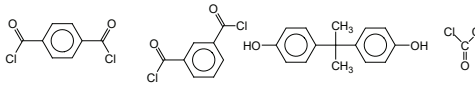


# PEC poly(ester carbonate)

| PARAMETER                              | UNIT               | VALUE   | REFERENCES   |
|--|--------------------|---|--|
| <b>GENERAL</b>                         |                    |   |  |
| Common name                            | -                  | poly(ester carbonate)   | Pinna, I; Hellums, M W; Koros, W J, Polymer, 32, 14, 2612-17, 1991.  |
| ACS name                               | -                  | 1,3-benzenedicarbonyl dichloride, polymer with 1,4-benzenedicarbonyl dichloride, carbonic dichloride and 4,4'-(1-methylethylidene)bis[phenol]   |  |
| Acronym                                | -                  | PEC   |  |
| CAS number                             | -                  | 71519-80-7  |  |
| <b>HISTORY</b>                         |                    |   |  |
| Person to discover                     | -                  | Cotter, R J; Sulzberg, T  | Cotter, R J; Sulzberg, T, US Patent 3,536,781, Union Carbide, Oct. 27, 1970.   |
| Date                                   | -                  | 1970  |  |
| <b>SYNTHESIS</b>                       |                    |   |  |
| Monomer(s) structure                   | -                  |   |  |
| Monomer(s) CAS number(s)               | -                  | 100-20-9; 99-63-8; 80-05-7; 75-44-5   |  |
| Monomer(s) molecular weight(s)         | dalton, g/mol, amu | 203.02; 203.02; 228.29; 98.92   |  |
| Formulation example                    | -                  | the resins are manufactured using phthaloyl chloride/carbonyl chloride mole ratio of 0.81/1 or greater  |  |
| Method of synthesis                    | -                  | polyestercarbonate resins are produced by the condensation of 4,4'-isopropylidenediphenol, carbonyl chloride, terephthaloyl chloride, and isophthaloyl chloride, such that the finished resins are composed of 45 to 85 mole% ester of which up to 55 mole% is the terephthaloyl isomer |  |
| Number average molecular weight, $M_n$ | dalton, g/mol, amu | 3,390-4,400   |  |
| Mass average molecular weight, $M_w$   | dalton, g/mol, amu | 3,700-21,800  |  |
| Polydispersity, $M_w/M_n$              | -                  | 1.01-1.09   |  |
| <b>STRUCTURE</b>                       |                    |   |  |
| Crystallinity                          | %                  | 0 (bisphenol A-based); 36.2-52.7 (1,3-propanediol-based)  | Murthy, N S; Aharoni, S M, Polymer, 28, 13, 2171-75, 1987; Chandure, A S; Umare, S S; Pandley, R A, Eur. Polym. J., 44, 2068-86, 2008. |
| <b>COMMERCIAL POLYMERS</b>             |                    |   |  |
| Some manufacturers                     | -                  | Sabir   |  |
| Trade names                            | -                  | Lexan   |  |
| <b>PHYSICAL PROPERTIES</b>             |                    |   |  |
| Density at 20°C                        | g cm <sup>-3</sup> | 1.13-1.2  |  |
| Color                                  | -                  | white   |  |
| Refractive index, 20°C                 | -                  | 1.6   |  |
| Transmittance                          | %                  | 85  |  |
| Haze                                   | %                  | 1   |  |

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|---|---|---|---|
| Odor  | -   | slight  |   |
| Melting temperature, DSC  | °C  | 41.4-45.5   |   |
| Thermal expansion coefficient, 23-80°C                              | 10 <sup>-4</sup> °C <sup>-1</sup>   | 0.6-0.92  |   |
| Thermal conductivity, melt  | W m <sup>-1</sup><br>K <sup>-1</sup>  | 0.21  |   |
| Glass transition temperature  | °C  | 126-128 (bisphenol A-based); -16.4 to -29.5 (1,3-propanediol-based) |   |
| Specific heat capacity  | J K <sup>-1</sup> kg <sup>-1</sup>  | 1,250   |   |
| Temperature index (50% tensile strength loss after 20,000 h/5000 h) | °C  | 125-130   |   |
| Heat deflection temperature at 1.8 MPa                              | °C  | 143-149   |   |
| Vicat temperature VST/B/50  | °C  | 160-185   |   |
| Relative permittivity at 60 Hz                                      | -   | 3.15-3.27   |   |
| Relative permittivity at 1 MHz                                      | -   | 3-3.1   |   |
| Dissipation factor at 60 Hz   | E-4   | 12-16   |   |
| Volume resistivity  | ohm-m   | 2.5E15  |   |
| Electric strength K20/P50, d=0.60.8 mm                              | kV mm <sup>-1</sup>   | 20-20.2   |   |
| Permeability to nitrogen, 25°C                                      | barrer<br>(cm <sup>3</sup> cm<br>cm <sup>-2</sup> s <sup>-1</sup><br>cmHg <sup>-1</sup> ) | 9.1   | Pinna, I; Hellums, M W; Koros, W J, Polymer, 32, 14, 2612-17, 1991. |
| Permeability to oxygen, 25°C  | barrer<br>(cm <sup>3</sup> cm<br>cm <sup>-2</sup> s <sup>-1</sup><br>cmHg <sup>-1</sup> ) | 1.85  | Pinna, I; Hellums, M W; Koros, W J, Polymer, 32, 14, 2612-17, 1991. |
| <b>MECHANICAL &amp; RHEOLOGICAL PROPERTIES</b>                      |   |   |   |
| Tensile strength  | MPa   | 71-78   |   |
| Tensile modulus   | MPa   | 2,090-2,250   |   |
| Tensile stress at yield   | MPa   | 65-66   |   |
| Elongation  | %   | 78-122  |   |
| Tensile yield strain  | %   | 6-8   |   |
| Flexural strength   | MPa   | 95-97   |   |
| Flexural modulus  | MPa   | 2,020-2,350   |   |
| Charpy impact strength, notched, 23°C                               | kJ m <sup>-2</sup>  | 15  |   |
| Izod impact strength, unnotched, 23°C                               | J m <sup>-1</sup>   | 3,200 to NB   |   |
| Izod impact strength, notched, 23°C                                 | J m <sup>-1</sup>   | 300-640   |   |
| Izod impact strength, notched, -30°C                                | J m <sup>-1</sup>   | 84-144  |   |
| Rockwell hardness   | -   | M85-92; R122-127  |   |
| Shrinkage   | %   | 0.7-1   |   |
| Melt index, 300°C/1.2 kg  | g/10 min  | 2-8   |   |
| Water absorption, 24h at 23°C                                       | %   | 0.15-0.19; 0.35 (saturation)  |   |

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| PARAMETER   | UNIT                | VALUE  | REFERENCES   |
|---|---------------------|--|--|
| Moisture absorption, equilibrium<br>23°C/50% RH           | %                   | 0.15-0.35  |  |
| <b>CHEMICAL RESISTANCE</b>                                |                     |  |  |
| Acid dilute/concentrated                                  | -                   | poor   |  |
| Alcohols  | -                   | good   |  |
| Alkalis   | -                   | poor   |  |
| Aliphatic hydrocarbons                                    | -                   | good   |  |
| Aromatic hydrocarbons                                     | -                   | poor   |  |
| Esters  | -                   | good   |  |
| Halogenated hydrocarbons                                  | -                   | poor   |  |
| Ketones   | -                   | poor   |  |
| Good solvent  | -                   | concentrated sulfuric acid   |  |
| Non-solvent   | -                   | m-cresol; sym-tetrachloroethane; 1-methyl-2-pyrrolidinone; N,N-dimethylacetamide; N,N-dimethylformamide; dimethylsulfide; and hexamethylphosphoric triamide      |  |
| <b>FLAMMABILITY</b>                                       |                     |  |  |
| Autoignition temperature                                  | °C                  | 630  |  |
| Volatile products of combustion                           | -                   | CO, CO <sub>2</sub> , methylene chloride, phenol, diphenylcarbonate  |  |
| UL rating   | -                   | HB; V-0 (fire-resistant grade)   | Shen, D; van de Grampel, R D; Lambertus, T; Singh, H R K; Lend, J-P, US Patent 20090062439, Sabic, 2009. |
| <b>BIODEGRADATION</b>                                     |                     |  |  |
| Typical biodegradants                                     | -                   | hydrolysis by <i>Rhizopus delemar</i>  | Chandure, A S; Umare, S S; Pandley, R A, Eur. Polym. J., 44, 2068-86, 2008.                              |
| <b>TOXICITY</b>   |                     |  |  |
| Oral rat, LD <sub>50</sub>                                | mg kg <sup>-1</sup> | 5,000  |  |
| Skin rabbit, LD <sub>50</sub>                             | mg kg <sup>-1</sup> | very slight irritant   |  |
| <b>PROCESSING</b>   |                     |  |  |
| Typical processing methods                                | -                   | injection molding, spraying  |  |
| Preprocess drying: temperature/<br>time/residual moisture | °C/h/%              | 120/3-4/0.02   |  |
| Processing temperature                                    | °C                  | 320-370  |  |
| Processing pressure                                       | MPa                 | 0.3-0.7 (back)   |  |
| Applications  | -                   | automotive bezels, automotive lightning, cookware, fire helmets, headlamp reflectors, medical applications (1,3-propanediol-based), mold release, pharmaceutical |  |
| Outstanding properties                                    | -                   | biocompatible, sterilizable  |  |
| <b>BLENDS</b>   |                     |  |  |
| Suitable polymers   | -                   | CB, PBS, PC, PMP, PU   |  |

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| PARAMETER                           | UNIT                | VALUE  | REFERENCES  |
|-------------------------------------|---------------------|--|---|
| <b>ANALYSIS</b>                     |                     |  |   |
| <b>FTIR (wavenumber-assignment)</b> | cm <sup>-1</sup> /- | C=O – 1736; ester – 1730-1728; C-O-C – 1173                            | Chandure, A S; Umare, S S; Pandley, R A, Eur. Polym. J., 44, 2068-86, 2008. |
| <b>NMR (chemical shifts)</b>        | ppm                 | 1,3-propanediol residue – 1.87-1.99; CH <sub>2</sub> – 2.33, 1.63-1.66 | Chandure, A S; Umare, S S; Pandley, R A, Eur. Polym. J., 44, 2068-86, 2008. |
|                                     |                     |  |   |
|                                     |                     |  |   |