Keeping that shine on your automobile is important to you. Our products help you maintain it.

Our innovative acrylic resins are used extensively in powder coating applications in the automotive industry. Other markets include aluminum wheels, outdoor furniture, lawn and garden equipment, and various architectural uses.

These resins contain glycidyl functional groups which, when combined with polycarboxylic acid compounds as the curing agent, exhibit excellent properties for coating materials.

Powder coating made from Almatex® GMA acrylics is especially noted for weatherability, gloss, crystal clarity, chemical resistance, and smooth finish. The resins exhibit excellent over bake tolerance, good caking stability, excellent electrical insulation properties, and an outstanding performance in electrostatic spraying equipment. These products are also more environmentally friendly than solvent based products.

Applications:
- Automotive Wheel
- Clear Top Coats
- Auto Primer
- Pigmented Coatings
- Architectural
- Outdoor Furniture
- Powder on Plastic
- Wood and MDF
- UV Curable Coatings
- Plumbing Fixtures
- Industrial
- Plastics and other Heat Sensitive Substrates
- Lawn & Garden
- Agricultural Machinery
**Chemistry of GMA Acrylic Resins**

Almatex® GMA Acrylic Resins are made by free radical, solution copolymerization of Glycidyl methacrylate (GMA) with other acrylic or vinyl aromatic co-monomers.

The stable -C-C- polymer backbone of GMA resins confers good outdoor weathering & chemical resistance. Unlike liquid coatings, powder coating resins are restricted to monomer selection and molecular weight (MW) to inhibit sintering and provide good flow during melt and cure. Hence, the glass transition temperature (Tg) of the final resin is designed to be above some minimum value (usually 40-45 °C) to insure physical stability of the powder coating. Tg of GMA acrylic powder resin is controlled by two equations:

\[ \frac{1}{T_{g_{c}}} = \frac{w_{1}}{T_{g_{1}}} + \frac{w_{2}}{T_{g_{2}}} + \frac{w_{3}}{T_{g_{3}}} + \cdots \]

By controlling monomer compositions and molecular weight, Almatex GMA resins can be designed with a wide range of melt viscosities, Tg, epoxy equivalent weight, and functionality for different application needs. The selection of monomers and polymer modification processes can produce Almatex® GMA acrylic resins with a variety of properties such as enhanced pigmentation, compatibility and flexibility.

Removal of solvent and unreacted monomers from resin product syrup is important to maintain the essentially zero VOC advantage of powder coatings. The volatile contents of Almatex resins are well controlled to below 0.5%. Anderson Development Company is installing a revolutionary continuous devolatilization capability in 2007 to further cut the residuals and low molecular weight portion (LMWP) in Almatex® GMA Acrylic Resins.

ADC and its parent company Mitsui Chemicals Inc. have full capability to tailor-make Almatex GMA acrylic powder resins to fit various special application needs.

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**Variables:**
- Degree of Functionality
- Monomer Composition
- Initiator Type
- Molecular Weight
- Glass Transition Temperature

**Advantages:**
- Excellent Long-term Weatherability & UV Durability
- Superb Chemical Resistance
- Crystal Clarity
- Outstanding Hardness
- Low to High Gloss
- Superb Smoothness & Appearance
GMA Powder Coating Formulation

Since GMA acrylic powder coating resins are epoxy functional, any curing mechanism for epoxy resins will also function with GMA resins. At this time the preferred curative for GMA acrylic powder resins is 1,12-dodecanedioic acid (DDDA) due to its combination of favorable melting point, cure rate & viscosity reduction. DDDA also provides cured coatings with excellent clarity, chemical resistance and weatherability. Other polycarboxylic acids or anhydrides may be used as curatives or additives to modify cure rate or coating properties.

Many additives used in the powder coating industry may also be used in GMA acrylic powder formulations. These additives include: flow control agents (FCA), de-gassing agents, UVAs, and HALS. For clearcoat applications, non-silica dispersed FCA's or special solid FCA's are preferred. The selection of UVA/HALS can also affect the yellowing and degree of outdoor durability.

Anderson has tackled many of the misnomers that surround GMA powder coatings. Our resin designs and powder coating formulations have improved flexibility, allowed robust pigmentation, proved to be effective in obtaining a wide range of matte and gloss finishes and can be combined with other powder chemistries.

Anderson Development Company and its parent company Mitsui Chemicals Inc. have over 30 years experience with GMA powder coatings for various applications, and would be glad to design private label resins or assist in formulating for specific coating applications.
Anderson R&D Support

Capabilities:

Global Support

Complete Powder Coating Laboratory
  - Premix through Oven Cure

Complete Powder Testing Facility
  - Thermal Analysis
  - GPC
  - GC
  - FTIR

Formulation Development

Problem Solving

Lab to Pilot Scale
**Dependable Anderson Production Capabilities:**

- Continuous Devolatilization
  - Heat Sensitive & UV Curable Resins
- Masterbatching
- Bulk Packaging
  - Supersacks
  - Drums
- Private Label Manufacturing
  - Solid Acrylic Resins
  - Liquid Acrylic Toll Resins
- ISO 9001:2000 Certified

**Comparison of Powder Melting-Curing Profile of GMA & Polyester Powder Coatings**

**GMA vs Other Powder Coating Chemistry in Weatherability**

- Higher cross-linking density
- Rapid melt & Lower flow viscosity

**Graphs:**

1. Complex Viscosity vs. Time (sec)
2. Percent 60 Gloss Retention vs. Xenon Arc Weatherometer (KJ/m)

**Legend:**
- GMA Acrylic
- Superdurable Polyester
- HFA Acrylic
- Semidurable Polyester
- Standard Polyester

**Heating Conditions:**
- Ramp from 80°C to 145°C @ 10°C/min & hold @ 145°C
General Purpose Almatex® Resins

- PD-7610
  - High Tg
  - Good Pigmentation
  - Short Gel-time
  - Lower Odor & Cost
  - Higher Reactivity
  - Lower GMA Content
  - Dual Functionality
  - GMA-Hydroxy
  - polyester compatible & Better Pigmentation

- PD-4219
- PD-9200
- PD-1700
- PD-4411

High Performance Almatex® Resins

- PD-3402
  - Better Flow
  - Higher Cross-linking Density

- PD-4408
- PD-4418
- PD-4421

Developmental (Semi-Commercial) Almatex® Resins

- UV Curable Solid Acrylic Resins (AP-4410, AP-4414, AP-4416)
- Polyester Powder Coating Compatible GMA Resins (AP-4411)
- Hydroxy Functional Acrylic Resin (HA-2001)
- Crystalline Aliphatic Polyester for High Flexibility (AP-8500)
- Other Experimental Resins (AP-XXXX)

Almatex® Resin Properties

<table>
<thead>
<tr>
<th>ALMATEX® Resin</th>
<th>Epoxy Equivalent (g/eq)</th>
<th>Tg (°C)</th>
<th>Melt Index (g/10 min @ 125°C)</th>
<th>Melt Viscosity (poise @ 150°C)</th>
<th>Applications</th>
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</thead>
<tbody>
<tr>
<td>PD-7610</td>
<td>510-560</td>
<td>42-46</td>
<td>46-54</td>
<td>200-240</td>
<td>General Purpose, Wheel, Auto Trim, Auto Primer, High Durability</td>
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<tr>
<td>PD-6300</td>
<td>550-560</td>
<td>55-58</td>
<td>10-16</td>
<td>&gt;500</td>
<td>Wheel, Polyester Matting Indoor or Outdoor</td>
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<tr>
<td>PD-6400</td>
<td>385-415</td>
<td>46-51</td>
<td>30-43</td>
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<td>PD-7690</td>
<td>450-500</td>
<td>44-46</td>
<td>43-54</td>
<td>200-250</td>
<td>General Purpose, Wheel, Auto Trim, Auto Primer, High Durability</td>
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<tr>
<td>PD-4219</td>
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<td>45-60</td>
<td>180-260</td>
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<tr>
<td>PD-9200</td>
<td>650-690</td>
<td>43-48</td>
<td>45-60</td>
<td>180-280</td>
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<tr>
<td>PD-1700</td>
<td>570-625 950-1150*</td>
<td>48-50</td>
<td>35-45</td>
<td>250-310</td>
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<tr>
<td>PD-4409</td>
<td>720-760 950-1200*</td>
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<td>75-120</td>
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<td>500-550 2900-3200*</td>
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<td>AP-2025</td>
<td>280-310</td>
<td>66-70</td>
<td>1-2</td>
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<td>PD-3402</td>
<td>360-400</td>
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<td>Automotive CC, Wheel</td>
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<td>60-80</td>
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<tr>
<td>HA-2001</td>
<td>652-748*</td>
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<td>40-60</td>
<td>200-250</td>
<td>Hydroxy Functional Acrylic, Urethane-Acrylic PC</td>
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</table>

* Hydroxy Equivalent Weight  **Double Bond Equivalent Weight

ALMATEX® GMA resins contain the lowest volatiles available in the industry (<0.5%). Color (Gardner) <2

The resin data shown in this table is only for resin selection guideline not for QC specification. “AP” and “HA” indicates the Almatex grade is a developmental or semi-commercial resin.
Select Cure-curve of Almatex® GMA Resins

Bibliography

15. “Powder Clearcoat, a Leap in Paint Technology” by Editor of Aec Feb 2001; p204-208.

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