CRAY VALLEY
Resins par excellence

APPLICATION BULLETIN

Poly bd® Resins

Hydroxyl Terminated Polybutadiene Resins

Starting formulations

Poly bd® R-45HTLO Resin Formulations

Part A	Part B
1. Poly bd R-45HTLO Control	Isonate 143L
2. Poly bd R-45HTLO/Voranol 220-530 (2/1 equivalents)	Isonate 143L
3. Poly bd R-45HTLO/Voranol 220-530 (1/1 equivalents)	Isonate 143L
4. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)	Isonate 143L
5. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (1/1 equivalents)	Isonate 143L
6. Poly bd R-45HTLO/Voranol 230-238 (2/1 equivalents)	Isonate 143L
7. Poly bd R-45HTLO/Voranol 230-238 (1/1 equivalents)	Isonate 143L
8. Poly bd R-45HTLO/Voranol 240-800 (2/1 equivalents)	Isonate 143L
9. Poly bd R-45HTLO/Polybutene	Isonate 143L
10. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)	Vestanat IPDI
11. Poly bd R-45HTLO/Voranol 220-260 (2/1 equivalents)	Vestanat IPDI
12. Poly bd R-45HTLO/Voranol 220-260 (1/1 equivalents)	Vestanat IPDI
13. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)	Mondur MR
14. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)/DUP	Isonate 143L
15. Poly bd R-45HTLO Non-Urethane	Ricon 131MA10
16. Poly bd R-45HTLO/Asphalt AC-20	Isonate 143L
17. Poly bd R-45HTLO/Process Oil/Asphalt/Carbon Black	PAPI 2901
18. Poly bd R-45HTLO/Carbon Black	Isonate 143L
19. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)/CaCO3	Isonate 143L
20. Poly bd R-45HTLO/2-Ethyl-1,3-Hexanediol (2/1 equivalents)/Clay	Isonate 143L

Poly bd® Resin Starting formulations

The following formulations demonstrate the range of physical properties that can be obtained by incorporating Poly bd® resin in urethane and non-urethane formulations and the compatibility of Poly bd resin with various additives.

The basic formulation or control, Poly bd R-45HTLO and an aromatic isocyanate, is shown in sample 1.

Curing Agents

Poly bd resin can be cured with either aromatic or aliphatic isocyanates, depending on the application and properties required.

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TOTAL

Aromatic isocyanates, such as Isonate 143L (Samples 1 through 9, 14, 10, 18, 19 and 20) and Mondur MR (sample 13) result in a quicker cure rate and a slightly stiffer urethane than those cured with aliphatic isocyanates. PAPI 2901 (sample 17), a polymeric MDI, can also be used.

Aliphatic isocyanates provide a slower cure rate and a softer urethane with a lower tensile strength and greater elongation. These characteristics are apparent by substituting isophorone diisocyanate (IPDI), sample 10, for Isonate 143L in a comparable formulation, (sample 4). Other formulations containing IPDI are (samples 11 and 12).

Non-urethane systems can be prepared using Poly bd resin (sample 15).

Polyols

Reinforcing polyols increase the tensile strength, hardness, elongation and tear strength when added to the Poly bd urethane formulation. Reinforcing diols used are Voranol 220-530 (samples 2 and 3), Voranol 220-260 (samples 11 and 12), and 2-ethyl-1,3-hexanediol (samples 4, 5, 10, 13, 14, 19 and 20). Samples 6 and 7 are formulated with the triol, Voranol 230-238. The effects of a tetrol, Voranol 240-800, are shown in (sample 8).

Plasticizers

Various plasticizers are compatible with Poly bd resin and function to decrease mix viscosity and reduce hardness of the product. Diundecyl phthalate (DUP), (sample 14), remains non-volatile at elevated temperatures (125°C) and can be added to either Part A or Part B to adjust mix ratios.

A variety of other extending oils, polybutene (sample 9), process oils (sample 17), and asphalt (samples 16 and 17) an also be used a s a plasticizer.

Fillers

The addition of fillers, such as carbon black (samples 17 and 18), calcium carbonate (sample 19), and clay (sample 20), can be used to adjust viscosity, reduce formulation costs and increase tensile strength.

Asphalt

The compatibility of Poly bd resin with asphalt is exhibited by (samples 16 and 17).

Sample 1
Poly bd® R-45HTLO Resin Control

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	12.59

Mix until uniform.

*Add defoamer and catalyst as needed.

NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	131 (0.903)
Elongation, 100%	101
Modulus 100%, psi (MPa)	131 (0.903)
Tear Strength, pli (kN/m)	28 (4.9)
Hardness, Shore A	37
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1MHz)	4.1

Sample 2
Poly bd® R-45HTLO Resin/Voranol 220-530 (2/1 Equivalents)

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 220-530	4.39
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143	18.89

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	275 (1.90)
Elongation, 100%	327
Modulus 100%, psi (MPa)	136 (0.938)
Modulus 200%, psi (MPa)	194 (1.34)
Tear Strength, pli (kN/m)	49 (8.6)
Hardness, Shore A	53
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1MHz)	3.6

Sample 3
Poly bd® R-45HTLO Resin/Voranol 220-530 (1/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 220-530	8.78
Irganox 1520	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	25.19

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	486 (3.35)
Elongation, 100%	269
Modulus 100%, psi (MPa)	266 (1.83)
Modulus 200%, psi (MPa)	396 (2.73)
Tear Strength, pli (kN/m)	96 (17)
Hardness, Shore A	64
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1MHz)	3.3

Sample 4
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol (2/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	3.03
Irganox 1520	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	18.89

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	229 (1.58)
Elongation, 100%	257
Modulus 100%, psi (MPa)	142 (0.979)
Modulus 200%, psi (MPa)	194 (1.34)
Tear Strength, pli (kN/m)	37 (6.5)
Hardness, Shore A	50
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{16}
Dielectric Constant (1MHz)	2.8

Sample 5
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol (1/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	6.06
Irganox 1520	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	25.59

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	433 (2.99)
Elongation, 100%	249
Modulus 100%, psi (MPa)	242 (1.67)
Modulus 200%, psi (MPa)	365 (2.52)
Tear Strength, pli (kN/m)	81 (14)
Hardness, Shore A	0
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1MHz)	3.3

Sample 6
Poly bd® R-45HTLO Resin/Voranol 230-238 (1/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 230-238	19.60
Raylox 46	0.50
Tinuvin P	0.25
BYK 070	0.08*
Part B	
Isonate 143L	25.19

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	264 (1.82)
Elongation, 100%	207
Modulus 100%, psi (MPa)	180 (1.24)
Modulus 200%, psi (MPa)	255 (1.76)
Tear Strength, pli (kN/m)	45 (7.9)
Hardness, Shore A	50
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{14}
Dielectric Constant (1Mhz)	3.9

Sample 7
Poly bd® R-45HTLO Resin/Voranol 230-238 (1/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 230-238	19.60
Raylox 46	0.50
Tinuvin P	0.25
BYK 070	0.80*
Part B	
Isonate 143L	25.19

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile strength, psi (MPa)	264 (1.82)
Elongation, 100%	207
Modulus 100%, psi (MPa)	180 (1.24)
Modulus 200%, psi (MPa)	255 (1.76)
Tear Strength, pli (kN/m)	45 (7.9)
Hardness, Shore A	50
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{14}
Dielectric Constant (1MHz)	3.9

Sample 8
Poly bd® R-45HTLO Resin/Voranol 240-800 (2/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 240-800	3.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	18.89

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	189 (1.30)
Elongation, 100%	221
Modulus 100%, psi (MPa)	97 (0.67)
Modulus 200%, psi (MPa)	168 (1.16)
Tear Strength, pli (kN/m)	26 (4.5)
Hardness, Shore A	38
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric Constant (1MHz)	3.5

Sample 9
Poly bd® R-45HTLO Resin/Polybutene

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Indopol L14 (Polybutene)	75.00
Irganox 1520	0.50
Tinuvin P	0.25
Foamkill 8D	0.07*

Part B	
Isonate 143L	21.59

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	82 (0.57)
Elongation, 100%	154
Modulus 100%, psi (MPa)	64 (0.44)
Tear Strength, pli (kN/m)	17 (3)
Hardness, Shore A	18
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric Constant (1MHz)	2.5

Sample 10
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol (2/1 Equivalents)

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	3.03
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Vestanat	14.51

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	137 (0.945)
Elongation, 100%	386
Modulus 100%, psi (MPa)	73 (0.50)
Modulus 200%, psi (MPa)	101 (0.696)
Modulus 300%, psi (MPa)	121 (0.834)
Tear Strength, pli (kN/m)	41 (7.2)
Hardness, Sore A	28
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{14}
Dielectric Constant (1MHz)	3.4

Sample 11
Poly bd® R-45HTLO Resin/Voranol 220-260 (2/1 Equivalents)

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 220-260	9.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Vestanat IPDI	14.51

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 083 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	84 (0.58)
Elongation, 100%	196
Modulus 100%, psi (MPa) 5	7 (0.39)
Tear Strength, pli (kN/m)	28 (4.9)
Hardness, Shore A 2	8
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{13}
Dielectric Constant (1MHz)	4.4

Sample 12
Poly bd® R-45HTLO Resin/Voranol 220-260 (1/1 Equivalents)

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
Voranol 220-260	17.90
Irganox 1520	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Vestanat IPDI	19.35

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	112 (0.772)
Elongation, 100%	254
Modulus 100%, psi (MPa)	69 (0.48)
Modulus 200%, psi (MPa)	97 (0.67)
Tear Strength, pli (kN/m)	35 (6.1)
Hardness, Shore A	7
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1Mhz)	4.8

Sample 13
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol (2/1 Equivalents)

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	3.03
Raylox 46	0.50
Tinuvin P	0.25
BYK 070	0.08*
Part B	
Mondur MR	17.26

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	105 (0.724)
Elongation, 100%	102
Modulus 100%, psi (MPa)	103 (0.710)
Modulus 200%, psi (MPa)	-
Tear Strength, pli (kN/m)	21 (3.7)
Hardness, Shore A	42
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric constant (1MHz)	3.7

Sample 14
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol/DUP

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	3.03
DUP (Diundecyl phthalate)	56.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Isonate 143L	17.26

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile strength, psi (MPa)	73 (0.50)
Elongation, 100%	139
Modulus 100%, psi (MPa)	60 (0.41)
Tear Strength, pli (kN/m)	19 (3.3)
Hardness, Shore A	15
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{14}
Dielectric Constant (1MHz)	4.2

Sample 15
Poly bd® R-45HTLO Resin Non-Urethane Control

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
DMP-30	0.20
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
Ricon 131MA10	82.00

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile strength, psi (MPa)	80 (0.55)
Elongation, 100%	48
Modulus 100%, psi (MPa)	-
Modulus 200%, psi (MPa)	-
Tear Strength, pli (kN/m)	15 (2.6)
Hardness, Shore A	18
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{16}
Dielectric Constant (1MHz)	3.5

Sample 16
Poly bd® R-45HTLO Resin/Asphalt AC20

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Asphalt AC20	200.00
Irganox 1520	0.50
Tinuvin P	0.25
BYK 070	0.08*
Part B	
Isonate 143L	13.99

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	205 (1.41)
Elongation, 100%	470
Modulus 100%, psi (MPa)	74 (0.51)
Modulus 200%, psi (MPa)	92 (0.63)
Tear Strength, pli (kN/m)	39 (6.8)
Hardness, Shore A	36

Sample 17
Poly bd® R-45HTLO Resin/Process Oil/Asphalt/Carbon Black

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Asphalt AC 20	72.90
Sundex 8125	72.90
Monarch 120 (Carbon black)	2.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.08*
Part B	
PAPI 2901	12.76

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	71 (0.49)
Elongation, 100%	155
Modulus 100%, psi (MPa)	58 (0.40)
Modulus 200%, psi (MPa)	-
Tear Strength, pli (kN/m)	16 (2.8)
Hardness, Shore A	23
Surface Resistivity, ohm	10^{15}
Volume Resistivity, ohm-cm	10^{14}
Dielectric Constant (1MHz)	3.4

Sample 18
Poly bd® R-45HTLO Resin/Carbon Black

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
Sterling R (Carbon black)	10.00
Raylox 46	0.50
Tinuvin P	0.25
BYK 070	0.08*
Part B	
Isonate 143L	12.59

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	Results
Tensile Strength, psi (MPa)	244 (1.68)
Elongation, 100%	212
Modulus 100%, psi (MPa)	153 (1.05)
Modulus 200%, psi (MPa)	235 (1.62)
Tear Strength, pli (kN/m)	35 (6.1)
Hardness, Shore A	39
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric Constant (1MHz)	4.3

Sample 19
Poly bd® R-45HTLO Resin/2-ethyl-1,3-hexanediol/ CaCO3

Formulation	Parts by Weight
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	3.03
Ultra-Pflex	80.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.11

Part B	
Isonate 143L	18.89

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	324 (2.23)
Elongation, 100%	338
Modulus 100%, psi (MPa)	231 (1.59)
Modulus 200%, psi (MPa)	271 (1.87)
Modulus 300%, psi (MPa)	308 (2.12)
Tear Strength, pli (kN/m)	57 (10)
Hardness, Shore A	41
Surface Resistivity, ohm	10^{17}
Volume Resistivity, ohm-cm	10^{15}
Dielectric Constant (1MHz)	4.0

Sample 20
Poly bd® R-45HTLO Resin / 2-ethyl-1,3-hexanediol (1/1 Equivalents) / Clay

Formulation	**Parts by Weight**
Part A	
Poly bd R-45HTLO Resin	100.00
2-ethyl-1,3-hexanediol	6.06
Burgess KE	50.00
Raylox 46	0.50
Tinuvin P	0.25
Foamkill 8D	0.10*
Part B	
Isonate 143L	25.59

Mix until uniform.

*Add defoamer and catalyst as needed.
NCO/OH = 1.05
OH value = 0.83 meq/g

Physical Properties	**Results**
Tensile Strength, psi (MPa)	1349 (9.301)
Elongation, 100%	276
Modulus 100%, psi (MPa)	611 (4.21)
Modulus 200%, psi (MPa)	1067 (7.357)
Tear Strength, pli (kN/m)	162 (28.3)
Hardness, Shore A	69
Surface Resistivity, ohm	10^{16}
Volume Resistivity, ohm-cm	10^{15}
Dielectric Constant (1MHz)	3.3

Functions of Additives and Suppliers

Product	Function	Supplier
AC-20	Asphalt	Koch Materials
Burgess KE	Treated Clay	Burgess Pigment
BYK-070	Defoamer	BYK Chemie
Carbon black	Pigment	Various
Dibytyltin dilaurate (T-12)	Catalyst	Air Products
DMP-30	Catalyst	Rohm & Haas
Diundecyl phthalate	Plasticizer	BASF
Foamkill	Defoamer	Crucible Chemical
Indopol L-14	Cable Oil (Plasticizer)	Ineos Oligomers
Irganox 1520	Antioxidant	Ciba (BASF)
Isonate 143L	Isocyanate (Aromatic)	Dow Chemical
Isophorone diisocyanate(IPDI)	Isocyanate (Aliphatic)	Evonik
Mondur MR	Isocyanate (Aromatic)	Bayer
PAPI 2901	Isocyanate (Aromatic)	Dow Chemical
Raylox 46	Antioxidant	Raschig Industries
Ricon 131MA10	Anhydride Polybutadiene	Cray Valley
Sundex 8125TN	Plasticizer (Aromatic)	Sunoco
Tinuvin P	UV Stabilizer	Ciba (BASF)
Ultra-Pflex	Precipitated Calcium Carbonate	Specialty Minerals Inc.
Voranol	Reinforcing Polyol	Dow Chemical
2-Ethyl-1,3-hexanediol	Reinforcing Diol	Kyowa Hakko