PPG Silica Products

Hi-Sil™ EZ 200G

Highly Reinforcing HD Silica

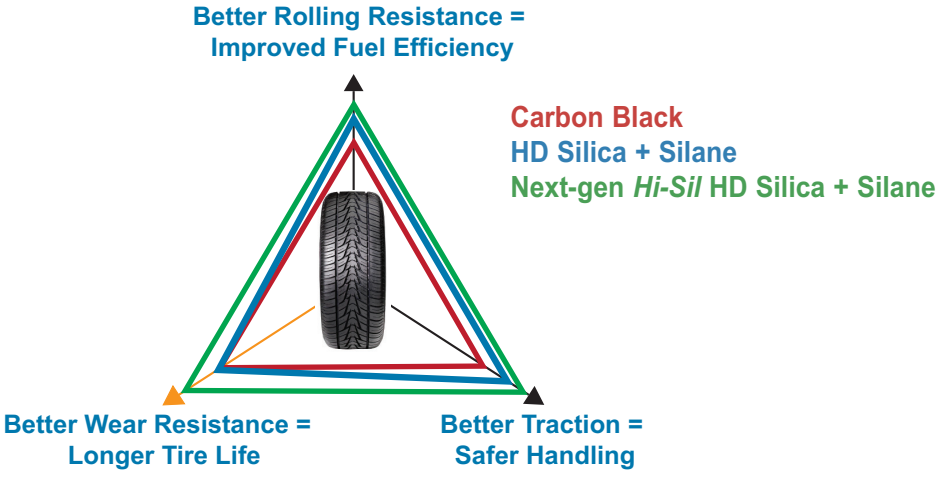
TIRE

Hi-Sil™ EZ 200G silica is a highly-reinforcing highly-dispersible synthetic amorphous precipitated silica engineered to provide performance improvements relative to conventional highly-dispersible silicas in passenger car and light truck tread compounds.

Hi-Sil EZ 200G silica utilizes an innovative combination of surface area and microporosity to optimize the hysteretic (rolling resistance) and reinforcement (wear resistance) properties of tread compounds. This, in turn, enables a paradigm shift in the tire "magic triangle" that results in improved fuel efficiency, safety, and longevity.

Benefits relative to conventional highly-dispersible silicas

- Better traction for improved safety and handling, especially in wet, snowy, or icy conditions
- Better wear resistance for longer tire life and lower material consumption
- Equal or better rolling resistance for improved fuel efficiency
- Equal or better processing



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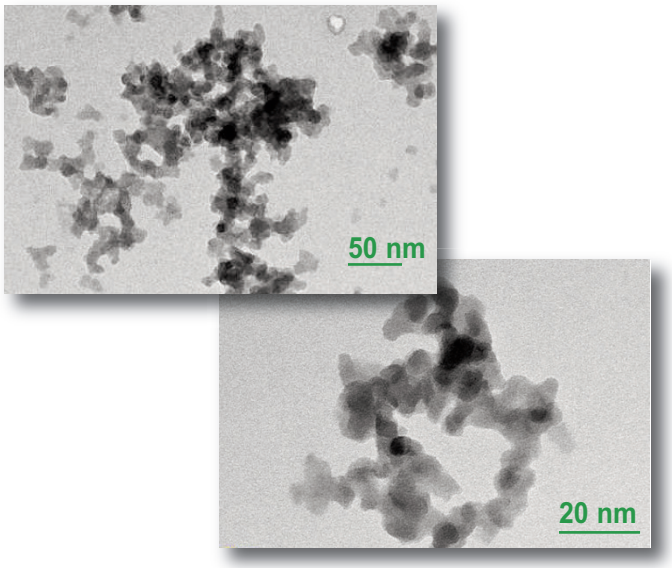
Hi-Sil EZ 200G Silica — Typical Properties	
N_2 BET-5 Surface Area, m^2/g	300
CTAB Surface Area, m^2/g	200
pH, 5% slurry in water	7.0
Residual Salt Type	Na_2SO_4
Physical Form	Micro-granule
Moisture Content, weight %	6.0
Apparent Tamped Density, lb/ft^3	~16
Apparent Tamped Density, g/L	~260
Manufacturing Locations	Delfzijl, The Netherlands Lake Charles, LA USA



TEM photomicrographs of Hi-Sil™ EZ 200G silica

Green Tire Tread Model Formulation and Compounding Recommendations

Compound optimization studies have been performed for *Hi-Sil* EZ 200G in green tire tread model formulations. One example model formulation is provided below.

Hi-Sil EZ 200G silica should be added as early as possible in the mixing schedule. Ideally, the silica should be added at the same time as the polymer(s) and before the addition of process oil to allow time for silica incorporation in the polymers(s). Split oil additions are recommended to maintain a high viscosity as increased shear aids in dispersion.

Green Tire Tread Model Formulation — First Pass

Time	Temp	RPM	Pass 1	PHR	GRAMS
0"	150°F	85	Buna® VSL 5228-2	103.10	504.26
"		85	Budene® 1207	25.00	122.27
0.5"		85	Silica	40.00	195.64
"		85	Si 69®	7.00	34.24
1"		85	Silica	40.00	195.64
"		85	Vivatec™ 500	5.00	24.45
1.5"		85	Sweep Ram		
2"		VAR	Sweep Ram – Speed Change – Vary speed to maintain temp at 160°C +/- 3°C		
5"			DUMP: 5" @ 160°C +/- 3°C		
			Total PHR:	**220.10**	**1076.50**

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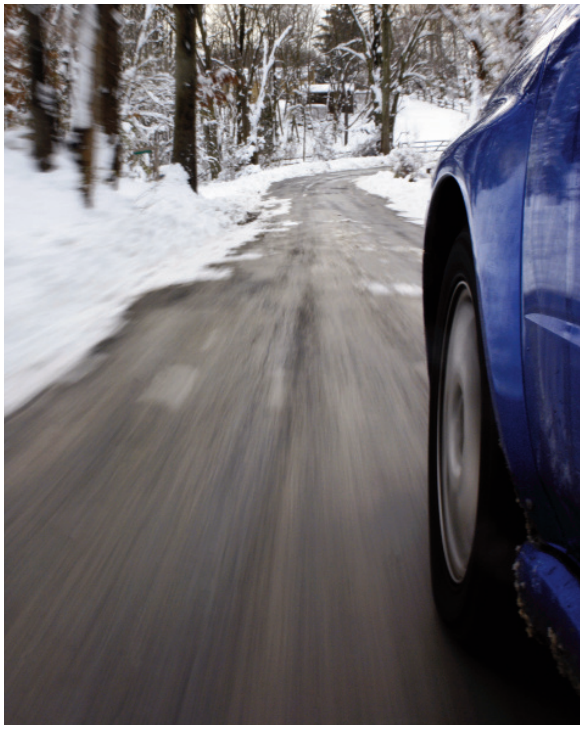
Green Tire Tread Model Formulation — Second Pass					
Time	**Temp**	**RPM**	**Pass 2**	**PHR**	**GRAMS**
0"	150°F	85	Master Batch	220.10	1076.50
"		85	Zinc Oxide	2.50	12.23
0.5"		85	Stearic Acid	1.00	4.89
"		85	Santoflex® 13	2.00	9.78
"		85	Sunproof® Improved	1.50	7.34
1"		85	Sweep Ram		
1.5"		VAR	Speed Change – Vary speed to maintain temp at 160°C +/- 3°C		
11"			DUMP: 11" @ 160°C +/- 3°C		
			Subtotal PHR:	**7.00**	**34.24**
			Total PHR:	**227.10**	**1110.74**

Green Tire Tread Model Formulation — Mill Finish		
	PHR	**GRAMS**
Master Batch	227.10	1110.74
RM Sulfur	1.40	6.85
CBS	1.70	8.31
DPG	2.00	9.78
Mill Time: ~5 minutes – 5 side cuts & 5 end passes		
Subtotal PHR:	**5.10**	**24.94**
Total PHR:	**232.10**	**1135.68**



Solution SBR = Buna® VSL 5228-2

- Vinyl content: 52 wt.%
- Styrene content: 28 wt.%
- Oil content (TDAE): 27.3 wt.%
- Mooney viscosity (ML (1+4) 100°C): 50
- Tg: -20°C

BR = Budene® 1207

- Vinyl content: 1.5 wt.%
- cis 1,4 content: 97 wt.%
- Mooney viscosity (ML (1+4) 100°C): 55
- Tg: -104°C

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A comparative example of *Hi-Sil* EZ 200G and a conventional HD silica in one optimized green tire tread model formulation is provided below.

Green Tire Tread Model Formulation – Laboratory Properties

	Conventional HD Silica	*Hi-Sil* EZ 200G	*Hi-Sil* EZ 200G / Conventional HD Silica
Silica Loading, phr	80	60	75%
Si-69 Loading, phr	7.00	8.25	118%
Dump Temperature, °C	160	140	88%
Dispersion, %	99.7	99.3	100%
Processing			
Viscosity, MU	84	81	96%
Scorch, minutes	9.1	10.2	112%
Cure Time, minutes	31.8	16.6	52%
Performance			
Elongation, %	298	299	100%
Modulus @ 300%, MPa	18.4	19.5	106%
Hardness @ 23°C, Shore A	65	65	100%
Tan Delta			
@ 60°C	0.077	0.064	84%
@ 0°C	0.287	0.278	97%
DIN Abrasion Loss, mm^3	163	141	87%

Samples

Samples are available per request from customer service.

Packaging

Standard packaging includes small bags and Flexible Intermediate Bulk Containers (FIBCs). Bags are unitized for shipping on pallets which are stretch wrapped with clear plastic film. FIBCs are single or double stacked on wood pallets. Please consult with Silica Customer Service or your Silica Sales Representative regarding additional packaging options including custom package sizes and bulk shipments.

Storage

To ensure product integrity, PPG recommends that our silica products be stored under dry, clean conditions, protected against exposure to direct sunlight and other substances, and used within twelve months of the date of manufacture.

Safety and Health Effects

PPG Industries recommends that, before use, anyone using or handling this product thoroughly read and understand the information and precautions on the label, as well as in other product safety publications such as the Material Safety Data Sheet. Any health hazard and safety information contained herein should be passed on to your customers or employees, as the case may be. The products mentioned herein can be hazardous if not used properly. Like all potentially hazardous materials, this product must be kept out of the reach of children.

Product Safety and Regulatory Information

For the latest product safety and regulatory information, please reference the Product Safety Sheets at www.ppgsilica.com.

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