

Environmentally friendly resins

by

Cristiano Tunice

Sales and technical
responsible for

BENASEDO SPA



21042 CARONNO PERTUSELLA (VA)
Via Asiago,332 ITALY

Lille December 6th

BENASEDO

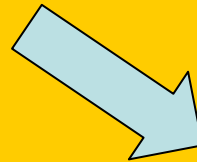
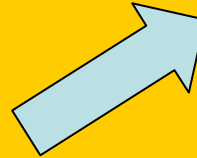
Location: CARONNO
PERTUSELLA – VARESE -ITALY

Industrial Surface: 25,000 m²

Employees: 76

Capacity: 25,000 Tons/Year

Annual Turnover : 40 Mil EURO



In 2002 acquisition of

POLIRESIN

Employees: 19

Industrial Surface: 30,000 m²

Capacity: 5,000 Tons/Year

Annual Turnover : 10 Mil
EURO

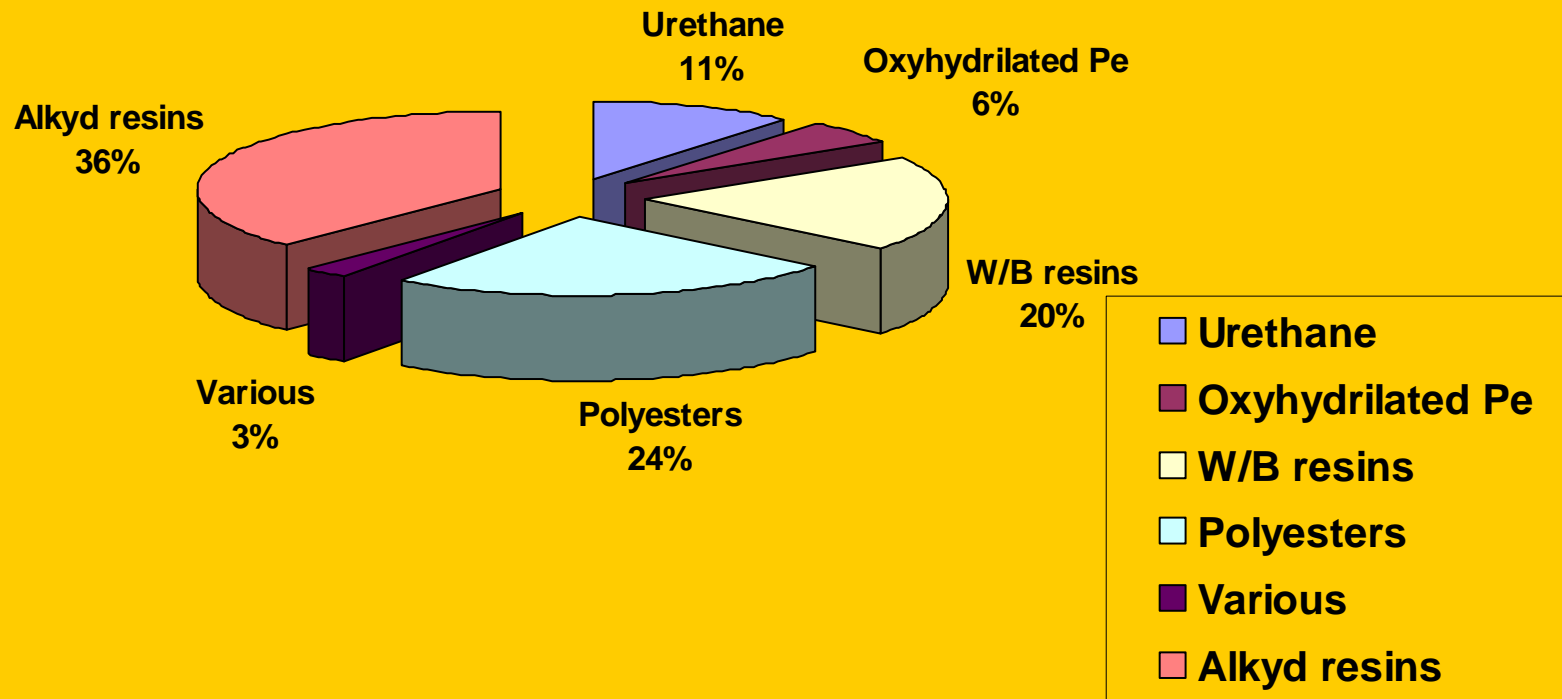
Since 2007 cooperation with

CREST COMPANY

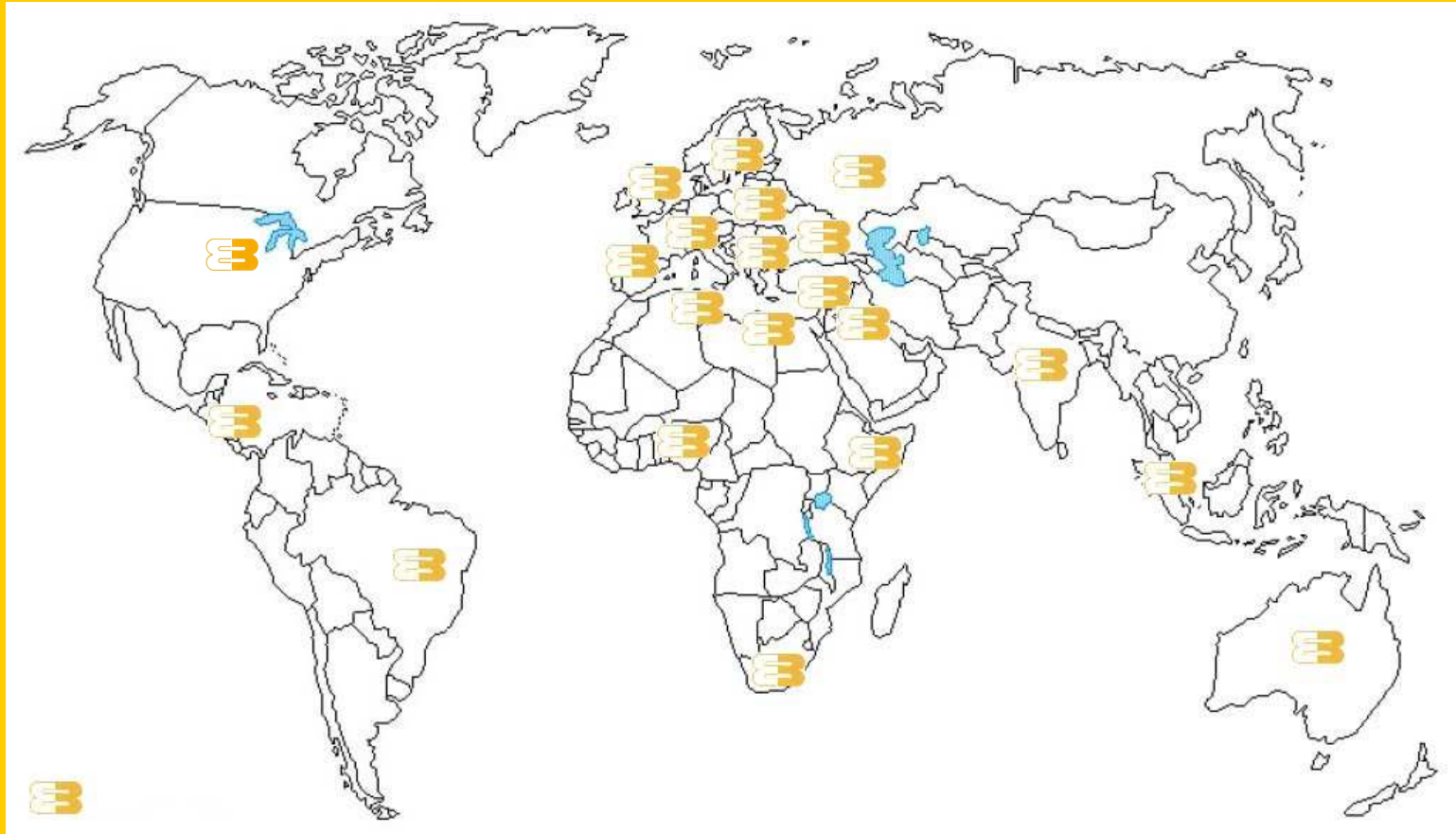
in INDIA

Since 2010 shareholder in their
border

BENASEDO product distribution



COUNTRIES SUPPLIED BY BENASEDO



Content of the presentation

- *Introduction*
- *Alkyds w/b binders*
- *Polyester w/b binders*
- *Polyurethane w/b binders*
- *New developments*
- *Conclusions*

IDROBEN®

WATERBORNE OR WATER REDUCIBLE RESIN SERIES

Alkyds

- *Waterborne*
- *Water reducible*

Polyester

- *Waterborne*
- *Water reducible*

Polyurethanes

- *Waterborne*
- *UV Waterborne*

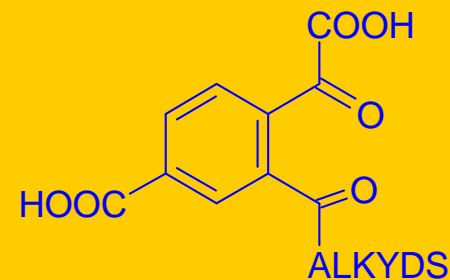
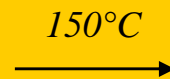
ALKYD RESINS

They are the most common resins to be used in solvent-based paints.

They are modified polyesters and are used both for air-drying and for bake paints.

To make alkyd resins suitable for water-reducible paints, it is necessary to change them chemically by attaching hydrophilic sites to the polymer molecules to be neutralized with amines.

*Alkyd Resin +
Trimellitic
anhydride*



WATER REDUCIBLE ALKYDS

(25-30% Butylglycol)

- IDROBEN 828 (75% in BG, oil 30%)
- IDROBEN 827 (70% in BG, oil 36%)
- IDROBEN 4705 (75% in BG, oil 38%)
- IDROBEN EP 878 (68% in BG, oil 48%)
- IDROBEN EP5595 (70% in BG, oil 38%)

WATERBORNE ALKYDS

(Solvent free)

- IDROBEN 5117 (50% in water, oil 38%)



WATERBORNE ALKYDS

(solvent free - internal emulsifier)

- IDROBEN 130 (44% in water, oil 20%)
- IDROBEN 180 (43% in water , oil 20% urethane modified)
- IDROBEN 160 (42% in water, oil 35% urethane modified)
- IDROBEN 178 (44% in water, oil 33% urethane modified)

WATER REDUCIBLE ALKYDS



STRONG POINTS

- Wettability
- Easy to hand
- Good relationship price/performance



WEAK POINTS

- pH dependence
- Poor hydrolytically stability
- Rheological behaviour
- Presence of co-solvent (VOC)

Water reducible alkyd resins

IDROBEN 828/827: non yellowing fast air drying binders. To be used by spray or dip applications both for primers and topcoats on metals. To be cured in oven with amine-resins, 20-30 minutes at 130°C-150°C.

Pendulum hardness values Persoz:

	<u>827</u>	<u>828</u>
Air-drying	114''	124''
Oven*	225''	290''

*=8/2 resin melamine

IDROBEN 4705: non yellowing binder suitable for bake enamels. High gloss and build up. Recommended use: exterior paints for drums.

Pendulum hardness values Persoz: 265'' (8/2 melamine)

IDROBEN 878: epoxy ester modified alkyd resin. To be used **as a primer** or as **direct topcoat in industrial applications**, with very good adhesion properties on aluminum, galvanised steel and alloys, matched with very good chemical resistance properties. To be cured in the oven also at low T.

IDROBEN 5595: epoxy ester acryl modified alkyd resin. To be used **as a primer in industrial applications**, with very good adhesion properties on aluminum, galvanised steel and alloys, matched with very good chemical resistance properties. To be cured at room T or in the oven.

Proposed formulation

<u><i>IDROBEN 827-70%BG-BA</i></u>		<i>307</i>
<u><i>IDROBEN 828-75%BG-BA</i></u>	<i>327</i>	
<i>Dysperbyk 184</i>	<i>8</i>	<i>7</i>
<i>KRONOS R 2190</i>	<i>284</i>	<i>250</i>
<i>BYK 025</i>	<i>0,7</i>	<i>0,6</i>
<i>Butyl Glicol</i>	<i>70</i>	<i>61</i>
<i>DMEA</i>	<i>22</i>	<i>20</i>
<i>Mill and complete with</i>		
<u><i>IDROBEN 827-70%BG-BA</i></u>		<i>120</i>
<u><i>IDROBEN 828 – 75% BG-BA</i></u>	<i>128</i>	
<i>BYK 025</i>	<i>0,9</i>	<i>1</i>
<i>BYK 333</i>	<i>0,5</i>	<i>0,5</i>
<i>Cymel 303</i>	<i>85</i>	<i>75</i>
<i>Water</i>	<i>73,7</i>	<i>158</i>
<i>DMAE till pH 7,5</i>		

45-50microns
Cured on
metal with 25'
at 140°C

<i>IDROBEN 878 68%BG</i>	<i>270</i>
<i>Butyl Glicol</i>	<i>70</i>
<i>AMP 95</i>	<i>6</i>
<i>Cymel 325</i>	<i>50</i>
<i>Tego foamex 1488</i>	<i>1</i>
<i>Serad FN1576</i>	<i>5</i>
<i>Red iron oxide</i>	<i>110</i>
<i>Calcium carbonate (< 2micron)</i>	<i>130</i>
<i>Soma 2 (Antisettling)</i>	<i>50</i>
<i>Additol VXW</i>	<i>6</i>
<i>Tegofoamex 1488</i>	<i>5</i>
<i>DMEA</i>	<i>4</i>
<i>Water</i>	<i>293</i>

Application: dipping

***35 microns cured on metal
at 120°C for 30'***

Final gloss: above 85

WATERBORNE ALKYDS



STRONG POINTS

- **Wettability**
- **Solvent free**
- **Excellent relationship price/performance**

WEAK POINTS

- **pH dependence**
- **Poor hydrolytically stability**
- **Rheological behaviour**

Completely solvent free binder

IDROBEN 5117: *non yellowing alkyd resin, with very good adhesion, build up and reactivity properties. Suggested use: spray and dip industrial enamels, in combination with amino resins cured for 20'-30' at 120°C-150°C.*

<u>IDROBEN 5117 50%W</u>	307
<i>Disperbyk 184</i>	<i>8</i>
<i>Kronos R 2190</i>	<i>284,5</i>
<i>Byk 025</i>	<i>0,7</i>
<i>Water</i>	<i>134,4</i>
<i>Grind and complete</i>	
<u>IDROBEN 5117 50% W</u>	154,4
<i>Cymel 303</i>	<i>57,04</i>
<i>Byk 025</i>	<i>0,9</i>
<i>Byk 333</i>	<i>0,5</i>
<i>Water</i>	<i>52,56</i>
<i>DMEA till pH 7,5</i>	

*45-50 microns cured at
130°C for 25'-30'*

WATERBORNE ALKYDS - INTERNAL EMULSIFIER

(solvent free)



STRONG POINTS

- Wettability
- No pH dependence
- Better hydrolytic stability
- Solvent free



WEAK POINTS

- Presence of hydrophilic PEO portion
- Poor UV stability

Non yellowing water alkyd with internal emulsifier

IDROBEN 130: Recommended for spray or dip applications with amino resins cured at 130°-150°C. It improves gloss and brushability when combined with acrylic binders. Multi compatible resin for pigmented pastes.

Aliphatic isocyanate modification

IDROBEN 160: Suggested uses: spray applications, cured at air or very low temperatures. Suitable for outdoor wood, metal and plastic substrates.

IDROBEN 178: Suggested uses: spray for air drying decorative and general industrial applications. Suitable for outdoor wood, metal and plastic substrates, particularly recommended for agricultural machinery field.

Aromatic modified with internal emulsifier

IDROBEN 180: *Suggested uses: spray for air drying and low T as a primer or general purpose enamels for industrial applications. It provides good adhesion on galvanised steel and plastic substrates (ABS, polystyrene,..).*

<u>IDROBEN 130 42% W</u>	309
<i>Byk 025</i>	2
<i>Disperbyk 154</i>	3
<i>Kronos R 2190</i>	310
<i>Grind and complete with</i>	
<u>IDROBEN 130 42%W</u>	205
<i>Cymel 327</i>	52
<i>Water</i>	87
<i>Butyl glycol</i>	30

Cured for 20' at 120°C

DFT: 45-50 microns

Final gloss: >90

<u>IDROBEN 178 44 %W</u>	248
BYK 154	3
Kronos R 611	180
Grind and complete with	
<u>IDROBEN 178 44 %W</u>	550
Byk 025	3
Co octoate 8%	4,3
Zr octoate 12%	8,7
Coatex BR 100 – DIMED	3

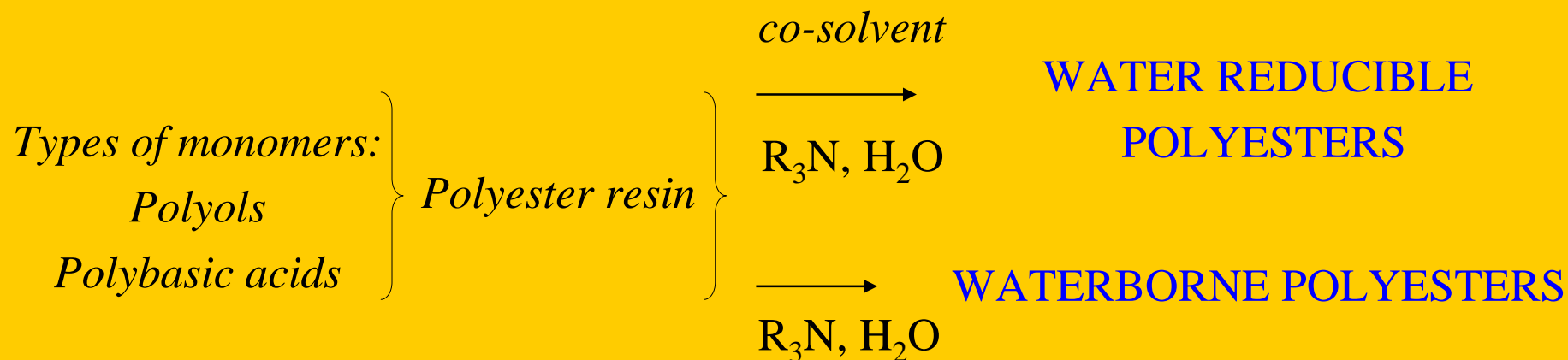
Dried at Room T

DFT: 35microns

Gloss: >90

POLYESTER RESINS

Used in w/b coatings to reduce VOC levels. They have both hydroxyl and carboxylic groups. Acid numbers in the range of 40 – 60 are required to give amine salt solutions in solvents or without, which can be diluted with water



WATER REDUCIBLE POLYESTERS

- **IDROBEN 3519 (70% in BG or 33% in water)**
- **IDROBEN 4526 (80% in metyl propilen glycol)**
- **IDROBEN 5011*(33% in water/BG)**
- **IDROBEN 2019 (50% in water/BG(6/4))**

WATERBORNE POLYESTERS (Solvent free)

- **IDROBEN 2026 (50% water)**
- **IDROBEN 2027 (50% in water)**

WATER REDUCIBLE POLYESTERS



STRONG POINTS

- Thermal and UV stability
- Excellent mechanical properties
- Easy to hand
- Good relationship price/performance

WEAK POINTS

- pH dependence
- Poor hydrolytically stability
- Rheological behaviour
- Presence of co-solvent (VOC)

Water reducible saturated polyester

IDROBEN 3519: Suggested uses: oven applications with amino resins, exterior parts of collapsible tubes and cans. High gloss, build up, flow and hardness properties.

IDROBEN 4526: slightly branched polyester. Suggested uses: oven applications with amino resins. Its high solid content makes it suitable for VOC compliance paints. High gloss, adhesion and very good mechanical properties.

IDROBEN 5011: Suggested uses: oven applications (130-150°C) with amino resins, as a vehicle for primers with high mechanical properties: can coating applications. Very good quality/price relationship.

IDROBEN 2019: Suggested uses: oven applications with amino resins, suitable for industrial applications. High gloss, build up, flow and hardness properties, with less VOC impact.

<u>IDROBEN 2019 50 % W</u>	285,5
<i>Dysperbyk 184</i>	7
<i>Titanio R 900 Du Pont</i>	255
<i>BYK 024</i>	1,5
<i>Grind and complete with</i>	
<u>IDROBEN 2019 50% W</u>	147
<i>BYK 024</i>	0,5
<i>BYK 333</i>	0,5
<i>Cymel 303</i>	45
<i>Acqua</i>	258
<i>DMEA till pH 8,5</i>	

<i>Vx CF 4/20°C</i>	300
<i>Substrate</i>	<i>Steel</i>
<i>Drying conditions</i>	<i>20' at 150°C</i>
<i>Gloss</i>	85
<i>T bend</i>	<i>O T</i>
<i>Cross hatch</i>	<i>GT O</i>

WATERBORNE POLYESTERS

STRONG POINTS

- Solvent free
- Thermal and UV stability
- Excellent mechanical properties
- Excellent relationship price/performance



WEAK POINTS

- pH dependence
- Poor hydrolytically stability
- Rheological behaviour

Waterborne Saturated Polyester

IDROBEN 2026: *Good reactivity, flexibility, build up and adhesion properties. Suggested uses: oven with amino resins (130°-180°C), recommended for can coating primers and top coats where high mechanical properties are requested.*

IDROBEN 2027: *Similar to Idroben 2026, but with much better levelling properties due to a lower surface tension.*

<u>IDROBEN 2026 50 % W</u>	307,23
<i>Dysperbyk 184</i>	<i>7,96</i>
<i>Titanio R 900 Du Pont</i>	<i>284,47</i>
<i>BYK 024</i>	<i>0,68</i>
<i>Water</i>	<i>34,13</i>
<i>Grind and complete with</i>	
<u>IDROBEN 2026 50% W</u>	154,65
<i>BYK 024</i>	<i>0,91</i>
<i>BYK 333</i>	<i>0,45</i>
<i>Cymel 303</i>	<i>57,04</i>
<i>Acqua</i>	<i>152,48</i>
<i>DMAE till pH 8.5</i>	

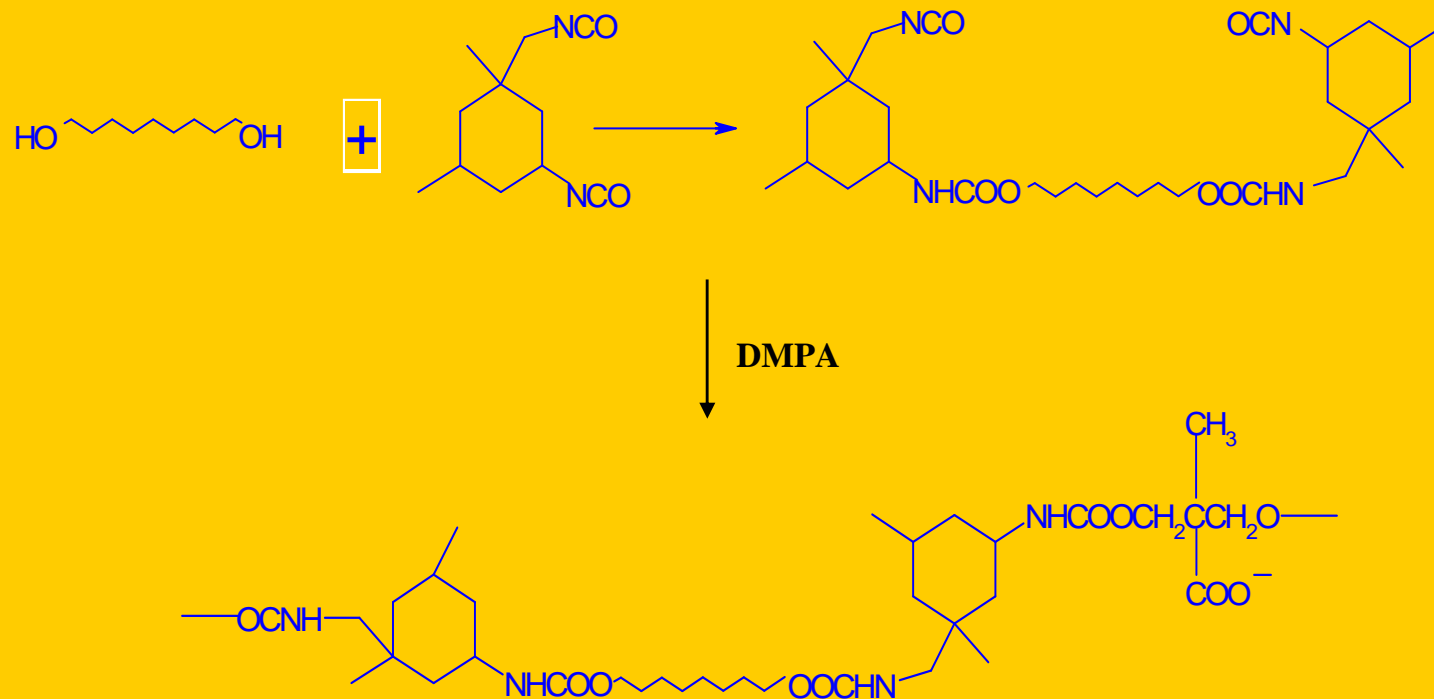
50 microns

Cured for 25' at 150°C

Gloss: > 90

POLYURETHANE DISPERSIONS

The polyurethane dispersions are obtained by introducing the dimethylol-propionic acid in the polymerization of diols with di-isocyanates. They can be synthesized *via* the so-called pre-polymer mixing process or "acetone process".



WATERBORNE PUD (Solvent free)

- **IDROBEN PD 201 (35% in water)**
- **IDROBEN PD 204 (32% in water)**
- **IDROBEN PD 205 (32% in water)**
- **IDROBEN UV 747 (40% in water)**
- **IDROBEN UV 737G (40% in water)**
- **IDROBEN UV 777P (40% in water)**
- **IDROBEN UV 7721 (40% in water)**

WATERBORNE PUD FATTY ACIDS MODIFIED

(Solvent free)

- **IDROBEN PD 717 (40% in water)**
- **IDROBEN PD 721 (40% in water)**
- **IDROBEN PD 524 (40% in water, 2,5% OH)**
- **IDROBEN PD 7051 (40% in water 4,5% OH)**

WATERBORNE PUD



STRONG POINTS

- Mechanical properties
- Scratch resistance
- Good adhesion
- Good hydrolytical stability

WEAK POINTS

- pH dependence
- Rheological behaviour
- Low wettability

Solvent free PU dispersions

IDROBEN 201: *aromatic aliphatic. Fast air drying properties, good flexibility, adhesion and hardness. Interesting use as a binder as a binder for plastic or glass applications. It can be used for baking enamels, alone or with amino resins.*

IDROBEN 204: *aromatic dispersion. Very fast air drying properties, good flexibility, adhesion and hardness. It can be used for baking enamels, alone or with amino resins.*

IDROBEN 205: *aliphatic polyurethane dispersion. Fast drying binder, with good flexibility, hardness and adhesion properties. Recommended uses: plastic and glass (with acrylics) top coats. It can be used for baking enamels, alone or with amino resins.*

<u>IDROBEN 204 34%W</u>	330
<i>Coatex Br 3</i>	3,5
<i>Foamaster 410</i>	3
<i>Kronos 2160</i>	210
<i>Grind and complete with</i>	
<u>IDROBEN 204 34%W</u>	420
<i>Foamaster 410</i>	2
<i>Byk 341</i>	3
<i>Byk 346</i>	4
<i>Tafigel PUR 40</i>	3
<i>Water</i>	21,5

*Cured on metal at
room T*

DFT: 40 microns

Gloss : 85-90

UV curing PU Dispersions

IDROBEN PUD UV 747: Particularly suited for *clear top coat on wood*. Easy to be formulated. Good chemical resistance properties. Pendulum hardness values of 160”.

IDROBEN PUD UV 777: Particularly suited for *pigmented sealers and top coats on wood*. Good chemical resistance properties. Pendulum hardness values of 270”.

UV curing PU Dispersions

IDROBEN PUD UV 737G: Particularly suited for *high gloss clear top coats on wood*. Pendulum hardness values of 230".
Good scratch and chemical resistance properties.

IDROBEN PUD UV 7721: Particularly suited for flexible applications. Pendulum hardness values of 80". *It shows good adhesion on methyl methacrylate substrates and provides good outdoor resistance*, though chemical resistances are not so high.

<u>Idroben PUD UV 747</u>	62,1
Tafigel PUR 40	0,2
Byk 420	0,2
Butyl Glycol	2
Disperbyk 192	0,2
Syloid C 807	3,3
Dynol 604	0,8
Byk 333	0,5
Tego Airex 902 W	0,7
Idroben 2643	30

*Applied with different
coloured pastes at 130
gr/m² (WFT) on steel*

*Cured for 20' at 80°C
followed by 1 Hg and 1
Ga lamp*

Gloss below 10

HSS more than 700 hours

<u>Product</u>	<u>Quantity (g)</u>
<u><i>Idroben PUD UV 777/P 40%W</i></u>	<u><i>88,8</i></u>
<u><i>Tafigel PUR 40</i></u>	<u><i>0,2</i></u>
<u><i>Byk 420</i></u>	<u><i>0,2</i></u>
<u><i>Dowanol DPM</i></u>	<u><i>2</i></u>
<u><i>Disperbyk 192</i></u>	<u><i>0,2</i></u>
<u><i>Syloid C 807</i></u>	<u><i>3,2</i></u>
<u><i>Tego Airex 902</i></u>	<u><i>0,5</i></u>
<u><i>Byk 025</i></u>	<u><i>0,3</i></u>
<u><i>Byk 346</i></u>	<u><i>0,8</i></u>
<u><i>Dynol 604</i></u>	<u><i>0,5</i></u>
<u><i>Irgacure 819 DW</i></u>	<u><i>0,8</i></u>
<u><i>Darocure 1173</i></u>	<u><i>1,5</i></u>
<u><i>Aquacer 539</i></u>	<u><i>1</i></u>

Cured with different pigmented pastes for 20? At 40°C followed by one Ga and one Hg UV lamps

WATERBORNE PUD FATTY ACIDS MODIFIED (Solvent free)



STRONG POINTS

- **Mechanical properties**
- **Scratch resistance**
- **Good adhesion**
- **Good hydrolytic stability**
- **Excellent wettability**
- **Hydrophobic**
- **Improved chemical resistance**
- **Crosslink at room temperature**

WEAK POINT

- **pH dependence**

Air drying PU fatty acid modified

IDROBEN PD 721: special air drying aliphatic binder. Fast air drying resin, suitable for **outdoor glossy (clear and pigmented) applications on metal**, plastic and wood substrates (especially for DIY).

IDROBEN PD 717: special air drying aliphatic. Very fast air drying resin, particularly suitable for **outdoor matt (clear and pigmented) applications on metal, glass, plastic and wood substrates (parquet and concrete)**, where it shows very high penetration matched with high water resistance properties

Air drying PU fatty acid modified

IDROBEN PD 524: *Hydroxilated aliphatic polyurethane dispersion. Suitable for **2 K applications, combined with aliphatic poly-isocyanates**, providing high hardness and build up properties. It provides good adhesion on different substrates, like wood, metal, glass and plastic.*

IDROBEN PD 7051: *Hydroxilated aliphatic polyurethane dispersion. Suitable for **2 K glossy applications both for wood and metals**. It provides good gloss and flexibility properties, matched with a good final hardness.*

<i>Idroben PD 721 40% W</i>	<i>300</i>
<i>Byk 020</i>	<i>2</i>
<i>Disperbyk 184</i>	<i>2</i>
<i>Efka 26</i>	<i>8</i>
<i>Kronos 2310</i>	<i>240</i>
<i>Water</i>	<i>10</i>
<i>Grind keeping the T below 45°C</i>	
<i>Octa Soligen Co 7</i>	<i>1</i>
<i>Zircat</i>	<i>2</i>
<i>Mill until obtaining Hegman value below 10 micron</i>	
<i>Idroben 721 40% W</i>	<i>321,5</i>
<i>Byk 346</i>	<i>4</i>
<i>Butyl Glycol</i>	<i>2</i>
<i>Water</i>	<i>38</i>
<i>Corrosion inhibitor</i>	<i>2</i>
<i>Eskin 2</i>	<i>2</i>
<i>Wax solution*</i>	<i>34</i>
<i>PU thickener*</i>	<i>25</i>

*45-50 microns
dried at room T*

<u><i>Idroben PD 717 40% W</i></u>	<i>430</i>
<i>Byk 024</i>	<i>3</i>
<i>Byk 346</i>	<i>4</i>
<i>Syloid ED 50</i>	<i>10</i>
<i>Lancowax 1362 D</i>	<i>10</i>
<i>Lanco thix PUR 21</i>	<i>3,5</i>
<i>Octa Soligen Co 7</i>	<i>3</i>
<i>Zircat</i>	<i>3</i>
<i>Water</i>	<i>6</i>
<i>Stir keeping the T below 45°C</i>	
<i>Butyl Glycol</i>	<i>35</i>
<i>Water</i>	<i>39</i>
<u><i>Idroben PD 717 40% W</i></u>	<i>454</i>

***Parquet formulation dried at
room T***

120 microns WFT

The already shown binders represent all the work done by Benasedo in these years to achieve w/b systems similar or even superior to the corresponding solvent borne ones.

Other challenges, coming from the market, i.e. Sustainability, are pushing toward new researches.

A demonstration of what till now achieved is a new renewable binder

Idroben NAT 100

Air drying modified long oil non yellowing resin (BPA free)

Oil content:(89%)

solid content of 50% in water

Viscosity: < 1000 cps

It was tested in some basic formulas (matt and satin) showing promising results as follows:

TACK FREE: 10 minutes at 100 WFT

COMPLETE DRYING: 4h at 100 WFT

FINAL HARDNESS PERSOZ: 50-70” at 100 WFT after 3 weeks

ADHESION ON DIFFERENT SUBSTRATES: Plastic, gypsum steel, PVC

COV : less than 2gr/l method ISO 11890 (in compliance with the max limits)

COV emission: Class A+, < 1000 $\mu\text{gr}/\text{m}^3$ after 3 and 28 days

Bio source composition: > 98% carbon bio source on carbon total

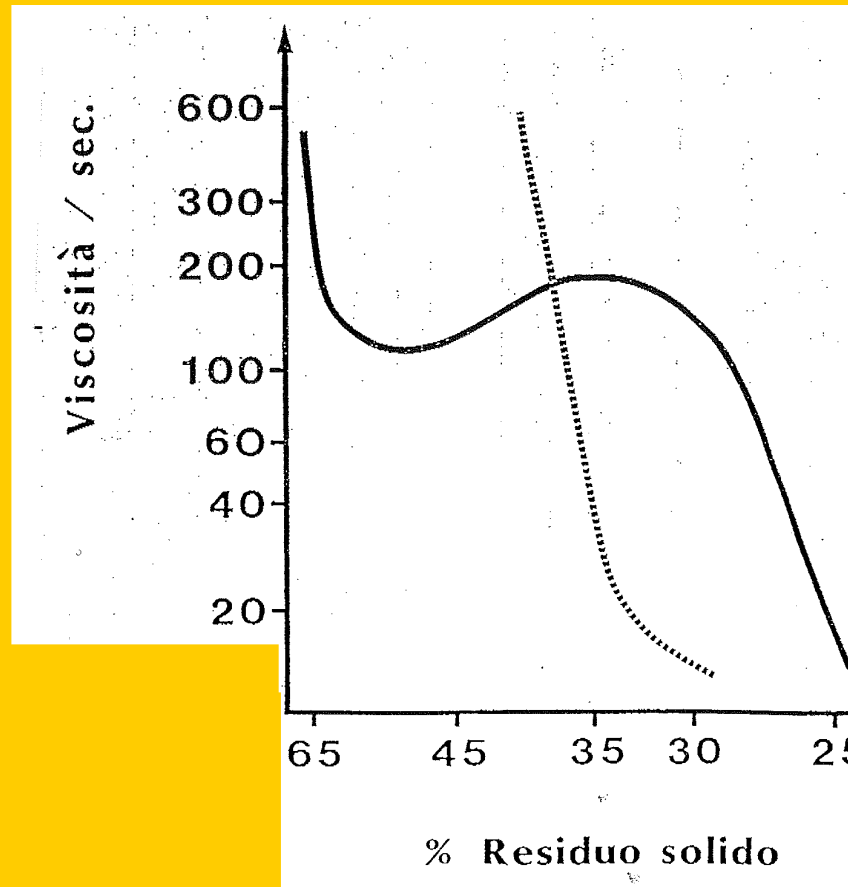
Conclusion

In this presentation all the most recent developments in the field of w/b resins were introduced, showing their features and the applications already on the market.

These are remarkable results obtained by Benasedo investing a lot in new technologies and, above all, cooperating with customers in order to satisfy and to follow all the market requirements.

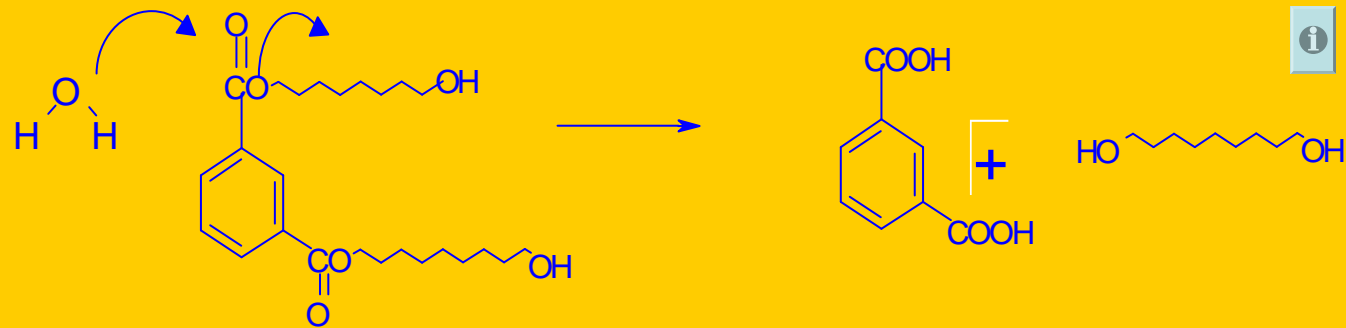
**THanks for your
Kind attention**

Rheological behaviour



— Alkyd Resins water reducible
..... Alkyd Resins self emulsifier

Carboxylic groups hydrolysis



POLYETHYLENEGLYCOL

