

Innovathane® Isocyanates for Spray Polyurea *Excellent Reactivity Control and Physical Properties*

Description

Air Products offers a series of proprietary isocyanates for spray polyurea applications. These new isocyanates impart improved abrasion resistance, adhesion, tensile strength, tear strength and modulus to spray polyurea applications. Compared to commercial high 2'4 MDI prepolymers, applicators can expect gel and tack free times to be extended by a factor of 1.6 to 2.2, resulting in a smoother surface finish as well as better surface wet-out and adhesion. Innovathane Isocyanates are drop-in replacements for conventional MDIs. The line includes the two products outlined below.

Sample Preparation: Gusmer H-20/35, GAP-Pro spray-gun
Instrument/Hose temperature: 165 F, Pressure =2500 psi
Isocyanate Index =1.05

Part B Formulation: Diethyltoluenediamine (DETDA)--25.0 wt%
Polyetheramine (Mw=2,000, di-functional) - 70.0 wt%
Polyetheramine (Mw=5,000, tri-functional) - 5.0 wt%

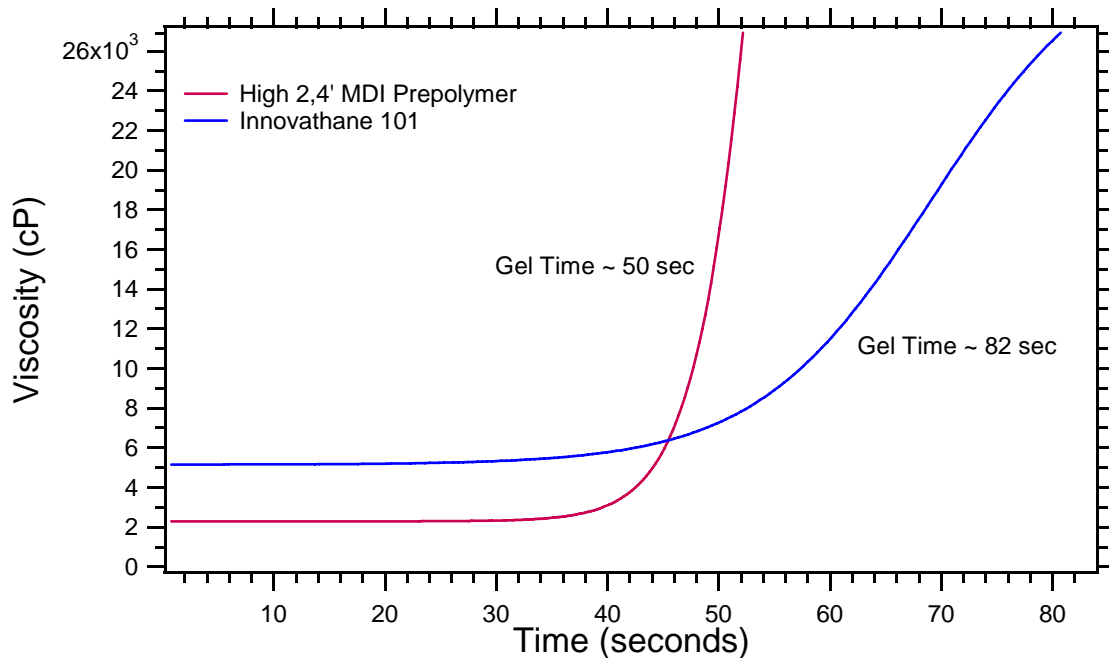
DRY COATING PROPERTIES	ISOCYANATES		
	Innovathane Isocyanate 101	Innovathane Isocyanate 201	MDI Control
Solids by Volume	100%	100%	100%
Functional Backbone	PTMEG	PPG	PPG
Volatile Organic Compound (lbs/gal)	0	0	0
% NCO	16	16	16
Viscosity (cPs, @ 77 °F)	1100	950	500
Tensile Strength (psi) ASTM D-412	4690	3800	2800
Elongation (% in/in) ASTM D-412	334	332	400
Hardness (Shore D) ASTM D2240-81	48	49	50
100% Modulus (psi) ASTM D-412	1400	1250	1280
300% Modulus (psi) ASTM D-412	3880	3170	2100
Taber Abrasion (mg lost) ASTM D-4060; H22 Wheel, 5000 cycles	96	185	296
Tear Resistance--Die-C (lbf/in) ASTM D-624	670	570	460
Gel Time (s)	5	6	3
Tack-Free Time (s)	7	13	5

Improved Reactivity

A key property of Innovathane isocyanates is their effect on reactivity. By reason of this property, Innovathane isocyanates offer formulators an additional tool for controlling reactivity on the iso side of the formulation, without having to lower NCO and without having to compromise other physical properties.

Formulators can expect a delay in gel-time of 1.6 to as much as 2.2 times (compared to a conventional high 2,4' MDI) when Innovathane isocyanate is included in the formulation. The graph below illustrates this effect with Innovathane Isocyanate 101 and neat E300. Innovathane Isocyanate 201 exhibits similar performance.

Reactivity of Neat E300 with Commercial MDI and Innovathane Isocyanate 101



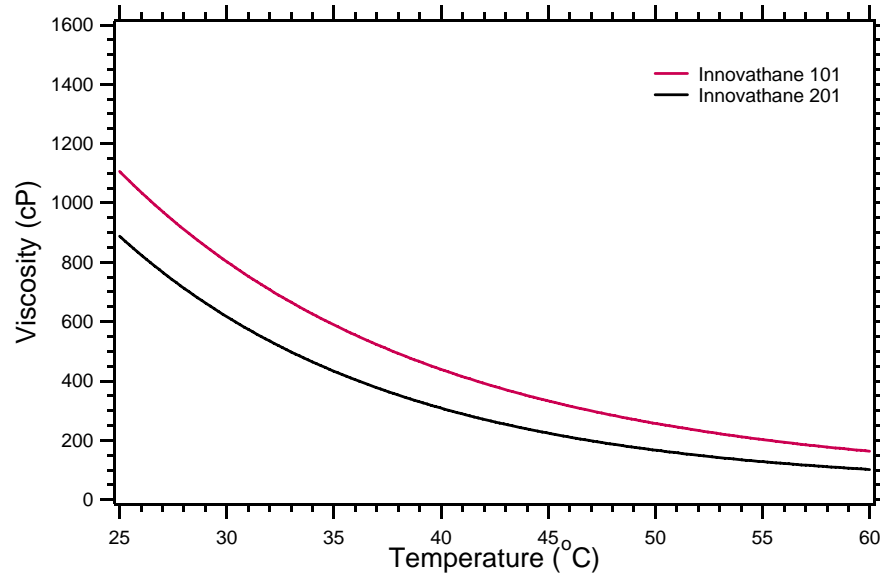
Adhesion Testing

By extending the reactivity, Innovathane isocyanates enable formulators to build in longer gel and tack free times. As a result, coatings formulated with Innovathane isocyanates generally exhibit better wet-out and substrate adhesion compared to conventional MDI-based formulations. The results below were obtained with the basic formulations described earlier in this document.

	Innovathane Isocyanate 101	Innovathane Isocyanate 201	Conventional High 2,4' MDI
Concrete	Cohesive failure of concrete	Cohesive failure of concrete	Cohesive failure of concrete
Steel	1,750 psi	2,000psi	1,340 psi
% Improvement vs. MDI	30%	50%	--

Isocyanate Viscosity Curves

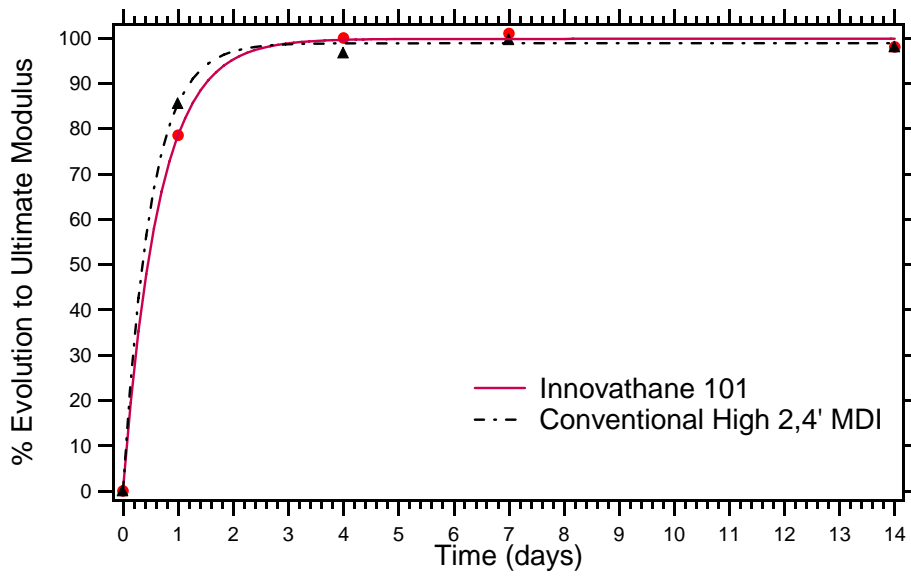
The viscosity of both the isocyanate and the amine resin components can have a large impact on the process ability, mixing and final physical properties of a polyurea coating. Innovathane isocyanates exhibit excellent viscosity profiles that enable easy pumping and spraying of the product.



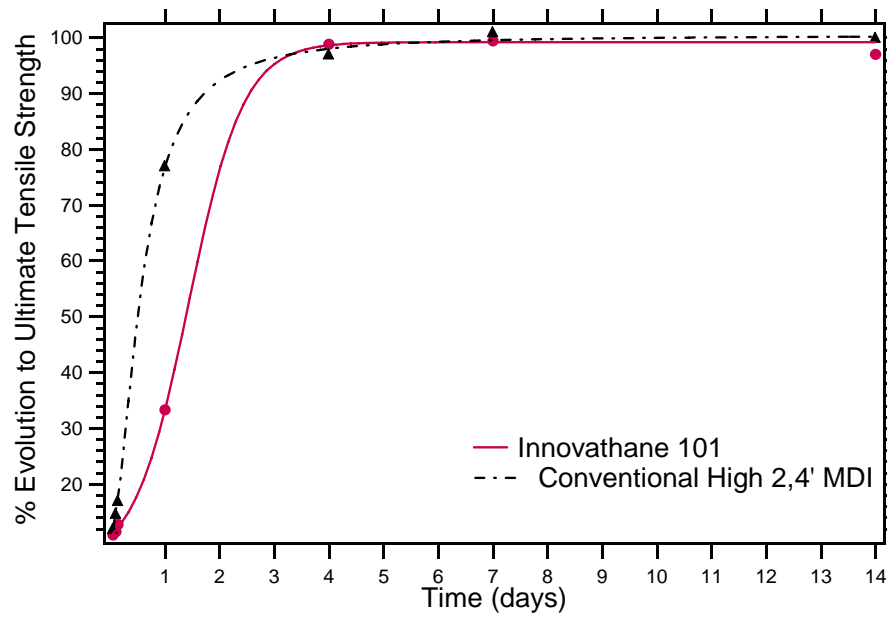
Property Evolution

While extended gel times are generally desired, most end users of polyurea spray coatings are unwilling to sacrifice fast back-end physical property development of applied coatings. Innovathane isocyanates have a minimal effect on the time-scale of modulus and tear strength development. This means that jobs can be returned to service in the same time-frame as conventional formulations. Innovathane isocyanates do extend the development of ultimate tensile strength, however, from 1.7 to 2.5 days (compared to a conventional high 2,4' MDI).

Time Evolution of 100% Modulus and Tear Strength



Time Evolution of Ultimate Tensile Strength



Low - Temperature Stability

Innovathane isocyanates offer improved low-temperature stability compared to conventional MDI formulations. This property could be translated into more contractor-friendly formulations for seasonal applications.

Observation after 1 week exposure at the following temperatures				
	50°F / 10°C	40°F / 4.4°C	30°F / -1.1°C	0°F / -17.8°C
Innovathane Isocyanate	Clear & Fluid	Cloudy & Fluid	Semi Solid & Cloudy	Solid White
Observation after 24 hour equilibration to 75°F				
Innovathane Isocyanate	Clear & Fluid	Clear & Fluid	Clear & Fluid	Cloudy & Fluid

If Innovathane isocyanate does freeze and therefore become cloudy during transport or storage, the material can be easily clarified and returned to its usable state by heating through to 60°C and rolling or stirring the product.

Safe Handling

Innovathane Isocyanates contain monomer extracted toluene diisocyanate (TDI) prepolymers. Free TDI monomer content is less than 0.06% by weight. To ensure that the health and safety of the applicator are not compromised when using these new materials, a series of Industrial Hygiene surveys were conducted to quantify the potential inhalation exposure to both TDI and MDI during handling and spraying of these materials in realistic conditions. As a benchmark, the survey used the most conservative Occupational Exposure Limit set forth by OSHA, ACGIH TLV, and AIHA Workplace Environmental Exposure Levels.

Task-specific personal protective equipment (PPE) should always be used when spraying any type of coating. In this survey, the PPE used was: ½ face respirator, Tyvek® suit, nitrile gloves, and goggles.

The survey results are summarized below.

Analyte	8-hour TWA	OEL
TDI (Employee 1)	Below Detection Limits ¹	0.005
TDI (Employee 2)	Below Detection Limits	0.005
MDI (Employee 1)	Below Detection Limits ²	0.005
MDI (Employee 2)	Below Detection Limits	0.005

These results suggest that the hazards associated with these materials are comparable to those exhibited by commonly used MDI-based quasi-prepolymers

¹ TDI Detection Limit = 0.00056

² MDI detection limit = 0.00020

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