

# Metal Catalysts for Polyurethanes



PATCHAM

# A Sustainable Approach to Technology

Patcham FZC is a global manufacturer of specialty additives headquartered in the United Arab Emirates. Since its inception, Patcham has steadily grown to become a leading supplier of metal carboxylates and specialty additives for Paint & Coatings, Inks, PVC, Composites and Polyurethane. We also manufacture a range of tin based and tin free catalysts for various end use industries.

The company's Pat-Add range of coating additives includes driers, wetting & dispersing agents, defoamers, slip & leveling agents, rheology modifiers. All our products are APEO free and many are produced from green raw materials. Several are designed to enable our customers to make products that are low VOC or VOC free.

Patcham has a strong manufacturing and R&D infrastructure that enables 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 supply chain network enables us to deliver our products and services to customers around the globe with minimal lead-time.



Catalysts for these reactions are mainly tertiary amines and metal-containing compounds.

Principal Reactions		Product	Amines	Metal-Based Catalysts
Trimerization	NCO/NCO	Polyisocyanurate	Weak	Very Strong
	Isocyanate/isocyanate			
Gel reaction	NCO/OH	Polyurethane	Strong	Very Strong
	Isocyanate/polyol			
Blow reaction	NCO/H <sub>2</sub> O	Urea + CO <sub>2</sub>	Strong	Weak
	Isocyanate/water			

Principal Reactions	Product	Catalysts		
		Amines	Metal-Based Catalysts	
Chain Extender	NCO/NH <sub>2</sub> RNH <sub>2</sub> Isocyanate / diamine	Polyurea	Weak	Very Strong

Metal containing catalysts are far more desirable than amines:

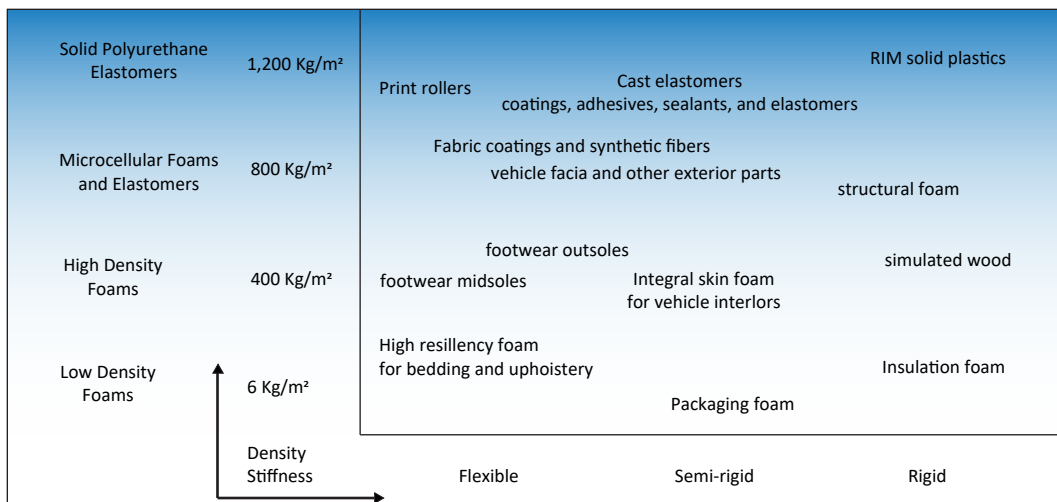
Amines	Metal-Based Catalysts
Bad smell	Low odor
Corrosive	Non-corrosive
High pH	Neutral
Toxicity issues	Many have very low toxicity
Instability with acid treated pigments	Non-reactive towards acid treated pigments
Deactivation of HFO blowing agents	Stable with HFO blowing agents
Low Flash Point	Many have high flash point
End product discoloration	Several have very low color

## General Information

Polyurethanes (PU) are one of the most versatile plastic materials.

Catalysts exert a considerable influence on PU structures and its end properties. There are several chemical reactions that occur in Polyurethane PU and Polyisocyanurate PIR systems.

The three primary chemical reactions are: isocyanate/isocyanate; isocyanate/polyol, and isocyanate/water.



Trimerization is required for the production of rigid foams.

Gel reaction is the defining reaction for all urethanes.

Blow reaction is important for many foams but produces unwanted gassing in other systems.

These reactions occur readily at temperatures above 110°C. However, at room temperature without a catalyst, they are slow, taking days.

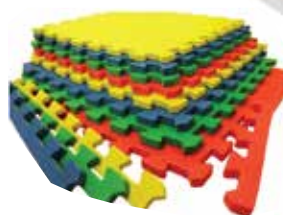
Often di-amines (and short chain diols) are added as crosslinking agents.

Catalysts have a tendency to catalyze several reactions at once, although to differing degrees, and their individual action can be highly temperature and time dependent.

A mix of catalysts is often required to achieve a delicate balance between all these reactions in order to achieve the desired end product properties and pot life.

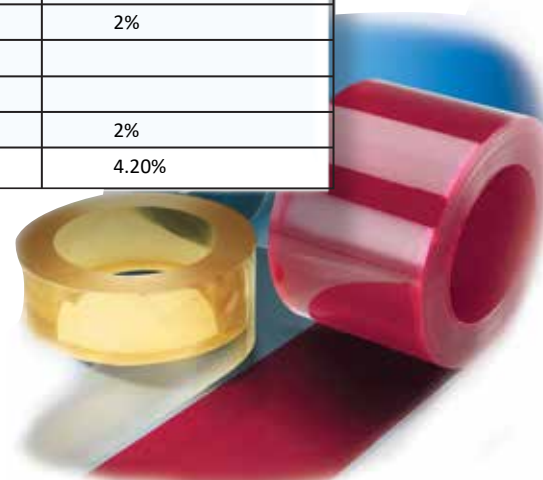
Addition of metal-containing catalysts in concentrations that can be measured in ppm have a profound effect on the rate of reactions and offer synergy with amies catalysts.

Catalyst deactivation can be a function of water content in the PU system and thus hydrolytic stability of the catalyst is also an important formulating consideration.



Tin Catalyst		
PATcat 3012	Stannous octoate	28.00%
PATcat 3017	Monobutyltin trioctate	19.00%
PATcat 3028	Dimethyltin dineodecanoate	23.50%
PATcat 3027	Dimethyltin dilauryl mercaptide	21.00%
PATcat 3030	Dimethyltin di (2 ethylhexyl thioglycolate)	19.00%
PATcat 3003	Dibutyltin diacetate	33.00%
PATcat 3004	Dibutyltin dineodecanoate	20.00%
PATcat 3001	Dibutyltin dilaurate	18.00%
PATcat 3014	Dibutyltin lauryl mercaptide	18.00%
PATcat 3026	Dibutyltin di (2 ethylhexyl thioglycolate)	18.00%
PATcat 3020	Dibutyltin carboxylate	18.00%
PATcat 3025	Dibutyltin di (2 ethylhexyl maleate)	17.00%
PATcat 3015	Dibutyltin carboxylate laurate	18.00%
PATcat 3006	Dibutyltin dipentanedionate	27.00%
PATcat 3024	Diocetyl tin dineodecanoate	17.00%
PATcat 3005	Diocetyl tin dilaurate	16.00%
PATcat 3022	Diocetyl tin di (2 ethylhexyl thioglycolate)	15.00%
PATcat 3023	Diocetyl tin diacetate	26.00%
PATcat 3009	Diocetyl tin carboxylate laurate	16.00%
PATcat 3016	Diocetyl tin dipentanedionate	21.00%

Non-tin Catalysts		
PATcat 4001	Bismuth Neodecanoate	16.50%
PATcat 4005	Bismuth Octoate	24.00%
PATcat 4006	Bismuth Octoate	28%
PATcat 4007	Bismuth Neodecanoate	20%
PATcat 4009	Bismuth-Zinc Complex	8% each
PATcat 4012	Bismuth Complex	18%
PATcat 4014	Special Bismuth Complex	12%
PATcat 5001	Potassium Octoate (DEG)	15%
PATcat 5004	Potassium Acetate (DEG)	10%
PATcat 5005	Potassium Acetate (DEG)	15%
PATcat 5006	Potassium Acetate (MEG)	10%
PATcat 5007	Potassium Acetate (MEG)	15%
PATcat 5010	Potassium Neodecanoate (DEG)	10%
PATcat 7001	Nickle Complex	2%
PATcat 8001	Zirconium Neodecanoate	12%
PATcat 9001	Zinc Octoate	23%
PATcat 9002	Zinc Octoate	18%
PATcat 9003	Zinc Octoate	19%
PATcat 9005	Zinc Octoate (Glycol Ether)	20%
PATcat 11001	Manganese Neodecanoate	2%
PATcat 11002	Special Manganese Neodecanoate	2%
PATcat 12001	Proprietary Catalyst	
PATcat 13001	Proprietary Catalyst	
PATcat 14001	Copper Neodecanoate	2%
PATcat 17002	Aluminum Complex	4.20%

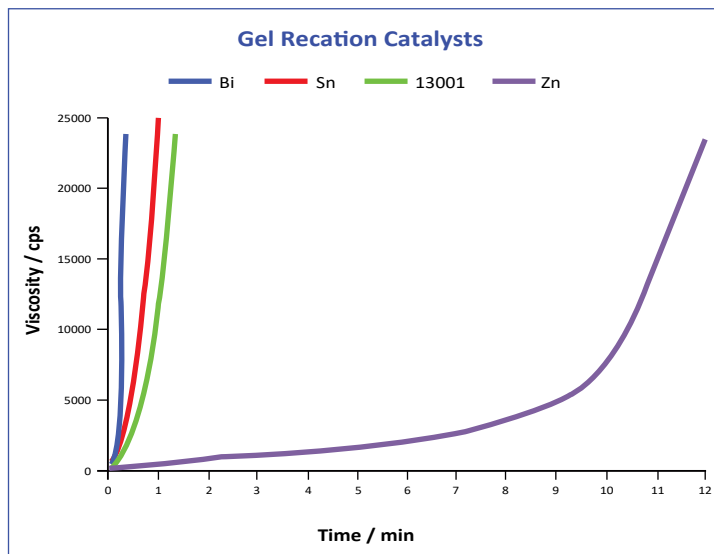


## Tin Catalyst

- Tin-based catalysts are widely used in the industry as general purpose fast acting catalysts.
- PATcat 3001 (DBTL) and PATcat 3003 (DBTDA) are very versatile catalysts. For CASE applications, DBTDL can be considered as the workhouse catalyst due to its high efficiency.
- PATcat 3012 (Stannous Octoate) is the principal tin catalyst used to manufacture flexible polyurethane foam.
- PATcat 3022 is a slow action catalyst providing longer pot life and good hydrolytic stability among other tin catalyst.

## Non-tin Catalysts

- Apart from being more environmentally accepted, these catalysts may offer performance advantages over tin catalysts in some applications.
- Bismuth catalysts' catalytic activity is comparable to tin catalysts. They provide low toxicity, are non-yellowing and demonstrate excellent gloss retention.
- Zirconium Catalysts are fast curing catalysts with selective catalysis. They also provide good pot life with excellent exterior selectivity
- Zinc Catalysts are versatile catalysts and are hydrolytically stable. They provide long reaction time with good selectivity.
- Potassium catalysts are primarily used as trimerisation catalysts and also contribute in gel reaction.



## Mercury Alternative Catalysts

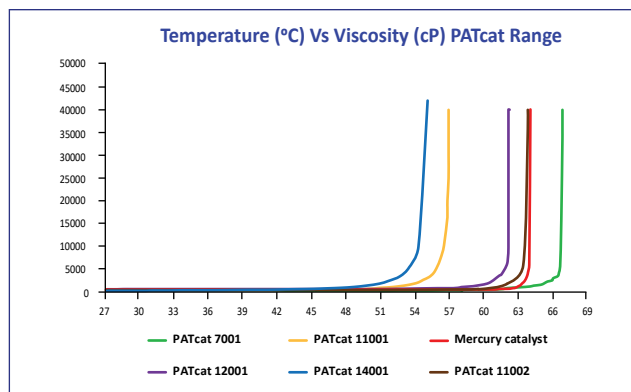
These catalysts show low initial activity at room temperature.

Their activity increases as the exotherm rises or when external heat is applied.

Delayed-action catalysts are of particular interest in molded product application where initial flow properties are paramount.

Many industrial adhesive, sealant and cast-able elastomer applications require a delay before onset of the gel reaction often followed by a "snap cure". Organomercury compounds are known to provide a long induction period (delay) followed by a sharp gelation profile (snap cure) but due to their inherent toxicity replacements are essential.

Most of the delayed action catalysts offered by Patcham produce gel times slightly shorter than those provided by mercury catalysts at ambient temperature, allowing for greater product throughput.



# Section 1 Trimerization Catalyst

Trimerization provides a rigid cell structure important for high insulation foams as well as flame retardancy and structural integrity.

Potassium Acetate is more of a general purpose catalyst that is very powerful with the trimerization reaction.

Potassium Octoate is a more specific trimerization catalyst.

Grade	
PATcat 5001	Potassium Octoate 15% in DEG
PATcat 5004	Potassium Acetate 10% in DEG
PATcat 5005	Potassium Acetate 15% in DEG
PATcat 5006	Potassium Acetate 10% in MEG
PATcat 5007	Potassium Acetate 15% in MEG
PATcat 5010	Potassium Neo 10% in DEG

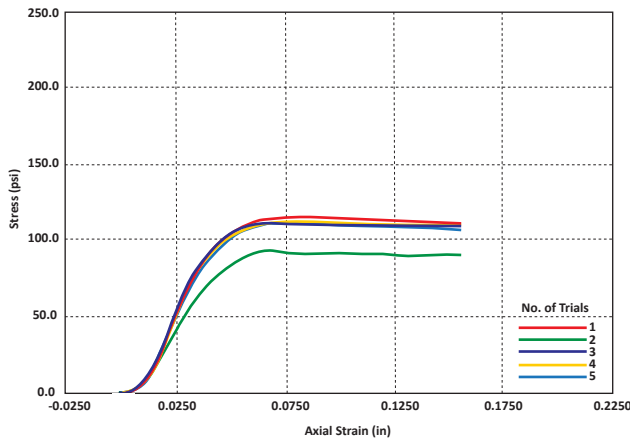
PATcat 5004 Foam Reaction Performance



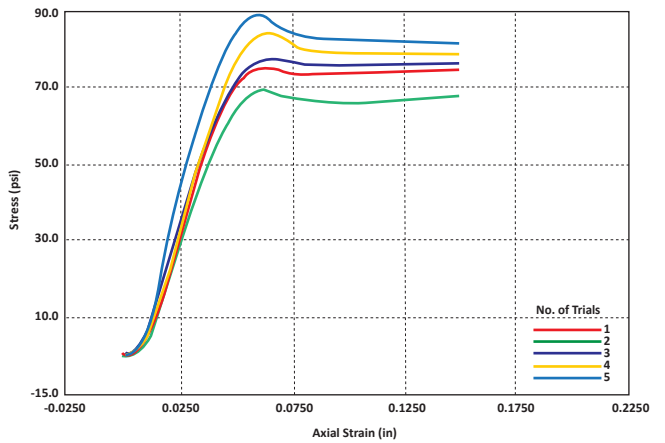
PATcat 5001 Foam Reaction Performance



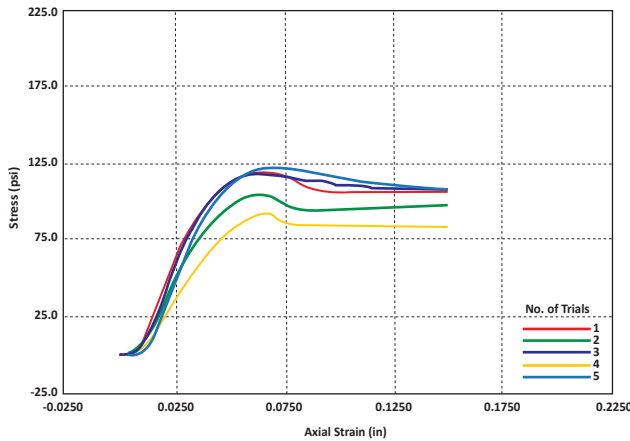
Compressive Strength Parallel to Rise (ASTM D1621)



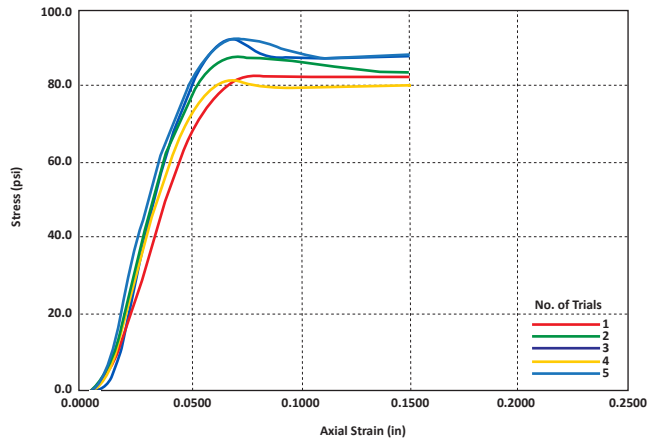
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Compressive Strength Perpendicular to Rise (ASTM D1621)



### Pat-Add DA 3225

#### Additives for Pigment Dispersion used in PU Foam and Coatings

**Pat-Add DA 3225** - Polymeric dispersant based on Patcham's proprietary HVM Ultra Charged technology. Recommended for pigment concentrates based on polyether polyol and plasticizers. Enables high color strength and long term stability.

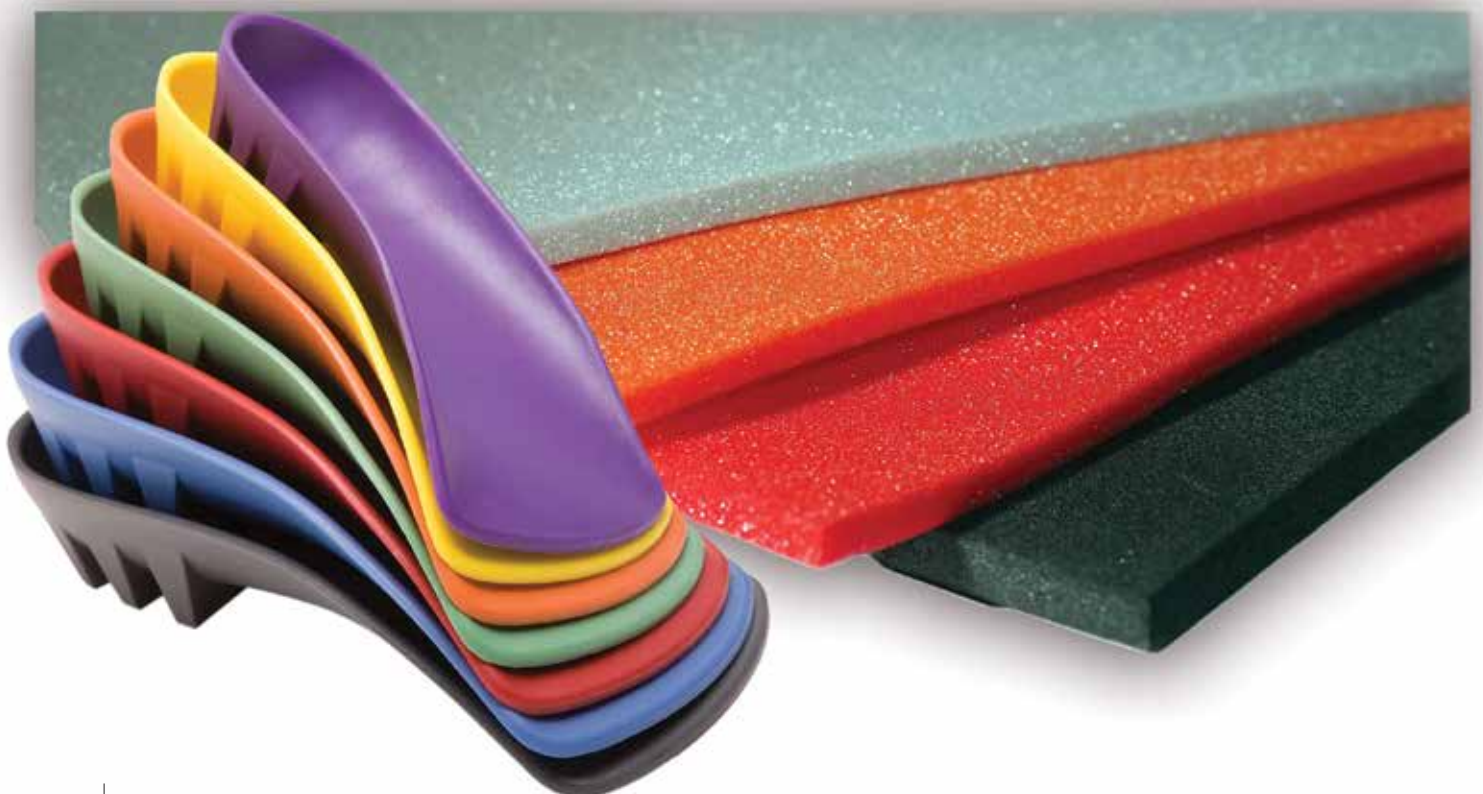


Blue PB 15:3

Yellow PY 74

Green PG 7

Red PR 254





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