

Application: fluoro-resin for measurement instrument-related applications

Fluoro-resin used: PTFE (CAS No. 9002-84-0)

Product Overview: reference reflectors and septums for calibration of colorimeters

Fluoro-resin is used in measurement instrument, reference reflectors used in the calibration of colorimeters such as color chromatometers, and septum materials for analytical vials.

Such an application requires properties such as reflectance, long-term stability (temperature and humidity resistance, light degradation resistance), heat resistance, chemical resistance, and purity, and fluoro-resin is employed as a member satisfying required specifications. Fluoro-resin is the only material that satisfies the abovementioned performance requirements, and no alternative products have been found.

If fluoro-resin is not usable for reference reflectors, routine calibration of colorimeters such as a color difference meter will not be possible.

If fluoro-resin is not usable for septum, silicone can be considered as an alternative. However, there is concern about the contamination of samples due to, for instance, elution of silicone-derived components. Fluoro-resin is required in terms of chemical resistance.

We believe that the restriction of the use of fluoro-resin in this application will make accurate measurements impossible and has a significant impact on society.

For this reason, we believe that no restriction is appropriate as per the proposal relating to restriction.

Representative properties of fluoro-resin are shown in the following table.

Physical properties	Test method	Unit	PPS	PAR	PTFE	PSU	PES	Physical properties	Test method	Unit	LCP	PEEK	PEI	PAI	TPI					
Classification and characteristics			GF30% Cross-linking type	Natural	Natural	Natural	GF30% Natural	GF30% Natural	Classification and characteristics		GF30% Type I	GF30% Type II	GF30% Type III	Natural	GF30% High fluidity	Natural	Natural	Amorphous Natural		
Mechanical properties									Mechanical properties											
Tensile strength	ASTM D 638	MPa	150	70	27~34	71	108	84	140	Tensile strength	ASTM D 638	MPa	137	211	113	97	236	105	191	92
Tensile break elongation	ASTM D 638	%	1.2	70	200~400	50~100	2	80	3	Tensile break elongation	ASTM D 638	%	1.7	2.2	3.8	80	5	60	15	90
Bending strength	ASTM D 790	MPa	206	78	118 ⁽¹⁾	108	157	129	190	Bending strength	ASTM D 790	MPa	157	250	176	142	330	145	240	137
Bending elastic modulus	ASTM D 790	GPa	13.7	1.9	0.34~0.62	2.6	7.6	2.5	8.3	Bending elastic modulus	ASTM D 790	GPa	13.3	14.7	12.6	3.7	21.1	3.3	5.0	2.9
Load impact strength with notches	ASTM D 256	J/m	69	245	157	69	78	88	78	Load impact strength with notches	ASTM D 256	J/m	108	137	118	88	—	49	147	88
Rockwell hardness	ASTM D 785	R scale	123	125	—	120	134	120	134	Rockwell hardness	ASTM D 785	R scale	77	84(M)	69	126	124	109(M)	86(E)	129
Thermal properties									Thermal properties											
Load deflection temperature ⁽¹⁾	ASTM D 648	°C	260	175	55	—	203	216	—	Load deflection temperature ⁽¹⁾	ASTM D 648	°C	346	240	180	152	300	200	278	238
: 0.45 Mpa load		°C	—	—	121	174	181	210	—	: 0.45 Mpa load		°C	—	—	—	—	210	—	—	—
: 1.82 Mpa load		°C	—	—	—	—	—	—	—	: 1.82 Mpa load		°C	—	—	—	—	—	—	—	—
Continuous use temperature ⁽²⁾	UL746B	°C	200~220	140~160	180	140~160	140~160	180~190	180~190	Continuous use temperature ⁽²⁾	UL746B	°C	240~280	~220	—	240	240	170~180	200~220	—
Linear expansion coefficient	ASTM D 696	10 ⁻⁵ ×K ⁻¹	2.9	6.2	10	5.6	1.9	5.6	2.3	Linear expansion coefficient	ASTM D 696	10 ⁻⁵ ×K ⁻¹	1.2	—	—	4.6	—	5.6	3.1	5.5
Flammability		—	V-0/0.5V	V-2	V-0	HB	V-0	V-0	V-0	Flammability		—	V-0	V-0	V-0	V-0	V-0	V-0/0.5V	V-0	V-0
Physical properties									Physical properties											
Specific gravity	ASTM D 792	—	1.67	1.21	2.14~2.20	1.24	1.49	1.37	1.60	Specific gravity	ASTM D 792	—	1.60	1.62	1.60	1.30	1.44	1.27	1.42	1.33
Water absorption rate	ASTM D 570	%	0.05	0.26	<0.01	0.3	0.49	0.43	0.30	Water absorption rate	ASTM D 570	%	<0.1	0.05	0.02	0.14	—	0.25	0.33	0.34
Molding shrinkage rate	ASTM D 955	mm/mm	0.0025	0.008	—	0.007	0.002	0.006	0.002	Molding shrinkage rate	ASTM D 955	mm/mm	—	—	0.0022 ⁽⁴⁾	—	0.006	0.006	—	0.008
Electrical properties									Electrical properties											
Volume resistivity	ASTM D 257	Ω·mm	1×10 ¹⁵	2×10 ¹⁶	>10 ¹⁷	—	—	10 ¹⁶	10 ¹⁵	Volume resistivity	ASTM D 257	Ω·mm	1×10 ¹⁵	3×10 ¹⁵	5×10 ¹⁵	10 ¹⁶	—	10 ¹⁶	2×10 ¹⁶	—
Dielectric breakdown strength	ASTM D 149	kV/mm	17.2	—	30~35	17	19	16	16	Dielectric breakdown strength	ASTM D 149	kV/mm	25	43	—	19	—	30	24	—
Dielectric constant (10 ⁶ Hz)	ASTM D 150	—	3.8	3.0	<2.1	3.1	3.7	3.5	—	Dielectric constant (10 ⁶ Hz)	ASTM D 150	—	3.6	3.8	2.7	3.3	—	3.15	3.9	3.1
Dielectric tangent (10 ⁶ Hz)	ASTM D 150	—	0.0014	0.01	0.0001	0.005	0.004	0.0035	—	Dielectric tangent (10 ⁶ Hz)	ASTM D 150	—	0.034	0.017	0.020	0.003	—	0.0013	0.031	0.0034

Note: (1) Previous "heat distortion temperature"
(2) There are three items of mechanical strength (with or without impact) and electrical properties.
(3) Compression strength
(4) Average value of MD and TD Actual value: MD/TD=0.0013/0.0033

Remarks The abbreviations and names of each resin are as follows.
PPS: Polyphenylene sulfide, PAR: Polyarylate, PTFE: Polytetrafluoroethylene,
PSU: Polysulfone, PES: Polyether sulfone, LCP: Liquid crystal polymer,
PEEK: Polyether ether ketone, PEI: Polyetherimide, PAI: Polyamideimide,
TPI: Thermoplastic polyimide, GF: Glass fibers

- Cited documents
1) "Teflon Practical Handbook" by Chemours-Mitsui Fluoroproducts Co., Ltd., 1989
2) "Fluororesin Handbook", edited by Takaomi Kurokawa, Nikkan Kogyo Shimbun, Ltd., 1990
3) Industrial Materials, Nikkan Kogyo Shimbun, Ltd., November 1976
4) VALQUA review, Vol. 35, No. 1, by Ryuji Ikeda
5) "Plastic Processing Technology Handbook," The Society of Polymer Science, Japan, Nikkan Kogyo Shimbun, Ltd., 1995
6) Technical references by DAIKIN INDUSTRIES, LTD.
7) Technical references by Chemours-Mitsui Fluoroproducts Co., Ltd.

Reference: VALQUA Handbook, Technical Section