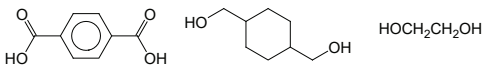
# PCTG poly(ethylene-co-1,4-cyclohexylenedimethylene terephthalate)

| PARAMETER | UNIT | VALUE | REFERENCES |
|---|---|---|---|
| **GENERAL** | | | |
| **Common name** | - | poly(ethylene-co-1,4-cyclohexylenedimethylene terephthalate) | |
| **ACS name** | - | 1,4-benzenedicarboxylic acid, polymer with 1,4-cyclohexanedimethanol and 1,2-ethanediol | |
| **Acronym** | - | PCTG | |
| **CAS number** | - | 25038-91-9 | |
| | | | |
| **SYNTHESIS** | | | |
| **Monomer(s) structure** | - |  | |
| **Monomer(s) CAS number(s)** | - | 100-21-0; 105-08-8; 107-21-1 | |
| **Monomer(s) molecular weight(s)** | dalton, g/mol, amu | 166.0; 144.21; 62.07 | |
| **Monomer(s) expected purity(ies)** | % | -;99;>99 | |
| **Ethylene content** | % | 67 | Matsuda, H; Nagasaka, B; Asakure, T, Polymer, 44, 4681-87, 2003. |
| **Method of synthesis** | - | melt polycondesation | |
| **Mass average molecular weight, $M_w$** | dalton, g/mol, amu | 30,000-52,600 | |
| | | | |
| **STRUCTURE** | | | |
| **Cis content** | % | 30 | Matsuda, H; Nagasaka, B; Asakure, T, Polymer, 44, 4681-87, 2003. |
| **Entanglement molecular weight** | dalton, g/mol, amu | 4,900 | Barany, T; Czigany, T; Karger-Kotsis, J, Prog. Polym. Sci., 35, 1257-87, 2010. |
| | | | |
| **COMMERCIAL POLYMERS** | | | |
| **Some manufacturers** | - | Eastman; Ticona | |
| **Trade names** | - | Eastar; Thermx | |
| | | | |
| **PHYSICAL PROPERTIES** | | | |
| **Density at 20°C** | g $cm^{-3}$ | 1.23; 1.39-1.55 (20-40% glass fiber) | |
| **Color** | - | colorless | |
| **Transmittance** | % | 89-91 | |
| **Haze** | % | <1 | |
| **Odor** | - | slight | |
| **Melting temperature, DSC** | °C | 225-285 | |
| **Softening point** | °C | 83-88 | |
| **Thermal expansion coefficient, 23-80°C** | $10^{-4}$ $°C^{-1}$ | 0.70-0.87 | |
| **Thermal conductivity, 20°C** | W $m^{-1}$ $K^{-1}$ | 0.19 | |
| **Glass transition temperature** | °C | 77-91 | |
| **Specific heat capacity** | J $K^{-1}$ $kg^{-1}$ | 1,340 | |
| **Heat deflection temperature at 0.45 MPa** | °C | 74-89; 280 (20-40% glass fiber) | |

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| **Heat deflection temperature at 1.8 MPa** | °C | 64-78; 256-265 (20-40% glass fiber) | |
| **Vicat temperature VST/A/50** | °C | 83-88 | |
| **Dielectric constant at 1000 Hz/1 MHz** | - | 2.8/2.6 | |
| **Dissipation factor at 1000 Hz** | E-4 | 60 | |
| **Dissipation factor at 1 MHz** | E-4 | 190 | |
| **Volume resistivity** | ohm-m | 1E13 | |
| **Surface resistivity** | ohm | 1E16 | |
| **Electric strength K20/P50, d=0.60.8 mm** | kV $mm^{-1}$ | 16.1-19.7 (20-40% glass fiber) | |
| **Comparative tracking index, CTI, test liquid A** | - | 560 (20-40% glass fiber) | |
| **Permeability to nitrogen, 25°C** | $cm^3$ mm $m^{-2}$ $day^{-1}$ $atm^{-1}$ | 3 | |
| **Permeability to oxygen, 25°C** | $cm^3$ mm $m^{-2}$ $day^{-1}$ $atm^{-1}$ | 10 | |
| | | | |
| **MECHANICAL & RHEOLOGICAL PROPERTIES** | | | |
| **Tensile strength** | MPa | 30-53; 100-128 (20-40% glass fiber) | |
| **Tensile modulus** | MPa | 2,010 | |
| **Tensile stress at yield** | MPa | 45 | |
| **Elongation** | % | 340; 1.9-2.3 (20-40% glass fiber) | |
| **Tensile yield strain** | % | 5 | |
| **Flexural strength** | MPa | 67; 155-200 (20-40% glass fiber) | |
| **Flexural modulus** | MPa | 1,800; 5,900-11,000 (20-40% glass fiber) | |
| **Charpy impact strength, unnotched, 23°C** | kJ $m^{-2}$ | NB | |
| **Izod impact strength, unnotched, 23°C** | J $m^{-1}$ | NB; 520-800 (20-40% glass fiber) | |
| **Izod impact strength, notched, 23°C** | J $m^{-1}$ | 49; 60-75 (20-40% glass fiber) | |
| **Rockwell hardness** | - | R105 | |
| **Shrinkage** | % | 0.2-0.5 | |
| **Water absorption, equilibrium in water at 23°C** | % | 0.13 | |
| | | | |
| **CHEMICAL RESISTANCE** | | | |
| **Acid dilute/concentrated** | - | fair | |
| **Alcohols** | - | good-fair | |
| **Alkalis** | - | good | |
| **Aliphatic hydrocarbons** | - | good | |
| **Aromatic hydrocarbons** | - | poor | |
| **Esters** | - | poor | |
| **Greases & oils** | - | good | |
| **Halogenated hydrocarbons** | - | poor | |
| **Ketones** | - | poor | |

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|---|---|---|---|
| **Good solvent** | - | methylene chloride | |
| | | | |
| **FLAMMABILITY** | | | |
| **UL rating** | - | HB; HB (20-40% glass fiber) | |
| | | | |
| **WEATHER STABILITY** | | | |
| **Excitation wavelengths** | nm | 330; 260-390 | Allen, N S; Rivalle, G; Edge, M; Roberts, I; Fagerburg, D R, Polym. Deg. Stab., 67, 325-34, 2000. |
| **Emission wavelengths** | nm | 380, 460; 450, 550 | Allen, N S; Rivalle, G; Edge, M; Roberts, I; Fagerburg, D R, Polym. Deg. Stab., 67, 325-34, 2000. |
| | | | |
| **TOXICITY** | | | |
| **HMIS: Health, Flammability, Reactivity rating** | - | 1/1/0 | |
| **Oral rat, $LD_{50}$** | mg $kg^{-1}$ | >3,200 | |
| **Skin rabbit, $LD_{50}$** | mg $kg^{-1}$ | >1,000 (highest dose tested) | |
| | | | |
| **PROCESSING** | | | |
| **Typical processing methods** | - | injection molding | |
| **Preprocess drying: temperature/time/residual moisture** | °C/h/% | 65-95/4-12/0.05 | |
| **Processing temperature** | °C | 215-295 | |
| **Processing pressure** | MPa | 0.3-1 (back) | |
| **Process time** | min | 4 (max residence time) | |
| **Applications** | - | medical (anesthesia manifold, wound healing systems) | Sashi, V R, Plastics in Medical Devices, Elsevier, 2010, pp. 121-173. |
| **Outstanding properties** | - | heat resistance, resistance to automotive fluids, low dielectric constant, low moisture absorption | |
| | | | |
| **BLENDS** | | | |
| **Suitable polymers** | - | PAR, PC; PEI, PET | |
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