



Matthias Konrad, Stefan Bomballa

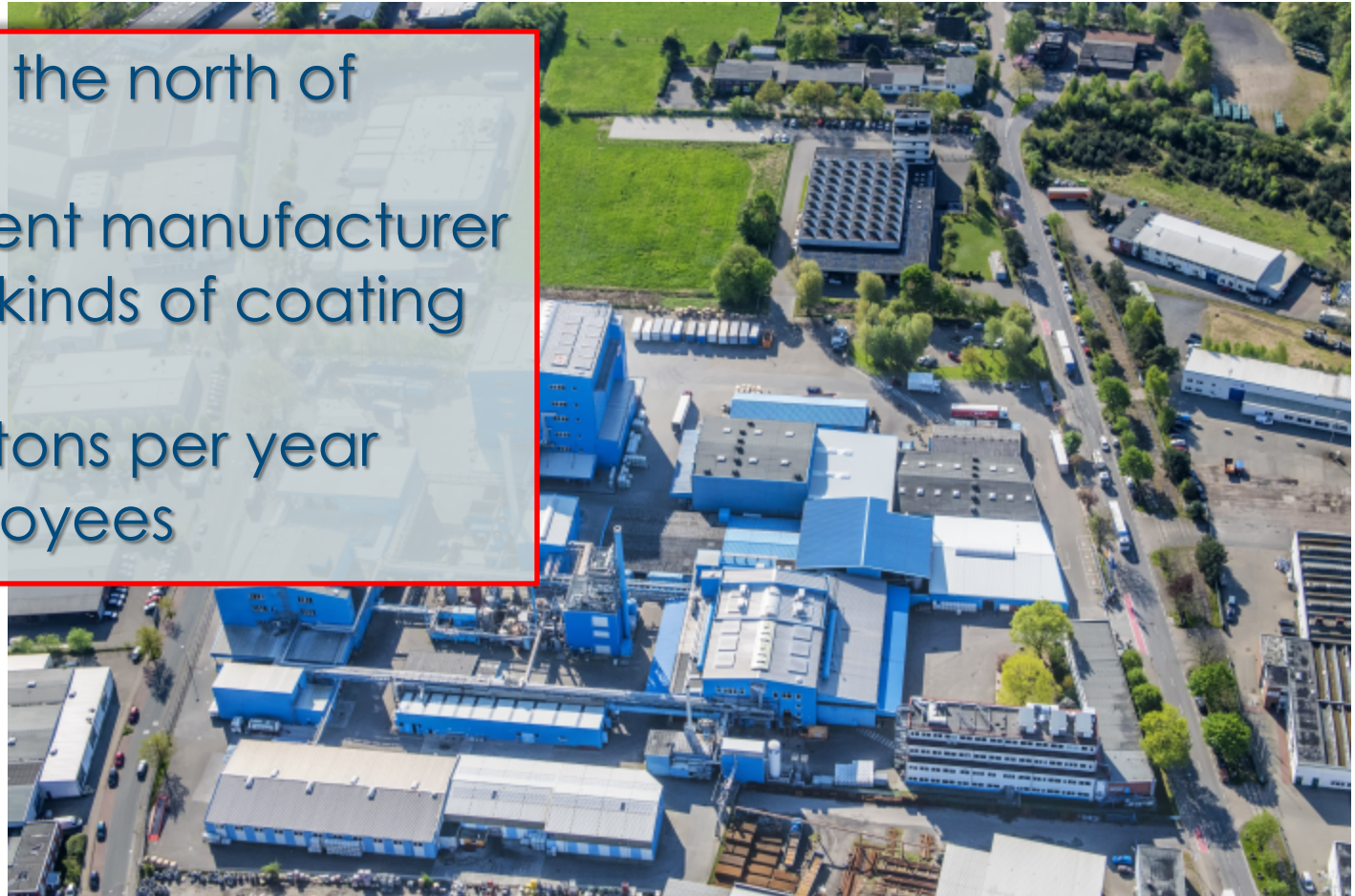
Green Alkyd Resins for Solvent Based Wood Coatings

About us

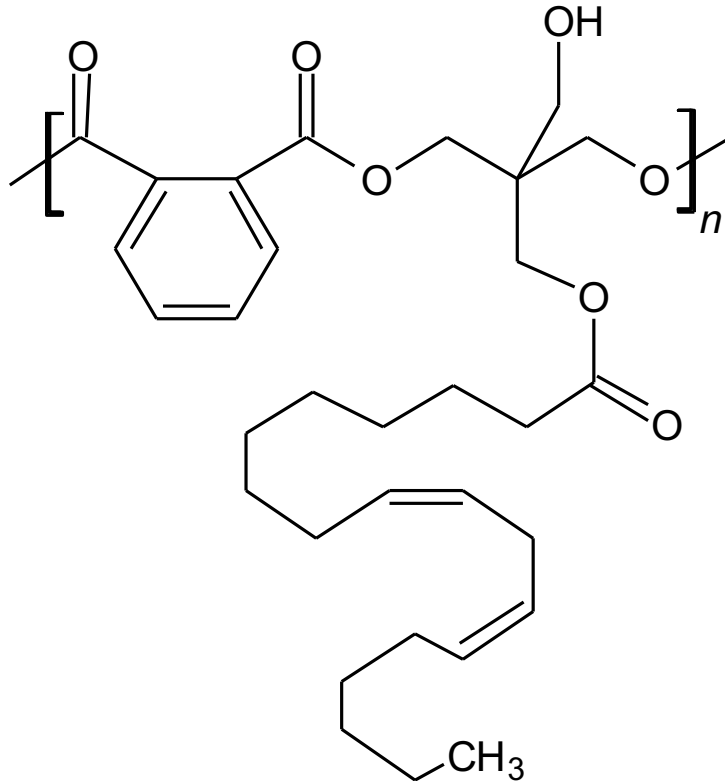


About us

- located in the north of Germany
- independent manufacturer of several kinds of coating resins
- ~ 65000 mtons per year
- ~190 employees



Introduction: alkyd resins

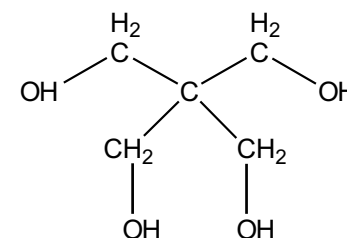
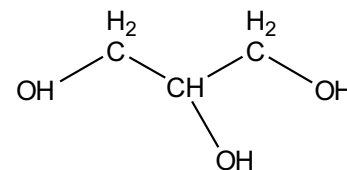


schematic structure
of alkyds

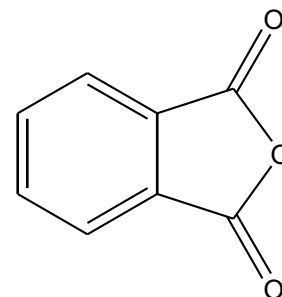
Alkyd resins – raw materials

Conventional raw materials

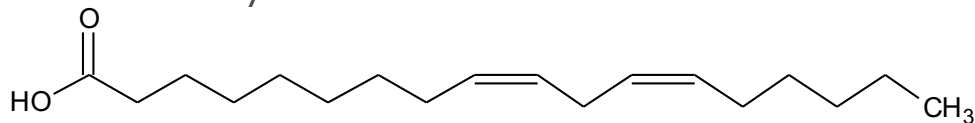
- polyols like glycerol, pentaerythritol → can be renewable



- phthalic anhydride → petrochemical origin



- fatty acids → always renewable



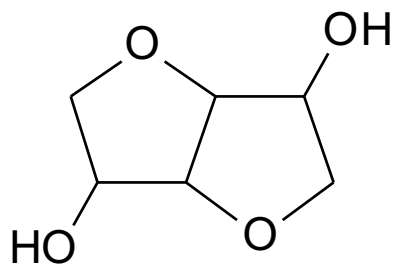
How much „green chemistry“ in alkyds ?

going to 100 %
renewability or at least
very close to 100 %

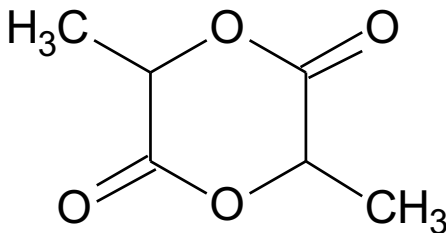
**more ambitious goal
compared to other
classes of resins**

even conventional
alkyds have a high
renewable content

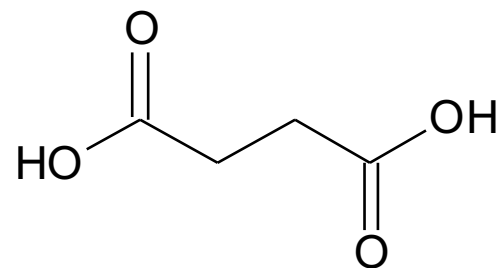
Possible renewable raw materials for alkyd resins



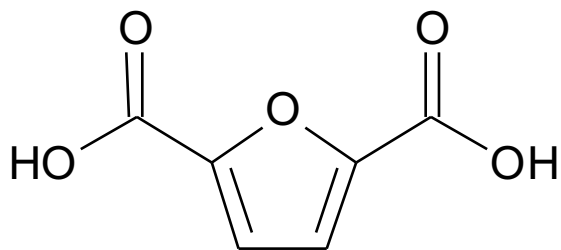
isosorbide



lactide



succinic acid



furane dicarboxylic acid

also:

- fatty acids
- glycerol
- possible: pentaerythritol

What about the medium ??

water-based approaches

Two blue lines originate from the bottom corners of the 'water-based approaches' box and point towards the top corners of the two boxes below it.

resins with high acid values

- difficult (raw materials)
- neutralising agent ??

emulsions

- difficult
- 100 % renewable emulsifiers ??

solvent-based approach

- easier to achieve 100 %
- interesting solvents available



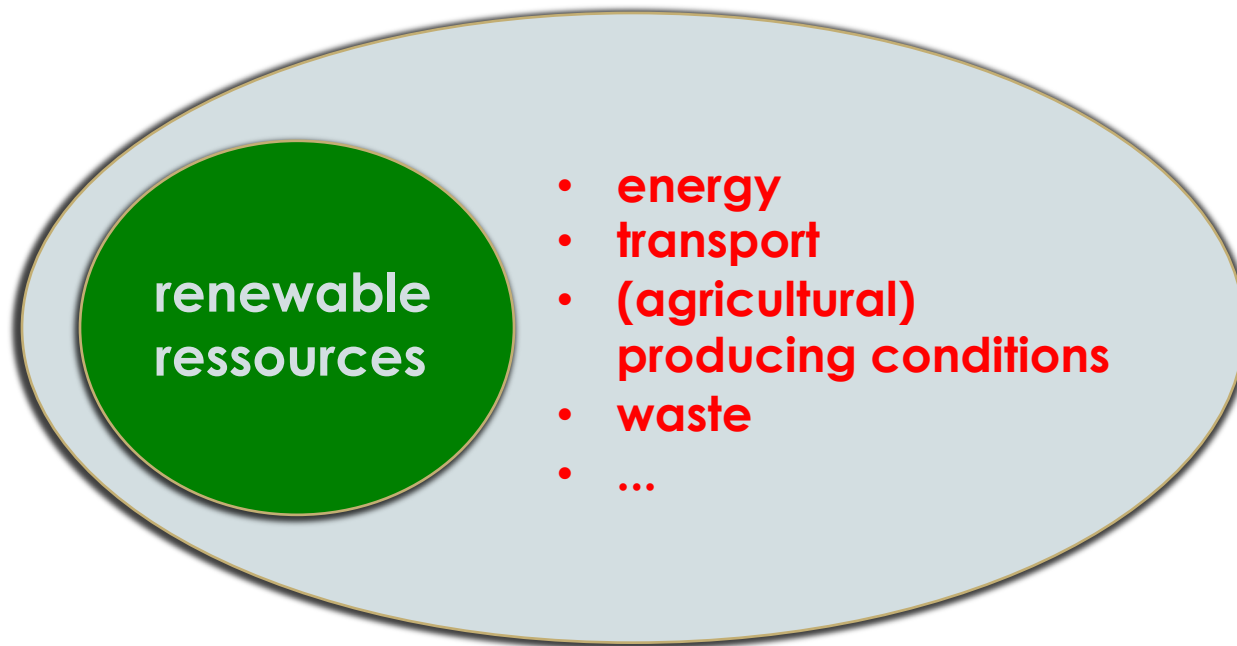
goal:

- High-Solid alkyd resin
- with 100 % renewable content
- for use in (mainly decorative) solvent-based wood coating formulations

Aspects of sustainability

Can solvent-based systems be „green“ ??

When talking about sustainability, renewable raw materials are only one part



Aspects of sustainability

- life-cycle analysis: durability is a major aspect of sustainability (might be easier with solvent-based system)
- interesting comparison: acrylic dispersions and alkyd resin → result: even solvent-based alkyds (High-Solids) are „greener“ than acrylic dispersions

Ad Hofland, Progress in Organic Coatings 73 (2012), 274-282

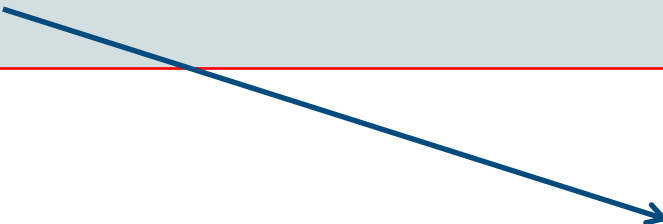


When taking other aspects of sustainability into account, solvent-based renewable alkyds turn out to be an interesting contribution

Synthalat QL 4814

Physical and chemical properties

- completely based on renewable raw materials
- „oil length“ of 77 % (mainly linoleic)
- acid value ~ max. 12 (g KOH per kg of resin)
- colour value max. 8 (iodine)
- viscosity 7000 – 11000 mPas
- nvc: 100 %

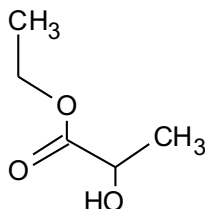
A blue arrow originates from the text 'nvc: 100 %' in the list above and points towards the text box on the right.

customer free in their
choice of solvent

„Green solvents“ - examples

ethyl lactate

Purasolv EL from Corbion

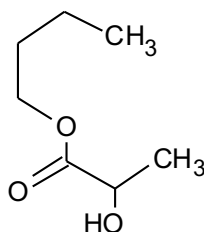


unpolar / aliphatic-like bio solvent

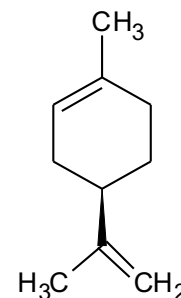
Isane Biolife 15 from Total

butyl lactate

Galaster BL 97 from Galactic

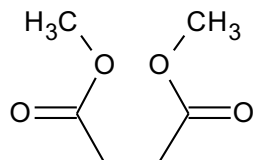


orange oil

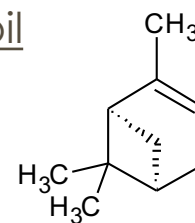


dimethyl succinate

Provichem 2511 eco from Proviron



turpentine oil



Co-free high-gloss decorative paint

ingredient	supplier	function / description	amount
Synthalat QL 4814	Synthopol	binder	47.5 %
Nuosperse 2006	Elementis	wetting & dispersing	0.5 %
Bentone SD-1	Elementis	rheological	0.5 %
BYK-067 A	BYK	defoaming	0.2 %
Tronox CR-828	Tronox	white pigment	25.0 %
Omyacarb Extra GU	Omya	calcium carbonate	5.0 %
Purasolv EL	Corbion	solvent	19.0 %
DriCat 2753 F	Dura Chemicals	drier Mn	0.4 %
DriCat 8316	Dura Chemicals	sec. drier Bi	0.8 %
Duroct Sr 18 %	Dura Chemicals	sec. drier Sr	0.8 %
Skin Blocker 100	Bohrmann	anti-skinning	0.3 %
sum:			100 %

test		value
drying on glass (150 µm, drying recorder)	setting after ...	1 h
	surface dry after ...	3 h
	through dry after ...	6 h
pendulum hardness on glass (150 µm)	after 1 day	38 sec
	after 7 days	45 sec
gloss on glass (150 µm) at 60°	after 1 day	88.6 %
	after 7 days	88.0 %
dark yellowing (150 µm on glass)	Wi / Yi after 1 day	88.4 / 0.8
	Wi / Yi after 7 days	85.8 / 1.4
QUV A weathering – wood, gloss at 60°C	after 0 hours	87.7 %
	after 100 hours	64.0 %
	after 300 hours	61.9 %

Thick-layer wood stain with water incorporation

ingredient	supplier	function / description	amount
Synthalat QL 4814	Synthopol	binder	52.5 %
Nuosperse 2006	Elementis	wetting & dispersing	0.2 %
Bentone SD-1	Elementis	rheological	0.5 %
Lo-Vel 8300	PPG	matting	3.5 %
U Trox ...	Coelln Coat	colour paste mixture	2.3 %
Dri Cat ...	Dura Chem	drier mixture based on Mn	2.3 %
Strodex FT 428	Ashland	emulsifier	1.5 %
water	-	medium	15.0 %
Galaster BL 97	Galactic	solvent	22.0 %
Skin Blocker 100	Bohrmann	anti-skinning	0.2 %
sum			100 %

almost 90 % of renewables !!

Semi-gloss clear coating for wood

- in combination with „conventional“ thix alkyd Synthalat QTL 3199
- mixture of bio and conventional solvent: Purasolv EL / D60

combinations with conventional
solvents and resins possible

Semi-gloss coloured decorative coating

- very good drying
- relatively stable semi-gloss
- high hardness (150 µm, glass): 48 sec after 7 days

Good results with Mn as well as with Fe drier, but dependent on solvent !

- Mn (Dura Chemicals, DriCat 2753) works better with ethyl lactate (Purasolv EL)
- in case of dimethyl succinate (Proviron, Provichem 2511 eco): Fe (Borchers, Oxycoat 1310) works best
- Mn / dimethyl succinate yields cissing problems when overcoating

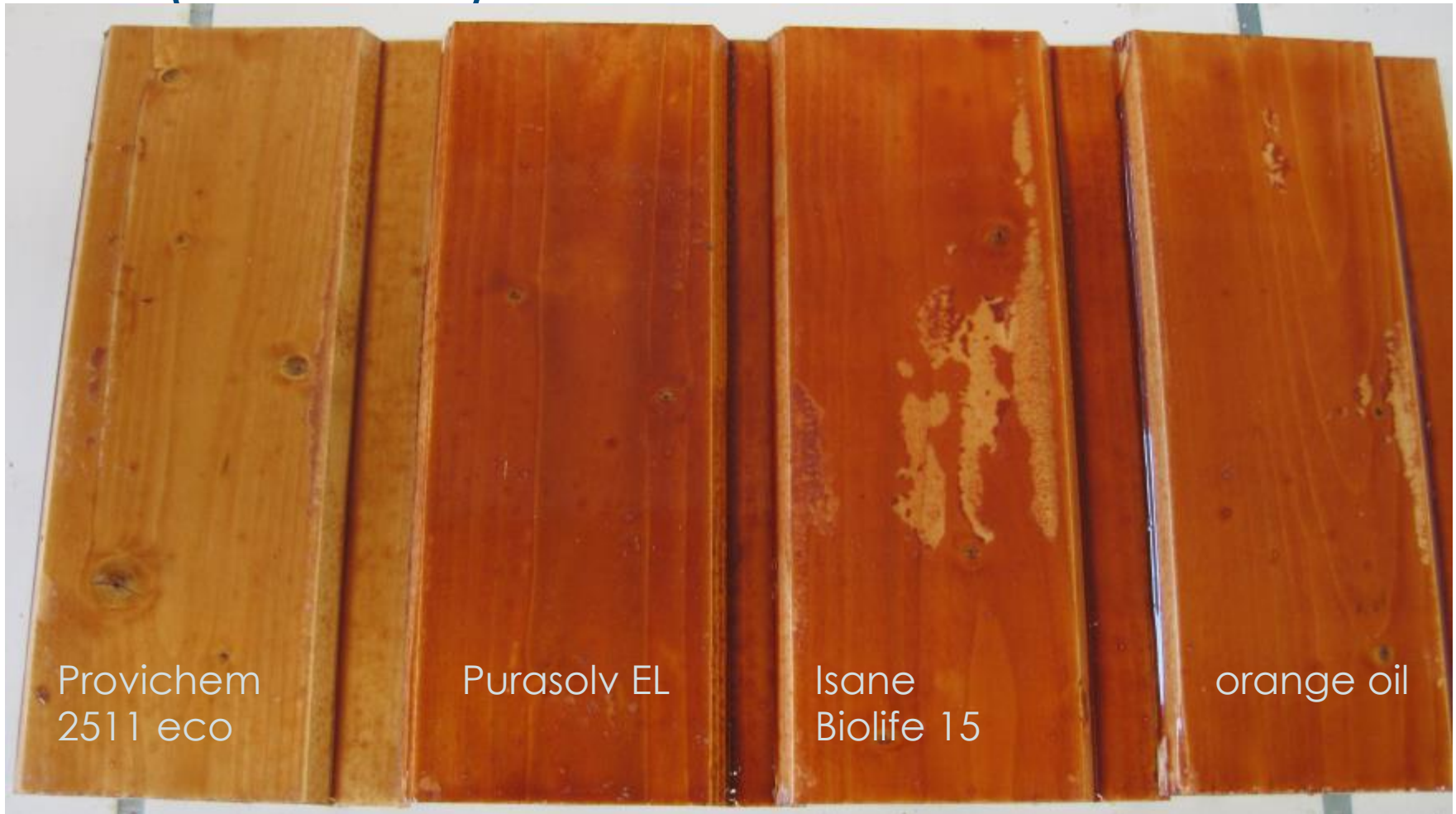
Comparison of different driers and solvents

ingredient	amount
Synthalat QL 4814	60.0 %
Troysol Z370	0.3 %
Bentone SD-1	0.3 %
Masterwax Antiblock	4.0 %
pigment pastes	3.0 %
- drier mixture -	2.1 %
- bio solvent -	30.0 %
Honeywell MPKO	0.3 %
sum	100 %

Wood stain formulation
(similar to above)

→ test of different driers
and solvents

Comparison after blocking resistance test (Mn drier)



Comparison – wood stain

- generally in wood stains, Mn seems to work better in comparison to Fe (drying !)
- but: more influence of Mn on tone of colour
- drying: best results with butyl lactate (better than ethyl lactate !)
- blocking resistance: ethyl and butyl lactate best, but dependent also on solvent / drier combination

Provichem
2511 eco

Purasolv EL

Isane
Biolife 15

orange oil

Comparison of different driers and solvents

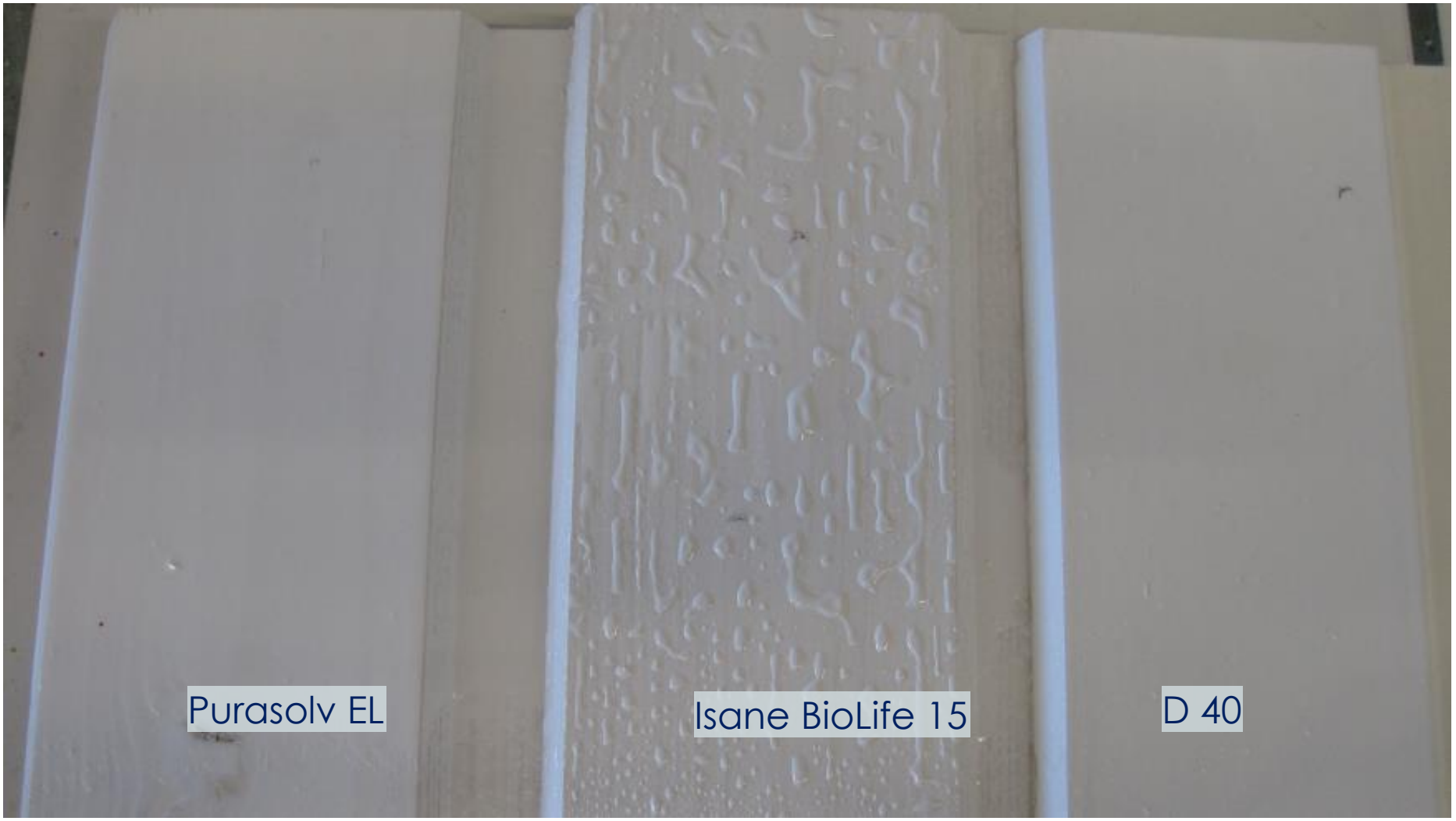
ingredient	amount
Synthalat QL 4814	47.5 %
Nuosperse 2006	0.5 %
Bentone SD-1	0.5 %
BYK-067 A	0.2 %
Tronox CR-828	25.0 %
Omyacarb Extra GU	5.0 %
- (bio solvent)	19.0 %
- drier mixture	2.0 %
Skin Blocker 100	0.3 %
sum:	100 %

Decorative formulation

→ test of different driers and solvents

- applied twice on wood
- driers: Mn and Fe
- solvents: ethyl lactate, Isane BioLife 15 and D40

Comparison after 2nd application (Mn drier)

The image shows three vertical rectangular samples of resin. The left sample is smooth and light grey. The middle sample is covered in a dense, irregular pattern of small, raised bumps or droplets. The right sample is also smooth and light grey, similar to the left one.

Purasolv EL

Isane BioLife 15

D 40

Comparison – decorative paint

- generally, in the first application, differences between Fe and Mn not as pronounced as in wood stain
- drying relatively similar
- second application: in case of Isane BioLife 15, problems in formulation with Mn, but no issue with Fe
- resistances: best with ethyl lactate

Purasolv EL

Isane BioLife 15

D 40

General assessment of different solvents for Synthalat QL 4814

	ethyl lactate	butyl lactate	dimethyl succinate	Isane BioLife 15	orange oil	turpentine oil
smell	☹️	☹️	😊	😊	☹️	☹️☹️
labelling	☹️	😊	😊😊	☹️	☹️☹️	☹️☹️
drying	😊	😊	☹️	☹️	😊	😊
blocking resistance	😊😊	😊	☹️	☹️	☹️	☹️

Outlook (work in progress)

- work on 100 % renewable alkyd for use in industrial solvent-borne wood coatings
- work on (true !) water-based systems

*resin mixture based on
Synthalat QL 4814 with
> 80 % renewable
content → water-based
formulation with > 75 %
renewable content*



Summary

- use of bio based solvents as an alternative to water-based systems
→ transition technology
- Synthalat QL 4814 (100 % renewable) as a very versatile alkyd in several decorative coating formulations with up to 90 % renewable content
- Synthalat QL 4814 can be easily combined with other resins
- high performance comparable to conventional binders (or even better)
- choice of solvent depends on formulation; more polar solvents are of advantage
- Meko-free and Co-free formulation possible – choice between Fe and Mn dependent on solvent and formulations

Thanks

- Ralf Kotthoff (synthesis)
- Wenke Mienert (formulation preparation and testing)
- all companies providing raw materials, especially solvent suppliers: Corbion, Galactic, Provion, Total,...

... and you for your attention !

