DAINIPPON INK & CHEMICALS

TECHNICAL REPORT (9712-023)

TRANSPARENT IMPACT RESISTANT THERMOPLASTIC RESIN

CLEAPACT

TECHNICAL PAPER

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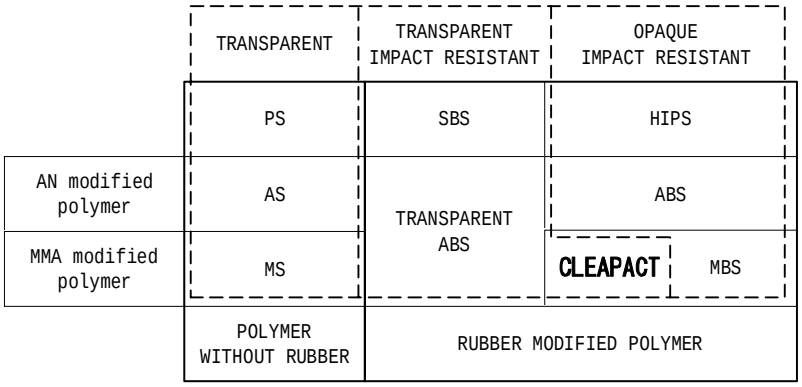
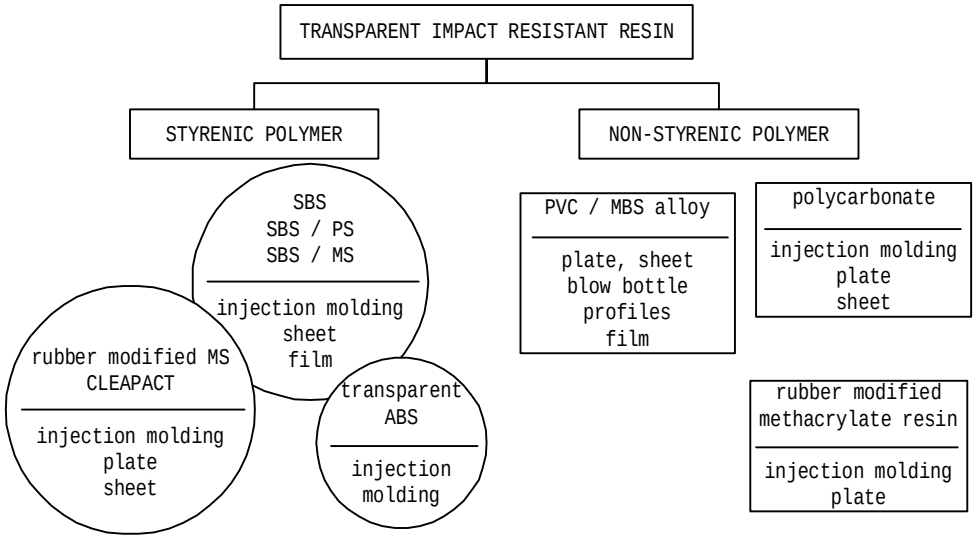
1) INTRODUCTION

CLEAPACT is a new grade of styrene-based copolymer that DIC has developed through an original polymerization technology. This thermoplastic resin possesses an excellent balance of transparency and impact strength, in addition to a good processability.



2) RESIN CHARACTERISTICS

a. High impact strength and good transparency
b. Good recyclability and easy rework
c. Better light resistance than AS resin or PS resin
d. Good processability like AS resin or PS resin
e. Easy postforming, injection and extrusion molding, vacuum forming, pressure forming



	CLEAPACT	AS	Transparent ABS	SBS
Transparency	○	◎	○	○～◎
impact resistance	○	×	○～◎	△
recyclability	○	△	△～○	×
weathering resistance	○	△	○	×
stiffness(rigidity)	○	◎	△	×
chemicals resistance	△	○	○	△
processability	○	○	○	△

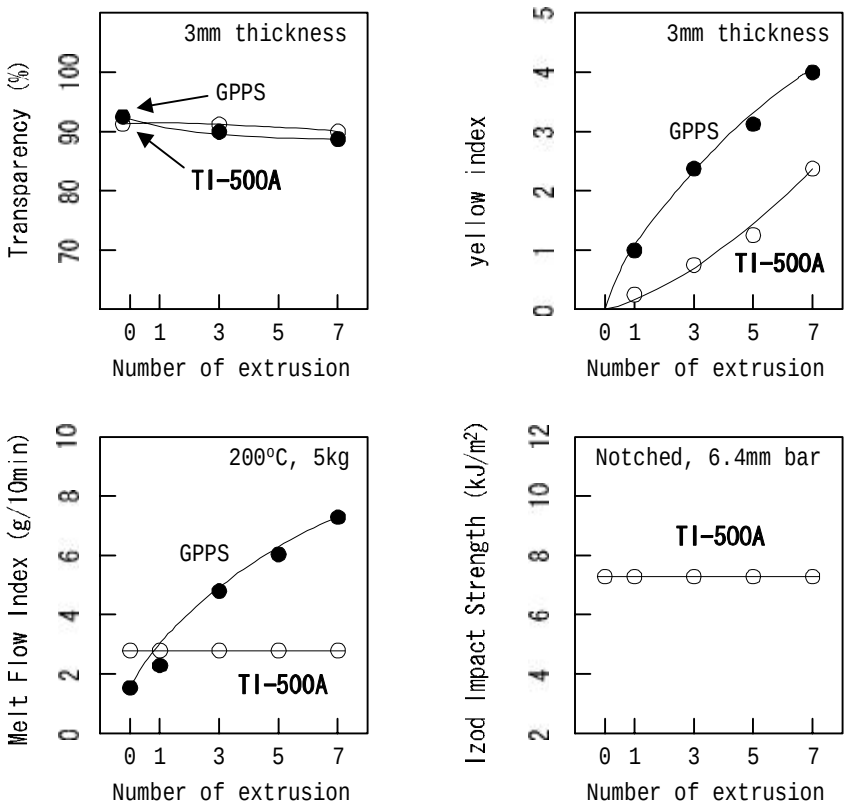
◎:Excellent
○:Good
△:Fair
×:Poor

BASIC PROPERTIES OF CLEAPACT

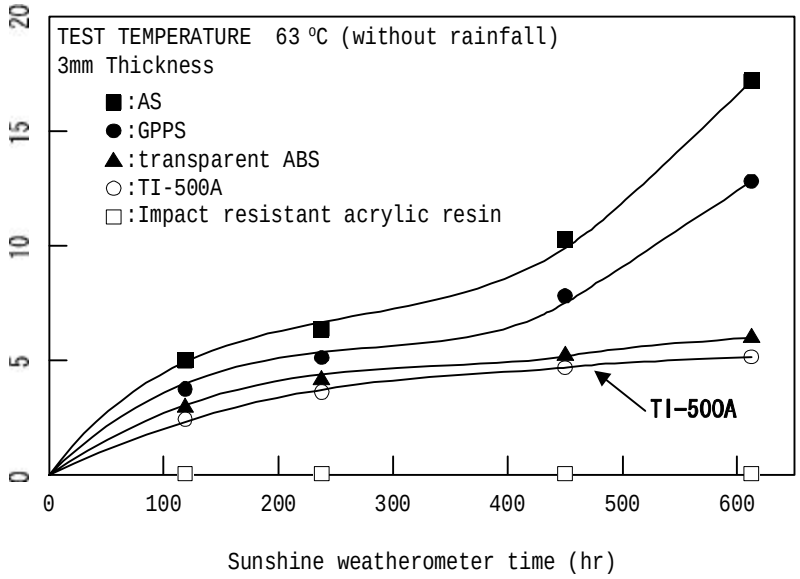
	UNIT	Test Method	CLEAPACT TI-500A	AS	Transparent ABS	SBS
Specific Gravity	-	JIS K7112	1.10	1.07	1.08	1.02
Transparency[1)]	%	JIS K7105	91	91	89	90
Haze[1)]	%	JIS K7105	2.5	0.8	3.5	5.5
Melt mass-flow rate	g/10 min	JIS K7210	3.4	1.6	2.6	8.0
Charpy Impact Strength	KJ/m^2	JIS K7111	11	1.7	8.7	1.5
Tensile Strength	MPa	JIS K7161	50	70	54	39
Flexural Strength	MPa	JIS K7171	75	109	79	34
Flexural Modulus	MPa	JIS K7171	2500	3550	2,490	1,600
Rockwell Hardness	L-Scale	JIS K7202	77	-	75	55
Vicat softening temperature	°C	JIS K7206	84	92	92	62

Notes: 1) Injection molded plate of 3mm thickness

4) RECYCLABILITY OF CLEAPACT



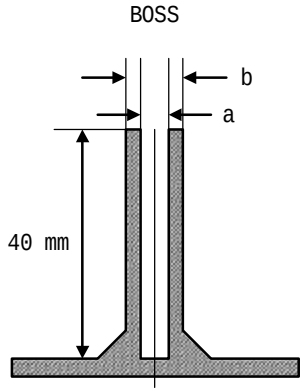
5) WEATHERING RESISTANCE OF CLEAPACT

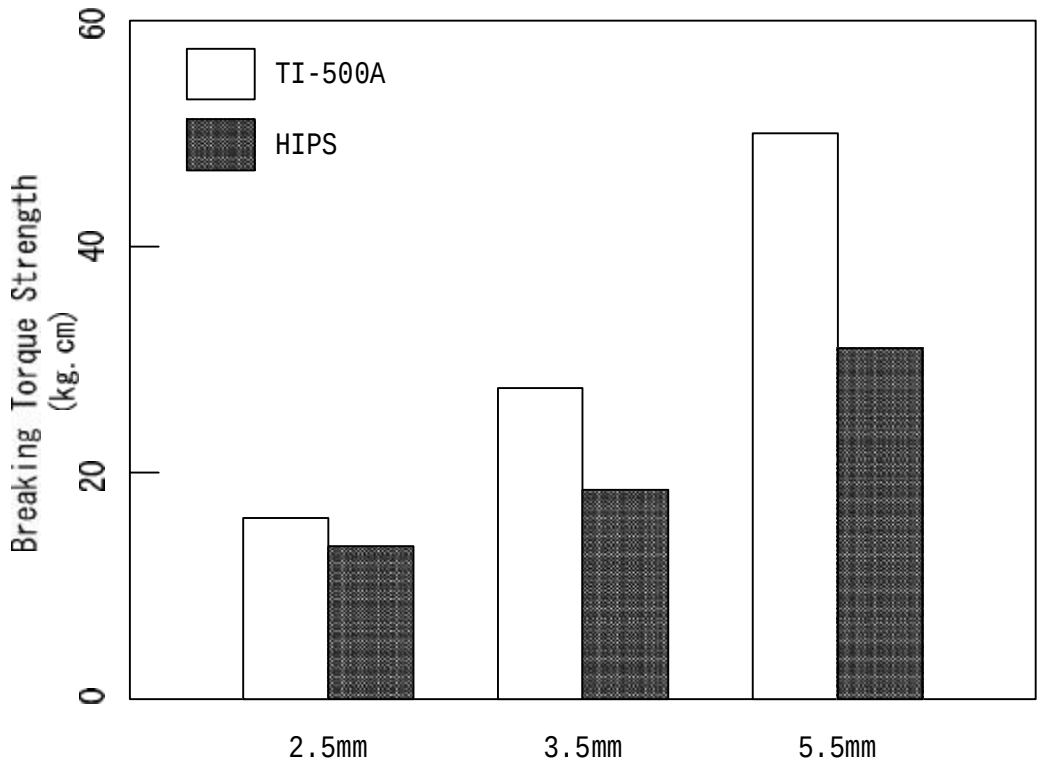


6) SELF TAPPING STRENGTH OF CLEAPACT

TEST PROCEDURE: Screw a screw to the boss. Breaking torque is measured with a torque tester.

	Boss shape		screw diameter
	Φa (mm)	Φb (mm)	
1	5.5	9.5	6.0
2	3.5	7.5	4.0
3	2.5	6.5	3.0





7) PROCESSING RECOMMENDATIONS

(1) Injection Molding (TI-500A)

a. Drying Conditions

- CLEAPACT polymers require drying as they absorb moisture like AS resin or ABS resin. The pellets should be dried for two to three hours at 75°C.

b. Molding Conditions

- Molding temperature can range of 190 to 250°C. In most cases, the temperature is adjusted to 220 to 230°C.
- By using mold temperature control unit, mold surface temperature should range from 50 to 60°C. Usually, set temperature is adjusted to 50°C.

Box-shaped part of depth180mm x width130mm x height25mm, thickness2mm, central direct gate	
Injection molding machine of 150ton clamping force	
Cylinder set temperature(°C)	(Hopper side) 190-210-220-220 (Nozzle side)
Nozzle set temperature(°C)	220
Mold temperature control unit(°C)	50
Back pressure(kg/cm^2)	5
Dwell time(sec)	10
Cooling time(sec)	20

c. General Processing Considerations

- Particular attention should be given to changing over resins and contamination because contamination with other resins such as PS resin or AS resin may lower not only transparency but also strength of the item itself.
- CLEAPACT polymers have low transparency immediately after molding like transparent ABS resins. Upon cooling to room temperature, they become transparent.
- Smooth surface of the mold is important to obtain good appearance such as transparency and surface gloss. Plating or adequate polishing of the mold is required.
- If nothing interferes, higher mold temperature, injection pressure, and injection speed maximize appearance such as transparency and surface gloss. Especially, it is recommended to set temperature of mold temperature control unit at 50°C or above.

Sheeting (TI-300)

a. Drying Conditions

- Despite moisture absorbent nature, CLEAPACT polymers do not require drying when they are sufficiently devolatized with vacuum vented extruder. If non-vacuum vented extruder is used, the pellets should be dried for three hours at 75°C.

b. Sheeting Conditions (example)

- Sheet Thickness

  500 μ m

- Equipment (Extruder)

  90mmϕvacuum vented single screw extruder with T-die of 0.6mm lip divergence.

- Extrusion Conditions(only cleapact)

  Cylinder and Die Temperature

C1	C2	C3	C4	C5～	AD	Gear Pump	Die
190	205	230	240	250	250	250	250

  Roll Temperature 50°C

  Gear Pump Inlet Pressure 30 kg/cm^2

  Degree of Vacuum of Vent 720 mmHg

c. General Sheeting Considerations

- Transparency is improved by lowering draw ratio that is realized by controlling draw velocity and lip divergence.
- In the case of insufficient devolatilization, residual water may cause evolution of bubbles.

d. General Thermoforming Considerations

- When sheet is thermoformed, overheating may cause lowering of transparency.
- In order to avoid bubble generation during thermoforming, sheet should not be stored under the circumstances of high temperature and humidity.