

Hi-Sil™, Ciptane™, Agilon™, and Silene™ Reinforcing Silica Products in EPDM

PPG's silica products range in reinforcing capabilities from semi to high. To provide a demonstration of these capabilities, several PPG silica products were evaluated in an EPDM motor mount type application. The PPG silica products reviewed are found in the tables below.

Silica Typical Properties

	<u>Surface Area BET-5 (m²/g)</u>	<u>Manufacture Location</u>	<u>pH</u>	<u>Physical Form</u>
Silene™ 732D	30	USA	8.5	powder
Hi-Sil™ 532EP	55	USA	8.5	powder
Hi-Sil™ 200 Series (210, 233, 243LD)	135	USA	7	pellet, powder, and granule
Hi-Sil™ HDP-320G	160	USA	6.5	micro-granule
Hi-Sil™ 134G	180	USA	6.3	granule
Hi-Sil™ 190G	195	USA	6.9	granule

Mercapto-Silane Treated Silica Typical Properties (USA)

	<u>Surface Area BET-5 (m²/g)</u>	<u>Surface Area CTAB (m²/g)</u>	<u>pH</u>	<u>Physical Form</u>
Agilon™ 400	-----	130	6.8	granule
Ciptane™ I	135*	-----	7	pellet
Ciptane™ LP	175*	-----	7	bead

*surface area based on base silica

Rubber Processing Recommendations

For all Hi-Sil™ silica forms, it is recommended that the silica 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 into the polymer(s). For high loadings of silica, split additions are recommended...first addition with the polymer(s) and the second with the process oil. For loadings of high density - low dust silica granules, a single addition can be made with the polymer/s and just before process oil addition.

Split oil additions are recommended to maintain a high viscosity as increased shear aids in silica dispersion. Granules and pellets tend to need slightly more mixing time to disperse than milled powders.

For Ciptane™ and Agilon™ products, it is recommended adding separately, with polymer/s or directly after polymer breakdown and blending.

Note: Silica incorporation time and dispersion in rubber will vary based on internal mixer type and rotor design.

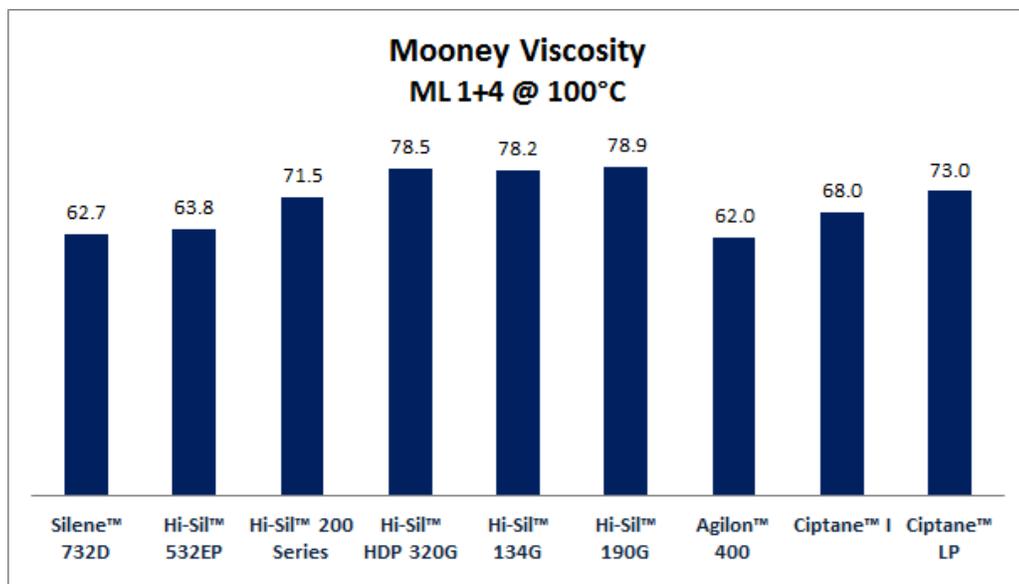
PPG's silica products range in reinforcing capabilities from semi to high. To provide a demonstration of their capabilities, several PPG silica products were evaluated in an EPDM motor mount type application. Ultramarine blue was added for dispersion analysis purposes. The EPDM motor mount formula and performance data are found in the table below.

Two pass mixing was performed in a 2-wing laboratory internal mixer and test pieces were cut from gauged sheets processed on a 13 inch lab mill.

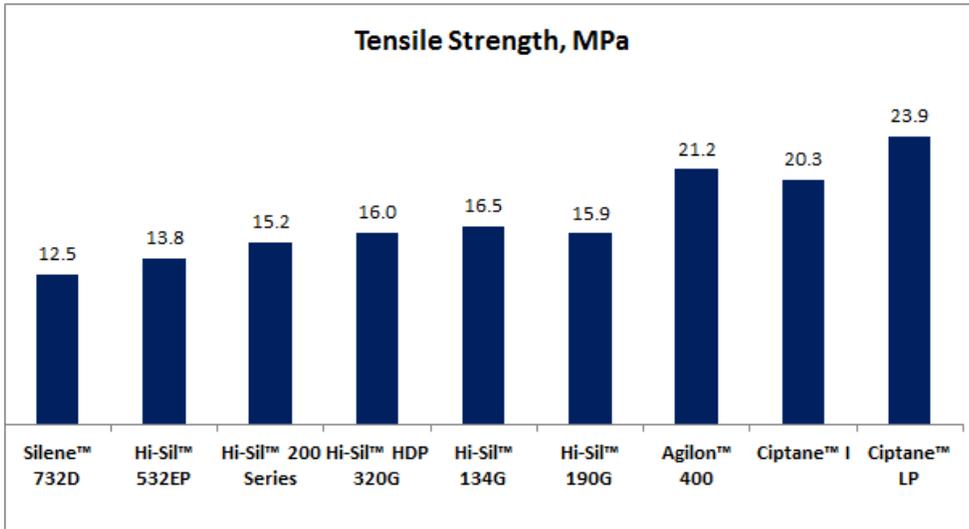
Processing and testing was done in accordance to ASTM.

50 Durometer EPDM Motor Mount Type

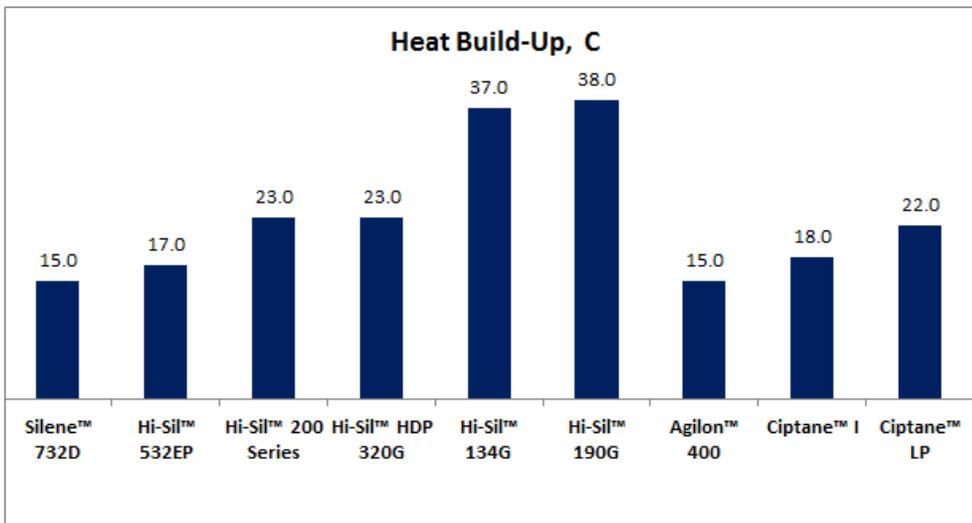
Min	Temp	RPM	PASS 1		Min	Temp	RPM	PASS 2	
0'	160°F	77	Vistalon 3666 EPDM	175.0	0'	140°F	77	Master Batch	254.0
"	Build	"	Vanox ZMTI	1.0	"	Build		Spider Sulfur	0.5
"		"	Agerite™ Resin D	2.0	"			Santocure™ TBBS	2.0
0.5'		"	Ultramarine blue	8.0	"			Perkacit™ ZDBC	1.5
"		"	Filler	50.0	"	V		Vultac™ 710	1.0
1.5'		116	Calsol 510	5.0	3'	220°F ± 10°	77	DUMP:	
"		"	Stearic acid	1.0				Subtotal:	5.0
"		"	Polyethylene A-C 6	3.0				Total:	259.0
"		"	PEG 3350	1.0					
4.5'	V	77	Zinc Oxide	8.0					
6'	290°F ± 10°	77	DUMP:						
			Total:	254.0					



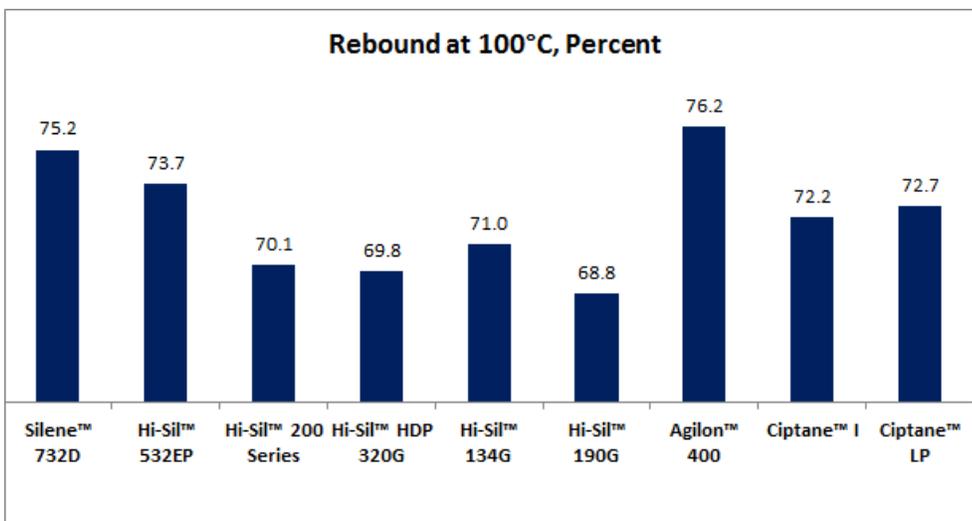
Viscosity at processing temperature shows an increase as silica surface area (reinforcement) increases. Increasing surface area also increases compound stiffness. The mercapto-silane treated and lower surface area products show comparable viscosity results.



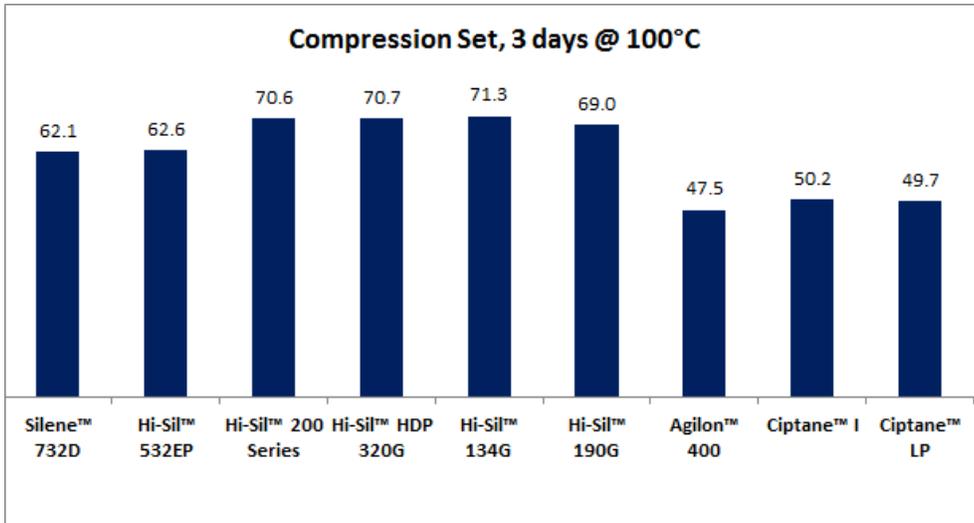
An increase in tensile strength is achieved when using the silane treated products like Agilon™ and Ciptane™.



Lower heat build-up is achievable with lower surface area products like Silene™ 732D or Hi-Sil™ 532EP. These products provide less stiff compounds compared to the higher surface area products. Even lower heat build-up is obtained with silane treated products like Agilon™ or Ciptane™.



Higher hot rebound is achievable with lower surface area products like Silene™ 732D or Hi-Sil™ 532EP. Even higher hot rebound is obtained with silane treated products like Agilon™ or Ciptane™.



Lower Compression Set was obtained using lower surface area products like Silene™ 732D or Hi-Sil™ 532EP. Lowest set is obtained with silane treated products like Agilon™ or Ciptane™.

Samples and Service

PPG's Technical Service specialists are available for consulting on the use, handling and storage of Hi-Sil™, Ciptane™, and Silene™ Silica products.

Gallon containers and bag-size samples are available upon request from Customer or Technical Service.



Europe

PPG Chemicals bv
P.O. Box 181
9930 AD Delfzijl
The Netherlands

Tel: +31-596-676710
Fax: +31-596-618166



PPG Industries, Inc.
Silica Products
440 College Park Dr.
Monroeville, PA 15146

Customer Service: 1-800-243-6745
Technical Service: 1-800-764-7369



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