Momentive Performance Materials Inc.
Momentive Specialty Chemicals Inc.
迈图集团

Global Leader in Specialty Chemicals and Materials

特种化学品和材料的全球引领者

Momentive Creates One Of The Largest Global Specialty Chemical And Materials Growth Platforms
迈图集团创建了全球最大的特种化学品和材料的增长平台之一

(in millions)

Momentive Performance Materials Holdings
Craig Morrison

Revenue: $7.7 bn (1)
EBITDA: $1.0 bn (1)

Epoxy, Phenolic & Coating Resins Division
Jody Bevilaqua

Revenue: $3,372 mm
EBITDA: $470 mm

- Base Epoxy Resins
- Specialty Epoxy Resins
- Versatic™ Acids & Derivatives
  叔碳酸及其衍生物部门
- Specialty Phenolic Resins
- Oilfield
- Powder Coatings
- Global Dispersions
- Acrylic Monomers

Silicones & Quartz Division
John Dandolph

Revenue: $2,570mm
EBITDA: $340 mm

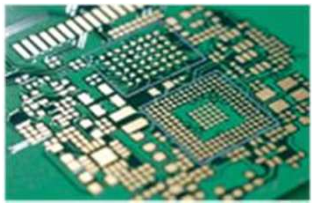
- Silicone Fluids
- Silanes and Resins
- Silicone Intermediates
- Silicone Elastomers
- Silicone Engineered Materials
- Urethane Additives
- Consumer Sealants and Adhesives
- Fused Quartz and Ceramic Materials

Forests Products Resins Division
Dale Plante

Revenue: $1,777 mm
EBITDA: $181 mm

- Forest Products Resins
- Formaldehyde
- Formaldehyde Derivatives
- Wax Additives





Global Leadership Positions Across A Broad Range Of Technologies And Industries
领跑全球多种工业技术领域

Epoxy Resins
Global

Quartz
Global

Silicones
Global

Phenolic Specialty
Resins
Global

Versatic Acids &
Derivatives
Global

Forest Product Resins
Global

Oilfield Proppant Resins
Global

LEADING MARKET POSITIONS IN MORE THAN 80% OF ITS REVENUE BASE

超过80%的产品为世界第一

The New Momentive – Forges An Industry Leader
新迈图 – 强强联手铸就工业领导者

MOMENTIVE performance materials
The science behind the solutions.

+

HEXION™
Specialty Chemicals

迈图高新材料

翰森特种化学品

MOMENTIVE™

Pro forma Revenue $7.5 Billion
Pro forma Adjusted EBITDA $1.2 Billion

Versatic Acid & Derivatives Business
溯源叔碳酸及其衍生物部业务

Versatic Acid & Derivatives Applications
叔碳酸及其衍生物应用领域概览

VeoVa™ VINYL ESTER

- Emulsions (paints & adhesives)
- Powder additives (construction)
- Fuel additives

CARDURA™ GLYCIDYL ESTER

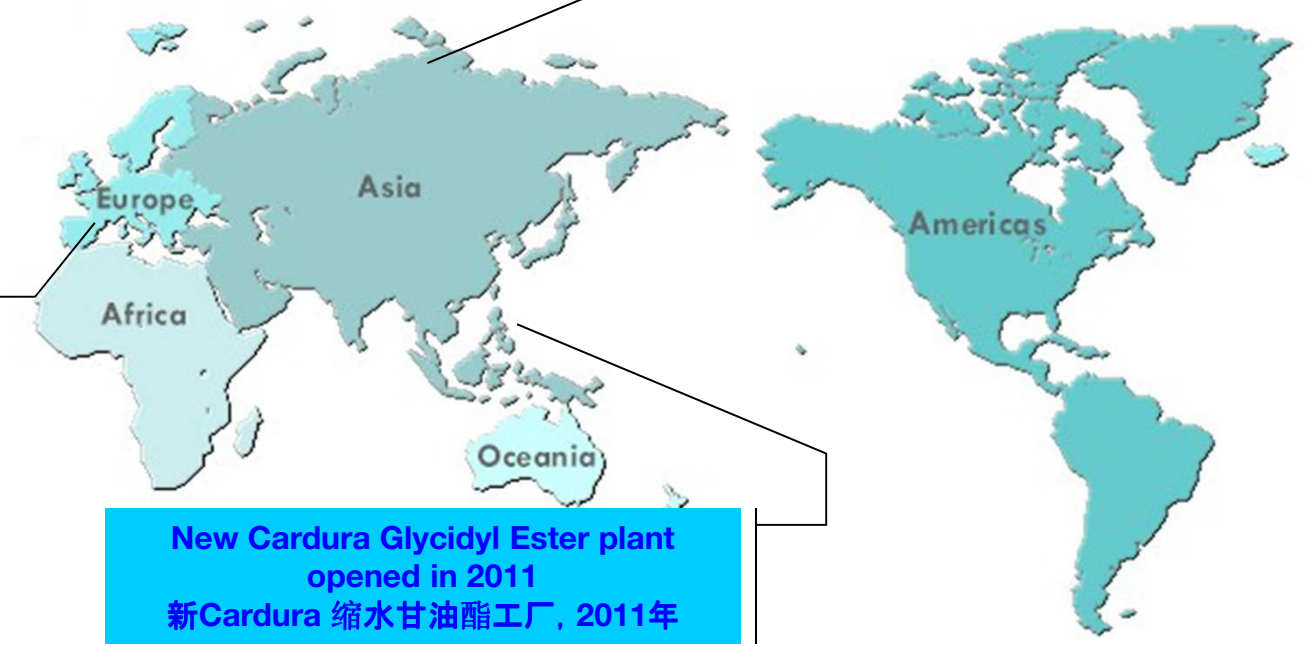
- Automotive coatings
- Coil and Industrial coatings
- Reactive diluents (Civ. Eng.)
- Pigment Paste

Versatic™ Acid NEOCARBOXYLIC ACID

- Peroxides
- Pharmaceuticals intermediates
- Agrochemicals
- PVC stabilizers
- Paint dryers
- Tire adhesives
- Lube additives
- Metal Working Fluids

Versatic Acid & Derivatives Manufacturing Footprint In Asia
叔碳酸业务部在亚洲的工厂

New VeoVa Vinyl Ester plant
Opened in 2012
新VeoVa单体工厂，2012年



Existing:
2 Acid plants
1 Cardura Glycidyl Ester plant
2 VeoVa Vinyl Ester plants

New Cardura Glycidyl Ester plant
opened in 2011
新Cardura 缩水甘油酯工厂，2011年

- Roughly doubling capacity

VERSATIC DERIVATIVES

Unconventional Chemistry

叔碳酸及其衍生物

创造非同寻常的化学作用

MOMENTIVE™

Synthesis And Application Of Cardura™ E10P Based Water-borne APO And PUD

基于Cardura™ E10P水性羟基丙烯酸树脂和聚氨酯分散体的合成和应用

CARDURA™ GLYCIDYL ESTER

Scott Wang/王丰万

May 15-16, 2013

Agenda 议程

- Introduction 引言
- Synthesis and application of Cardura E10P based water-borne acrylic resin

  基于Cardura E10P水性丙烯酸树脂的合成和应用
- Application and application of Cardura E10P based PUD

  基于Cardura E10P聚氨酯分散体的合成和应用
- Conclusion 结语

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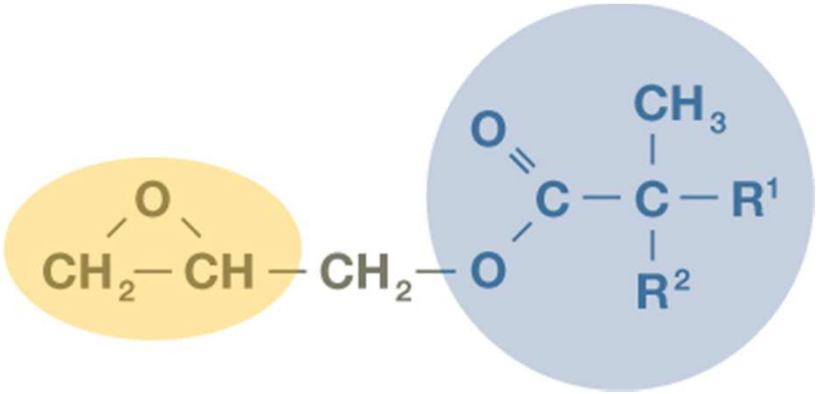
Why Cardura E10P (CE10P) For Waterborne Dispersions
为什么研发基于Cardura E10P (CE10P) 的水性分散体

- The need to reduce the emission of VOCs has led to the development of waterborne binders;
  出于减少有机挥发物的需要，水性树脂正在被开发；

- Conventional WB dispersions have a solvent removal step which requires high energy and causes side reactions；
  常规的水性分散体需要一个除溶剂步骤，常常造成高能耗和副反应。

- Waterborne resins can be prepared in a more convenient and simple process using CE10P as reactive diluent for initial reactor charge.
  使用CE10P作为活性稀释剂打底，水性树脂分散体的制备工艺更加便利、简单。

What Is Cardura E10P
Cardura E10P是什么



Reactive epoxy-group
活性环氧基团

- Easy incorporation in polymers due to highly reactive towards amines, acids and alcohols
与胺类、羧酸及醇类反应活性大，易于引入聚合物中；
- Ring opening generates an hydroxyl group for curing
开环产生羟基，可用于固化；
- Enhanced metal adhesion
改善附着力。

of Versatic Acid 10
叔碳酸10
(R^1+R^2=7 Carbon atoms)

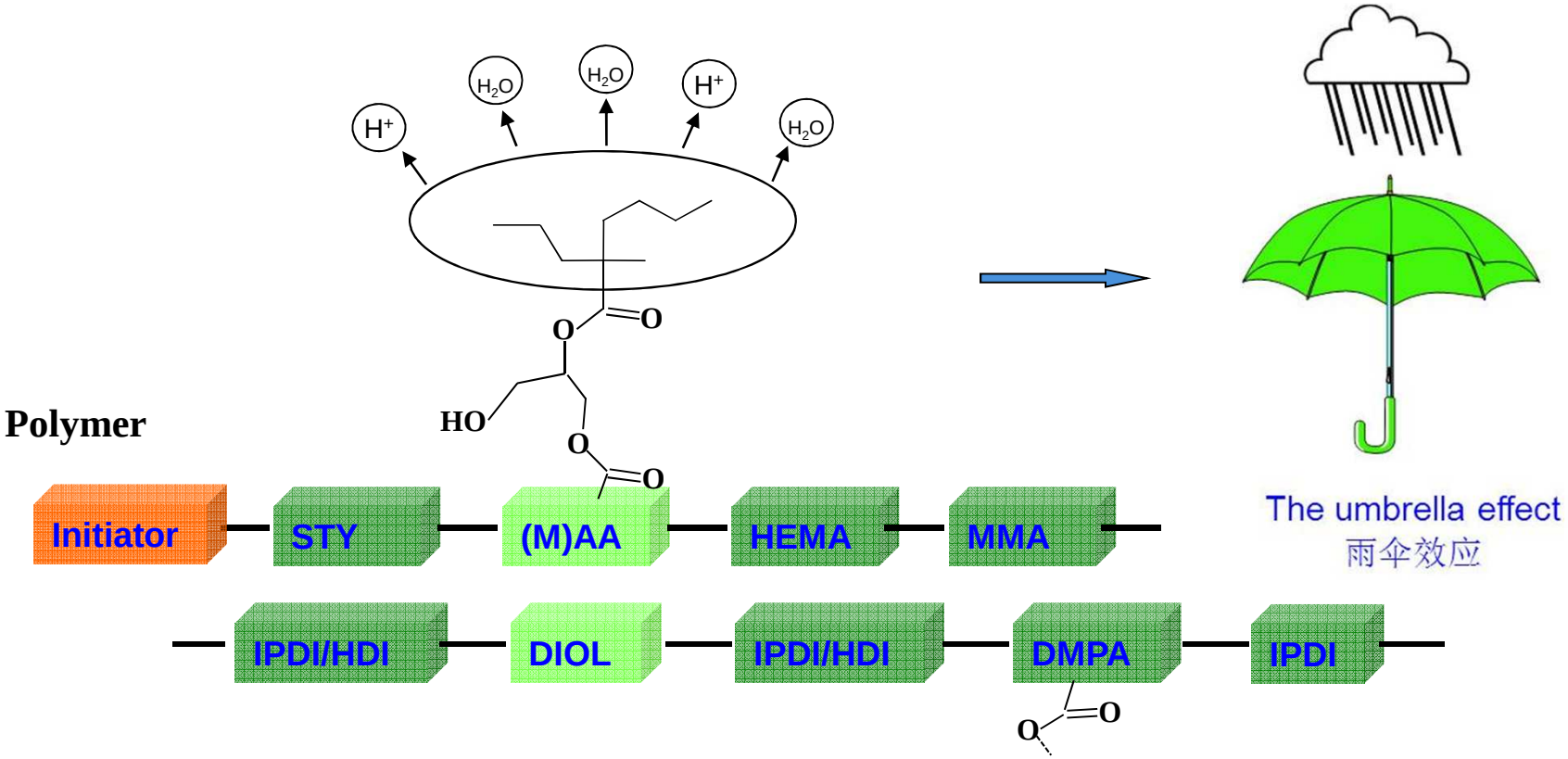
- Bulky structure 大体积结构
- Reduce intermolecular interaction 减少分子间作用力
- Sterically protected ester group 位阻保护酯键
- Aliphatic Structure 脂肪族结构
- Hydrophobicity 疏水性

Key Characteristic
主要特性

- Superior appearance, DOI, film build, etc.
极好的外观，如鲜艳性，丰满度等
- A simple polymerization process
简化合成工艺
- Excellent acid and alkali resistance
极好的耐酸碱性能
- Water resistance 耐水
- Enhanced flow and leveling
改善流动和流平
- Good pigment wetting and improve inter-coat adhesion
好的颜料润湿和改善层间附着
- High solid content low viscosity resin
制备高固低粘树脂
- Superior outdoor durability 耐候

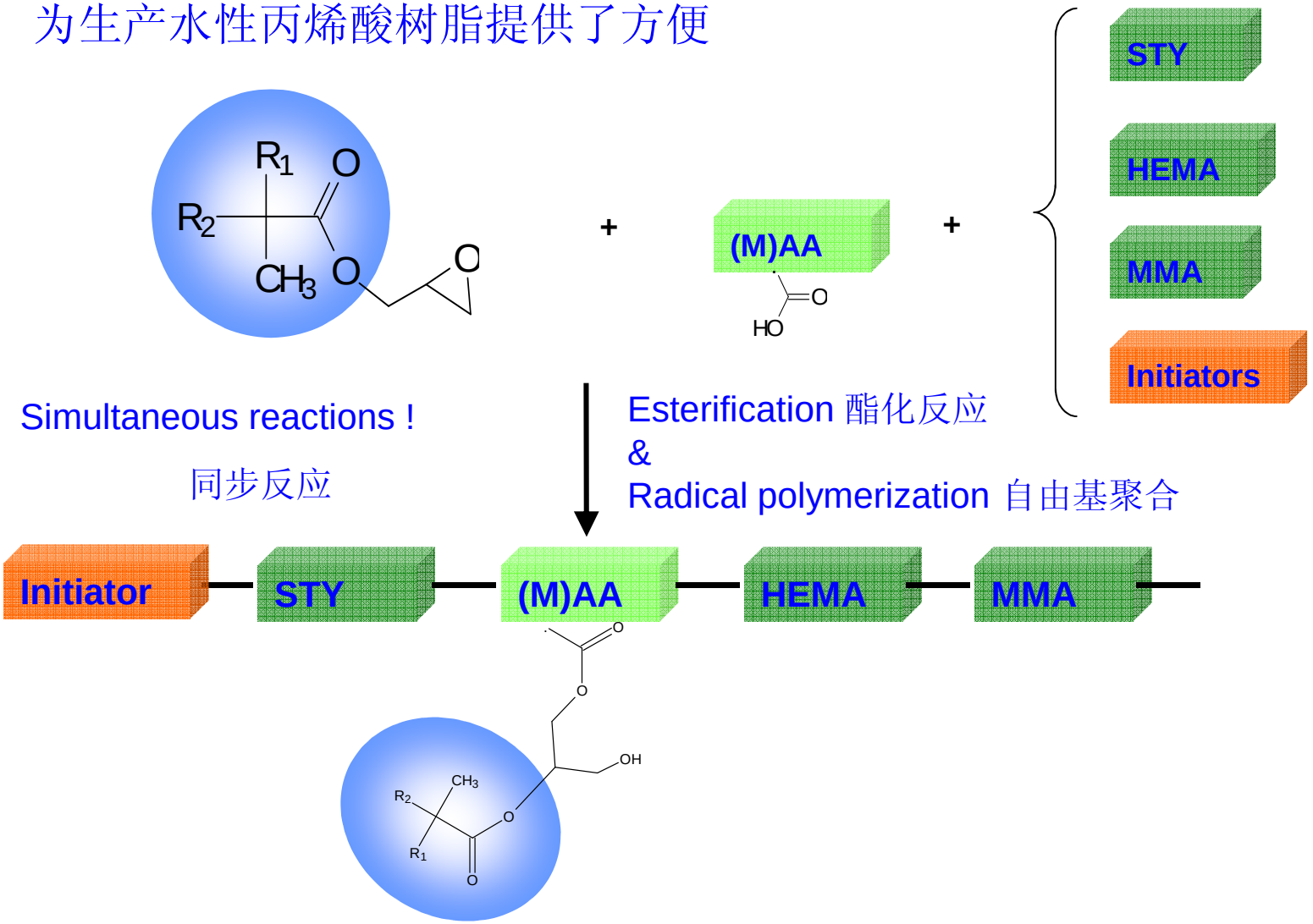
The Advantages For CE10P Based Resins
基于Cardura E10P树脂的优势

➢ The steric influence and hydrophobicity of CE10P protect the cross-link from hydrolysis and lead to improve chemical resistance;
CE10P的空间位阻效应和疏水性保护交联的化学键减少水解、改善耐化学品性；



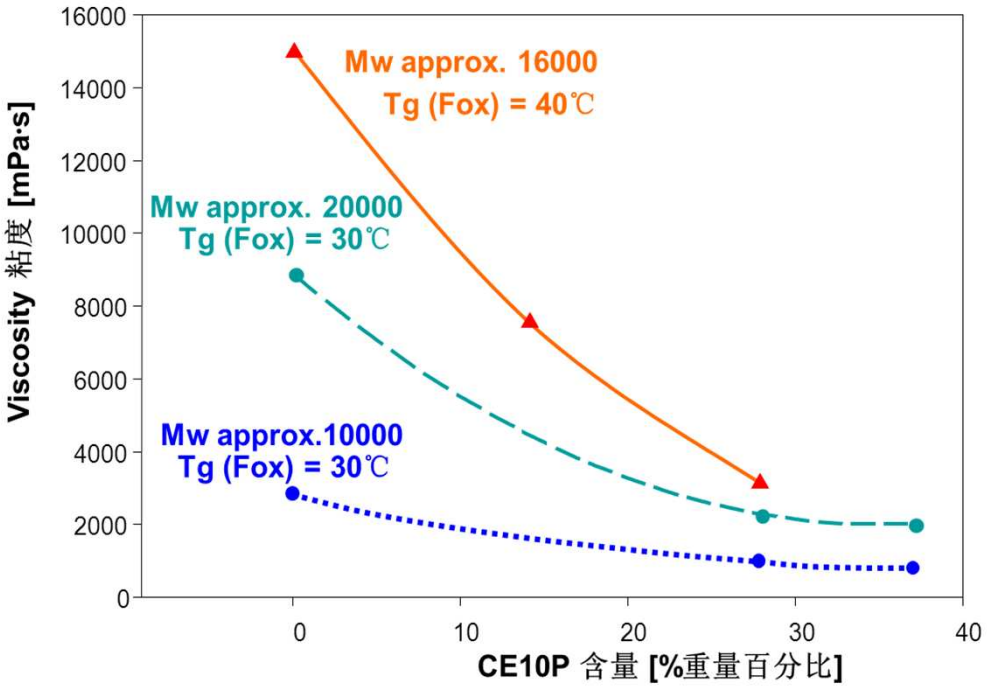
The Advantages For CE10P Based Resins
基于Cardura E10P树脂的优势

➢ Offer a considerable processing advantage during the resin production
为生产水性丙烯酸树脂提供了方便



The Advantages For CE10P Based Resins
基于Cardura E10P树脂的优势

➢ Viscosity cutting power of Cardura E10P
Cardura E10P的降粘力



- A reasonably low content of Cardura E10P in the polyol structure contributes to **strong viscosity reduction**

  在多元醇中适当的Cardura E10P就能强烈地降低粘度

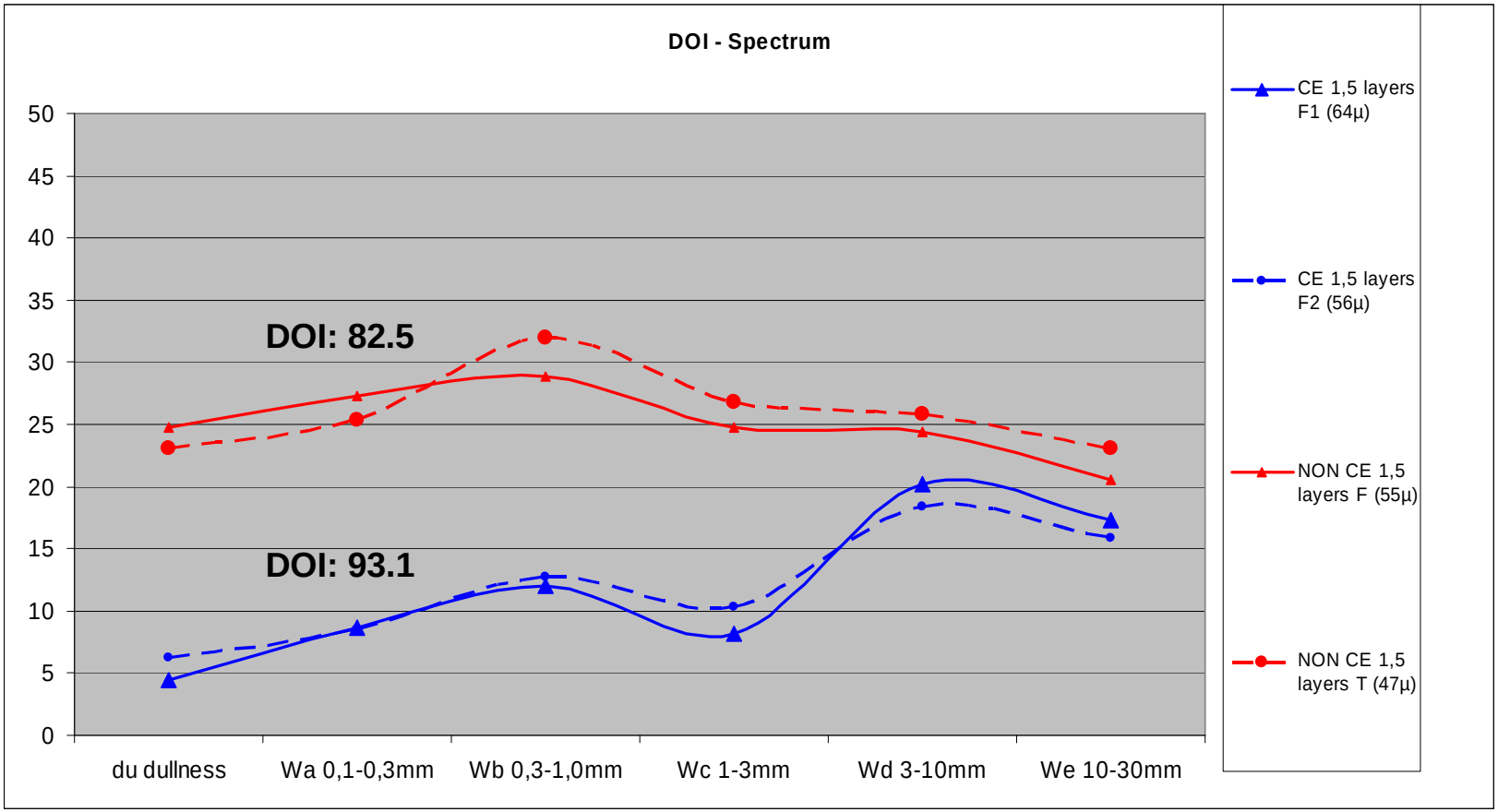
- Cardura E10P produces lower viscosity resins which can be used for **low VOC** applications.

  基于Cardura E10P制备的低粘树脂可以制备低VOC涂料

Cardura E10P reduces the resin viscosity because its bulky structure also limits the chain interactions limiting hydrogen bonding.
归于大体积结构，降低了分子间的作用力（如氢键、缠绕），从而降低树脂粘度。

The Advantages For CE10P Based Resins
基于Cardura E10P树脂的优势

- Cardura E10P based coatings show a better appearance
  基于Cardura E10P涂料制备的涂膜具有更好的外观



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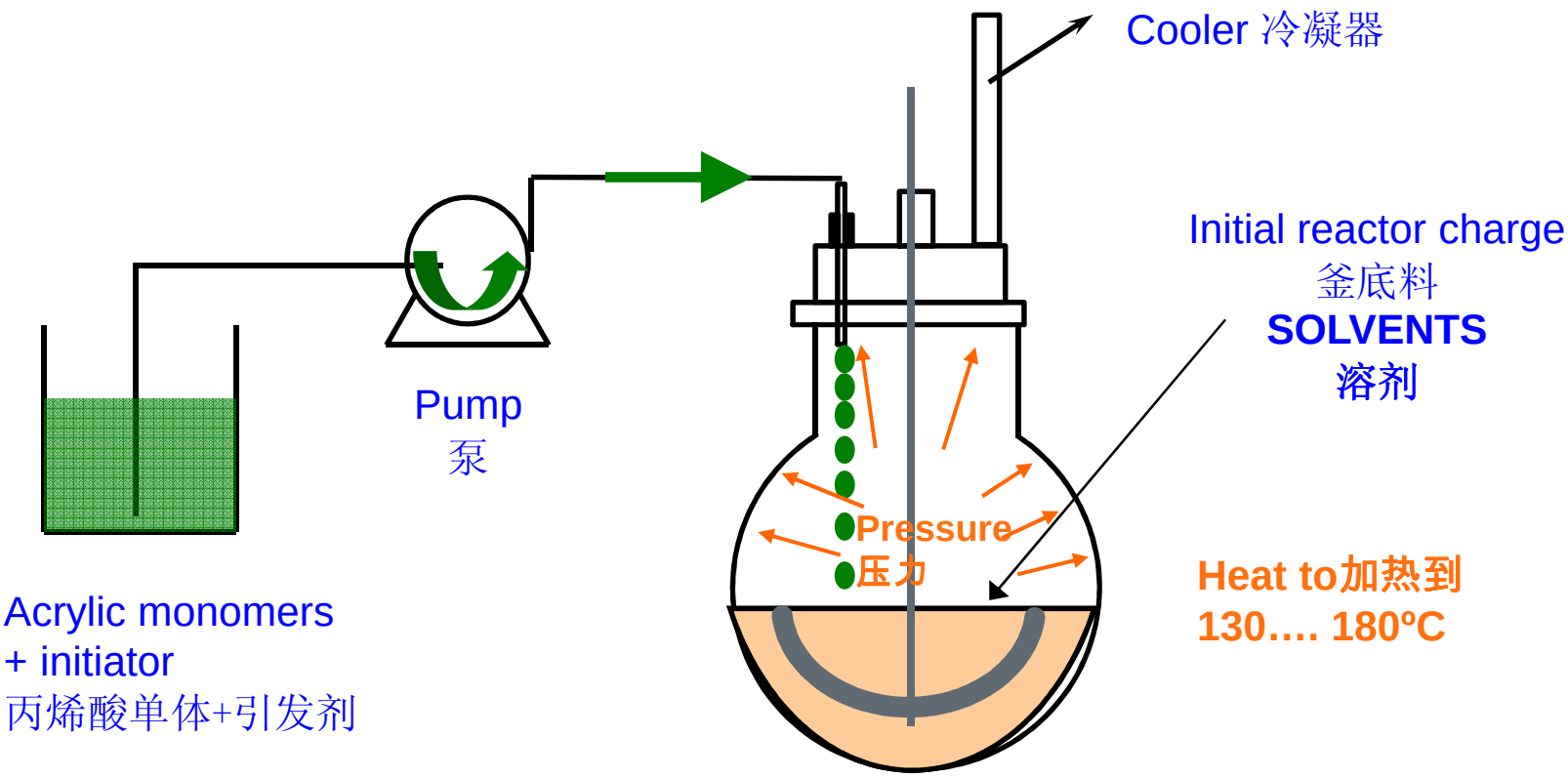
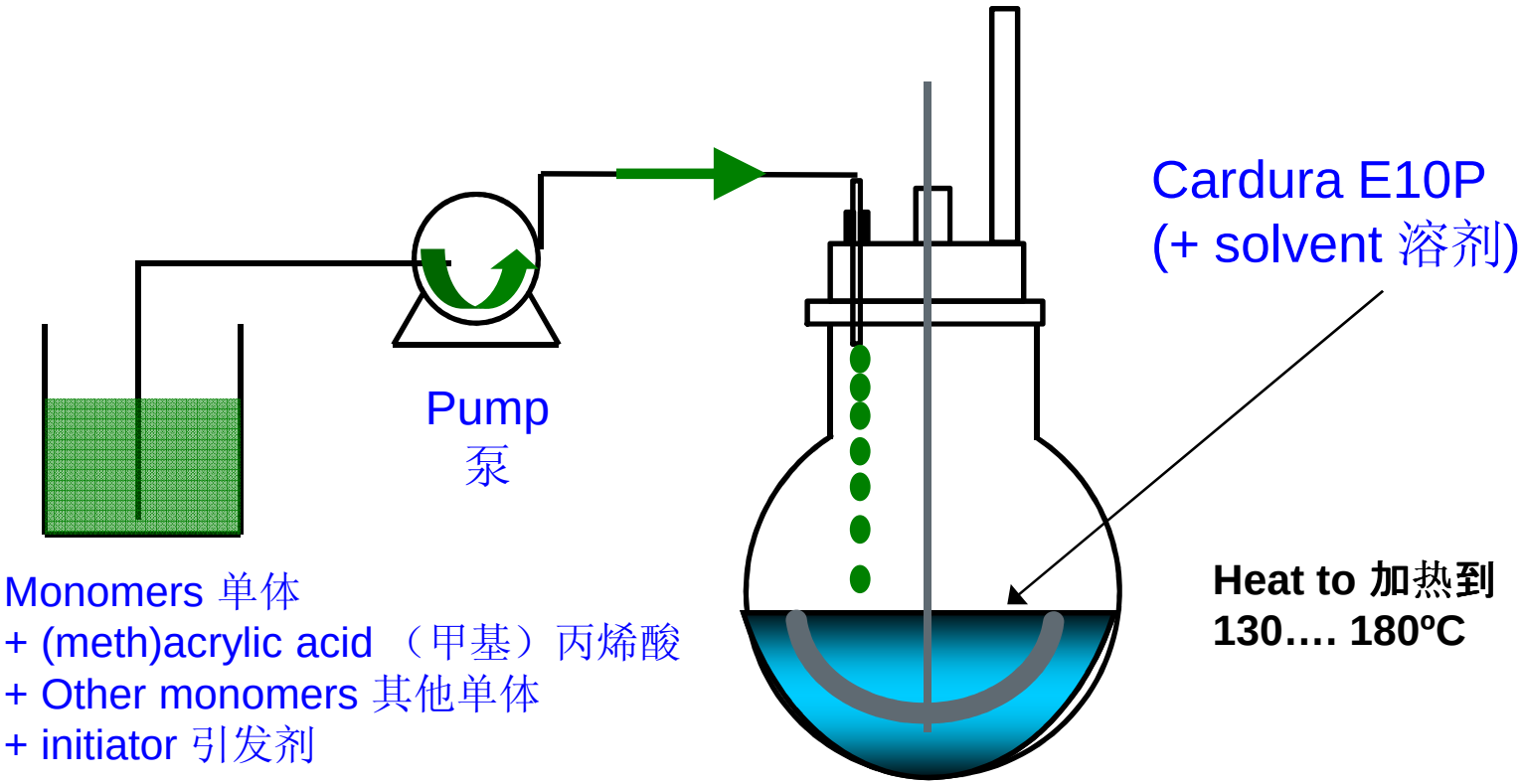
Synthesis Of Acrylic Polyols - free of CE10P
不含CE10P的丙烯酸多元醇合成



☹ Pressure reactor needed
需要使用压力反应釜

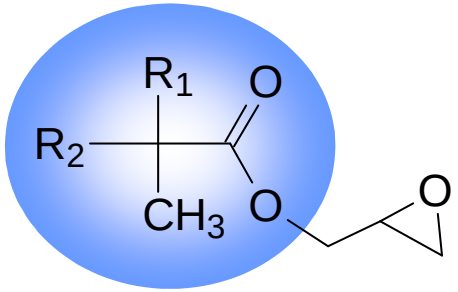
High Polymerisation Temperature With Cardura Monomers
使用Cardura 单体可以应用更高的聚合温度



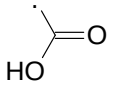
- Very high polymerisation temperatures are possible in conventional reactors!

  在传统的反应釜中进行高温聚合成为可能！

Incorporation Of Cardura E10P In acrylic polyols
在丙烯酸多元醇中引入叔碳酸缩水甘油酯



+ (M)AA +



STY

HEMA

MMA

Initiators

Simultaneous reactions !

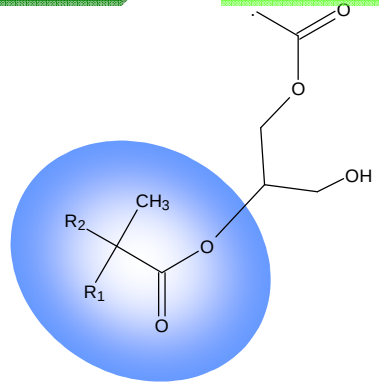
同步反应

Radical polymerization 自由基聚合

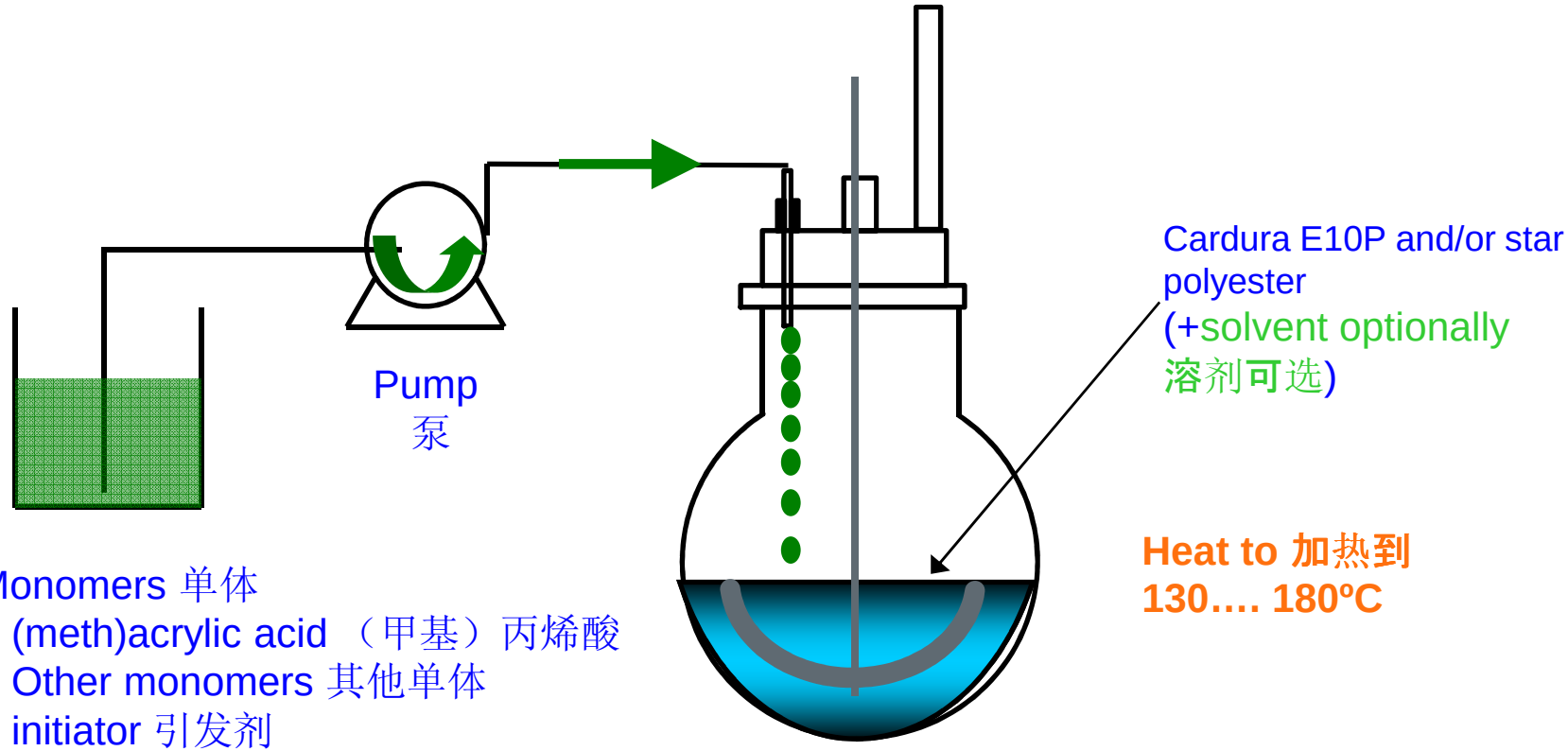
&

Esterification 酯化反应

Initiator — STY — (M)AA — HEMA — MMA —



CE10P Based APO For Waterborne Clearcoats
基于CE10P的丙烯酸多元醇用于水性清漆

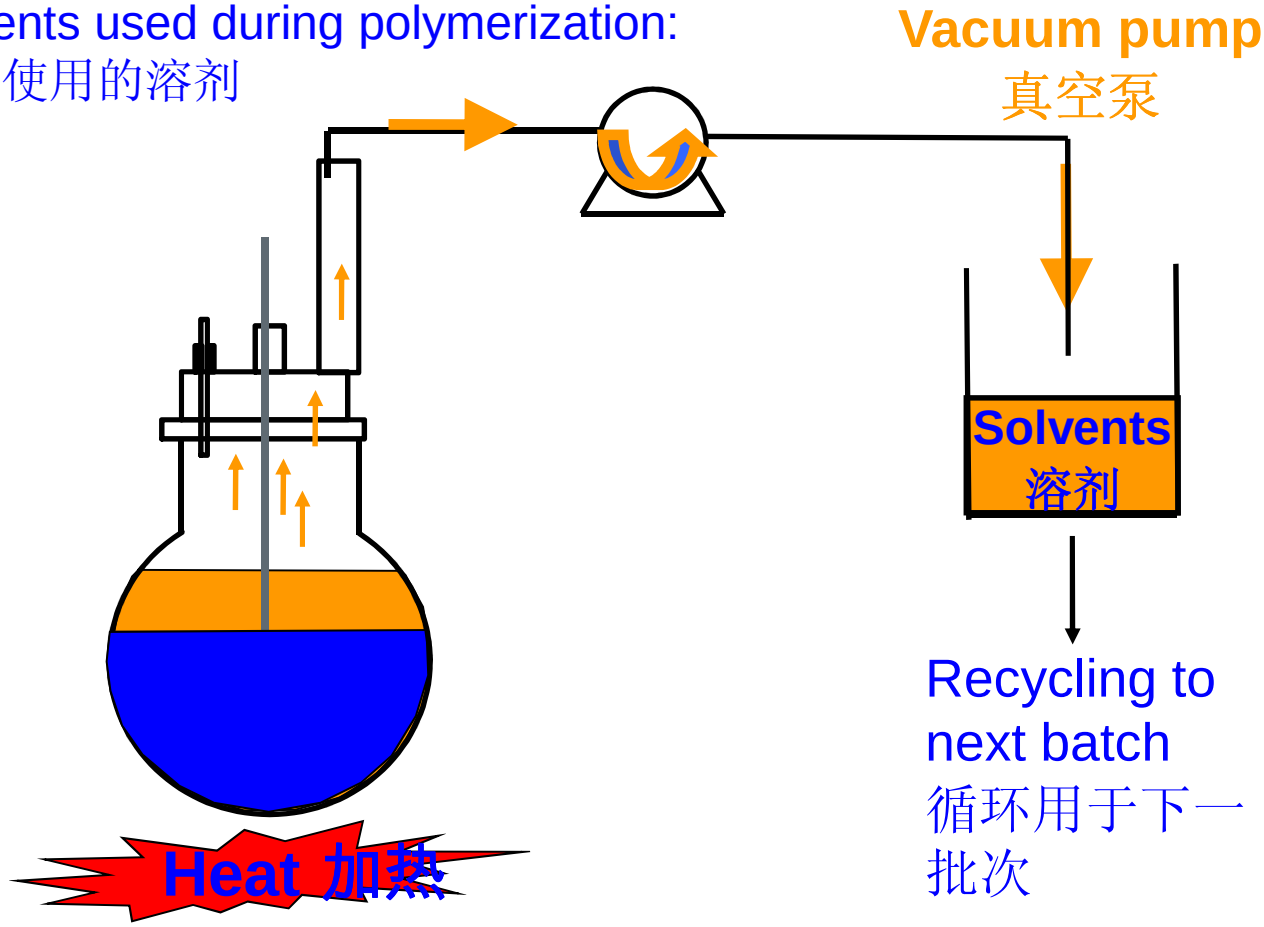


➢ No need to remove (strip) the excess solvents

无需除去过量的溶剂

APO For Waterborne Clearcoats – free Of CE10P
不含CE10P的丙烯酸多元醇用于水性清漆

Removal of the solvents used during polymerization:
需要除去聚合过程中使用的溶剂

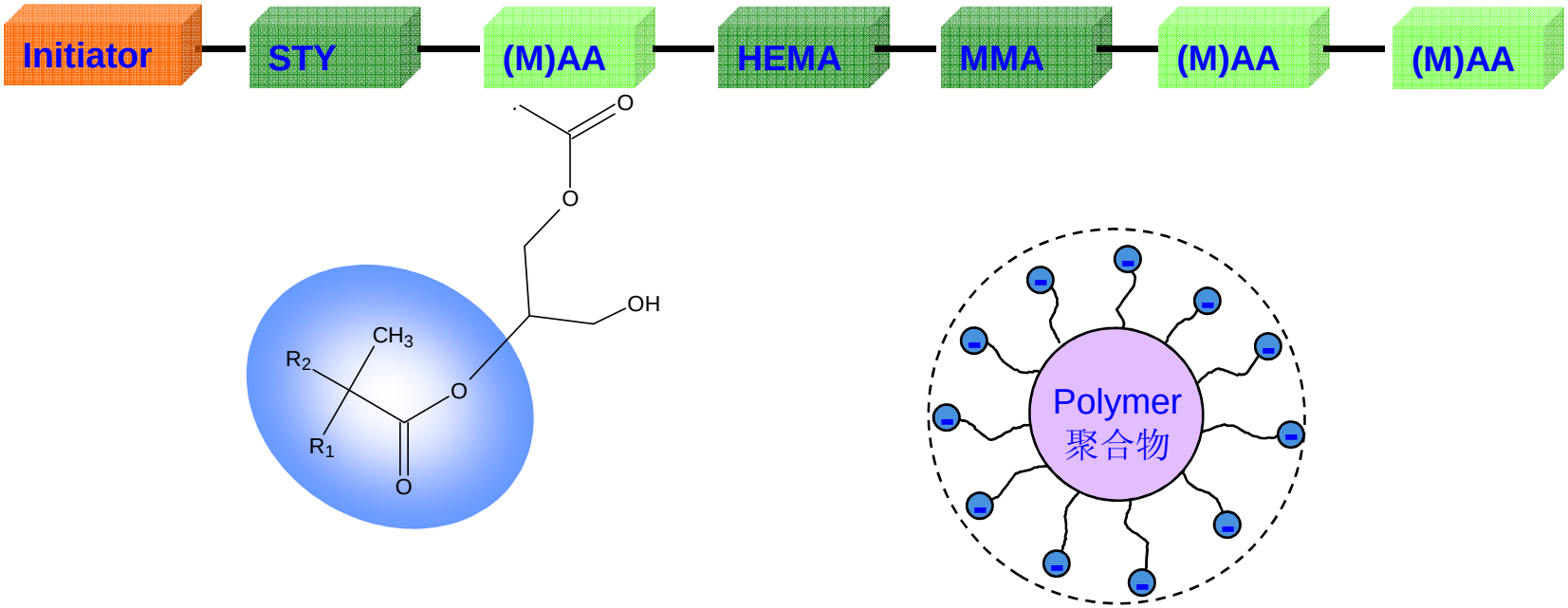


☹ Time and energy consuming 消耗时间和能源
☹ Side reactions during solvent removal 除去溶剂时的副反应

Key Design Of CE10P Based Waterborne Acrylic Resin
基于CE10P水性丙烯酸树脂的关键设计要点

➢ The distribution of the acid groups may be random, but better results are obtained by introducing poly-acrylic acid blocks.

丙烯酸在聚合物中的分布也许是随机的，但是如果这些丙烯酸在聚合物中是封端排布的话，效果会更好。



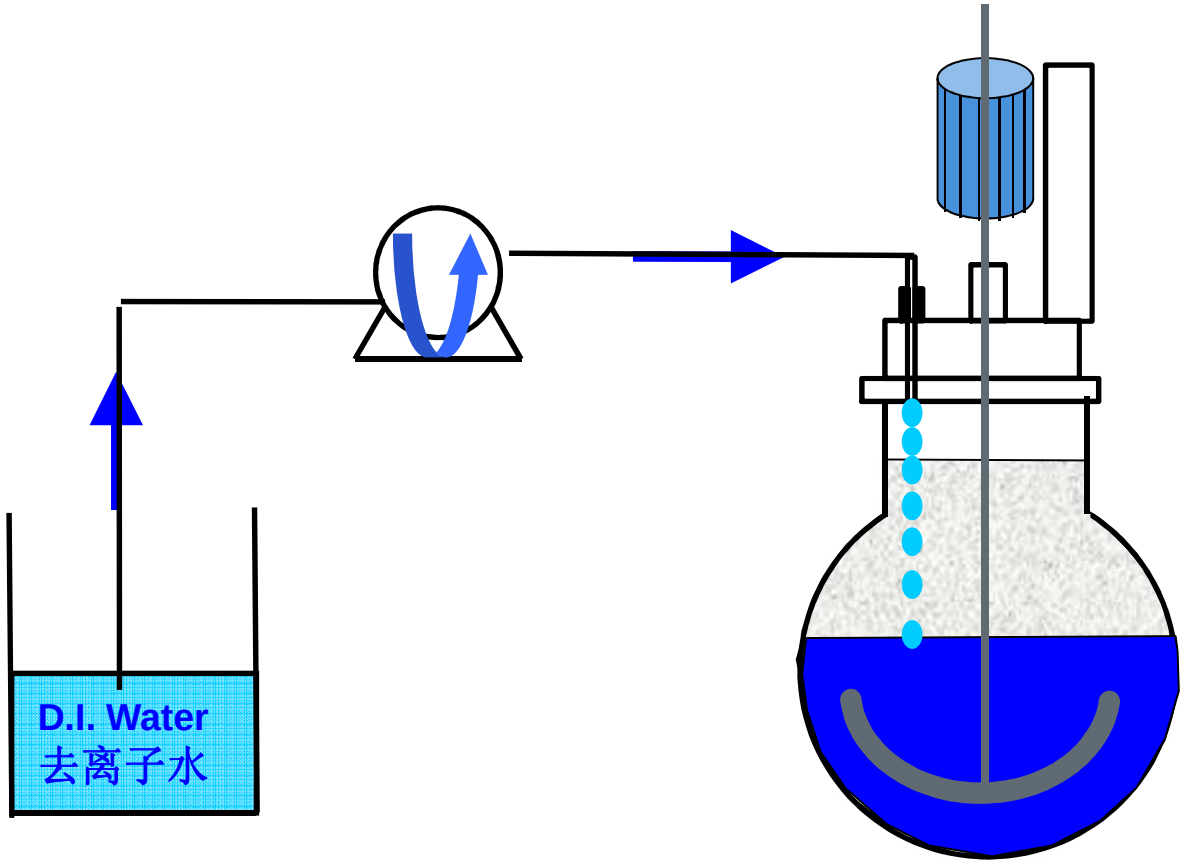
Formulation Of CE10P Based Waterborne Acrylic Resin
基于Cardura E10P的水性丙烯酸树脂的制备

Ingredients/process 组份/工艺	Weight, g 重量，克
Solvent-borne acrylic resin 溶剂型丙烯酸树脂	496.7
Di-methyl ethanolamine 二甲基乙醇胺	19.5
First water addition 第一次加水量	273.2
Second water addition 第二次加水量	74.5
Third water addition 第三次加水量	136.1
Total 总量	1000.0

Preparation Procedure For Aqueous Dispersions
丙烯酸树脂的水性化制备工艺

- Heat solvent-borne acrylic resin to 70℃
加热溶剂型丙烯酸树脂至70℃

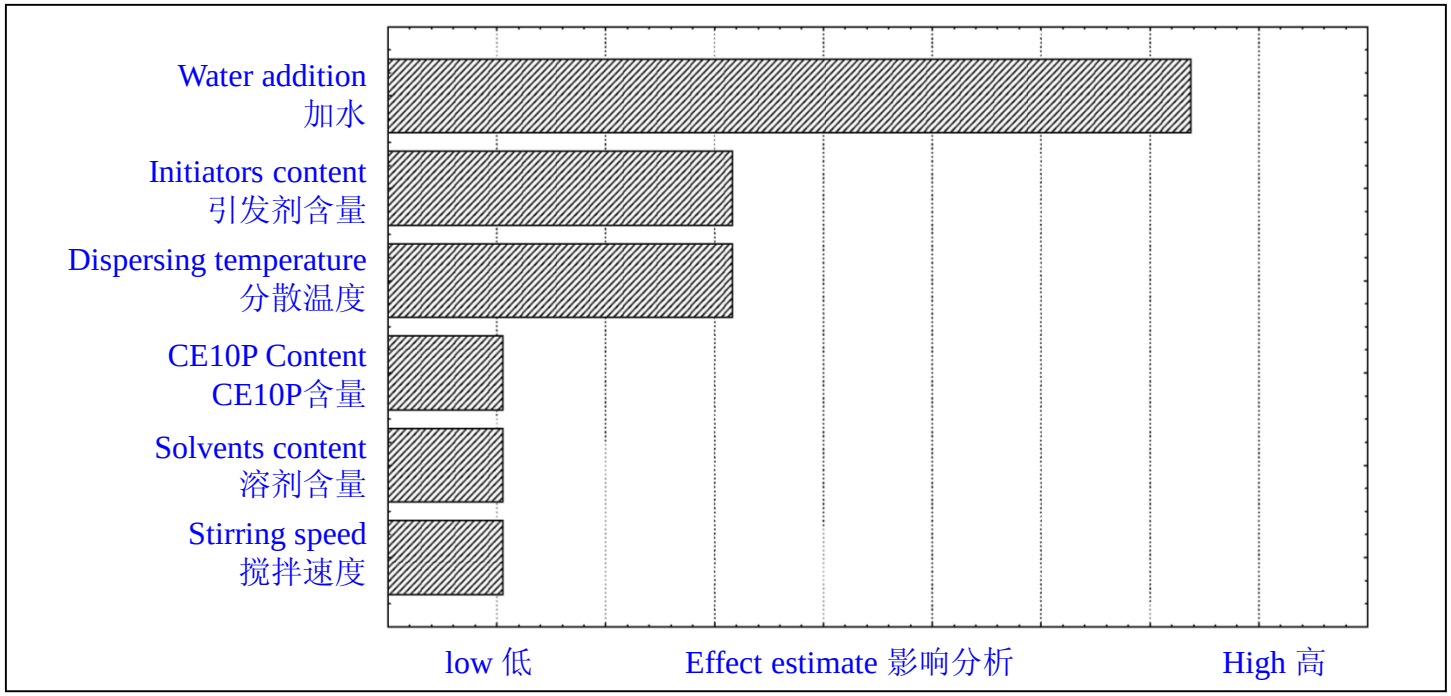
- Add DMEA to the resin solution at 70℃ to neutralise about 80% of the acid groups, and stir well for 15 minutes.
在70 °C，滴加二甲基乙醇胺中和80%的羧基基团，并搅拌15分钟左右；



The Major Factors To Particle Size And Stability Of WB Acrylic
水性丙烯酸分散体稳定性的影响因素

- Average particle size，which is related primarily to the addition rate of water to the neutralised resin. It is therefore recommended that sufficient time is allowed for the dispersion process;

平均粒径：在完全转水前，加水到被中和聚合物的速率对粒径是非常关键的，我们推荐使用足够的时间进行分散。



Formulation Of Cardura E10P Waterborne Acrylic Coating
基于Cardura E10P的水性丙烯酸涂料的制备

Ingredients 组份	**Weights, g 重量，克**
Acrylic dispersion 丙烯酸分散体	100
Melamine resin 氨基树脂 (Cymel 303)*	19.3
Acid catalyst (1%) 酸催化剂	1.3
Additives 助剂	1.0
D. I. Water去离子水	7.0
Total 总计	128.6

* 氰特工业公司的氨基树脂

Application And Cure Conditions Of Water-borne Coatings
水性涂料的应用及固化条件

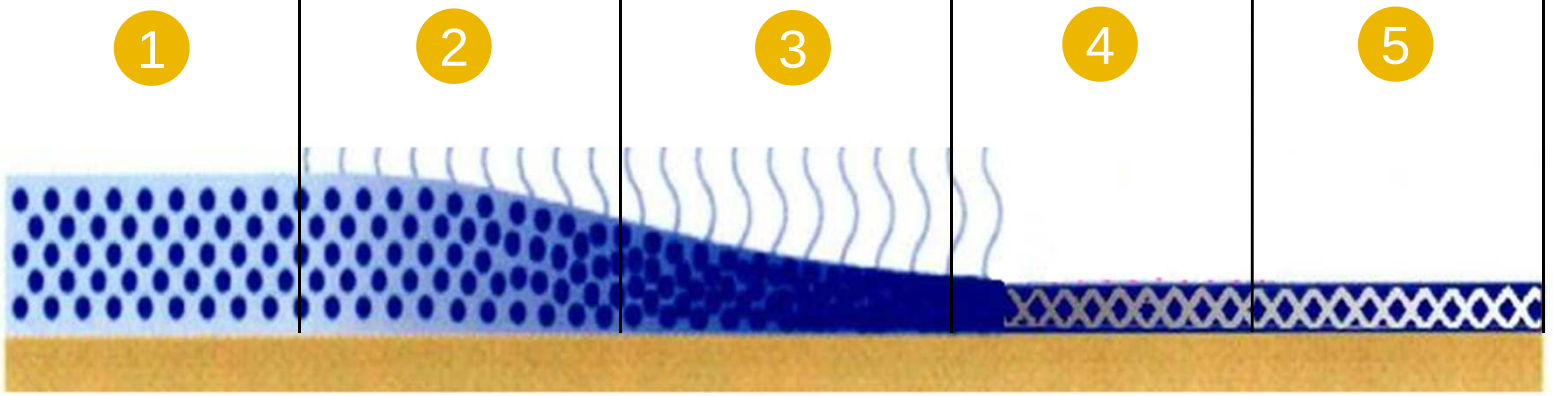
● Spray it to produce a dry film thickness of about 40 microns.
➢ 喷涂，漆膜大致40μm;

● Panels are left to dry 15 min at room temperature.
➢ 样板在室温下放置15分钟;

● A flash-off of 5 minutes at 70 ℃ is applied.
➢ 70 °C 下预烤（流平 ）15分钟;

● The panel is baked for 30 minutes at 140℃.
➢ 样板在140 °C下烘烤30分钟;

● Cured systems are tested after 1 day at 23 ℃.
➢ 烘烤后样板放置一天后测试。



Poroperties Of The Film Of WB Acrylic Coating
水性丙烯酸清漆的漆膜性能

Test items 测试项目	Unit 单位	Results 结果
Film thickness 膜厚	μm，微米	30~40
Gloss 光泽 (20/60°)	%	91/94
Pendulum hardness 摆杆硬度	s，秒	203
Pencil hardness 铅笔硬度		2H
BA resistance 耐醋酸丁酯		OK
Xylene resistance 耐二甲苯		OK
Petrol resistance 耐汽油性		OK
MEK resistance（Double rub 来回）	Cycles 循环	>100
Fingernail scratch resistance 耐指甲划伤		OK

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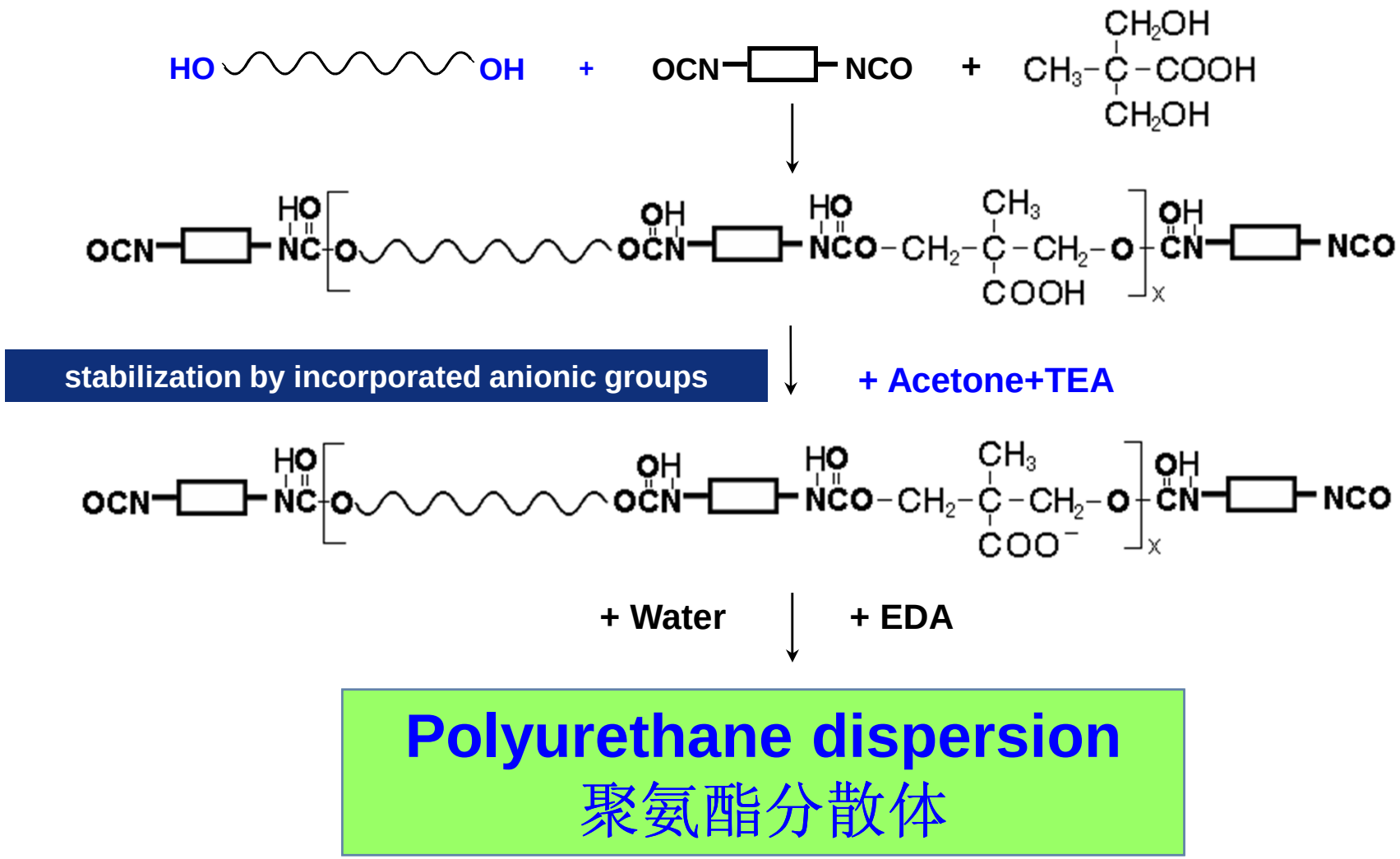
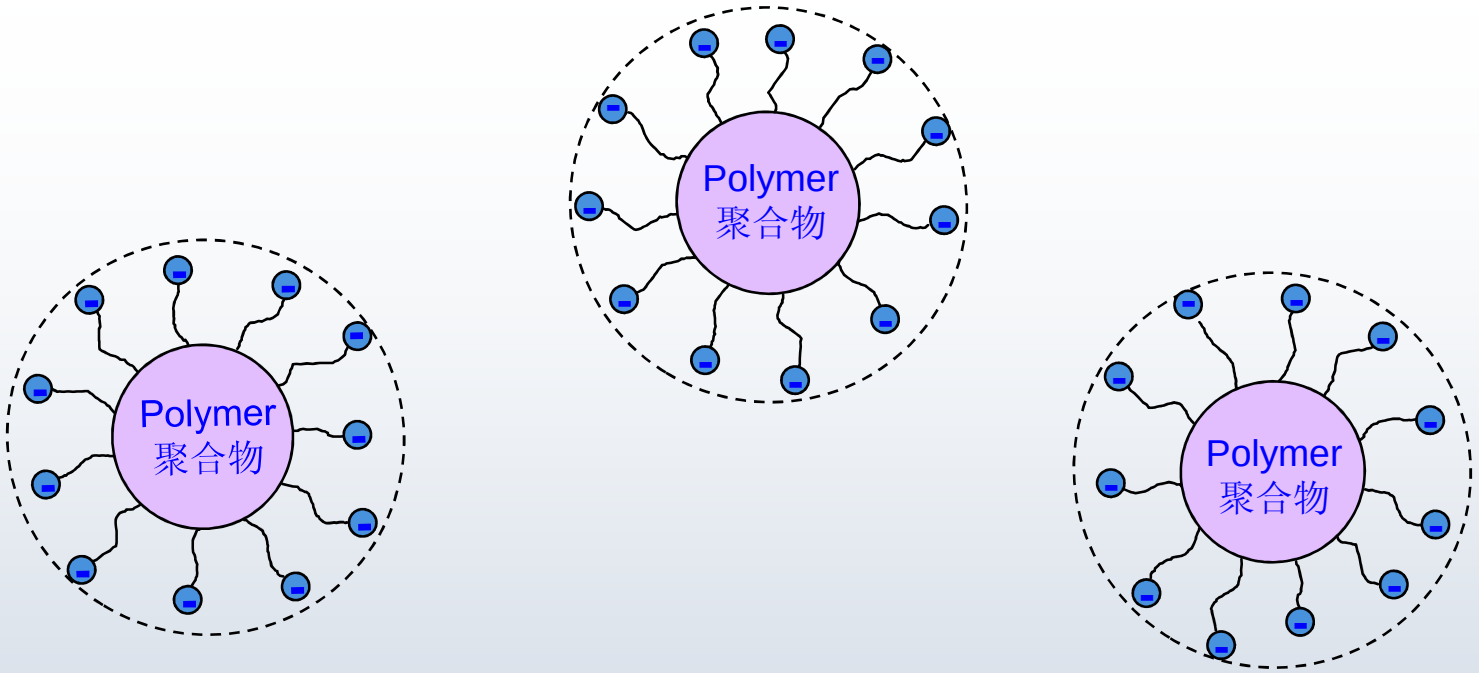
The Synthesis Process Of PUD---(DMPA)
PUD的合成工艺 ---（二羟甲基丙酸）



Polyurethane dispersion

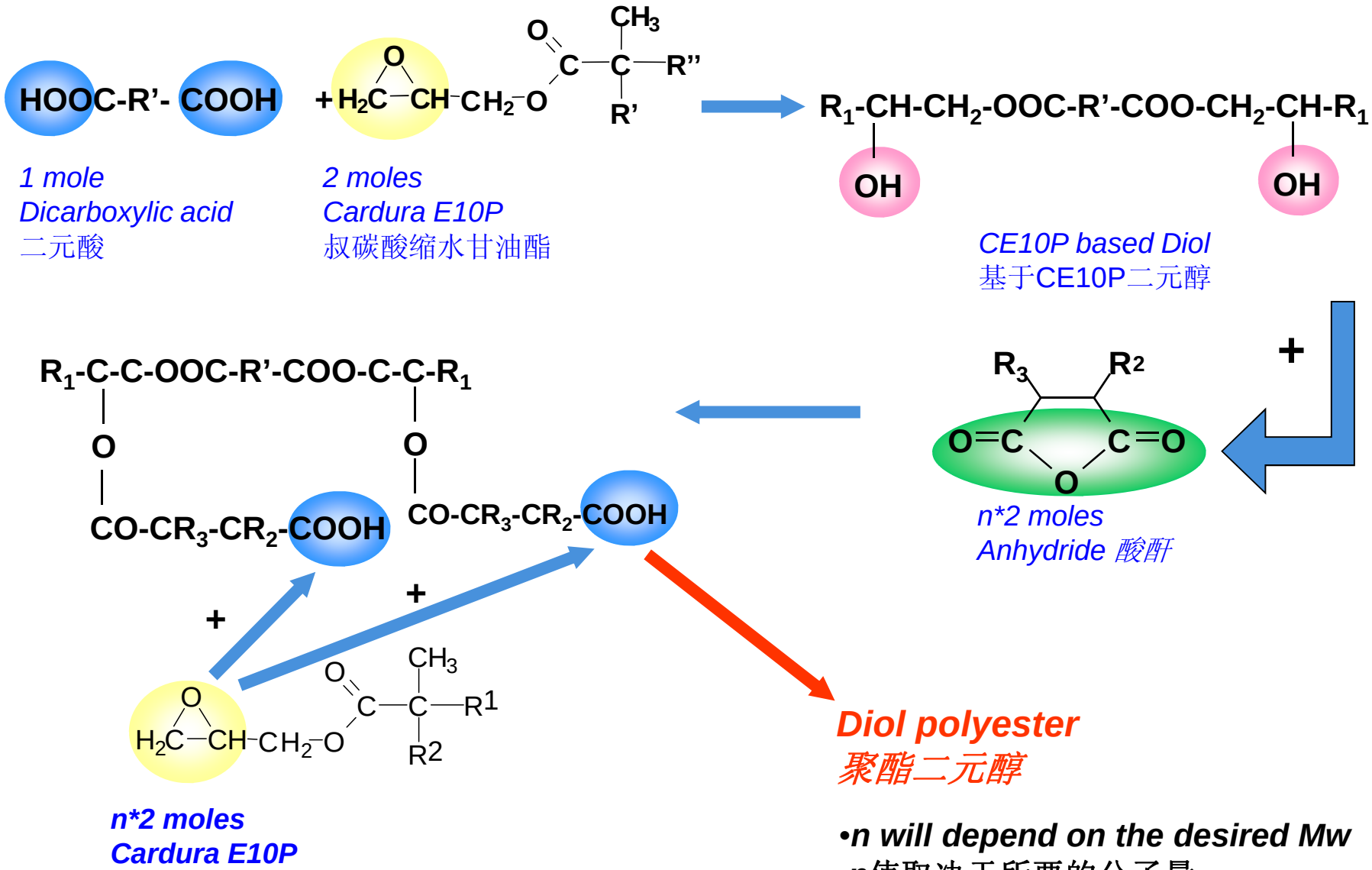
聚氨酯分散体

Principle Of The Stability Of PUD
PUD的稳定性原理

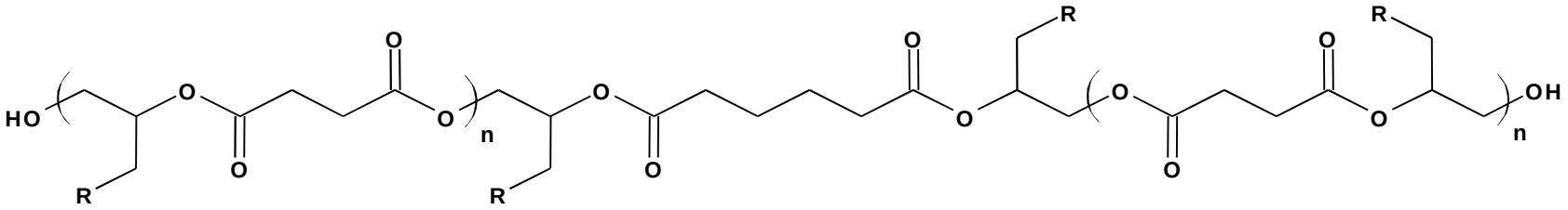


- Dispersed particles are surrounded by a stabilizing hydrophilic core
  分散的聚合物粒子由稳定的亲水基团包覆
- Hydrophilic core is composed of anionic groups in the polymer
  亲水核是由在聚合物上的阴离子组成

The Preparation Of The CE10P Based Diol
基于CE10P二元醇的制备



The Structure Of The Diol
二元醇的结构



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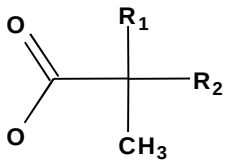


Potential added values of CE10P based diol polyesters: 能够改善

- Step process 反应过程
  - → narrow molecular weight distribution 分子量分布
  - → polymer with low viscosity 聚合物粘度低
  - → Ideal balance between viscosity and mechanical properties
    对机械性能与粘度的良好平衡
- Can modulate molecular weight via the n factor 通过调节n值来控制分子量
- Hydroxy function at both ends of the chain 端羟基
- Hydrophobicity 增水性
  - → Improved chemical and water resistance 改善耐水、耐化学品
  - → Helps wetting of apolar substrates 帮助润湿非极性底材

Two Cases
例子

HO- CE - Adipic acid – CE - OH

HO- CE – 己二酸 – CE - OH

Typical properties 典型性能	
OH (%)	5.4
Mn (g/mol)	643
Mw (g/mol)	666
Mw / Mn	1.04
Solids content (%) 固含	100
Viscosity (mPa·s) 粘度	3000

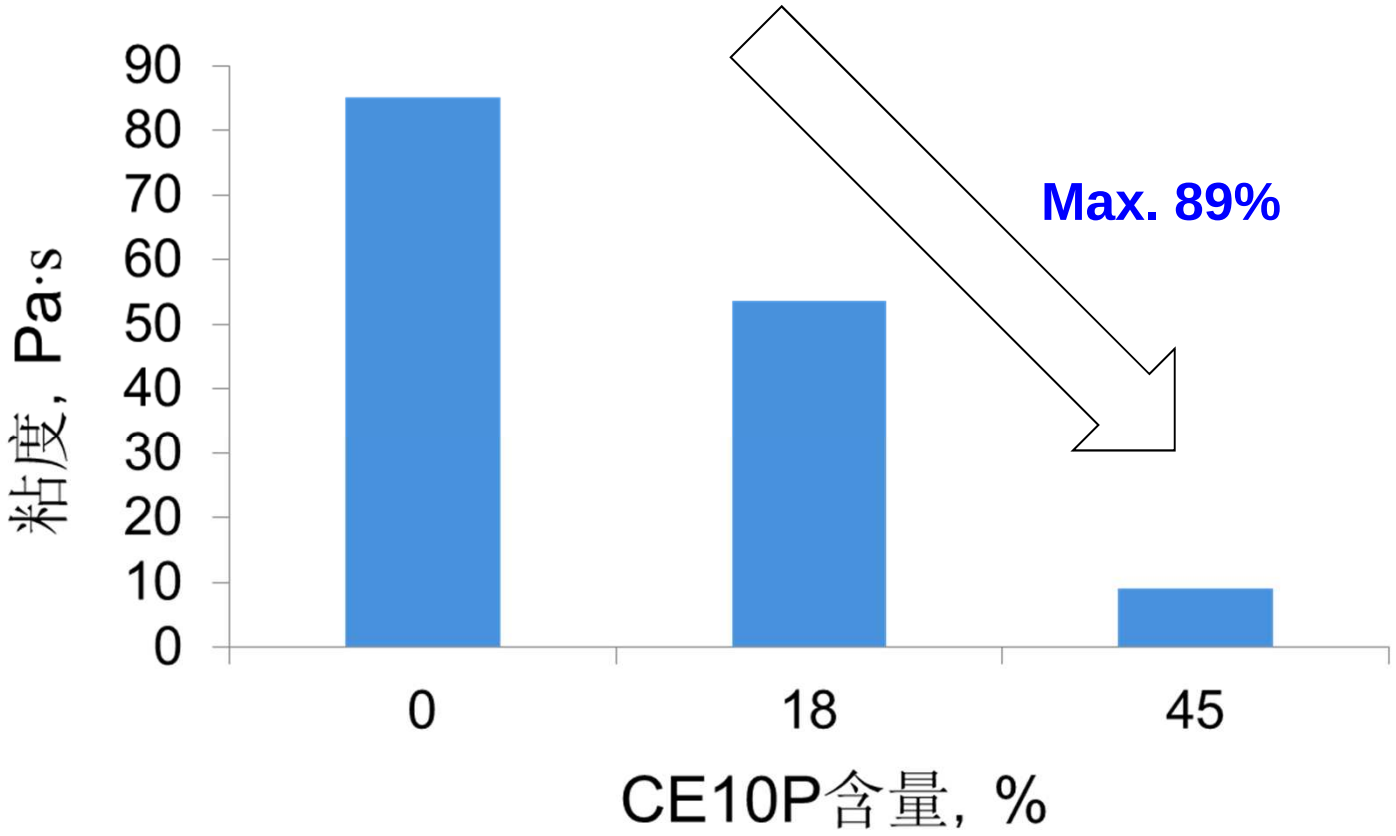
HO-(CE- succinic anhydride - CE - Adipic acid - CE - succinic anhydride- CE)$_n$-OH

HO-(CE- 琥 珀 酸 酐 - CE - 己二酸 -(CE - 琥 珀 酸 酐 -CE)$_n$-OH

The Viscosity Comparison Of Prepolymer For PUD
用于PUD的预聚物粘度比较

Ingredients 组份	No.1	No.2	No.3
PBA 2000 聚已二酸丁二醇酯二醇	22.04	14.51	-
CEP10 based Diol 626	-	8.1	-
CE10P based Diol 2000	-	-	22.04
DMPA 二羟甲基丙烷	1.50	1.50	1.50
IPDI/HDI	9.35	9.35	9.35
Catalyst（1% in Acetone）催化剂	0.3	0.3	0.3
Co-solvent 共溶剂	4.26	4.26	4.26
Glycol 乙二醇	0.60	0.03	0.60
React them to the calculated value or about 3~4 hours NCO反应至理论值或反应大约3-4个小时			
Acetone 丙酮	4.18	4.18	4.18
Results 结果			
Viscosity, 粘度 mPa·s	85000	53600	9000

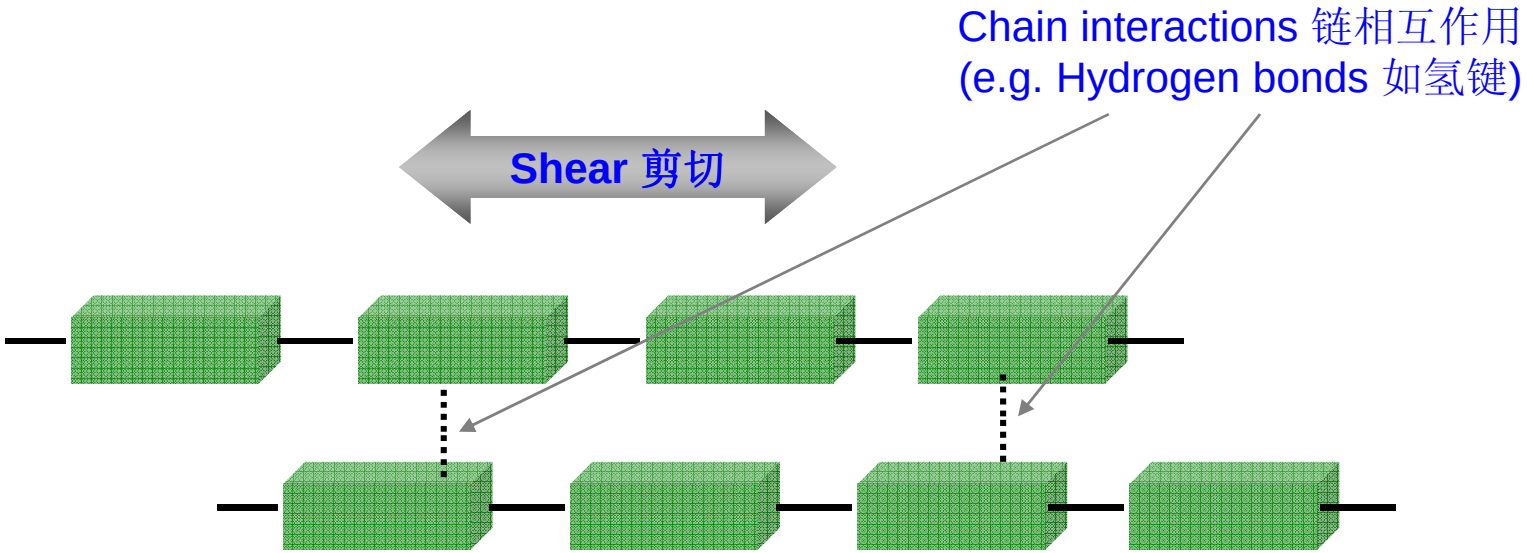
Viscosity Cutting Power Of The CE10P For Prepolymer
CE10P对预聚物的降粘力



Viscosity cutting power allows for prepolymer with lower VOC or bigger molecular weight

降粘力可以制备更低VOC或更大分子量的预聚物

A Standard Polymer Structure
常规的聚合物结构



- The polymer chains are more prone to interactions, i.e. hydrogen bonds, resulting in building up with an impact to the final resin viscosity

聚合物链更倾向于分子相互作用，如氢键，从而导致更高的树脂粘度

A Cardura E10P Based Polymer Structure
基于Cardura E10P的聚合物结构

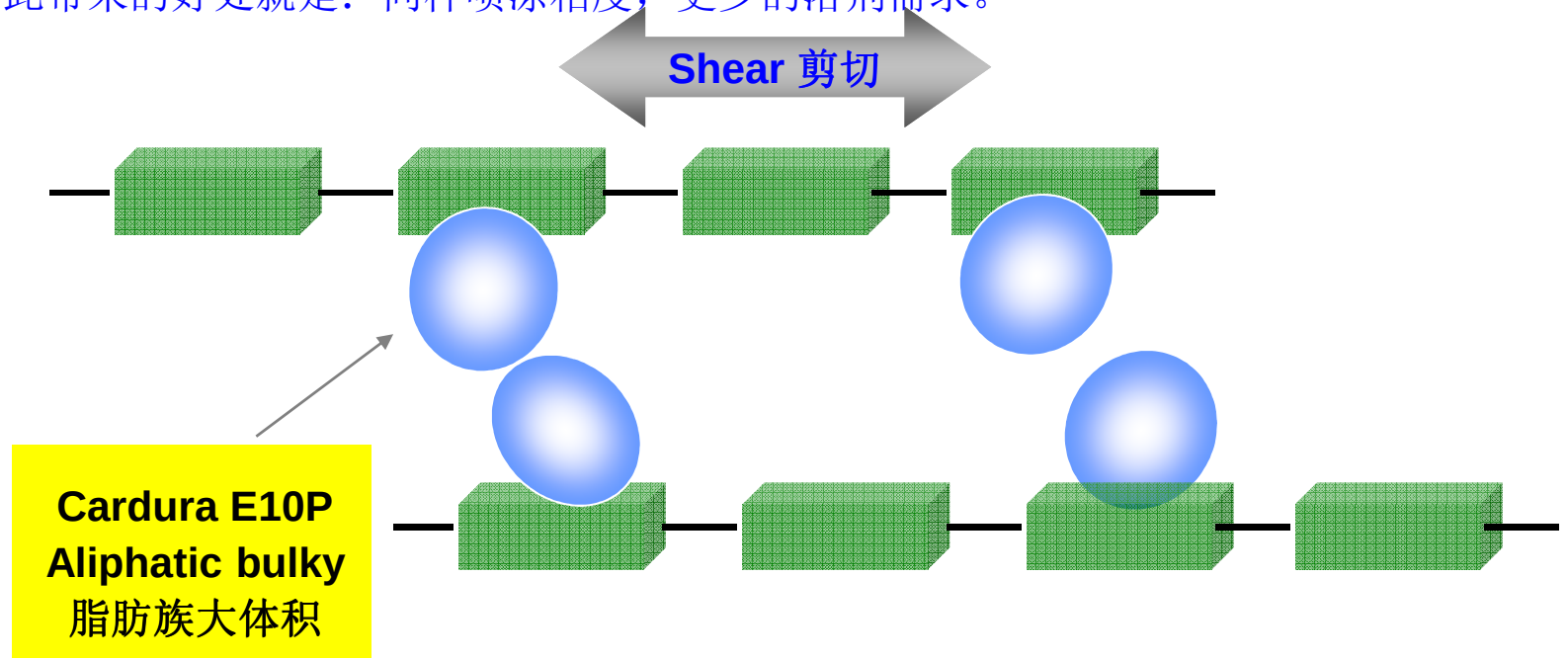
MOMENTIVE

- With Cardura E10P bulky group there is more space between polymer chains hence the hydrogen bonding is reduced;

归于Carudra E10P的大体积结构，分子链间作用力减少，尤其氢键；

- As a positive effect, less solvent is needed to reach the good spraying viscosity (lower VOC)。

由此带来的好处就是：同样喷涂粘度，更少的溶剂需求。



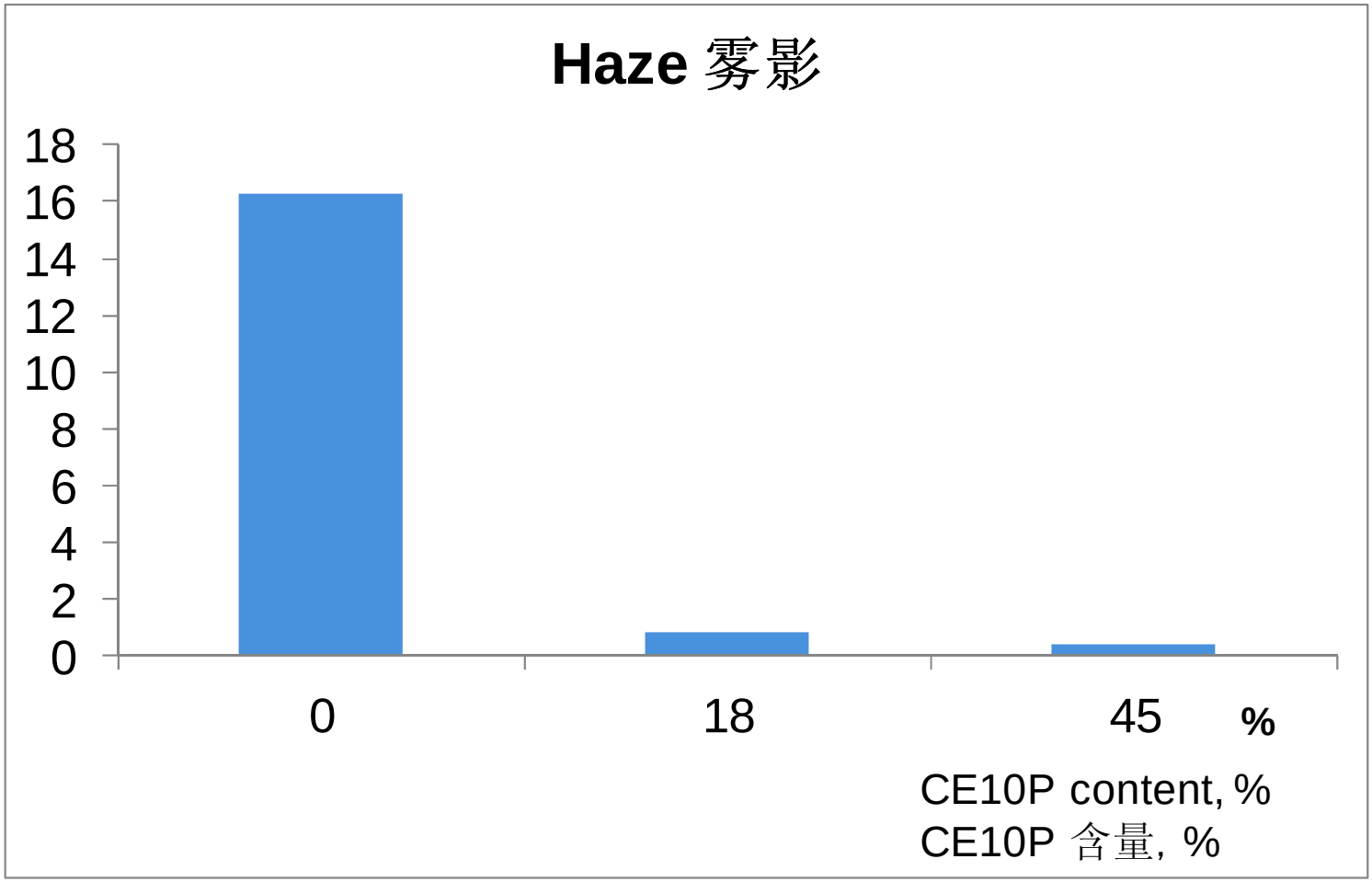
The low viscosity property allows for prepolymers with higher solids
低粘度特性可以制备更高固含的预聚物

The Properties Comparison Of The PUDs
聚氨酯分散体的应用性能对比

MOMENTIVE

		No.1 PBA 2000	**No.2** PBA 2000 + Diol 626	**No.3** Diol 2000	**Benchmark** 参考
Specular gloss 光泽	20°	30.5	81.0	81.5	81.0
	60°	65.9	87.0	86.8	87.0
Transparency 透过率		88	90	90	90
Haze 雾影		16.3	0.8	0.4	0.7
Clarity清晰度		98.4	99.3	99.6	99.0
Pendulum hardness, s 摆杆硬度，秒		40	38	-	40
Tensile strength, MPa 拉伸强度		40.0	32.5	-	25.3
Elongation at break, % 断裂伸长率		345	440	-	214

The Effect Of CE10P Content To Transmittance Haze Of The PUDs
CE10P含量对聚氨酯膜的透射雾影的影响



Agenda 议程

- Introduction 引言
- Synthesis and application of Cardura E10P based water-borne acrylic resin
  基于Cardura E10P水性丙烯酸树脂的合成和应用
- Application and application of Cardura E10P based PUD
  基于Cardura E10P聚氨酯分散体的合成和应用
- Conclusion 结语

Conclusions
结论

- ✓ CE10P can be conveniently synthesized to water-borne resins with excellent performance by introducing preparation conditions and process;

详细介绍了水性树脂的设计和制备工艺，CE10P能够更加便利的用于水性树脂分散体中，且性能优异;

- ✓ CE10P based polymer has lower viscosity, which is helpful to convert the phase of the solution and reduce VOC;

基于CE10P的聚合物具有更低的粘度，有利于转相，降低VOC;

- ✓ Water-borne coatings based on CE10P gives the film with a good gloss level, low haze, etc.

基于CE10P的水性涂料给予漆膜非常好的外观和性能，如高光泽、低雾影等性能。

MOMENTIVE™

Thanks For Your Attention