QPAC® is available in a variety of forms, including granulates, pellets, aqueous dispersion and solutions. If you would like more information or would like to discuss a specific application, contact us at:

100 Interchange Boulevard
Newark, DE 19711
Telephone: 302.452.6600
Email: customerservice@empowermaterials.com
Website: www.empowermaterials.com

QPAC® CO₂-based polymers for a cleaner, more demanding world.
QPAC® polycarbonate carbonate copolymers are a unique family of innovative thermoplastic polymers. While traditional plastics have been primarily petroleum-based, these materials are derived from carbon dioxide and are produced through the copolymerization of CO2 with one or more epoxides. The resultant polymers are amorphous, clear, readily processible, and have long-term mechanical stability. They are also environmentally friendly by consuming 50% fewer petrochemicals, as compared to other polymers which are 100% petrochemical based. In addition, they may exhibit biodegradable properties consistent with an environmentally friendly binder.

QPAC® 25, polyethylene carbonate, and QPAC® 40, polypropylene carbonate, are the two most widely used products within our family of binders. However, there are a wide range of QPAC® polymers possible by varying the epoxide monomer or using blends of epoxides to produce a specific reaction. Our technical group has the expertise to effectively work with you to develop the appropriate product for your application.

Thermogravimetric analyses in both air and nitrogen show complete decomposition of poly(propylene carbonate) at low temperatures, heating rate is 10°C/minute.

**Application**  
**Benefits**  
**End Use/Industry**

- **Electronic ceramic binders**
  - Improve green strength and lubricity
  - Complete burnout at low temperature in any firing atmosphere
  - Low ash content
  - Electronic/technical ceramics, powder metals

- **Brazing solutions**
  - Compatibility with a variety of filler metals
  - Viscosities are custom-tailored for solution or paste requirements
  - Automotive, HVAC, aircraft

- **Diamond cutting tools**
  - Coats diamond powders evenly
  - Decomposition is uniform and controlled reducing the likelihood of cracks and voids in the final part
  - Construction, cutting tools

- **Energenics**
  - Decomposition is uniform and controlled
  - Flame temperatures are noticeably reduced during combustion
  - Flame temperatures are noticeably reduced during combustion
  - Flame temperatures are noticeably reduced during combustion
  - Propellants, pyrotechnics, airbag inflators

- **Pore formers**
  - Decomposes completely by 340°C in any environment
  - Amorphous thermoplastic which will solubilize completely and homogeneously
  - Mesoporous carbon composites, titanium structures, nanomaterials

- **Polymer foaming aids**
  - Reduced density of high temperature thermoplastics
  - Environmentally acceptable
  - Low temperature decomposition
  - Engineering thermoplastics for numerous industries

- **Lost foam casting**
  - Complete burnout
  - Minimal carbon residue
  - Metal castings, foundries, aluminum, iron

- **Technical glass binders**
  - Complete decomposition
  - Low ash content
  - Display screens, backlights, glass prisms

Typical Applications

QPAC® polymers can be processed using typical processing techniques, including solution processing, spin casting, injection molding or extrusion. This family of copolymers has attractive performance characteristics in a variety of applications. The following table shows some of these applications and QPAC® benefits:

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>160</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
</tr>
<tr>
<td>240</td>
<td></td>
</tr>
<tr>
<td>280</td>
<td></td>
</tr>
<tr>
<td>320</td>
<td></td>
</tr>
<tr>
<td>360</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
</tr>
<tr>
<td>440</td>
<td></td>
</tr>
<tr>
<td>480</td>
<td></td>
</tr>
<tr>
<td>520</td>
<td></td>
</tr>
<tr>
<td>560</td>
<td></td>
</tr>
</tbody>
</table>

**Advantages of QPAC®**

The following is a short list identifying some of the advantages of QPAC®. However, the advantages that our customers see go well beyond these benefits.

- **Design emissions**
  - Water and CO2

- **Low temperature / clean burnout**
  - Occurs at 220°C, complete at 340°C

- **Virtually no residue**
  - Less than 0.1% residue ash and metal

- **All sintering atmospheres**
  - Nitrogen, Oxygen, Argon, vacuum, ingot gases processed in industry

- **Controlled debind**
  - Polymers with unique properties controlled over a range of debind conditions

- **Excellent green strength**
  - Tacky, high molecular weight, amorphous thermoplastic polymers allow high density green shapes, tapes, films and other structures

- **Benign emissions**
  - Water and CO2

- **Low temperature / clean burnout**
  - Onset at 220°C, complete at 340°C

- **Virtually no residue**
  - Less than 10 ppm residue ash and metal

- **All sintering atmospheres**
  - Nitrogen, Oxygen, Argon, vacuum, ingot gases processed in industry

- **Controlled debind**
  - Polymers with unique properties controlled over a range of debind conditions

- **Excellent green strength**
  - Tacky, high molecular weight, amorphous thermoplastic polymers allow high density green shapes, tapes, films and other structures