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# **Service Life Prediction of Wood Claddings by *in-situ* Measurement of Wood Moisture Content Status after 5 years of Outdoor Exposure**

**IRG/WP 09-20401**

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## Objectives

- To study the wood moisture content development by continuous *in-situ* resistance measurements in cladding type set-ups protected by various surface coating systems
- To study the long term appearance of various coating systems (cracking, blistering, blue-stain a.o.) and compare to wood moisture data
- To perform data analyses on trends in mean moisture content and moisture content variation
- Assess prediction possibilities
- Develop an alternative to efficacy tests (EN 599) and short term weathering tests (EN 927-3) for wood protection coating systems





## Test method

- A test rack is constructed from six EN 927-3 (2000) panels mounted as one-on-two on four support panels; all planed with rounded edges. Fixing from back side
- Graphite measurement points positioned 3 mm below the coating surface are made at nine positions in each test rack
- The measurement points are connected by PVC insulated wires to a resistance meter (Material-Fox Mini; Scanntronik GmbH). Data acquired every sixth hour
- Resistance data is converted to wood moisture content by the use of the formulas developed by Samuelsson (1990), Träteknik Report L 9006029 with an additional temperature correction





## Test rack

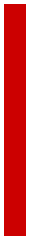


Measurement points ( 3 x 3 pr. rack)

A. *Centre-board, minor moisture loading*

B. *Butt-joint, medium moisture loading*

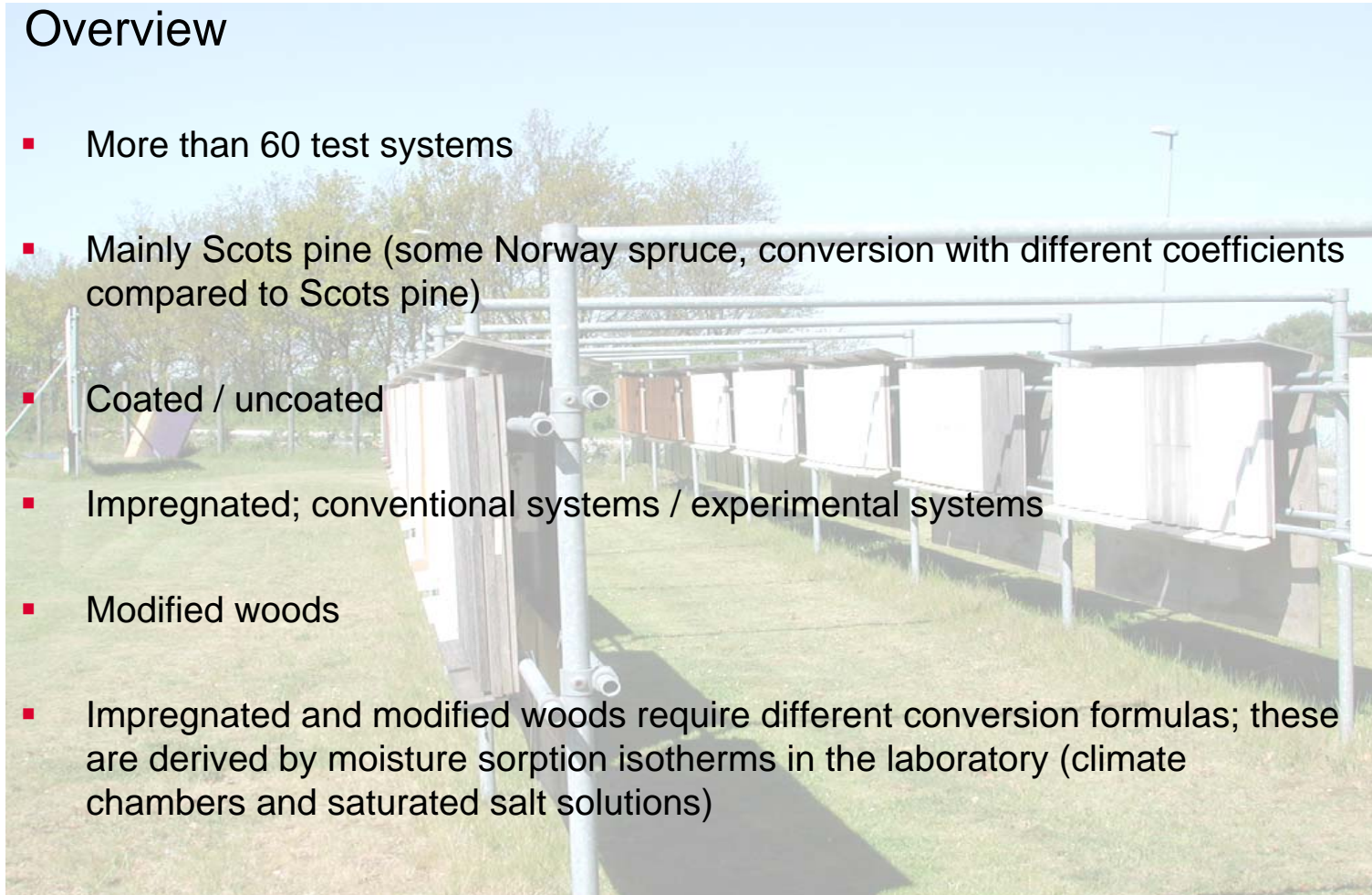
C. *End-board, major moisture loading*





## Overview

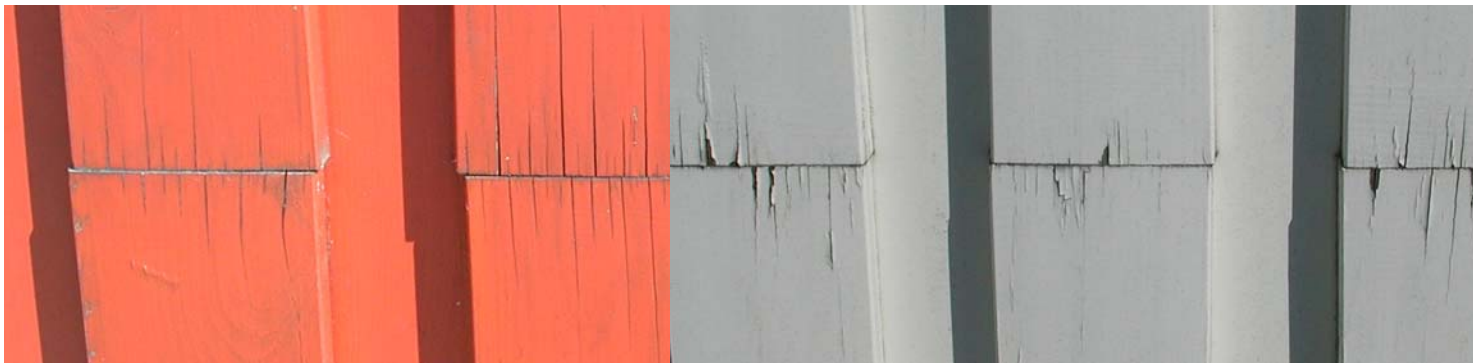
- More than 60 test systems
- Mainly Scots pine (some Norway spruce, conversion with different coefficients compared to Scots pine)
- Coated / uncoated
- Impregnated; conventional systems / experimental systems
- Modified woods
- Impregnated and modified woods require different conversion formulas; these are derived by moisture sorption isotherms in the laboratory (climate chambers and saturated salt solutions)





## Registrations

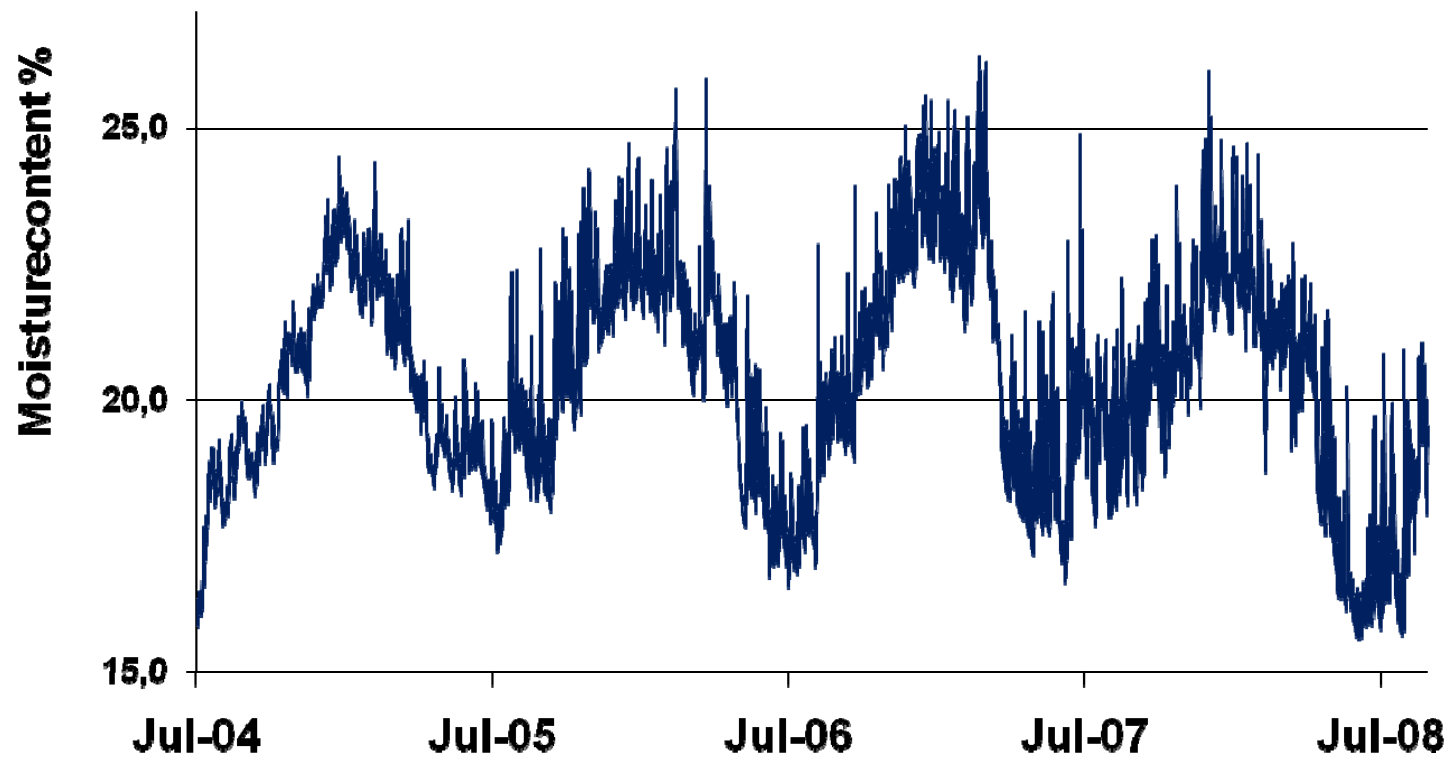
- Hourly: air temperature, relative humidity and precipitation (Vantage Pro II)
- Every sixth hour: wood temperature, resistance
- Yearly: gloss and colour change (CIE LAB), cracking, chalking, mould growth, blistering, flaking, wood degradation, blue stain, and photo registration





## Examples (IA)

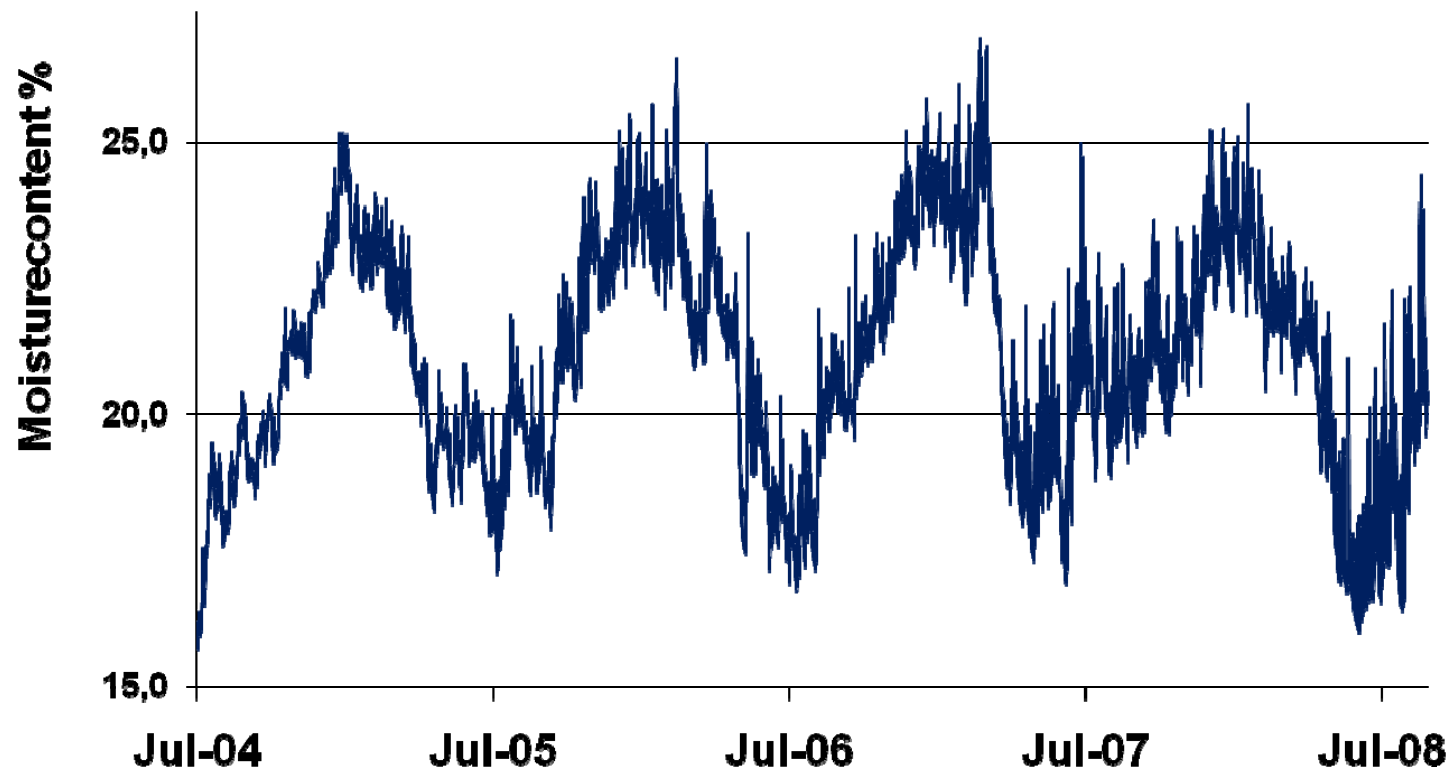
- Scots pine sapwood with waterborne acrylic coating (centreboard)





## Examples (IB)

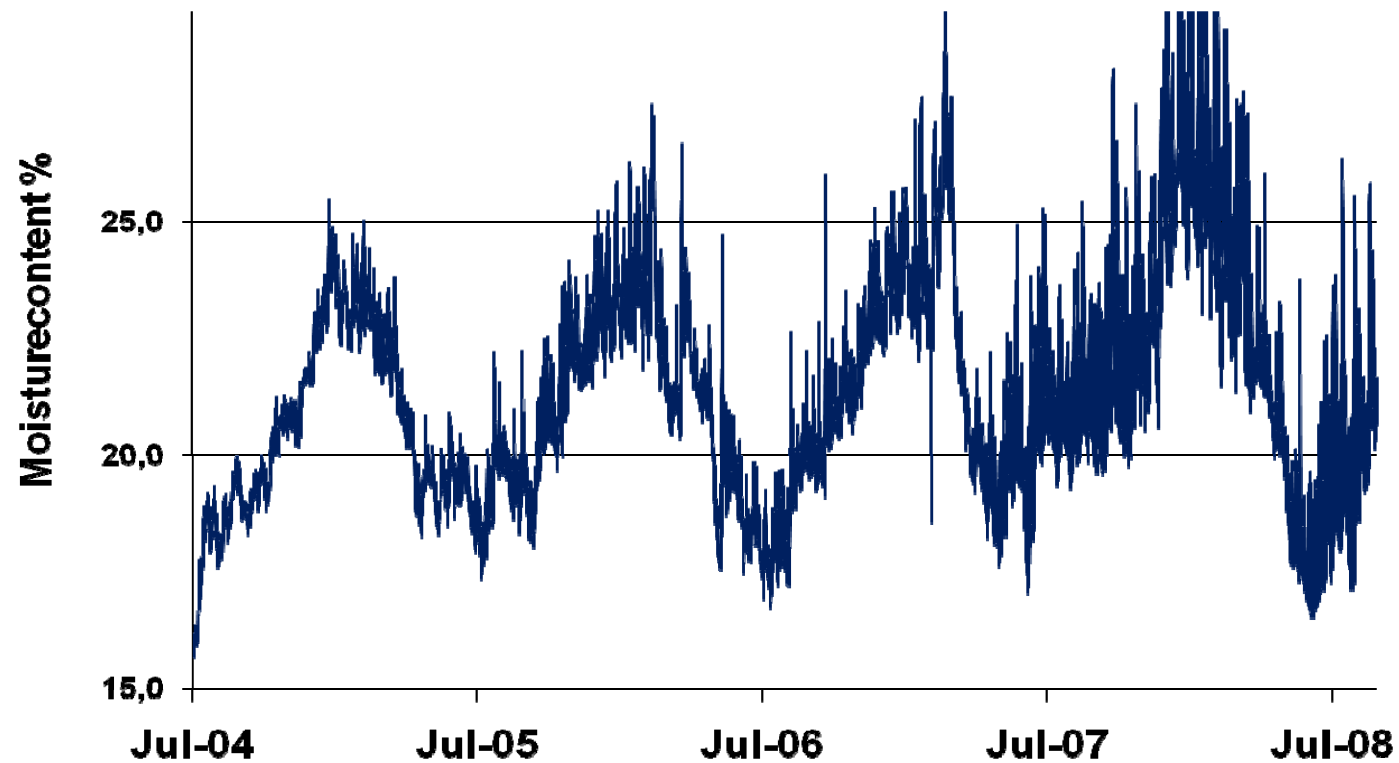
- Scots pine sapwood with waterborne acrylic coating (butt-joint)





## Examples (IC)

- Scots pine sapwood with waterborne acrylic coating (end-grain)



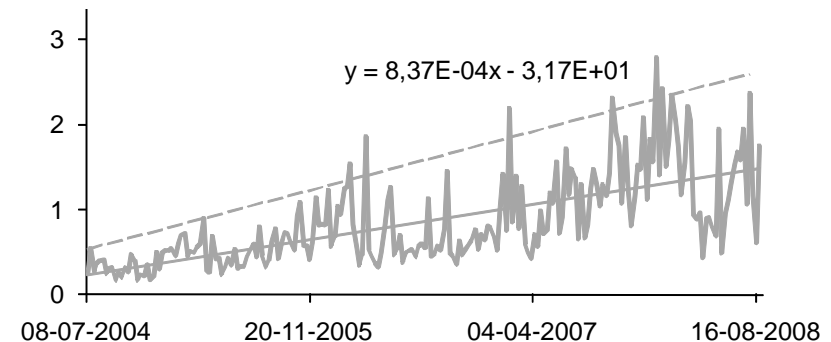


Aim: a simple system to evaluate time to coating failure, moisture build up, or moisture reducing effects

- Wood moisture content data recalculated to weekly averages

- Normalization of weather data

- Linear trend lines
  - Mean moisture content
  - Standard deviation



- Comparison to visual registrations

*Coating service life*

- Calculation of time spent in different risk classes

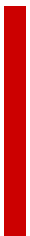
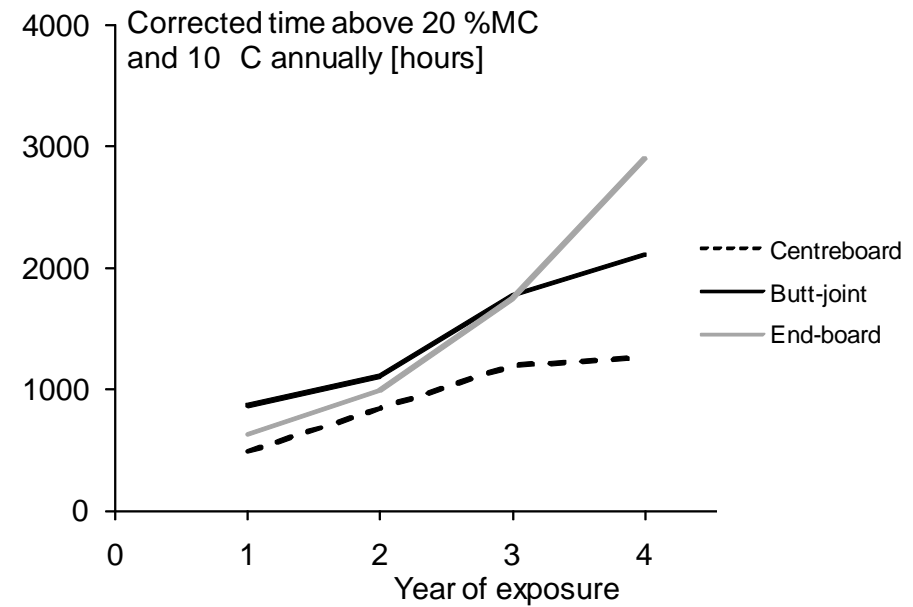
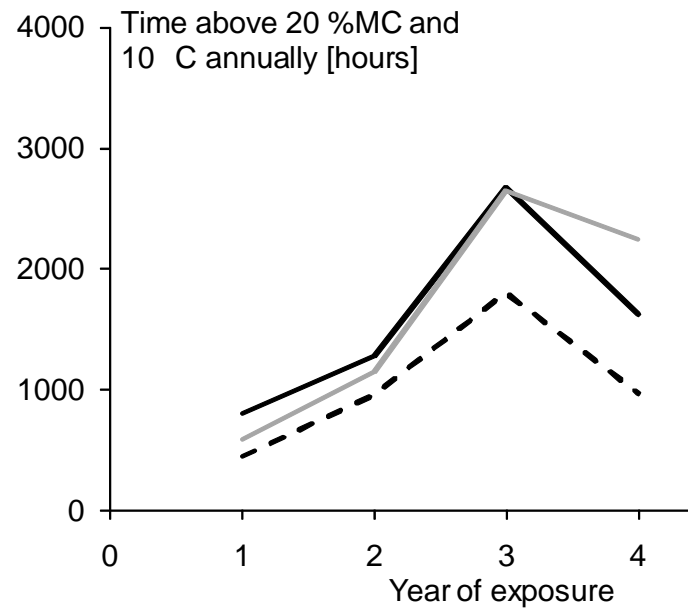
*Wood service life*

YEAR 4		CORRECTED			
		From	To		
		13-08-2007	11-08-2008		
<b>CENTREBOARD</b>		<b>Moisture content</b>			
Temperature		>20 %	>22 %	>25 %	>30 %
>10 °C		1260	93	0	0
>15 °C			23	0	0
>20 °C				0	0
<b>BUTT-JOINT</b>		<b>Moisture content</b>			
Temperature		>20 %	>22 %	>25 %	>30 %
>10 °C		2108	241	0	0
>15 °C			70	0	0
>20 °C				0	0
<b>END-BOARD</b>		<b>Moisture content</b>			
Temperature		>20 %	>22 %	>25 %	>30 %
>10 °C		2902	879	117	0
>15 °C			288	16	0
>20 °C				0	0



## Moisture build-up

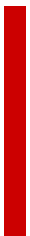
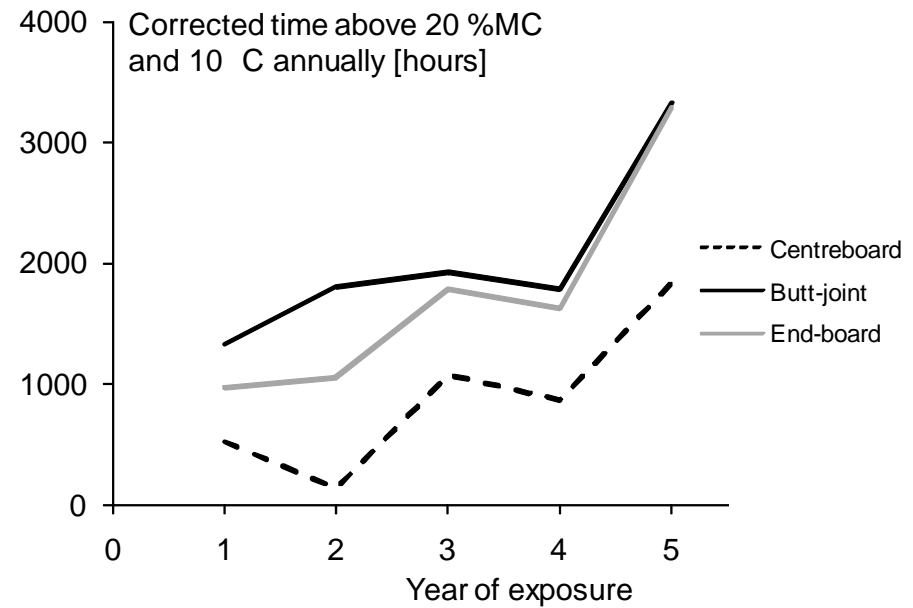
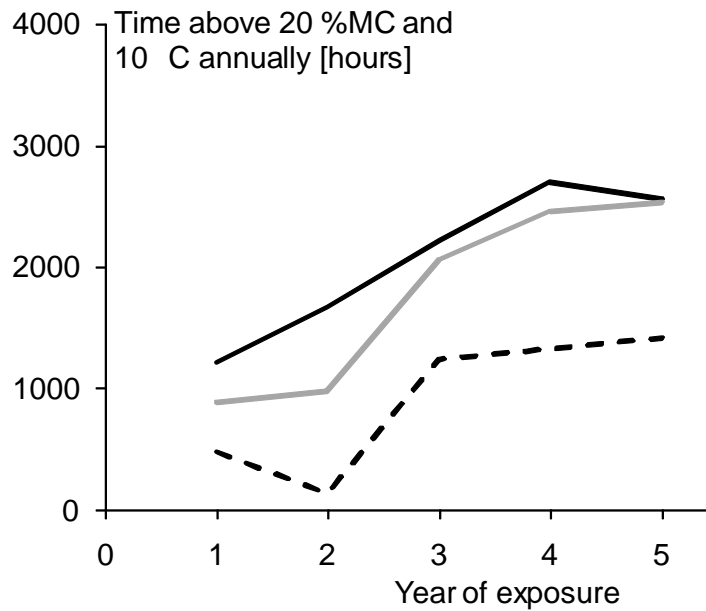
- Scots pine sapwood with opaque, white waterborne acrylic coating





## Moisture build-up

- Scots pine sapwood with Internal Comparison Product; semitransparent alkyd





## Conclusions

- Continuous *in-situ* moisture registrations give insight into coating systems' performance
- Simple raw data pre-treatments seem to be sufficient prior to data analysis
- The “data bank” needs to be larger in order to assess the prediction ability
- The wood moisture content variation may be used to assess the coating service life
- Actual wood degradation has not yet occurred, but the development in long term wood moisture content seems to be a promising parameter to predict decay occurrence





# THANK YOU FOR YOUR ATTENTION



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