



PATCHAM



Additives for Composites

A Sustainable Approach to Modern Coating Technology

Patcham (FZC) is a well-established manufacturer of specialty additives headquartered in the United Arab Emirates. Since its inception, Patcham has steadily grown into a leading supplier of additives for Composites, Paints & Coatings, Inks and PVC.

The Company's Pat-Add range of additives includes wetting & dispersing agents, air release agents, levelling agents and rheology modifiers. With focus on environmental sustainability, the company manufactures products using green raw materials where possible. All our products are APEO and formaldehyde free and several have low or no VOC.

The PATcure series of products includes a full range of accelerators in stable, easy to use liquid form. PATcure accelerators are available in various metal concentrations and carriers.

Patcham has built a strong manufacturing and R & D infrastructure that enables a rapid transition from concept to products. The company has strategically located technical service laboratories, offices and representatives around the world to provide efficient customer service. In addition, a well developed robust network enables it to deliver its products and services to customers around the globe with minimal lead time.



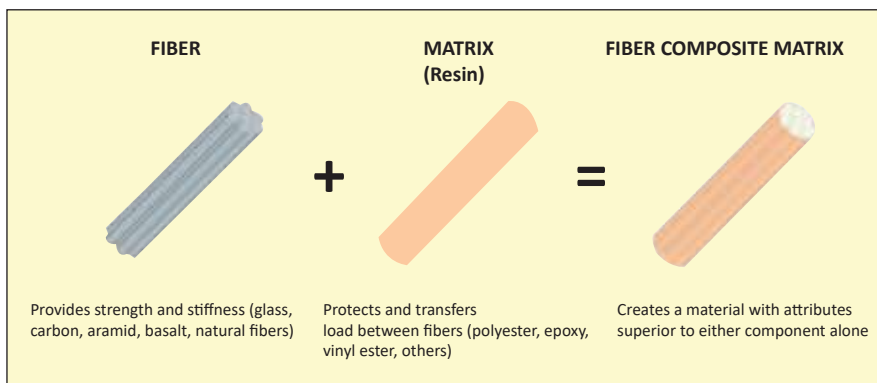
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Introduction

The innovation in composite technology today provides an alternative to conventional structural materials such as concrete, steel, aluminum and wood. A combination of properties like high strength, low weight, non-corrosive, and electrical insulation make composites an ideal material for structural purpose.

Composites which is also known as Fiber-Reinforced Polymer (FRP) composites are made from a resin matrix that is reinforced with an engineered, man-made or natural fiber or other reinforcing material. The fiber provides strengths and stiffness while more flexible matrix (resin) provides shape and protection. Composites may also contain fillers, additives, core materials or surface finishes designed to improve the manufacturing process, appearance and performance of the final product.



Commonly used Raw Materials for Composites

 <p>Pigments/Fillers</p> <ul style="list-style-type: none">• ATH• Kaolin Clay• White Pigment• Colored Pigments	 <p>Resins</p> <ul style="list-style-type: none">• Unsaturated Polyester• Vinyl Esters• Epoxy Resins• Polyurethane	 <p>Additives</p> <ul style="list-style-type: none">• Air Release Agents• Leveling Agents• Wetting and Dispersing Agents• Rheology Modifiers	 <p>Reinforcements</p> <ul style="list-style-type: none">• Glass Fibers• Carbon Fibers• Aramid Fibers• Natural Fibers
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Manufacturing Processes of Thermoset Composites

A. Open Molding Process

- Hand Lay-up
- Spray-up
- Filament Winding

B. Closed Molding

- Vacuum Bag Molding
- Vacuum Infusion Processing
- Resin Transfer Molding
- Compression Molding
- Pultrusion
- Reinforced Reaction Injection Molding
- Centrifugal Casting
- Continuous Lamination

C. Cast Open Molding

- Gel Coated Cultured Stone Molding
- Solid Surface Molding

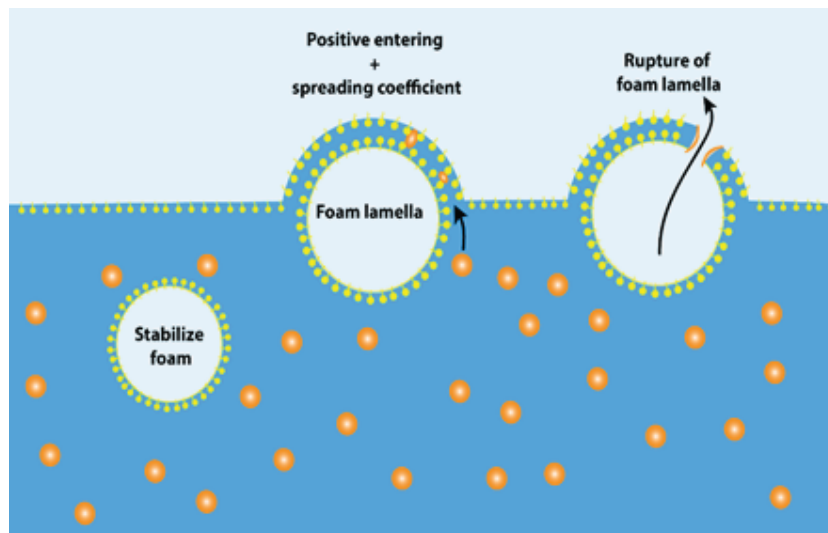
Air Release Agents

Entrapped and stabilized air remains as micro- or macro-foam in the system after curing and acts as source of porosity, weak points, insufficient fiber wetting and poor mechanical properties in composite materials.

The introduction of Patcham's air release agents helps to release the entrapped foams even from highly viscous systems.

Mechanism

- Air release agents, emulsified into fine droplets, penetrate into the foam lamella and disrupt the foam stabilizing surfactant layer
- Spread rapidly across the disrupted surfactant layer
- Lower the elasticity of the lamella for easy destabilization
- Destabilization leading to rupture of the lamella

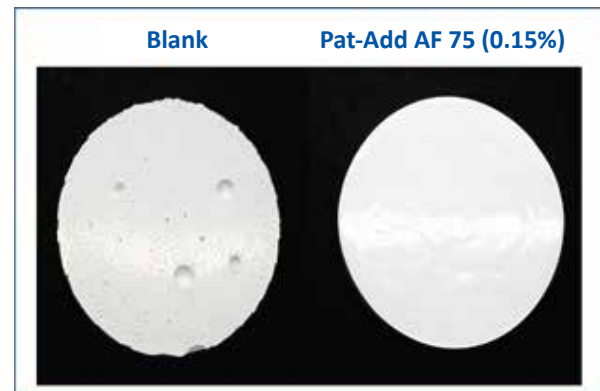


Air release mechanism

Pat-Add AF 75

- Polymeric air release agent for UPR systems, gelcoats
- Demonstrates rapid de-aeration
- Wide compatibility
- Functions at low dosages
- For pigmented and highly filled systems

Performance in UPR White Cast



Pat-Add AF 75 Performs efficiently even at lower dosage

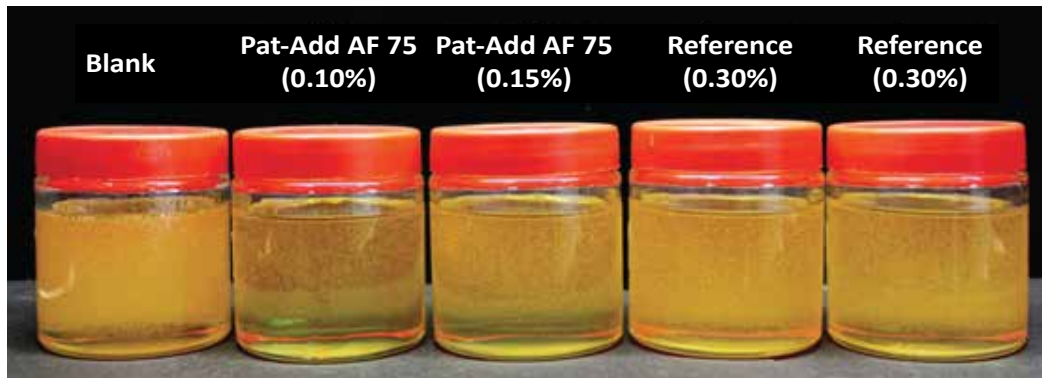


Table 1. Formulation of clear laminates

RM No.	Raw Materials	p/hr	Procedure
1	Unsaturated polyester resin	100.00	Step 1: Mix RM 1,2&3 in a clean glass bottle at 2000 RPM for 5 min & rate defoaming behavior Step 2: After completion of defoaming add hardener & mix well For 1 min Step 3: Pour into mold & rate defoaming during cure.
2	Co (Accelerator)	1.50	
3	Pat-Add AF 75/ Reference	0.15	
4	Hardener (MEKP)*	2.00	
	Total	103.65	

* Methyl Ethyl Ketone Peroxide

Pat-Add AF 76

- Silicone-free, polymeric de-aerator and defoamer for UPR systems, as well as PUR and epoxy systems
- Demonstrates rapid de-aeration and excellent compatibility in a wide variety of resin based formulations
- Maintains clarity without altering film properties of laminates or composites
- Highly recommended for transparent systems

Performance test in UPR Clear Laminates

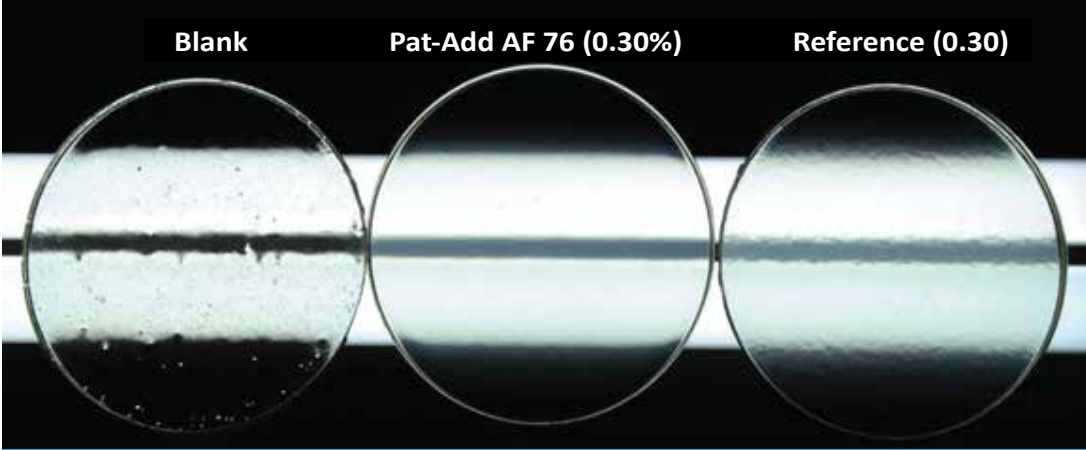
Blank	Pat-Add AF 76 (0.30%)	Reference (0.30)
		
Haze Value		
22.3	2.9	30.6

Table 2. Formulation of clear laminates

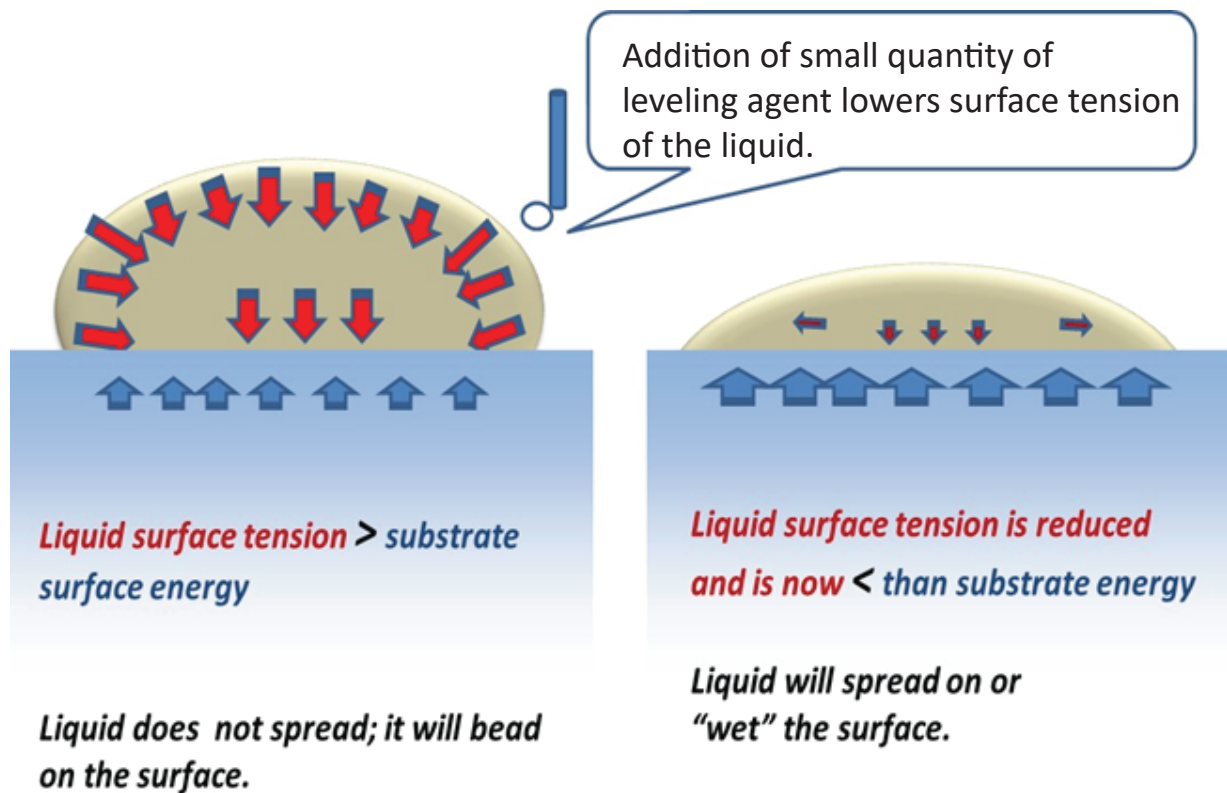
RM No.	Raw Material	phr	Process Details
1	UPR	100.00	Step 1: Mix RM 1,2&3 in a clean glass bottle at 2000 RPM for 5 min & rate defoaming properties. Step 2: After completion of defoaming add hardener & mix well for 1min . Step 3: Pour in to mold & rate defoaming during cure.
2	PATcure 2716	0.25	
3	Pat-Add 76/ Reference	0.30	
4	Hardener (MEKP)*	1.50	
	Total	102.05	

* Methyl Ethyl Ketone Peroxide

Leveling Agents

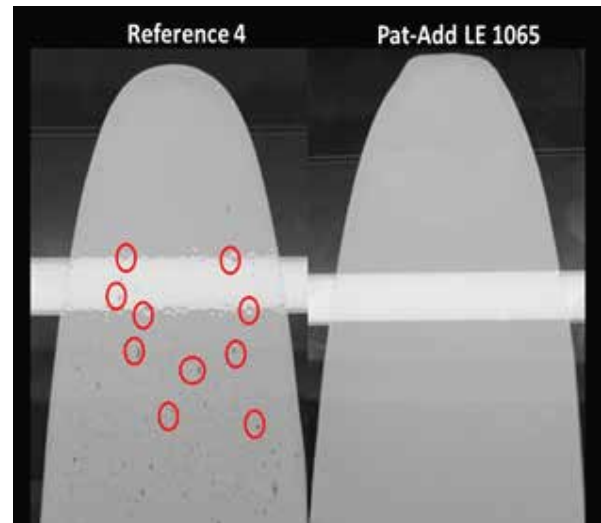
Leveling agents are added to systems to lower their surface tension and to form a defect free surface. The general mechanisms of performance is explained in the below figure.

Performance of Leveling Agent



Pat-Add LE 1065

- Efficient surface tension reducer
- Effective at very low concentrations
- Promotes film leveling and avoids formation of craters
- Suitable for pigmented as well as clear systems



**Appearance of
UPR White Topcoat**

Table 3. Properties of UPR White Topcoat

Parameters	Reference	Pat-Add LE 1065
Gloss (20°, 60°)	90, 97	90, 97
Spreadability/Wetting	Poor	Excellent
Cratering/Incompatibility	Severe	Absent

Table 4. Formulation of UPR White Topcoat

RM No.	Raw Materials	phr	Process Details
1	Ortho UPR	100.00	Step 1: Add RM 1 to 4 to a clean vessel and start mixing at 3000 RPM for 30min then allow the sample to rest for 1HR Step 2: Add Hardener and mix well for 1min and apply to glass panel and observe wetting behavior
2	TiO2	15.00	
3	PATcure 2716	0.25	
4	Pat-Add LE 1065	0.60	
5	Hardener (MEKP)*	2.00	
	Total	117.85	

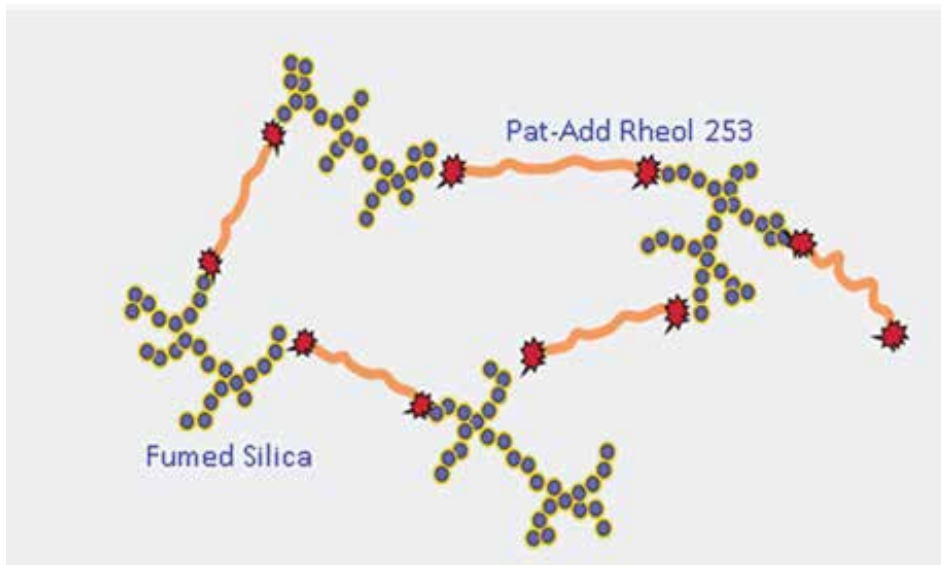
* Methyl Ethyl Ketone Peroxide

Rheology Modifiers

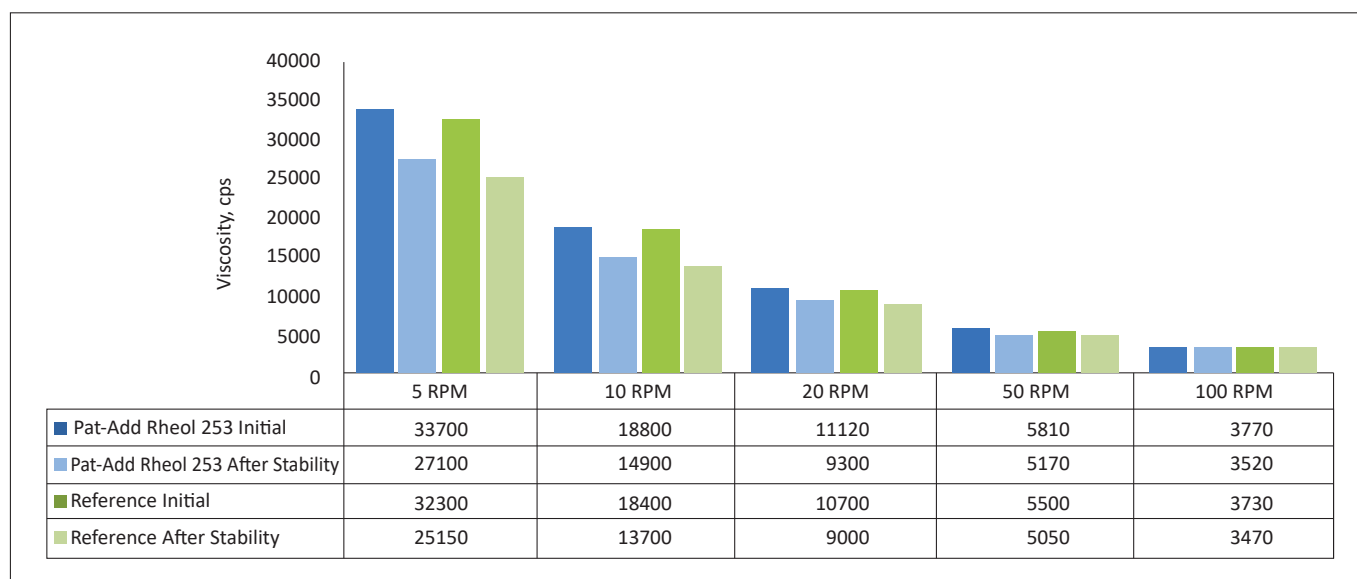
Pat-Add Rheol 253

- A liquid rheology modifier for UPR systems
- Demonstrates excellent compatibility in a wide variety of systems
- Does not require any chemical activation
- Boosts thixotropic behavior and reduces risk of sedimentation in UPR gel coat systems
- Fumed silica and clay-based additives are used as solid thixotropes to control UPR formulations. Hydrogen bonding creates a three-dimensional network, resulting in pseudo plastic and thixotropic flow behavior.
- To enhance and boost the three dimensional structure, liquid rheology modifier can be added to increase thixotropy or reduce the loading of clays and fumed silica.

Interaction of Pat-Add Rheol 253 with Fumed Silica



Viscosity profile of UPR Gel coat



Sag Resistance of Gel Coat

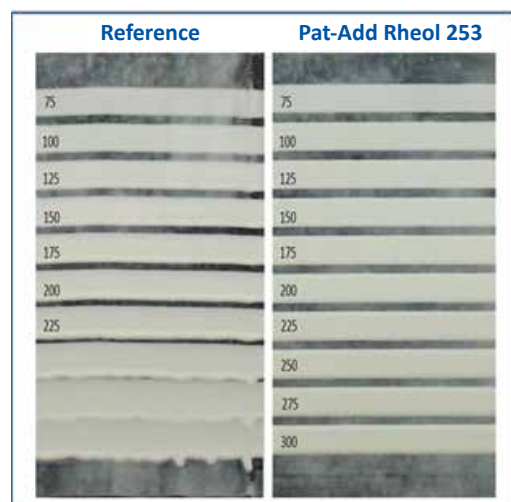


Table 5. Formulation of UPR Gel Coat

RM No.	Raw Materials	Parts by weight	Process Details
1	UPR Resin	86.72	Step 1: Add RM 1,2 and mix in the vessel at 500 RPM Step2: Add RM 3,4 and mix at 3000 RPM for 30 min Step 3: Add RM 5,6,7 and mix for 5min at 500RPM, complete batch process and check initial viscosity using Brookfield Viscometer at various RPM. Repeat the same viscosity reading process after 12 hrs and after 24 hrs.
2	Pat-Add Rheol 253	0.13	
3	Pigment R 902	7.8	
4	Aerosil 200	2	
5	Cobalt 1% drier	2.55	
6	Pat-Add AF 75	0.5	
7	Pat-Add LE 1065	0.3	
	Total	100.00	

Dispersing and Wetting Agents

Dispersing and Wetting

Without wetting and dispersing additives, pigments and fillers in a composite cannot be properly stabilized and once dispersed, would not remain evenly suspended in the mixture.

The Wetting and Dispersing Process

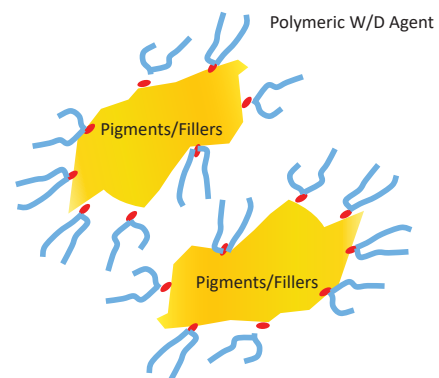
During processing of gelcoats or composites the pigment agglomerates are broken down into smaller particles. The cohesive forces within a pigment agglomerate increase with decreasing particle size. The wetting and dispersing agent has to enable wetting of these particle surfaces, stabilize them and affirm a satisfactory performance of the composite.

The wetting and dispersing agents work on either of the following mechanisms-

- a) Steric stabilization
- b) Electrostatic repulsion

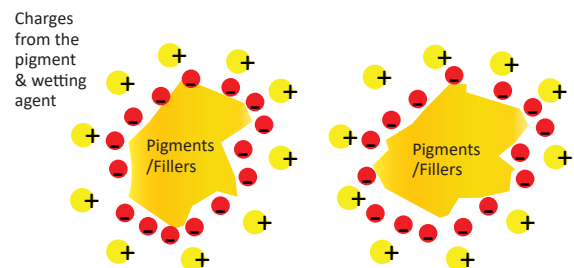
Steric Repulsion

- Additives containing one or more pigment affinic groups providing strong adsorption on pigment surface.
- Resin/solvent compatible chains protruding into the surrounding vehicle.



Electrostatic repulsion

- Stabilization increases with thickness of electrical double layer



Pat-Add DA 2702

Wetting and Anti-Settling Agent

- Wetting and dispersing additive for dispersion of commonly used fillers such as Aluminum trihydroxide (ATH) and Calcium carbonate
- Reduces compound viscosity for high filler loading
- Provides anti-settling properties even at lower system viscosity
- For spray lay-ups, hand lay-ups and casting

Table 6. Formulation of ATH/CaCO₃ based slurry

RM No.	Raw Materials	Percent weight	Process Details
1	Ortho UPR / ISO UPR	59.75	Step 1: Add RM 1,2, in a clean vessel and mix well at 500 RPM for 5min Step 2: Gradually add RM 3 and mix well at 1500 RPM for 30 min and complete the batch process
2	Pat-Add DA 2702 /Reference	0.25	
3	ATH/ CaCO ₃	40.00	
Total		100.00	

Performance of Pat-Add DA 2702 in UPR

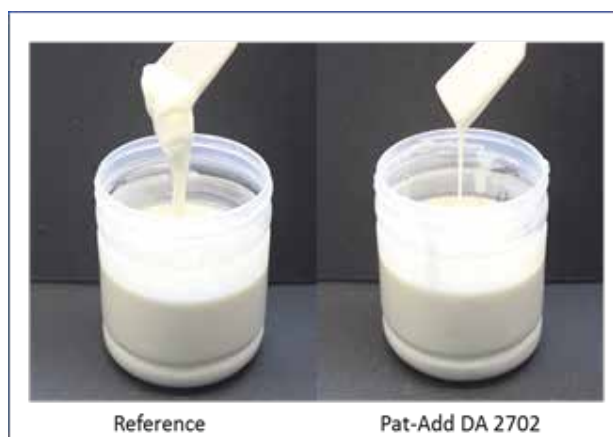


Table 7. Properties of ATH/CaCO₃ based slurry

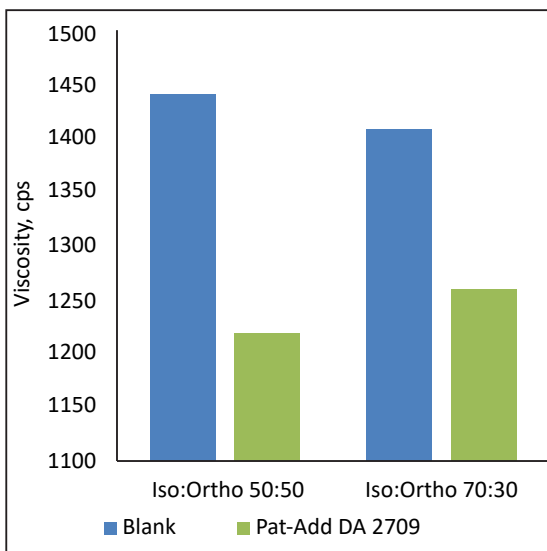
Properties	Isophthalic UPR	
	Pat-Add DA 2702	Reference
Initial Viscosity In KU	106.4	121.0
After 24 hrs. Viscosity in KU	102.3	122.6
Degree of Separation (Observation done after 24 hrs.)	No Separation	No Separation

Pat-Add DA 2709

Wetting & Dispersing additive based on green chemistry

- Enables high loading of ATH and fillers
- Strong reduction of viscosity and improves flow and leveling behavior of polyester casting resin
- Does not affect curing characteristics
- For cultured marbles, onyx and polymer concrete casting systems

Viscosity at 60 phr ATH loading



Viscosity at 160 phr ATH loading

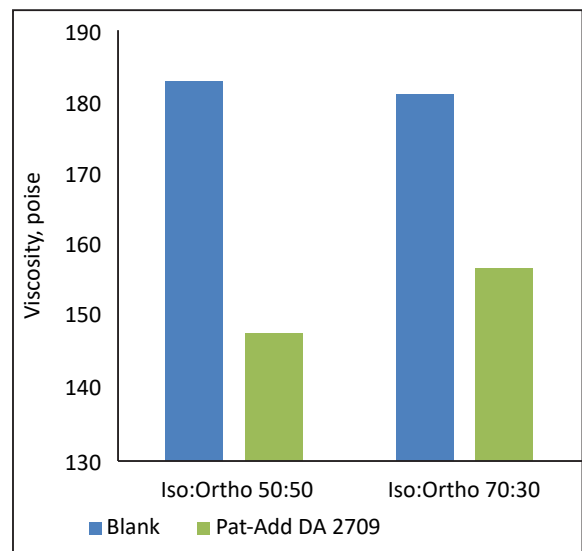


Table 8. Testing formulation for Wetting Agent

RM No.	Raw material	ISO : Ortho				Process Details
		50:50	70:30	50:50	70:30	
		60 phr		160 phr		
1	ISO UPR	50	70	50	70	Step 1: Add RM 1,2, in a clean vessel and mix well at 200 RPM for 5min Step 2: Gradually add RM 3, 4 and mix well at 500 RPM for 30 min and complete the batch process.
2	Ortho UPR	50	30	50	30	
3	Pat-Add DA 2709	0.6	0.6	1	1	
4	ATH (13-15 μm)	60	60	160	160	
	Total	160.6	160.6	261	261	

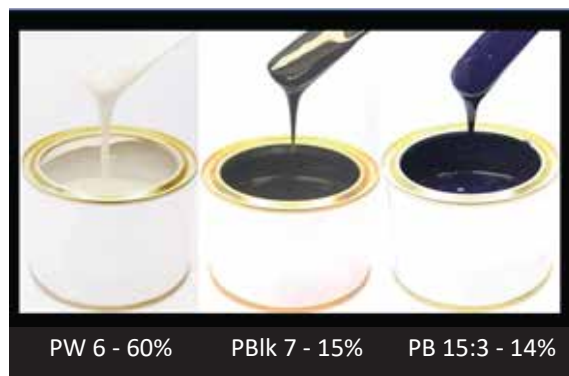
Pat-Add DA 895

Wetting and Dispersing Agent

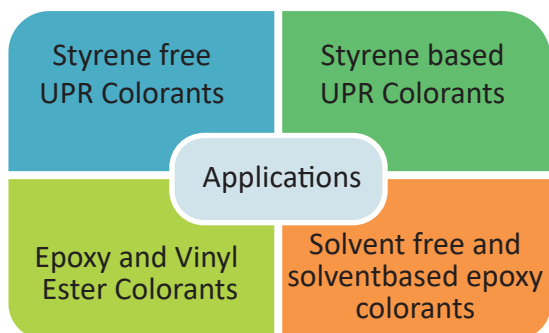
Being electroneutral gives better interaction with both acidic and alkaline pigments thus prevents flocculation.

- Can be used for developing various colorants based on different resin-systems
- Improves color strength
- Allows high loading of pigments
- Enhances stability
- Gives better flow and low viscosity to the colorants

Flow behavior RMPC in UPR Styrene free

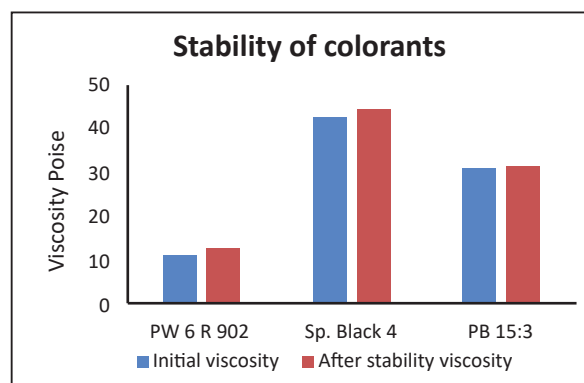


Pat-Add DA 895 in Colorants



Solubility and Compatibility of Pat-Add DA 895

- Solvents
 - Reactive Diluents
 - Acetate Solvents
 - Hydrocarbons
- Resins
 - Epoxy / Vinyl Ester Resins
 - Castor Oil
 - Unsaturated Polyester Resins



Note: Viscosity checked by Brookfield CAP 2000 viscometer at 100 RPM using Spindle no. 3

Table 9. Dosage recommendation for Pat-Add DA 895

Pigments	Additive dosage
TiO ₂ and Inorganic Pigments	10 % on Oil Absorption value
Organic Pigments	30 - 50% on BET value
Carbon Black Pigments	30-50 % SOP

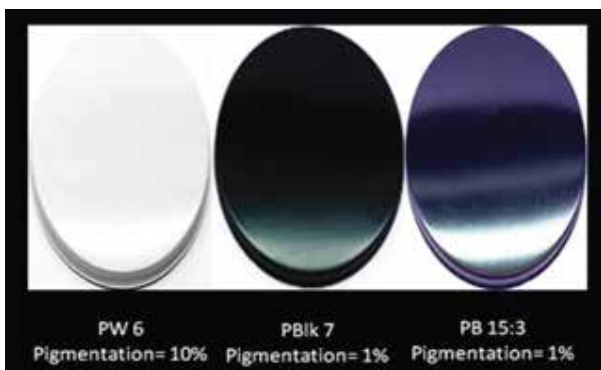
In UPR casting, desired color could be achieved by adding a particular amount of colorant. RMPC with Pat-Add DA 895 displayed good color development in a precast UPR.

Formula below is a typical example of precast.

Table 10. Formulation of UPR Cast

Raw material	Phr
Isophthalic Resin	100.0
Pat-Add LE 1065	0.30
Pat-Add AF 75	0.50
Cobalt 12%	0.125
Total	100.925

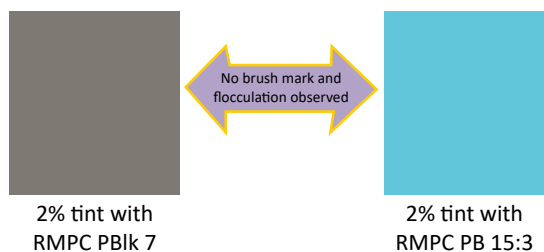
UPR Colored Precast



RMPC in UPR Styrene free Gel coat

Flooding and floating are problems in many composite systems. If pigment concentration is uniform on the surface but not through the thickness of the film, one refers to ‘flooding’ (horizontal separation). If, however, concentration differences are visible across the surface of the paint film, one refers to ‘floating’ (vertical separation).

Flood free brush application



2% RMPC Phthalo Blue 15:3



Initial After 24 hr

2% RMPC PBik 7



Initial After 24 hr

Floation free Gelcoat

PATcure Accelerators

Cobalt Accelerators

Cobalt Accelerators, very effectively, decompose organic peroxide initiators to form the free radicals that promote cross-linking of unsaturated resins.

Cobalt may be used on its own or in conjunction with other metals listed above.

Cobalt is typically used at 0.005 to 0.020 %, based on weight metal / binder solids

Gel-time-drift suppressor – PATcure Co 21 Neo

Pre-accelerated resins are very practical because only one additional component, the peroxide catalyst, must be added to cure the resin at room temperature. However, pre-promoted resins can be susceptible to a shelf life stability problem known as gel-time drift. Gel time drift is defined as a change in the resin's measured gel time compared to the original gel time measured at the time of its manufacture.

*Do not premix cobalt with peroxides as it could cause an explosion hazard.

PATcure Cobalt 12% 10% 8% 6%	Octoates	White spirit
PATcure Cobalt 12% 10% 6%	Octoates	Xylene
PATcure Cobalt 12% 10% 6%	Octoates	High flash point
PATcure Cobalt 12% Neo	Neodecanoate	High flash point 2 EHA free Aromatic free
PATcure Cobalt 12% AcAc	Acetylacetonate	Low discoloration Aromatic free
PATcure 2716		Colorless accelerator Replacement for Co 6
PATcure Cobalt 21% Neo	Neodecanoate	High flash point 2 EHA free

Potassium Accelerators

Potassium Accelerators improve the efficacy of cobalt improving discoloration. Assists in polymerization.

PATcure Potassium 15%	Octoates	High Flash Point Aromatic free
PATcure 2801 Potassium 15% WW	Octoates	Water White High Flash Point
PATcure Potassium 10%	Acetate	Improved effect on Cobalt High Flash Point

Copper Accelerators

Copper Accelerators reduce the peak exotherm. Improve shelf life.

PATcure Copper 8%	Naphthenate	
PATcure Copper 10%	Neodecanoate	High Flash Point 2 EHA free
PATcure Copper 12%	Octoates	High Flash Point Economical

Zinc Accelerators

Zinc Accelerators reduce the reaction rate allowing for clearer and more consistent polymers.

PATcure Zinc 8%	Naphthenate	
PATcure Zinc 8% 16% 18% 22%	Octoates	High Flash Point
PATcure Zinc 18%	Naphthenate	High Flash Point 2 EHA free

Sodium Accelerators

Sodium Accelerators produce slightly less discoloration than Potassium accelerators.

PATcure Sodium 8%	Octoates	High Flash Point
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Calcium Accelerators

Calcium Accelerators improve the action of cobalt and reduce gel time drift in pigmented systems.

PATcure Calcium 10%		High Flash Point
PATcure Calcium 6%	Octoates	High Flash Point Neutral

PATcure 2720

PATcure 2720 is an economic replacement of Cobalt accelerator 12%

Test Results in Orthophthalic Resin

Properties	PATcure 2720	Cobalt Octoate 12%
Gel Start Time	10 minutes 50 seconds	9 minutes 25 seconds
Time to peak exotherm	20 minutes 20 seconds	21 minutes 10 seconds
Peak exotherm temperature	125°C/257°F	128°C/262.4°F

Test Results in Isophthalic Resin

Properties	PATcure 2720	Cobalt Octoate 12%
Gel Start Time	7 minutes	9 minutes 45 seconds
Time to peak exotherm	13 minutes	19 minutes 25 seconds
Peak exotherm temperature	137°C/278.6°F	141°C/285.8°F

Orthophthalic resin cast



PATcure 2720

Cobalt Octoate 12%

Isophthalic resin cast

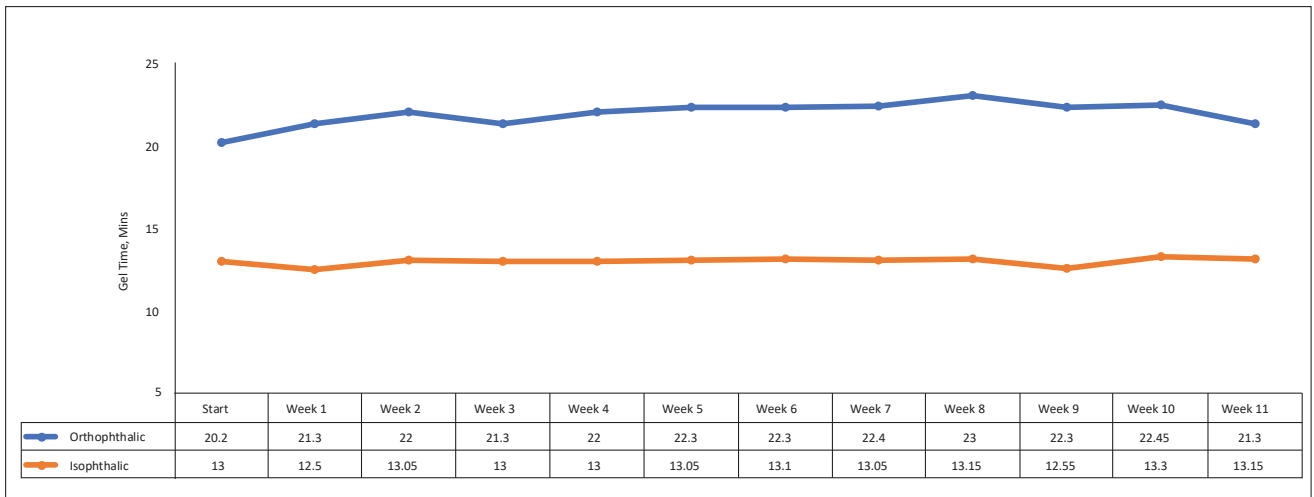


PATcure 2720

Cobalt Octoate 12%

Gel Drift Time

Testing done at room temperature (22°C-27°C/71.6°F-80.6°F)



PATcure 2721

PATcure 2721 is an economic replacement of Cobalt accelerator 10%

Test Results In Orthophthalic Resin

Properties	PATcure 2721	Cobalt Octoate 10%
Gel Start Time	8 minutes 10 seconds	9 minutes
Time to peak exotherm	17 minutes	19 minutes
Peak exotherm temperature	144°C/291.2°F	136°C/276.8°F

Test Results Isophthalic Resin

Properties	PATcure 2721	Cobalt Octoate 10%
Gel Start Time	6 minutes 15 seconds	8 minutes
Time to peak exotherm	13 minutes	17 minutes
Peak exotherm temperature	155°C/311°F	140°C/284°F

Orthophthalic resin cast



PATcure 2721 Cobalt Octoate 10%

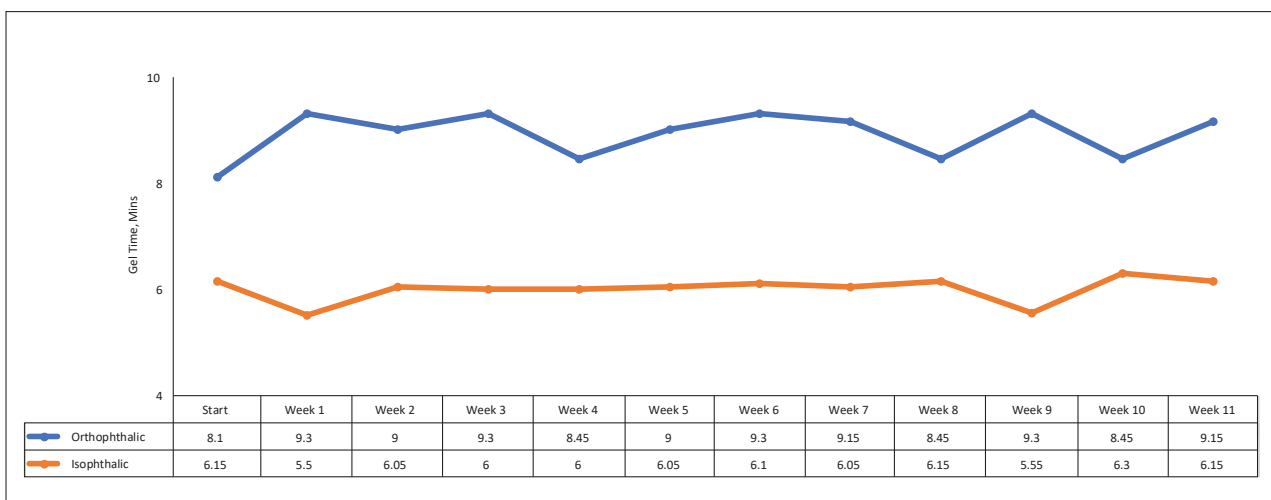
Isophthalic resin cast



PATcure 2721 Cobalt Octoate 10%

Gel Drift Time

Testing done at room temperature (22°C-27°C/71.6°F-80.6°F)



PATcure 2722

PATcure 2722 is an economic replacement of Cobalt accelerator 6%

Test Results In Orthophthalic Resin

Properties	PATcure 2722	Cobalt Octoate 6%
Gel Start Time	8 minutes	9 minutes 15 seconds
Time to peak exotherm	16 minutes	19 minutes
Peak exotherm temperature	144°C/291.2°F	137°C/278.6°F

Test Results Isophthalic Resin

Properties	PATcure 2722	Cobalt Octoate 6%
Gel Start Time	6 minutes	7 minutes 45 seconds
Time to peak exotherm	14 minutes	17 minutes
Peak exotherm temperature	152°C/305.6°F	142°C/287.6°F

Orthophthalic resin cast



PATcure 2722 Cobalt Octoate 6%

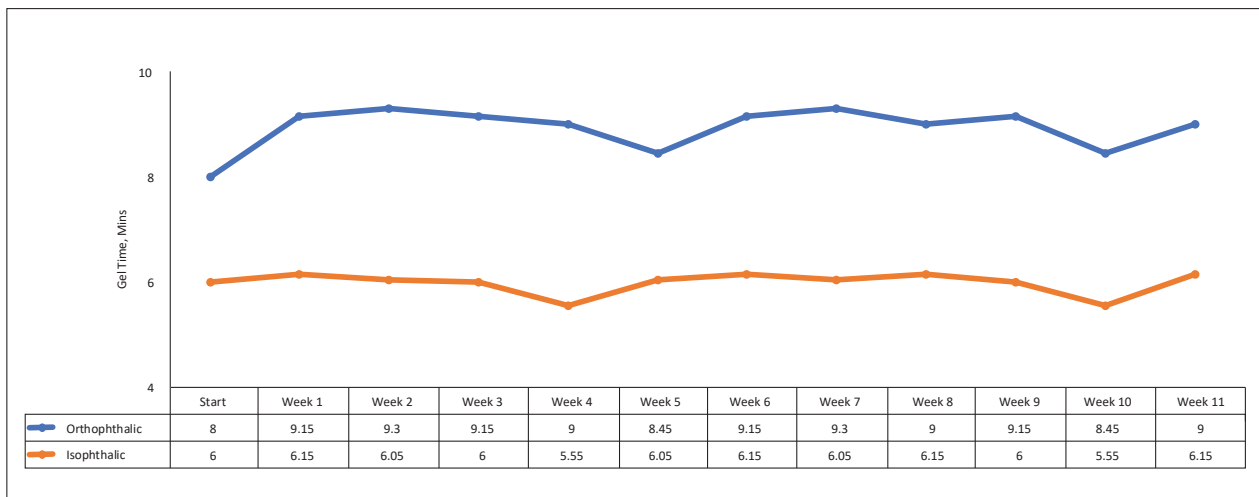
Isophthalic resin cast



PATcure 2722 Cobalt Octoate 6%

Gel Drift Time

Testing done at room temperature (22°C-27°C/71.6°F-80.6°F)



PATcure 2716

Colorless Cobalt Accelerator

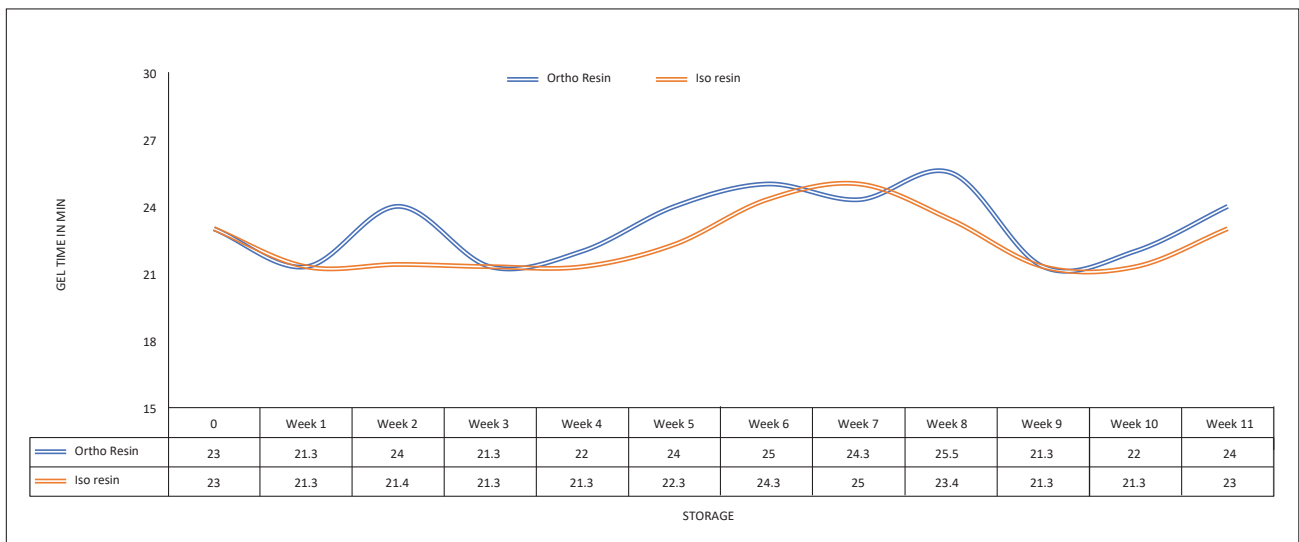
- Colorless Cobalt accelerator
- Weight to weight replacement for Cobalt 6%

Properties	PATcure 2716
Standard Gel Time (18-28 minutes)	23 minutes
Appearance of Casting	Colorless and Clear
Typical formulation : Resin 100g, Accelerator 0.25g, MEKP 1.5g	



Gel Drift Time

Testing at room temperature (22°C-27°C/71.6°F-80.6°F)



PATcure 2801

Water White Potassium Octoate 15%

- Potassium Octoate is often used as a synergist or promoter along with Cobalt in unsaturated polyester resin systems. PATcure 2801 is designed as a partial replacement of cobalt for use in gel coat and hand lay-up unsaturated polyesters.
- The use of PATcure 2801 helps to obtain a lighter colored unsaturated polyester resin cast and minimizes gel time drift upon ageing.

Specification data

Physical state	Clear Liquid
Color (APHA)	<100
% Non-volatile Matter	≥ 92.0%
% Metal content	15.0 + 0.2%
Water (KF)	3.0 – 5.0 %
Specific Gravity at 25°C (77°F)	1.090 - 1.120

Clarity of PATcure 2801





PATCHAM

www.patchamltd.com



PATCHAM (FZC)

P.O. Box: 7753,
Saif Zone, Sharjah, UAE
Tel: +971-6-5570035
Fax: +971-6-5570038
Email: patcham@emirates.net.ae

PATCHAM INDIA

B-52, Pravasi Industrial Estate
Vishweshwar Nagar, Off Aarey Road
Goregoan (E), Mumbai - 400 063 (India)
Tel: +91-22-29272471
Email: india@patchamltd.com

PATCHAM EUROPE BV

Klavermaten 65-1
7472 DD Goor
Netherlands
Email: eu@patchamltd.com

PATCHAM USA LLC

10 Commerce Road
Fairfield, New Jersey - 07004
Tel: (201) 293-4282
Fax: (201) 820-0818
Email: info@patchamusa.com