



Sustainable Solutions.
Endless Innovation™



VERSATILE SOLUTIONS FOR SYNTHETIC & NATURAL BASED OILS

POLYMERS FOR OIL MODIFICATIONS



OPTIONS THAT MEET THE MOST DEMANDING PERFORMANCE NEEDS.

Kraton™ offers an extensive range of hydrogenated styrenic block copolymers (SBCs) to meet the industry's most demanding needs for oil modification. Oil gels, also called oleogels, are highly versatile oils modified with SBC that provide endless possibilities for new uses and formulations for diverse consumer or industrial markets. Our polymers are compatible with various carrier systems to deliver gel solutions for many applications and meet the United States Food and Drug Administration's (FDA) regulations.

Applications:

- ▶ Cable-Filling Compounds
- ▶ Foam Control Agents (Defoaming, Anti-Foaming)
- ▶ Transparent, Scented Candles
- ▶ Orthopedic and External Prosthetic Devices
- ▶ Injection Molded, or Extruded "Foamed" Oil Gels
- ▶ Sealants, Coatings & Energy Damping

Our products are formulated to create moisture-resistant, strong, and easily processable gels, and when blended with synthetic or natural-based oils, these polymers provide thickening, solid, shear-thinning, and film-forming behaviors. These blends also perform very well at low temperatures and possess excellent oil retention.

Kraton G and A polymers can create viscous oils, greases, or flexible solid gels depending on the polymer used, its concentration, and oil type.

These polymers can be used to modify the viscosity of:

- ▶ Petroleum
- ▶ Mineral
- ▶ Polar & Natural Based Oils
- ▶ Paraffinic and Microcrystalline Waxes

Whether used as a sole rheology modifier or to complement other gelling agents, Kraton solutions offer a variety of features and benefits. They provide elasticity, excellent moisture barriers, and other outstanding properties over a wide range of temperatures. Additionally, our polymers can be directly dissolved in heated oil.

Features & Benefits:

- ▶ High Level of Formulation Versatility
- ▶ Excellent Compatibility with a Variety of Oils
- ▶ Broad Range of Rheological Profiles
- ▶ High Clarity
- ▶ Enhanced Product Stability
- ▶ High Moisture Resistance
- ▶ Excellent Film-Forming Properties
- ▶ Can be Made Tacky or Non-Tacky



Property	G1701	G1702	G1750
Tensile Strength, MPa ^{1,2}	2	2	<0.3
300% Modulus, MPa ^{1,2}	-	-	-
Elongation at Break, % ^{1,2}	<100	<100	100
Hardness (10s), Shore A ³	64	41	11
Specific Gravity	0.92	0.91	0.86
Brookfield Viscosity (25w% ⁴), mPa.s or cP	>50,000	50,000	8,700
Brookfield Viscosity (10w% ⁴), mPa.s or cP	-	280	140
Melt Flow Rate (MFR), g/10 min (200°C/5kg)	<1	<1	8
Melt Flow Rate (MFR), g/10 min (230°C/5kg)	<1	<1	-
Styrenic/Rubbery Units Weight Ratio ⁵	37/63	28/72	0/100
Diblock Content, % ⁵	100	100	-
Physical Form	Powder	Powder	Bale
Comments ⁶	FDA	FDA	FDA

KRATON™ G SEP & EP POLYMERS

Kraton G styrene-ethylene-propylene (SEP) polymers with a di-block structure can thicken mineral oils while promoting shear thinning behavior. Alternatively, Kraton ethylene/propylene (EP) star polymers increase the viscosity of oils without thixotropic behavior. When using these polymers to thicken oils, film formation is improved, and a moisture barrier is created.



KRATON™ G SEBS POLYMER GRADES

Kraton G styrene-ethylene-butylene-styrene (SEBS) polymers with a tri-block structure solidify mineral oils to provide strength, enhanced flexibility, and cushioning properties.

Property	G1633	G1650	G1651	G1652	G1654	G1657	G1726
Tensile Strength, MPa ^{1,2}	-	35	>28	31	>27	23	2
300% Modulus, MPa ^{1,2}	-	6	-	5	-	2.4	-
Elongation at Break, % ^{1,2}	-	500	>800	500	>800	750	200
Hardness (10 sec), Shore A ³	-	70	60	70	63	47	60
Specific Gravity	0.91	0.91	0.91	0.91	0.91	0.9	0.91
Brookfield Viscosity (25w% ⁴), mPa.s or cP	>50000	8000	>50000	1500	>50000	4200	200
Melt Flow Rate (MFR), g/10 min (200°C/5kg)	<1	<1	<1	<1	<1	8	65
Melt Flow Rate (MFR), g/10 min (230°C/5kg)	<1	<1	<1	5	<1	22	>100
Styrenic/Rubbery Units Weight Ratio ⁵	30/70	30/70	33/67	30/70	31/69	13/87	30/70
Diblock, % ⁵	<1	<1	<1	<1	<1	30	70
Tg of Rubber Block, C	-53	-53	-53	-53	-55	-35	-55
Physical Form (Also Available)	Crumb	(Pd) & (C)	(Pd) & (C)	(Pd) & (C)	(Pd) & (C)	Dense	Dense
Comments ⁶	FDA	FDA	FDA	FDA	FDA	FDA	FDA

KRATON™ G ERS POLYMER GRADES

When mixed with mineral oils, Kraton G Enhanced Rubber Segment (ERS) polymers allow softer, lower temperature processable gels. ERS polymers have lower softening points and may be helpful for temperature-sensitive formulations. Low viscosity oil gels may be achieved when using these particular grades.

Property	G1640	G1641	G1642	G1643	G1645
Tensile Strength, MPa ^{1,2}	>20	>17	>21	>10	10
300% Modulus, MPa ^{1,2}	4.5	4.3	-	-	-
Elongation at Break, % ^{1,2}	>800	>800	>1200	>600	600
Hardness (10s), Shore A ³	60	52	48	52	35
Specific Gravity	0.91	0.91	0.9	0.9	0.89
Melt Flow Rate (MFR), g/10 min (230°C/2.16kg)	<1	<1	<1	19	3.5
Melt Flow Rate (MFR), g/10 min (230°C/5kg)	<1	<1	<1	75	13
Styrenic/Rubbery Units Weight Ratio ⁵	32/68	33/67	21/79	19/81	13/87
Diblock Content, % ⁵	<1	<1	<1	<7	<7
Tg of Rubber Block, C	-38	-38	-38	-35	-38
Physical Form	Crumb	Powder	Powder	Dense	Dense
Comments ⁶	FDA	FDA	FDA	FDA	FDA

LOWER SOFTENING POINT ERS PROPERTIES

The following chart demonstrates the ring and ball softening point of Kraton polymers based oil gel (ASTM E28-67) at 6% and 10% weight in Drakeol™ 34 mineral oil.

Data in tables is representative of each grade and not the guaranteed specification.

Physical Form Key

■ Bale (B)	■ Porous Pellet (Po)
■ Dense Pellet (D)	■ Powder (Pd)
■ Fluffy Crumb (C)	■ Multiple Forms

Footnotes

1 ASTM method D412.

2 Typical properties determined on film cast from toluene solution.

3 Typical values on polymer compression molded at 170-200°C.

4 Neat polymer concentration in toluene at 25°C.

5 Related to SBC polymer fraction.

6 For specific FDA clearances, letters will be provided upon request

SEBS	Drop Point (°C)	
Polymer %	6	10
G1650	67.8	77.2
G1651	123	141
G1652	56.1	65.6
G1654	96.7	117
G1657	26.7	37.8
SEBS (ERS)	Drop Point (°C)	
Polymer %	6	10
G1641	114	132
G1642	65.6	72.8
G1643	42.2 ¹	45.6
G1645	47.8	50

KRATON™ A POLYMERS

Kraton A polymers have a unique midblock structure compatible with natural, polar, and ester oils. Natural oils, such as almond, coconut, olive, rice bran, sesame seed, soybean, sunflower, olive, grapeseed, and walnut, exhibit excellent compatibility with Kraton A1535 and A1536 polymers.

Property	A1535	A1536
Tensile Strength, MPa ^{1,2}	28	>34
300% Modulus, MPa ^{1,2}	7.9	6.4
Elongation at Break, % ^{1,2v}	>600	660
Hardness (10s), Shore A ³	83	65
Specific Gravity	0.96	0.93
Melt Flow Rate (MFR), g/10 min (230°C/2.16kg)	<1	<1
Melt Flow Rate (MFR), g/10 min (260°C/5kg)	<1	7
Styrenic/Rubbery Units Weight Ratio ⁵	58/42	42/58
Diblock Content, % ⁵	<1	<1
Physical Form	Powder	Powder
Comments ⁶	FDA	FDA

Data in tables is representative of each grade and not the guaranteed specification.

Physical Form Key

- Bale (B)
- Dense Pellet (D)
- Fluffy Crumb (C)
- Porous Pellet (Po)
- Powder (Pd)
- Multiple Forms

Footnotes

1 ASTM method D412.

2 Typical properties determined on film cast from toluene solution.

3 Typical values on polymer compression molded at 170-200°C.

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5 Related to SBC polymer fraction.

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GEL BASED ON ESTER OILS

Aliphatic Ester Oils			
Composition, %w	1	2	3
Erucical™ EG-20	91	88	-
Finester™ EH-25	-	-	91
Kraton A1535 Polymer	9	12	9
R&B S.P. °C	91	109	56
Hardness			
Probe, gm	100	180	60
Shore 00	0	0	0
Oil Bleed	No	No	No

Aromatic Ester Oils		
Composition, %w	1	2
Finsolv™ TN	90	80
Kraton A1535 Polymer	10	20
Viscosity at 25°C	Low	High

Finsolv is a trademark of Innospec Performance Chemicals US. Corp.

Erucical is a trademark of Vantage Specialties, Inc.

Finester is a trademark of Innospec Performance Chemicals US. Corp.







LOW DENSITY AND HIGH TEMPERATURE RESISTANCE

When blended with oils and thermoplastic expandable microspheres, Kraton G polymers may also be used to create low-density foams. These foams can be thermoplastic or thermoset. Thermoset UV-cured foams are more resistant to higher temperatures.

CLOSED CELL, LOW DENSITY GELS

Formulation, %w	1	2	3	4	5
Kraton G1654 Polymer	10	9.5	9	8.5	8
Ondina™ N68 Oil	90	89.5	89	88.5	88
Expancel™ D 091/80	0	1	2	3	4
Properties					
Density, g/ml	0.84	0.59	0.5	0.43	0.43
Drop Point	135	145	153	192	196
Viscosity, 100c (Pa.S)	1,300	6,100	10,800	18,500	21,500
Oil Bleed Out Ranking ¹	3	2	2	2	2

Ondina is a trademark of Shell Trademark Management, B.V.
Expancel is a trademark of Casco Adhesives A.B. Corp.

Data in tables is representative of each grade and not the guaranteed specification.

Footnotes

1 Visual ranking: 1=no evidence of oil on filter paper, 2=filter paper wet with oil, 3=filter paper saturated with oil.

2 Gels were also exposed to fluorescent room light for one week. Plug distortion was prepared by putting 33 mm diameter plug in beaker in oven for 1 hour at 70°C.

3 Bleed on surface was noted after one month.

THERMOSET OIL GELS BY UV CURE

Formulation	%wt
Drakeol™ 7 Oil	83.7
Kraton SBS Polymer	7.5
Kraton G1650 SEBS Polymer	7.5
SR 238 Hexandiol Diacrylate	1
Irgacure™ 819 BAPO Photoinitiator	0.2
Plug Distortion After Irradiation ²	None
Oil Bleed Out ³	No

Drakeol is a trademark of Calumet Penneco, LLC.
Irgacure is a trademark of Ciba Specialty Chemicals Corp.
Sartomer SR 238 is a trademark of Sartomer Technology USA, LLC.



CREATING OIL GELS WITH KRATON POLYMERS

Kraton experts are available to provide technical assistance in regard to modifying the viscosity or mixing our polymers with oils.

Recommendations may involve:

- ▶ Mixing Time
- ▶ Mixing Temperature
- ▶ Mixing Shear Rate
- ▶ Preparation of Foamed Gels
- ▶ Preparation of Ultra-Soft Compounds

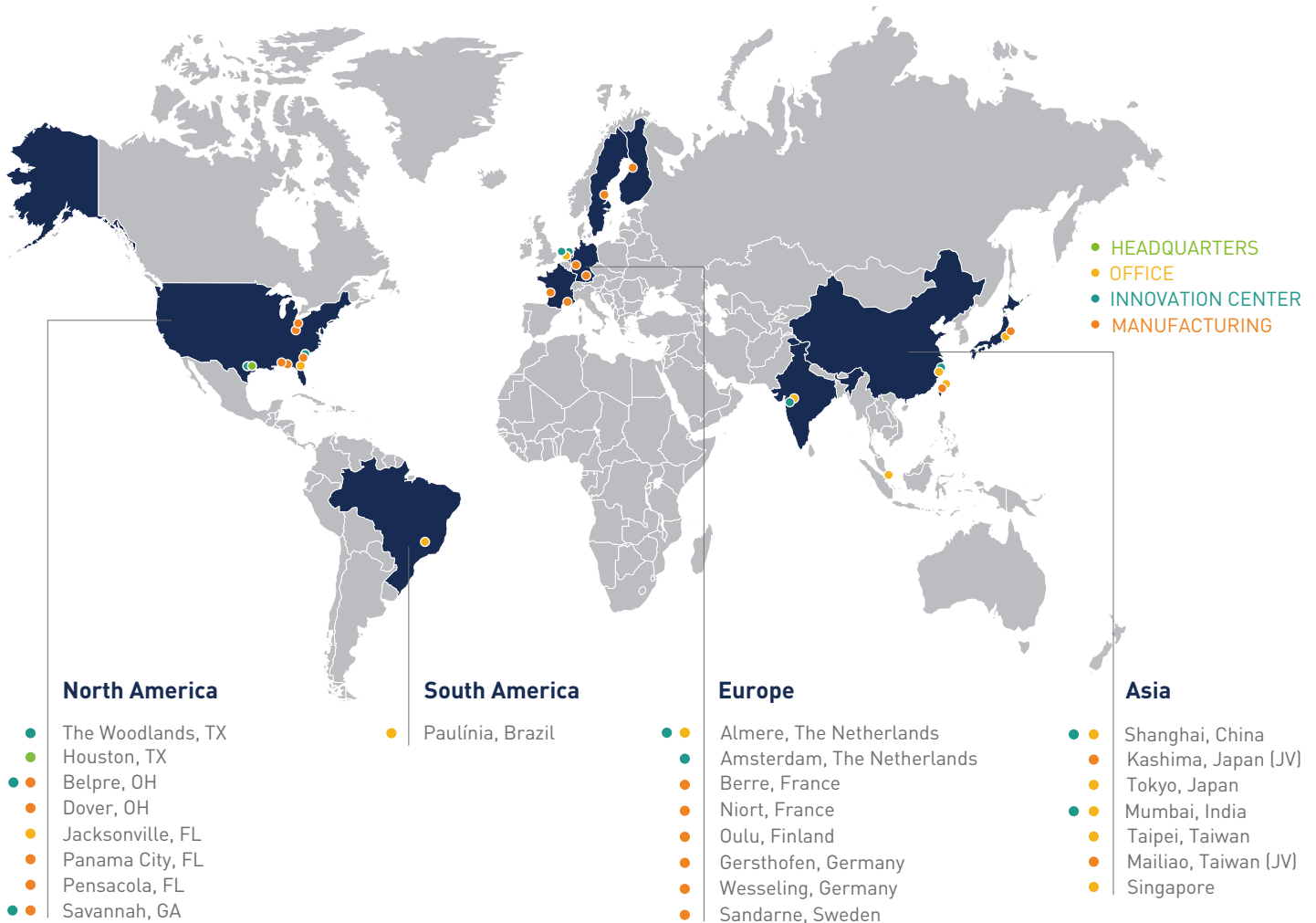
Kraton offers a diverse range of innovative, hydrogenated SBCs. Our polymers may be used as rheology modifiers to mineral, polar, natural, and ester oils that offer unique structure and film-forming properties. They are suitable for solution or melt processing and can be formulated with other polymers, resins, fillers, pigments, oils, thickeners, waxes, and stabilizers to obtain a desired balance of properties.

Kraton provides value-added solutions that are designed to meet your most stringent performance needs.



KRATON

GLOBAL FOOTPRINT



KRATON CORPORATION

For more information, visit our website at www.kraton.com.

U.S.A. Headquarters
The Woodlands, Texas

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