NAN YA PBT Engineering Plastics

Mechanical Properties · Durable · Heat Resistant ·
Moisture Absorption · Abrasion Resistant · Glossy · Coloring

Introduction

PBT (Polybutylene terephthalate) is an engineering plastics series manufactured by NAN YA PLASTICS. Through the polymerization of 1.4-Butylene glycol (1.4-BG) with Pure Terephthalic Acid (PTA) or Dimethyl Terephthalate (DMT), the process utilizes a mix of hybrid processes to manufacture PBT with excellent mechanical properties, high rigidity, dimensional stability, heat aging resistance and chemical properties. Due to the ease of processing and coloring, abrasion resistance and electrical properties, PBT applications in the information, electrical, electronics and automobile industries have increased rapidly. NAN YA PBT Engineering Plastic can provide products with the aforementioned properties at any grade such as ordinary grade, reinforced grade, heat resistant grade and special grade.

NAN YA PBT Engineering Plastic Characteristics

1. High mechanical properties with excellent durability.
2. Good heat resistance qualities, ul long term heat resistant temperature 140, heat deflection temperature 58/210.
3. Excellent electrical properties.
4. Good weather resistance and chemical resistance.
5. Low moisture absorption and high dimensional stability.
6. High abrasion resistance.
7. High crystallization speed, excellent formation properties, and ease of flow allow production into thin films.
8. Shiny texture and good coloring properties.
9. Conforms to UL 94 V-0 flammability standards.

NAN YA PBT APPLICATION

From the above properties, NAN YA PBT has a wide range of applications, as listed below:

Electrical and Electronics	Connectors, terminals, transformers and cables, phone receiver keypad base, FBT component of TVs, air-outlet of hairdryer, hair dresser comb, micro-switch, measuring devices, mechanical base of various timers, switches, external casing of shavers and components, energy-saving lamp base and cover, motor casing and air-outlet of air conditioner.
Automotive Industry	Windscreen wipers, door handles, engine ignition starters, electricity distribution boards (board, cover and rotor), front panel air-inlet of air conditioner, electrical connectors, pump components, and exhaust air emission bottles.
Other Industries	OA machine heat sink fans and casings, OA machine external casings, watches, clocks and components, camera components, pipe fittings and roller skates
Other	Fibers (Use in heat retention clothing such as sports suits and swimsuits), other extrusion purposes, and use of BLEND materials in Polymer-alloys.

PHYSICAL PROPERTIES

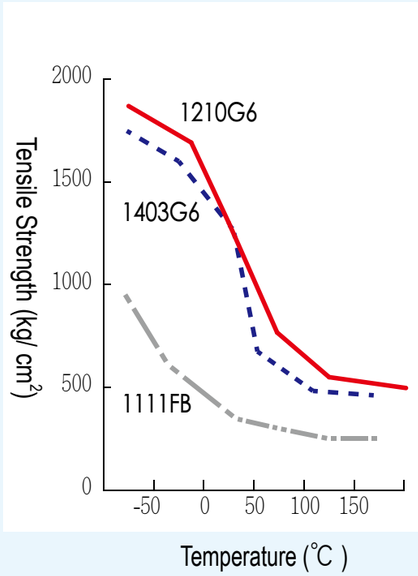
Due to different uses in different environments, the effects on the physical properties will also vary. The relations of NAN YA PBT physical properties and the temperature, heat aging properties and weather resistance will be described as follows:

♦ Relation between physical properties and temperature

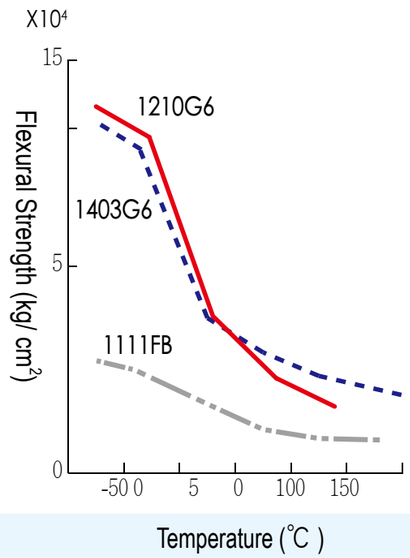
The relations of tensile strength, flexural strength and IZOD Impact Strength of the representative models, 1111FB, 1210G6, 1403G6 against temperature are as illustrated in Graphs 1~3.

♦ Heat aging resistance

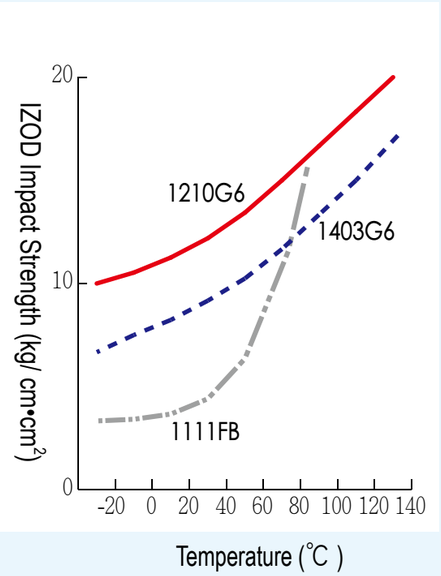
When NAN YA PBT representative models of 1210G6 and 1111FB are subjected to temperatures of 120℃ and 140℃ , the tensile strength versus heat-aging resistances are as shown in graphs 4 and 5.the graphs show the excellent qualities of the products. in graph 6, the graph shows the decay time and temperature countdown at 50% tensile strength.



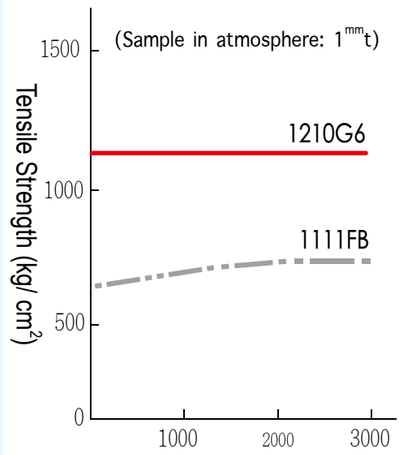
Graph 1: Relation between tensile Strength and temperature



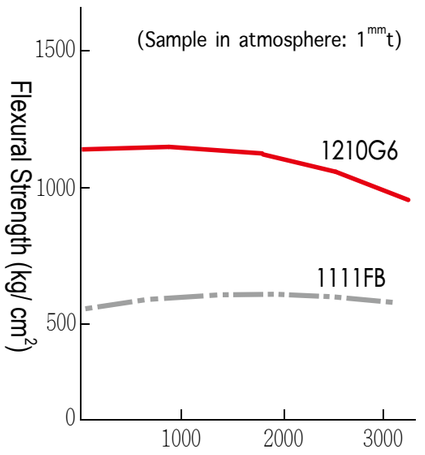
Graph 2: Relation between flexural strength and temperature



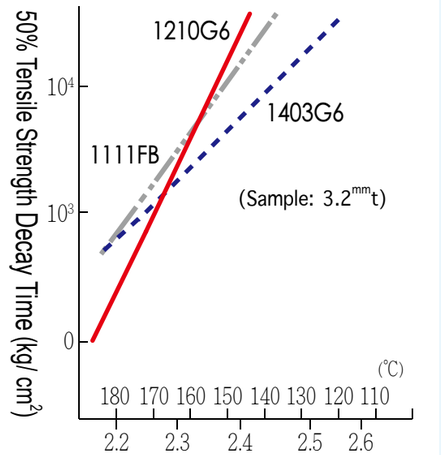
Graph 3: Relation between IZOD Impact strength and temperature



Graph 4: 120℃ heat- aging resistance



Graph 5: 140℃ heat- aging resistance



Graph 6: 50% tensile strength decay time

PHYSICAL PROPERTIES

♦ Weather Resistance

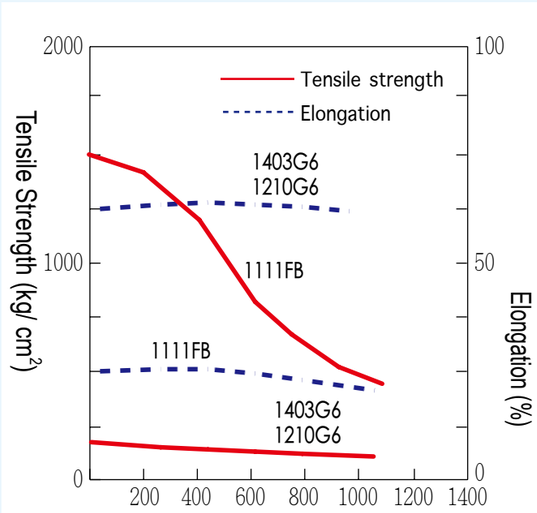
For plastics, weather resistance is an important factor to consider. In this test, the plastic will be tested using two methods, the simulator and outdoor exposure.
NAN YA PBT models 1111FB, 1210G6 and 1403G6 test results are as shown in Graphs 7 and 8. The tensile strength of non-reinforced model 1111FB drops drastically when subjected to minor exposure while the tensile strengths of glass fiber reinforced 1210G6 and 1403G6 drop much less than the non- reinforced model.

♦ Electrical Characteristics

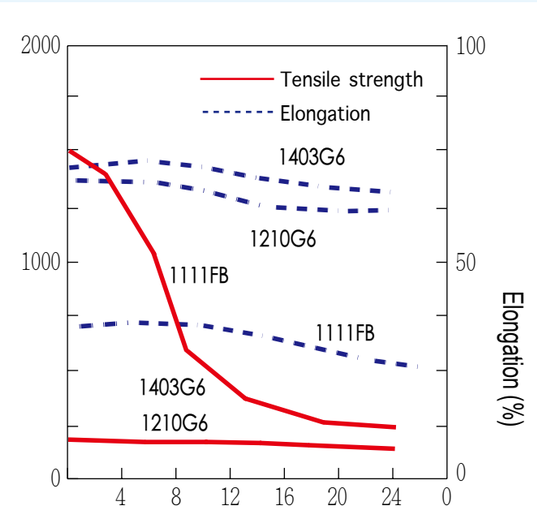
PBT has excellent electrical and heat resistance properties. From graphs 9 and 10, the dielectric strength and volume resistivity against temperature can be observed. UL specifications are as shown in table 1.

Table 1: UL Specifications Certification Table

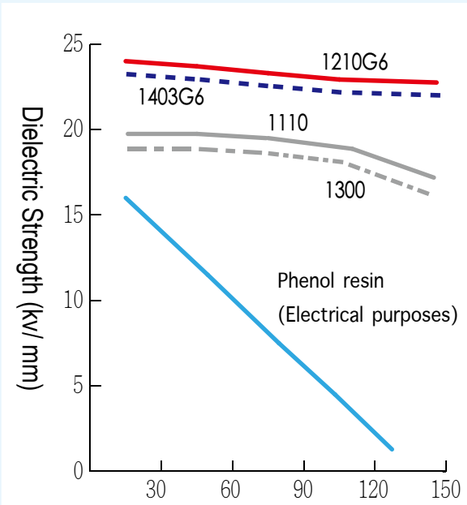
	Thick-ness (mm)	Hot Wire ign	Flam-mab-ility UL	High Amp. Arc Ign	High Volt. Track Rate	D-495 Arc Resis-tance	IEC Track (CTI)
1210G6	0.81	35	94HB	-	0.8	-	-
	1.57	68	94HB	200+	0.8	-	-
	3.07	115	94HB	200+	0.9	67	555
	6.10	268	94HB	200+-	1.8	-	-
1403G6	0.79	25	94-VO	-	9.6	-	-
	1.47	36	94-VO	200+	2.2	-	-
	3.05	52	94-VO	200+	2.3	101	190
	6.10	127	94-5V 94-VO	200+	2.0	-	-
1111FB	0.83	7	94HB		0.2	-	-
	1.57	14	94HB	200+	0.4	-	-
	3.12	29	94HB	200+	0.4	178	600
	6.09	70	94HB	200+-	0.7	-	-



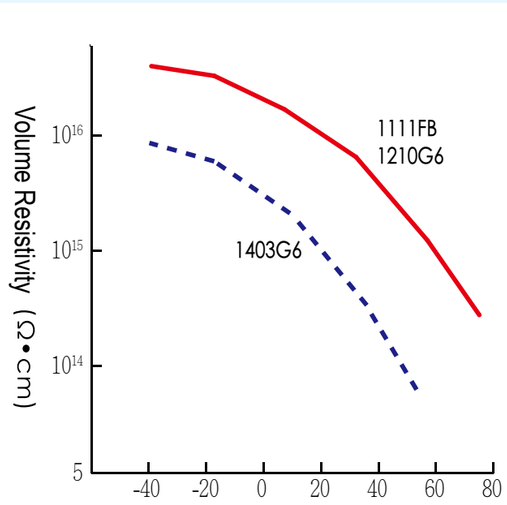
Graph 7: Weather resistance test



Graph 8: Outdoor exposure test



Graph 9: Dielectric strength against temperature

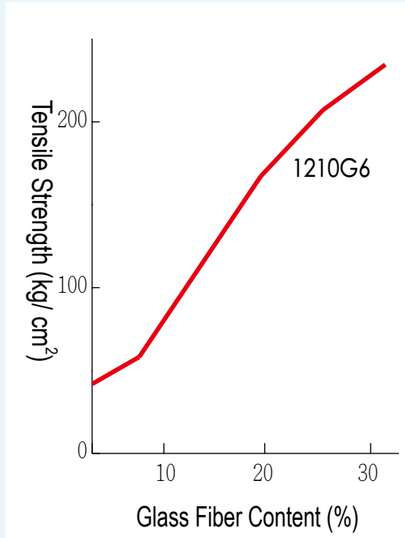


Graph 10: Volume resistivity against temperature

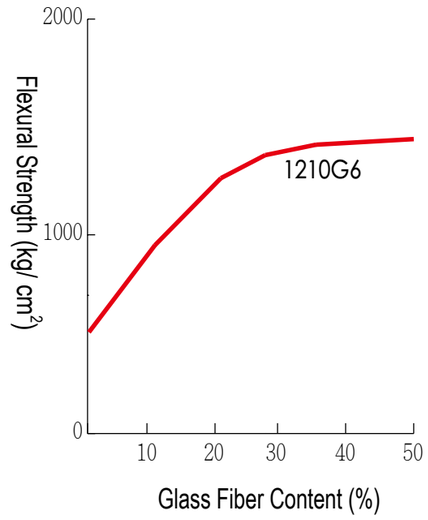
PHYSICAL PROPERTIES

♦ Relation between glass fiber content and physical properties

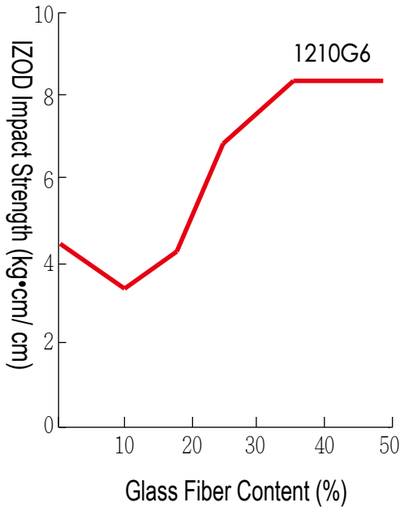
As PBT Engineering Plastic uses glass fibers to reinforce the physical properties, the glass fiber content and heat deflection temperature (pressure 18.6kg/cm2), tensile strength, and IZODimpact are as shown in Graphs 11~13 while glass fiber content, tensile strength, and IZOD impact strength of flame resistant models are shown in Graphs 14 and 15.



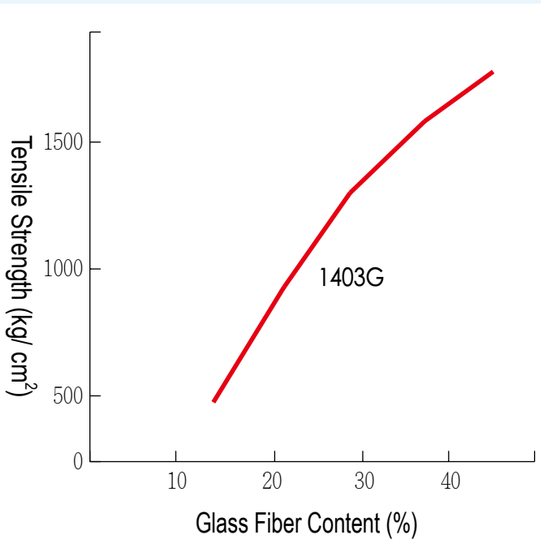
Graph 11:
NAN YA model glass fiber content against heat distortion temperature (pressure 18.6kg/cm^2)



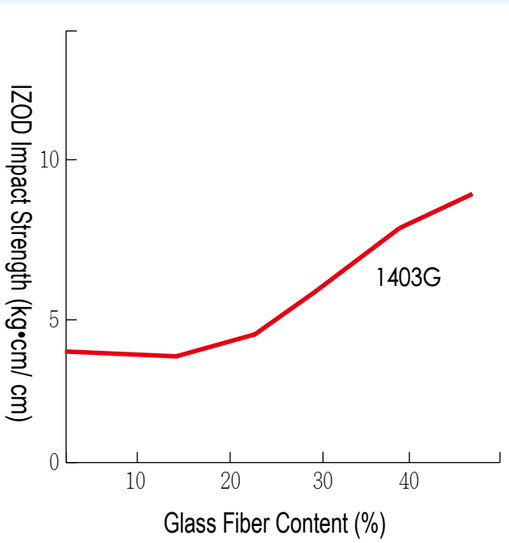
Graph 12:
NAN YA model glass fiber content against tensile strength



Graph 13:
NAN YA model glass fiber content against IZOD Impact



Graph 14:
NAN YA flame resistant model glass fiber content against tensile strength



Graph 15:
NAN YA flame resistant model glass fiber content against IZOD Impact

♦ Chemical Resistance Properties

Applications in different environments may cause the plastic to be in contact with different chemical substances. Table 2. provides reference information for application development. Normally, due to their chemical structures, polyester resins have better acidic solvent resistances but resistances for alkaline solvents are lower, as can be seen in Table 2.

Table 2: Chemical Resistance Properties

Model	Chemical	Immersion temper-ature (℃)	Tensile strength retention rate(%)		Weight Increase (WT%)	
			7 Days	30 Days	7 Days	30 Days
1403G6	5% NH_4OH (aq)	23	96	94	0.1	0.2
	10% NaOH	23	35	2	1.8	0.5
	10% HCl	23	94	88	0.2	0.2
	36% H_2SO_4	23	100	96	0.1	0.1
	36% H_2SO_4	70	92	84	0.6	0.1
1210G6	5% NH_4OH (aq)	23	97	95	0.1	0.2
	10% NaOH	23	34	2	1.6	0.4
	10% HCl	23	95	89	0.1	0.1
	36% H_2SO_4	23	100	97	0.1	0.1
	36% H_2SO_4	70	92	84	0.6	1.1
1111FB	5% NH_4OH (aq)	23	97	95	0.1	0.2
	10% NaOH	23	94	93	0.2	0.2
	10% HCl	23	94	96	0.2	0.3
	36% H_2SO_4	23	99	99	0.1	0.1
	36% H_2SO_4	70	91	92	0.4	0.3

PHYSICAL PROPERTIES

In Table 3, the lubricant and processing oil resistances can be observed. Besides 1111FB which shows a lack of performance at 70℃ during braking, the oil resistances are relatively good.

Table 3: Oil Resistance Properties

Model	Oil	Immersion temperature (℃)	Tensile strength retention rate(%)		Weight Increase (WT%)	
			7 Days	30 Days	7 Days	30 Days
1403G6	Gasoline	23	100	100	0.1	0.1
	Shaft Lubricant	23	100	100	0	0.1
		70	100	100	0.3	0.5
	Braking Oil	23	100	100	0	0
		70	100	100	0.2	0.4
	Silicone Oil	23	100	100	0.1	0
		70	100	100	0	0
	Water- soluble Cutting Oil	23	100	100	0.1	0.2
		70	100	100	0.3	0.4
1210G6	Gasoline	23	100	100	0.1	0.1
	Shaft Lubricant	23	100	100	0	0.1
		70	100	100	0.3	0.5
	Braking Oil	23	100	100	0	0
		70	100	100	0.2	0.4
	Silicone Oil	23	100	100	0.1	0
		70	100	100	0	0
	Water- soluble Cutting Oil	23	100	100	0	0
		70	100	100	0.1	0.2
1111FB	Gasoline	23	100	100	0	0
	Shaft Lubricant	23	100	100	0	0
		70	100	100	0.3	0.5
	Braking Oil	23	100	100	0	0
		70	92	87	0.3	0.6
	Silicone Oil	23	100	100	0.1	0.1
		70	100	100	0	0
	Water- soluble Cutting Oil	23	100	100	0	0
		70	100	100	0.2	0.2

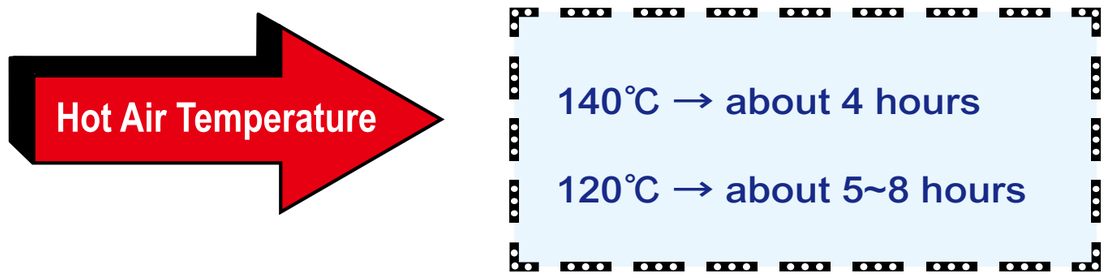
FORMATION OF NAN YA PBT

NAN YA PBT can be made into products through injection or by extrusion methods. Due to wide applications of the injection methods, the required conditions are stated as follows:

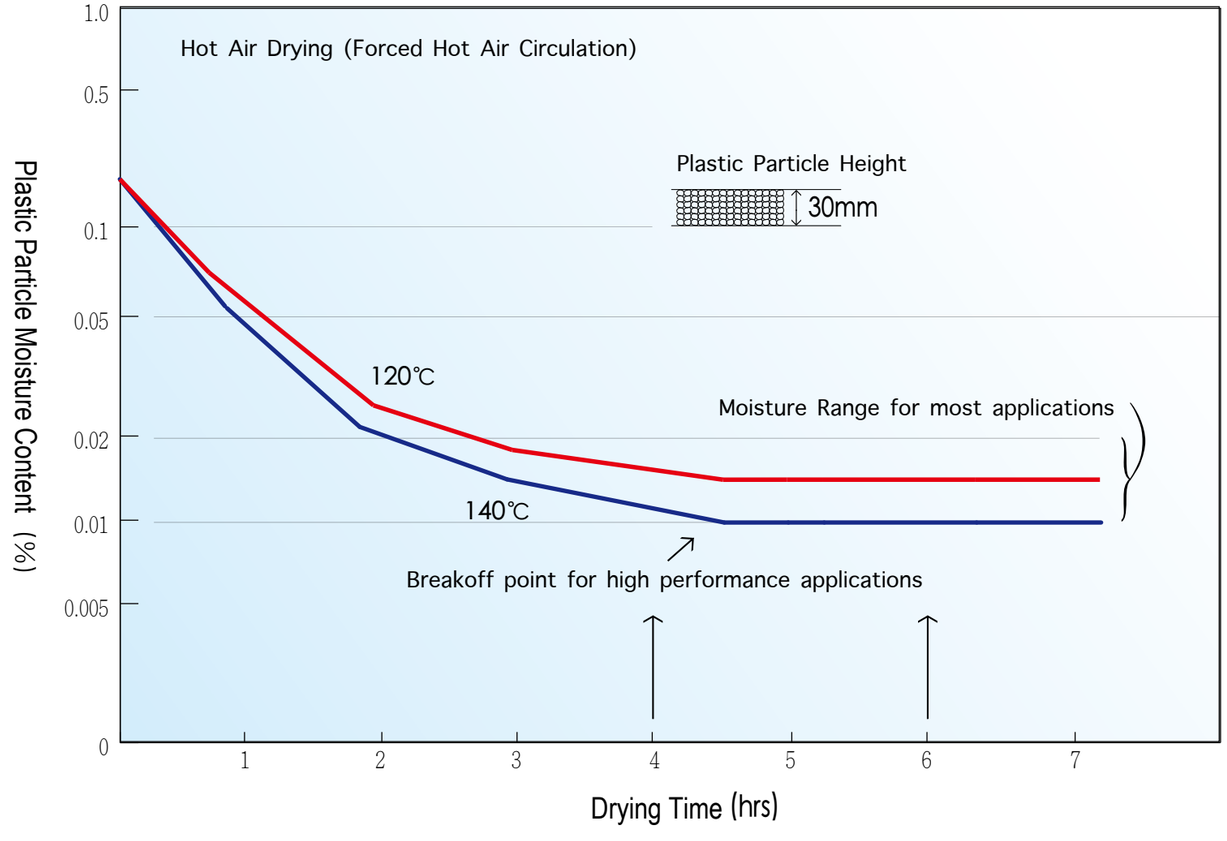
♦ Drying before Injection

NAN YA PBT should be completely dehydrated before injection as moisture content will cause a decrease in mechanical properties.

The drying graph of PBT engineering plastic particles is as shown in Graph 16. Take note that drying temperature should be above 100℃ .

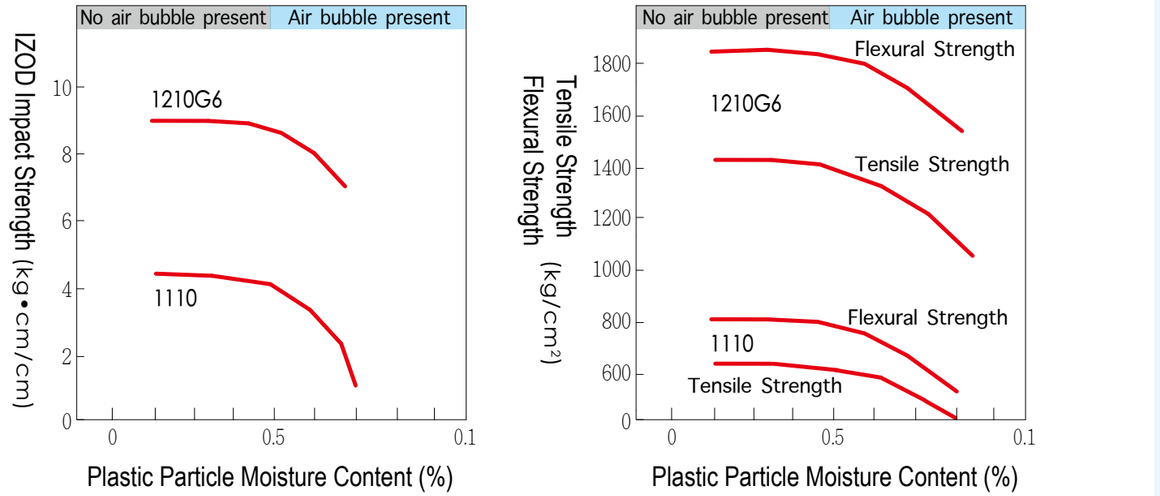


Graph 16: Plastic Particle Drying Speed

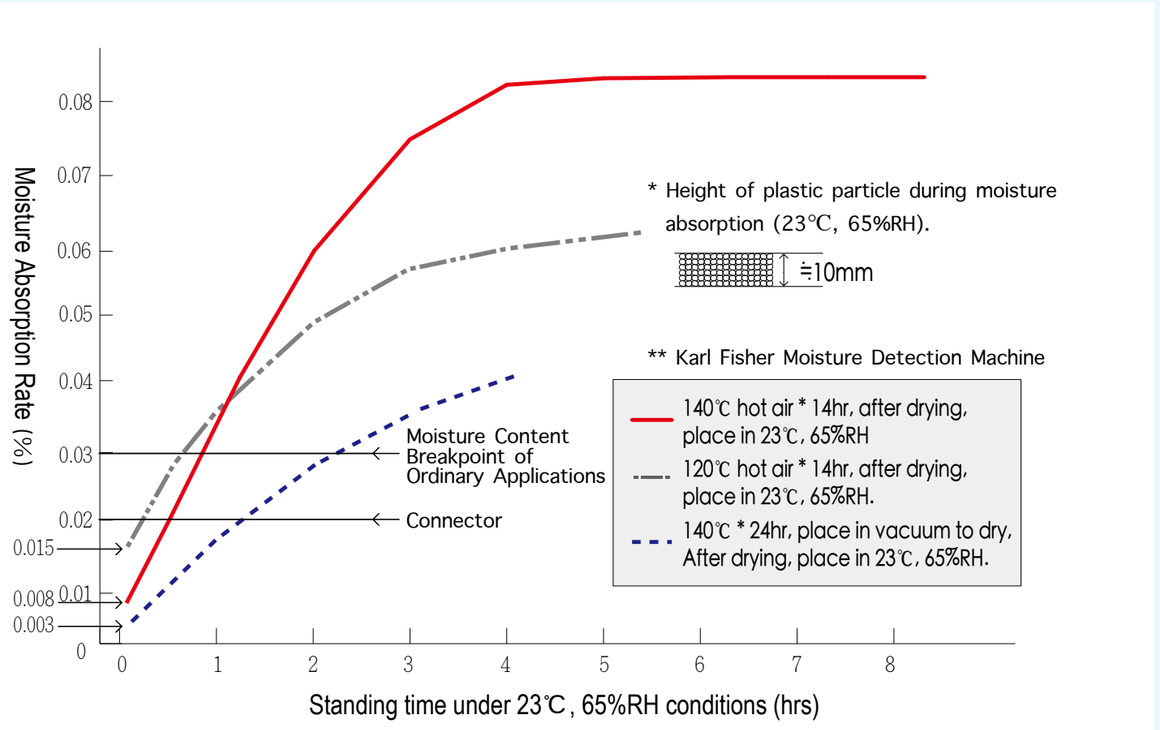


♦ Relation Between Moisture Content and Formation and Physical Properties

From Graph 17, when PBT is formed, the moisture absorption will affect physical properties.
When moisture content is above 0.03%, the product exterior appearance will change and lose certain mechanical properties; hence, when using high- precision projection, the material must be thoroughly dried and injected within half an hour after drying is complete. Moisture absorption is as shown in Graph18.



Graph 17: Relation of Moisture Content and Physical Properties



Graph 18: Moisture absorption of NAN YA PBT 1403G6 under 23℃ and 65%rh conditions

♦ Molding Machine

1. The SCREW-IN-LINE type machine is suitable for formation of NAN YA PBT
2. When selecting injection machine model, assess the product weight. The product weight should ideally be around 50%~80% of projector capacity.
3. For material injection, ordinary injection nozzles may be used with precise temperature control to avoid production errors. If using non- reinforced or low viscosity models, to avoid dripping, SHUT-OFF nozzles may be used.
4. During production, the abrasion resistance of the material feed cylinder, screws and mold on the reinforced model (including glass fibers or non-organic additives) should be considered.

MOLDING OF NAN YA PBT

♦ Molding Conditions

1. Processing temperature of NAN YA PBT plastics is 250~265℃ . If temperature exceeds 275℃ , a short residence time will cause the physical properties to decrease or decomposition issues.
2. Mold temperatures should be ideally around 40~80℃ . To obtain quality exterior appearances or quality dimensional stability, the mold temperature must be maintained. In short, reinforced model or high-precision PBT products require a higher mold temperature.
3. After completion of product, the remaining plastic material in cylinder should be removed and the pipes should be cleaned with PE, PP, or PP cleaning agents.

♦ Molds

1. Mold Surface Processing: For molds used for reinforced models, the surface of the mold should be electroplated or polished and hardened to ensure durability of mold.
2. Gate: SIDE-GATE, PIN-GATE types may be used and reference dimensions are as follows:
3. Exhaust Vents: To solve the problems of bad ventilation and burnt products, exhaust vents of 0.02mm thickness and 1~5mm wide can be considered.

Formation Conditions:
Injection Molding Machine3.5OZ
Sheet molded product 3 mm t x80 mm x80 mm
0.55 mmt Film Gate (film gate)

Model		1100F 1110F	1216M6 1216M6	1300	1403G6
Cylinder Temperature Rear	℃	235	240	235	235
Cylinder Temperature Center	℃	240	245	240	240
Cylinder Temperature Front	℃	240	245	240	240
Nozzle Temperature	℃	245	255	245	250
Mold Temperature	℃	80	80	80	80
Injection Pressure	kg/cm^2	300~400	500~700	300~400	400~500
Screw Rotation Speed	rpm	80	80	80	80
Injection Speed	---	max	max	max	max

Type	Product Thickness	Gate Size
SIDE GATE	1mm	0.5mm x1.0mm
	3	1.5~2.0 x2.5~3
	5	2.5~3.5 x3.5~5
PIN GATE	3mm below	1mmØ (lowest 0.8mmØ)
	3~5	1~2

MOLDING OF NAN YA PBT

♦ Flow ability

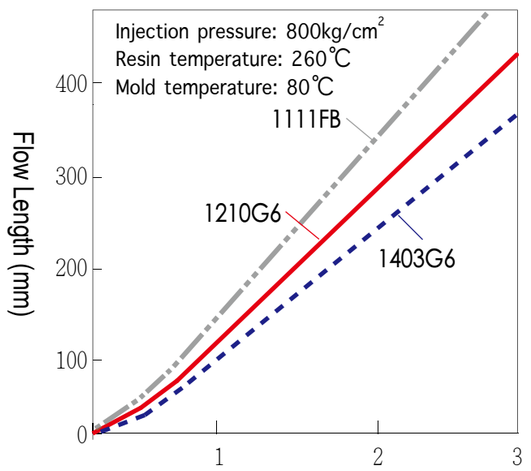
Flow ability of NAN YA PBT representative models is shown in Graphs 19 and 20.

♦ Melting Heat Stability

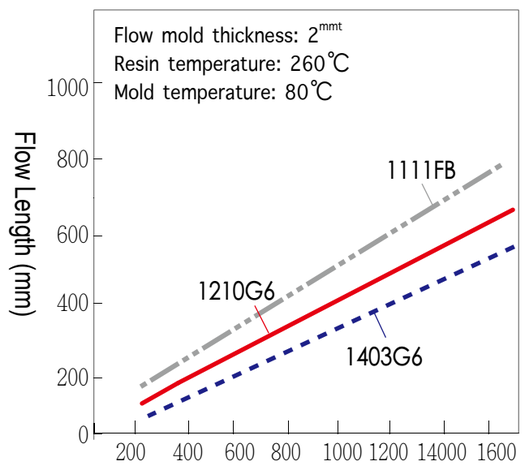
As shown in Graphs 21~23, it can be observed that when NAN YA PBT is subject to high temperatures, residence time will affect decrease in physical properties.

As shown in Graph 21, users should know that when under 270℃ , a half hour residence time will cause a 20% decrease in physical properties.

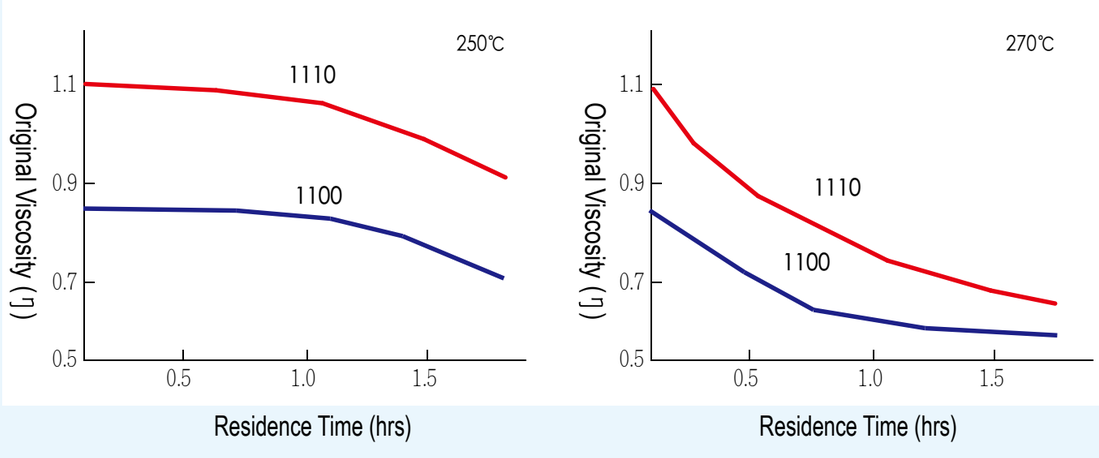
As NAN YA PBT 1403G6 has a wide range of applications, a series of tests is conducted as seen in Graphs 22 and 23. Users are advised to decrease the cylinder temperature for operations lasting more than half an hour to ensure product quality.



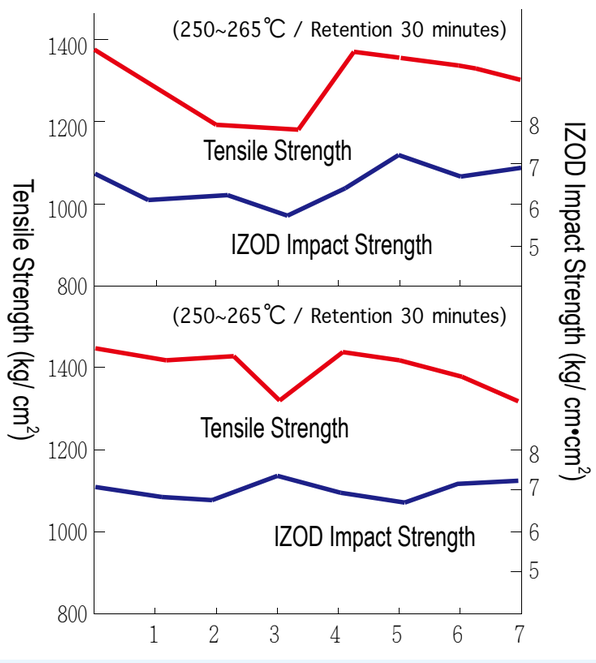
Graph 19: Relation of product thickness and NAN YA PBT flow length



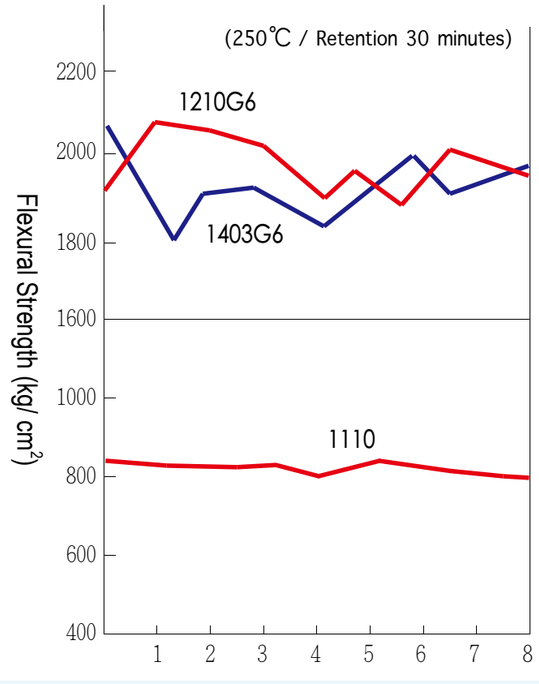
Graph 20: Relation of injection pressure and NAN YA PBT flow length



Graph 21: Melting stability of 1110 at 250℃



Graph 22: Heat stability of melted NAN YA PBT-1403G6



Graph 23: Heat stability of melted NAN YA PBT

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