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可同时实现高折射率和低双折射率的透明树脂材料， 这就是三井化学的APEL™。

APEL™是三井化学根据齐格勒聚合技术所开发出的一种环状烯烃共聚物(COC)。

它兼具聚烯烃树脂和非晶性树脂的性能，并且其耐热性和流动性可以控制。

此外，它在非晶性聚烯烃中具有最高折射率、以及低光学各向异性，是双折射率非常低的材料。

APEL™在作为光学塑料镜片的用途上取得了丰硕的成绩。同时由于它优越的防潮性、耐化学品性、非吸附性而被应用于医疗用包装材料。

APEL™所具有的多样功能和优异特性，开创出了透明材料崭新的应用潜力。

APEL™ of Mitsui Chemicals is a transparent resin material that combines high refractive index and low birefringence.

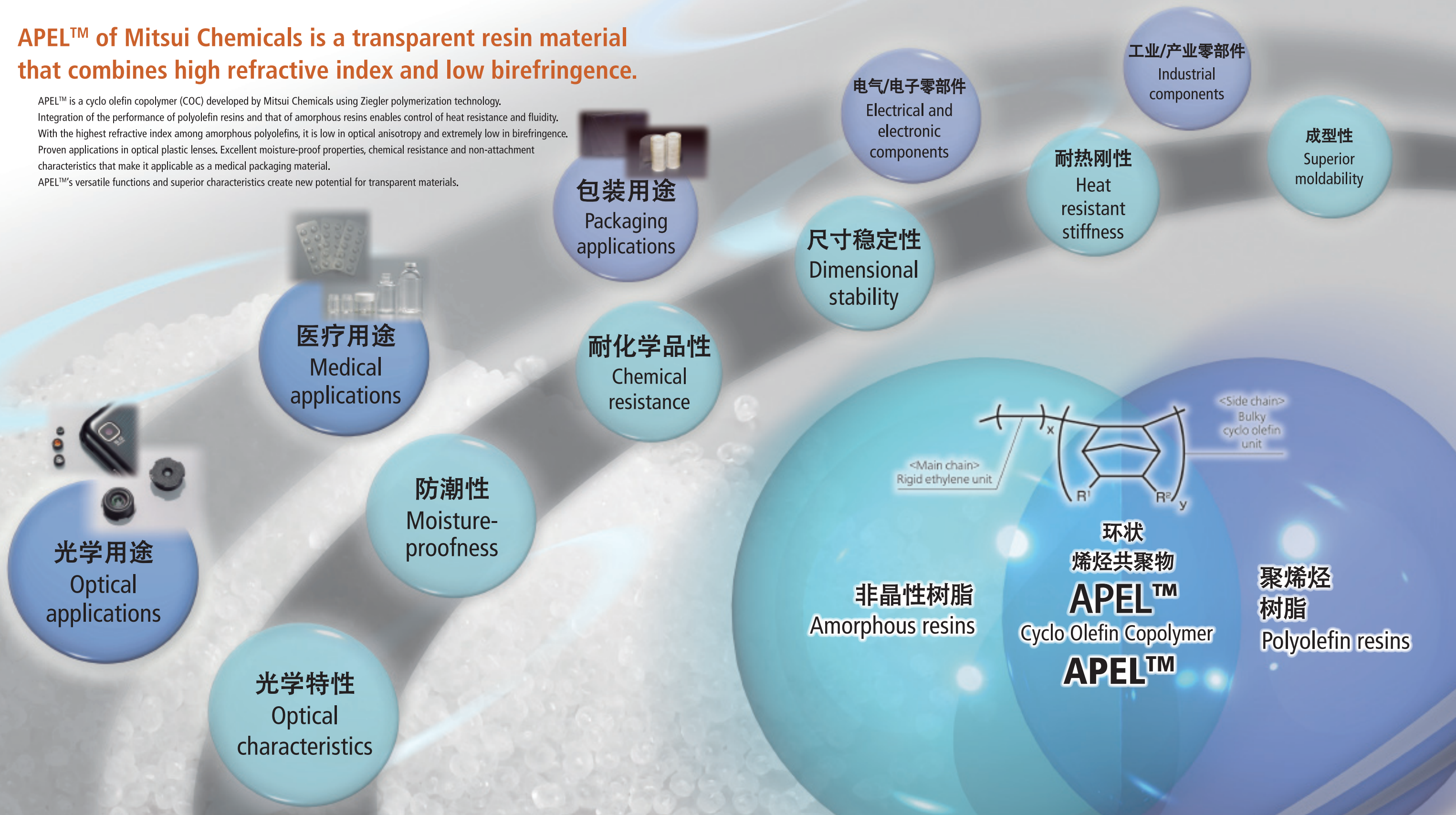
APEL™ is a cyclo olefin copolymer (COC) developed by Mitsui Chemicals using Ziegler polymerization technology.

Integration of the performance of polyolefin resins and that of amorphous resins enables control of heat resistance and fluidity.

With the highest refractive index among amorphous polyolefins, it is low in optical anisotropy and extremely low in birefringence.

Proven applications in optical plastic lenses. Excellent moisture-proof properties, chemical resistance and non-attachment characteristics that make it applicable as a medical packaging material.

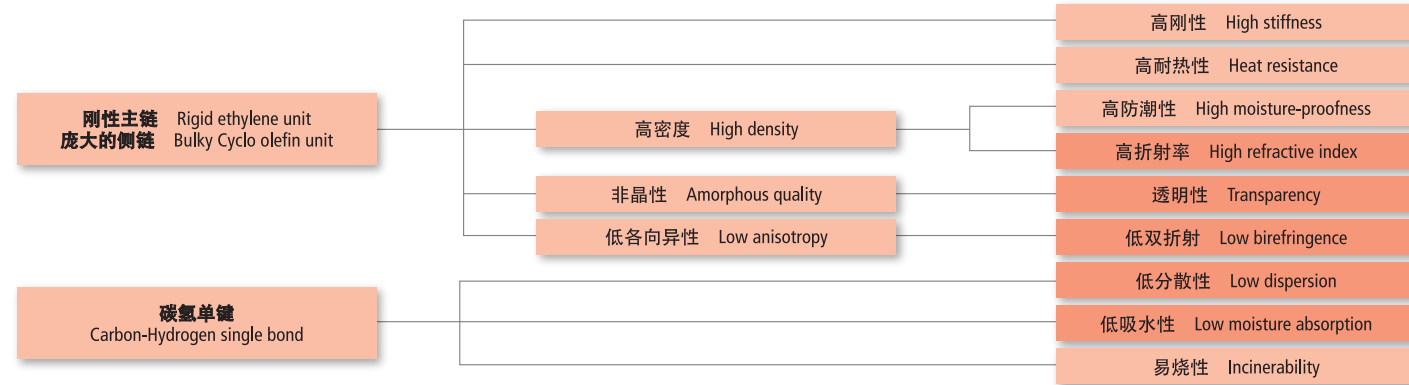
APEL™'s versatile functions and superior characteristics create new potential for transparent materials.



光学特性 Optical Characteristics

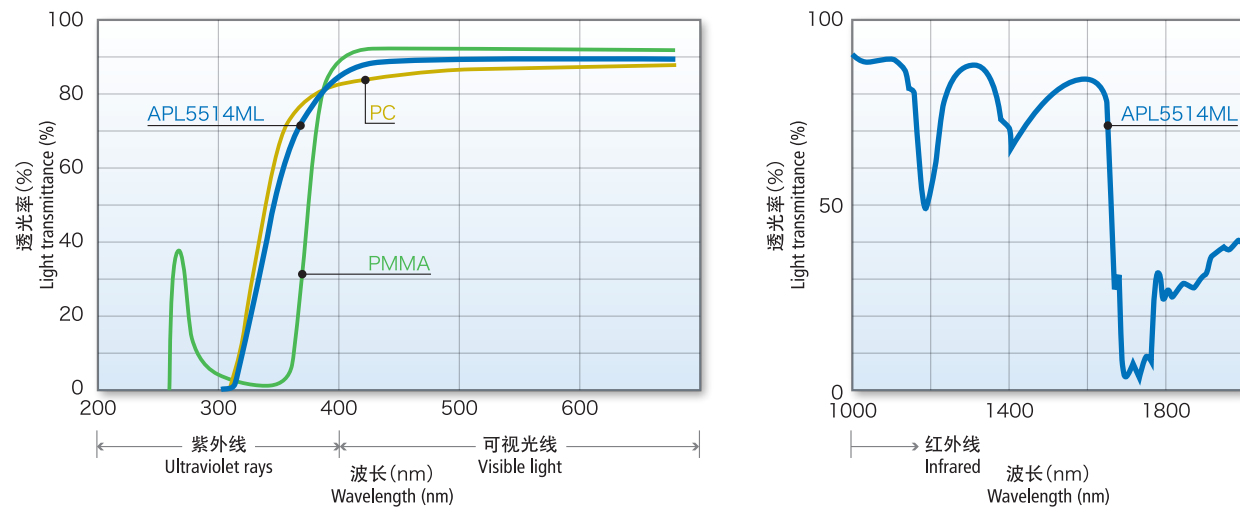
在光学用途上 APEL™的特点

Characteristics in Optical Applications



透光率

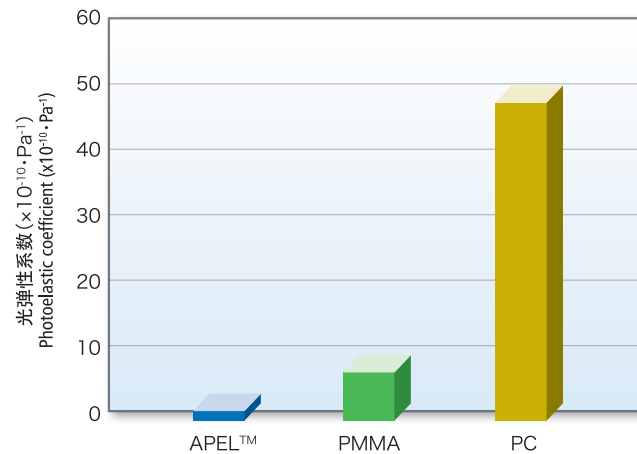
Light Transmittance



透明树脂的应力光学系数

Stress Optical Coefficient (S.O.C.) of Transparent Resins

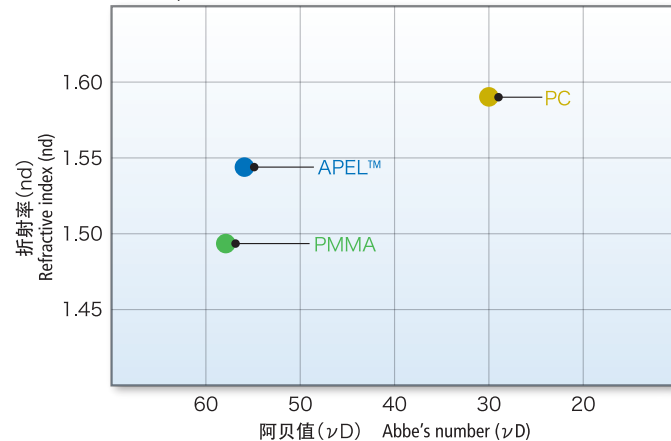
该材料的光学各向异性较低，本质上双折射率也较低。
APEL™ is low in optical anisotropy and essentially low in birefringence.



透明树脂的折射率和阿贝值

Refractive index and Abbe's number of Transparent Resins

与PMMA相比，APEL™的折射率较高，但两者的阿贝值几乎相同。
APEL™ has a higher refractive index than PMMA, but their Abbe's number is almost equivalent.



折射率的波长和温度依赖性

Wavelength and temperature dependability of refractive indices

测量温度 Measuring Temperature	测量波长 Measurement Wavelength					阿贝值 (νD) Abbe's number (νD)
	g线 g line (435.8nm)	F线 F line (486.1nm)	d线 d line (587.6nm)	C线 c line (656.3nm)	LD LD line (780.1nm)	
10°C	1.5578	1.5522	1.5455	1.5425	1.5392	56
25°C	1.5565	1.5510	1.5442	1.5413	1.5380	56
55°C	1.5532	1.5478	1.5411	1.5383	1.5349	56
70°C	1.5516	1.5463	1.5396	1.5368	1.5334	56

光学特性的比较

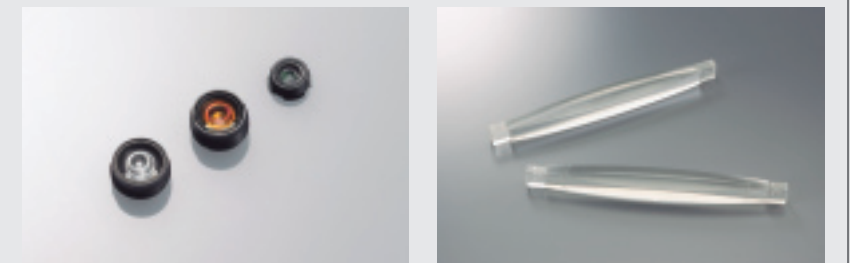
Comparison of optical characteristics

项目 Item	单位 Unit	测试条件 Testing conditions	APEL™ (APL5514ML)	PMMA	PC
比重 Gravity	—	4°C	1.04	1.18	1.20
热变形温度 Heat distortion temperature	°C	1.82MPa	125	75	125
透光率 Light transmittance	%	2mmt	90	92	90
折射率 (nD) Refractive index (nD)	—	25°C	1.54	1.49	1.58
阿贝值 (νD) Abbe's number (νD)	—	25°C	56	58	30
吸水率 Water absorption rate	%	23°C×24h	<0.01	0.3	0.2

光学应用实例 Optical application example

适用于要求双折射率低、尺寸精度高的光学产品、精密镜片等。
Suitable for optical products and precision lenses that require low-level birefringence and high dimensional accuracy.

- 图像传感器用镜片
- 光盘用读取器镜片
- 激光打印机用fθ 镜片
- Lenses for image sensors
- Pickup lenses for optical disks
- f-theta (fθ) lenses for laser beam printers

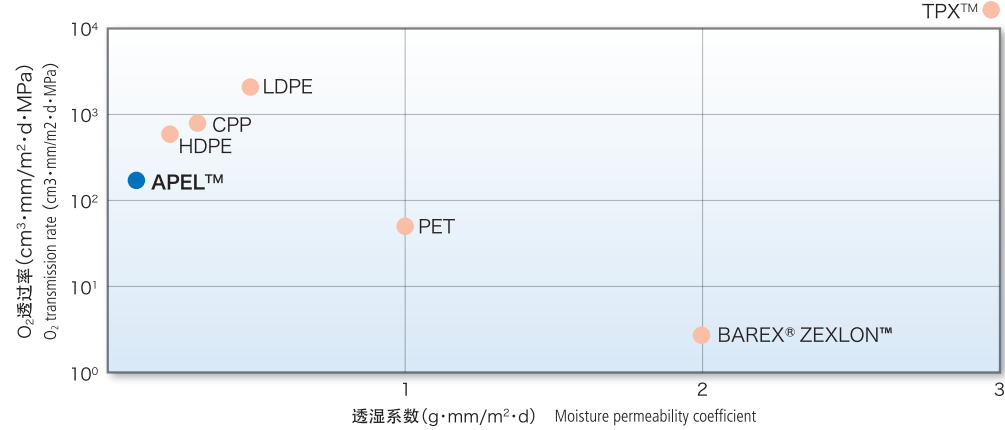


防潮性 Moisture-proofness

气体阻隔性 / 透气性

Gas barrier properties/Gas permeability

呈现出较高的防潮性。 APEL™ displays excellent moisture-proof properties.

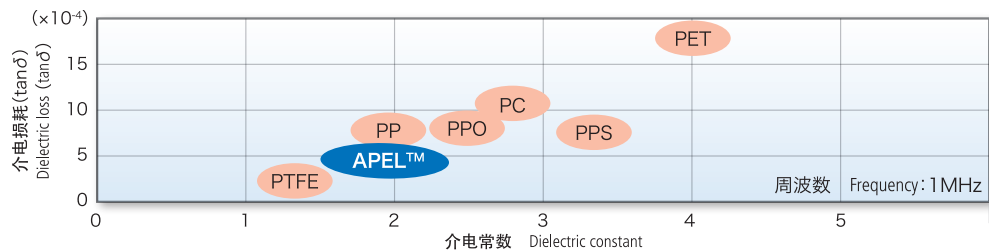


电气特性 Electrical characteristics

透明树脂的电气特性比较

Electrical characteristics comparison of transparent resins

与其他聚烯烃一样，具有优越的电气特性。 APEL™ has superior electrical characteristics inherent to polyolefins.

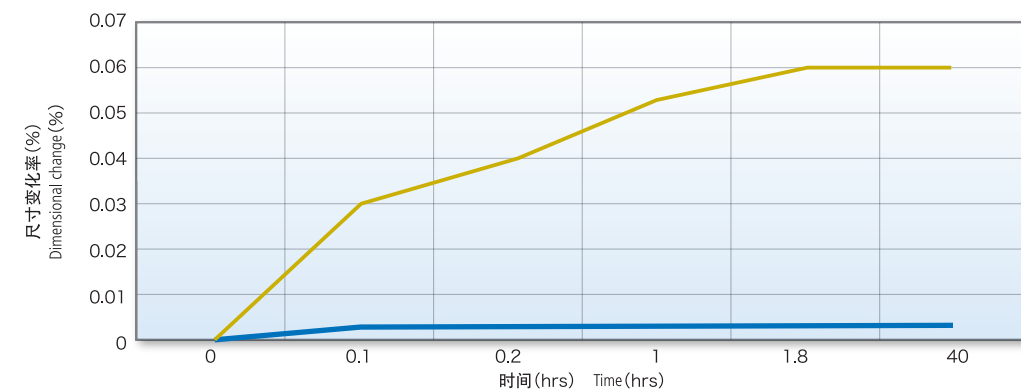


尺寸稳定性 Stability in dimensions

因吸水引起的尺寸变化

Dimensional change by water absorption

由于吸水性较低，因此尺寸不发生变化。 Free from dimensional variation due to its low water absorption.



— APEL™
— PC

测量条件=105℃、100% R.H.
试件=3.5英寸圆盘
Measurement conditions: 105 °C, 100% R.H.
Test piece: 3.5" disk

耐化学品性 Chemical resistance

透明树脂的耐化学品性比较

Chemical compatibility of transparent resins

APEL™具有高度的耐酸、耐碱、耐极性溶剂的特性。
APEL™ has excellent chemical resistance to acid, alkali and polar solvents.

○可使用 △注意 ×不可使用
+ good / swell - dissolve

化学品的种类 Chemicals	APEL™	PS	PET	PVC
酸 Acid	○ +	○ +	△ /	○ +
碱 Alkali	○ +	○ +	× -	△ /
无机盐类 Inorganic salt	○ +	○ +	○ +	○ +
醇 Alcohol	○ +	△ /	△ /	○ +
酮 Ketone	○ +	× -	○ +	× -
酯 Ester	○ +	× -	○ +	× -
氯系溶剂 Chlorinated solvent	× -	× -	○ +	× -
芳香族溶剂 Aromatic	× -	× -	○ +	× -
汽油 Gasoline	× -	× -	○ +	× -
润滑油 Grease	× -	× -	○ +	△ /
色拉油 Salad oil	○ +	△ /	○ +	○ +
柠檬 Limonene	× -	× -	○ +	○ +

面向医药、医疗用途的卫生试验结果

Hygienic test results for medicinal/medical applications

试验的分类 Test classification	项目 Item	标准 ^{※1} Standard ¹	APL8008T(Tg 等级低的牌号) APL8008T (lower Tg grade)	APL6015T(Tg 等级高的牌号) APL6015T (Higher Tg grade)
材料试验 (依据日本药典) Material test (JP compliant)	炽灼残渣 Residue on ignition	0.10%以下 ^{※1} not more than 0.10 % ¹	○ +	○ +
	重金属 Heavy metal	浓度不高于对照液 ^{※1} not greater turbidity than control solution ¹	○ +	○ +
	Pb	低于标准溶液的吸光度 ^{※1} not more absorbance than standard solution ¹	○ +	○ +
	Cd	低于标准溶液的吸光度 ^{※1} not more absorbance than standard solution ¹	○ +	○ +
	Sn	低于标准溶液的吸光度 ^{※1} not more absorbance than standard solution ¹	○ +	○ +
溶出试验 (依据日本药典) Dissolution test (JP compliant)	起泡沫 Foaming test	在3分钟之内消失 ^{※1} disappears within 3 minutes ¹	○ +	○ +
	pH	与空白溶液之间的差异1.5以下 ^{※1} difference not more than 1.5 from blank solution ¹	○ +	○ +
	氯化物 ²⁾ Chloride ²⁾	低于标准溶液的吸光度 ^{※2} not more absorbance than standard solution ²	○ +	○ +
	KMnO ₄ 还原性物质 KMnO ₄ reducing substance	与空白溶液之间的差异1.0ml以下 ^{※1} difference not more than 1.0 ml from blank solution ¹	○ +	○ +
	UV吸收光谱 UV absorption spectrum	220~241nm: 0.08以下 ^{※1} 220 - 241 nm: not more than 0.08 ¹ 241~350nm: 0.05以下 ^{※1} 241 - 350 nm: not more than 0.05 ¹	○ +	○ +
生物学试验 Biological test	蒸发残留物 Residue on evaporation	1.0mg以下 ^{※1} not more than 1.0 mg ¹	○ +	○ +
	细胞毒性试验 Cytotoxicity test	IC ₅₀ : 90%以上或呈阴性 ^{※1} IC ₅₀ : not less than 90% or negative ¹	○ +	○ +
	急性毒性 Acute toxicity	呈阴性 ^{※3} negative ³	+ (0/10)	+ (0/10)
	皮肤致敏性试验 Skin sensitization test	呈阴性 ^{※3} negative ³	○ +	○ +
	溶血性试验 Hemolysis test	呈阴性 ^{※3} negative ³	○ +	○ +
热原质试验 Pyrogen test	呈阴性 ^{※3} negative ³	○ +	○ +	

○=试验结束后得到的结果属于标准范围内或呈阴性。
※1 标准：日本药典第十三修正版的“聚乙烯或聚丙烯制水溶性注射剂容器”中记载的标准
※2 日本药典第十二修正案
※3 《医用塑料原料树脂标准》日本医疗器械工业协会（原日本医疗器械协会）

+ = Compliant or negative results obtained in the performed tests.
*1 Standard: polyethylene or polypropylene containers for aqueous injections (Japan Pharmacopoeia 13th edition)
*2 Japan Pharmacopoeia 12th edition
*3 Medical plastic raw material resin standard (Japan Medical Devices Manufacturers Association (former JAMMI))

医疗应用实例 Medical application example

APEL™不仅在要求具备良好防潮性的包装 / 容器中使用，还应用于可以进行γ射线辐照灭菌或高压灭菌，并要求具有耐化学品性或非吸附性的容器中。

Other than for packages/containers that require excellent moisture proofness, APEL™ is applicable for gamma-ray sterilization and autoclave sterilization as well as for containers requiring chemical resistance and non-attachment characteristics.

- PTP包装膜
- 预充式注射器
- PTP sheets
- Pre-filled syringes
- 药瓶
- 化妆品容器/检查用容器
- Bottles for medicine
- Bottles for cosmetics, Cells for analysis



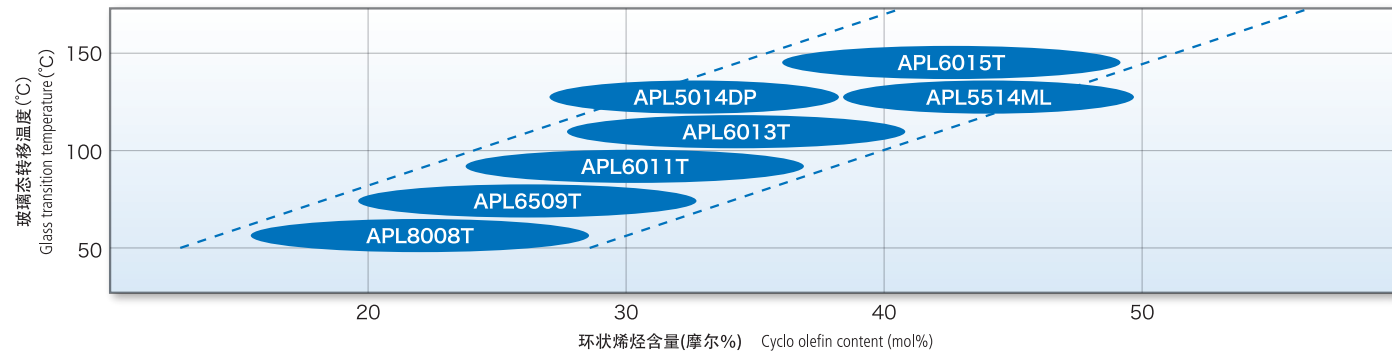
APEL™

APEL™



APEL™的产品阵容

APEL™ Grade Line-up



主要牌号的物性

Physical properties

试验项目 Properties	测量方法 Test method	单位 Unit	APL8008T	APL6509T	APL6011T	APL6013T	APL5014DP	APL5514ML	APL6015T
TMA	三井化学法 MCI method	°C	80	90	115	135	147	147	155
Tg	三井化学法 MCI method	°C	70	80	105	125	135	135	145
比重 Specific gravity	ASTM D792	—	1.02	1.02	1.03	1.04	1.04	1.04	1.04
MFR (260°C, 2.16Kg)	ASTM D1238	g/10min	15	30	26	15	36	36	10
HDT (1.82MPa)	ASTM D648	°C	60	70	95	115	125	125	135
抗拉强度 Tensile strength at yield	ASTM D638	MPa	50	60	60	60	60	60	60
断裂伸长率 Tensile strength at break	ASTM D638	%	100	60	3	3	3	3	3
抗弯弹性模量 Flexural modulus	ASTM D790	MPa	2400	2500	2700	3000	3200	3200	3200
抗弯强度 Flexural strength	ASTM D790	MPa	90	100	110	110	100	100	110
IZOD冲击强度 Izod impact strength	有缺口 notched	J/m	45	35	25	25	25	25	25
	无缺口 w/o notched	kJ/m ²	33	20	15	15	10	10	10
透湿系数 Moisture permeability	ASTM F1249	g·mm/m ² ·d	0.09	0.09	0.09	0.09	0.09	0.09	0.09
透光率 Light transmittance	ASTM D1003	%	91	91	90	90	90	90	90
雾度 Haze	ASTM D1003	%	2	2	3	3	2	≤0.5	4
折射率 Refractive index	ASTM D542	nD	1.54	1.54	1.54	1.54	1.54	1.54	1.54
成型收缩率 Mold shrinkage (MD/TD)	三井化学法 MCI method	%	0.6 / 0.5	0.6 / 0.5	0.6 / 0.5	0.6 / 0.5	0.6 / 0.5	0.6 / 0.5	0.6 / 0.5
线膨胀系数 Linear expansion Coeff. (×10 ⁻⁵) (MD/TD)	D696	—	7/6	7/6	7/6	7/6	7/6	7/6	7/6
应用实例 Applications	—	—	薄膜、片材 Film, Sheet	薄膜、片材 Film, Sheet	工业零部件 Industrial parts	热灌装容器 Hot-fill containers	光学用 Optical	光学用 Optical	医疗容器 Medical package

基本物性的比较

Comparison of basic properties

试验项目 Test items	试验方法ASTM Test method ASTM	试验条件 Testing conditions	APEL™ (APL6509T)	APEL™ (APL6015T)	PC	PMMA	PS	硬质PVC Rigid PVC
比重 Specific gravity	D792	23°C/4°C	1.02	1.04	1.20	1.18	1.05	1.38
热变形温度(°C) Heat distortion temperature (°C)	D648	1.82MPa	70	135	125	75	80	70
抗拉强度(MPa) Tensile strength at yield (MPa)	D638	23°C	60	60	65	65	45	55
断裂伸长率(%) Tensile strength at break (%)	D638	23°C	60	3	110	2	3	150
抗弯强度(MPa) Flexural strength (MPa)	D790	23°C	100	110	90	110	80	100
抗弯弹性模量(MPa) Flexural modulus (MPa)	D790	23°C	2500	3200	2400	3000	3100	3000
IZOD冲击强度 有缺口(J/m) Izod impact strength (notched) (J/m)	D256	23°C	35	25	650	20	20	20
洛氏硬度 Rockwell hardness	D785	23°C	120	125	70	80	80	110
吸水率(%) Water absorption rate	D570	23°C×24h	<0.01	<0.01	0.2	0.3	0.03	0.1

认证标准

Certified Standards

并非所有牌号都取得了认证。如有认证牌号的需要，请咨询本公司。
Contact us when using a certified grade is required since not all the grades are certified.

认证标准	APL8008T	APL6509T	APL6011T	APL6013T	APL5014DP	APL5514ML	APL6015T
聚烯烃等卫生协议会： 注册编号[A]NEZar-0002-L Japan Hygienic Olefin And Styrene Plastics Association: Reg.No.[A] NEZar-0002-L	○	○	○	○	—	—	○
UL注册 UL Registration	—	—	—	—	94HB	94HB	—

化审法官报公示整理编号：(6)-1782

注意事项

Precautions

1.一般注意事项

- 在本宣传册中记载的数据，是根据本公司的试验方法得出的代表性测量值实例。
- 详细技术资料请另行索取。
- 详细的安全信息请参阅《物质安全数据表》。
- 使用宣传册中介绍的产品时，也请注意工业所有权。
- 另外，使用产品时，请事先评估产品的实用性并确认使用上不存在问题。
- 本宣传册中记载的内容根据当前获取的资料、信息、数据等编制而成，但是就所记载的数据和评估本公司不提供任何保证。
- 此外，由于上述注意事项的前提是一般处理，因此在实行特殊处理时，请根据新的用途、用法采取适当的安全措施后再进行处理。
- 在保管场所中，请避免靠近明火、直射阳光、漏水以及急剧的温度变化。
- 请避免在室外长期使用。被直射阳光暴晒后可能会引起变色或导致物性恶化。

2.在医疗/食品等方面作为容器、包装用途使用

- 当您考虑如此应用时，请咨询本公司。

1.General Precautions

- The data indicated in this brochure are representative values obtained by our own testing methods.
- Detailed technical information is available on request.
- As for detailed safety information, please refer to Materials Safety Data Sheet.
- Please pay attention to industrial property rights about applications listed in this brochure. Before using the product, please evaluate the practical applicability and make sure that it will not cause any problems in usage.
- The written contents in this brochure are based on currently available information and data etc. Please be mentioned that we do not provide any warranty about the listed data and evaluation.
- These precautions are given on the assumption that the product would be used in a normal way. If it is used in any special way, please take additional safety measures accordingly.
- Please avoid fire, direct sunshine, water wetting and any abrupt temperature change in the storage place.
- Please avoid outdoor use for a long period of time as it may cause color change or property deterioration.

2.Use for Medical or Food containers/packages

- Please contact us when you intend to use the product for such applications.



APEL™成型技术资料

1.注射成型机

1—1 成型机的选择基准

- 由于APEL™的光学产品通常在270℃左右(最大310℃)的高温下注射成型，因此需要具备足以达到该温度的加热容量并且能够控制温度。
- 针对产品容量，请选择适宜尺寸的成型机。尺寸过大的成型机，会加长熔融状态树脂的滞留时间，从而易导致树脂的碳化或黄变。

1—2 螺杆设计

- 螺杆压缩比最好为较低的2：1左右，但是当压缩比达到2.5：1时也可以成型。
- 建议使用全螺纹螺杆。另外，螺杆顶端最好带有回流防止机构。
- 若APEL™在可塑化时的剪切应力过大，则易引起树脂变色或混入黑点。

1—3 螺杆/料筒的材质

- 建议使用针对熔融树脂具有优越非附着性的涂层。
- 除Cr镀层之外，涂层还可以使用TiN、TiCN、TiC、W2C等。

1—4 喷嘴

- 既可以使用开放式喷嘴，也可以使用截流式喷嘴。

2.模具设计

2—1 基本结构

- 在模具设计上，请将APEL™的成型收缩率设计为0.6%，然后进行微调。此外，考虑到成型收缩率，请将起模斜度设置在2°以上。
- 由于APEL™是一种刚性较高、拉伸较小的树脂，倒勾形状会导致成型品出现裂纹，因此不适用。

2—2 模具的材质

- 由于可以充分地进行镜面抛光，因此在选择材料上请留意，在成型时衍生的气体成分应难以附着在模具表面上。

2—3 浇口、流道、浇道

- 可以与一般树脂的设计使用相同的形状。
- 针点浇口不易在成型品的浇口部位残留内应力，并且具有无需在成型品的浇口部位进行精加工的优点。
- 由于热流道易导致树脂的滞留，从而产生黑点、焦烧或变色，因此建议采用冷流道。
- 流道使用圆形最佳。

2—4 排气

- 尽管也有气体从分模线排出，但气体成分导致云雾状的白色现象时，需要设置0.02mm左右的排气槽。

2—5 防拉丝

- 喷嘴在高温时可能出现拉丝现象，但若采用具有防拉丝功能的浇道设计，可有效防止拉丝现象。

3.成型方法

3—1 预干燥

- 建议对粒料进行预干燥。
- 尽管APEL™属于吸湿性较小的树脂，即使不进行预干燥也可以成型，但是当料表面吸附微量水分时，可能会对成型品的外观造成影响。此外，由于空气溶存于粒料中，因此可能会导致黄变，或因溶存空气发生气化而导致转印不均匀。所以，对外观有高水平要求时，要进行预干燥，以有效防止上述现象。
- 对粒料进行预加热在成型时具有使可塑化更加顺利的效果。

■ 干燥条件

牌号	温度(℃)	时间
APL6509T	60	5~6
APL6011T	80~90	5~6
APL6015T	80~100	4~5

3—2 材料清洗

- 从其他材料进行更换时，请结合成型温度，使用市面上销售的清洗用粒料或聚丙烯(均聚物型)进行清洗(3~5kg)，然后更换为APEL™。更换后请用2~3kg的APEL™进行清洗，并确认清洗后的成型品没有油污或云雾状的白色现象。
- 如上述方法的清洗仍不充分时，可以在清洗材料中使用玻璃纤维增强PP或拔除螺杆进行清除。

3—3 成型条件

●料筒温度

- 不同牌号的APEL™耐热性不同，请根据所使用的牌号依据下列公式进行设定。
料筒温度＝APEL™的软化温度(TMA值)+100~130℃

- 除加料斗以外，请将各料筒体的温度设定在几乎相同的水平上。
- 设定温度过低时，由于料筒内可能会出现异常噪音，因此请调高料筒温度。特别是提高加料斗一侧(在螺杆压缩部分之前)的温度会更具效果。

●模具温度

- 由于APEL™是一种非晶性树脂，因此与像PP、PE那样的结晶性树脂相比，模具转印性更容易受到模具温度的影响。模具温度的上限请参阅下表。

牌号	模具温度的上限值℃
APL6509T	<80
APL6011T	<100
APL6015T	<140

●背压

- 一般为3MPa(300kgf/cm²)、最大为10MPa(100kgf/cm²)。
- 提高背压也可能导致焦烧、变色或出现凝胶。

●注射压力

- 请在50~150MPa的范围内尽可能低地设置保压(二次压力)。
- 由于APEL™这种非晶性树脂在模具内的固化速度较快，因此保压过高会导致浇口部位出现裂纹或引起变形残留等问题。

●注射速度

- 可以期待通过提升APEL™的注射速度，从而优化模具转印性，使得产品外观的品质得到提高。

●松退

- 请尽可能地不要进行松退。
- 尽管为预防拉丝而进行松退可取得效果，但是从喷嘴中卷入的空气会引起气泡的产生或出现焦烧。在不得不进行松退时，请尽可能地减少松退量。

●螺杆转速

- 转速过快时，可能会因卷入空气而导致气泡产生等现象发生。

3-4 中断、结束成型时的处置

- 在设备运行暂时中断时，请停止成型机。
- 运行中断时间超过1小时的情况下，请在料筒内更换为PP后停止成型机。更换为PP时，若将料筒温度降至170℃则更能达到效果。
- 运行结束时，在料筒内更换为PP后切断加热器。

本资料中记载了关于APEL™的一般注射成型的注意事项。

我们还另行准备了光学产品技术资料，有关光学产品的成型欢迎您前来咨询。

APEL™ Molding Technical Information

1.Injection-molding machine

1-1 Selection criteria of molding machine

- Optical grades of APEL™ are usually injection-molded at a high temperature around 270℃ (max. 310℃), thus require a molding machine that is equipped with sufficient heating capacity and temperature control to handle the temperatures.
- The molding machine size should be adequate to the product volume.A bigger machine tends to lengthen the retention time of molten resin, often resulting in carbonation and/or yellow discoloration of the resin.

1-2 Screw design

- A lower compression ratio around 2 is preferable, but molding is possible with about 2.5.
- A full flight screw is recommended to use. It is preferable that the screw head incorporates a backflow prevention mechanism (a check valve).
- High shear stress at plasticization may cause discoloration and/or black spots on APEL™.

1-3 Material of screw and cylinder

- Coating of non-attachment properties to molten resin is recommended to use.
- Effective coatings include Cr plating as well as TiN, TiCN, TiC or W2C.

1-4 Nozzle

- Open type or shut-off type is useable.

2. Mold design

2-1 Basic structure

- Mold should be designed with APEL™ mold shrinkage of 0.6%, followed by a fine adjustment. A drift angle of 2° or greater should be applied, taking the mold shrinkage into consideration.
- APEL™ is a resin that has a high rigidity and is low in extensibility, thus is not suitable for an undercut shape which may cause cracks on mold goods.

2-2 Material of mold

- Choose a material that is suitable for thorough mirror polishing and on the mold surface of which gases resulting from molding processes are unlikely to produce tarnish.

2-3 Gate, runner, sprue

- Shapes similar to those used for conventional resins are applicable.
- A pinpoint gate is effective for reducing internal stress in the gate of mold goods and also for eliminating the need of finishing process on the gate of mold goods.

- A cold runner is more recommendable than a hot runner as a hot runner may cause black spots, yellowing and/or discoloration due to retention of resin.
- Round type is the most suitable for a runner.

2-4 Degassing

- egassing can be done through the parting lines, but when tarnish that is likely on account of gases is recognized it will be necessary to make an approximately 0.02 mm deep ditch for degassing.

2-5 Stringiness prevention

- A high nozzle temperature can cause stringiness. A sprue having a stringiness preventing function will be effective.

3. Method of molding

3-1 Pre-drying

- Pre-drying of the pellets is recommended.
- APEL™, being a low hygroscopic resin, can be molded without pre-drying. However, a slight amount of water on the surface of a pellet may affect the appearance of molded goods. Moreover, dissolved air in such a pellet may cause yellow discoloration and when gasified it can cause poor transcription. Accordingly, pre-drying is effective whenever a high standard appearance is required.
- Pre-drying a pellet is also effective in making smooth plasticization at molding.

■ Pre-drying conditions

Grade	Temperature (℃)	Time (Hrs)
APL6509T	60	5~6
APL6011T	80~90	5~6
APL6015T	80~100	4~5

3-2 Material Purging

- When another material has been used, it is necessary to perform a purge with a commercially available cleaning pellet that is suitable for the molding temperature or polypropylene (homo-type) for 3 to 5 kgs or so before replacing to APEL™. This should be followed by a purge with APEL™ for 2 to 3 kgs. Check for a muddy or tarnished surface on the molded goods.
- If purging is still insufficient, it will be effective to use glass-fiber reinforced polypropylene as a purging material or to perform a cleaning with the screws removed.

3-3 Molding conditions

- Cylinder temperature
 - The heat resistance of APEL™ differs according to grade, thus a cylinder temperature should be set in line with the following formula:

$$\text{Cylinder temp.} = \text{APEL™ softening temp.} + 100 \text{ to } 130 \text{ } ^\circ\text{C}$$

- Except for the space under the hopper, the temperature of each cylinder block should be set practically flat.
- When temperature setting is too low and noise is heard in the cylinder, increase the cylinder temperature. Increasing the temperature in the hopper side (before screw compression section) will be especially effective.
- Mold temperature
 - APEL™ is an amorphous resin, thus its mold transcription tends to be susceptible to the mold temperature, compared to crystalline resins such as polypropylene and polyethylene. Refer to the table below for the upper limit temperatures of mold.

Grade	Max. temp. of mold (℃)
APL6509T	<80
APL6011T	<100
APL6015T	<140

- Back pressure
 - 3 MPa (300 kgf/cm²), maximum 10 MPa (100 kgf/cm²)
 - Too much backpressure may lead to yellowing, discoloration and/or gel generation.
- Injection pressure
 - Holding pressure (secondary pressure) should be set as low as possible in the range of 50 to 150 MPa.
 - Because of high solidification speed of amorphous materials such as APEL™, too high holding pressure will cause cracks and/or leave deformation around the gate.
- Injection speed
 - Increasing injection speed is effective in improving mold transcription, thus improving the appearance of goods.
- Suck-back
 - Suck-back should be avoided as much as possible.
 - Although suck-back is effective in preventing stringiness, by dragging air in from the nozzle it may cause bubbles and/or yellowing. If suck-back is unavoidable, make the suck-back volume minimal.
- Screw speed
 - If the screw speed is too high, it may drag air in and cause bubbles.

3-4 Pausing or termination of molding

- Stop the molding machine to interrupt the operation for a short time.
- When interruption is to last an hour or longer, replace the cylinder internal area with polypropylene, then stop the machine. Decreasing the cylinder temperature to 170℃ will be effective with polypropylene replacement.
- To terminate the operation, switch off the heater after the cylinder internal area is replaced with polypropylene.

This information describes points to consider concerning general APEL™ injection-molding.

As regards optical products’ molding, technical information on optical products is separately available upon request.