

New technical application challenges for the use of decorative finishing foils

Lecture at the TAPPI Symposium @ Interzum

„Insights Into Modern Surfaces“

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Decor Druck Leipzig GmbH



Dekor Druck Leipzig GmbH - a member of the Kosche Corporate Group



44 Years of decorative printing in Leipzig

Decor Druck Leipzig GmbH

- 4 rotogravure presses with print width of 1300 mm
- 1 rotogravure press with print width of 2250 mm
- about 100 employees
- About 90 million m² decorative foil
- 95 % of this total is decorative finished foil



Decorative foils

“Decorative foils include synthetic-resin dipped or synthetic-resin dipped, surface-treated decoratively printed or unprinted paper or fabric tape ... in a condition that will no longer react to pressure or heat.”

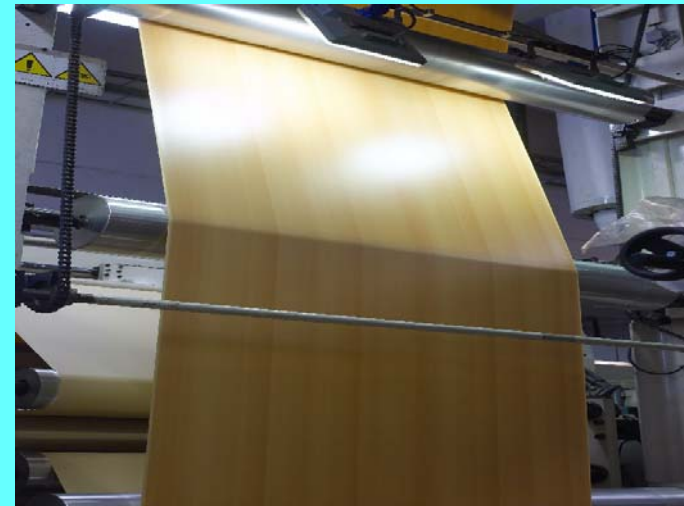
Peter Böhme „Dekorfolien - Herstellung, Verarbeitung und Eigenschaften von Dekorfolien“

Fachbuchverlag Leipzig 1986



Decorative foil with finished effect = Decorative finished foil

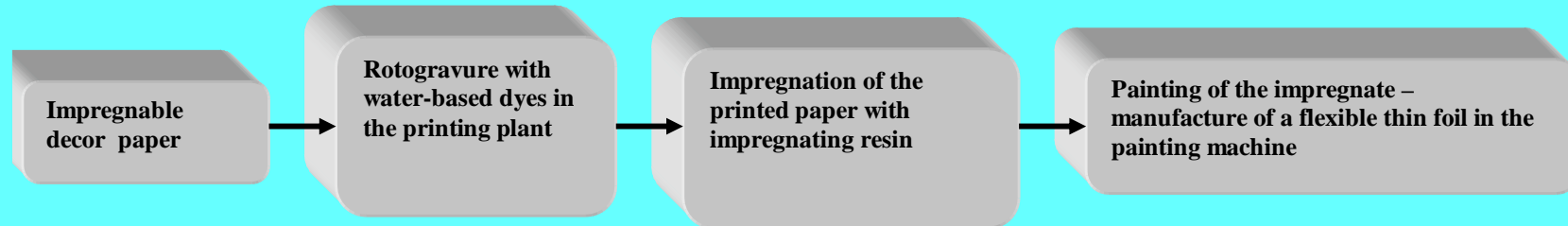
Decorative finished foils are “Decorative foils with finished effect that are more or less flexible, and include a finishing layer on a base of CN- or SH- unsaturated acrylate resin (or ESH- or UV - lacquers), unsaturated polyester resins, or PUR.”



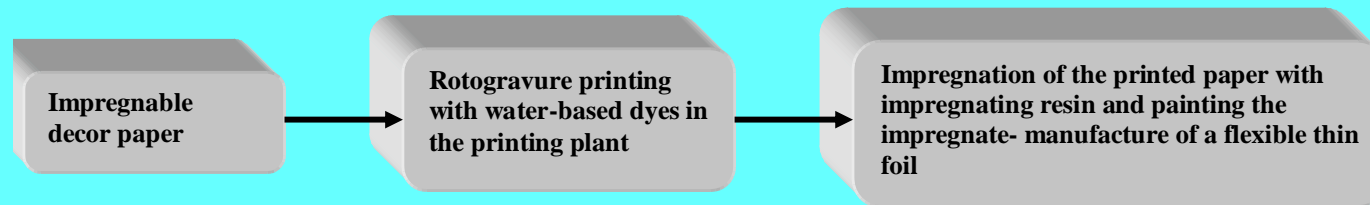
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Process to manufacture decor finished foils

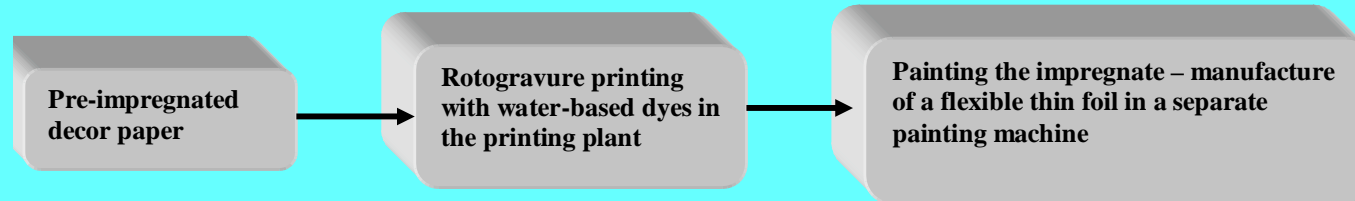
Multi-step procedure to manufacture a decor finished foil of impregnable papers



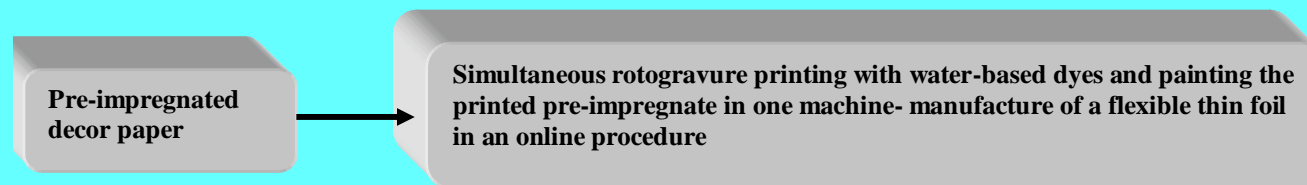
Two-step procedure 1 to manufacture a décor finished foil from impregnable papers



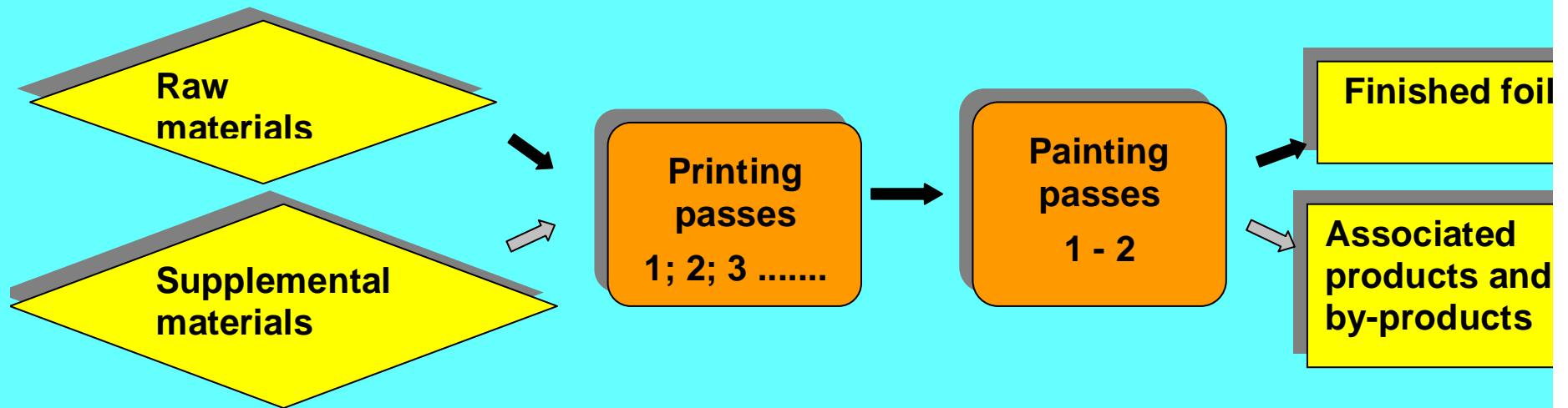
Two-step procedure 2 to manufacture a décor finished foil from pre-impregnate



One-step procedure to manufacture a décor finished foil from pre-impregnate



Manufacture of Decor finished foils from pre-impregnated papers



Raw materials:

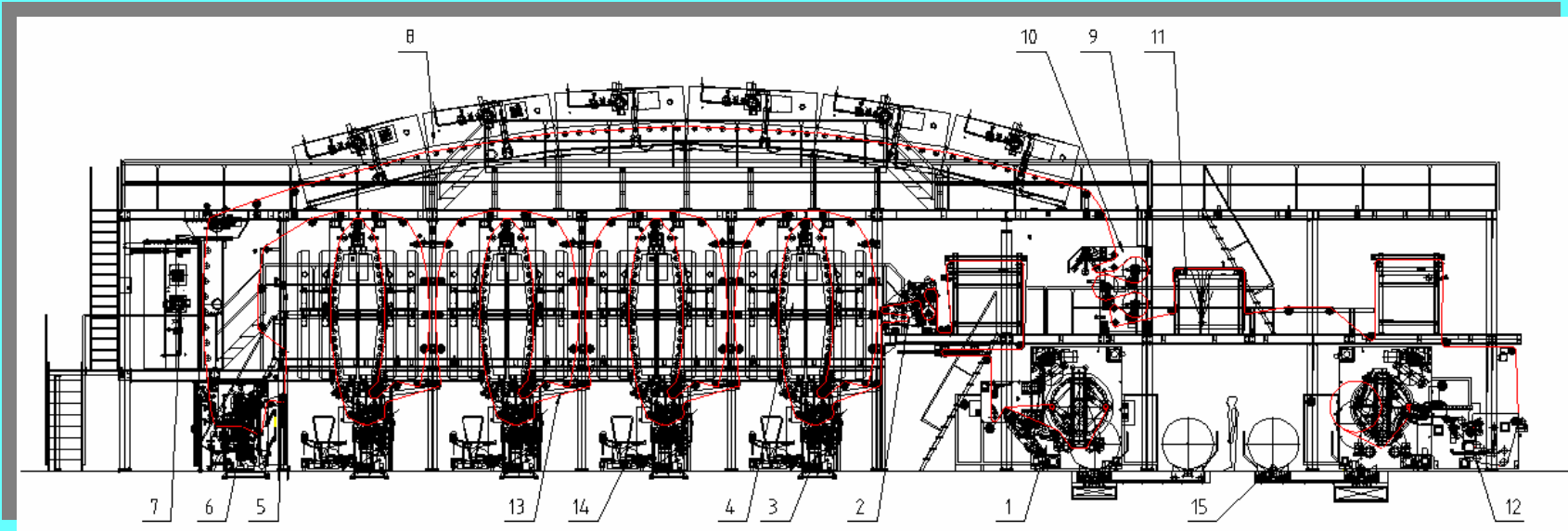
Pre-impregnate, Dyes, Lacquer

Supplemental materials:

Water, Additives

Rotogravure und painting machines

TDL2250



TECHNICAL PARAMETERS:

System speed	300 m/min
Goods width	max 2250 mm
Goods width	min 1000 mm
Pressure-cylinder diameter	max 450 mm

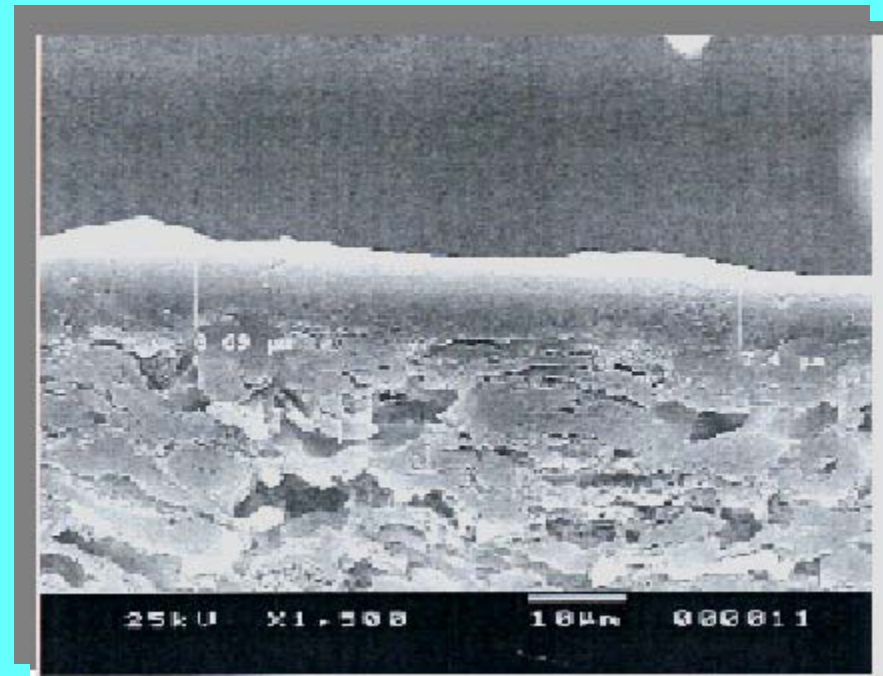
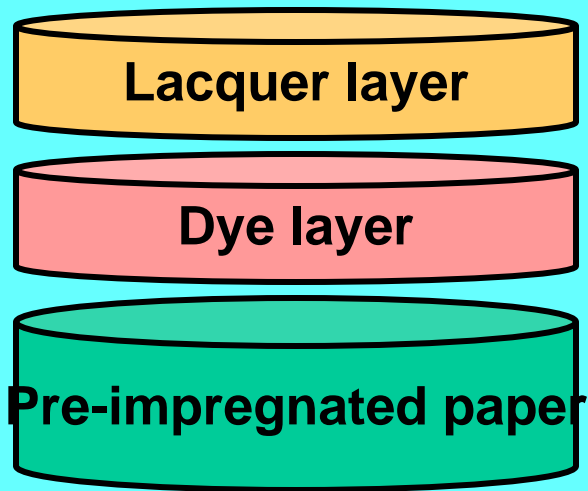
(LSF Maschinen- u. Anlagenbau GmbH Laußig)

Manufacture of decor finished foils

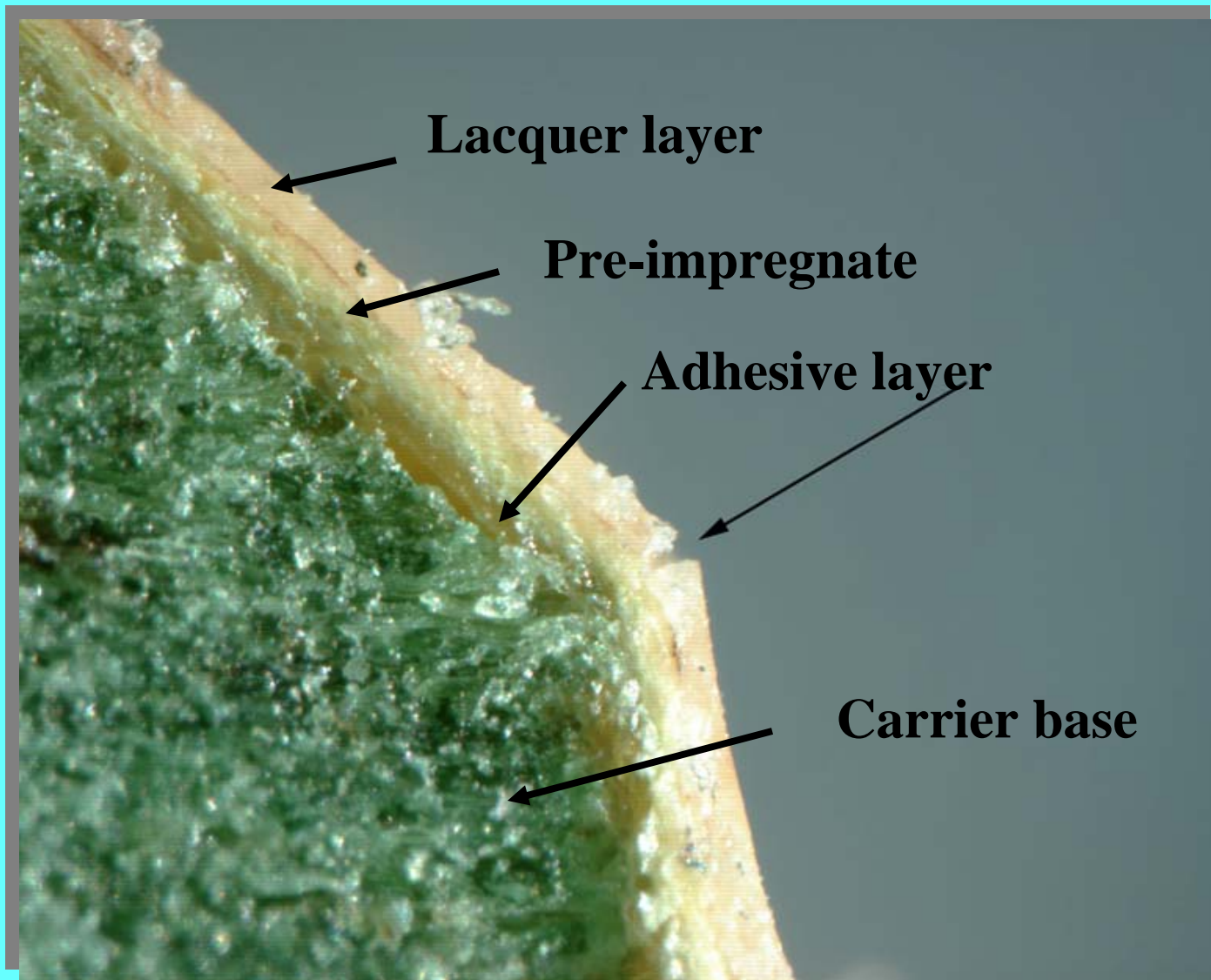


Structure of a decor finished foil

REM – photograph of foil cross section



Structure of a decor finished foil



Composition of a pre-impregnate

- 50 - 60%** wood-free cellulose
(e.g. Mixture of
20 – 30% pine pulp;
70 – 80% eucalyptus pulp)
- 15 - 25%** Pigments (Titanium oxide;
iron oxide; soot; organic pigments)
- 15 - 25%** Resin component
 - 1 - 5%** Additives (wet bonding agents etc.)
 - 2 - 5%** Residual moisture

Surface weight 45 – 110 g/m²
Ash content 1 – 25 %



Classification of pre-impregnates

Pre-impregnate

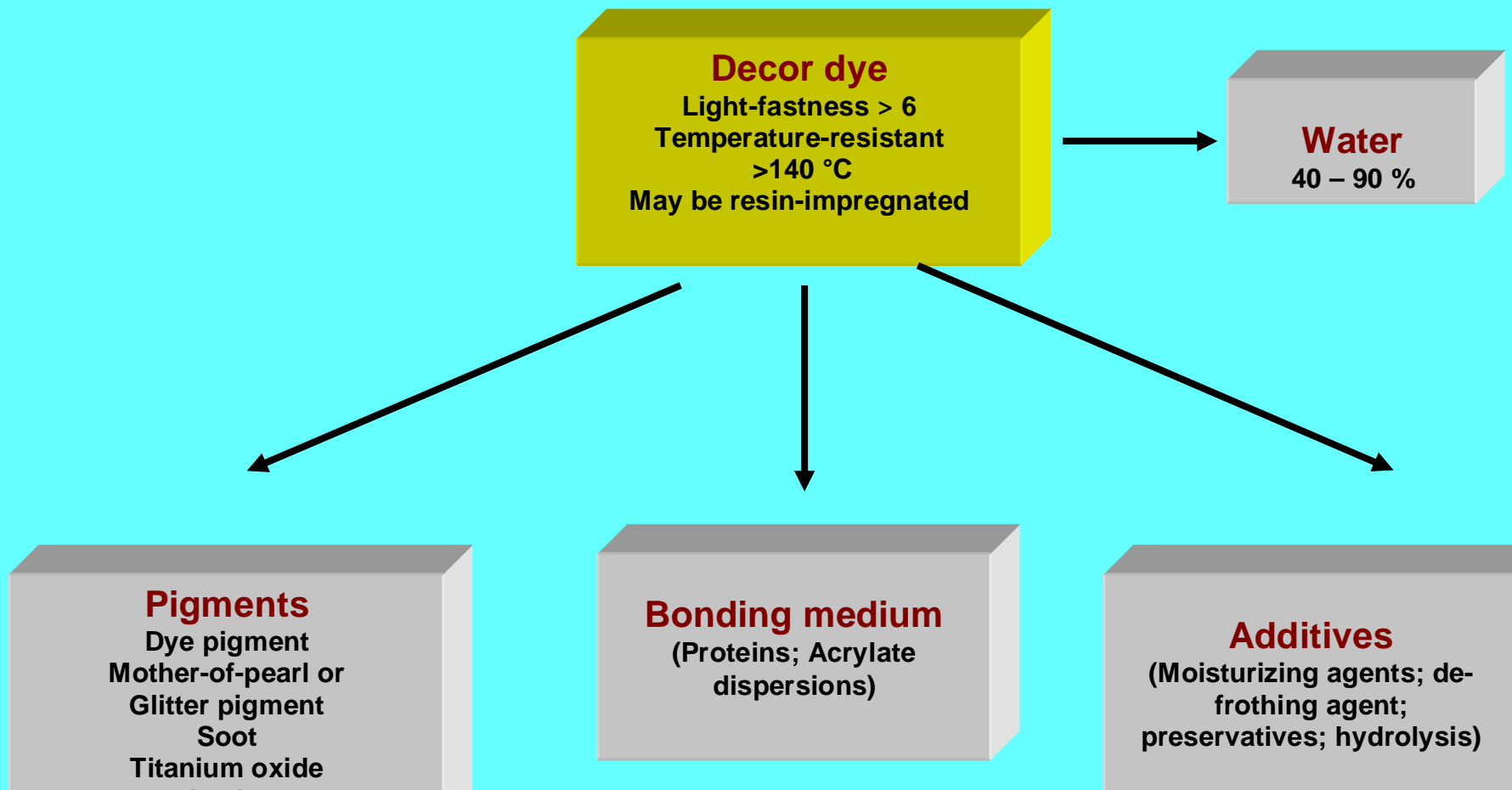
**Impregnation only with
modified Acrylate Polymer
dispersions**

**Impregnation with Urea
Melamin – Resins
and Acrylate – Polymer
dispersions for flexibility**

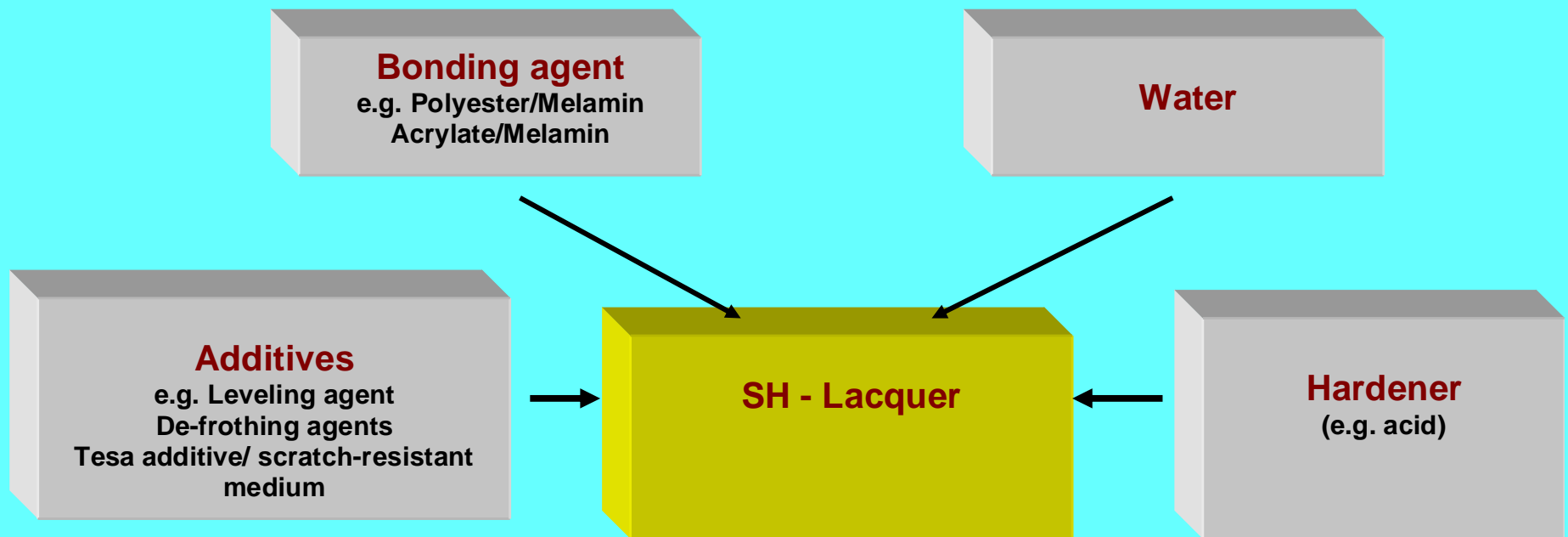
Characterization of Pre-impregnates

- **Gloss of the printed side (measured according to Bekk)**
120 to 400 sec (75 % of tested papers 150 – 250 sec)
(Print format and lacquer condition)
- **Cobb₃₀ – Value (Water) Printed side and opposite side**
1 to 14 g/m² (70 % of tested papers 8 to 12 g/m²)
(Print format and lacquer condition)
high Cobb – value – lacquer soaks into the paper
- **Cobb – Unger – Value (Ricinoleic)**
10 to 40 g/m² (90 % of tested papers 10 to 20 g/m²)
- **Penetration behavior (Ultra - Sound)**
1 to 30 sec (inflection point) (70 % of tested papers 2 to 6 sec)
Lacquer condition; chemical-reagent penetration;
- **Air permeability; surface tension**

Rotogravure dyes for decor finished foils



SH – lacquers for decor finished foils



Drying + Hardening

1st Step Drying (water removal)

2nd Step Hardening of the dried lacquer layer (chemical hardening)

At least 130 to 140 °C or 160 to 180 °C

The faster the speed, the higher the temperature

The more lacquer, the slower the speed

The shorter the drying path, the slower the speed

The thicker the paper, the slower the speed

Other Lacquers for decor finished foils

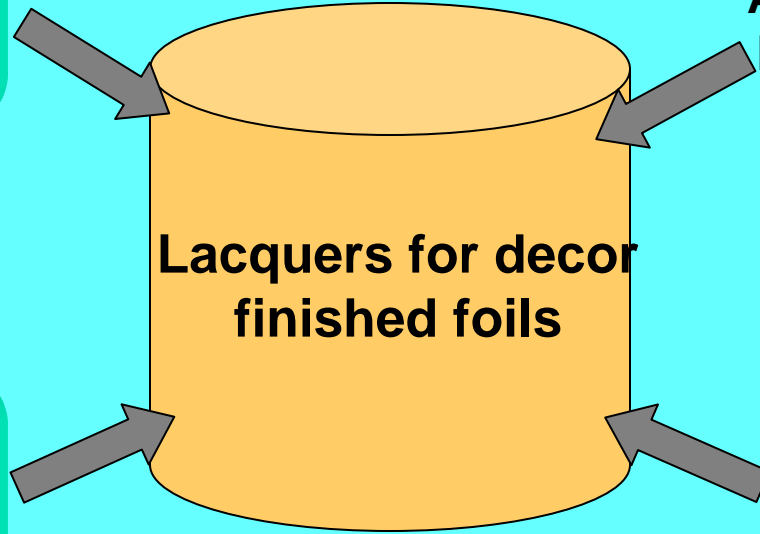
Irradiation-hardened
lacquers
ESH Lacquers

2-K – Acrylate lacquer
Acrylate bonding agent
hardener (Iso-cyanate)

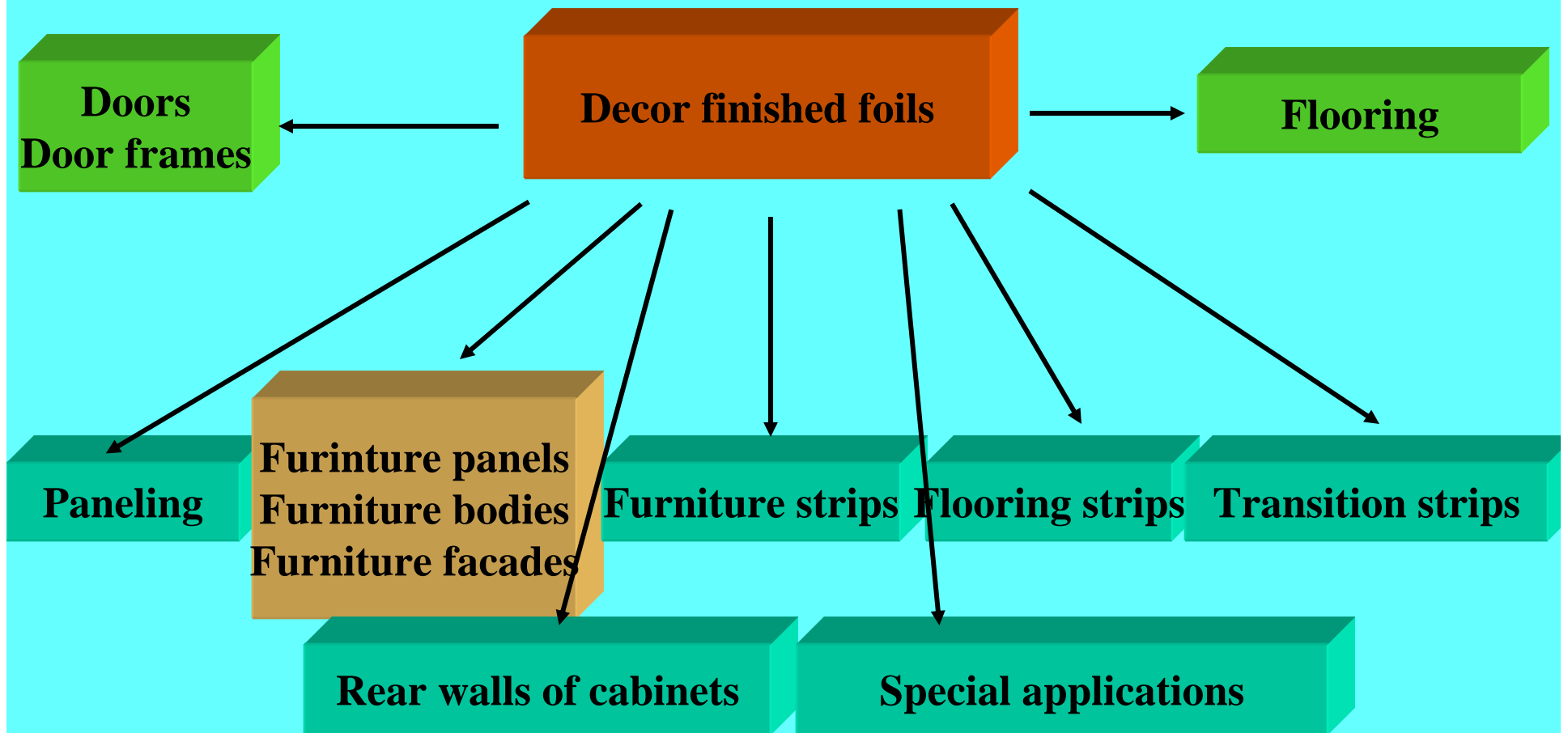
Lacquers for decor
finished foils

1-K – Acrylate lacquer

Polyester lacquers
(Peroxide moistening)



Applications for decor finished foils



Characteristics of a decor finished foil

1. Decorative Characteristics

- Color configuration of the decor (color location, metamery)
- Color consistency over many years
- Special effects (Glossy/matte; metallic effects; glitter)
- three-dimensional structures (impressions et al.)
- Texture (rough or smooth; hard or soft feel)



2. Functional and protective characteristics

- Resistance to cold liquids (against chemical reagents)
- Resistance to mechanical loads (wear; scratching)
- Resistance to temperature extremes and related alterations (heat, cold)

Characteristics of a decor finished foil

3. Environmental characteristics

- Emissions (VOC including Formaldehyde)
- Heavy metals (Cadmium, Lead, and Mercury)
- Resistance to saliva and perspiration
- Sense characteristics (aroma etc.)

4. Processing characteristics

- Tendency of the foil to curl (processing of curved goods in presses)
- Adherence of the foils to various bases and with various adhesive systems
- Mechanical processing characteristics (drilling and milling)
- Machine runs (surface polishing effects)



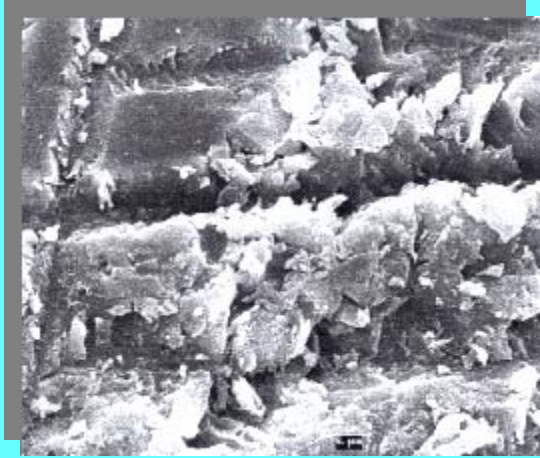
Functional and protective characteristics



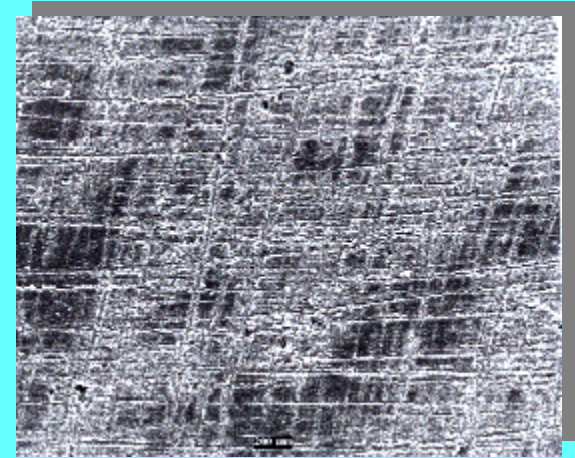
**Resistance to
mechanical loads
(wear; scratches)**

**Resistance to cold
liquids (to chemical
reagents)**

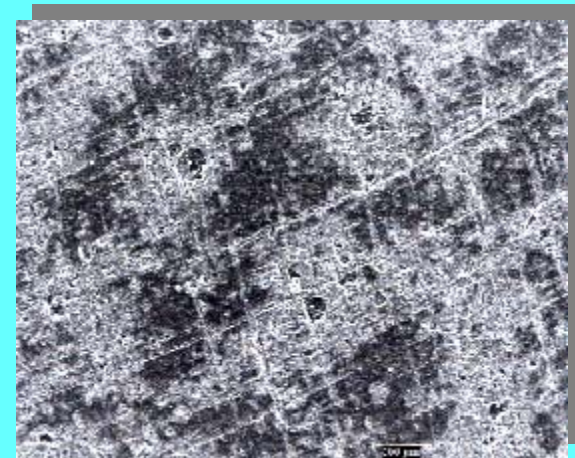
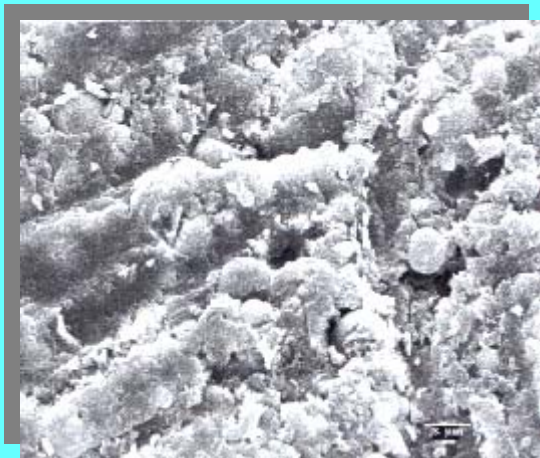
Mechanical surface characteristics



**Wear spurs
on lacquered
surface**



**Test medium:
S 33 Sandpaper**



Scratch-resistant surfaces

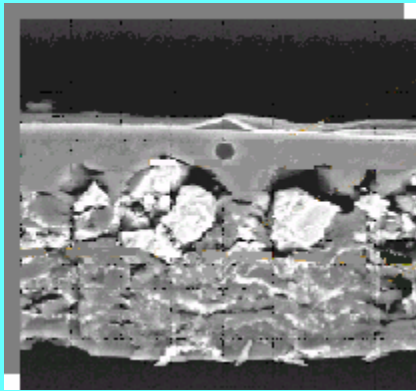


Photo: Prof. Dr. Mehnert
With permission

**Incorporation of
carborundum into
the surface
(Mohs hardness 9.0)**



**Incorporation of
micro-particles
(Mohs hardness
6.0 – 6.5)**

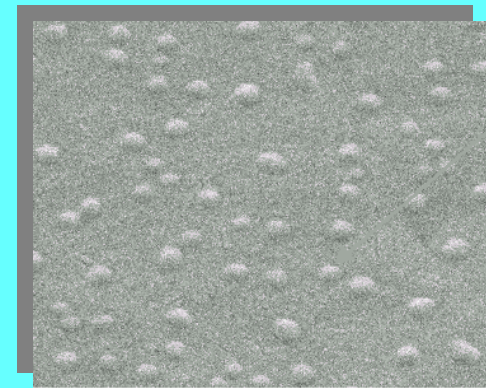
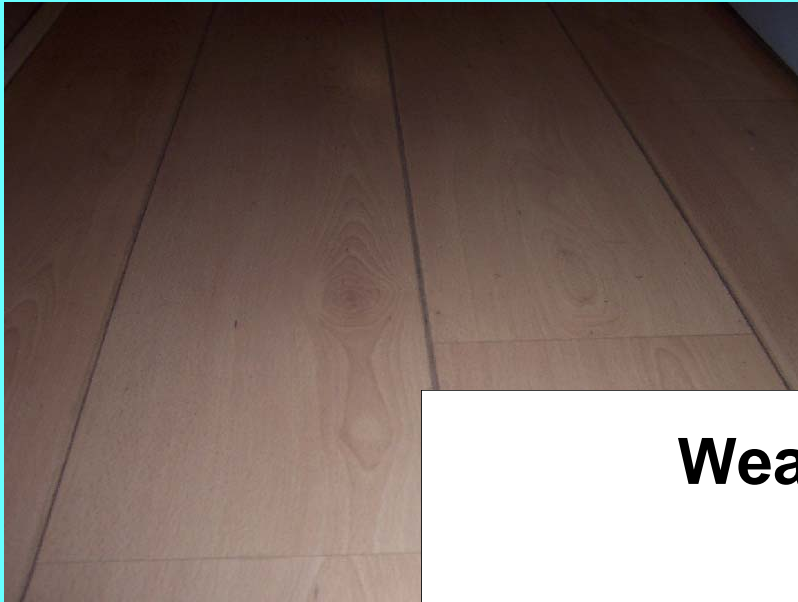


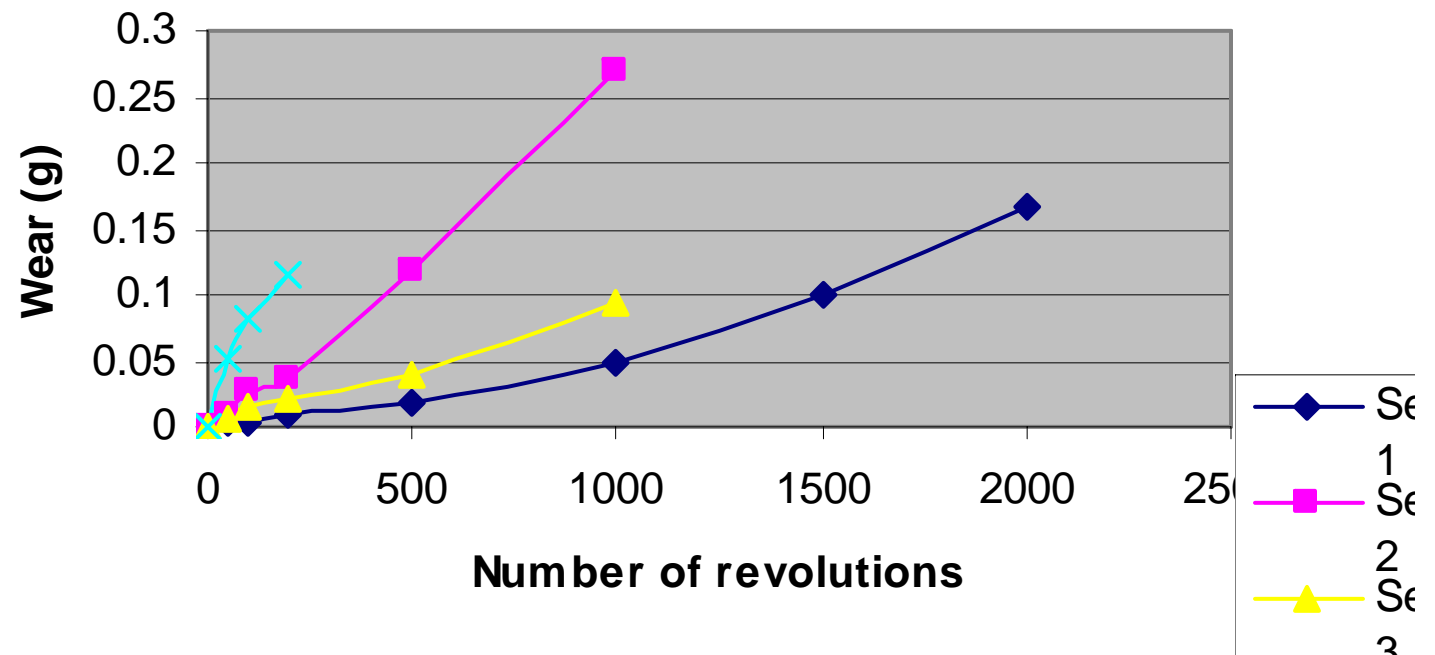
Photo: Prof. Dr. Mehnert
With permission

**Incorporation of
SiO₂ -
nanoparticles**



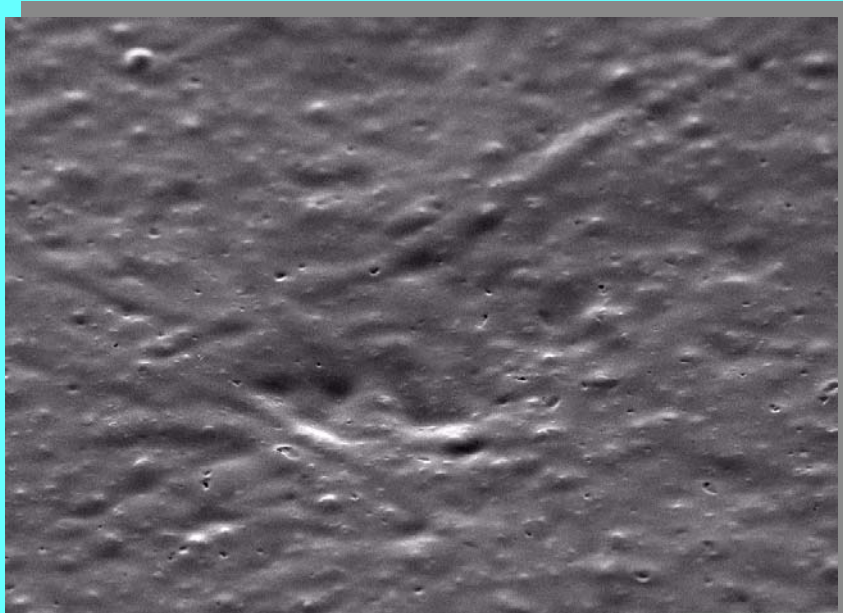
Scratch-resistant Surfaces

Wear testing of décor finished foils



Resistance to chemical reagents

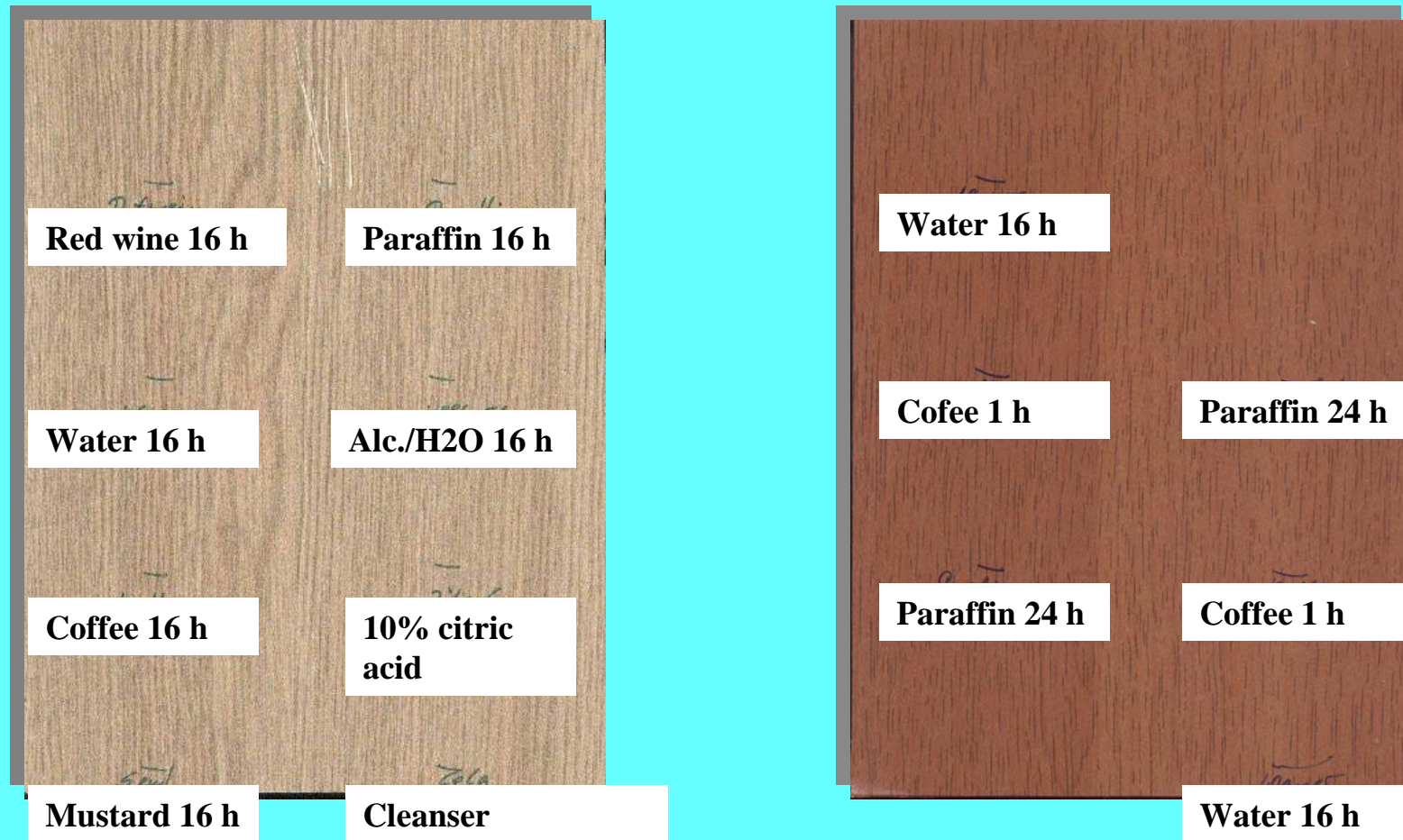
determined per DIN 68861 - 1



Resistance to cold liquids (chemical-reagent or water resistance) is the alteration of the surface of a decor finished foil applied to a base material (particle board; MDF; HDF) after the effects of specific household liquids such as, for example, water; cleansers; red wine; alcohol/water; coffee; tea; ink; H₂O₂ etc. after specified time intervals, e.g. 10 min; 1 h; 16 h; 24 h

Resistance to chemical reagents

determined per DIN 68861 - 1



Very good resistance

Credits:

Photographs

Institut für Holztechnologie Dresden

Decor Druck Leipzig GmbH

Kosche Profilmantelung GmbH

Arjo Wiggins (SEM - Aufnahmen)

Herr Prof. Dr. Mehnert (Cetelon Nanotechnik GmbH)

LSF Maschinen- u. Anlagenbau GmbH Laußig

Practical training

Herr Christian Zirk

Study Project

Herr Marcus Beyer

Thank you for your attention