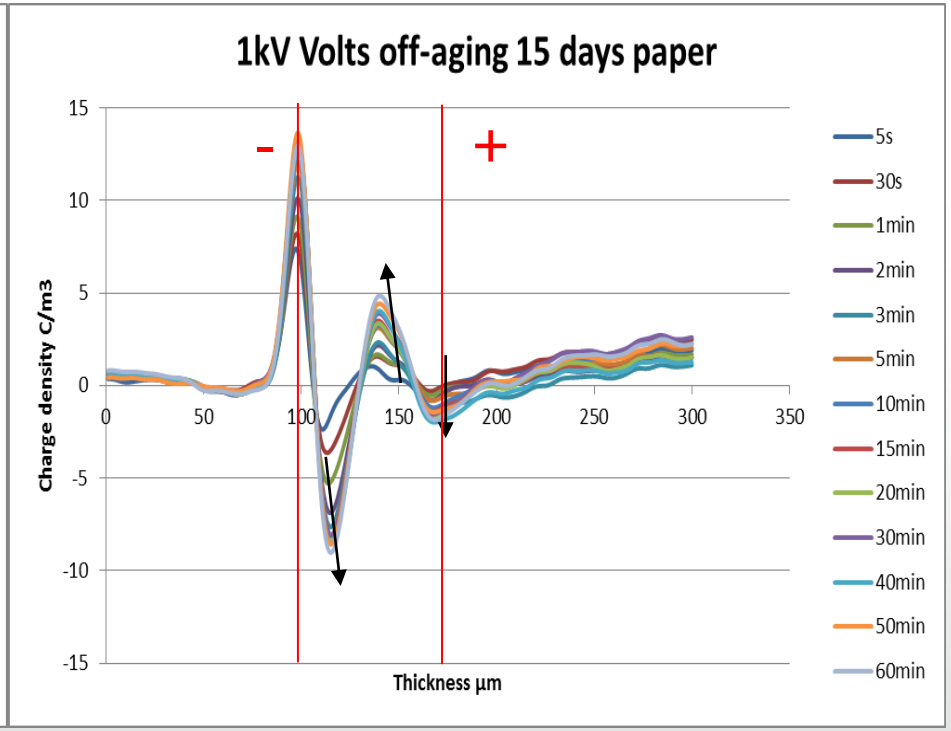
Experiment results

- **Space charge in thermal aged papers (Volts-off)**





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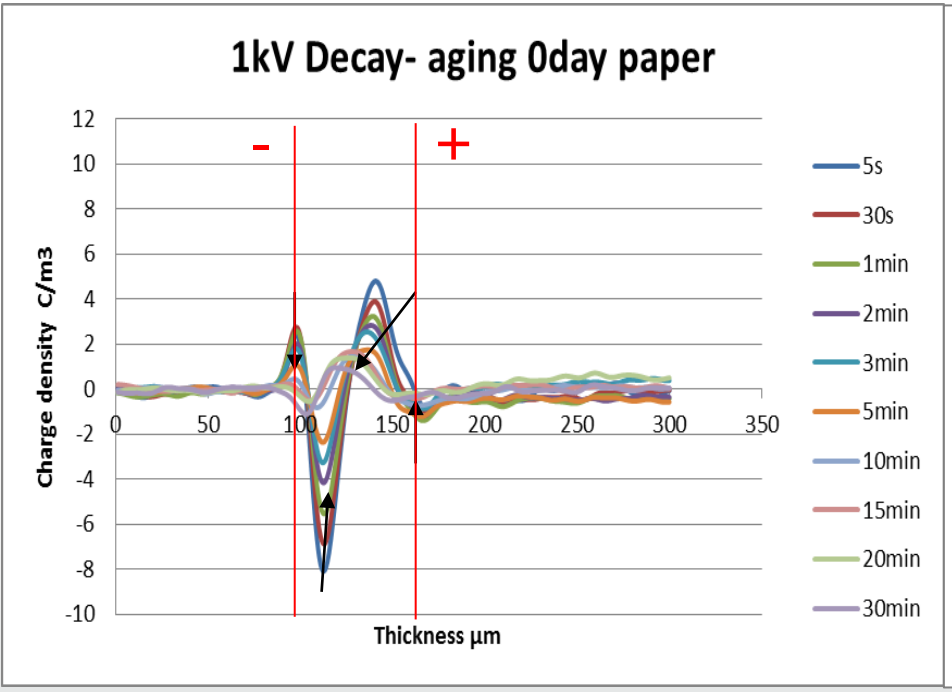
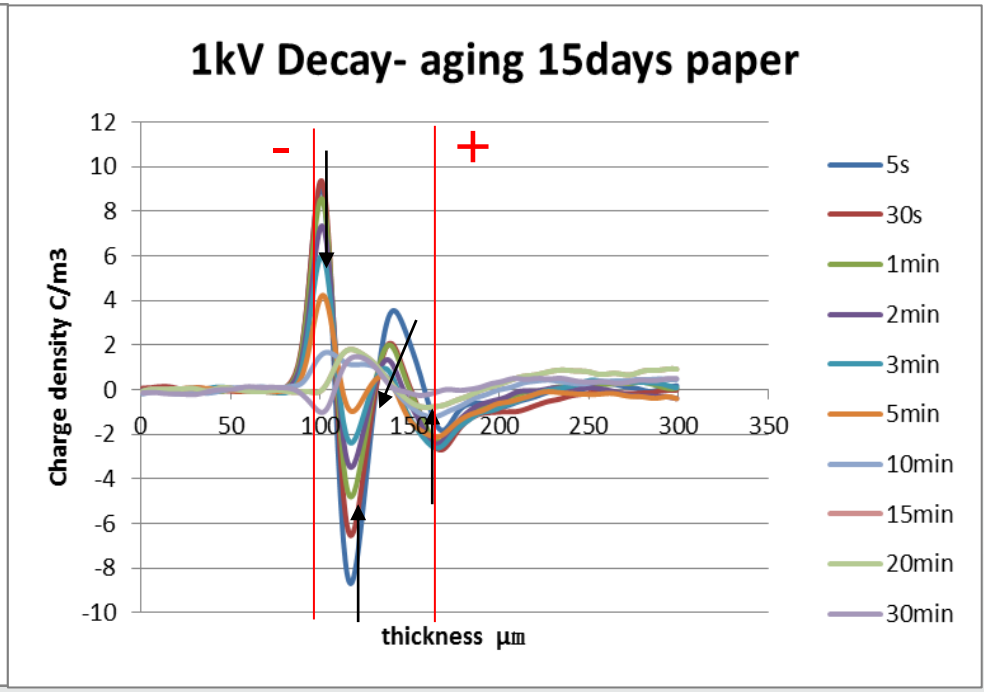
Experiment results

- **Space charge in thermal aged papers (Decay)**





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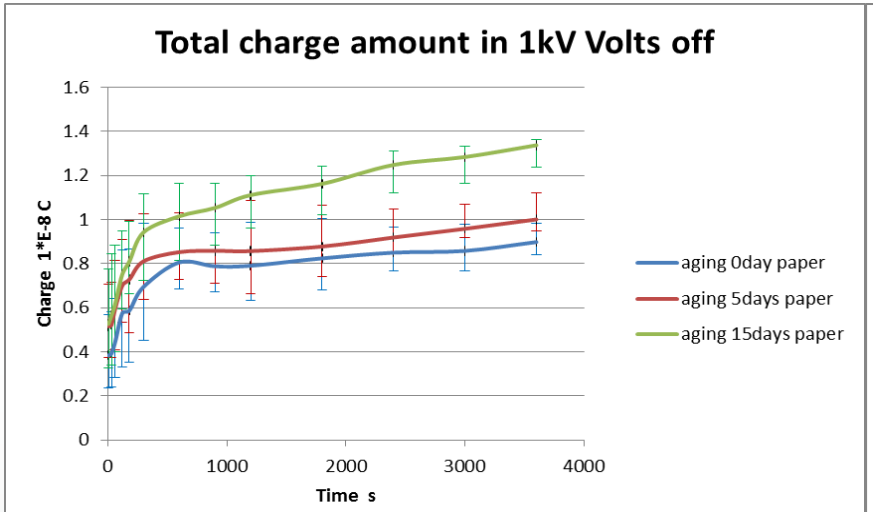
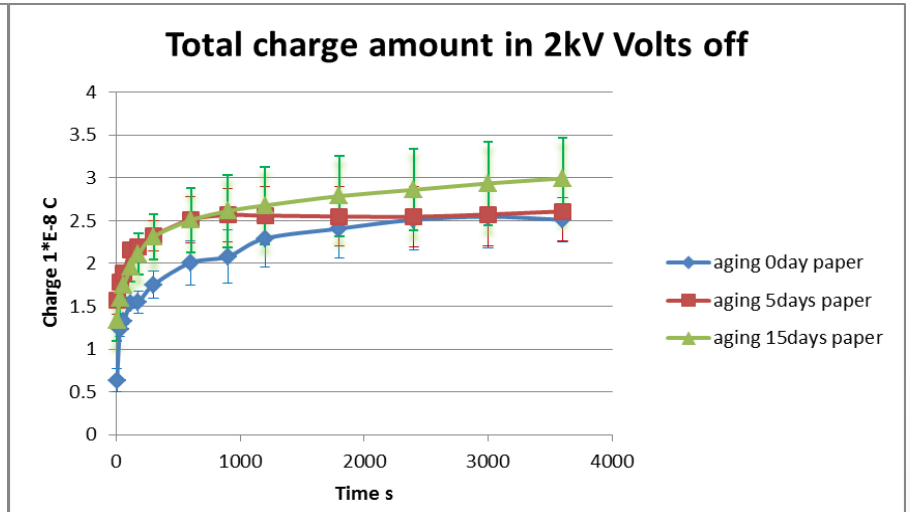
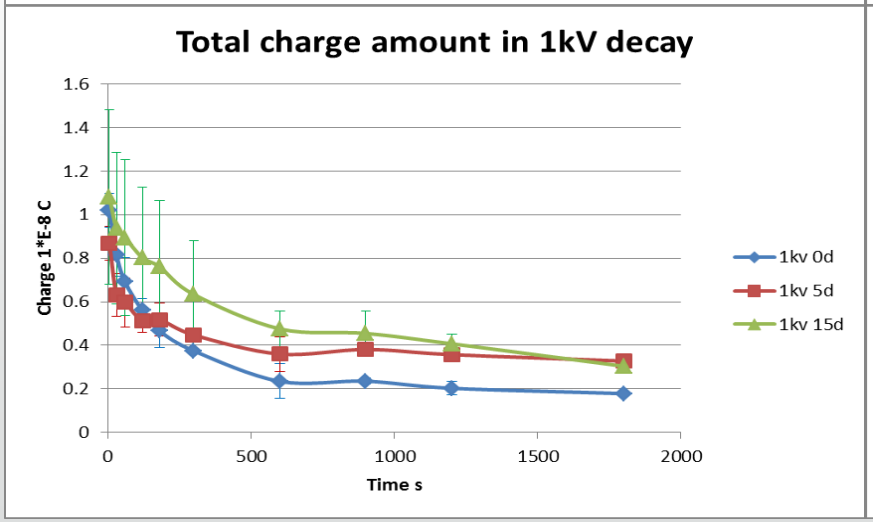
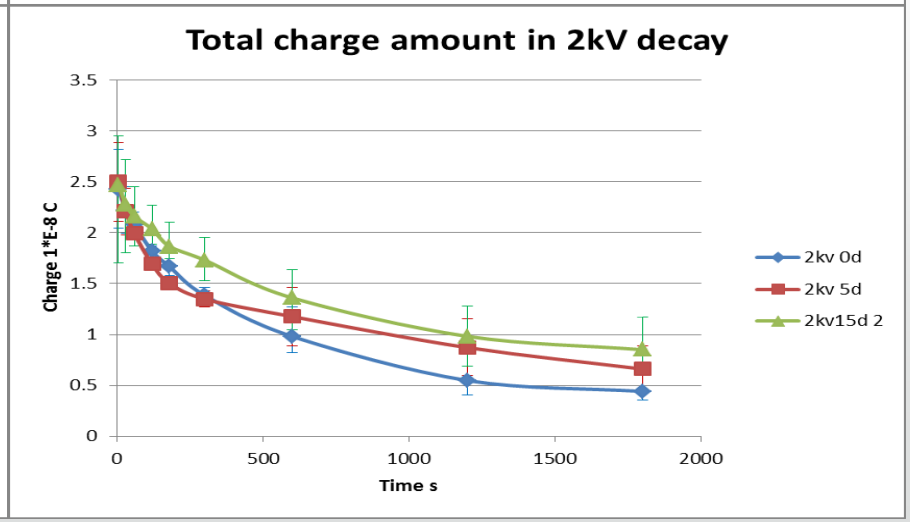
Experiment results

- **Space charge in thermal aged papers**









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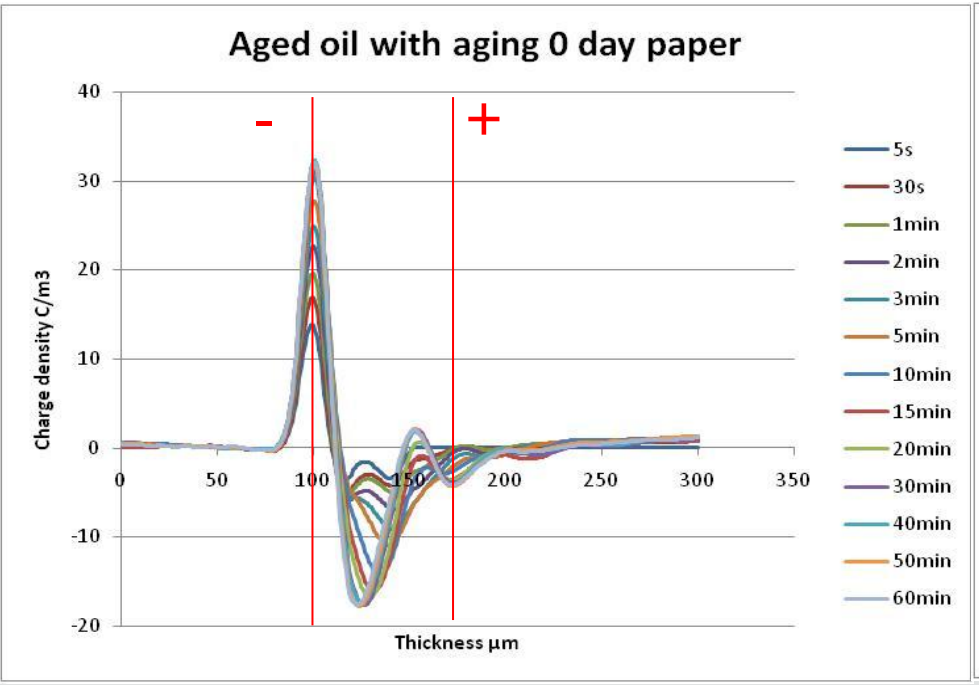
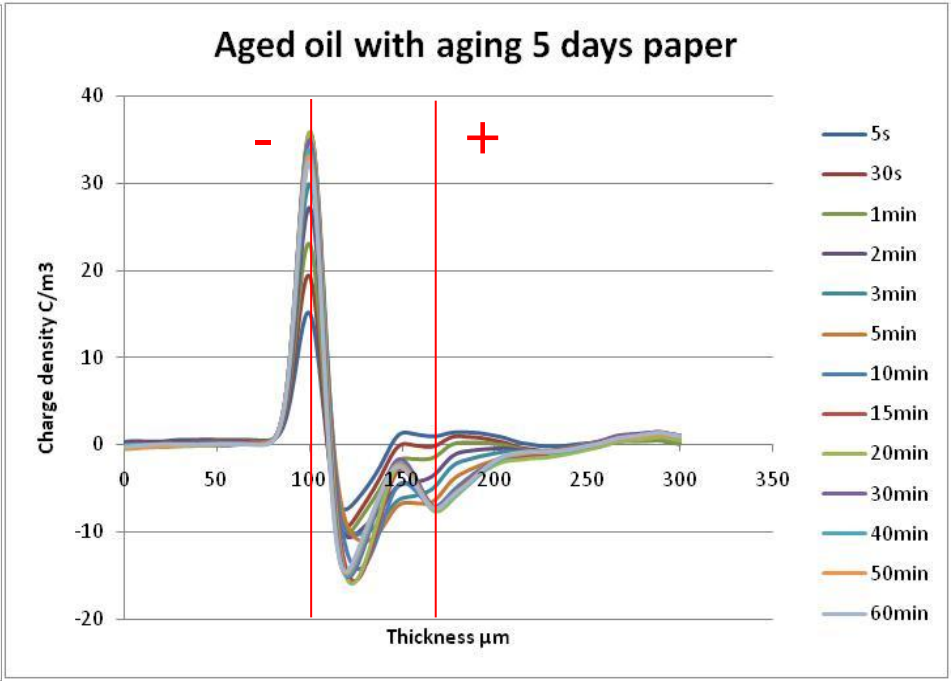
Experiment results

- **Space charge in aged oil (Volts-off)**
- **1kV**





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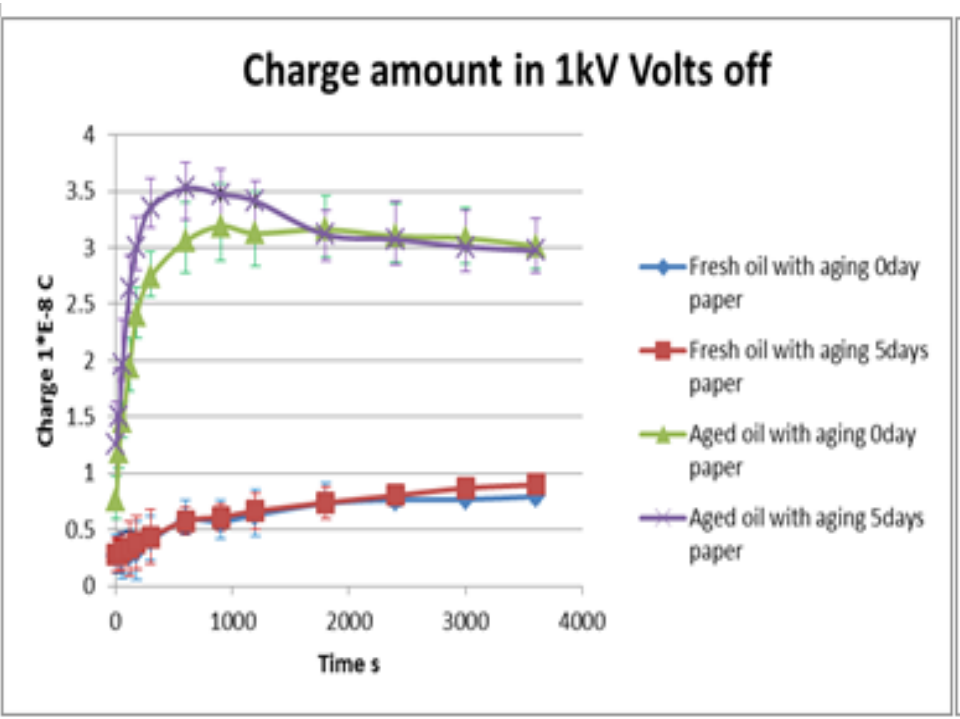
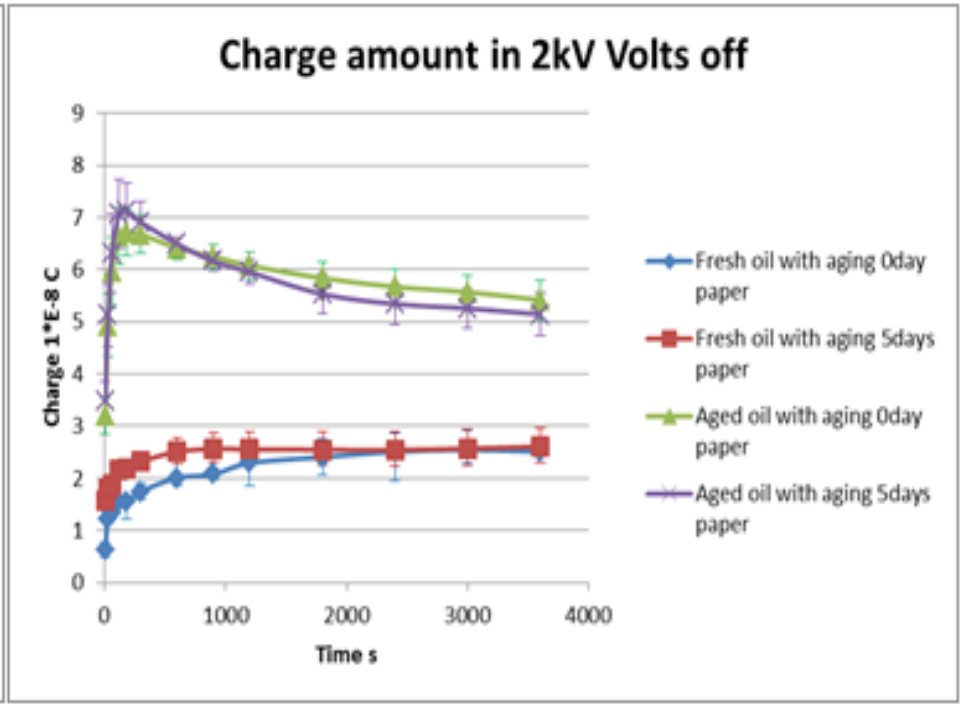
Experiment results

- **Space charge in aged oil**





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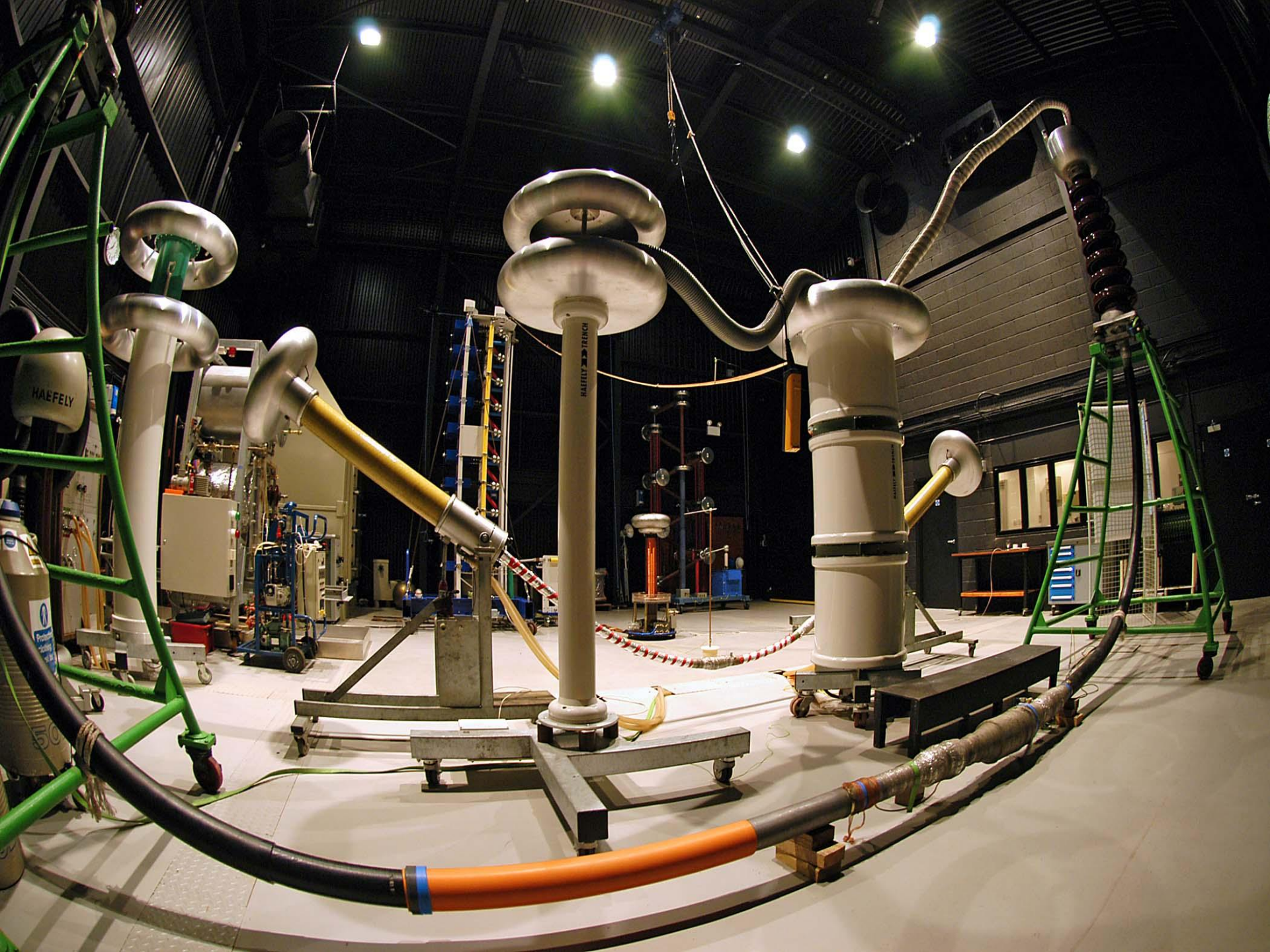
Conclusion

- The influence of aged paper for different aging times on space charge behaviour in the oil-paper insulation has been investigated by using PEA method.
- Thermal aged paper can affect the space charge formation in the oil-paper insulation. For 1 kV and 2 kV DC voltages, respectively, the more deterioration of the papers, the more space charge accumulates in the dielectric bulk. However, generally, the effects caused by the aging 15 days papers are not very significant.
- By applying serviced aged oil instead of fresh oil, much more significant effects caused by the aged oil are observed from the results. Remarkable negative charges are injected and accumulated in the sample. And the charge decay very fast in the decay test (disappear within 30s) indicating these negative charges are mainly fast charges due to the large conductivity of the aged oil.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