

# 聚酮 POKETONE(POK) 在接插件领域的应用

# Agenda

**I. 晓星介绍**

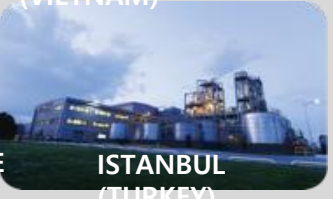
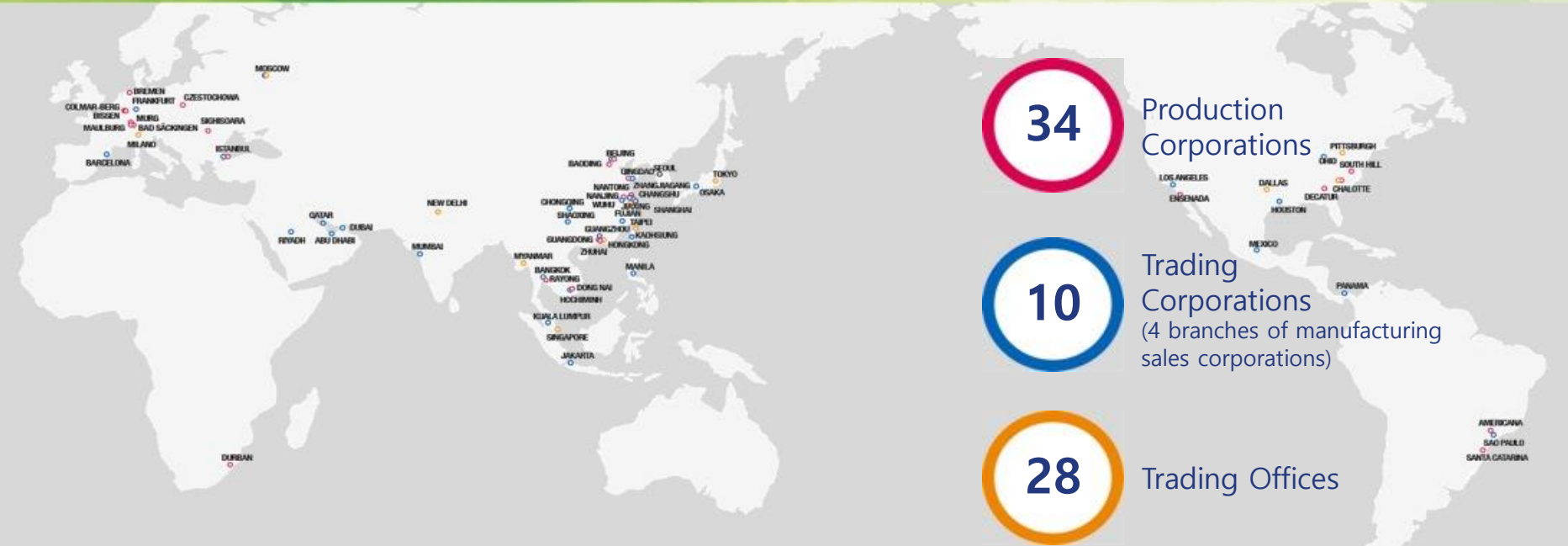
**II. 聚酮(POK)介绍**

**III. POK在接插件上的应用开发**

**IV. POK在接插件上的性能**

**V. 晓星的技术支持**

# I. 晓星集团介绍



晓星致力于工业和技术的各个领域，以使您的生活更加便捷和舒适

- 2015年销售额110亿美元
- 7大事业领域：纤维，产业材料，重工业，化学(PP/ TPA/ NF3 /**POK**)，建筑，贸易，情报通信
- 氨纶纤维，帘子布（全球第一）



TEXTILE



INDUSTRIAL MATERIALS



CHEMICALS



POWER & INDUSTRIAL SYSTEMS



CONSTRUCTION



TRADING



INFORMATION & COMMUNICATION



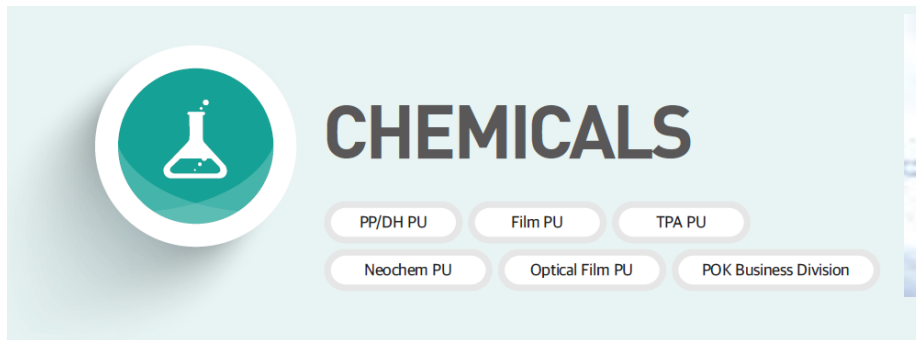
OTHER AFFILIATED COMPANIES





# 晓星-化学事业部

- 提供品种广泛的化学产品，比如TPA（对苯二甲酸），各种类型的薄膜，氟气体和聚丙烯，大量出口到亚洲，欧洲和中东市场
- 晓星是第一个开发脂肪族聚酮并成功实现商业化的公司，POK将凭借其优异的物理及化学性能和综合的竞争优势，在全球市场成为核心的应用材料之一



A graphic for the Chemicals division. On the left is a circular icon with a white flask on a green background. To the right, the word "CHEMICALS" is written in large, bold, black letters. Below this, there are five rounded rectangular buttons containing the following text: "PP/DH PU", "Film PU", "TPA PU", "Neochem PU", and "Optical Film PU". At the bottom right of the buttons is "POK Business Division".



# 晓星- 商业化工厂 \_ 50,000吨/年生产线



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By Royal Charter

### Certificate of Registration

QUALITY MANAGEMENT SYSTEM - ISO 9001:2008

This is to certify that:  
 Hyosung Co., Ltd.  
 Yonggong Plant-PK, Div. Division  
 65, Cheongyo-ro 487 Seon-gil  
 Nam-gu  
 Ulsan  
 44704  
 Republic of Korea

Halls Certificate No: **FM 638786**  
 and operates a Quality Management System which complies with the requirements of ISO 9001:2008 for the following scope:  
 The development, design and manufacture of polylactone.

For and on behalf of BSI:  
 Chris Cheung, Head of Compliance & Risk - Asia Pacific

Original Registration Date: 27/08/2015  
 Latest Revision Date: 27/08/2015

Effective Date: 27/08/2015  
 Expiry Date: 26/09/2018

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ENVIRONMENTAL MANAGEMENT SYSTEM - ISO 14001:2004

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 Republic of Korea

Halls Certificate No: **EMS 638787**  
 and operates an Environmental Management System which complies with the requirements of ISO 14001:2004 for the following scope:  
 The manufacture of polylactone.

For and on behalf of BSI:  
 Chris Cheung, Head of Compliance & Risk - Asia Pacific

Original Registration Date: 27/08/2015  
 Latest Revision Date: 27/08/2015

Effective Date: 27/08/2015  
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## ▶ 认证 ISO 9001 / ISO 14001

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QUALITY MANAGEMENT SYSTEM - ISO/TS 16949:2009

This is to certify that:  
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 Nam-gu  
 Ulsan  
 44704  
 Republic of Korea

Halls Certificate No: **TS 651360**  
 and operates a Quality Management System which complies with the requirements of ISO/TS 16949:2009 for the following scope:  
 The design and manufacture of polyethylene.

For and on behalf of BSI:  
 Managing Director Korea, Jongho Lee

Issue Date: 03/08/2016  
 Latest Issue: 03/08/2016

Expiry Date: 14/09/2018

Page: 1 of 2

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## ▶ 认证 ISO/TS 16949:2009

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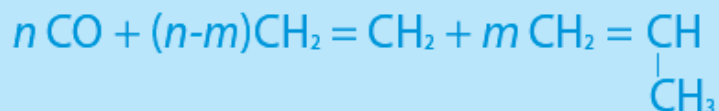
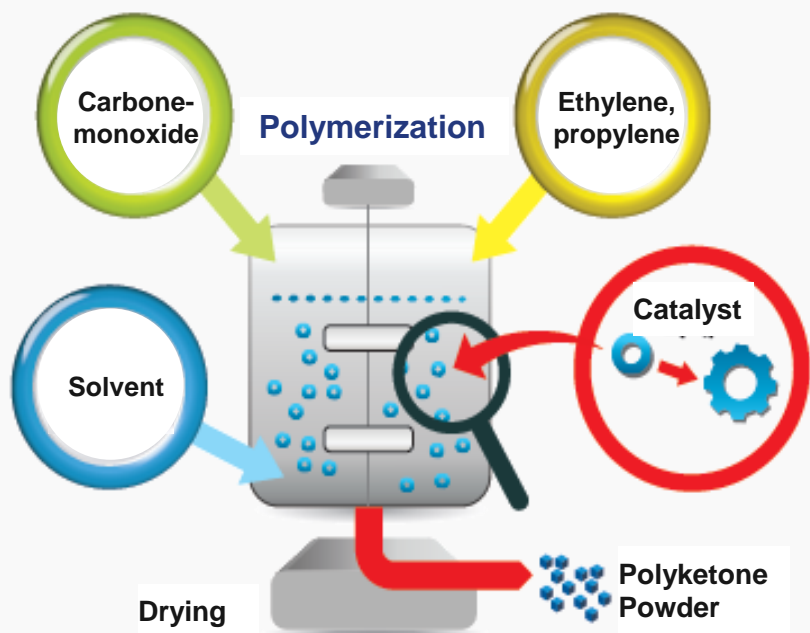
IV. POK在接插件上的性能

V. 晓星的技术支持



# 聚酮(POK)介绍

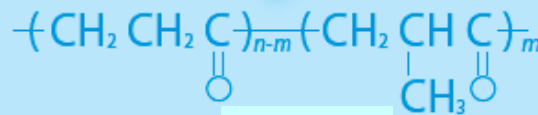
- 新的绿色环保型聚合物，它由一氧化碳和烯烃（乙烯，丙烯）聚合而成
- 合成物
  - ENPLA 三聚物（一氧化碳 + 乙烯 + 丙烯）
  - Super Fiber 共聚物（一氧化碳 + 乙烯）



Carbene-monoxide

Ethylene

Propylene



Polyketone





# 聚酮是什么

聚酮优异和宽泛的性能表现，使它成为一款“天然”的热塑性工程塑料

- 绿色环保，不含有害物质
- 在较宽的应用环境温度下，具有优异的抗冲击性能
- 出色的耐化学，耐燃油性和耐水解性
- 优异的耐磨性
- 低透水率和气体阻隔性

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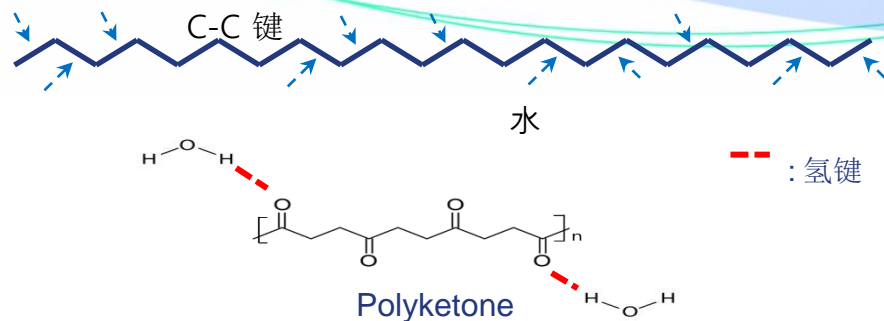
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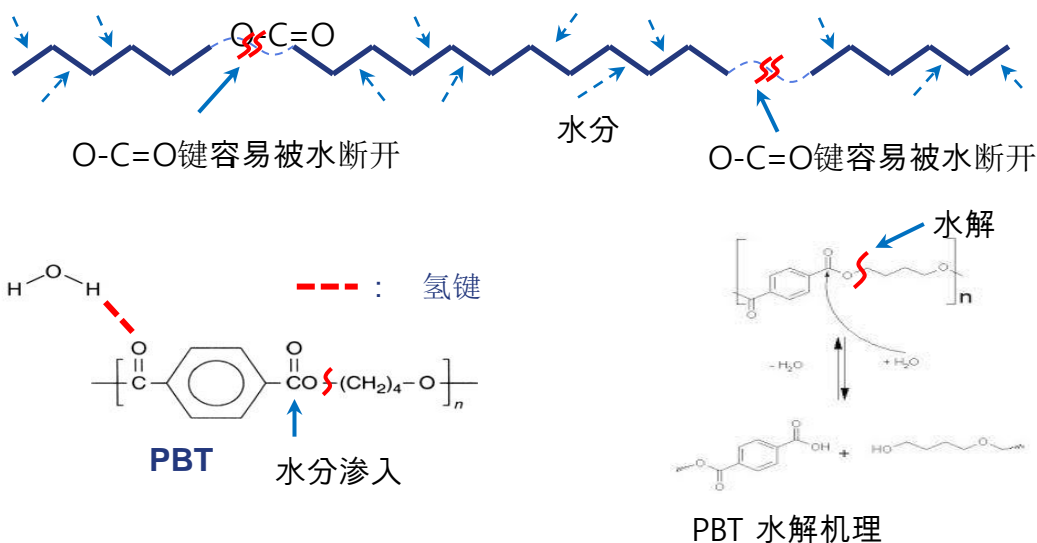
# 耐水解性

## PK 分子结构



- PK由不容易被水分子断裂的C-C键构成，比起其他工程塑料具有优异的耐水解性和耐化学性
- 但因PK同时含有羰基和不耐水的氢基，会有少量的吸水现象出现

## PBT 分子结构



- 虽然PBT比PK可吸水的链段少一些，但是O-C=O键遇水肯定分解，导致水解使产品性能下降

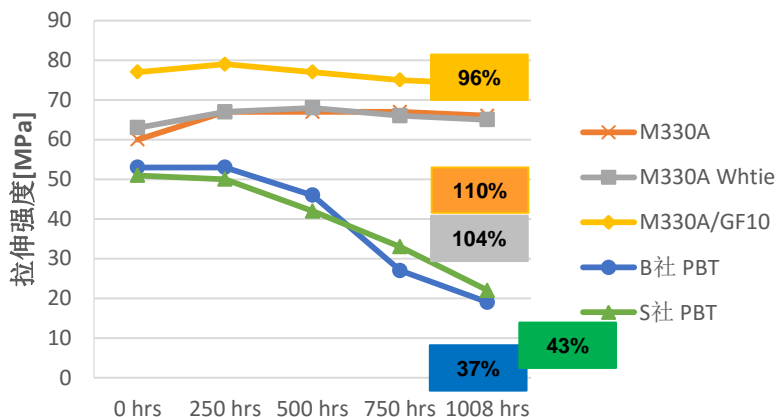


# 耐水解性

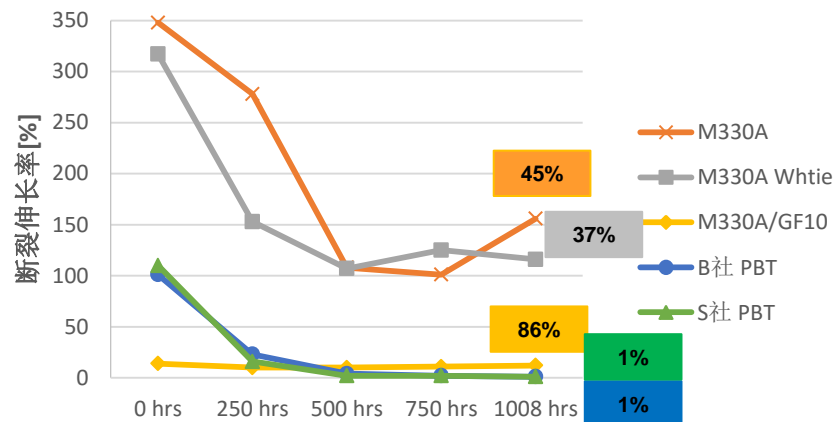
Test conditions : 85°C, 85% RH (8585 test)

Test method : ASTM

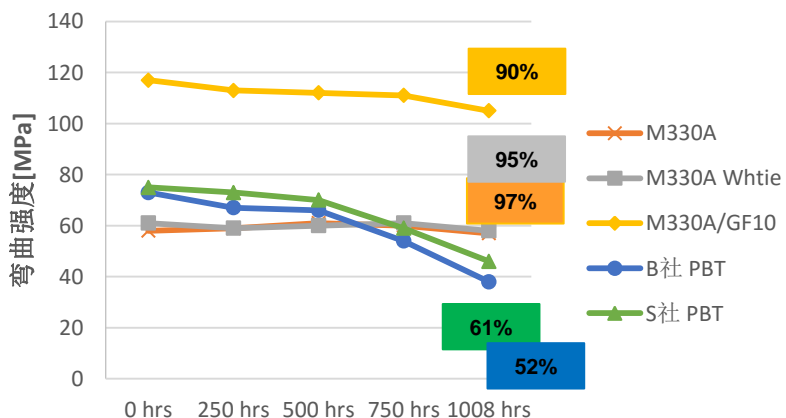
拉伸强度(@85°C, 85%RH / 1008hrs)



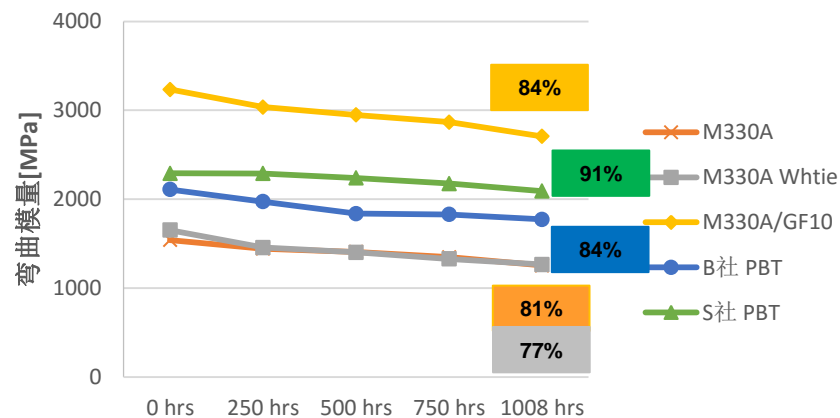
断裂伸长率(@85°C, 85%RH / 1008hrs)



弯曲强度(@85°C, 85%RH / 1008hrs)



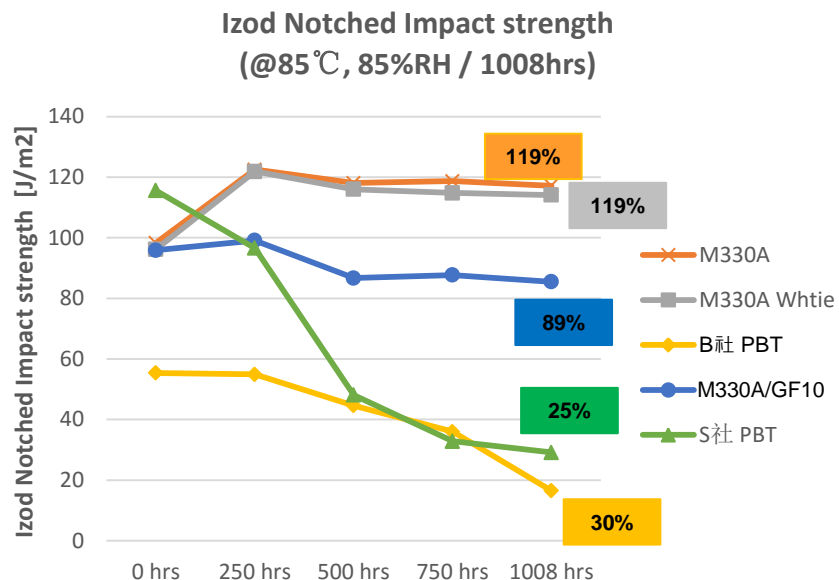
弯曲模量(@85°C, 85%RH / 1008hrs)



# 耐水解性

Test conditions : 85°C, 85% RH (8585 test)

Test method : ASTM



## ▶ Color change (PK vs PBT)

Materials	Color change		
	$\Delta E^*_{ab}$	$\Delta YI$	$\Delta Gloss$
M330A	5.7	13.5	-1.1
M330A White	4.7	8	-2.8
M330A/GF10	2.9	5.3	-28.5
B社 PBT	0.1	-0.04	-19.7
S社 PBT	0.6	0.9	6.7

## ➤ 结果

- 1008小时过后PK性能维持率优于PBT.
- 变色问题上PBT虽有优势，但其拉伸轻度，延伸率，冲击强度却大幅下降
- 耐久性PK更加优秀.

➔ 韩国主机厂 **POKETONE** 认证结束



▲PK ▲PK(White) ▲PK/GF10 ▲B社 PBT ▲S社 PBT

# 耐水解性

- 测试条件: 100°C, 100% RH (100100 test)
- 测试方法: ASTM

材料	冲击强度[J/m]				
	0 week	1 week	2 week	3 week	3 week 物性维持率(%)
M330A White	91.5	221.8	180.5	159.8	175%
B社 PBT	44.3	24.5	14.0	11.2	25%
S社 PBT	104.6	27.7	12.3	0.0	0%
M331AG2BA	84.1	95.7	98.6	97.7	116%
S社 PBT(GF 10%)	65.3	31.6	15.7	15.6	24%

Materials	Color change		
	$\Delta E^*_{ab}$	$\Delta YI$	$\Delta Gloss$
M330A	17.3	23.5	-29.1
M330A White	5.4	10.2	-2.8
M330A/GF10	12.1	20.3	-45.9
B社 PBT	1.6	-1.6	-4.5
S社 PBT	1.7	4.8	-10.1













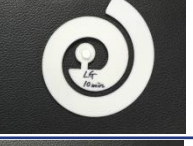


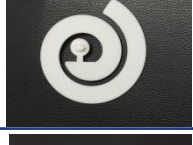
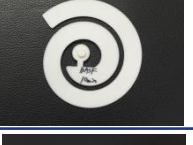

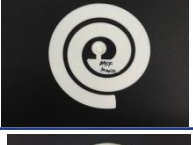


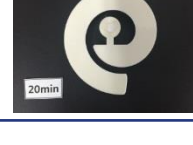

## ➤ 结果

- 3周过后 PK的性能维持率优于PBT.
- 变色问题上PBT虽有优势, 但其样条已分解到无法测试物性的程度
- 耐久性方面PK更加优秀
- 计划测试4周

# 各种型号的特点

根据滞留时间流动性和颜色的变化

材料型号	MI (g/10min.)	注塑机滞留时间评价							
		流动性变化 (cm)					色变( $\Delta E^*$ )		
		连续注塑	10min.	20min.	30min.	变化率(%)	10min.	20min.	30min.
PK M330A-W001	60(@240°C)	39	38	38	37	- 5%	0.8	1.1	1.6
L-PBT GP1000H	45(@250°C)	27	29	31	33	+ 22%	1.9	2.2	2.6
L-PBT GP1000K	57(@250°C)	28	30	31	33	+ 18%	1.3	1.3	1.8
B-PBT B4520HSP	50(@250°C)	29	35	40	48	+ 66%	0.1	0.7	0.9
S-PBT 1503S	10(@235°C)	16	17	19	19	+ 18%	0.8	0.9	1.0

Grade	滞留时间 连续注塑	10min	20min	30min	10s Drooling
M330A-W001					
L-PBT GP1000H					
L-PBT GP1000K					
BASF B4520HSP					
S-PBT 1503S					



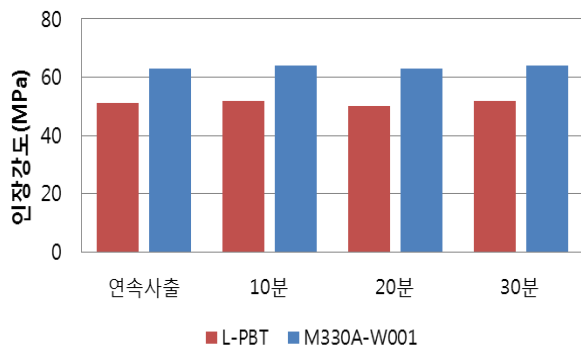
# 各种型号的特点

## 根据滞留时间机械性能的变化

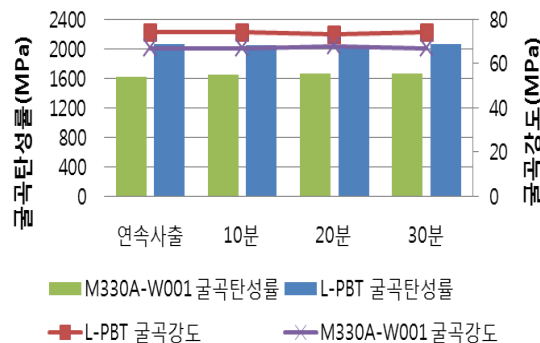
型号	滞留时间	拉伸强度 (MPa)	弯曲强度 (MPa)	弯曲模量 (MPa)	冲击强度 (Charpy Notched, KJ/m <sup>2</sup> )
M330A-W001	连续注塑	63	67	1620	8.6
	10min	64	67	1650	8.6
	20min	63	68	1670	8.7
	30min	64	67	1670	8.7
L-PBT-GP1000H	连续注塑	51	74	2050	4.0
	10min	52	74	2050	4.0
	20min	50	73	2020	3.9
	30min	52	74	2060	3.9

\* S-PBT 분석 중

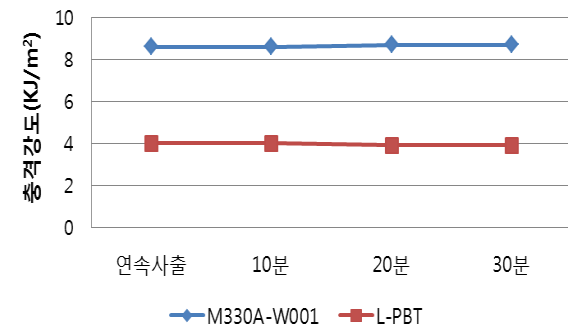
M330A-W001, L-PBT 체류시간 별 인장특성



M330A-W001, L-PBT 체류시간 별 굴곡특성

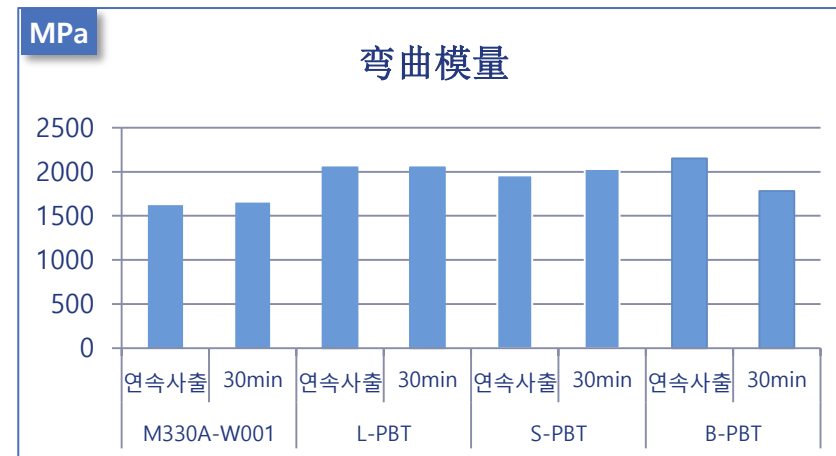
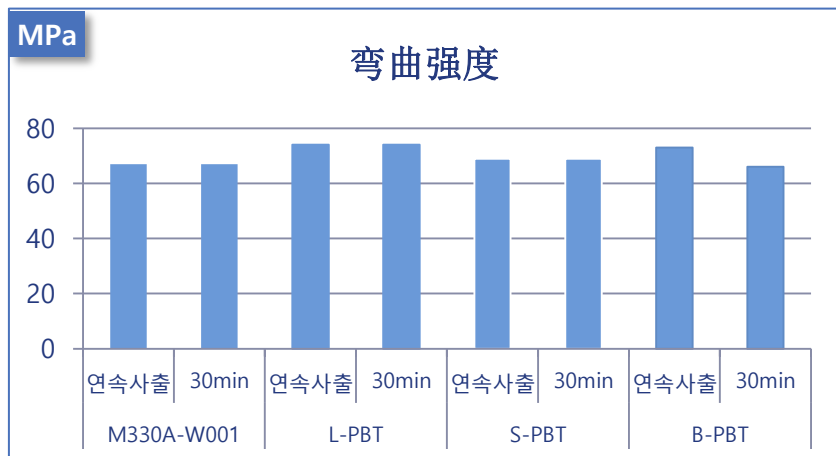
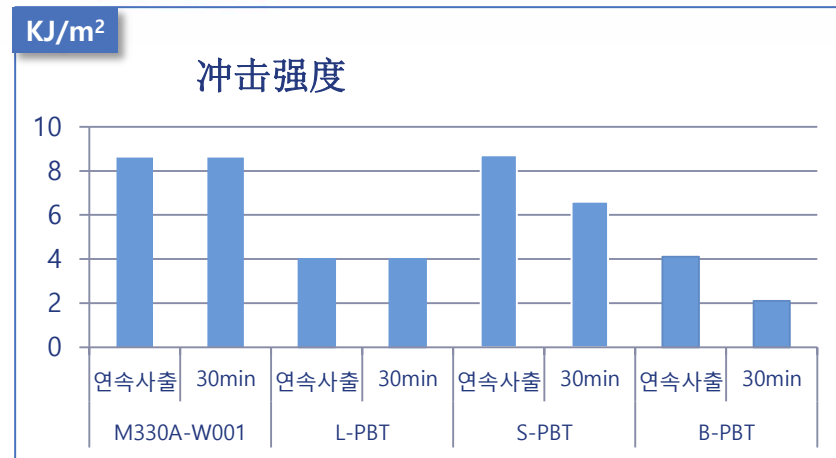
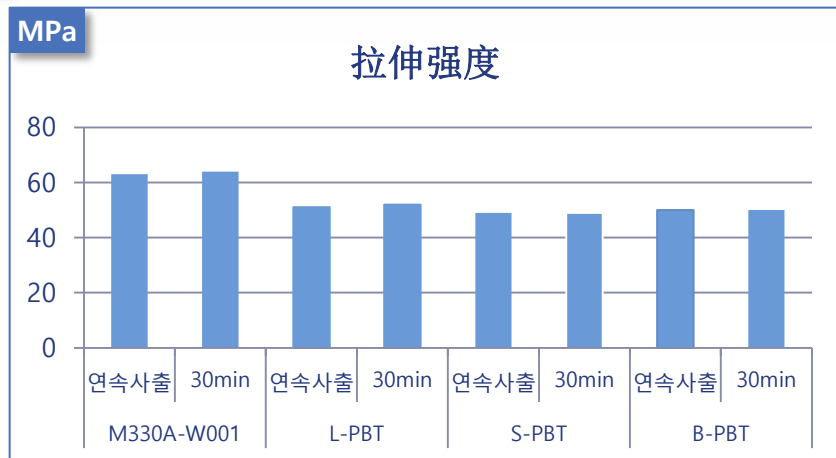


M330A-W001, L-PBT 체류시간 별 충격 특성



# 各种型号的特点

## 根据滞留时间机械性能的变化



滞留30分时性能维持的较好.(B-PBT的弯曲强度和弯曲模量, 冲击强度均有下降)

# 热性能 / 抗冲击性能

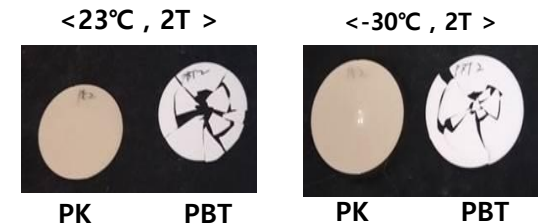
- 长期热稳定性：与PBT相当
- 各温度段机械性能：相似或优于 PBT
- 低温冲击性能优异
- 长期热稳定性 (拉伸强度)

Resin	Temp. (°C)	Unit	Elapsed Time (hr)						
			0	100	200	400	600	800	1000
PK	100	MPa	60	65	68	67	67	67	65
	120			64	67	66	64	67	60
PBT	100		60	63	62	62	61	60	62
	120			58	64	65	57	60	62

- 各温度段机械性能 (r.t. vs -30°C)

Property	Unit	Temp.	PK	PBT
拉伸强度	MPa	23°C	60	55
		-30°C	83	73
断裂伸长率	%	23°C	250	150
		-30°C	14	5.5
拉伸模量	MPa	23°C	2220	2990
		-30°C	4440	3310
冲击强度	KJ/m <sup>2</sup>	23°C	10	4.5
		-30°C	4.0	3.0

## Dynamic Impact Test



	Unit	Temp	PK	PBT
FDI	E(J)	23°C	28.16	21.69
		-30°C	7.05	2.44

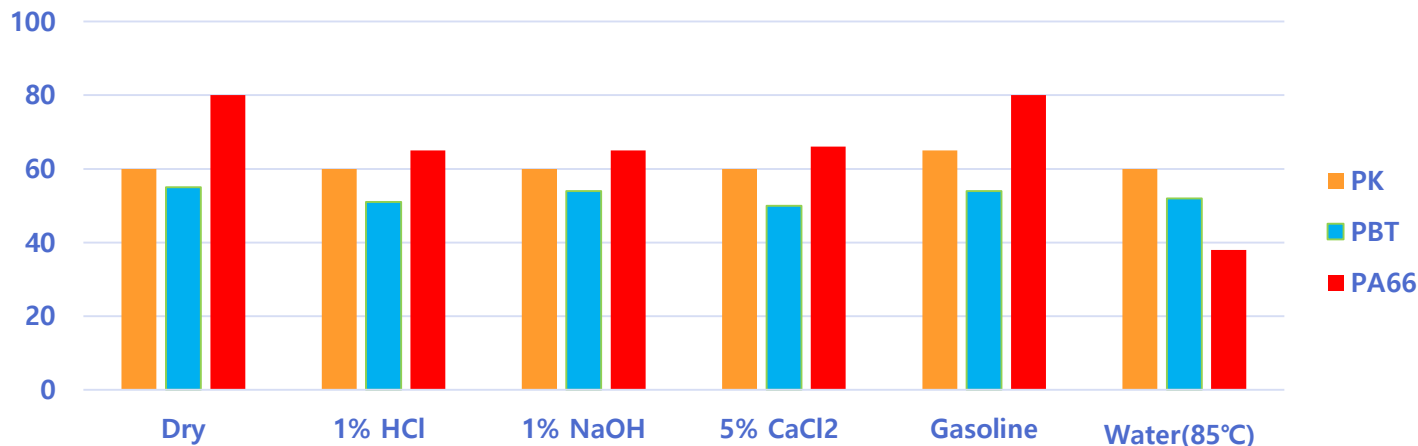
# 耐化学性

## PK vs PBT vs PA66

PK表现较高的耐化学性 (经化学处理后性能100%维持)

→ 酸, 碱, 防冻剂, 汽油, 水

拉伸强度 (250hrs, MPa)



Test	Unit	PK			PBT			PA66		
		0hr	240hrs	Maintenance rate	0hr	240hrs	Maintenance rate	0hr	240hrs	Maintenance rate
1% HCl	MPa	60	60	100%	55	51	93%	80	65	81%
1% NaOH		60	60	100%	55	54	98%	80	65	81%
5% CaCl <sub>2</sub>		60	60	100%	55	50	91%	80	66	83%
汽油		60	65	108%	55	54	98%	80	80	100%
85°C, 蒸馏水		60	60	100%	55	52	95%	80	38	48%



# 耐化学性

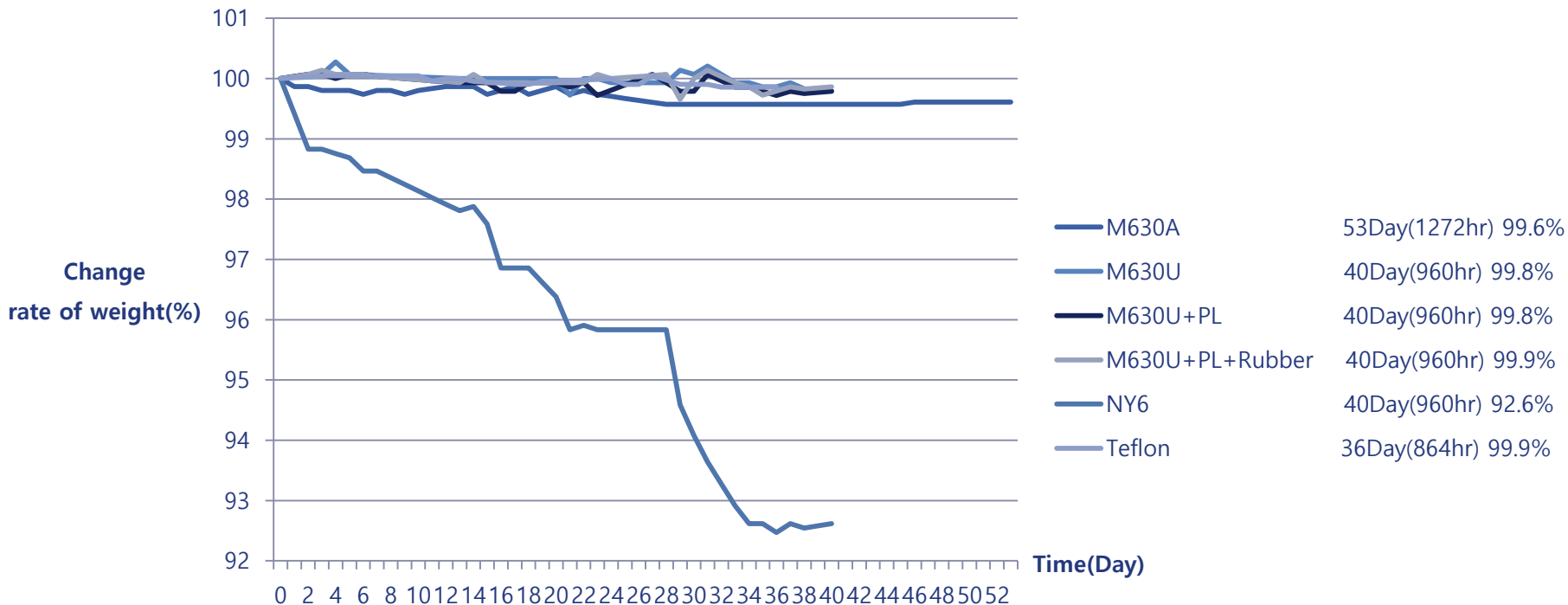
1. 测试方式 : SAE J2260
2. 测试用燃料
  - 1) 汽油
  - 2) 柴油
3. 温度 : 23°C
4. 目标期限 : 70 天 (1,680hrs)



# 耐化学性

汽油渗透 @ 23°C

## Gasoline @ 23°C

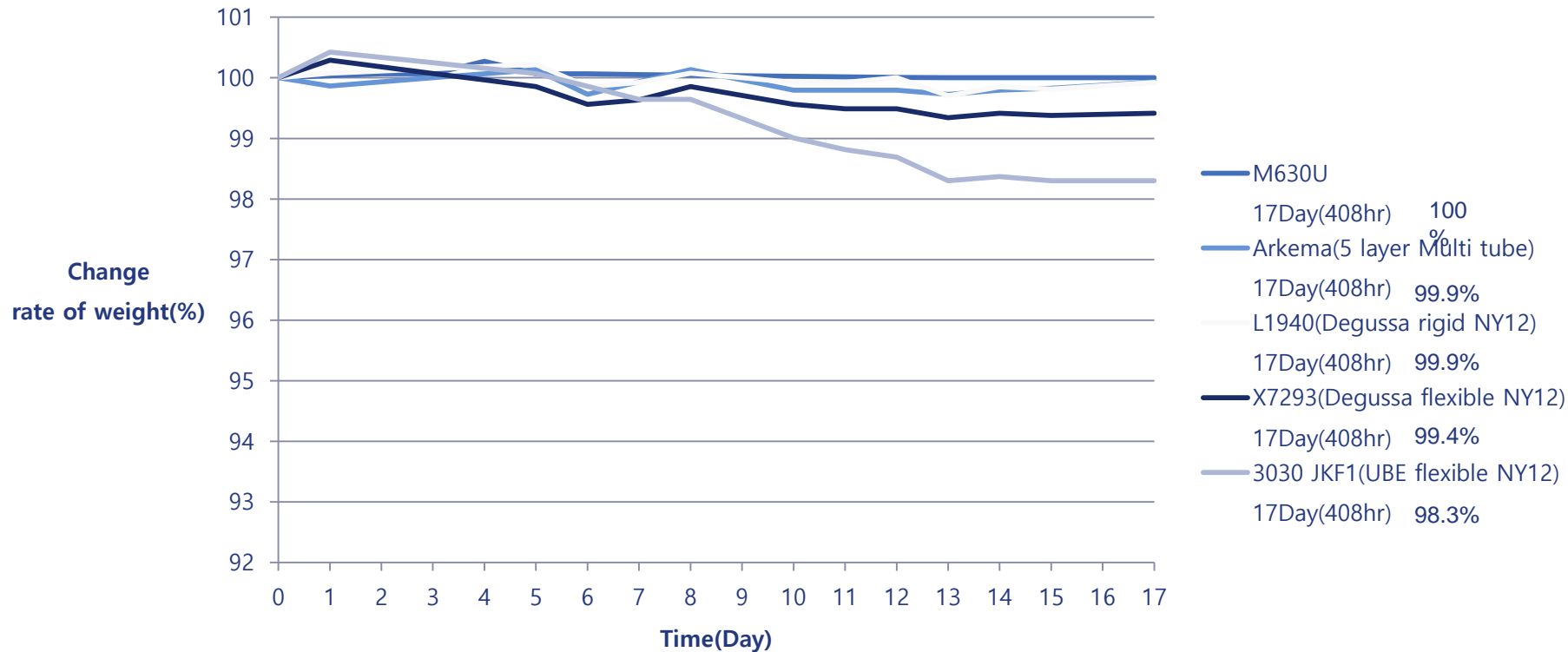


Equivalent performance w/ Teflon

# 耐化学性

PK 和 NY12 汽油渗透结果

## Gasoline @ 23°C

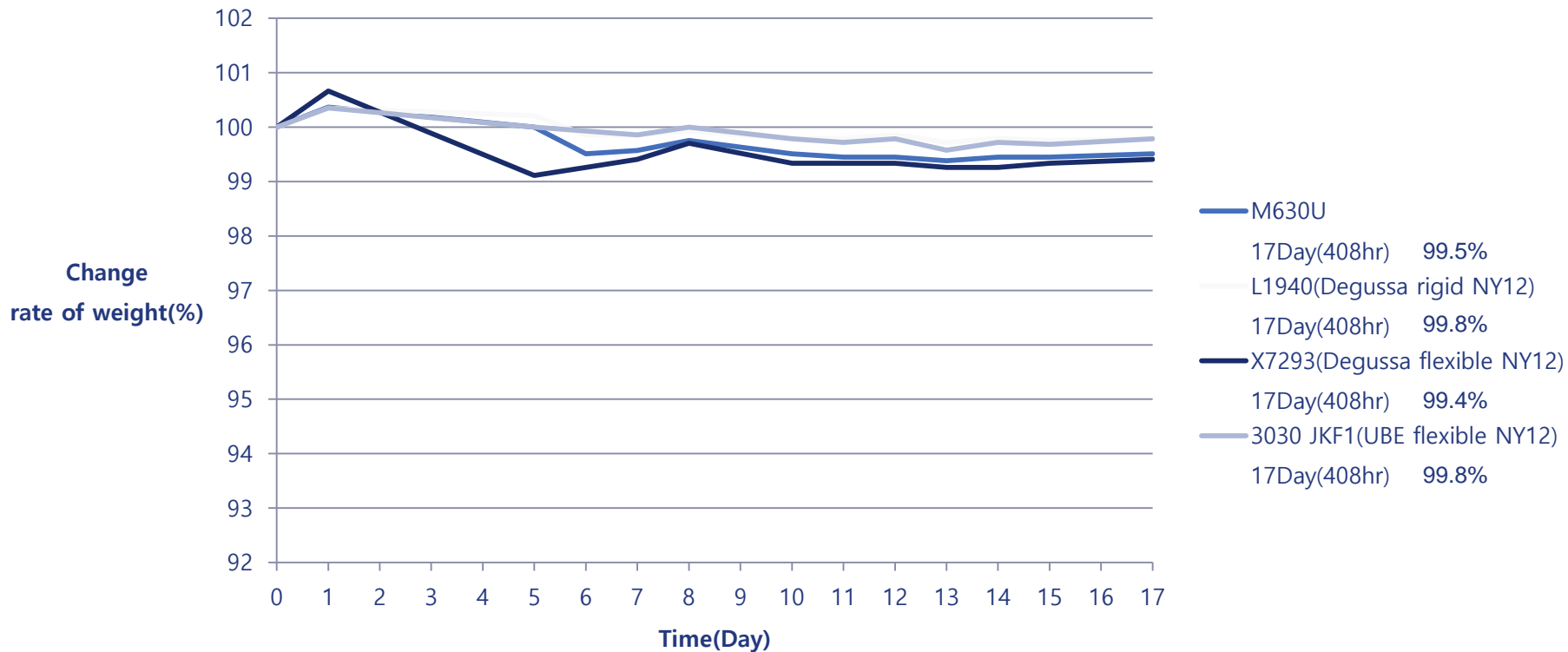


Equivalent performance w/ NY12 (mono, multi-layer)

# 耐化学性

PK 和 NY12 柴油渗透结果

Diesel @ 23°C



Equivalent performance w/ NY12 (mono-layer)



# 电性能

- 在汽车接插件应用上表现优异的绝缘性能

	检测方法	单位	PK M330A	B社 PBT	L社 PBT
介电强度	IEC 60243-1:2013-03	kV/mm	16	20	18.9
体积电阻率	ASTM D 257:2007	$\Omega\cdot\text{cm}$	$1.27\times 10^{16}$	$3.40\times 10^{16}$	$1.28\times 10^{17}$
表面电阻率	ASTM D 257:2007	$\Omega/\text{square}$	$1.8\times 10^{17}$	$1.27\times 10^{17}$	$1.8\times 10^{17}$
耐电弧性	ASTM D 495:1999	s	202	125	130
相对漏电起痕指数 (CTI)	IEC 60112:2009-10	V	600	600	575
灼热丝可燃性指数 (GWFI)	IEC 60695-2-12:2014-02	$^{\circ}\text{C}$	675	825	775
灼热丝起燃性温度 (GWIT)	IEC 60695-2-12:2014-02	$^{\circ}\text{C}$	700	725	700

# 基本特性

## PK vs PBT

低密度, 高抗冲击性(尤其在低温时), 高HDT, 良好的耐化学性, 薄壁加工能力

性能		PK	PBT	备注								
Basic	密度 (g/cm <sup>3</sup> )	1.24	1.31	相对于PBT减重超过6%								
功能性	耐化学性	100	91	Less severe limitation on chemicals								
机械性能	缺口冲击 (KJ/m <sup>2</sup> )	~10	4~8	Loss Reduction <table border="1" data-bbox="1400 659 1877 785"> <thead> <tr> <th>Drop Impact</th> <th>PK</th> <th>L-PBT</th> <th>S-PBT</th> </tr> </thead> <tbody> <tr> <td>@-40°C</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Drop Impact	PK	L-PBT	S-PBT	@-40°C			
Drop Impact	PK	L-PBT	S-PBT									
@-40°C												
热性能	热变形温度 (HDT) (°C), 1.82MPa(18.6 Kg/cm <sup>2</sup> )	100	70	更耐热, 热稳定性更佳								
加工性	注塑温度(°C)	230~240	245~260	降低生产成本								
	薄壁注塑	MI 60	MI 15~57	Possible to mold Thin wall Structure <table border="1" data-bbox="1278 1116 1684 1256"> <tbody> <tr> <td></td> <td></td> </tr> <tr> <td>PK</td> <td>PBT</td> </tr> </tbody> </table>			PK	PBT				
												
PK	PBT											

# 各种型号的特性

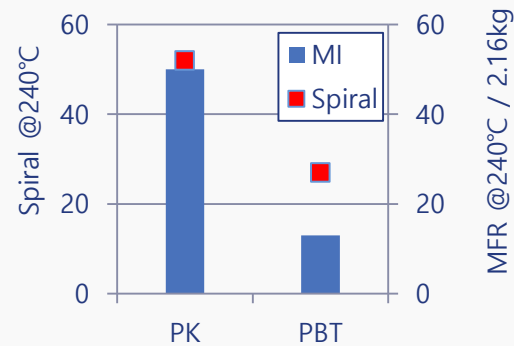
- 填充改性级别具有较高的机械性能和冲击性能
- 与PBT相比，阻燃级别只需添加 1/3 的绿色环保阻燃剂

性能	单位	PK (M330A)	PBT	PK GF30%	PBT GF30%	PK FR/GF30%	PBT FR/GF30%
密度	g/cm <sup>3</sup>	1.24	1.31	1.46	1.53	1.50	1.63
熔指	g/10min	60 (240°C)	28 (250°C)	>15 (240°C)	>10 (250°C)	-	-
拉伸强度	MPa	60	55	145	137	145	130
断裂伸长率	%	>250	>100	4	3	4	5
弯曲强度	MPa	60	80	190	210	210	205
弯曲模量	MPa	1,550	2,200	6,600	9,000	8,650	8,830
缺口冲击强度	KJ/m <sup>2</sup>	9	4	12	9	12	8
热变形温度 (HDT) (1.8 MPa)	°C	100	60	215	215	215	200
熔点	°C	220	220	220	220	220	260
阻燃性	Class	HB	HB	HB	HB	V-0	V-0

# 小结

## POK特性 VS PBT

- 低密度
- 高 HDT (热变性温度)
- 耐化学性 / 耐水 & 耐热
- 燃烧性：与PBT相似
- 良好的耐冲击性
  - : 室温和-30°C时是PBT的2倍
  - : 室温和-30°C时动态冲击性能优于PBT
- 高断裂延伸率
  - : 室温时PBT的1.6倍 (PK 250% vs PBT 150%)
  - : -30°C时是PBT的2.5倍 (PK 14% vs PBT 5.5%)
- 良好的加工性能 (成型性)



PK



PBT

# Agenda

I. 晓星介绍

II. 聚酮(POK)介绍

III. POK在接插件上的应用开发

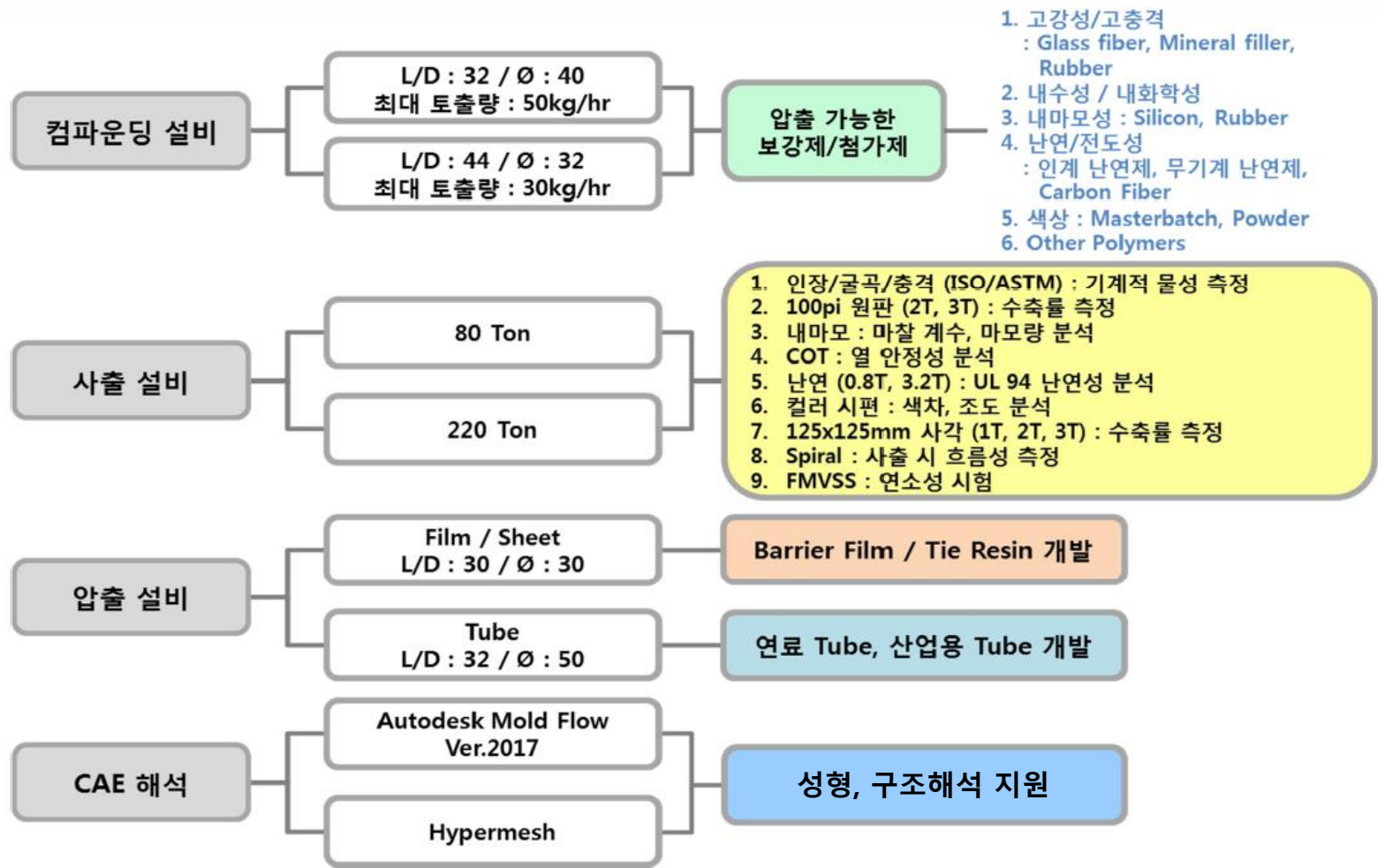
IV. POK在接插件上的性能

V. 晓星的技术支持



# 晓星的技术支持

▶ 注塑/挤出技术支持, 为客户量身定做原料配方, 材料/产品分析等技术服务 → 为客户提供特定的解决方案



# 晓星的技术支持 - 设备现状

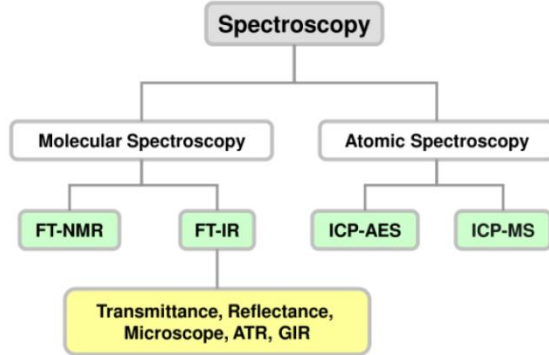
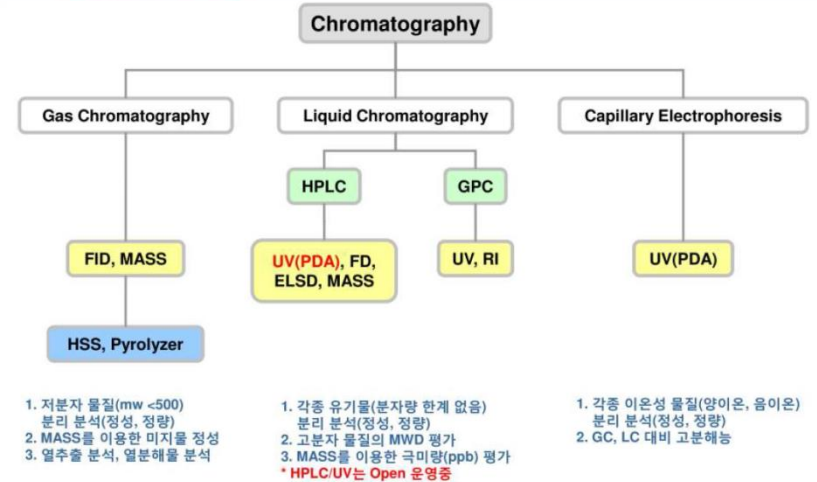
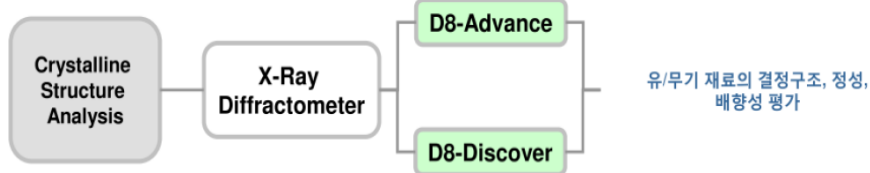
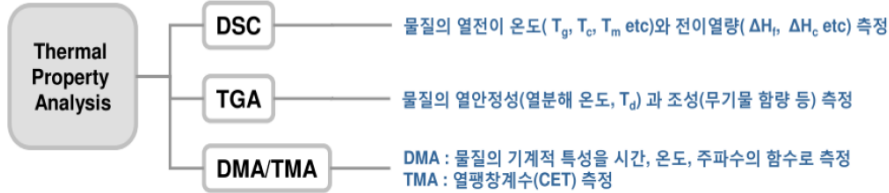
## 物理实验

Universal Test Machine	• 原纱/织物/Film的拉伸强度
Vibrojet 2000	• Monofilament 拉伸强度/延伸率
均一度测定仪(U%)	• 原纱均一性
热应力测试仪	• 热应力
摩擦指数	• F/F,F/M,F/C动/静摩擦力
Entanglement tester	• 交联
Abrasion tester	• 耐磨
材料分析/收缩率等 原纱基本物性	• Danier/Film/光泽/材料等
Weather-ometer	• 耐候性
显微镜	• 原纱织物的裁断面, 排向性 评价

## 树脂分析

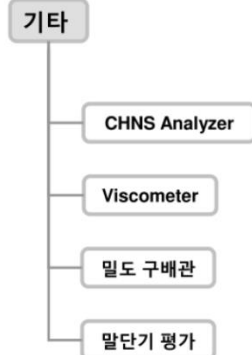
Capillary Rheometer	• 流动性
Rotational Rheometer	• 流动性
水分测定仪	• 固液体的水分含量
Izod 冲击强度	• Plastic 冲击强度
Rockwell 硬度	• 硬度
异物分析仪	• 异物分析
Universal Test Machine	• 拉伸强度/延伸率/弯曲/压缩
UL 94 Chamber	• 阻燃特性
HDT 测试仪	• 热变形温度

# 晓星的技术支持

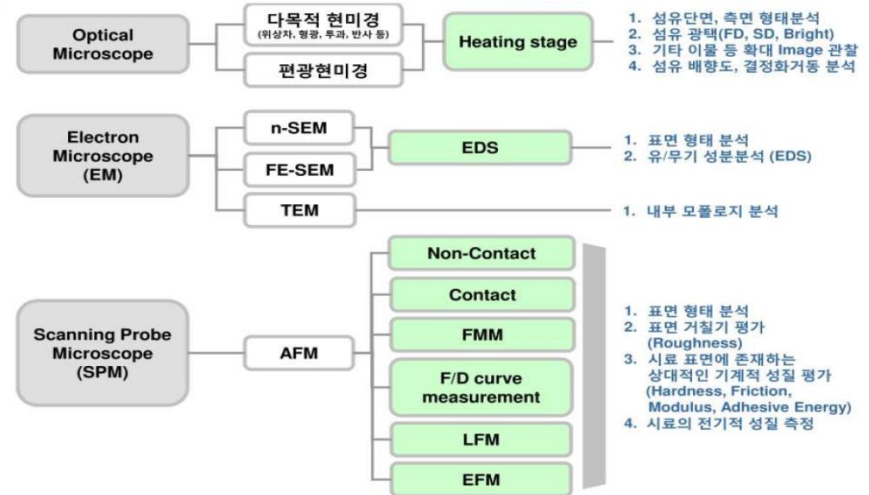


1. 각종 화학물질의 구조 분석
2. 공중합물 조성, 첨가제 정량

1. 각종 무기물의 정량 분석
2. ICP-MS 이전 추진 중



1. 유기물의 CHNS 함량평가
2. 각종 고분자 기본 물성 평가





**Thank You**