



Science For A Better Life

高性能双组分聚氨酯清漆 High Performance 2 Component Polyurethane Clear Coats

Hiroshi Morita
Frank Zhang
May 16, 2012

议程 Agenda



- 拜耳材料科技之业务单元：涂料，粘合剂及特殊化学品
Bayer MaterialScience, Business Unit : Coatings, Adhesives, Specialties
- 高性能聚氨酯清漆概念
Concepts for High Performance Polyurethane Clear Coats
- 汽车原厂漆清漆市场现状
OEM Clear Coats Market Situation
- 汽车原厂漆清漆技术对比
OEM Clear Coats Benchmark Study
- 先进的双组分混合技术
Advanced 2 Component Mixing technology
- 总结
Summary



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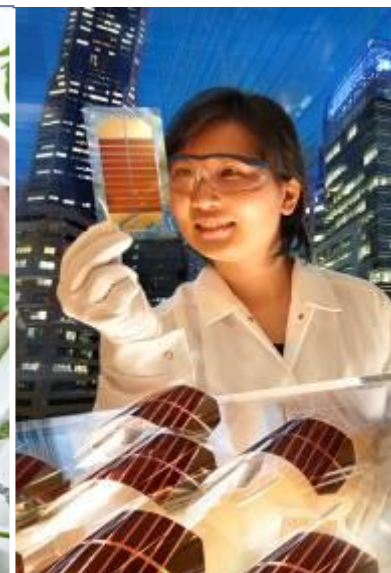
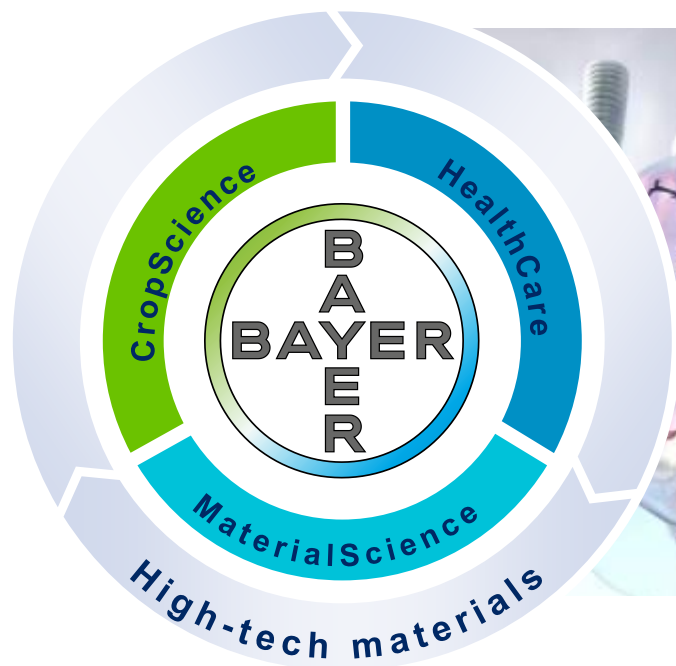


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拜耳公司概况 - 2011

Bayer's Profile – 2011



员工 **111,800 employees**
年销售额 **Full year sales: EUR 36.5 billion**
净收入 **Net Income: EUR 3.4 billion**
研发投入 **R&D expenditures: EUR 2.9 billion**

拜耳材料科技 Bayer MaterialScience: 2010在不同工业领域的销售 Sales in 2010 by customer industry



化学 工业
Chemical industry

7%



20%

汽车
Automotive

其它
Others

运动, 休闲, 鞋类, 包装,
医疗等
(sports, leisure, footwear
packaging, medical, etc.)

19%

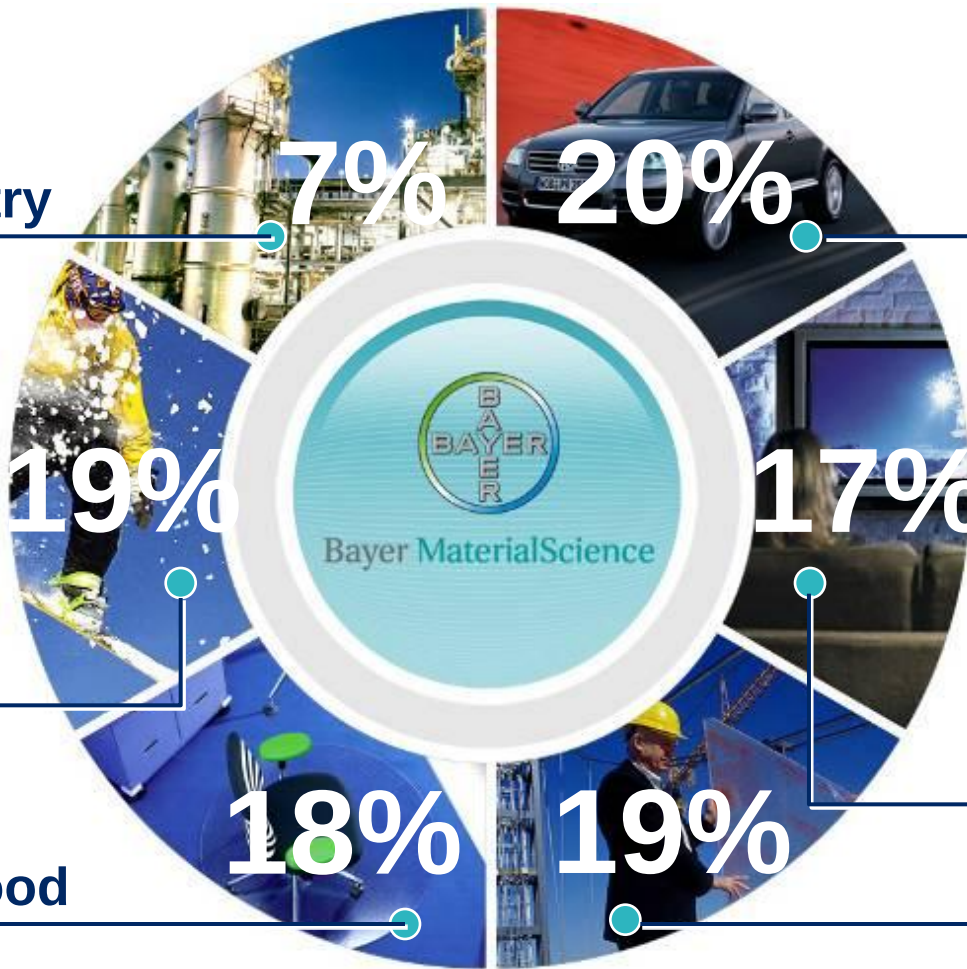
17%

电子/电气
Electrical /
Electronics
建筑
Construction

家具/木器
Furniture / Wood

18%

19%



拜耳材料科技 Bayer MaterialScience

Business Units 事业部



Polycarbonates

- Polycarbonate is a transparent, tough and heat resistant performance material
- Application in automotive (i.e. for weight reduction)
- Construction (i.e. integrated heat and light management)
- Electronics & IT
- CD/DVD/Blu-ray

Polyurethanes

- Polyurethane is a foam material
- Rigid foams : for insulation in construction, logistics and the cool chain
- Elastic foams : for comfort applications for furniture, car and other vehicle seats and mattresses
- Further applications include equipment housing or structural parts in automotive

Coatings, Adhesives, Specialties

- Input materials for coatings, adhesives, i.e.
 - VOC*-reduced
 - VOC-free
 - powder based
- Coatings for vehicles, industrial coatings, corrosion protection
- Adhesives for various applications
- Functional films and development businesses

* VOC = volatile organic compounds



涂料、粘合剂及特殊化学品

Coatings, Adhesives, Specialties (CAS):

产品应用领域 Customers' fields of application for CAS products



汽车/交通工具
Automotive /
Transportation

建筑
Construction

一般工业
General Industrial

塑料工业
Plastic Industrial

罐装、卷钢、玻璃
Can, Coil & Glass

防腐
Corrosion Protection

汽车修补
Automotive Refinish

木器/家具
Wood / Furniture



纺织/玻纤
Textile / Glass Fiber Sizing

鞋类
Footwear

消费品
Consumer

包装
Packaging

密封胶
Sealants

电子电气
IT/ Electrical /Electronics

医疗
Medical

化妆品
Cosmetics



涂料、粘合剂及特殊化学品事业单元

Coatings, Adhesives, Specialties (CAS) Business Unit



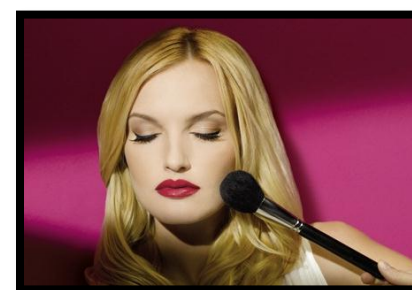
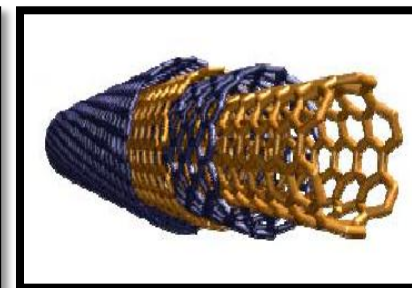
用于涂料和粘合剂的聚氨酯原材料
PU-based raw materials for the coatings and adhesives industry

产品线 **Product portfolio:**

- 脂肪族&芳香族聚异氰酸酯
Aliphatic & aromatic polyisocyanates
- 分散体 **Dispersions**
- 树脂 **Resins**

特殊化学品包括功能性膜、碳纳米管、医疗和化妆品

Specialties include Functional Films, Carbon Nanotubes and Medical & Cosmetics



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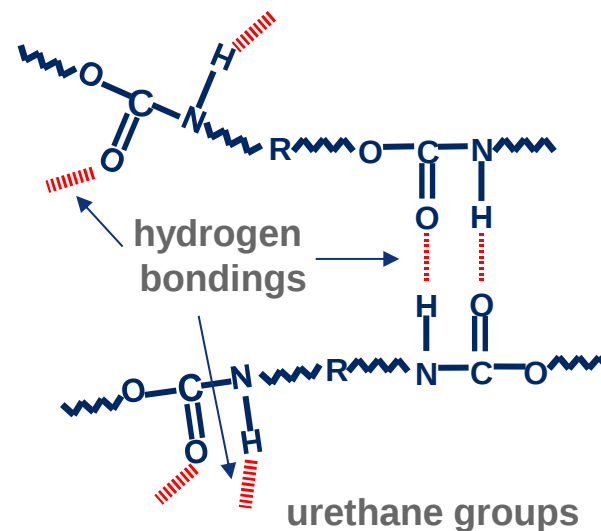
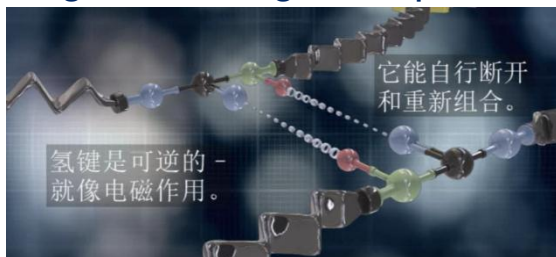


聚氨酯技术成功应用于涂料

Success of Polyurethane Technology for Coatings



- 高反应活性，即使在低温下也能完全交联固化
High reactivity and full crosslinking even at low temperature curing
- 耐化学性和耐候性
Chemical resistance and weather stability
- 硬度、韧性和弹性基于氨基甲酸酯和脲基结构
Hardness, toughness and elasticity due to urethane and urea structure
- 氢键分散外来能量
Hydrogen bondings dissipate external energy



具有长期的超强抗刮擦性和耐化学性的清漆

Ultra scratch and chemical resistant clear coat with long-term performance

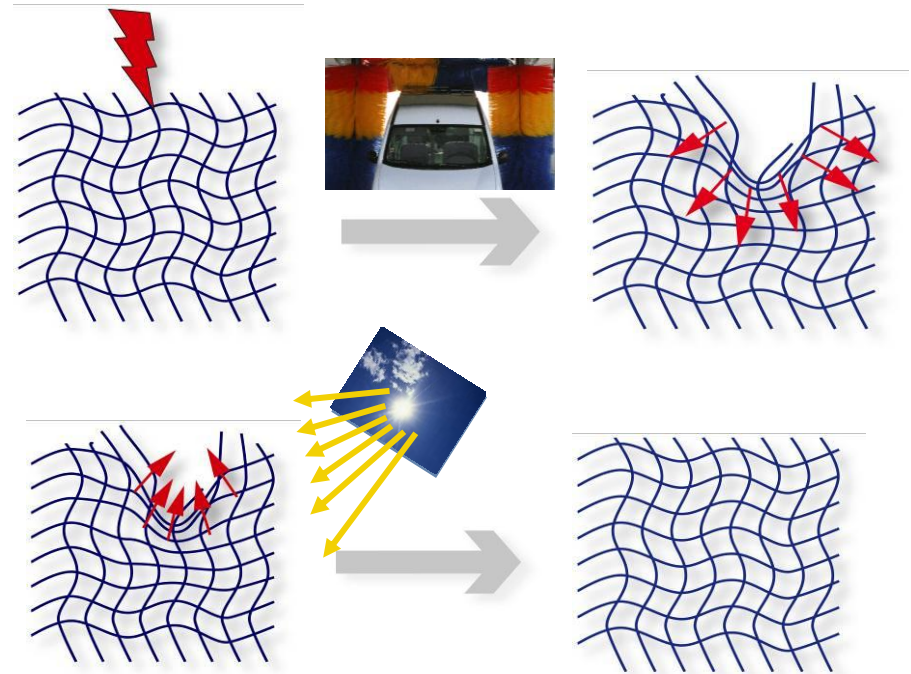
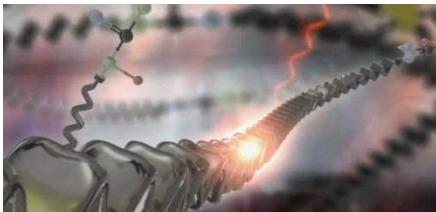


1. 自修复双组分聚氨酯清漆 Self Healing 2K-PU clear coat:

高交联密度及高密度的氨基甲酸酯基团（氢键）

High crosslink density & high content of urethan groups (H-bondings)

- 主要是具有自修复的塑性形变(形状记忆)
mainly plastic deformation
with self-healing (shape memory)
- 提高耐磨性及耐刮擦性
improved mar and scratch resistance
- 更好的耐化学性
better chemical resistance

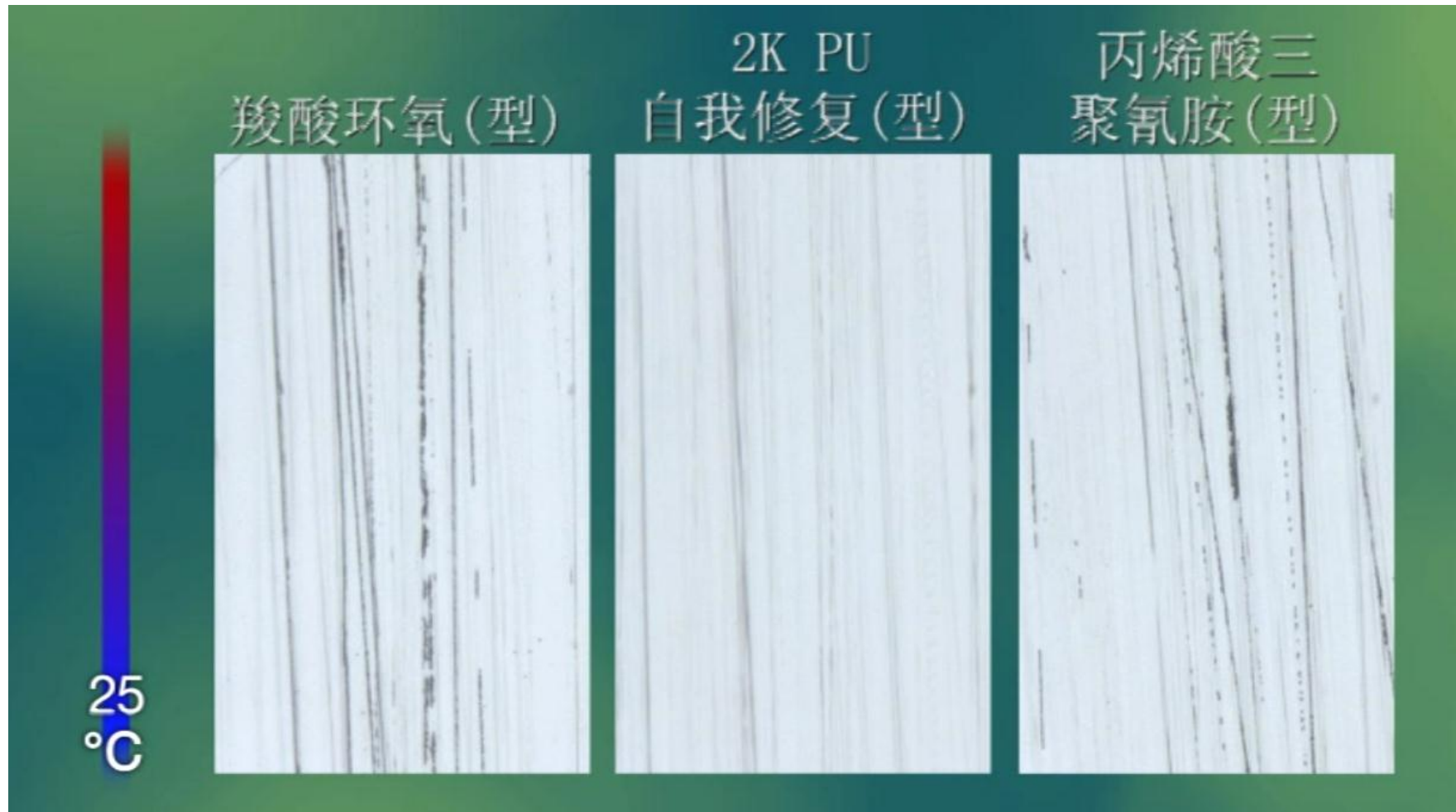


Detailed Description of Shape Memory on PU Coatings:

Fleck, Nowak, Meier-Westhues; ECJ 4.2009, page 106 and F&L 10.2008, page 23

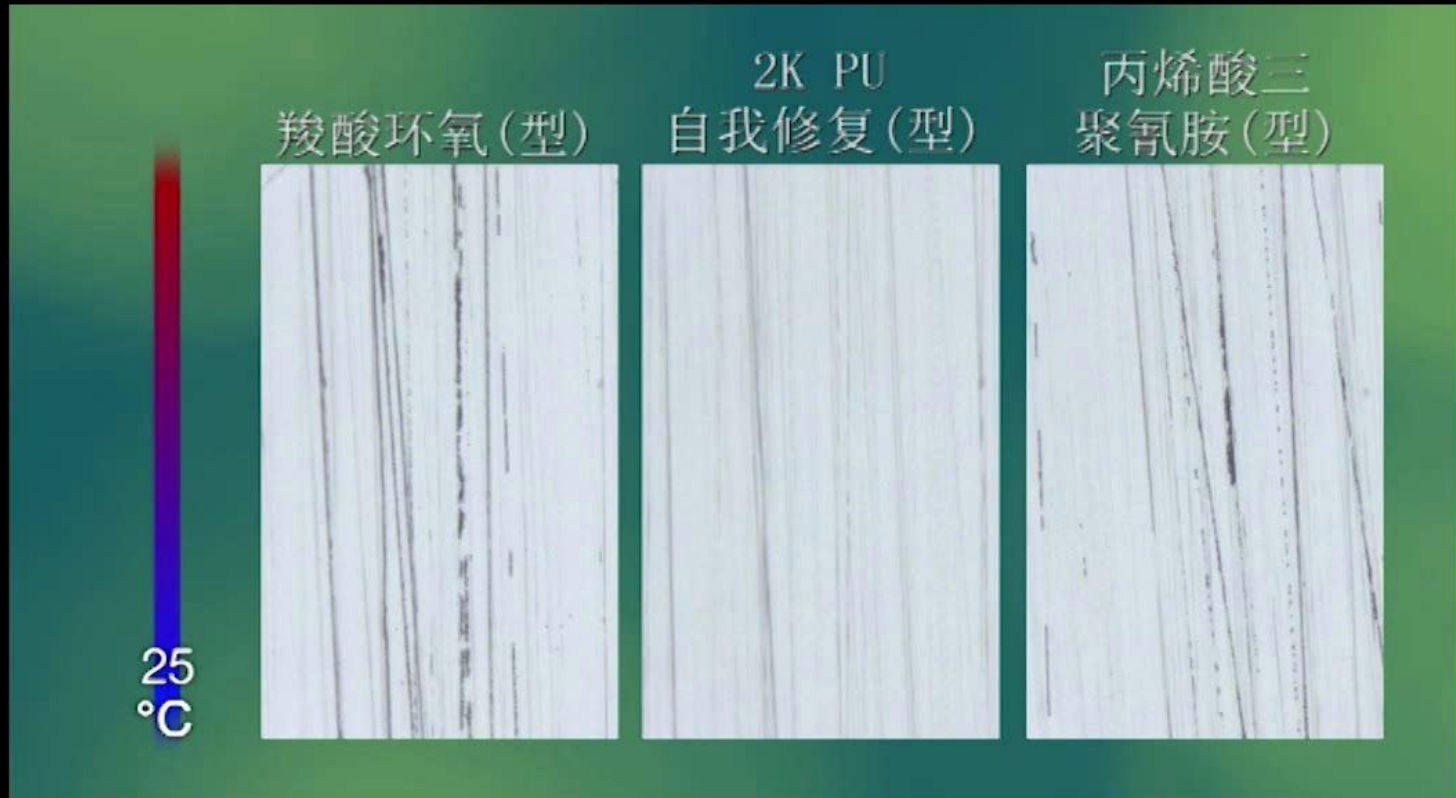
自修复的对比（钢丝绒）

Self-Healing in Comparison (Steel Wool) (10 min. video clip cut to 10 to 15 sec.)



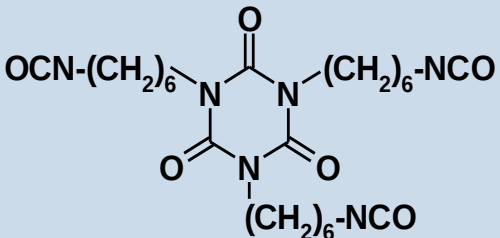
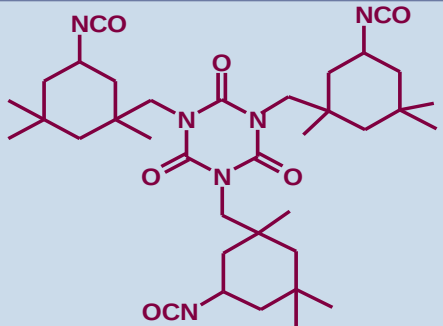
自修复的对比（钢丝绒）

Self-Healing in Comparison (Steel Wool) (10 min. video clip cut to 10 to 15 sec.)



用于双组分聚氨酯清漆的固化剂

Typical Hardeners for 2C Polyurethane Clear Coats

产品 Product	类型 Type	备注 Remarks
Desmodur N (标准 Standard)		- 标准型 Standard - F=3.5 (官能度)
Desmodur XP (高官能度 High functional)		- 自修复 For self sealing - F=4.5 (官能度)
Desmodur Z (高硬度 High hardness)		- 抗蚀 For etch resistance - 快干 For fast drying - F=3.3 (官能度)

使用不同固化剂的双组分聚氨酯的漆膜性能

Film performance of 2C Polyurethane Clear Coats with different hardeners



配方号 Formulation No.	1	2	3
固化剂 Hardener: Desmodur	N	XP	N/Z (2/1)
外观(雾影) Appearance (Haze)	16	13	12
摆杆硬度 Pendulum Hardness (Sec.)	150	165	180
耐化学性能(梯度烘箱) Chemical resistance [°C] (gradient oven)			
硫酸 sulphuric acid, 1%, 25µl	42	42	44
耐刮擦性能(洗车机测试) Scratch resistance (Car washer test)			
保光率 rel. gloss retention [%]	90	96	78
恢复后保光率 rel. gloss retention after reflow 2h 60°C [%]	95	98	91

羟基树脂 Polyol: 改性丙烯酸 modified Acrylic polyol

烘烤条件 Baking condition: 140°C, 30 min.

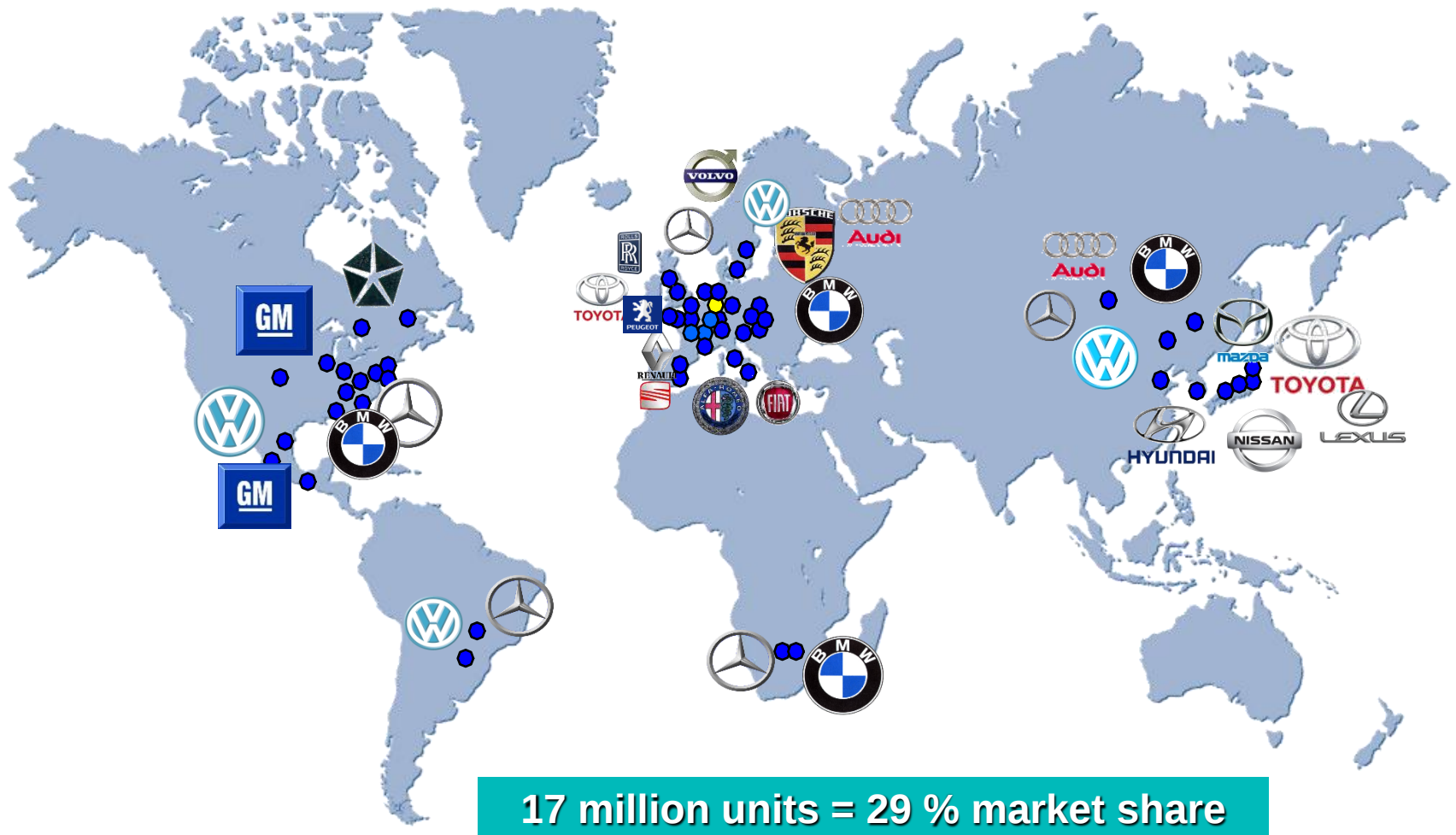
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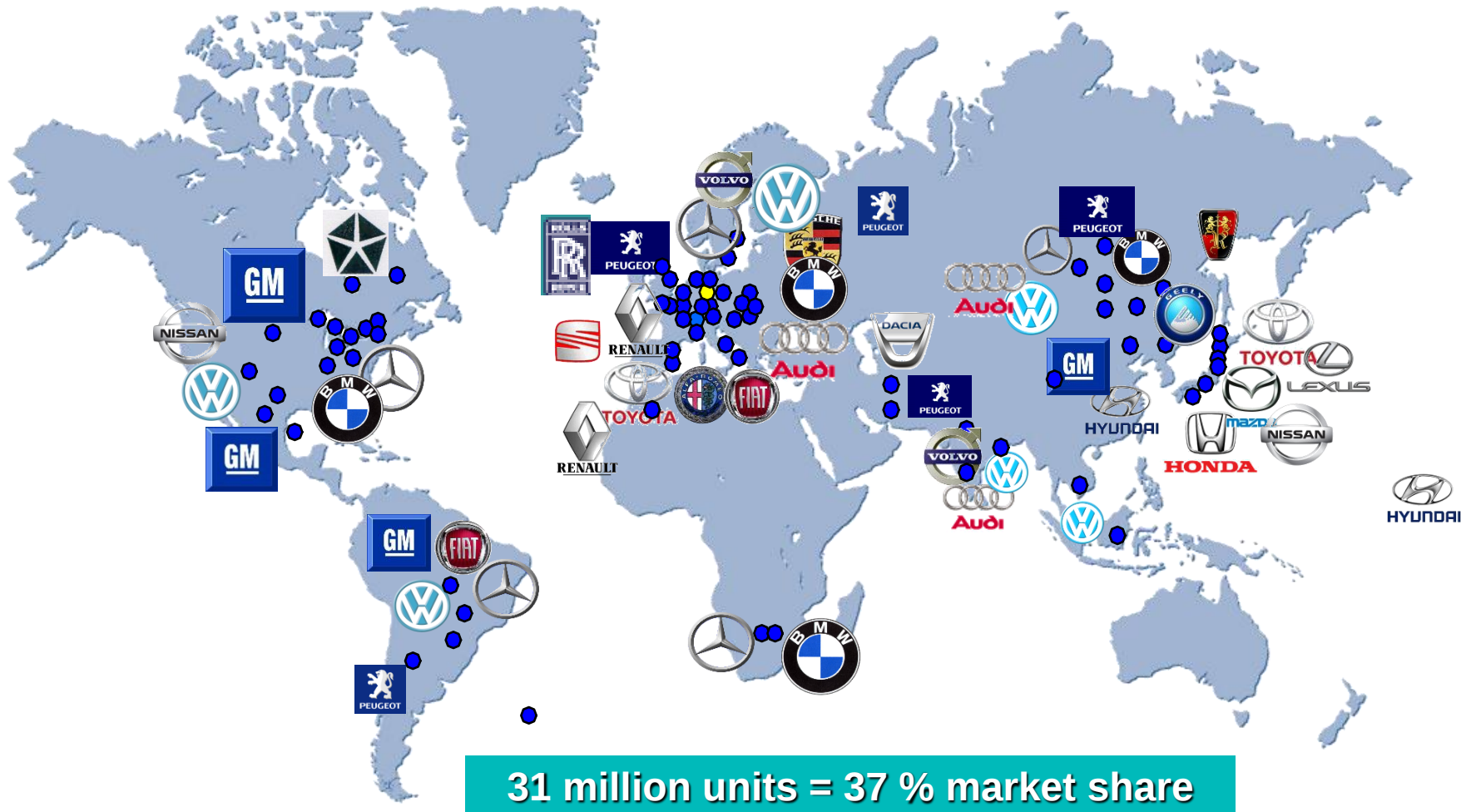
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2010: >1千7百万辆车涂有聚氨酯清漆
2010: > 17 Mio. Vehicles Coated with
Polyurethane Clear Coats



2015 预测：聚氨酯清漆技术继续扩张 Projection 2015: Further Expansion of Polyurethane Clear Coat Technology

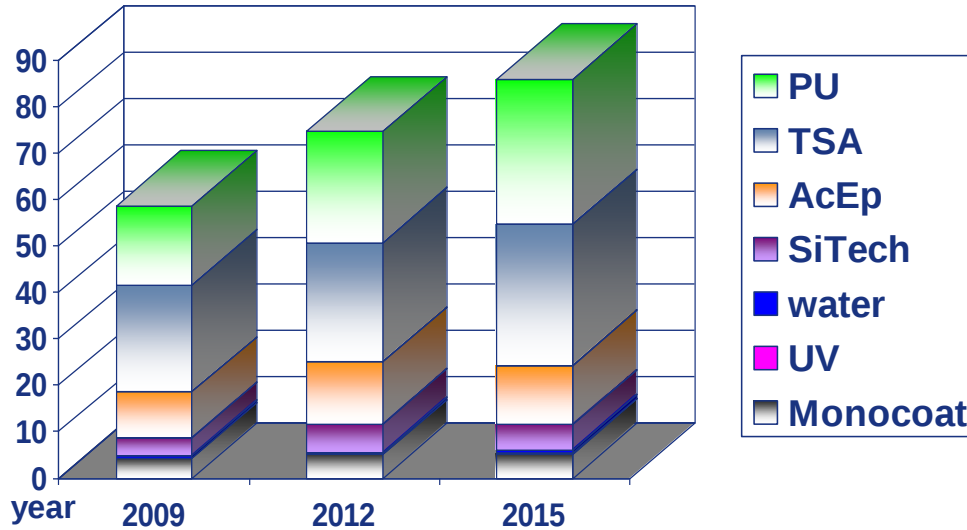


清漆技术 - 全球

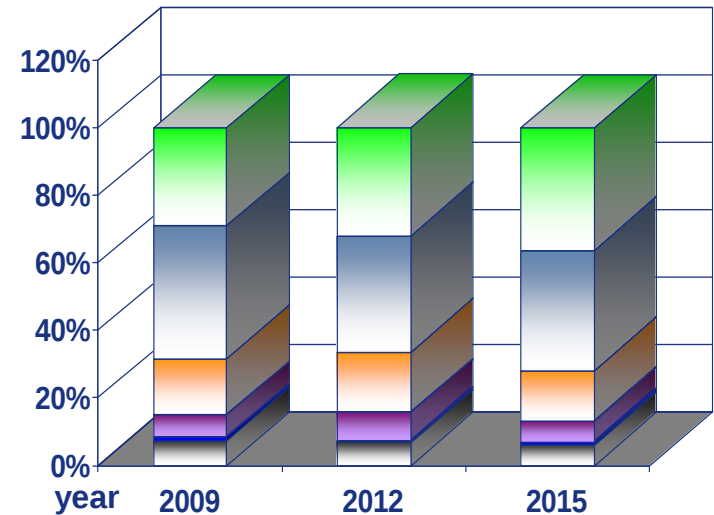
Clear Coat Technologies - Global



mio. cars

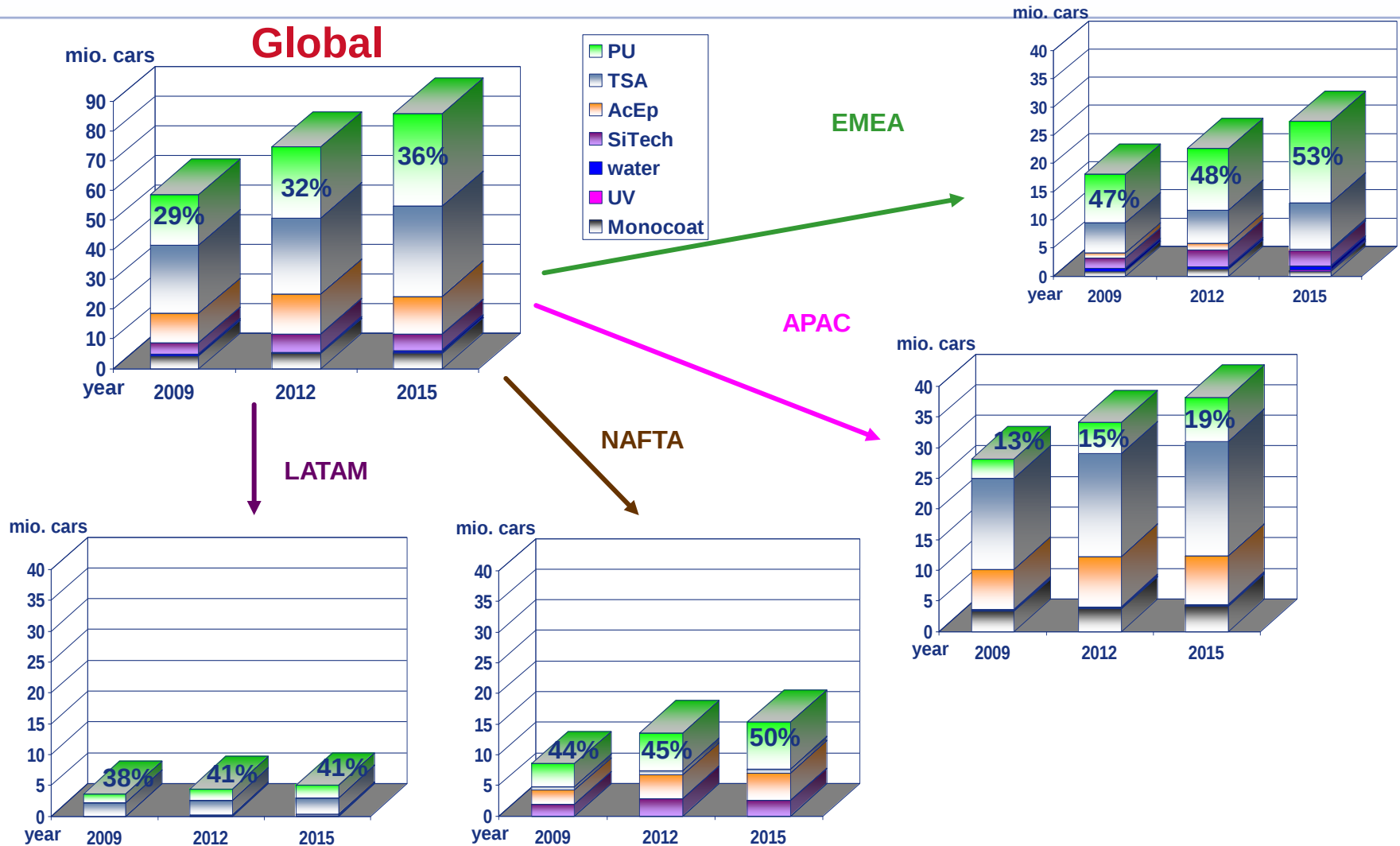


% of total



global	2009		2012		2015	
	mio cars	%	mio cars	%	mio cars	%
PU	17,0	29,0%	23,9	32,1%	31,3	36,4%
TSA	23,0	39,3%	25,8	34,5%	30,4	35,4%
AcEp	9,8	16,7%	13,3	17,8%	12,8	14,9%
SiTech	3,9	6,7%	6,2	8,3%	5,4	6,3%
water	0,6	1,0%	0,5	0,7%	0,8	0,9%
UV					0,2	0,2%
Monocoat	4,3	7,3%	5,0	6,7%	5,1	5,9%
total	58,4		74,6		85,9	

聚氨酯在全球的增长 Increase of Polyurethane in all Regions



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汽车原厂漆清漆技术对比：目前全球技术的回顾

OEM Clear Coats Benchmark Study

Global Technology Review of On-line Systems



➤ 36种清漆 36 Clear Coats

➤ 技术

Technologies:	2K-PU	12 x
	2K-PU nano	4 x
	TSA*)	2 x
	PU-mod. TSA	6 x
	Si-mod. TSA	3 x
	Acid Epoxy	4 x
	1K-Water	2 x
	2K-Water	3 x

*) 热固性丙烯酸 Thermosetting Acrylcs (Acrylat / Melamine)

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测试方法 Test methods:

➤ 湿刮擦 **Wet scratching:** Amtec (10 cycles)



Amtec after weathering (Ci5000)
耐老化后测试

% Residual gloss
% 剩余光泽

a) immediately
b) after reflow 2h 60 °C

100h / 250h / 500h / 1.000h

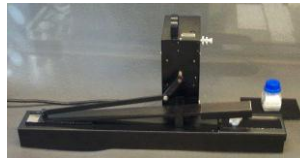
➤ 干刮擦 **Dry scratching:** Hammer test 锤子测试



% Residual gloss
% 剩余光泽

a) immediately
b) after reflow 2h 60 °C

Crockmeter



➤ 耐化学性能 **Chemical resistance:** Gradient oven (°C) 梯度烘箱



Evaluation after:
评估时间

1h / + 24h / + 2h 80°C

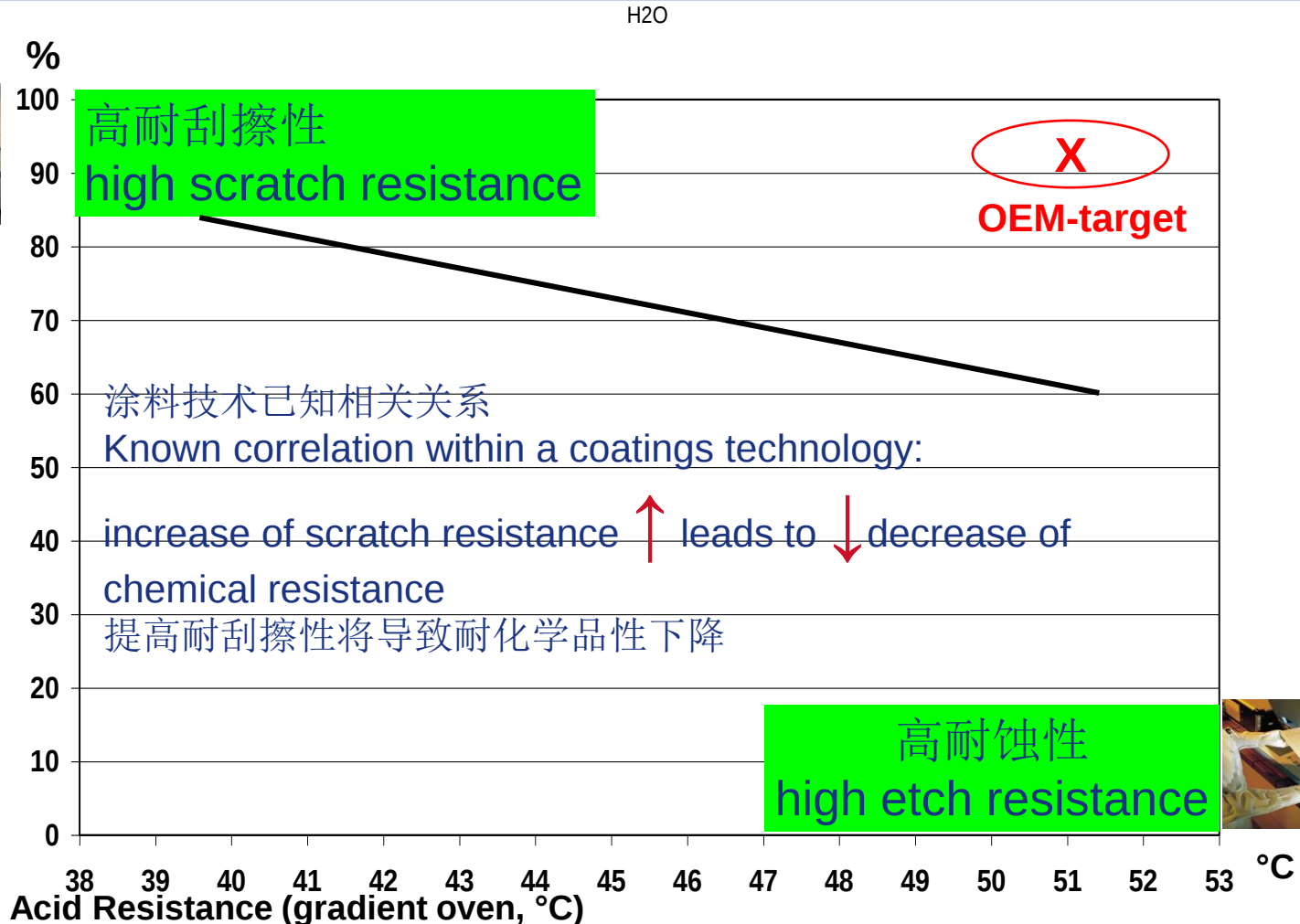
汽车原厂漆清漆技术对比：洗车测试及耐酸性

OEM Clear Coats Benchmark Study

Car Wash Test and Acid Resistance



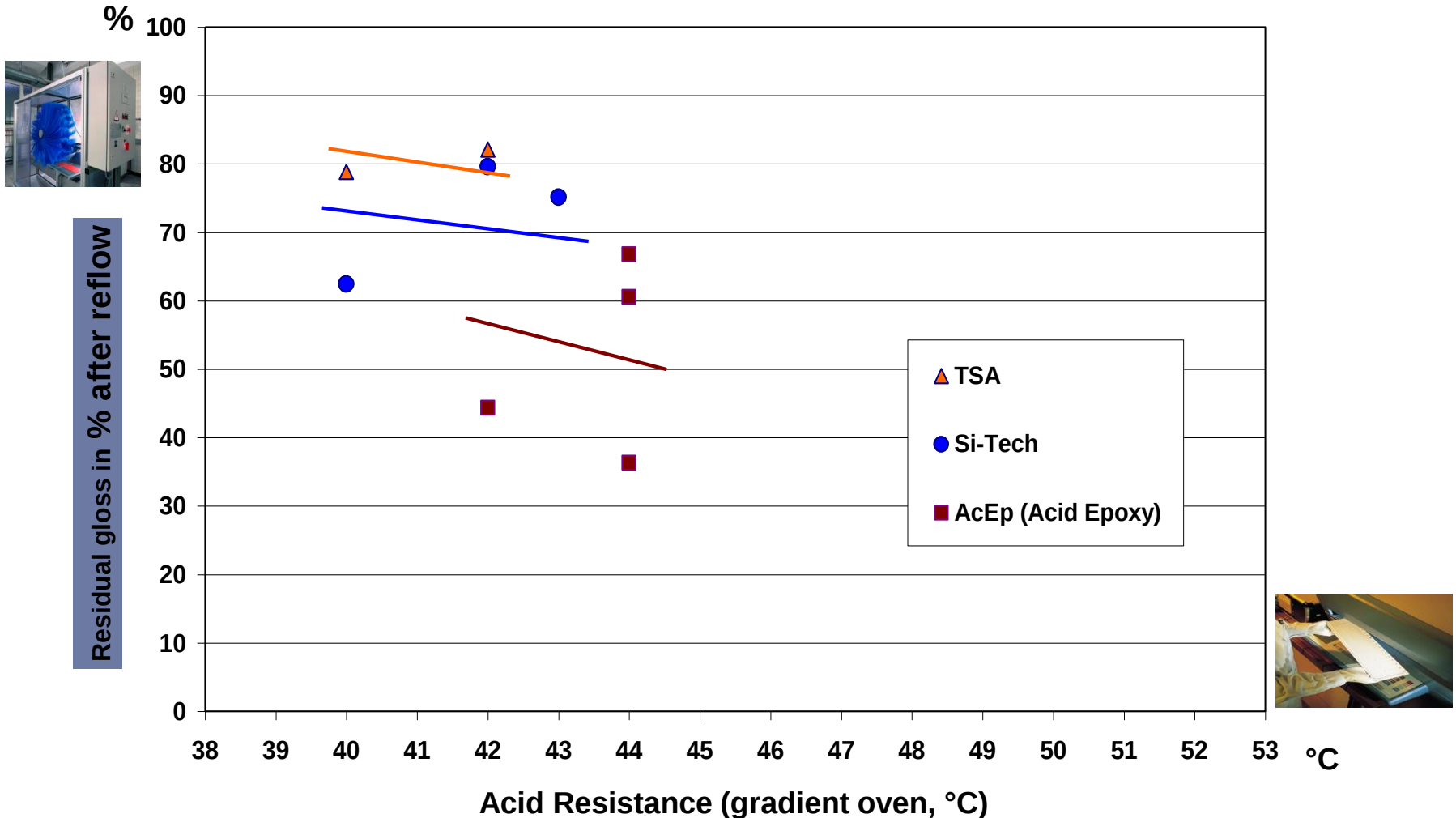
Residual gloss in % after reflow



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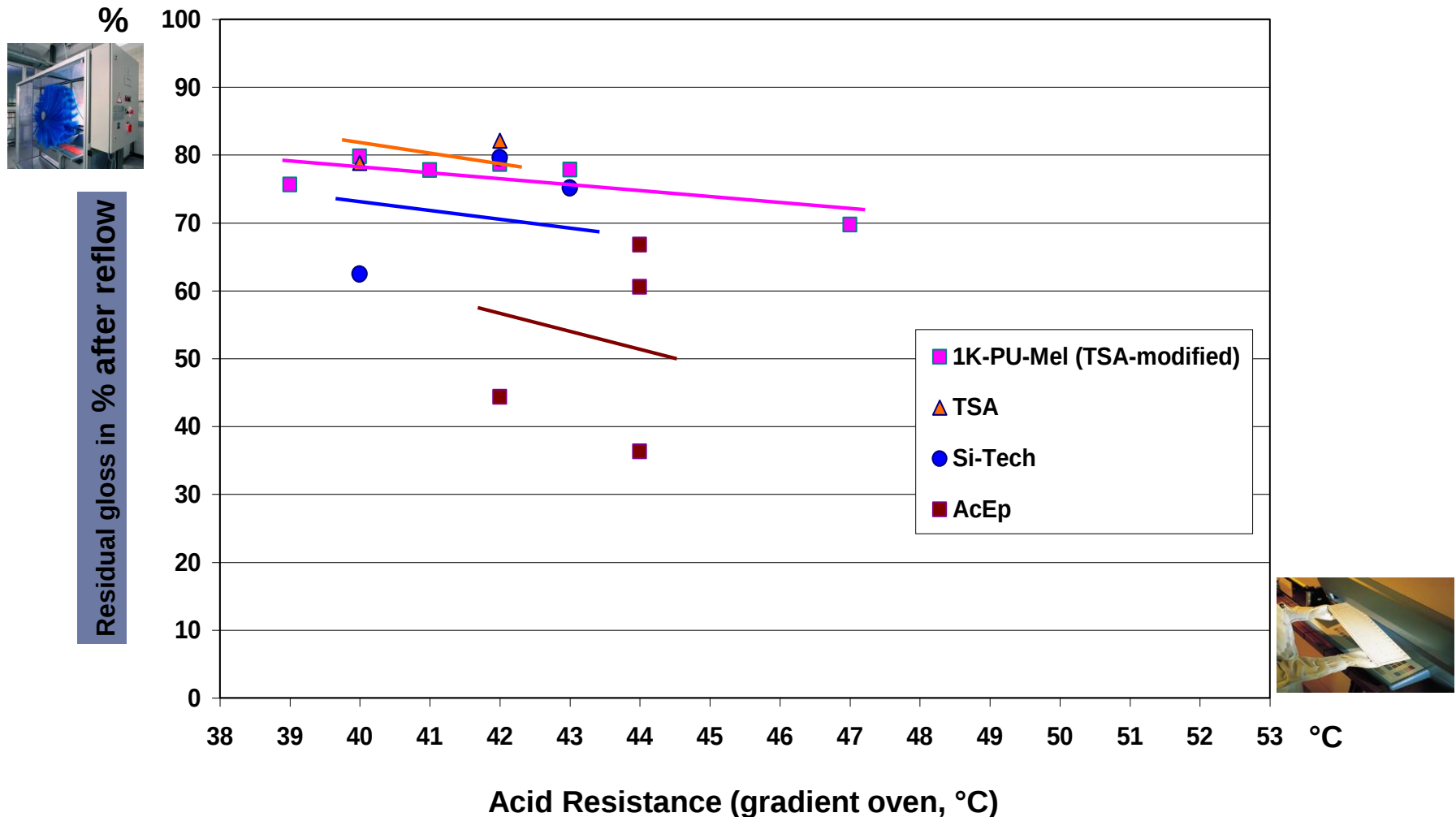
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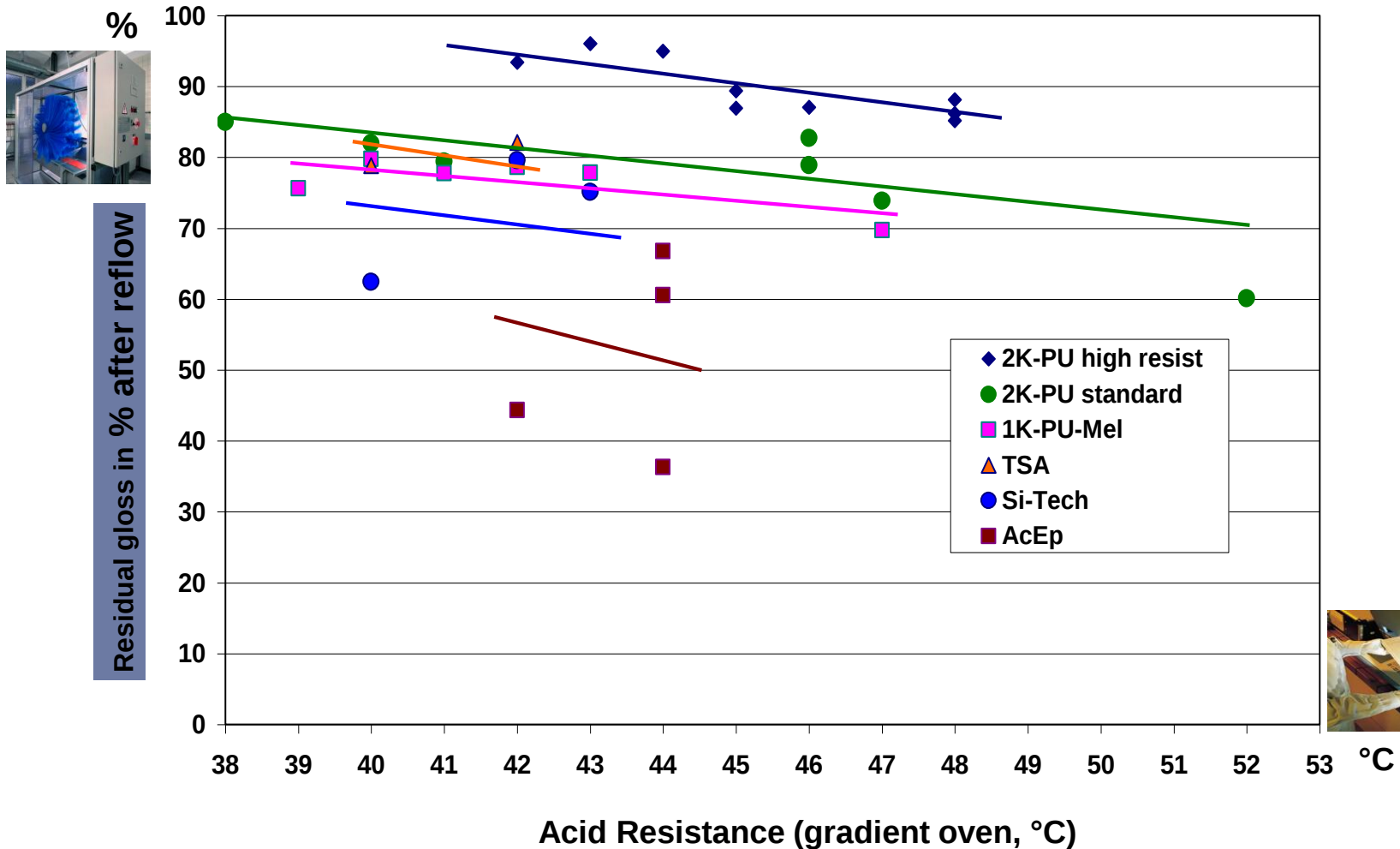
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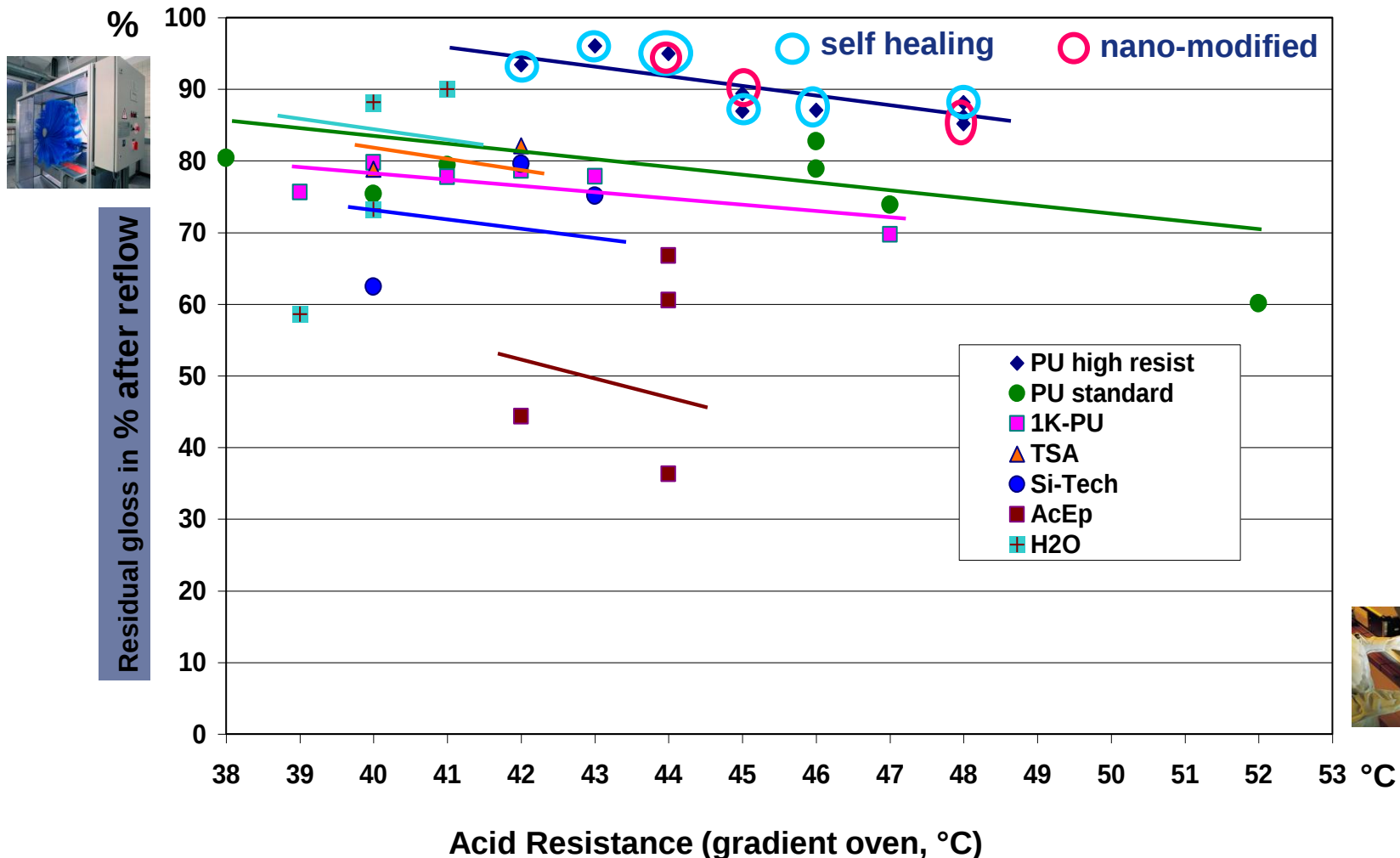
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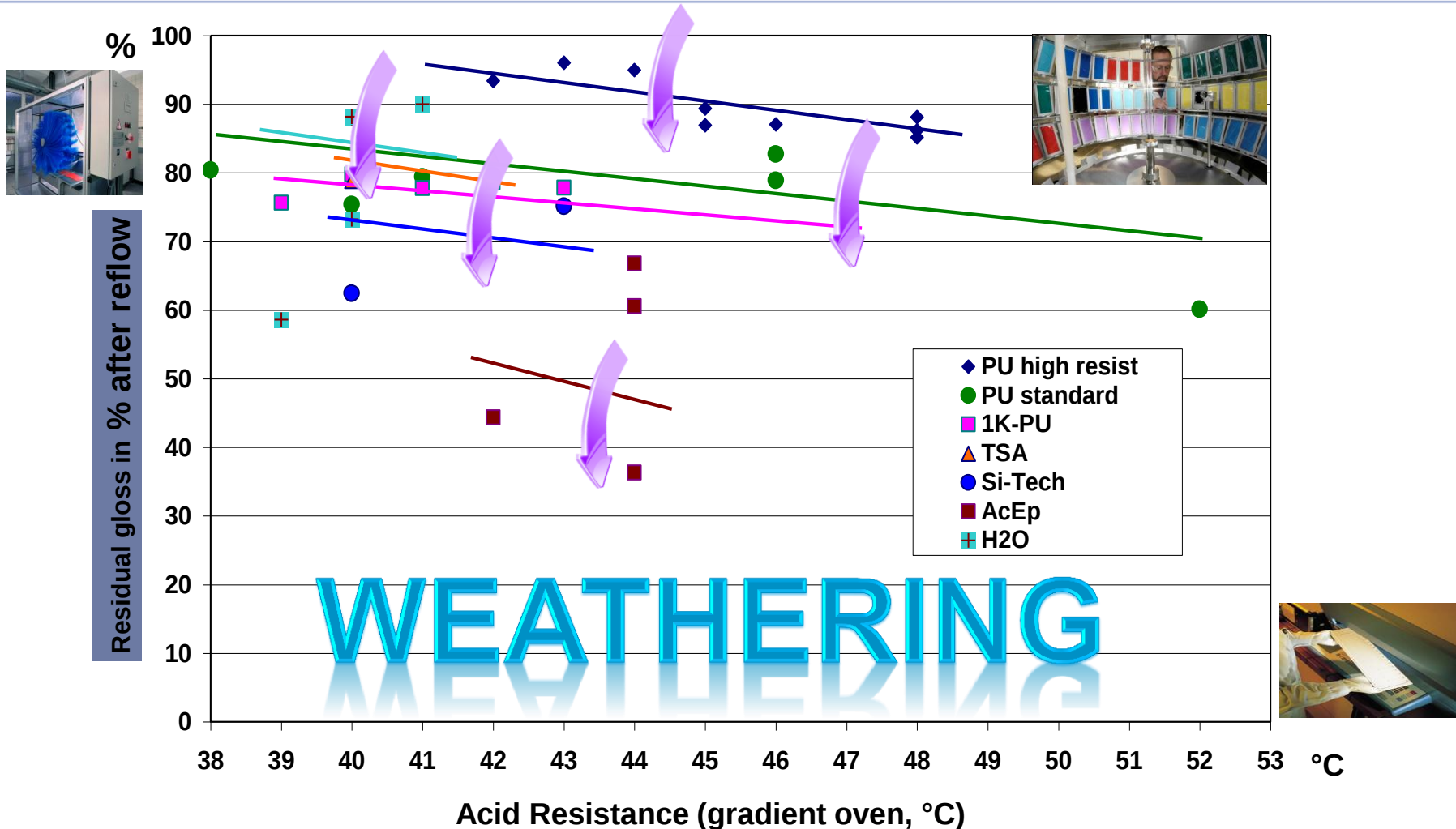
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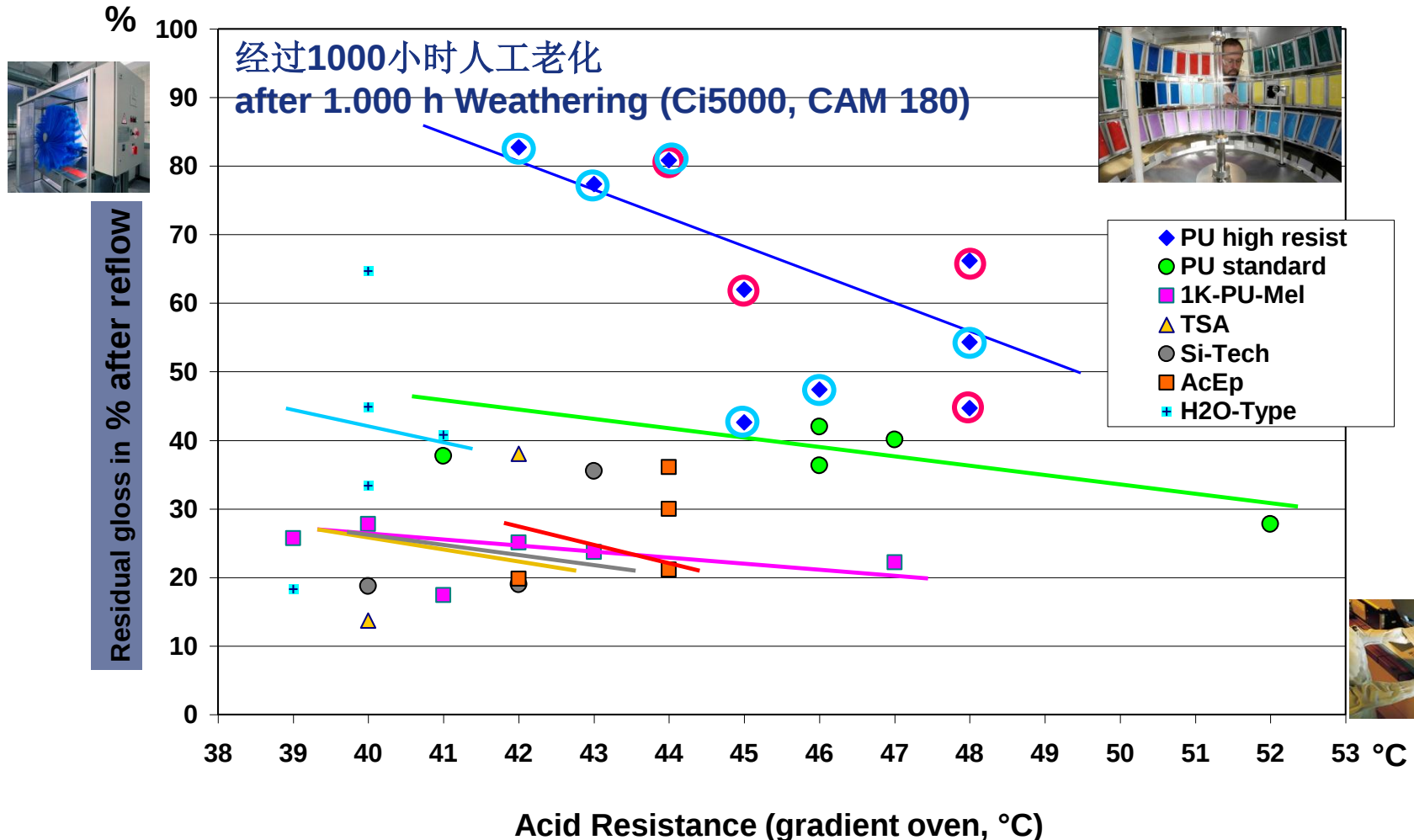
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先进的双组分混合设备

Advanced 2 Component Mixing Equipment

对双组分混合的设备的要求

Requirements for 2 C Mixing Equipment

- 能确保 A组分 和 B组分 的比例
Securing Component A / B mixing ratio
- 对涂料易操作
Easy handling of paint materials
- 易 维护
Easy maintenance
- 对涂装线容易清洗
Easy cleaning of paint lines



选用聚氨酯清漆的成功关键

Key to success for PU Clear coats adoption

- 高性能涂料
High performance coatings
- 高生产效率
High productivity
- 质量保证
Quality assurance

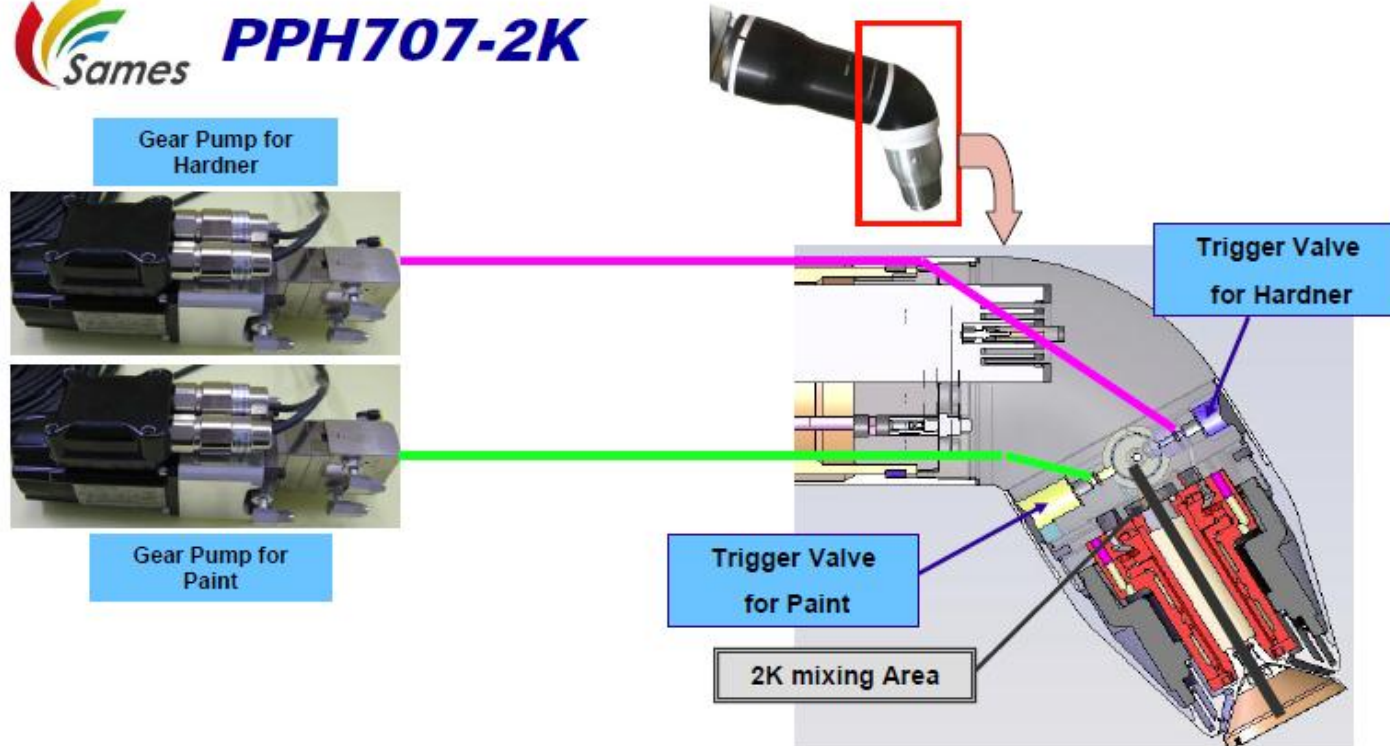


双组分混合设备(例子) 2K Mixing Equipment (example)



Taiki-Sha Zama Technical Center
Sames Atom. for S.B.2K Paint

TAIKI-SHA LTD.



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双组分混合的设备试验：清洗能力

2C Mixing Equipment Trial : Clean-ability

配方：双组分聚氨酯清漆（羟基丙烯酸 // Desmodur N固化剂）

Formulation : 2C PU Clear Coat (Acrylic polyol // Desmodur N hardener)

研究：可能性（易清洗性，混合性）

Investigation : feasibility (clean-ability, mixing-ability)

清洗能力 Clean-ability

循环 Cycle	additional wash out	Solid % in the line
1 cycle (Solv. + Air)	5 sec.	79%
	10 sec.	gel
	20 sec.	6.70%
3 cycle (Solv. + Air)	5 sec.	14%
	10 sec.	2%
5 cycle (Solv. + Air)	5 sec.	0%
	10 sec.	0%
7 cycle (Solv. + Air)	5 sec.	0%
	10 sec.	0%

⇒ 5循环 + 5秒钟溶剂清洗足够清洗干净涂装线

5 cycle + 5 sec. solvent wash out was sufficient to clean up the line.

双组分混合的设备试验：混合能力

2C Mixing Equipment Trial : Mixing-ability

混合能力

条件：

Mixing-ability

Condition: Bell 30 k rpm, static mixer 16 unit

混合条件 Mixing Condition		外观 Appearance		DMA		Etch resist.
混合比 Mixing ratio	Static mixer	光泽 Gloss 20°	雾影 Haze	Mc	Tg (°C)	1% H ₂ SO ₄
4.0/1.3	Yes	89	23	760	87	39
4.0/1.0	Yes	90	18	840	84	37
4.0/0.8	Yes	90	18	1010	83	37
4.0/1.0	No	89	36	830	85	37

⇒ 混合比例在1.0-1.3是合适的，而0.8不合适

The Mixing ratio in the range of 1.0-1.3 was OK but 0.8 was NG

提高外观，静态混合是必须的

The Static mixer was mandatory for better appearance.

双组分混合设备（案例）

Available 2C Mixing Equipment (example)

- ✓ 拜耳材料科技可以提供性能优异的油漆原材料
Advanced Paint Raw Materials are available from Bayer MaterialScience.
- ✓ 可以通过配合中国大气社的双组分混合设备试漆
Joint trial with 2C Mixing equipment is possible by Taikisha in China.

天津大气社塗装系統有限公司

Lab. & Pre-Assembly & Delivery

TAIKI-SHA LTD.

天津大气社塗装系統有限公司

(Tianjin Taikisha Paint Finishing System LTD.)



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Bayer MaterialScience, Business Unit : Coatings, Adhesives, Specialties
- 高性能聚氨酯清漆概念
Concepts for High Performance Polyurethane Clear Coats
- 汽车原厂漆清漆市场现状
OEM Clear Coats Market Situation
- 汽车原厂漆清漆技术对比
OEM Clear Coats Benchmark Study
- 先进的双组分混合技术
Advanced 2 Component Mixing technology
- 总结
Summary



总结

Summary



- 聚氨酯涂料具有非常优异的抗刮擦性能，高官能度的异氰酸酯能提高交联密度以达到高抗刮擦性能。
Polyurethane coats provide an excellent scratch resistance with plastic deformation characteristics. High functional polyisocyanate improves the scratch resistance with the increase of crosslinking density.
- 目前，世界上生产的汽车有三分之一涂有聚氨酯清漆。
One third of car produced in the world nowadays is coated with polyurethane clear coats.
- 由于其优异的外观和自修复性能，结合紧缩涂装工艺，聚氨酯清漆将会在高端车型中持续增长。
Polyurethane Clear Coats will continuously increase for high end car models with excellent appearance and/or self healing property, in combination with lean coatings process.
- 对比测试证明了聚氨酯涂层的高性能。
Benchmark study proofed high performance of polyurethane coats.
- 易于维护和操作的先进双组分混合设备将确保双组分聚氨酯的应用
Advanced 2C Mixing equipment is now available to secure 2C polyurethane application with easy maintenance and handling.



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Thank you for your attention
Any questions ?