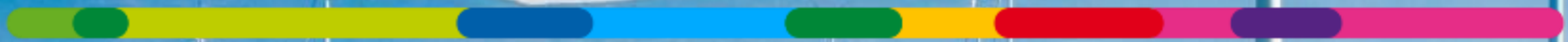

IERE joint R&D project (phase 2)

Methanol Ageing Marker for Power Transformers

Post-Mortem Sampling for Degree of Polymerization
Deterioration Modelling



Confidential



Restricted



Public



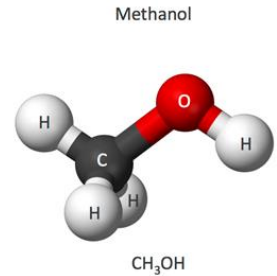
Internal

IERE

- Besides exchange of knowledge, IERE also stimulates collaborative research between large utilities and their R&D-centra.
- 2012-2016: IERE methanol phase 1 project lead by IREQ HYDROQUEBEC. Report on applicability of methanol was presented to IERE board in 2017.
- 2018: ENGIE Laborelec took the initiative to propose and lead a 4 year R&D-project as to build the first model to evaluate power transformer residual lifetime based on methanol-in-oil testing.
- Some words on who, what and added value.

Why is ENGIE Laborelec involved ?

- Ca. 2000: IREQ & EDF start with investigating alcohol ageing markers
- Ca. 2007: Laborelec starts-up multi-year research program



- As from ca. 2012: More research / activities within ASTM / CIGRE / IEC and other expert labs of OEM, ...
- Ca. 2014: ENGIE / Laborelec starts with the implementation of MeOH and MeOHc within routine oil condition monitoring for certain fleet of power transformers
- Jan. 2019: Temperature-corrected methanol is part of new best practices guideline Oil Condition Monitoring within ENGIE power plant transformer fleet worldwide.

Active members (status Q4 2019)

Active member as from 2019



Technical lead and coordination

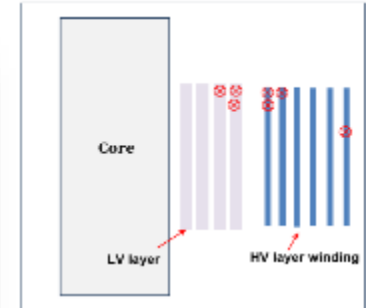
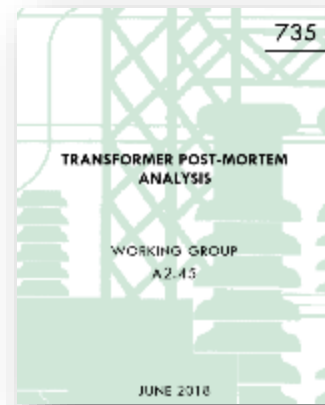


Possible active member as from 2020

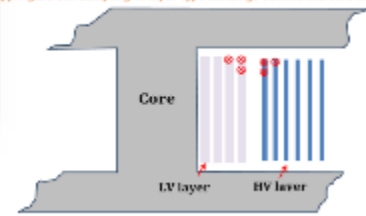
Marketing, coordination & communication



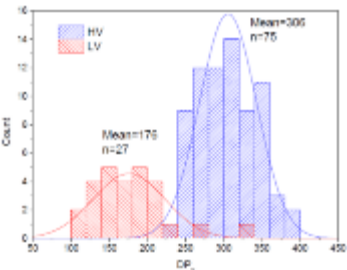
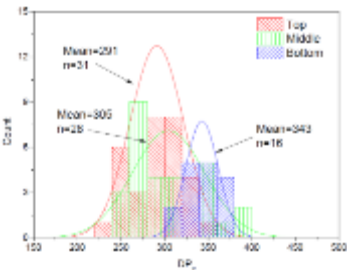
R&D to be performed ?



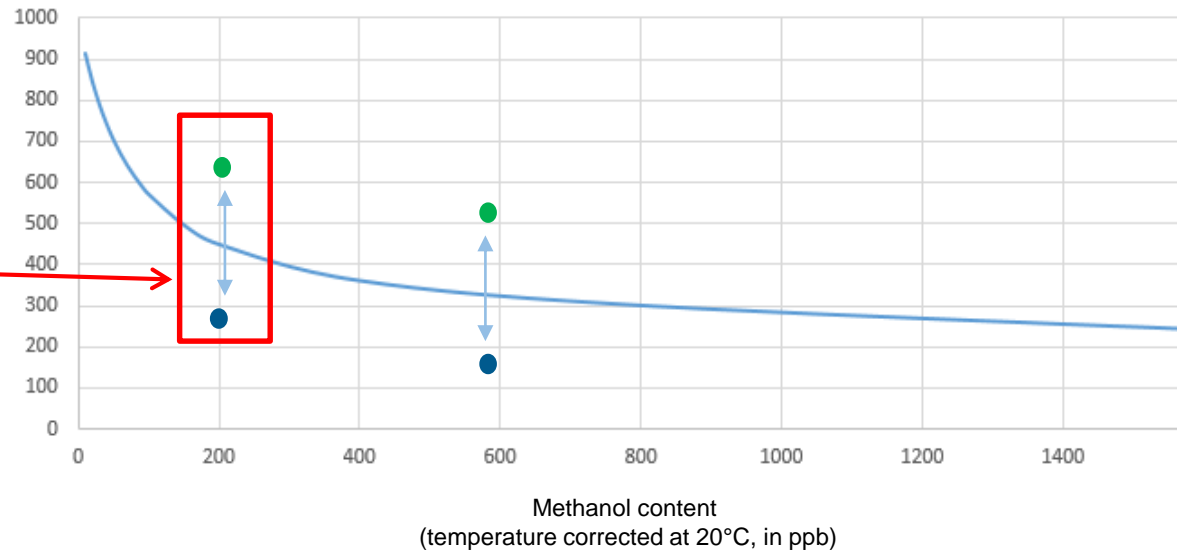
App Figure D.3 Sampling of layer-type windings outside the core window



App Figure D.4 Sampling of layer-type windings inside the core window

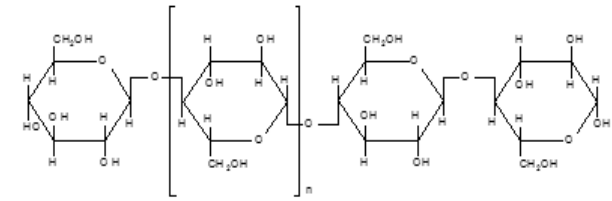
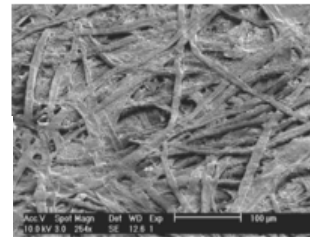
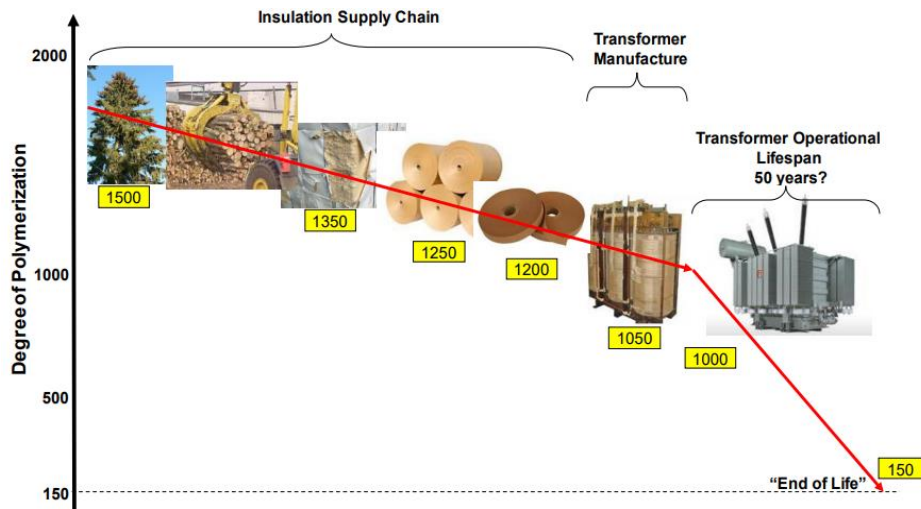


DP-value

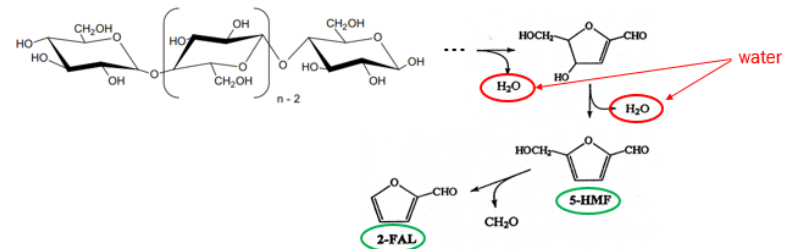


Why this collaborative R&D ?

Furan testing (IEC 61198 / ASTM D5837) only is not adequate for assessing winding paper ageing of many types of power transformers (membrane sealed units, Thermally Upgraded winding paper (TUP), inhibited oil, ...)!



New paper (before drying process) : DP of 1300-1200
 New paper (after drying process) : DP of 1100-1000
 End-of-life paper : DP of 200-150



Why this collaborative R&D ?

Furan testing (IEC 61198 / ASTM D5837) only is not adequate for assessing winding paper ageing of many types of power transformers (membrane sealed units, Thermally Upgraded winding paper (TUP), inhibited oil, ...)!

- Some types of winding paper yield no/very few furans during ageing process.

TUP / AIR			
Incubation time (hours)	MeOH (ppm)	2FAL (ppm)	DPv
0	0.0	< LoQ	1080
384	1.8	< LoQ	835
1152	5.7	< LoQ	670
1848	9.6	< LoQ	510

LoQ for 2FAL: 0.02
LoQ for MeOH: 0.01

(data: LABORELEC, 2012)

Some cases (1)

Furan testing (IEC 61198 / ASTM D5837) only is not adequate for assessing winding paper ageing of many types of power transformers (membrane sealed units, Thermally Upgraded winding paper (TUP), inhibited oil, ...)!

- Power plant Thailand

BBT-transformer
 HYOSUNG
 7 MVA
 6/0.9 kV
 Nynas Nytro 10XN

	Furans				
	Furan 5HMF	Furan 2FOL	Furan 2FAL	Furan 2ACF	Furan 5MEF
	IEC 61198	IEC 61198	IEC 61198	IEC 61198	IEC 61198
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
20/07/2010	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
27/11/2010	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
13/01/2012	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
26/08/2013	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
16/10/2014	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
05/11/2015	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
19/10/2016	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
09/11/2017	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

			20/07/2010	16/10/2014	05/11/2015	19/10/2016	09/11/2017
Methanol	Internal Method	mg/kg			0.64	0.52	0.63
Methanol (Tcorr at 20°C)	Internal Method	mg/kg			0.14	0.12	0.32

Average DPv estimated at ca. 500



Some cases (2)

Furan testing (IEC 61198 / ASTM D5837) only is not adequate for assessing winding paper ageing of many types of power transformers (membrane sealed units, Thermally Upgraded winding paper (TUP), inhibited oil, ...)!

- Power plant UAE

BAT-transformer
 HICO
 264 MVA
 15/400 kV
 Michang Mictrans DU

	Furans				
	Furan 5HMF	Furan 2FOL	Furan 2FAL	Furan 2ACF	Furan 5MEF
	IEC 61198	IEC 61198	IEC 61198	IEC 61198	IEC 61198
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
19/04/2010	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
12/10/2011	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
06/06/2012	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
25/07/2013	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
22/06/2014	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
26/03/2015	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
25/08/2016	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
09/07/2017	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
10/04/2018	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03

			19/04/2010	25/08/2016	09/07/2017	10/04/2018
Methanol	Internal Method	mg/kg		0.53	0.54	0.26
Methanol (Tcorr at 20°C)	Internal Method	mg/kg		0.10	0.12	0.09

Average DP_v estimated at ca. 575



Added value & attention points



Added value ?

- Specific knowledge: First international interpretation model for methanol in transformer oil (Q12 2020: ASTM and IEC will publish standards for methanol-in-oil analysis)
- Sharing best practices between large utilities !

Attention points ?

- Obtaining sufficient n° transformers for dismantling (therefore collaboration between large utilities is needed)
- Communication & km/language barrier

Message to all IERE members

- * Still 2 to maximum 3 utilities are welcome to join as active member.



Kick-off meeting KEPRI-offices (Daejong, May 2019)