King Industries' Catalyst PC : A Catalyst for Low-Temperature Bake Powder Systems.

Matt Salvi

Coating Additives Division

King Industries Inc.

2021

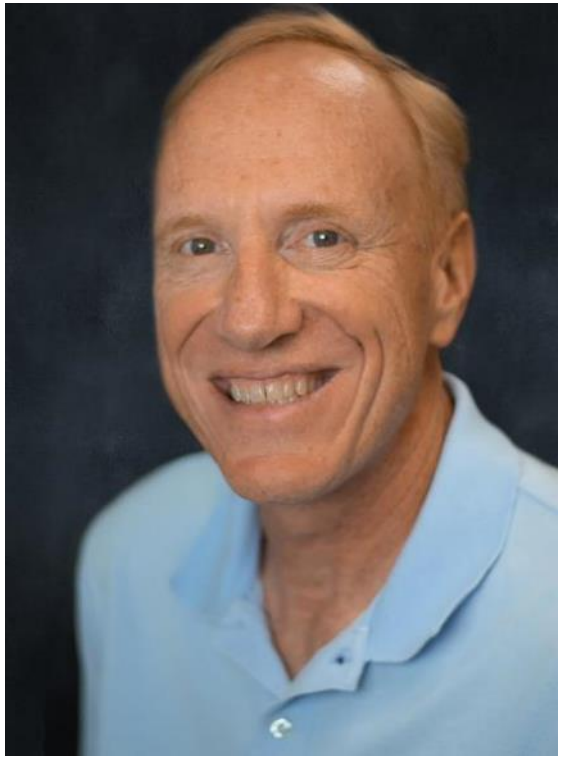
King Industries Overview

A family owned company providing solutions through chemistry since 1932

KING INDUSTRIES SPECIALTY CHEMICALS

Introduction
King Industries Heritage

- Specialty chemical manufacturer
- Founded in 1932 by Robert J. King
- Located in Norwalk, Connecticut – USA
- Technical sales offices also in Netherlands and China
- Moving toward 4th generation of leadership
- ~200 employees



Chris Fesenmeyer
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2021 Coatings Sales Team

KING INDUSTRIES
SPECIALTY CHEMICALS

King Industries' Catalyst PC

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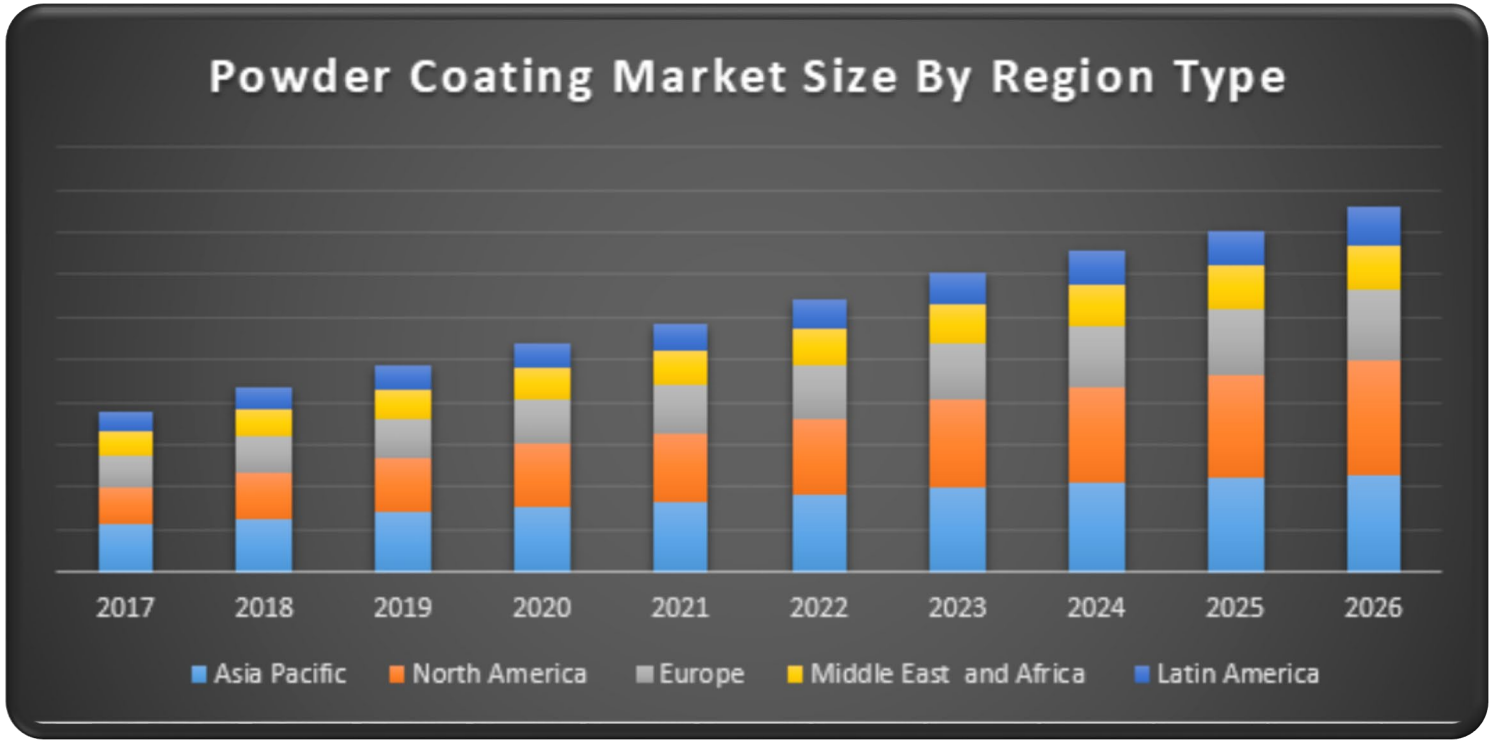
Powder Coatings Growth

Increasing demand for powder coatings across all markets

CAGR = 5% annually through 2026



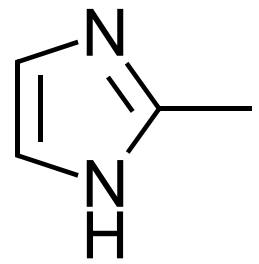
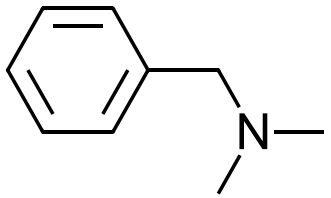
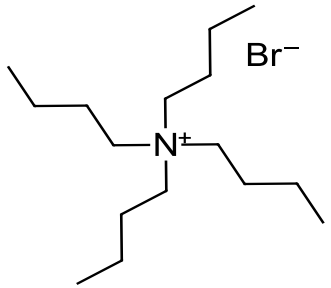
Credit: Maximize Market Research

Dominated by thermosets systems

- Increased resistance properties and performance in high temperature environments

KING INDUSTRIES SPECIALTY CHEMICALS

Conventional Catalysts for Powder Coatings

Imidazoles	Tertiary Amines	Quaternary Ammonium Salts
		
• Off-white powder • General purpose	• Colorless liquid • Low color • Better stability	• Off-white powder • Poor stability • White powder

Require elevated temperatures with long bake cycle

KING INDUSTRIES SPECIALTY CHEMICALS

Typical Challenges with Powder Coatings

Typical challenges

- Improper dwell time
- Heavy substrate
- Oven temperature

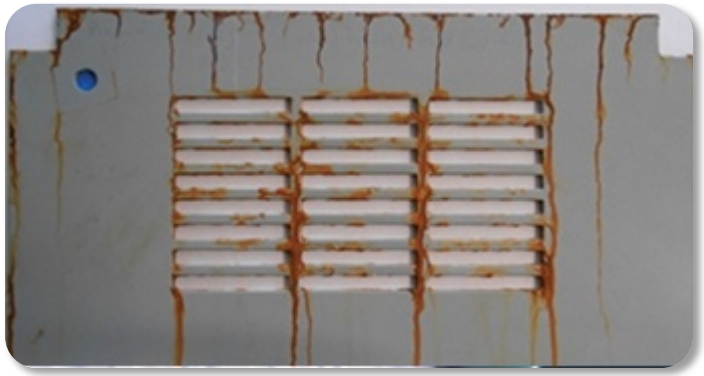
Lead to:

Under-Cured Film Properties

Poor chemical resistance

Poor impact resistance

Poor Edge Film Build and Exterior Durability



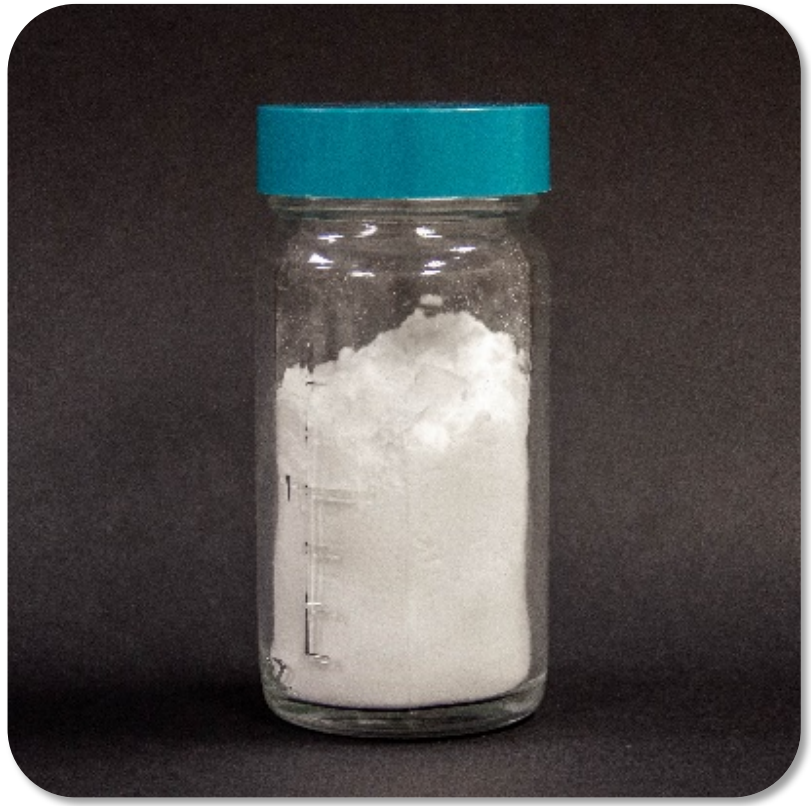
Credit: Coatings World Magazine

KING INDUSTRIES SPECIALTY CHEMICALS

Solution: King Industries' Catalyst PC

King Industries' Catalyst PC

Property	Description/Value
Chemistry	Amine Carboxylate
Appearance	White solid powder
Active	56%
Benefits	Low temp. cure Chemical resistance Improve impact resistance Reduced health hazards



KING INDUSTRIES SPECIALTY CHEMICALS

Advantages of King Industries' Catalyst PC

in your powder coatings system

The King
Advantage

- Achieve **low temp. curing**
- Increase **efficiency**
- Attain high **chemical resistance**
- Improve **impact resistance**

Without affecting color or appearance

King Quality:

- King Industries quality components
- Safe and easy to use

King Industries' Catalyst PC – Low-Bake Systems

Increase Production Capacity and Reduce Energy Costs

Reduce Peak Metal Temperature

200+°C → **140°C**

Allows for up to **60%** reduction of residence time

Shorten Cure Time

Reduce Oven Temps

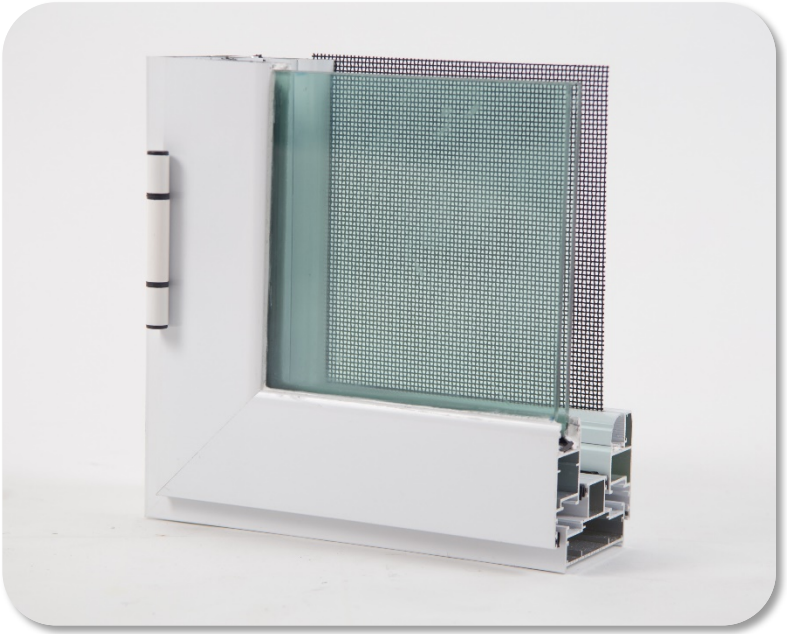
KING INDUSTRIES® SPECIALTY CHEMICALS

King Industries' Catalyst PC - Achieve Low Temp. Curing

Applications for LTC Powder Coatings

Coatings for:

- Heat-sensitive substrates
- Heavy duty objects
- Steel tanks/pipes



- Aluminum/plastic hybrid window

Performance of King Catalyst PC

King Industries' Catalyst PC *vs.* 2-M Imidazole

Formulated in polyester/BPA system

King Industries' Catalyst PC *vs. C17*-Imidazole

Formulated in TGIC system

KING INDUSTRIES SPECIALTY CHEMICALS

King Industries' Catalyst PC vs. 2-MI in Polyester/BPA

KING INDUSTRIES
SPECIALTY CHEMICALS

Preparation - White Polyester / BPA Hybrid

Standard Powder Coatings Cure Conditions

30 min at **190-220°C**

PMT (180-200°C)

King Catalyst PC **Low Bake Powder Coating Conditions**

15 min at **150-170°C**

PMT (140-170°C)

KING INDUSTRIES SPECIALTY CHEMICALS

Performance - White Polyester / BPA Hybrid

With conventional catalyst
Low Temp Cure: ⬇ 200° C

- Poor chip resistance
- Poor resistance properties

The King
Advantage

King Industries' Catalyst PC

- DTM thin films
- Full cure at low temp bake
- Improved chemical/impact resistance
- Improved gloss
- Good color properties
- Good heat age stability

KING INDUSTRIES SPECIALTY CHEMICALS

Catalyst PC vs. 2-MI – White Polyester / BPA Hybrid

Model Formulation: 70/30 Hybrid

Raw Materials	Description
BPA Hybrid	BPA, EEW - 755 g/eq
Polyester	Polyester, AV - 35 mg KOH/g
TiO_2	Pigment
$BaSO_4$	Extender
Polyacrylate	Flow Agent
Benzoin	Degassing Agent

The King **Advantage**

King Industries' Catalyst PC vs. 2-MI

Mfg. Costs ⬇

- Energy cost savings
- Potential higher throughput
- Better, more durable films

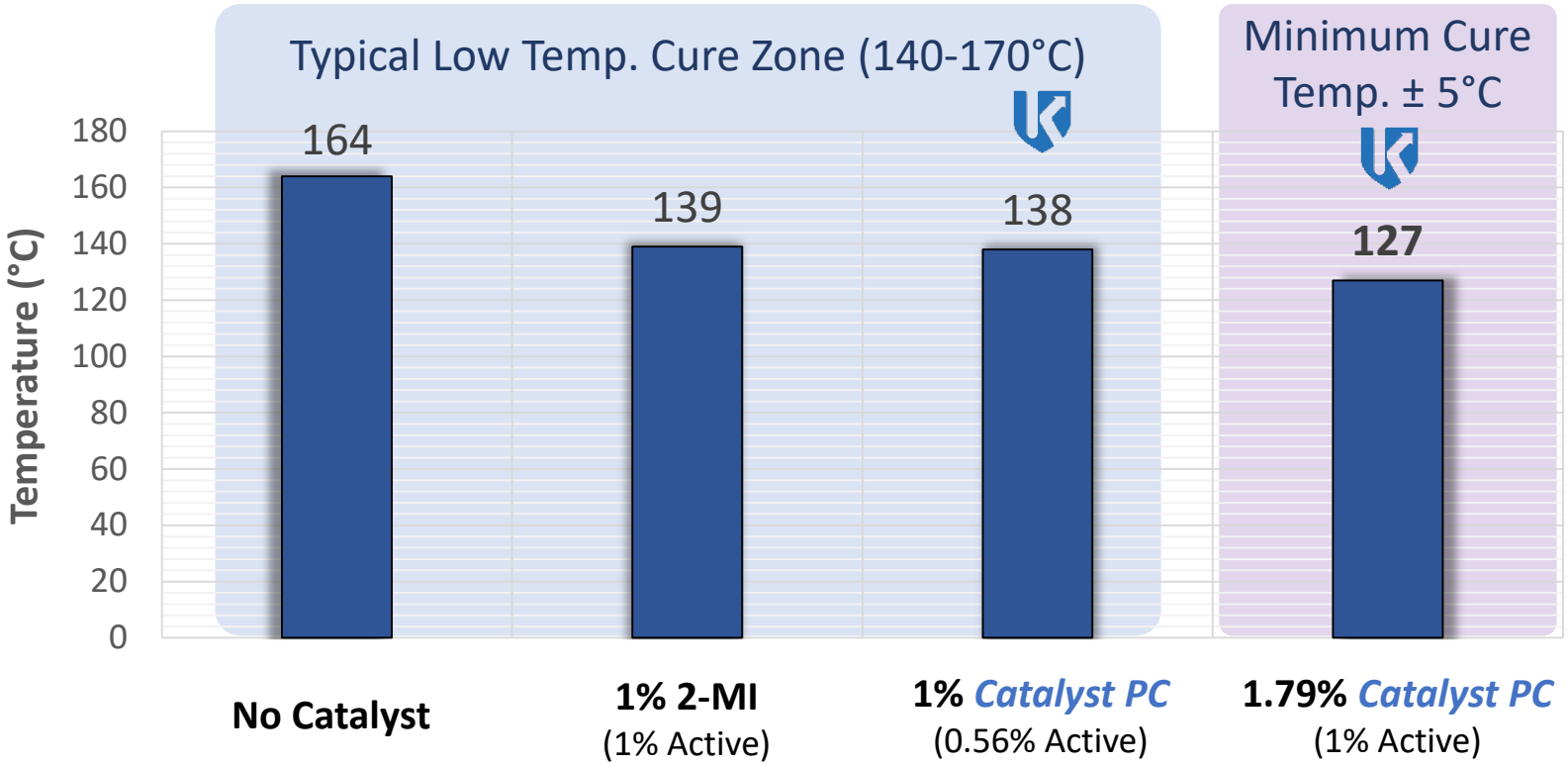
KING INDUSTRIES SPECIALTY CHEMICALS

Gel Temp – White Polyester / BPA Hybrid

Advantage

King Industries' Catalyst PC provides **decreased gel temperature** versus 2-MI

Rheometer Cure Study

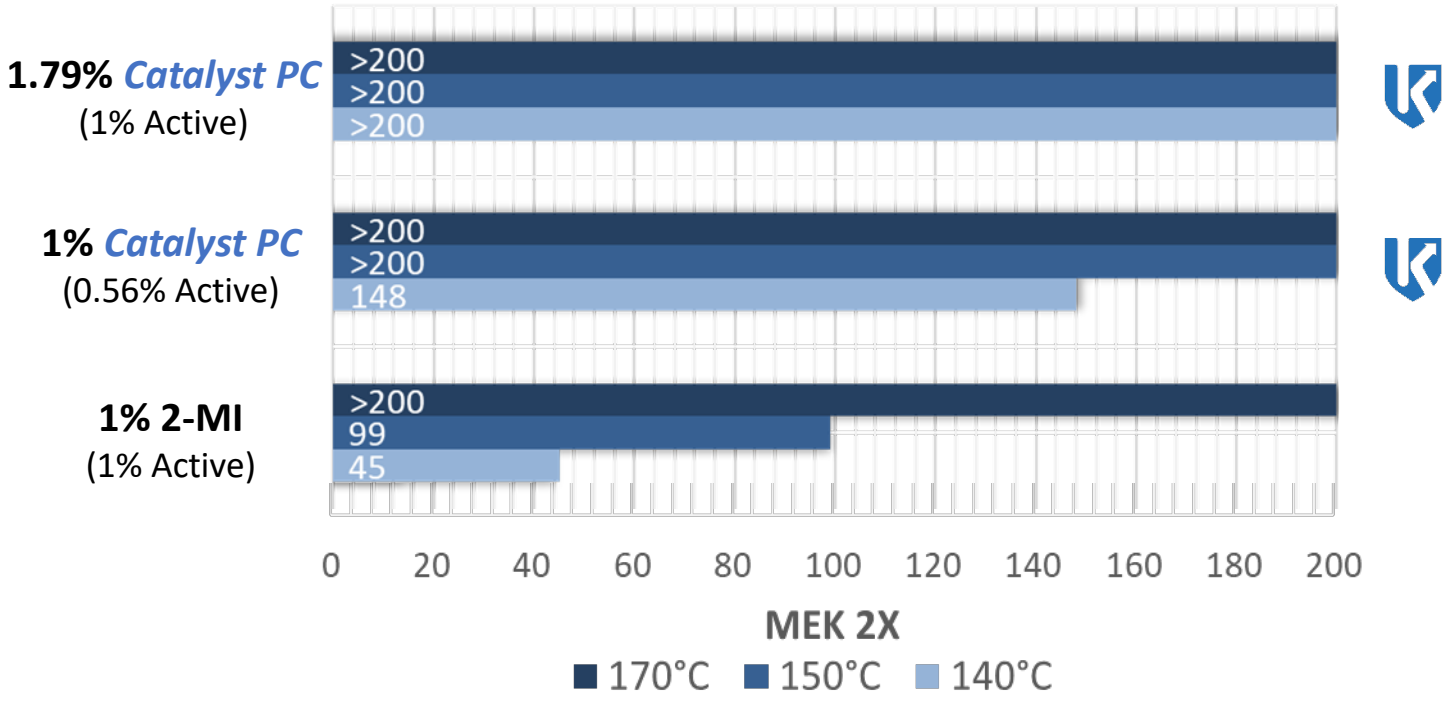


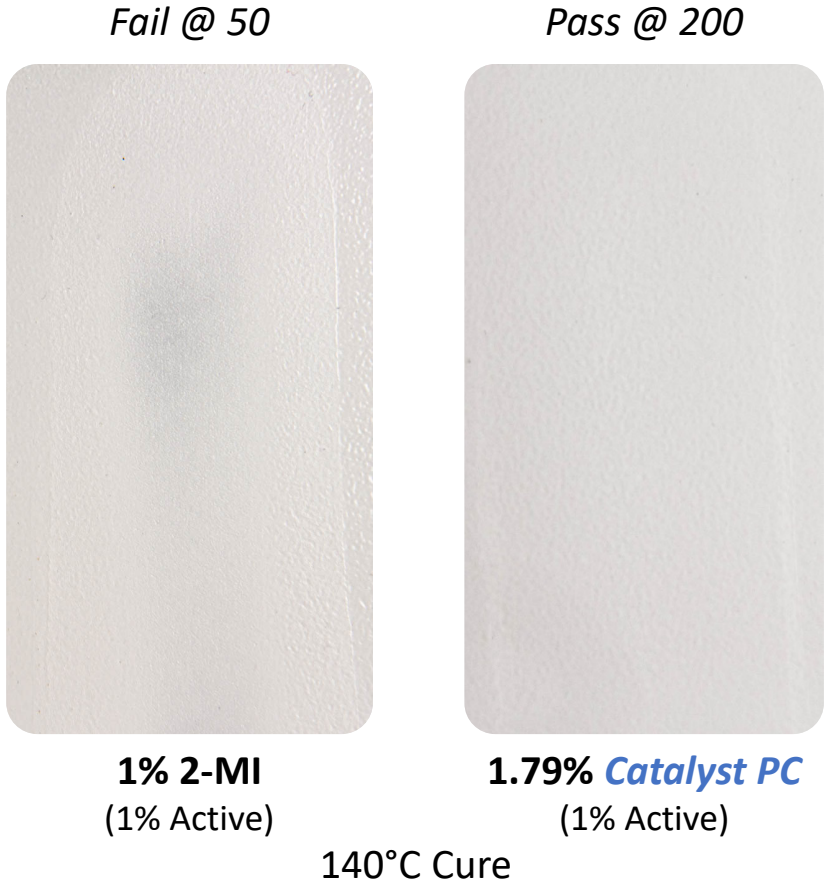
KING INDUSTRIES SPECIALTY CHEMICALS

MEK Resistance – White Polyester / BPA Hybrid

Advantage

King Industries' Catalyst PC improves **chemical resistance** properties at lower cure temperature



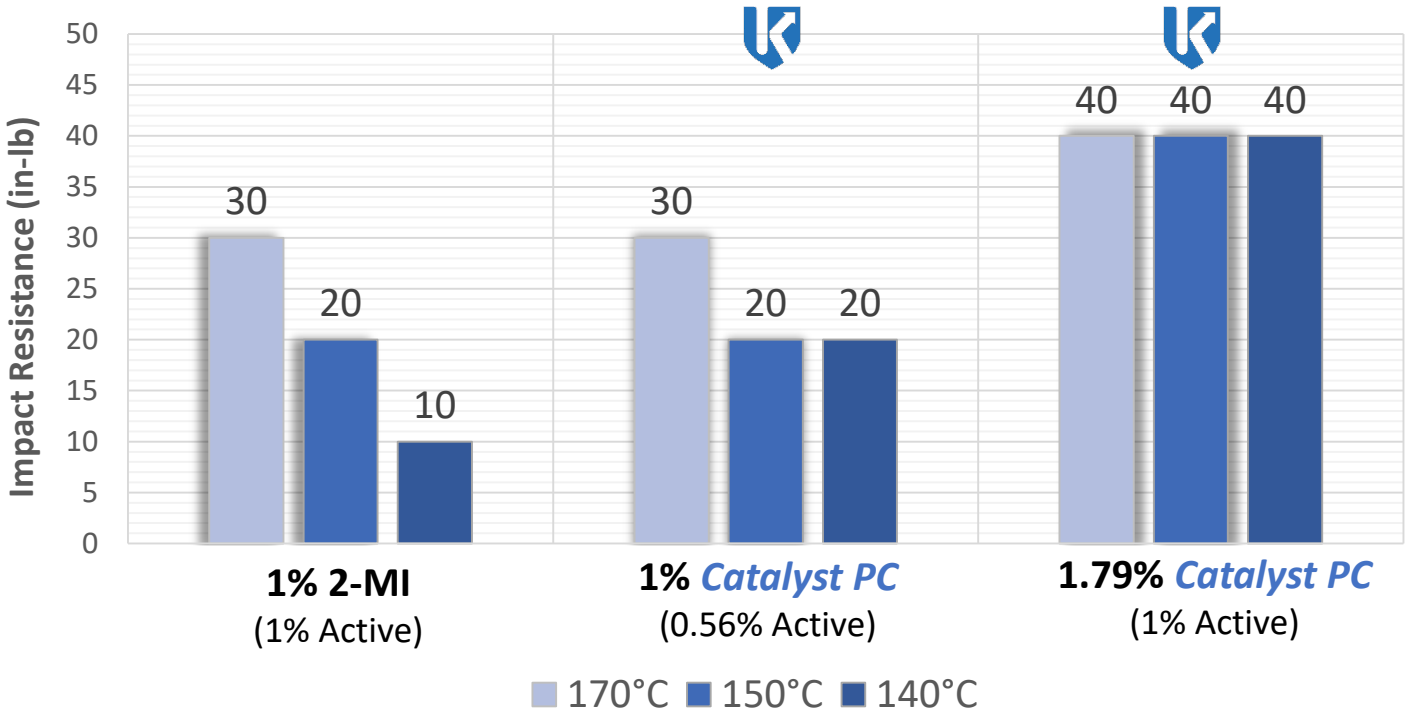


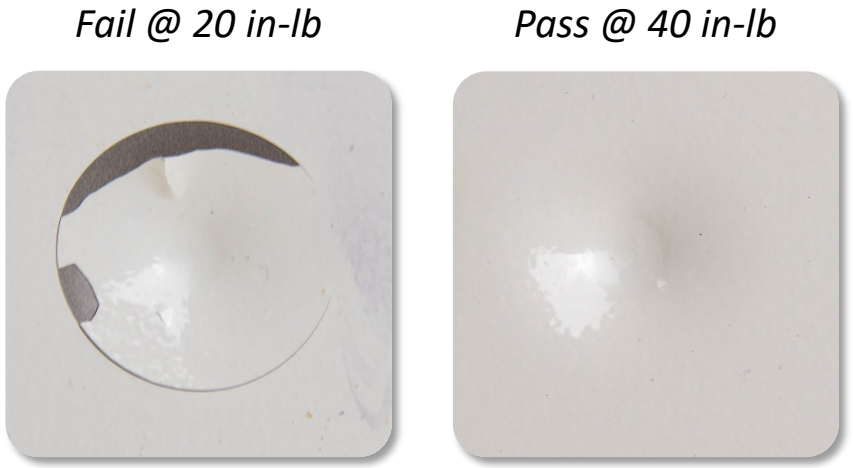
Impact Resistance – White Polyester / BPA Hybrid

Advantage

King Industries' Catalyst PC maintains **impact resistance** at lower cure temperature

Direct Impact





140°C Cure

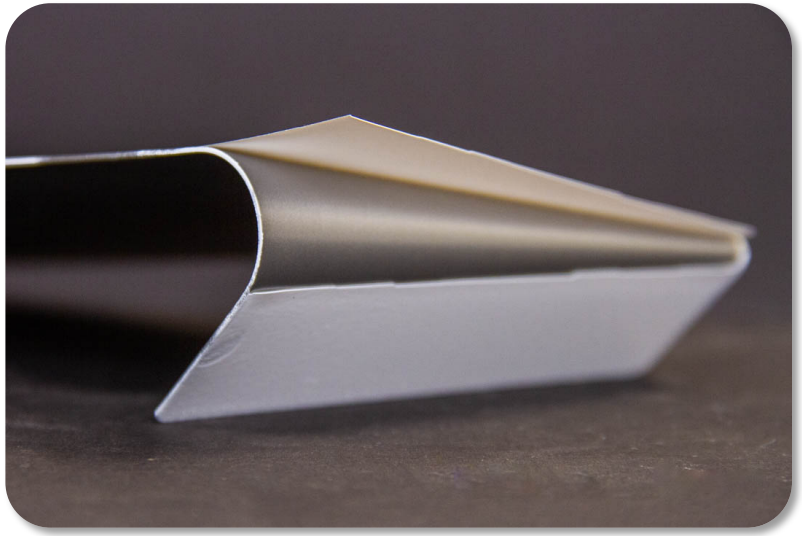
Adhesion – White Polyester / BPA Hybrid

Advantage

King Industries' Catalyst PC improves **adhesion** at lower cure temperature

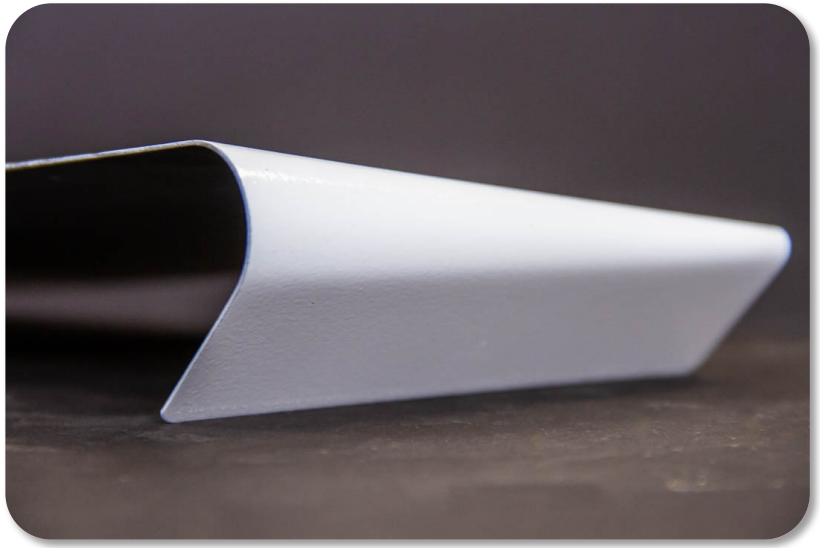
Mandrel Bend

Fail



1% 2-MI
(1% Active)

Pass



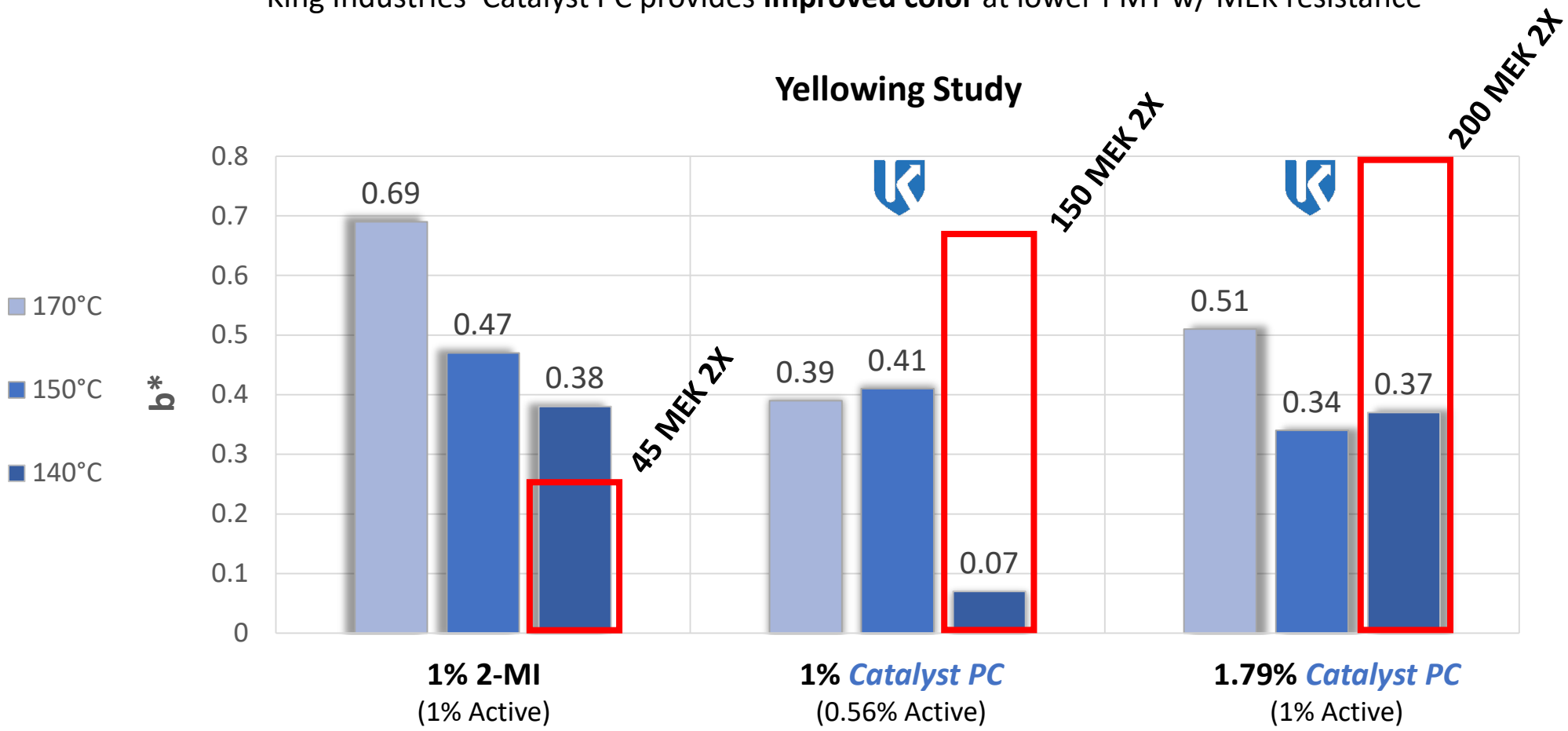
1.79% ***Catalyst PC***
(1% Active)

140°C Cure

Yellowing – White Polyester / BPA Hybrid

Advantage

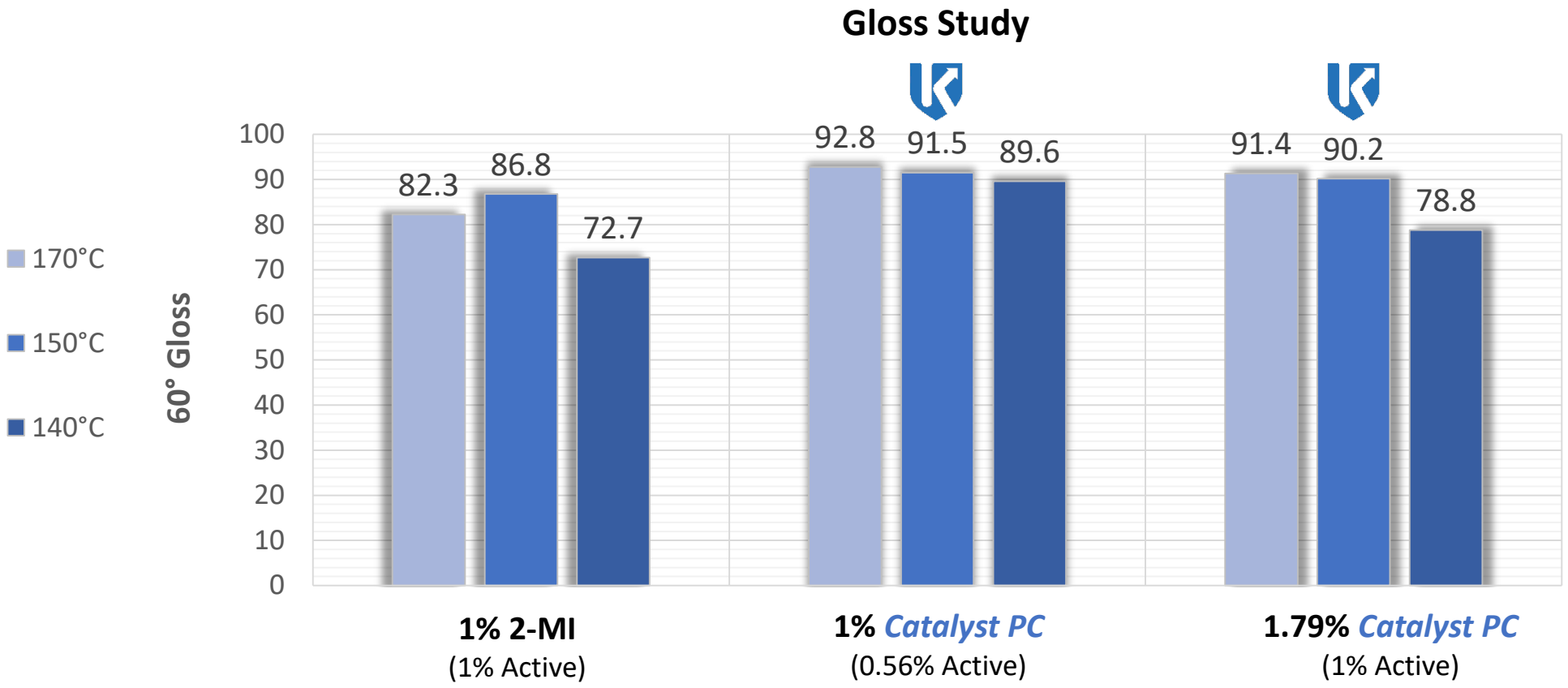
King Industries' Catalyst PC provides **improved color** at lower PMT w/ MEK resistance



Gloss – White Polyester / BPA Hybrid

Advantages

- King Industries' Catalyst PC provides **better gloss** than 2-MI
- 2-MI has a more severe effect on melt flow properties



King Catalyst PC *vs. C17*-Imidazole in Polyester/TGIC

KING INDUSTRIES SPECIALTY CHEMICALS

Preparation – Polyester / TGIC

Standard Powder Coatings Cure Conditions

30 min at **180 °C**

King New Catalyst PC **Low Bake Powder Coating Conditions**

25 min at **125 °C**

KING INDUSTRIES SPECIALTY CHEMICALS

Performance – Polyester / TGIC

With conventional catalyst

Low Temp Cure: ↓ 180° C

- Poor chip resistance
- Poor resistance properties
- Loss of edge control

The King **Advantage**

King Industries' Catalyst PC

- DTM thick film protection
- Lower temp curing
- Improve gloss
- Improved Impact resistance
- Good melt flow, overbake resistance

KING INDUSTRIES SPECIALTY CHEMICALS

King Catalyst PC vs. Imidazole – White TGIC

Model Formulation

Material	%
Polyester-amide, AV = 45	61.55
TGIC	6.84
Flow Agent	1.00
Degasser	0.50
TiO_2	30.10
TOTAL	**100**

Substrate: Bare CRS

Resin : TGIC = 9 : 1

%TiO_2 = 30

%TRS = 68.2

The King
Advantage

King Industries' Catalyst PC vs. Imidazole

- Lower temp curing
- Reduced active dosage

Mfg. Costs ⬇

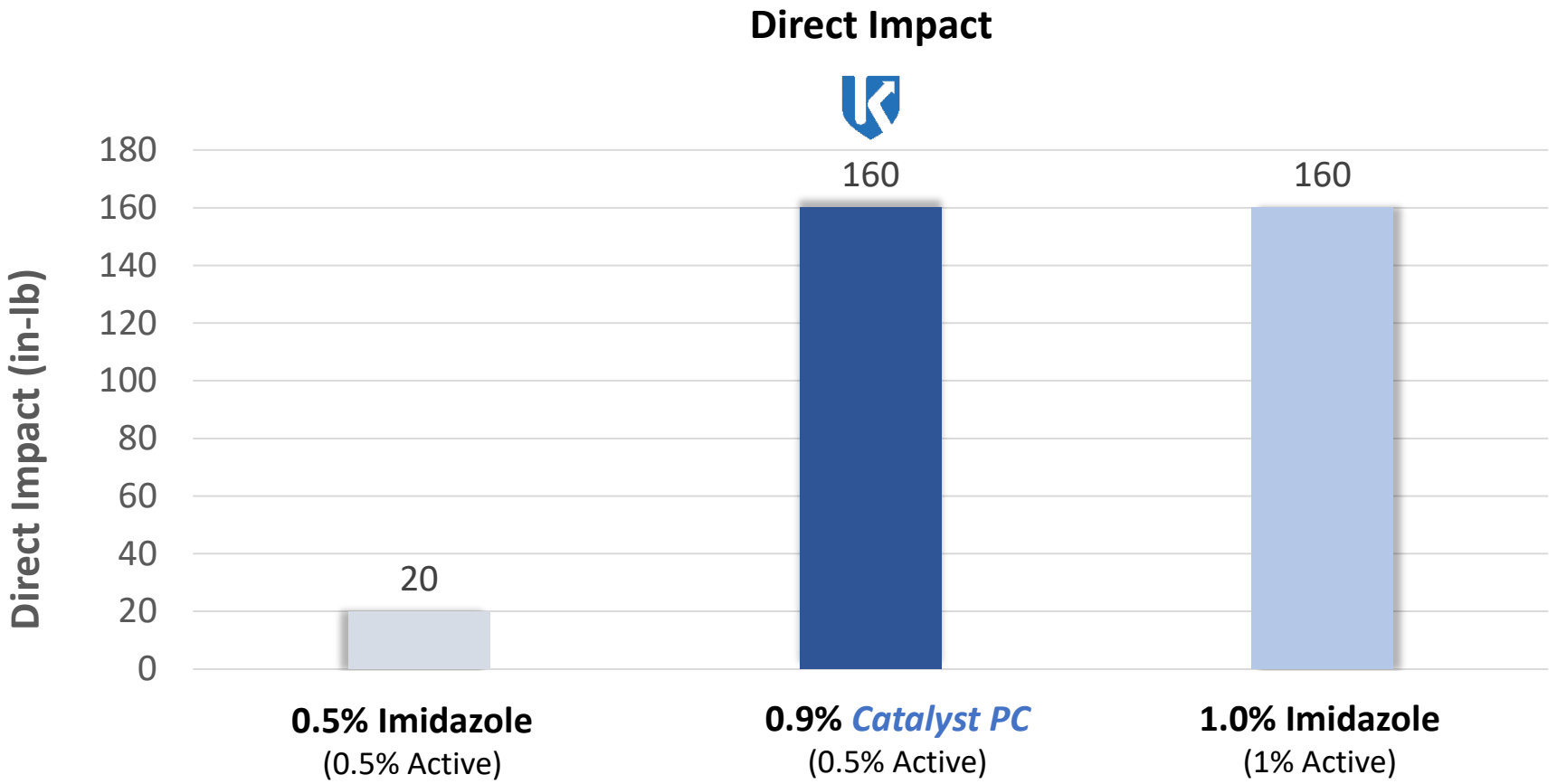
- Energy cost savings
- Reduce rejected product
- Potential higher throughput
- Better, more durable films

KING INDUSTRIES SPECIALTY CHEMICALS

Impact Resistance – White TGIC

Advantage

King Industries' Catalyst PC improves **impact resistance**

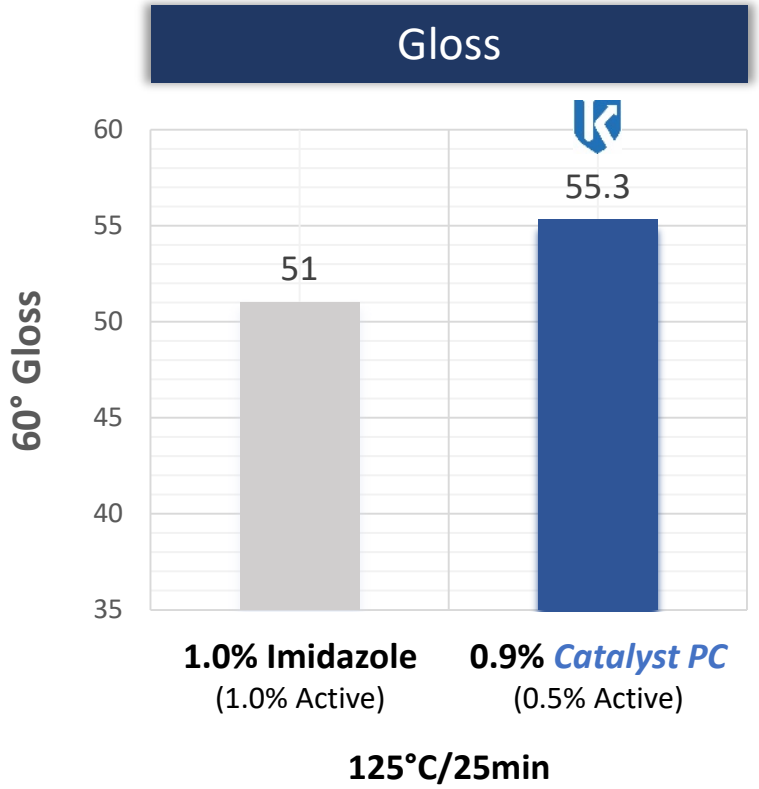


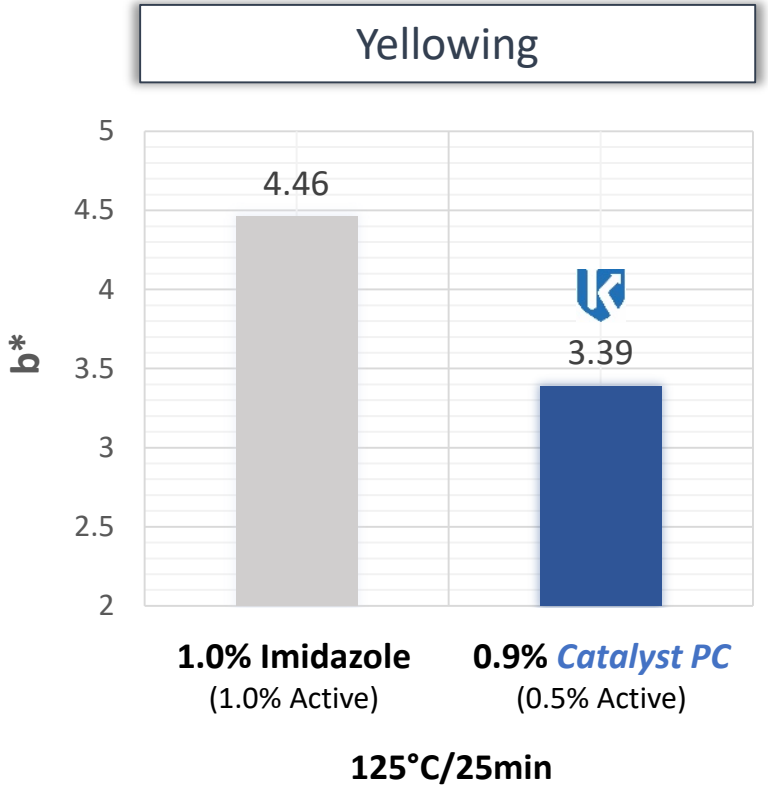
125°C cure
25 minutes

Gloss & Yellowing – White TGIC

Advantages

King Industries' Catalyst PC provides **better gloss** and **less yellowing**

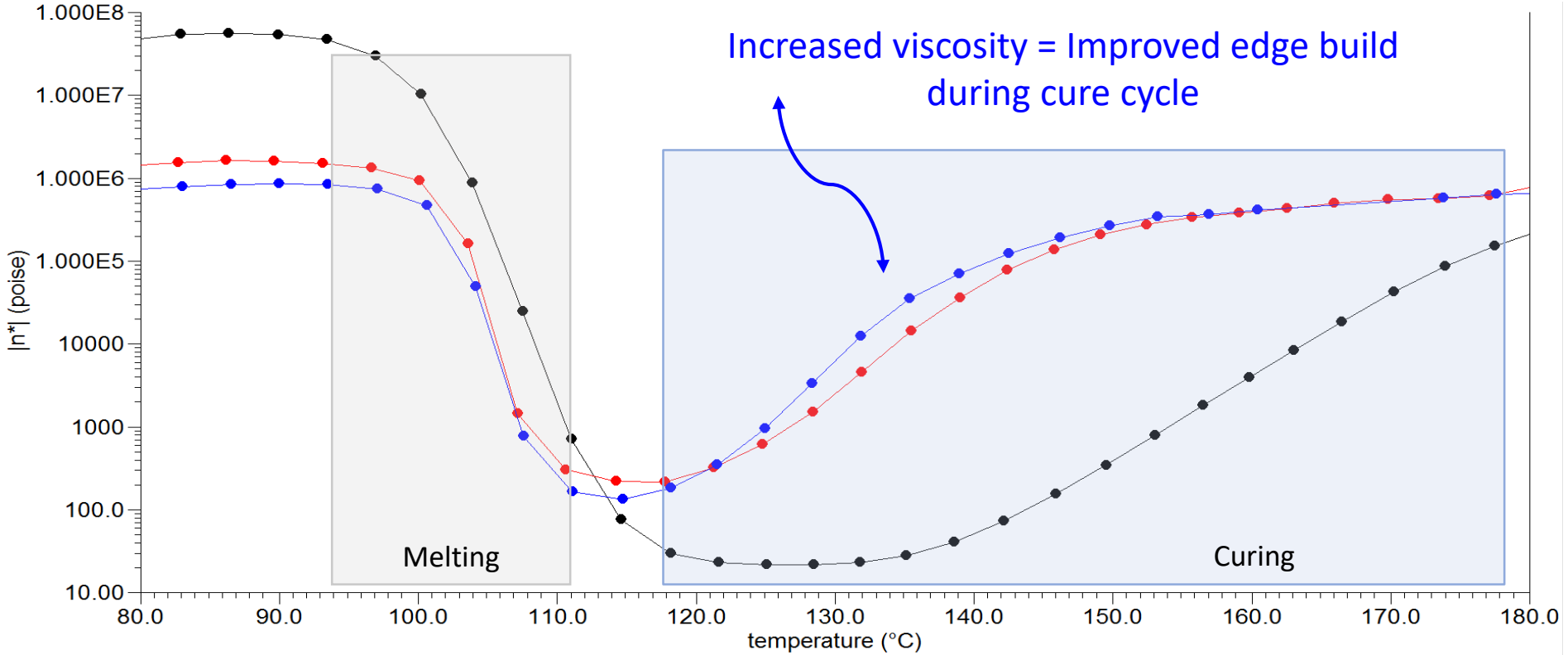




Melt Flow / Cure Profile – White TGIC

Advantages

- Catalyst PC shows comparable melt flow and cure profile to imidazole
- **Faster viscosity build** during curing process (edge control)
- Good stability in extruder



-●- No Catalyst

-●- 0.5% Imidazole

(0.5% Active)

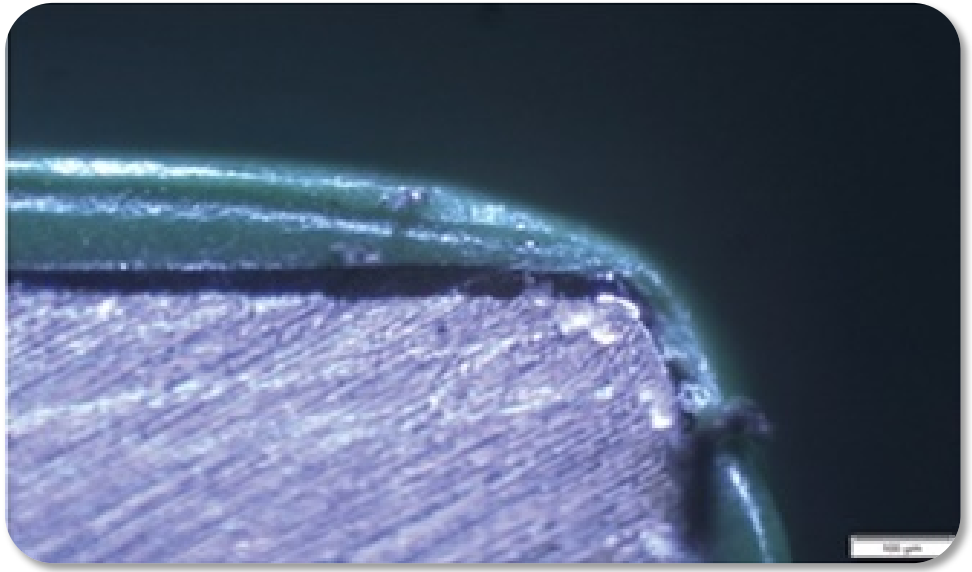
-●- 0.9% King Industries' Catalyst PC

(0.5% Active)

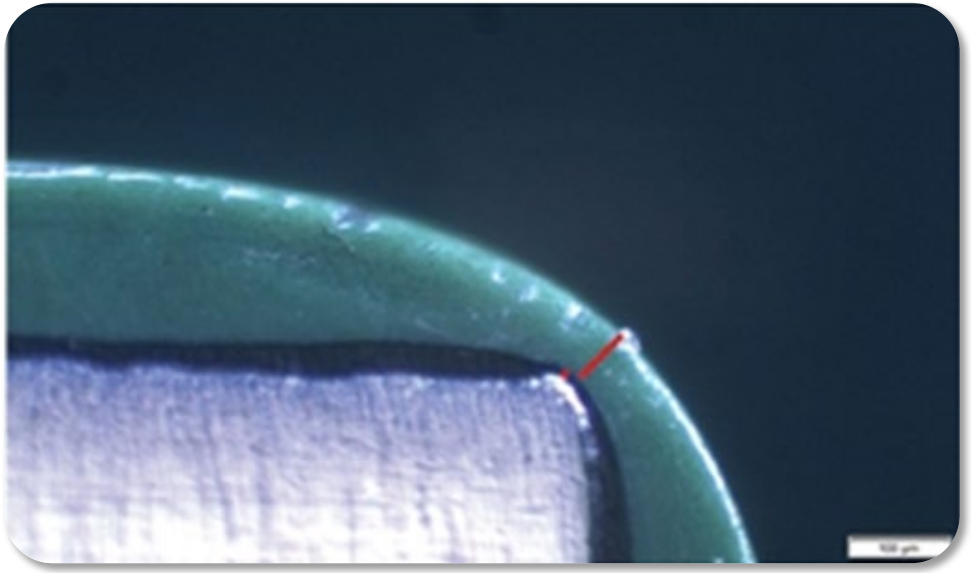
KING INDUSTRIES SPECIALTY CHEMICALS

Faster Viscosity Build = Better Edge Build

Slow viscosity build, poor edge thickness



Fast viscosity build, good edge thickness



Credit: Coatings World Magazine

Heat Aged Stability – Polyester / BPA Hybrid & TGIC

Advantages

No sintering or clumping following heat aged tests

50°C Storage

System With	Initial	1 Month+
Imidazoles	Free-flowing powder	Free-flowing powder
King Catalyst PC	Free-flowing powder	Free-flowing powder

King Industries' Catalyst PC Is Heat Aged Stable

KING INDUSTRIES SPECIALTY CHEMICALS

Safety / Handling

King Industries' Catalyst PC

Advantages

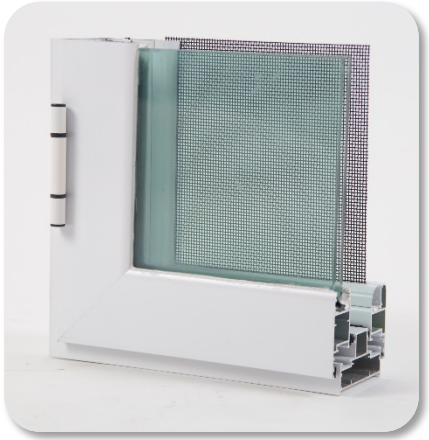
- Reduced health hazards
- Safe to handle
- No harmful solvents

Property	Description/Value
Appearance	White solid powder
Active	56%
Benefits	Low temp. cure Chemical resistance Improve impact resistance Reduced health hazards

King Industries' Catalyst PC – A Superior Catalyst

Enabling Low Temperature Bake Schedules with King Industries' Catalyst PC

Energy cost savings, Improve productivity, better performance, reduced active catalyst levels



Polyester / BPA Coatings

King Industries' Catalyst PC

DTM Thin films

- Chem/impact resistance
- Excellent gloss
- Good color properties
- Good heat age stability

TGIC Coatings

King Industries' Catalyst PC

DTM Thick films

- Chem/impact resistance
- Excellent gloss
- Reduced yellowing
- Good heat age stability
- Edge build control

Contact Us!

Let King's Catalyst Expertise Provide LTC for your Powder Coatings Systems

Literature available at
Booth 12

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