TMI® (META)

Unsaturated Aliphatic Isocyanate

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The operating allnex group is legally owned by Allnex Holdings S.à r.l., a company based in Luxembourg, which also provides long term strategic decisions relating to its investment in allnex.

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About allnex

Facts & Figures

- Global company with over €2.1 billion in sales
- Broad Technology portfolio: liquid coating resins, energy curable resins, powder coating resins, crosslinkers and additives, composites and construction materials
- Approximately 4000 employees
- Customers in more than 100 countries
- 33 manufacturing facilities
- 23 research and technology centers
- 5 joint ventures
- Extensive range of solutions for key coating segments: automotive, industrial, packaging coating and inks, protective, industrial plastics and specialty architectural

With manufacturing, R&D and technical facilities located throughout Europe, North America, Asia Pacific and Latin America, allnex offers global and reliable supply of resins and additives combined with local, responsive customer support.

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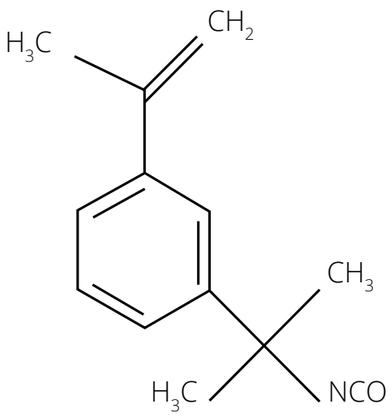
TMI®[1] (META) Unsaturated Aliphatic Isocyanate



α,α -Dimethyl meta-Isopropenyl Benzyl Isocyanate

Physical Properties	
Chemical Abstract Registry No.	2094–99–7
Molecular Weight	201.3
NCO (Isocyanate group) Content, % By Weight	20.9
Appearance	Clear, Colorless Liquid
Boiling Point, 1 atm	270°C
Density, g/mL. 25°C	1.0
Viscosity, cp, 27°C	3.0
Vapor Pressure, Torr, 100°C	2

Uses of TMI

Polymer Modification
Use NCO to attach desired functionality and polymerize.

Copolymerize TMI monomer with a variety of other monomers to create a polymer with free isocyanate groups available for crosslinking.

Coatings
Blocked version in acrylic copolymer for 1K acid etch resistant topcoat.

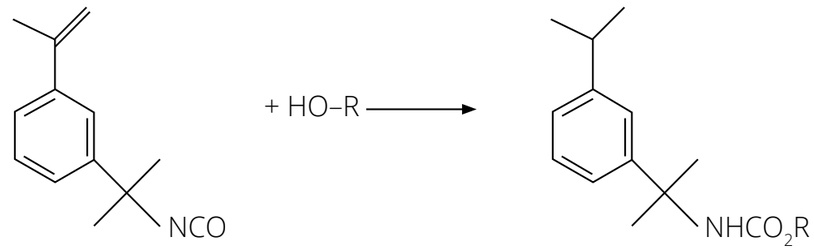
Unblocked version in acrylic copolymer for ambient cure paint.

Plastics Modification
Grafting to PP and TPO for improved surface properties.

[1] All TMI referred to herein are TMI (META) Unsaturated Aliphatic Isocyanate

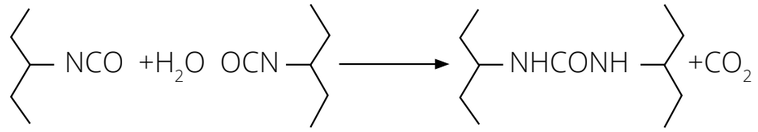
Modified Polymers Containing TMI®

Two Approaches
React –NCO group and then polymerize to incorporate specic functional groups.



- deblock and cure
- rheology modiers
- polymerizable surfactants
- wet adhesion modifers

Copolymerize TMI monomer into latex and moisture cure for selfcrosslinked lms for improved strength and scrub resistance.



Improved Performance of Modified Latex Films Containing TMI

Critical Parameters

Polymerization conditions[1]	• polymerize <40°C to prevent hydrolysis • increasing the concentration of TMI monomer can reduce polymerization rate - 2-5 wt% recommended
Location of TMI in latex	• location a ects both Im properties and storage stability - optimum location needs to be determinined for particular application
Catalyst choice	• catalyst affects film performance - incorporation of 2-5 wt% of (meth) acrylic acid recommended for speed of cure; will reduce NCO stability in latex

[1] Data obtained from sponsored research program at the Emulsion Polymers Institute, Lehigh University

Reactivity Ratios of TMI®

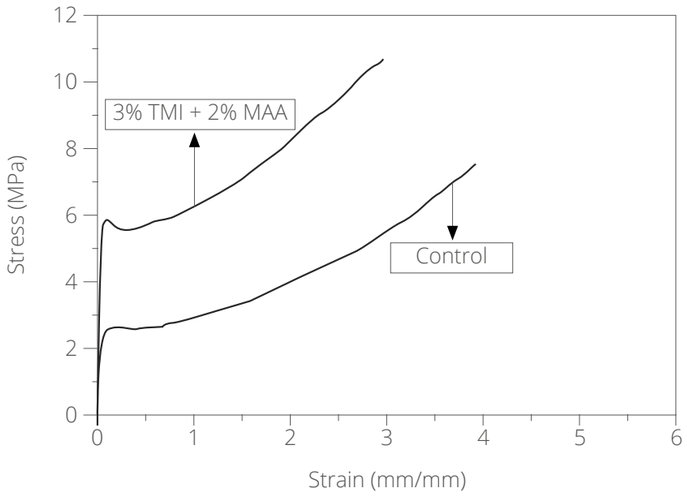
Bulk Polymerization at 70°C1
TMI as M1

M_2	r_1	r_2
Styrene	0.16	0.84
MMA	0.03	0.43
BA	0.38	0.08

Bulk Polymerization at 110°C2
TMI as M1

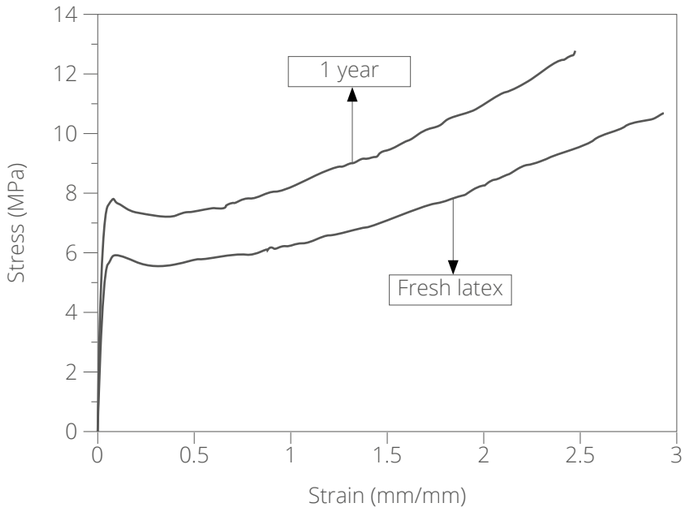
M_2	r_1	r_2
Styrene	0.72	0.80
MMA	0.62	0.31
BA	0.53	0.13

Improved Tensile Properties of a Modified Latex Containing TMI



Improved tensile property poly (MMA/BA/TMI/MAA) (40/55/3/2) compared to poly (MMA/BA) (45/55) control. Cast lms dried at room temperature for 10 days prior to testing.

Improved Tensile Properties of one-year-old Modified Latex Containing TMI



Tensile property of poly (MMA/BA/TMI/MAA) latex stored at room temperature for one year compared to that of the fresh latex; TMI = 3%, MAA = 2%.
Cast films dried at room temperature for 10 days.

[1] Lehigh data calculated using Kelen Tudos Method, J. Marcomol. Sci, Chem A9 (1), 1 (1975)
[2] TMI (META) Unsaturated Aliphatic Isocyanate Technical Data Sheet, Allnex

Blocked Isocyanates

Products Based on TMxdl® and TMI® in Powder Coatings
Products deblock at lower temperature vs. HDI and IPDI

TMI in Solvent Borne Coatings
Acid etch resistant OEM topcoat system based on TMI is reported in patent literature

Deblock Temperatures of Tertiary Aliphatic Isocyanates

Blocking Group	NCO Onset, Deblock Temperature °C
3,5-Dimethylpyrazole	55 - 65
2,6-Dimethyl-4-Heptanone Oxime	60 - 75
Methyl Ethyl Ketoxime	65 - 80
2-Heptanone Oxime	70 - 80
1,2,4-Triazole	80 - 90
ε-Caprolactam	95 - 105
Nonylphenol	145 - 165
t-Butanol	150 - 185
Propylene Glycol	> 180
Isopropanol	190 - 210
Methanol	200 - 220
n-Butanol	200 - 230
n-Hexanol	215 - 230
n-Pentanol	215 - 235

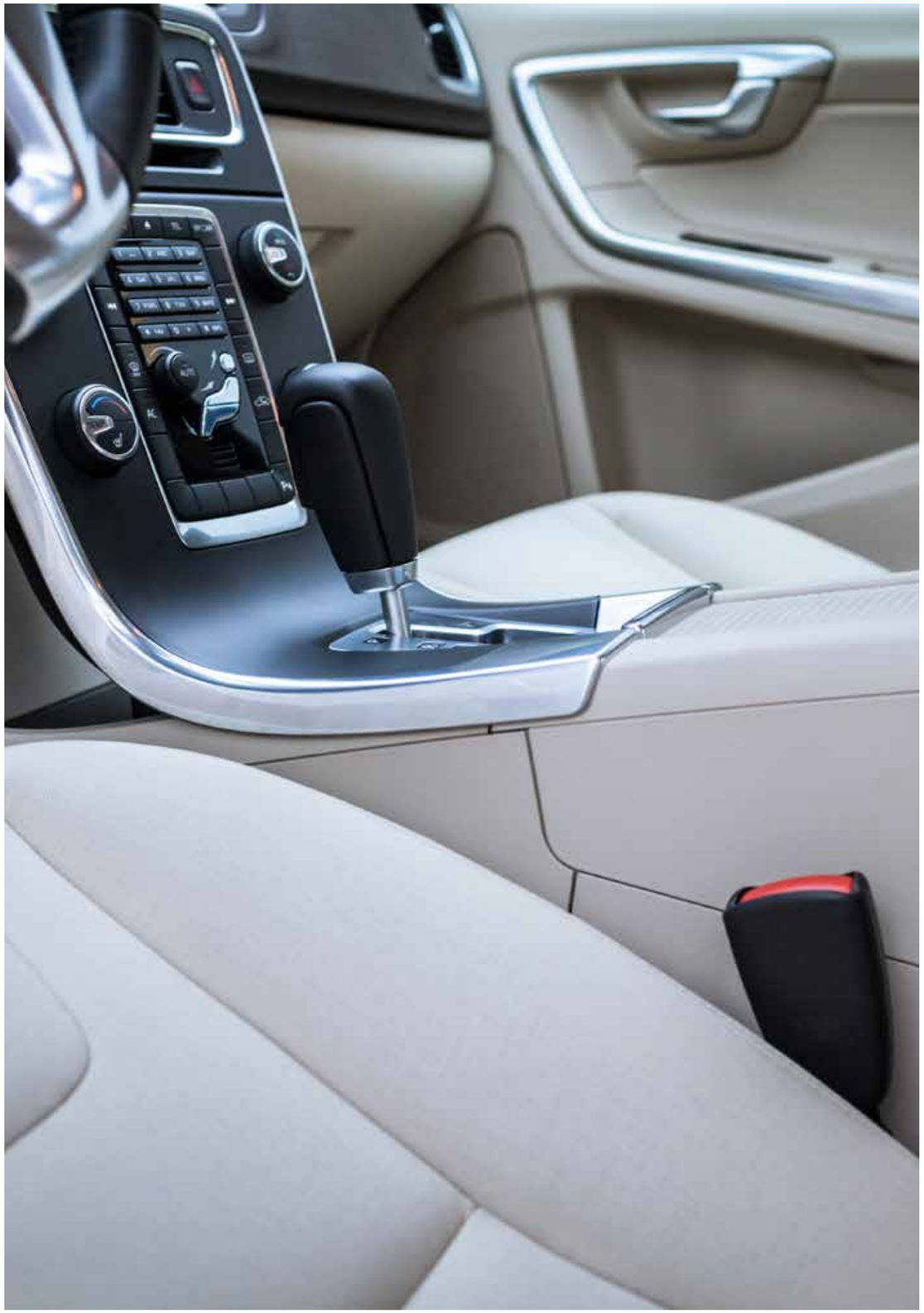
Physical Attributes of Blocked Isocyanates

Allnex's Isocyanate	Blocking Material	Physical State	Melting Point °C
TMI®	MEKO	Liquid	–
	3,5-Dimethylpyrazole	Liquid	–
	n-butanol	Solid	~ 27
	Methanol	Solid	~ 37
	t-butanol	Solid	~ 60
	ε–Caprolactam	Solid	~ 70
	Nonylphenol	Solid	~ 80
TMXDI®	MEKO	Resinous	–
	n-butanol	Solid	~ 68
	ε–Caprolactam	Solid	~ 117
	1,2,4-Triazole	Solid	~ 117
	Acetone Oxime	Solid	~ 125
	Methanol	Solid	~ 130

Cure Temperatures of Blocked TMI Self-Crosslinking Copolymers

Blocking Agent	Temperature[1], °C
Methyl ethyl ketoxime	120
N-Hydroxysuccimide	130
ε–Caprolactam	135

[1] Temperature to achieve 200 MEK double rubs without marring coating with 20 minutes bake cycle.



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