

Toray ABS Resin "TOYOLAC" for Medical application



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Toyolac Dept.

Toray Industries, Inc.

TORAY Transparent ABS(MABS) resin for Medical application

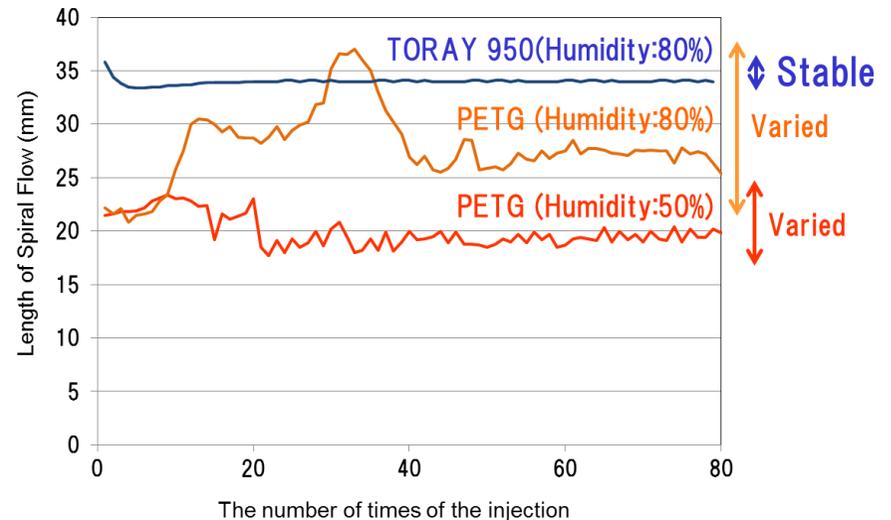
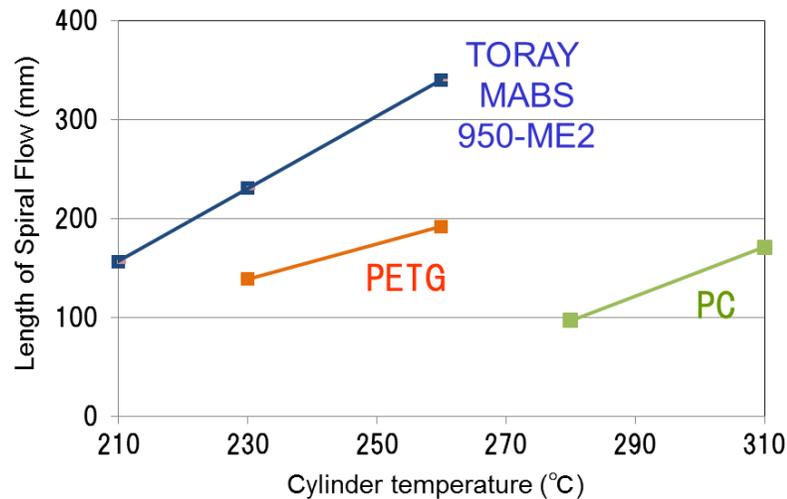
What is real benefit for you to utilise “TOYOLAC”?



ABS Resin
TOYOLAC™ *Advanced Transparent ABS (MABS)*
'950 ME1' '950 ME2'

- ✓ The best mold ability in transparent resins
- ✓ Excellent chemical resistance
- ✓ Well-balanced mechanical properties
- ✓ Superior in Secondary process / Solvent adhesion
- ✓ Biocompatible

Mold ability / Result of Length of Spiral Flow



TORAY Transparent ABS(MABS) resin for Medical application

Typical properties

		TORAY MABS 950 ME1	Competitor's MABS	PET-G	PC
Moldability					
Chemical resistance	Lipids				
	Disinfecting agents /Oxydol				
Stability for sterilization *Gamma irradiation	Discoloration				
	Mechanical properties				
Transparency Light Transmission(%)		87	87	91	90
Density		1.09	1.07	1.20-1.30	1.20
Impact Strength Charpy Impact Strength(kJ/m2)		12-14	4	>50	>50

*950 ME1, ME2 are used in a wide range of EOG sterilization uses



Biocompatibility / Acquired specifications

○USP<88> Biological Reactivity TEST
-USP Plastic Class VI

○ISO10993 Biological Evaluation of Medical Devices
-Part 4: Selection test for Interaction of blood
-Part 5: Test for Cytotoxicity
-Part10: Test for Skin sensitization
-Part11: Test for Systemic toxicity

Notes) Sterilization condition: Non-Sterility
Appearance: pellet-shaped solid

Summary

I 950 has both excellent mold ability and chemical resistance

I 950 enables to reduce defective rate, Shorten molding cycle

-For further information-

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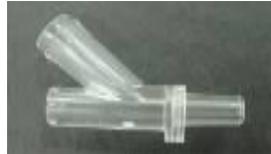
Example of TOYOLAC usable for medical application



IV Catheter
(Needle hub etc.)



Stopcock



Adapter,
Connector



Heat and Moisture
Exchanger



Tracheobronchial
Suction Catheter



Dialyzer



Membrane Plasma
Separator



Chest Drainage Box



Lancet
(Needle Hub)

Comparison Data - Typical Property

Property	Test Method	Test Condition	Unit	Toray		Competitor's	
				950 ME1 (MABS)	950 ME2 (MABS)	2802HD (MABS)	RX1805 (PC)
Tensile Strength	ISO 527	23°C / 50%RH	MPa	50	53	47	72
Tensile Elongation at Break	ISO 527	23°C / 50%RH	%	14	13	14	100
Flexural Strength	ISO 178	23°C / 50%RH	MPa	71	74	68	100
Flexural Modulus	ISO 178	23°C / 50%RH	MPa	2180	2340	1810	2260
Charpy Impact Strength	ISO 179	23°C / 50%RH	kJ/m ²	14	12 >	4	82
Melt Flow Rate	ISO 1133	220°C / 98N	g/10min	18	7 >	2	-
Density	ISO 1183	23°C	kg/m ³	1090	1090	1070	1200
Light Transmission	ISO 13468	23°C / 50%RH (3mmt)	%	86.0	86.0	87.7	84
Haze	ISO 14782	23°C / 50%RH (3mmt)	%	3.0	3.0	3.9	0.5
Color (Plate YI)	CCM	23°C / 50%RH (3mmt)	%	8.9	9.0	16.4	-

Chemical Resistance (Method)

Procedure

- Set the specimen on the Quarter-Ellipse tester with each chemical like Fig.1.
- Apply the chemicals on the specimen.
- Measure the cracked point on the specimen after 72 hours.
- Calculate the critical strain by formula shown in Eq.1 as follow.

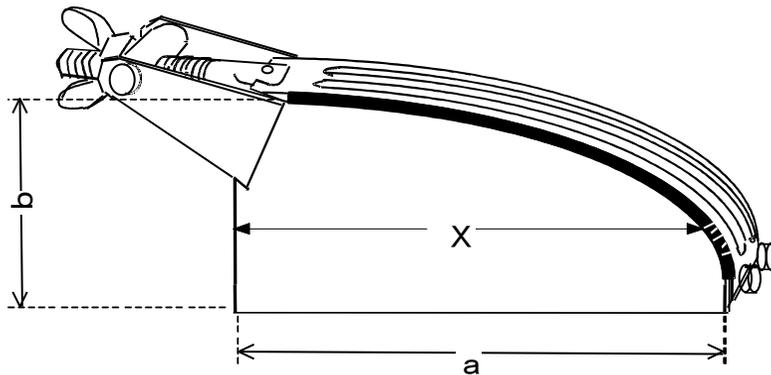


Fig.1. Quarter-Ellipse tester

$$\varepsilon (\%) = \frac{b \cdot t}{2 a^2} \left(1 - \frac{X^2 (a^2 - b^2)}{a^4} \right)^{-\frac{3}{2}} \times 100$$

$\varepsilon(\%)$: Critical strain ,

$a(\text{mm})$: length of tester(127mm) ,

$b(\text{mm})$: height of tester(38mm) ,

$t(\text{mm})$: thickness of specimen(1.5mm) ,

$X(\text{mm})$: length till cracked point

Eq1. Formula of critical strain

Chemical Resistance (Details)

Table1. Comparison of the value of critical strain(ϵ)

	950 ME1	950 ME2	2802 HD	<i>RX1805(PC)</i>
Fat emulsion(10%soy oil series)	0.9	≥ 1.0	≥ 1.0	≥ 1.0
Fat emulsion(10% hardened castor oil series)	0.8	≥ 1.0	≥ 1.0	≥ 1.0
Benzyl alcohol	0.2	0.2	0.2	0.2
Rubbing alcohol	0.3	0.6	0.5	1.0
Hexamethyldiamine	0.2	0.3	0.5	0.2
Oxydol	NB	NB	NB	2.0
vaseline	≥ 1.0	≥ 1.0	≥ 1.0	≥ 1.0
Olive oil	0.6	0.8	0.7	0.8
6%Sodium hypochloride solution	NB	NB	NB	2.0
Benzalkonium chloride	1.1	NB	NB	≥ 1.0

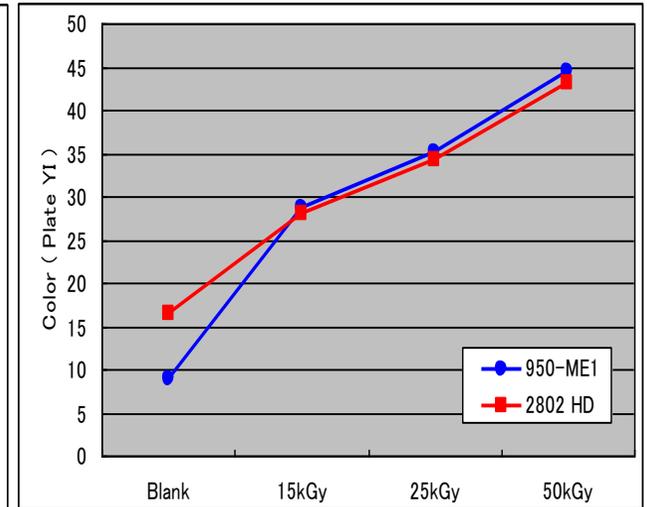
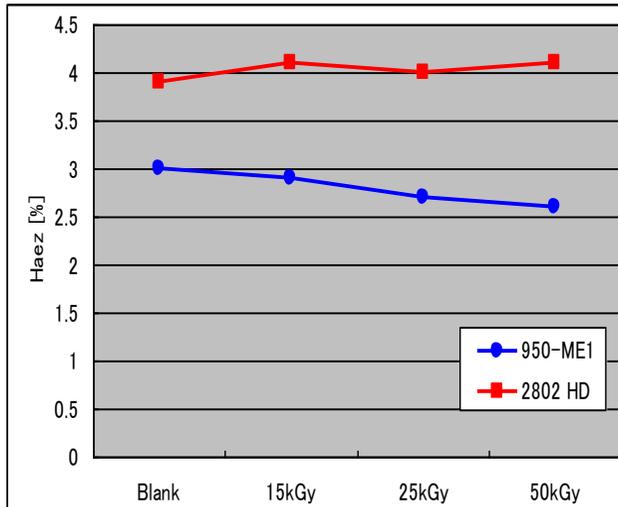
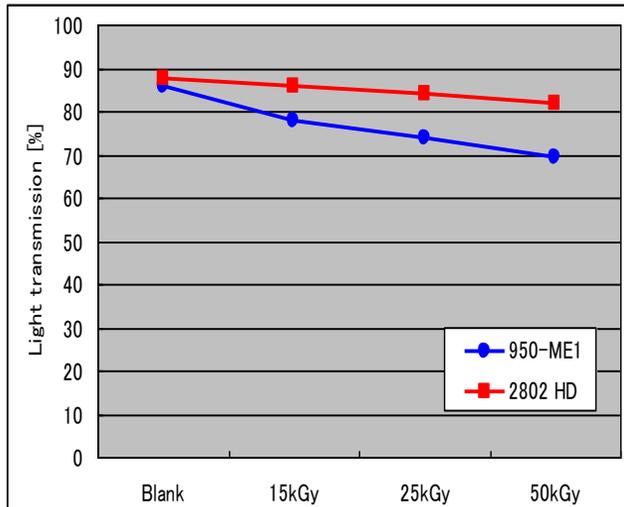
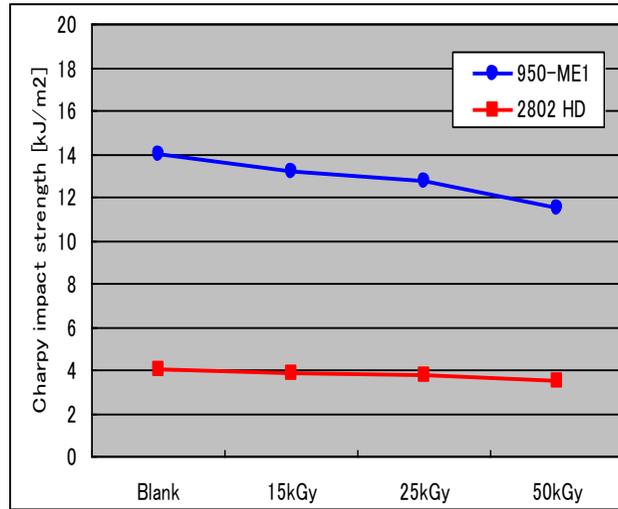
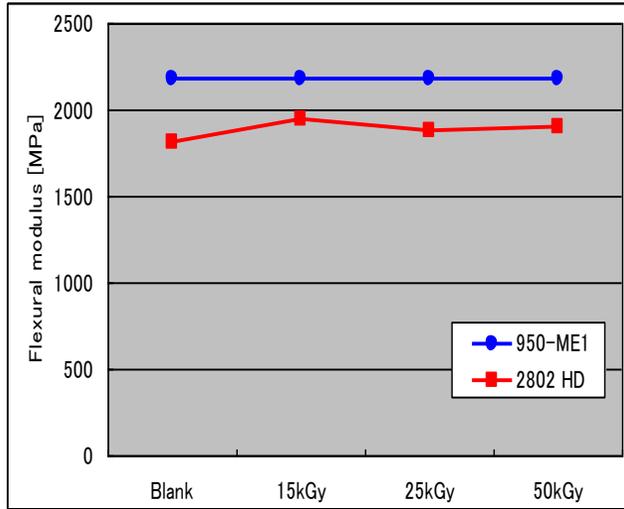
| 950-ME1 has good chemical resistance and high melt flow rate.

| 950-ME2 has best chemical resistance alongside of **2802HD** of all MABS grade and better melt flow rate than **2802HD**.

Mechanical properties after the gamma rays irradiation

Property	Unit	950 ME1				2802 HD			
		Blank	15kGy	25kGy	50kGy	Blank	15kGy	25kGy	50kGy
Tensile Strength	MPa	50	50	51	51	47	47	48	48
Tensile Elongation at Break	%	14	10.1	10.0	10.8	14	13.3	14.2	13.2
Flexural Strength	MPa	71	71	71	71	68	70	69	69
Flexural Modulus	MPa	2180	2180	2180	2180	1810	1940	1880	1900
Charpy Impact Strength	kJ/m ²	14	13.2	12.7	11.5	4	3.8	3.7	3.5
Temp. of Deflection Under Load	°C	75	74	74	73	79	79	78	77
Density	kg/m ³	1090	1090	1090	1090	1070	1070	1060	1070
Light Transmission	%	86.0	77.6	74.0	69.3	87.7	85.6	84.2	81.9
Haze	%	3.0	2.9	2.7	2.6	3.9	4.1	4.0	4.1
Color (Plate YI)	%	8.9	28.6	35.1	44.5	16.4	28.1	34.2	43.1

Mechanical properties after the gamma rays irradiation



950-ME1, 950-ME2 Summary

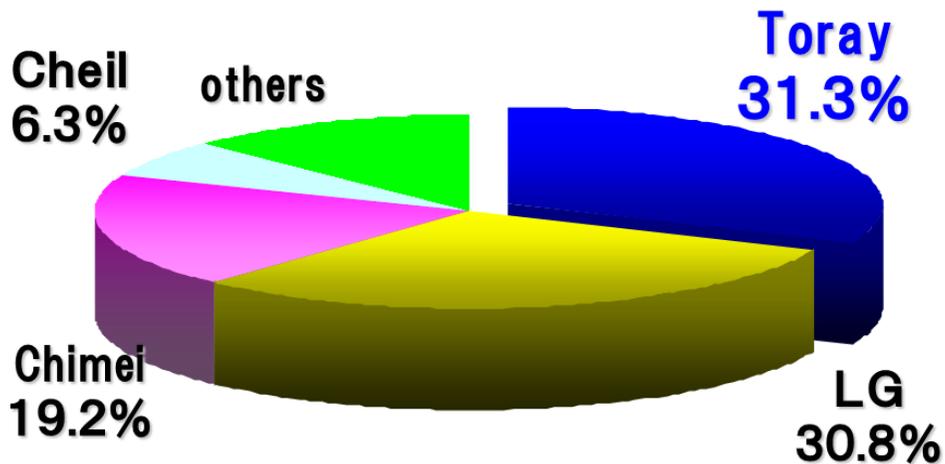
- ✓ The mechanical properties of Toray's medical grade are better than 2802HD.
- ✓ 950-ME1's medical chemical resistance is almost same as 2802HD.
- ✓ 950-ME2 is the new grade that chemical resistance were improved from 950-ME1.
- ✓ The High flow of Toray material can reduces residual stress of the molded parts.
- ✓ 950-ME1 maintains good properties after being irradiated by gamma ray.
- ✓ Main manufacturing location in Japan.

About TORAY Transparent ABS



“TOYOLAC” Transparent Grade

Transparent ABS World Market Share(2012)



*Demand:200K mt/y

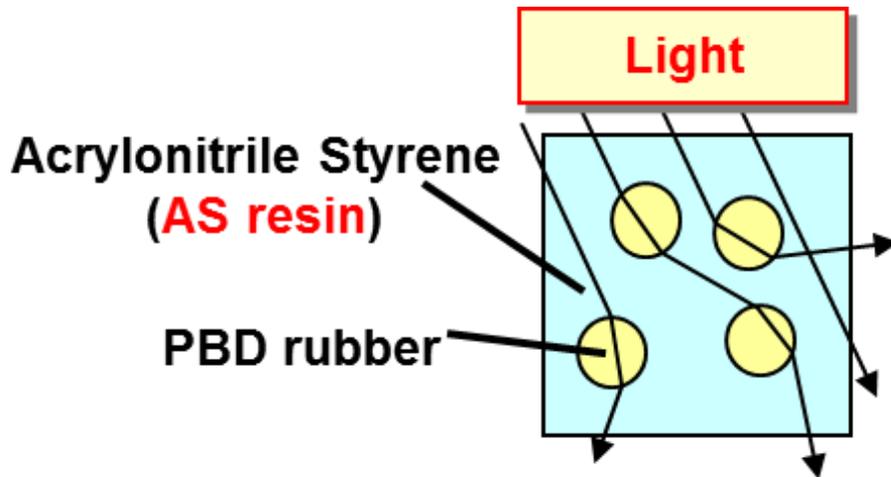
World No.1

Toray's Strength

- | Toray was the first company to start the manufacturing of transparent ABS, and Toray has accumulated over 30 years of technological experience.
- | Total cost can be reduced when replacing PC, PMMA, PETG and Competitor's ABS.

“TOYOLAC” Transparent ABS

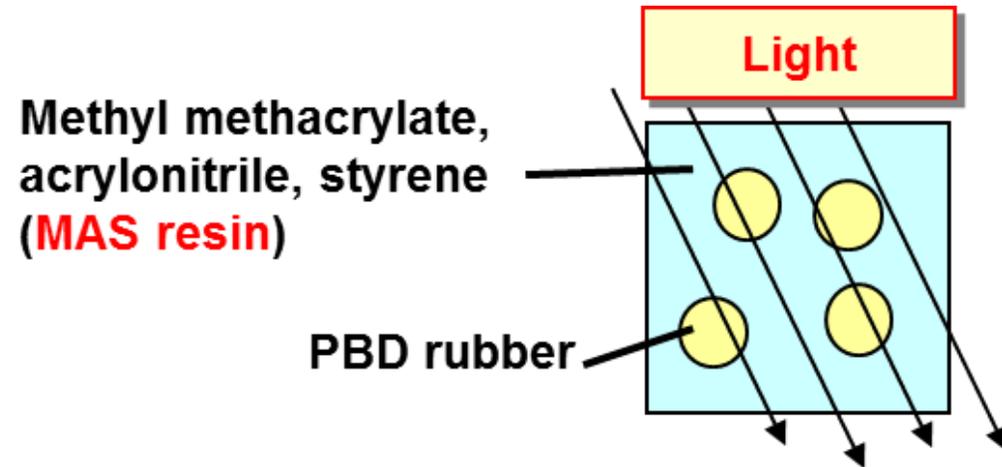
General Purpose ABS



Opaque



Transparent ABS (MABS)



Transparent



Features of Transparent ABS

Toray's Transparent ABS can satisfy many needs

! The best moldability among transparent resins

-Suitable for large and complicated molding.

***! Various lineup “Chemical resistance”,
“Anti-scratch”, “Anti-static” etc.***

-Superb functionality is available.

! Excellent in post-processing (Painting, High gloss etc)

-Enables you to design in various ways.

Molding Condition

<Setting>	<Item>		<Condition>
Material Pre-drying *1	Temperature / Duration Hot air ventilated oven		80°C / 3 ~ 5 hr
			90°C / 2 ~ 3 hr
Molding Temperature *2	Cylinder Temperature	Rear	195 ~ 235°C
		Center ~ Front	200 ~ 260°C
	Nozzle Temperature	Cold Runner	195 ~ 260°C
		Hot Runner	230 ~ 260°C
Mold Temperature *3	General Injection Molding	Core / Cavity	40 ~ 80°C
	Runnerless Molding	Manifold Temperature	230 ~ 260°C
		Band Heater Temperature	230 ~ 260°C
		Hot Runner Nozzle Temperature	230 ~ 260°C
	Core / Cavity	40 ~ 80°C	

*1 Depending on the molded part shape, pellet pre-drying might be also necessary even with vented type injection molding machine.

*2 Molded part becomes yellowish when molding at high temperature, long molding cycle and etc. as a result of material retention inside the cylinder.

*3 The influence to molded part appearance is significant, thus precaution is necessary when aesthetic appearance is desired.

Molded part appearance is improved by applying higher mold temperature, but too high mold temperature will cause long cycle time and possible to induce sink mark defect.

Attention / About TORAY's medical application

1. Refer to the Material Safety Data Sheet for "TOYOLAC" before use.
2. Small amount of volatile gases may be released and may irritate eyes, nose and throat.
Use adequate local exhaust ventilation during drying and molding.
3. Dump the waste matters following law, rules and regulations.
4. Keep away direct sunlight, rain and moisture.
5. "TOYOLAC" are flammable. Keep away heat and ignition source.
When burning, there is a threat that the harmful gas such as the carbon monoxide is generated.
Water, foam extinguishant, or powder extinguishant is usable for extinguishing.
- 6. Do not use it for an internal implantation use.**
- 7. When using with the medical devices, food devices, drink devices or toys for infant, consult TORAY about the concrete application and usage beforehand by all means.**
8. The information herein is given in good faith, but no warranty, express or implied, is made. The customer has to ensure that medical device or pharmaceutical application manufactured using "TOYOLAC" is safe, lawful and technically suitable for the intended use.
9. This information contained in this data sheet represents the best information currently available to us.
The data and descriptions may be revised without notice based on new information.
10. If UL 746D is applied, regrind can be added up to 25 weight percent.
Some grades are registered about combining it more than 25 weight percent.

TORAY

Innovation by Chemistry

We always create the new value.

