Tervakoski film ECT - SUPERIOR BOPP CAPACITOR BASE FILM

FOR DRY AC/DC CAPACITORS

COMPARISON WITH PREVIOUS GENERATION EC FILM and ALTERNATIVE HIGH CRYSTALLINITY FILM

1. INTRO

This report summarizes test results from a comparison of Tervakoski film ECT vs. EC film and as an addition also benchmarking Tervakoski film ECT vs. alternative tenter film (experimental film made in TFG from alternative common high isotactic polymer – further ECX). Tests were performed by Tervakoski Films Group engineers in R&D laboratories with capacitor elements wound from am. films.

Materials used for benchmarking:

- Tervakoski film ECT 6 µm
- Tervakoski film EC 6 µm
- Alternative high crystallinity tenter film ECX 6 µm

2. TESTS SETUP

- DC breakdown strength - routine test results comparison of base film
- Accelerated AC voltage endurance tests at elevated temperatures, capacitor elements made of zinc-aluminium alloy metallized film
- Long term ageing test, capacitor elements made of zinc-aluminium alloy metallized film

2.1. DC BREAKDOWN STRENGTH - ROUTINE TEST RESULTS COMPARISON

The following is a comparison of DC breakdown strength results from routine tests performed during base film manufacturing. Tests were performed with a large electrode area (typical 2,5m^2). The compared films are ECT vs. EC with a 6 µm thickness which is representative for this report. Thicknesses 4,8 and 9 µm are also included to broaden the picture. Results clearly show an overall superiority of ECT film vs. EC regarding breakdown strength characteristics.

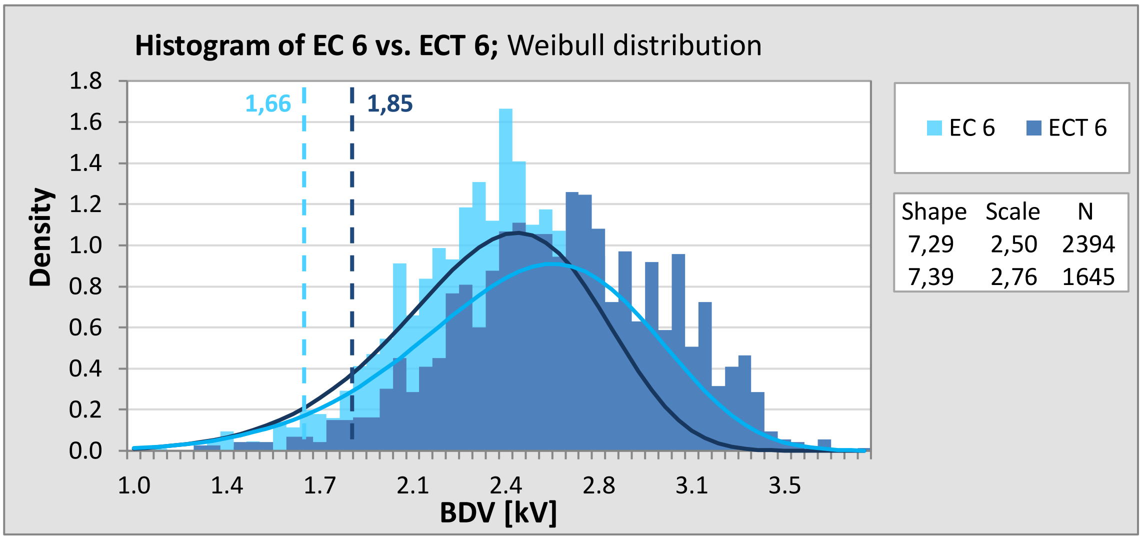
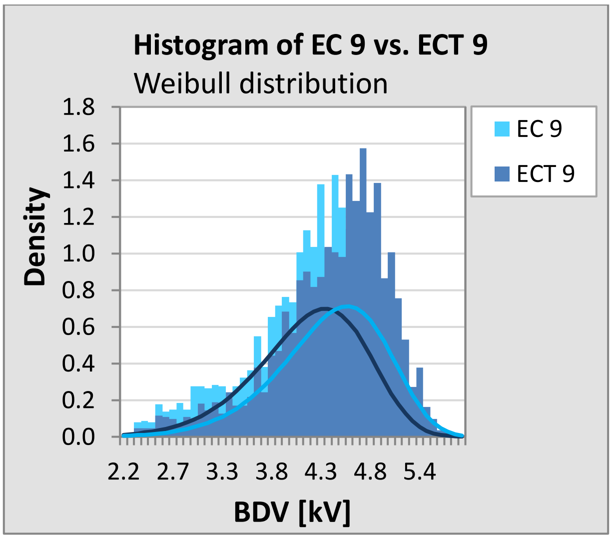


Fig.1: DC breakdown voltage, large electrode, 6 µm film.



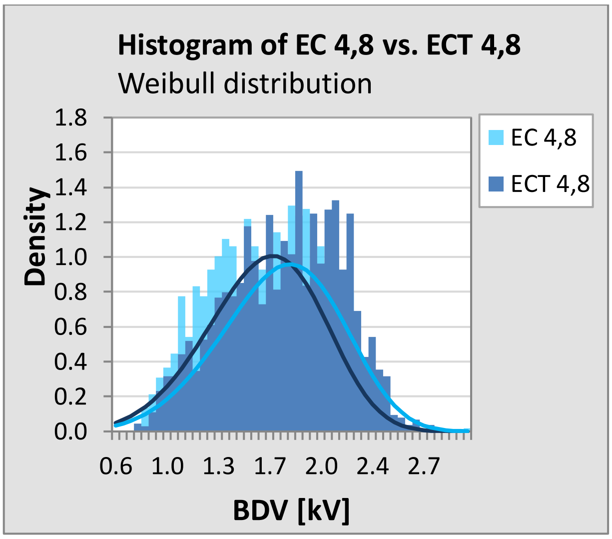


Fig.2: DC breakdown voltage, large electrode, 4,8 and 9 µm film.

2.2. ACCELERATED ENDURANCE TESTS – TYPICAL BEHAVIOUR

Accelerated endurance tests of dry capacitor elements were performed at AC voltage steps as in Fig.3 [Vac/µm] and elevated temperatures 85°C, 90°C, 95°C during the entire test. Tervakoski film ECT shows a very neutral behavior of the dissipation factor under voltage/temperature stress, which means exceptional safety regarding local ageing. A very subtle change in capacitance of ECT film made capacitors during tests underlines the safe performance of the film.

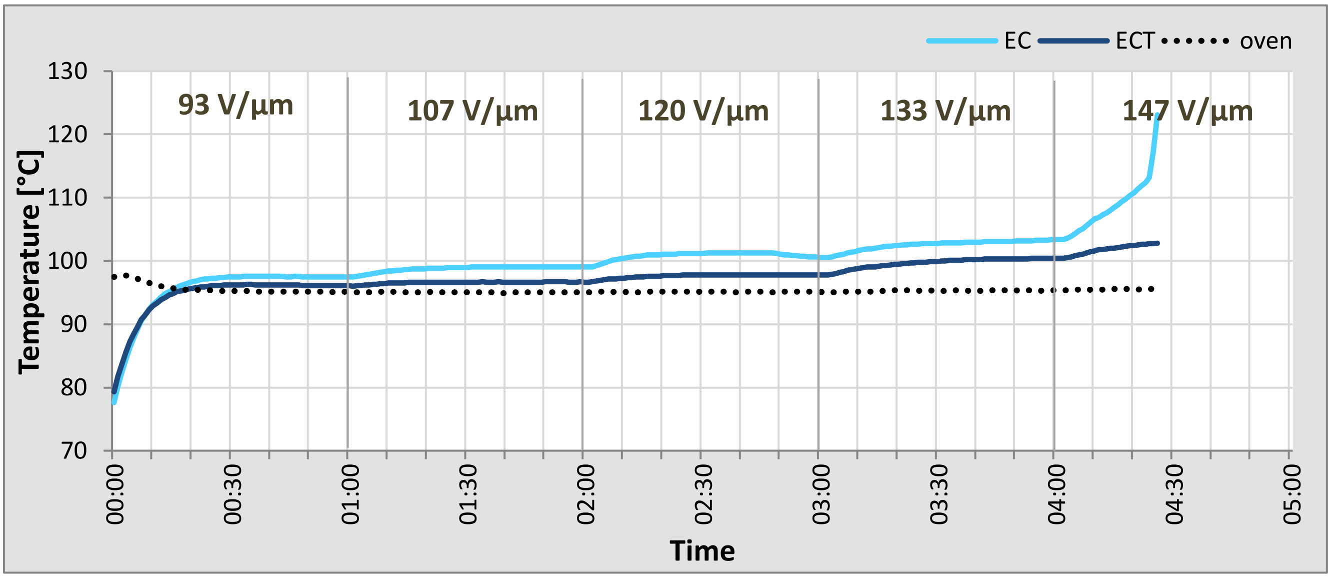


Fig.3: Accelerated endurance test of ECT vs. EC film at 95°C – temperature in capacitor element "hot spot".

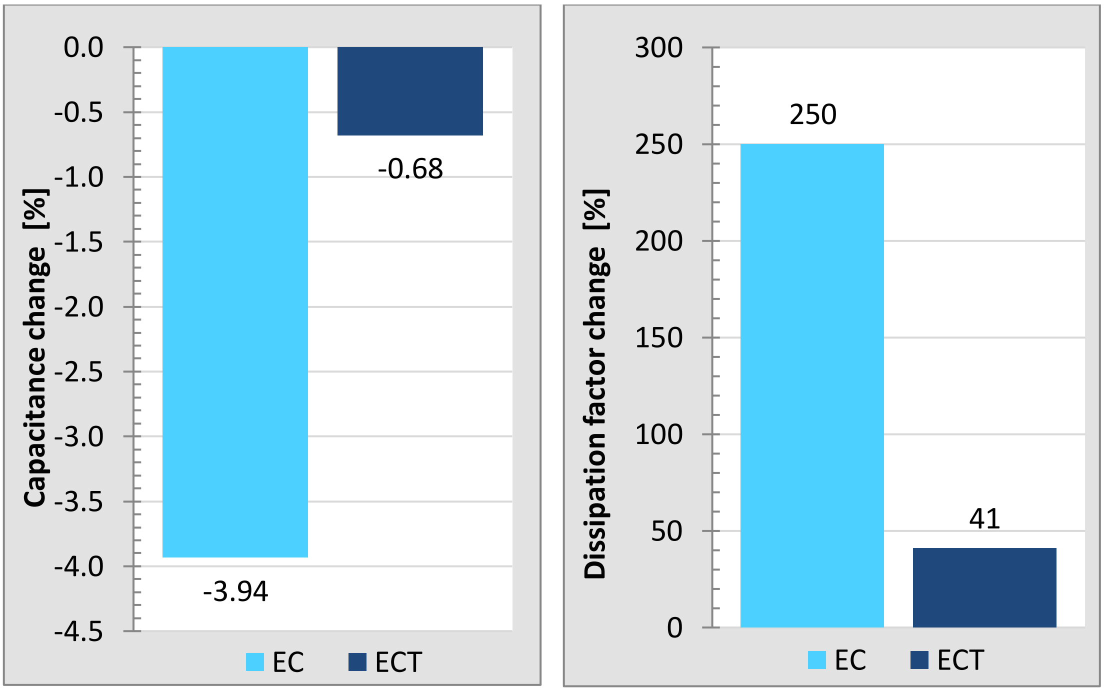


Fig.4: Accelerated endurance test of ECT vs. EC film 95°C – capacitance/dissipation factor change.

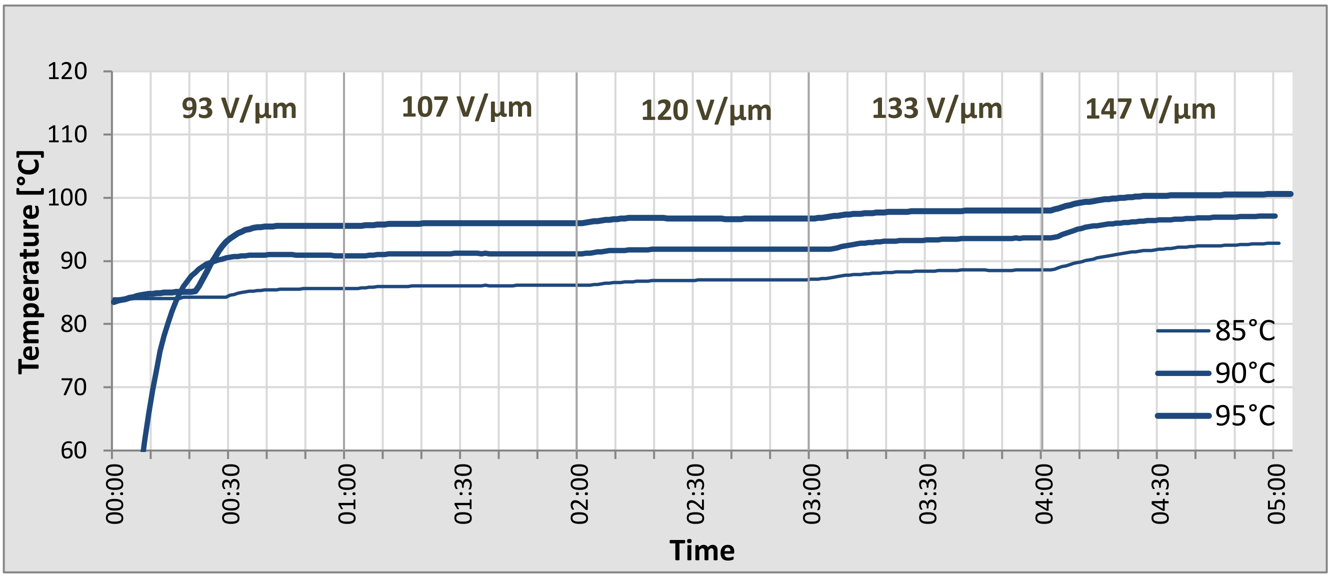


Fig.5: Accelerated endurance test at 85/90/95 °C - ECT film – temperature in capacitor element “hot spot”.

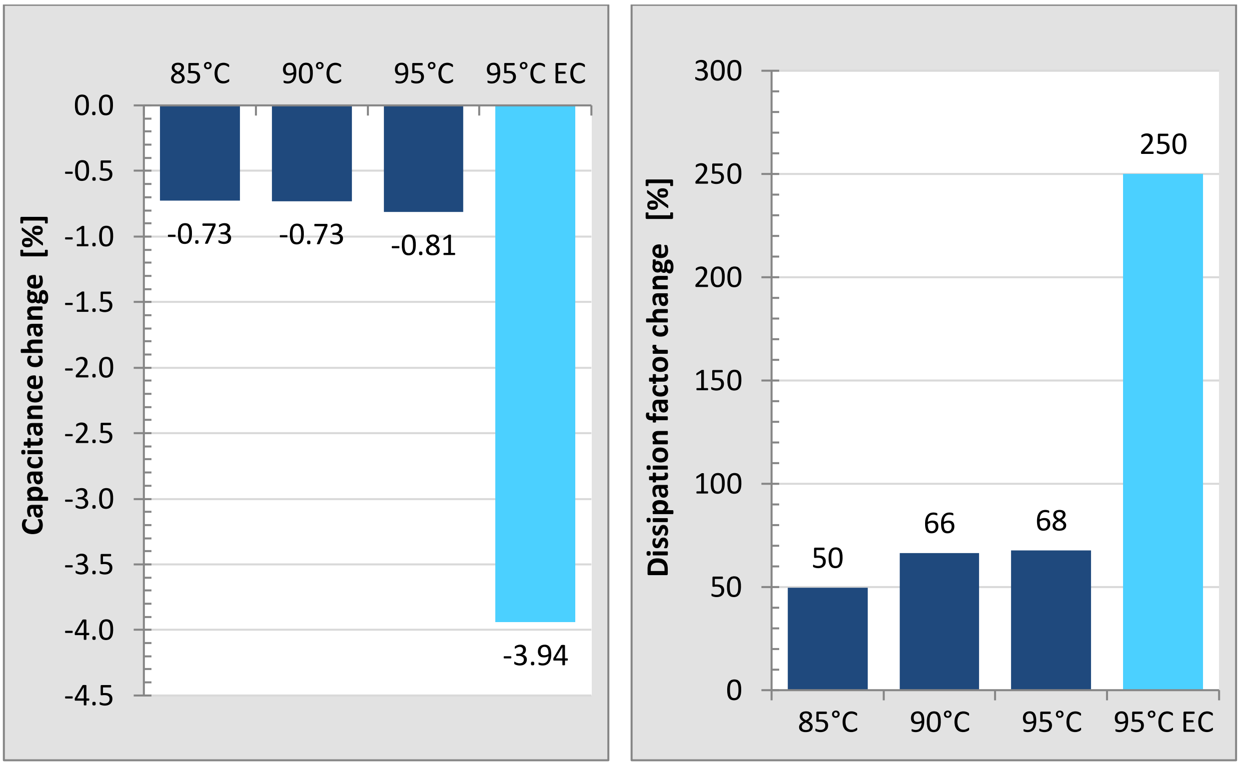


Fig.6: Accelerated endurance test at 85/90/95 °C - ECT film – capacitance/dissipation factor change,

(95°C EC film from fig.4 as a reference).

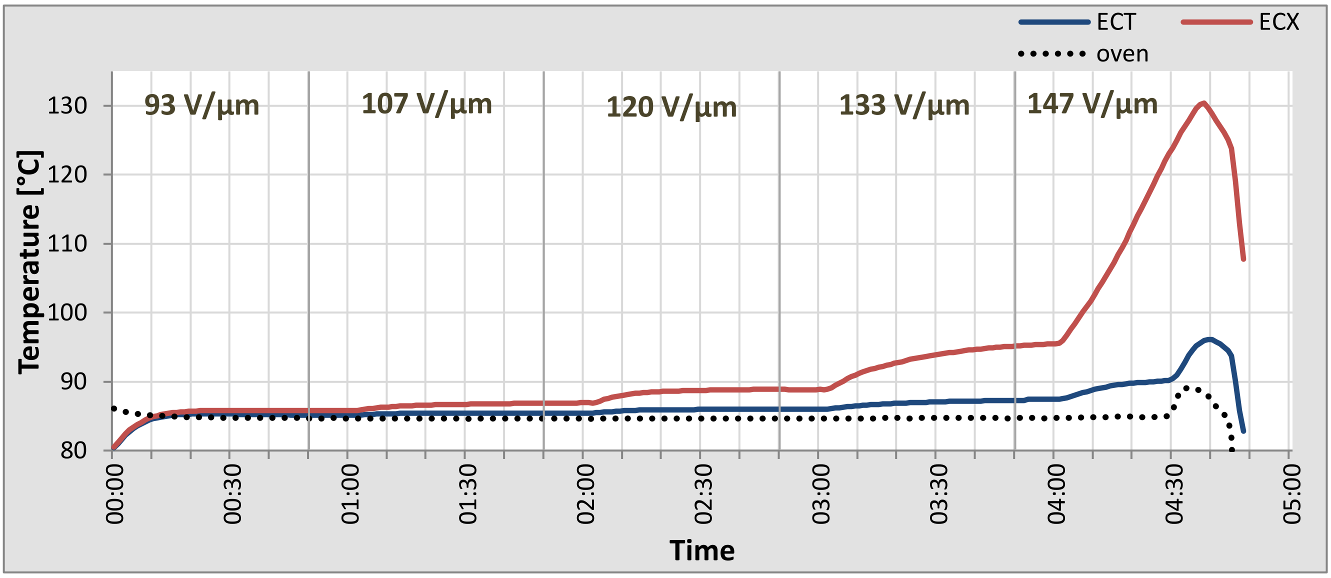


Fig.7: Accelerated endurance test of ECT vs. ECX film at 85°C – temperature in capacitor element "hot spot".

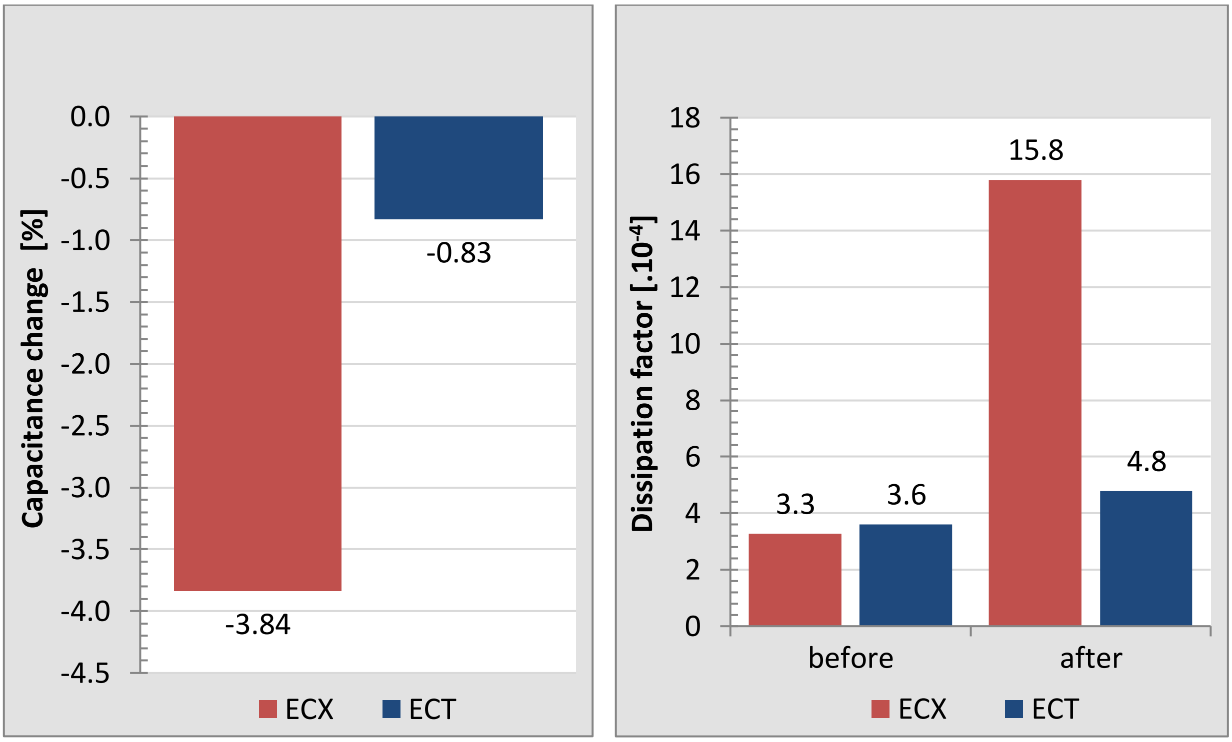


Fig.8: Accelerated endurance test of ECT vs. ECX film 95°C – capacitance/dissipation factor change.

2.3. LONG TERM AGEING TEST

The required lifetime for smart grid capacitors is decades, 30 even 40 years nowadays - much longer than in classic metallized film capacitors. Electrical ageing (local or general) of the capacitor film is a risk factor from the capacitor´s lifetime point of view. The film's dissipation factor and it´s change as a function of temperature and time are very critical.

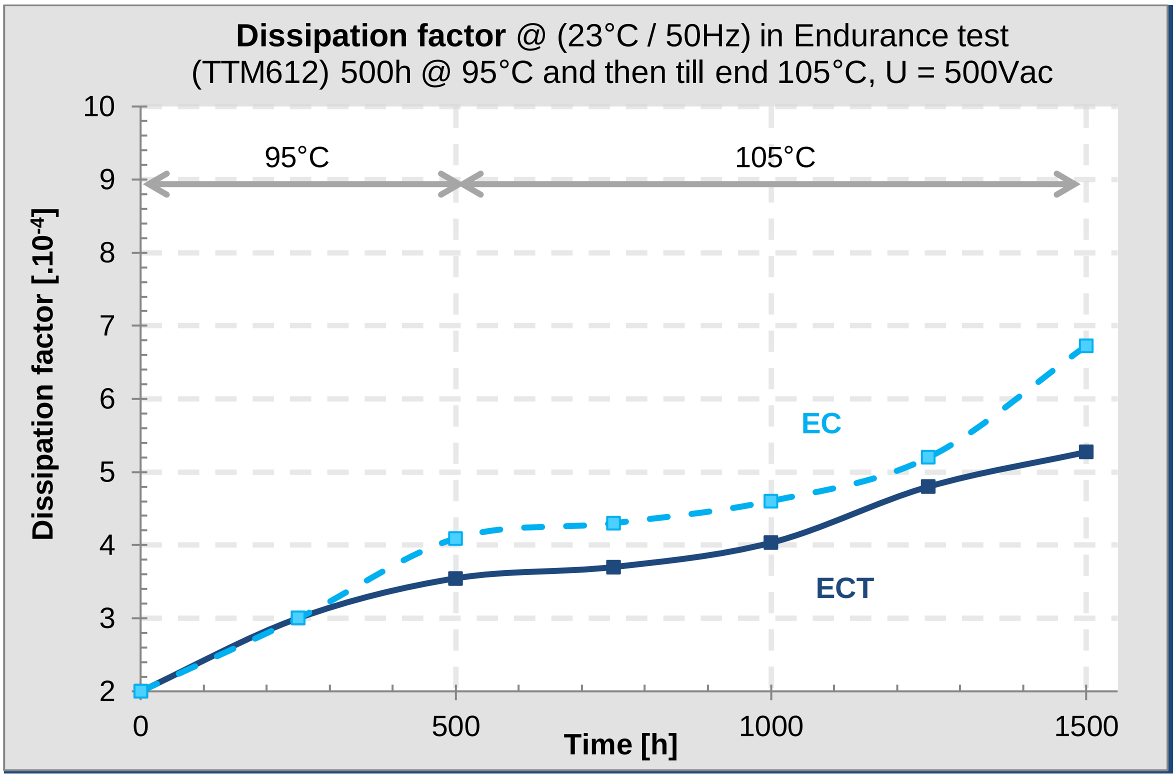


Fig.9: Long term ageing test at elevated temperature 95/105 °C.

The new high temperature film performs clearly better than a classic base film, which has a market reputation of a "low dissipation factor film". At room temperature, both film types had approximately the same initial dissipation factor. The characteristic is important in AC applications but also in DC capacitors due to the existence of ripple current.

Tervakoski film

3. SUMMARY

The general trend on the market from recent years was clearly showing continuous change towards the high crystalline films. In some segments of the market, e.g. DC applications, high crystalline films are used almost exclusively.

The primary target of our development work of ECT film was to generate a "real" High Temperature/ High Endurance Capacitor Film without compromising the positive features of the EC base film.

As experienced and tested already during a longer period, there are certain weaknesses in commonly available HIPP films regarding AC aging and ripple current conditions - especially in higher temperatures. The same things have been observed for the experimental film ECX, for which results are presented in this report.

On the other hand there was also a need to improve our "classic crystallinity" base film EC, to withstand higher temperatures mechanically and from an endurance point of view. For example smart grid and automotive applications require a superior film for high demanding metallized DC and AC film capacitors.

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