

New UV/Color Stable Spray Aliphatic Polyurea Coating Technology

Albemarle Corporation

Company Overview – Who We Are



Albemarle provides innovative development, manufacturing and marketing of complex chemistry solutions and services that create exceptional customer value while maximizing shareholder wealth.

Diversified mix of solution-based products and custom services sold to a wide range of customers and end markets.

- Over 3400 customers, 100 countries
- Operate 45 facilities, encompassing production, research & development facilities, and administrative offices in North and South America, Europe, the Middle East and Asia
- Over 4000 employees around the world



2010 Net Sales

Catalysts
38%

Polymer Solutions
38%

Fine Chemistry
24%

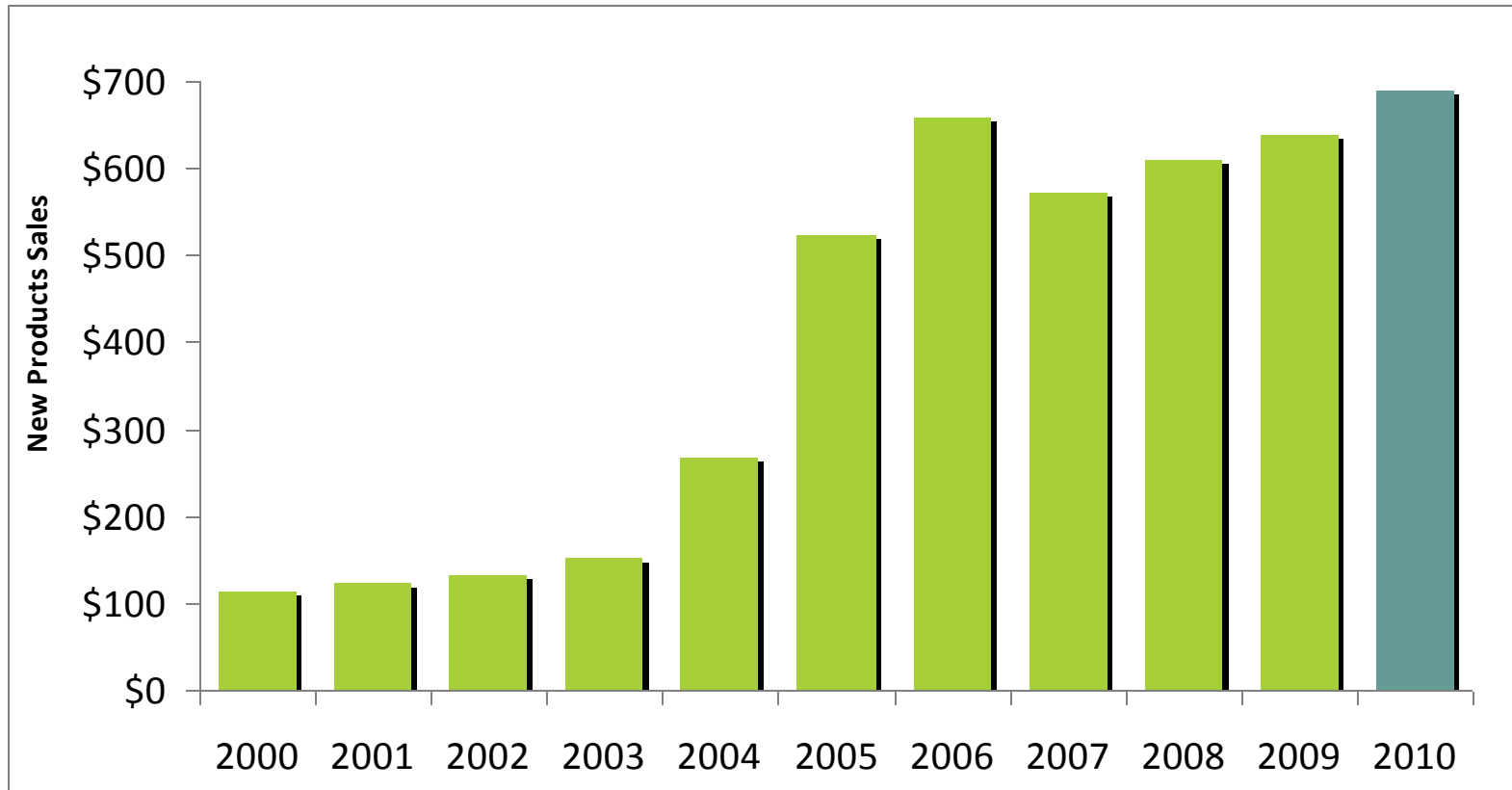
Scale and Scope



Differentiated by Our Innovation



Research and process development expertise that allow us to bring innovative technologies to the market more quickly and at a lower capital cost than our competitors.



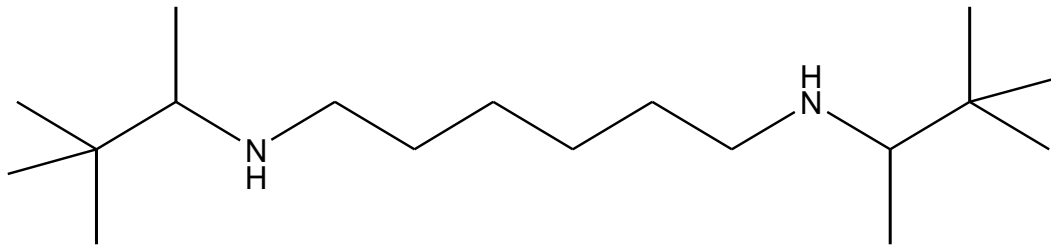
We provide innovative development, production and service for the application of complex chemistry to create exceptional customer value.

Polyurea Spray Coatings

- Two component solventless coatings (zero VOC)
 - A Side: Isocyanate prepolymer
 - B Side: Resin blend containing
 - Amine Curative hard segment
 - Polyetheramine soft segment
- Systems are fast reacting
 - Quick return to service
 - Need to moderate reactivity for cure rate control and smooth surface
- Most systems are aromatic (MDI and Ethacure 100) and thus lack UV/color stability.

Ethacure® 90

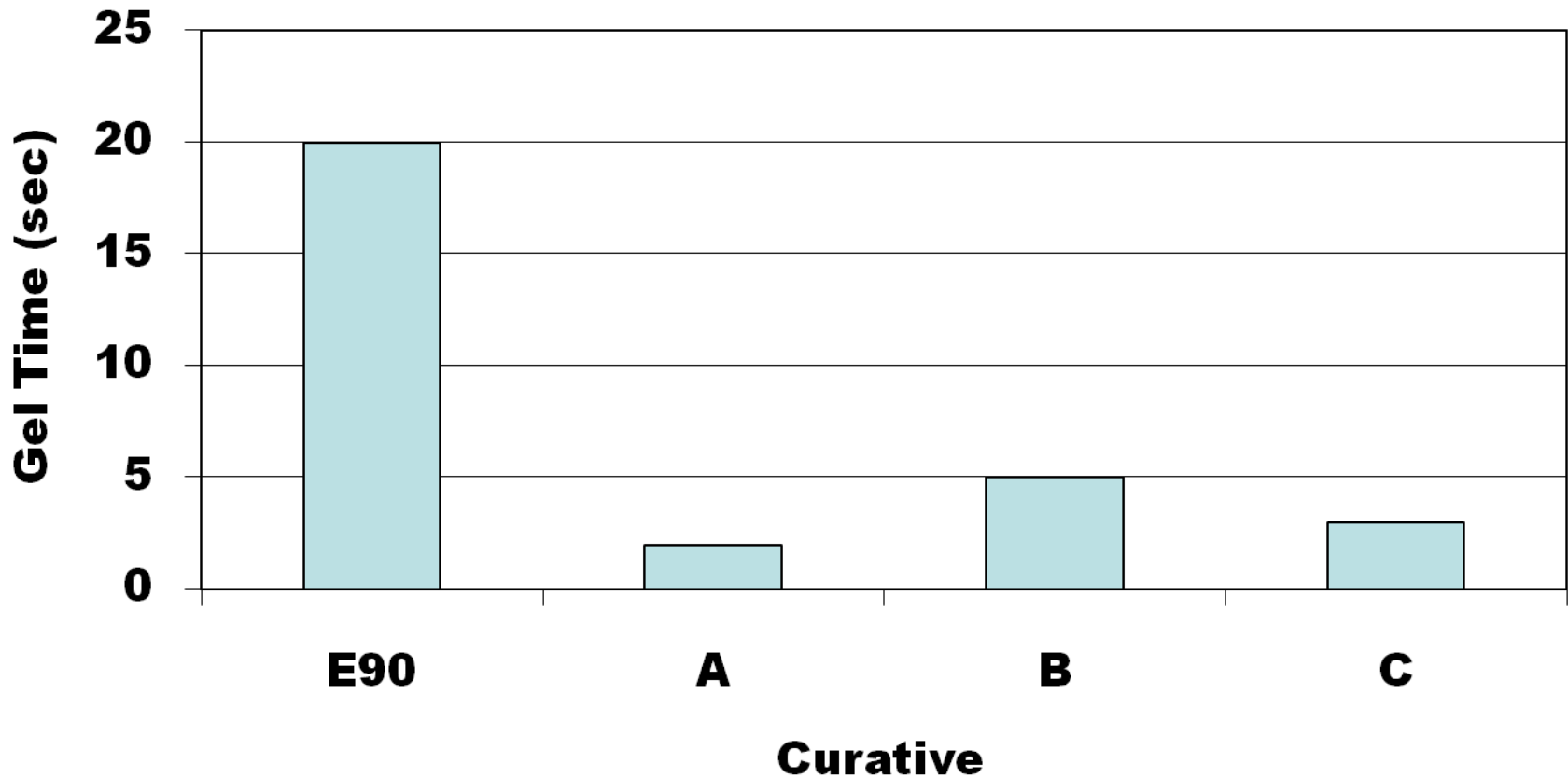
- New aliphatic amine curative commercialized in 2011 (TSCA registration in US in February).
- Chemical structure designed to provide moderate cure speed.
- Allows formulation of robust fully aliphatic spray polyurea systems.
- Global registration underway.



Aliphatic Polyurea Coatings

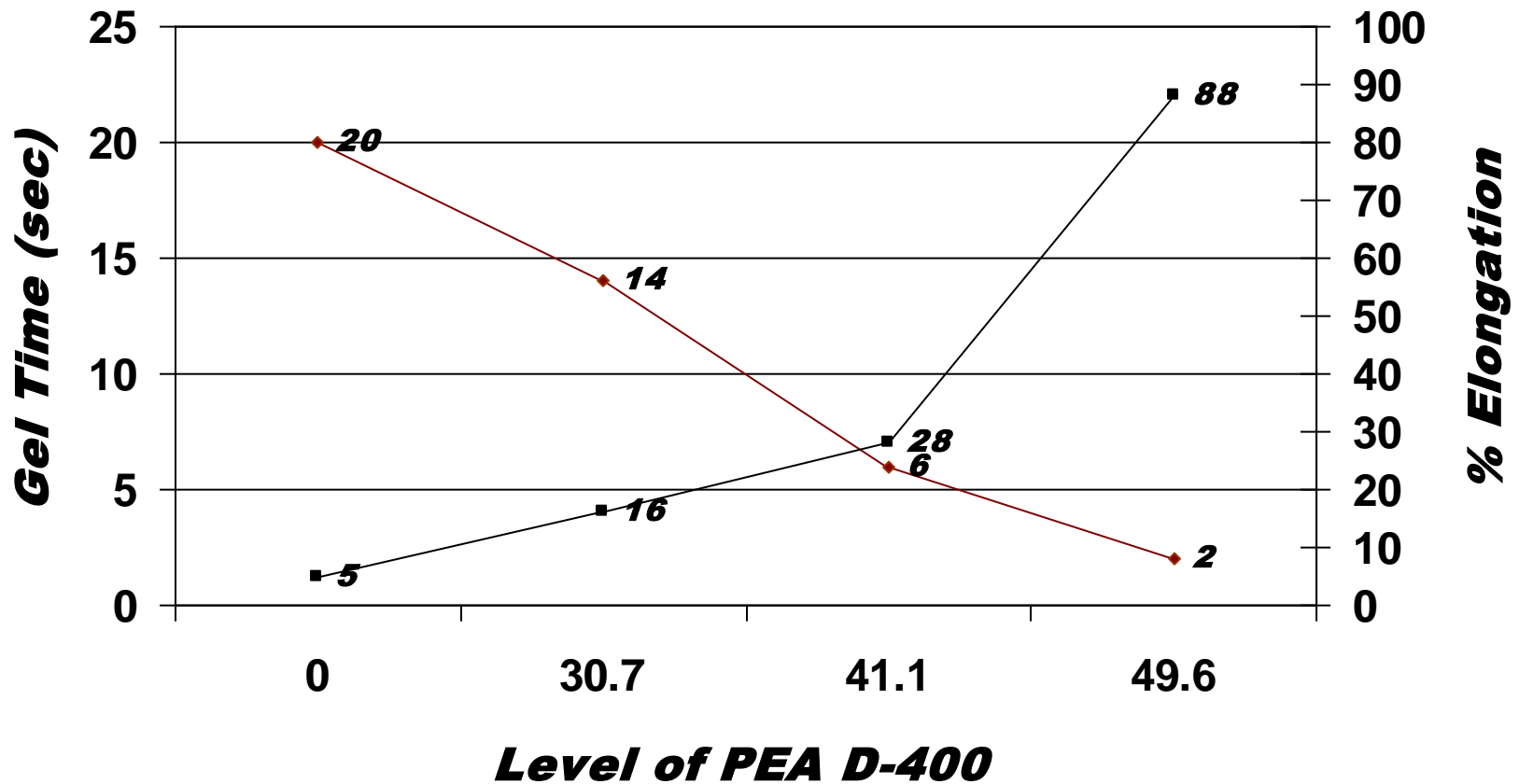
- The aliphatic polyurea coating system in this presentation is based on an HDI polyisocyanurate.
- Screening of formulations involved:
 - Mixing resin side components in a Speedmixer
 - Providing a 1:1 volume ratio with a dual cartridge syringe
 - Mixing iso and resin through a static mixer equipped with an air spray nozzle.
- Gel times were obtained by measuring time until the material no longer flowed when sprayed on a vertical surface

Ethacure 90 gives significantly longer gel times with HDI than other aliphatic secondary amines.



Formulation Flexibility

Addition of PEA D-400 Provides Allows Cure Rate Control as well as Increasing Elongation



Base Formulations and Coating Properties



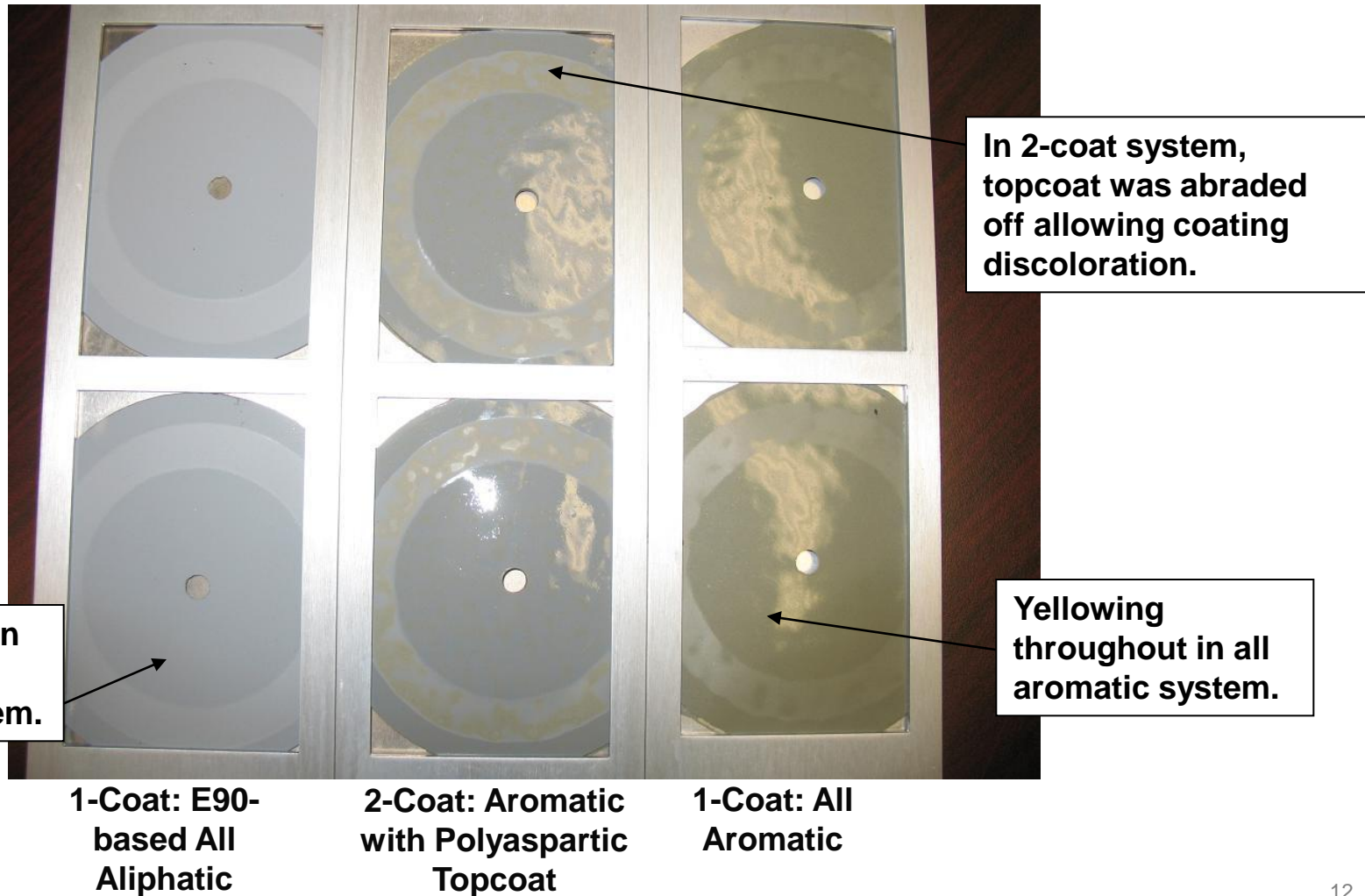
<u>Iso-side wt%</u>	Formula 1	Formula 2
HDI 19.4% NCO	100	100
<u>Resin-Side, wt %</u>		
E90	47.6	43.9
PEA D-400	17.6	23.4
PEA D-2000	23.3	21.2
IPDA	6.5	6.5
TiO ₂	5	5
<i>Index</i>	<i>1.10</i>	<i>1.10</i>
<i>Gel time, sec</i>	<i>8</i>	<i><6</i>
<u>Physical Properties</u>		
Thickness, mils	69	105
Hardness Shore A	94	95
Tensile Strength, psi	1920	2260
Elongation, %	68	90
Tear Strength, pli	520	460

Comparison of Aliphatic vs. Aromatic Spray Polyurea Coating Systems

- 1. Aliphatic System:** HDI-based spray aliphatic coating cured with Ethacure 90
- 2. Aromatic System:** MDI-based spray aromatic coating
- 3. Aromatic/Topcoat System:** MDI-based spray aromatic coating with aliphatic (polyaspartic) topcoat

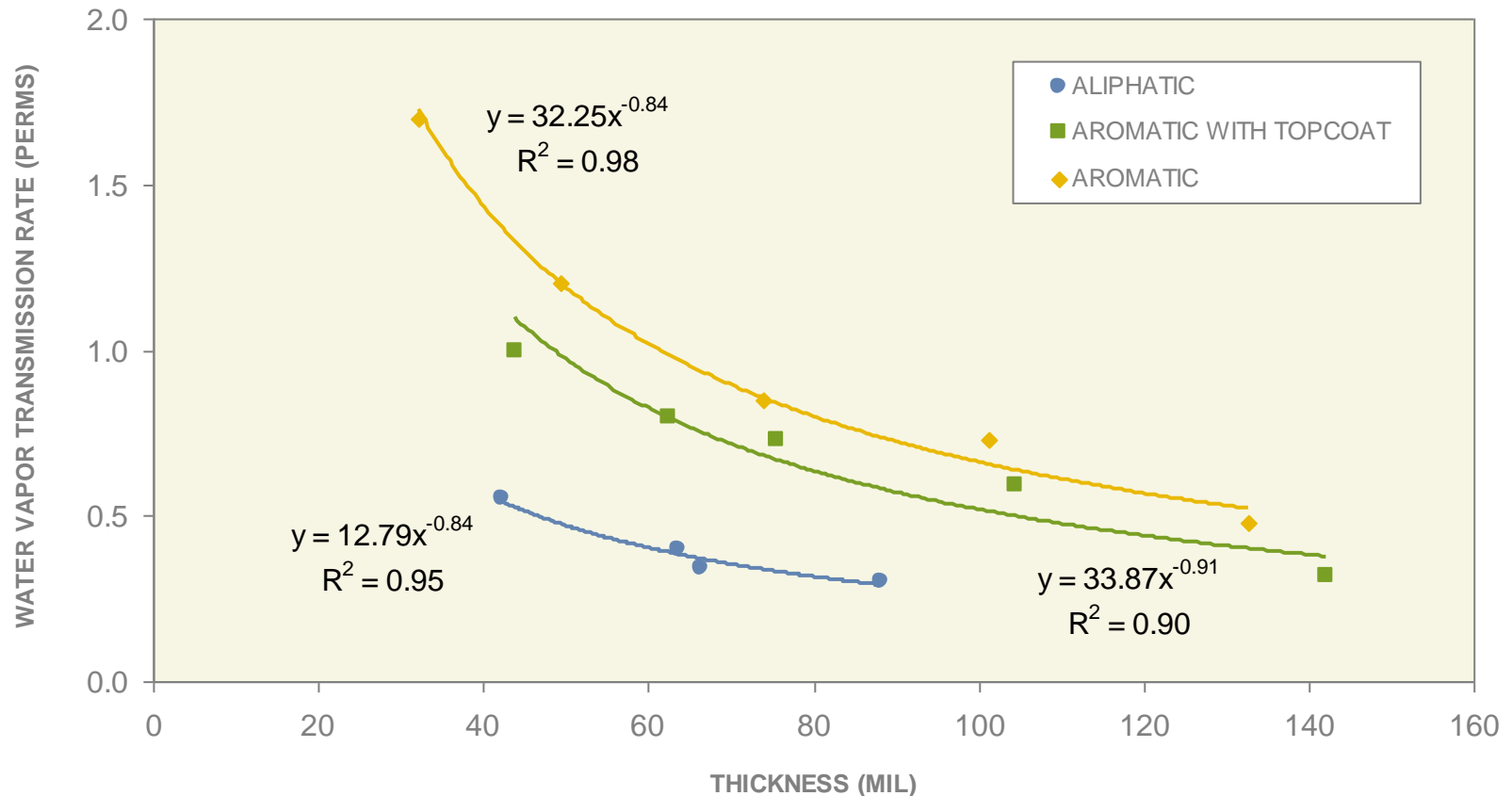
New E90-based One Coat All Aliphatic

- **Taber Abrasion and QUV (Weathering) Testing**



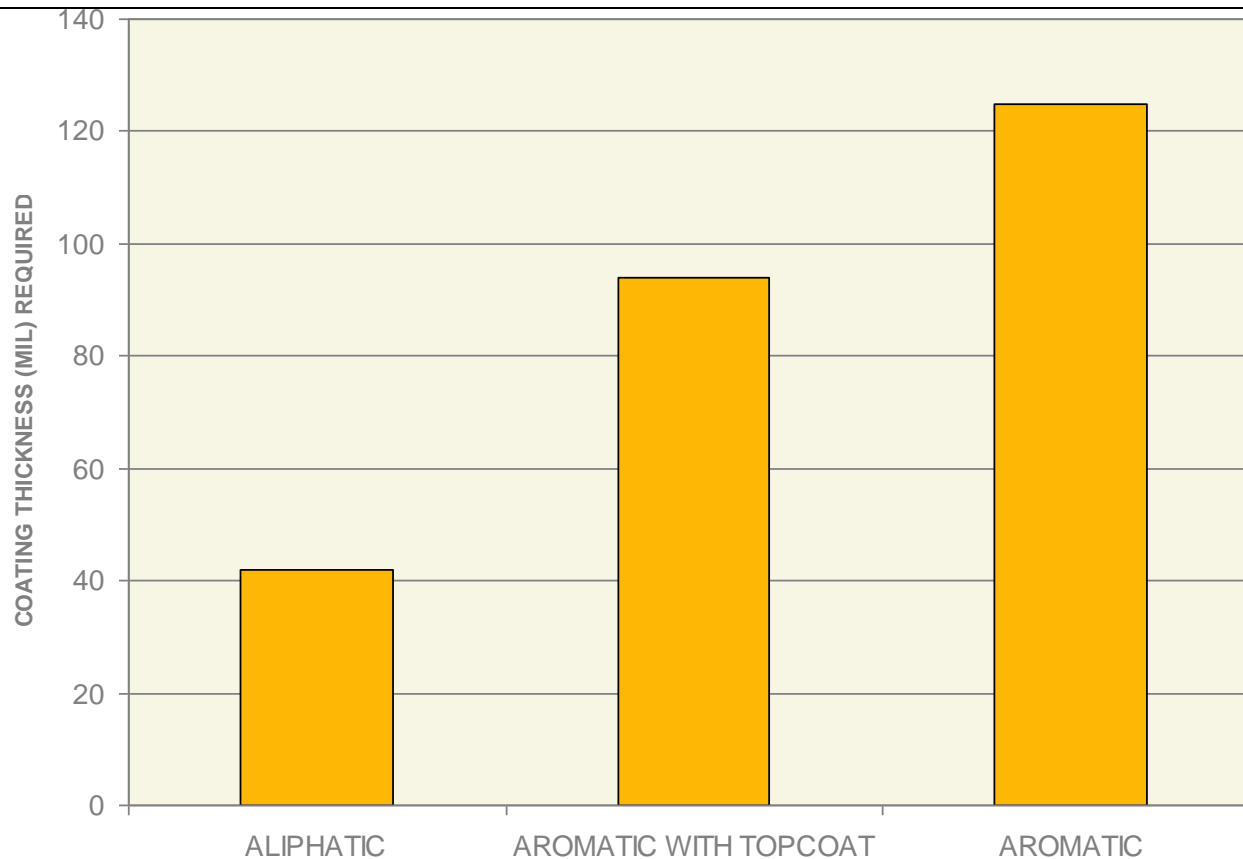
WVTR (Water Vapor Transmission Rate) following ASTM E 96-05

New aliphatic coating has 2-2.5 X lower moisture transmission rate than aromatic systems.



New aliphatic technology provides same moisture barrier protection at much lower coating thickness.

Required Coating Thickness for low MVT Rate (0.55 Perms)



2011 Applications

- New Ethacure 90-HDI based polyurea coating on the concrete below an amusement park ride.



Discovery Channel's Storm Chaser vehicle

The tough, new aliphatic spray coating protected the Discovery Channel's Storm Chaser vehicle from the severe tornado season of spring 2011.



Decorative Coatings

- Aliphatic system allows the colorful coating on this amusement park ride.

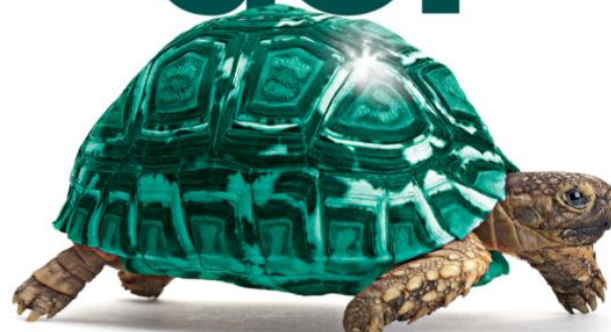


Conclusions

- The commercialization of Ethacure 90 in 2011 provides a new slow aliphatic diamine for formulators, allowing the formulation of robust fully aliphatic spray polyurea systems.
- The cure rate is slow enough to allow one to formulate with faster primary amines like PEA D-400 and IPDA.
- The WVTR of the aliphatic polyurea is less than half of that of the aromatic polyurea systems.
- The improved moisture barrier performance allows application of a thinner aliphatic polyurea coating, significantly improving the system economics.
- Global rollout and registrations in 2011-2012.

Special thanks to co-authors: Paul Wiggins (Albemarle), Terry Pe (Line-X Performance Coatings), Thalan Burriss (Albemarle), and Dustin Le (HORN)

**SLOW
MEANS
GO!**



For more information regarding Albemarle's curatives,
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