



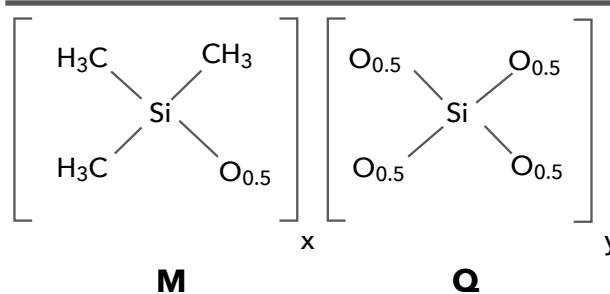
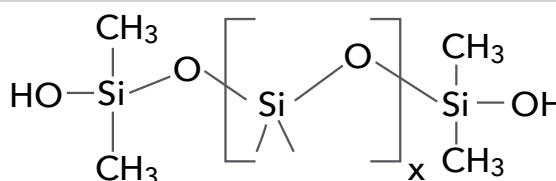
SFR100 silicone fluid

MARKETING BULLETIN

SFR100 silicone fluid is a high viscosity silicone containing a combination of a linear silicone fluid and a silicone resin that is soluble in the fluid. The resulting mixture is clear and colorless. SFR100 silicone fluid can be considered for polyolefins and thermoplastics use to help impart flame retardancy. When compounded properly with known organophosphorus flame retardants, or Group II A metal organic salts and other ingredients, varying degrees of flame retardancy enhancement can be obtained.

Key Features and Typical Benefits

- Halogen free
- Reduced smoke, flame out time and drip
- Can be a substitute for antimony- and halogen-based flame retardant systems
- Improved low temperature impact resistance
- Excellent electrical insulation properties
- Improved processability
- Improved melt and mold flow



Typical Physical Properties

Property	Value
Silicone Content	100%
Viscosity, at 25 °C	200,000 - 900,000 cps
Specific Gravity	1.00
Flash Point (°C)	202
Appearance	Clear, Colorless Liquid
Shelf Life, Unopened Drums	18 months
Density	8.7 lbs/gal avg.
Density	1.0 g/cc avg.

Typical properties are average data and are not to be used as or to develop specifications.

Key Performance Data

SFR100 Halogen Free Silicone Flame Retardant - Formulations

Chemicals	Weight %							
	PP Homopolymer	A [†]	B [‡]	C [‡]	D [‡]	E [‡]	F [‡]	G [‡]
Propylene	100	77.6	73.1	68.5	35.7	31.3	31.3	27
SFR100 Flame Retardant	0	0	4.5	8.3	0	8.7	4.4	8.7
Ammonium Polyphosphate	0	17.4	17.4	18.4	0	0	0	0
Pentaerythritol	0	5	5	4.8	0	0	0	0
Alumina trihydrate (ATH)	0	0	0	0	60	60	60	60
Magnesium Stearate	0	0	0	0	4.3	0	4.3	4.3

Product formulations are included as illustrative examples only. Momentive makes no representation or warranty of any kind with regard to any such formulations, including, without limitation, concerning the efficacy or safety of any product manufactured using such formulations.

[†] Compounded by Polymer Processing Institute at New Jersey Institute of Technology, Newark, NJ, U.S.A.

[‡] Compounded at Momentive Performance Materials Inc.

SFR100 Halogen Free Silicone Flame Retardant - UL94V Test Results

Test	Value										Unit	Standard		
	PP Homo-polymer	A	B	C	D [†]	E [†]	F [†]	G [†]						
UL 94V, 1.59 mm thickness	1 st ignition	Consumed	Consumed	V0	< 50**	V0	< 50**	Consumed	Consumed	Consumed	V1	77**	Sec.	UL94V
	2 nd ignition	N/A	N/A				N/A	N/A	N/A			79**	Sec.	
	Number of samples with afterflame up to clamp	5	5		< 50**	< 50**	5	5	1			0	--	
	Number of samples that ignited cotton	5	5	0	0	5	5	4			0	--		
UL 94V, 3.17 mm thickness	1 st ignition	Consumed	Consumed	V0	< 50**	V0	< 50**	Consumed	10	Not Conducted	Not Conducted		Sec.	UL94V
	2 nd ignition	N/A	N/A		< 50**		N/A	Consumed					Sec.	
	Number of samples with afterflame up to clamp	5	5				5	0					--	
	# of samples that ignited cotton	5	5	0	0	5	5						--	

With SFR100 flame retardant, organo-flame retardant formulations improved from "consumed" directly to "V0"

With SFR100 flame retardant and Mg-St synergist, inorganic-flame retardant formulations improved from "consumed" to "V1"

With SFR100 flame retardant, flame-out time was significantly reduced

[†] Compounded by Polymer Processing Institute at New Jersey Institute of Technology, Newark, NJ, U.S.A.

[‡] Compounded at Momentive Performance Materials Inc.

** Total time to extinguish five plaques

Test data. Actual results may vary.

SFR100 Halogen Free Silicone Flame Retardant - Other Test Results

Test	Value						Unit	Standard
	PP Homo-polymer	A	B	C	D	E		
Oxygen Index	<15	26.6	28	29	24.7	26.8	%	ASTMD2843
Smoke Density	Max. Light Absorption	--	64.9	60.4	--	41.5	%	ASTMD2843
	Smoke Density Rating	--	41	29.2	--	20.3	%	ASTMD2843
N Izod Impact	at 25 °C	0.47	0.48	1.1	1.3	0.33	ft-lbs/in	ISO180
	at -20 °C	--	0.32	0.65	0.47	0.31	ft-lbs/in	ISO180
	at -50 °C	--	0.3	0.47	0.43	0.21	ft-lbs/in	ISO180
Flexural Modulus, 103 psi	195K	227K	187K	192K	482K	293K	Psi	ASTMD790
Tensile Strength at Yield	5400	4167	3900	4200	2718	1796	Psi	ASTM D638
Density	0.92	1.01	0.99	1.02	1.34	1.47	g/cc	ASTM D792
Heat Distortion Temperature	at 66 psi	--	--	--	--	200	°F	ASTM D648-16, Method B
	at 264 psi	--	--	--	--	141		

Organo-flame retardant formulations incorporating SFR100 flame retardant demonstrated:

Reduced smoke density

Increased impact resistance

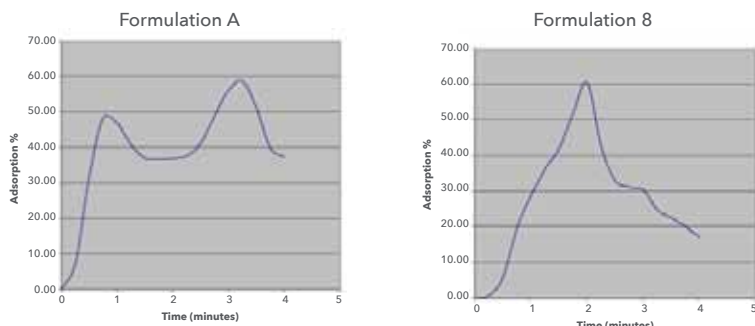
Reduced flexural modulus and tensile strength; acts as a plasticizer

Test data. Actual results may vary.

Key Performance Data (continued)

SFR100 Halogen Free Silicone Flame Retardant - Smoke Density/Light Absorption Results

Average Light Absorption vs. Time



SFR100 silicone fluid reduced smoke density by 30% based on area under the curves

Test results. Actual results may vary.

General Considerations for Use

Best results typically are obtained by compounding in a twin screw extruder using a specific screw element sequence, barrel temperature and screw speed. Due to high viscosity and tackiness of SFR fluid, it is difficult to prepare a permanently free flowing pre-mix of the SFR100 fluid, polypropylene and other dry ingredients.

Low shear mixing (Hobart mixer) typically will produce a powder that is free flowing for several days at room temperature. High shear (Henschel or dough mixer) can produce a tacky granular material, suitable for a Banbury type mixer, but not a twin screw extruder. It is most convenient to add SFR100 fluid separately into the extruder - allowing the dry ingredients to be mixed upstream, with SFR100 fluid being added downstream, after the polypropylene has melted when viscosities are similar making a better mix.

Banbury Compounding

Due to high viscosity of SFR100 fluid, better results typically are obtained if all dry ingredients are fluxed and melted prior to addition of SFR100 fluid. After the addition of SFR100 fluid, melt blend should be completed. A start-up temperature of 150 °C generally will increase to 190 °C due to shear heating.

Extrusion Compounding

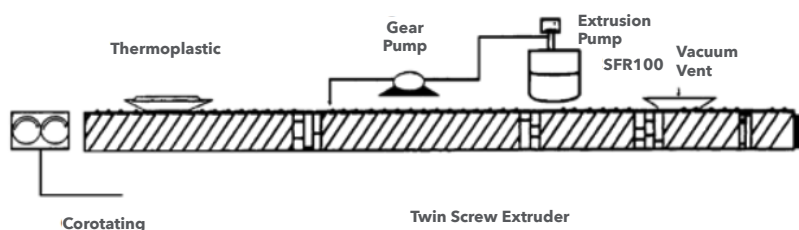
The twin screw extrusion process has been found to be very effective for compounding silicone flame retardant additives into polypropylene. This process is schematically shown in Figure 1 using the silicone side feed method with a twin screw extruder, which removes any material handling problems and typically has proven to be the most effective process to produce silicone containing polypropylene. The continuous melt blending can be conducted with a twin screw extruder, using downstream injection of SFR100 fluid. The solid pellets and powders are fed by volumetric feeders. K-Tron is a volumetric feeder that can work satisfactorily. The composition can be controlled by carefully calibrated feeders and gear pump. The effectiveness of the silicone flame retardant is dependent on thorough compounding. The performance of FR-polypropylene can be maximized in the twin screw extruder using a specific extruder geometry (e.g. co-rotating vs. counter-rotating), screw design and melt temperatures.

The temperature profiles recommended in the extrusion process affects the quality and properties of the product. The upstream temperatures range from 220 - 240 °C. However, the downstream temperatures should be lower, 180 - 200 °C. The screw speed should be 100 to 150 rpm.

SFR100 Silicone - Compounding

Screw Design Considerations:

A typical screw geometry and the screw design used in compounding SFR100 fluid is shown schematically. The extruder set-up requires two feeding ports, one for thermoplastics and one downstream injection port for the SFR100 silicone. The first section of the extruder should create a melt pool before the silicone is injected. The viscosities of the polymer melt and the silicone are matched near the injection port. Then this mass is allowed to homogenize in the latter part of the extruder. (See Figure 1).



SFR100 - Injection Molding

Almost all thermoplastics are recommended to dry before injection molding. A typical formulation comprised of SFR100 fluid should be dried at 80 - 120 °C for 4 to 8 hours. Injection molding pre-dried material optimizes mechanical properties and appearance (gloss). Increased channel flow and melt flow significantly improves moldability of both filled and unfilled polypropylene. Shorter cycle times and lower injection pressures are possible.

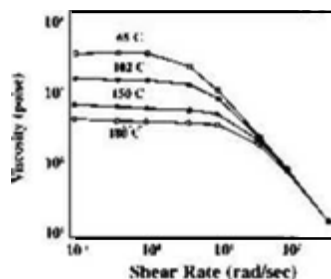
Injection Pressure/Speed

Injection pressure = 700 - 100 psi
 Hold pressure = 500 psi
 Back pressure = 100 psi
 Injection speed = moderate
 Screw speed = 50 rpm

Injection Barrel Temperatures (C)

Zone 1 = 177
 Zone 2 = 193
 Zone 3 = 193
 Nozzle = 193
 Melt temperature = 200
 Mold temperature = 50

Effects of Shear Rate and Temperatures on Viscosity of SFR100



Note: Test data. Actual results may vary

Blending and Properties Evaluation of SFR100/PP blend

Patent Status

Nothing contained herein shall be construed to imply the nonexistence of any relevant patents or to constitute the permission, inducement or recommendation to practice any invention covered by any patent, without authority from the owner of the patent.

Limitations

Customers must evaluate Momentive Performance Materials products and make their own determination as to fitness of use in their particular applications.

Product Safety, Handling and Storage

Customers should review the latest Safety Data Sheet (SDS) and label for product safety information, safe handling instructions, personal protective equipment if necessary, emergency service contact information, and any special storage conditions required for safety. Momentive Performance Materials (MPM) maintains an around-the-clock emergency service for its products. SDS are available at www.momentive.com or, upon request, from any MPM representative.

For product storage and handling procedures to maintain the product quality within our stated specifications, please review Certificates of Analysis, which are available in the Order Center. Use of other materials in conjunction with MPM products (for example, primers) may require additional precautions. Please review and follow the safety information provided by the manufacturer of such other materials.

Customer Service Centers

Worldwide

Email: commercial.services@momentive.com

Telephone

Americas

+1 800 295 2392
 +1 614 986 2495

Latin America

+55 11 4534 9660

Europe, Middle East, Africa and India

00800 4321 1000
 +40 213 044229

Asia Pacific

China
 800 820 0202

Japan

+81 276 20 6182

All Other Countries

+60 3 9206 1543

Disclaimer

DISCLAIMER: THE MATERIALS, PRODUCTS AND SERVICES OF Momentive Performance Materials Inc. and its subsidiaries and affiliates DOING BUSINESS IN LOCAL JURISDICTIONS (collectively "SUPPLIERS") ARE SOLD BY THE RESPECTIVE LEGAL ENTITY OF THE SUPPLIER SUBJECT TO SUPPLIERS' STANDARD CONDITIONS OF SALE, WHICH ARE INCLUDED IN THE APPLICABLE DISTRIBUTOR OR OTHER SALES AGREEMENT, PRINTED ON THE BACK OF ORDER ACKNOWLEDGMENTS AND INVOICES, AND AVAILABLE UPON REQUEST. ALTHOUGH ANY INFORMATION, RECOMMENDATIONS, OR ADVICE CONTAINED HEREIN IS GIVEN IN GOOD FAITH, SUPPLIERS MAKE NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, (i) THAT THE RESULTS DESCRIBED HEREIN WILL BE OBTAINED UNDER END-USE CONDITIONS, OR (ii) AS TO THE EFFECTIVENESS OR SAFETY OF ANY DESIGN INCORPORATING SUPPLIERS' PRODUCTS, MATERIALS, SERVICES, RECOMMENDATIONS OR ADVICE. AFOREMENTIONED EXCLUSIONS OR LIMITATION OF LIABILITY ARE NOT APPLICABLE TO THE EXTENT THAT THE END-USE CONDITIONS AND/OR INCORPORATION CONDITIONS CORRESPOND TO THE RECOMMENDED CONDITIONS OF USE AND/OR OF INCORPORATION AS DESCRIBED BY SUPPLIER IN ITS PRODUCT DATA SHEET AND/OR PRODUCT SPECIFICATIONS. EXCEPT AS PROVIDED IN SUPPLIERS' STANDARD CONDITIONS OF SALE, SUPPLIERS AND THEIR REPRESENTATIVES SHALL IN NO EVENT BE RESPONSIBLE FOR ANY LOSS RESULTING FROM ANY USE OF ITS MATERIALS, PRODUCTS OR SERVICES DESCRIBED HEREIN. Each user bears full responsibility for making its own determination as to the suitability of Suppliers' materials, services, recommendations, or advice for its own particular use. Each user must identify and perform all tests and analyses necessary to assure that its finished parts incorporating Suppliers' products, materials, or services will be safe and suitable for use under end-use conditions. Nothing in this or any other document, nor any oral recommendation or advice, shall be deemed to alter, vary, supersede, or waive any provision of Suppliers' Standard Conditions of Sale or this Disclaimer, unless any such modification is specifically agreed to in a writing signed by Suppliers. No statement contained herein concerning a possible or suggested use of any material, product, service or design is intended, or should be construed, to grant any license under any patent or other intellectual property right of Suppliers or any of its subsidiaries or affiliates covering such use or design, or as a recommendation for the use of such material, product, service or design in the infringement of any patent or other intellectual property right.