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SiSiB SILICONES

A part of SINOPCC group.

SiSiB SILANES for Crosslinking PE

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SiSiB SILICONES

SiSiB SILICONES, a part of SINOPCC group established in 1989, is one of the leading manufacturers in silicone industry, focusing on the development and manufacture of silanes and silicones.

Strategically positioned within the silicone supply chain, SiSiB SILICONES provide a comprehensive range of performance-enhancing products and solutions to meet the need of customers. These include silanes and siliconates, silicone fluids, silicone emulsions, silicone rubber, silicone gum and fumed silica.

Today our products are used successfully throughout the wold in the adhesives and sealants, agriculture, artificial marbles, building protection, coatings & paints, fillers & pigments, foundries, fiber glass, leather & textile, lubricants, personal care, pharmaceuticals, plastics & thermoplastics, polyurethane foam, rubber & tyre, wires & cables.

Why select SiSiB SILICONES?

- Strong silane and silicone manufacturing capabilities built over 30+ years history.
- Flexible manufacturing facility able to handle kilograms to thousands of tons per years.
- Rapid and professional process development and scale-up capabilities.
- Offer tailored options while adhering to high quality and safety standards.

SiSiB SILANES

BACK GROUND

Polyethylene has been crosslinked for many years by a number of proven methods. The initial goal was to extend the maximum service temperature. However, this technology delivers many important advantages compared to non-crosslinked polymers like polyethylene or PVC:

Property of polyethylene	Change after cross-linking of polyethylene
Melt index	Decrease
Density	No changes/decrease
Molecular weight	Significantly increased
Tensile strength	No changes/slightly increase
Elongation-at-break	Decrease
Impact resistance	Significantly improved
Abrasion resistance	Greatly improved
Stress-crack resistance	Greatly improved
Elastic properties	Greatly improved
Environmental stress crack resistance	Increase
Resistance to slow crack growth	Increase
Temperature resistance	Greatly improved
Chemical resistance	Significantly increased

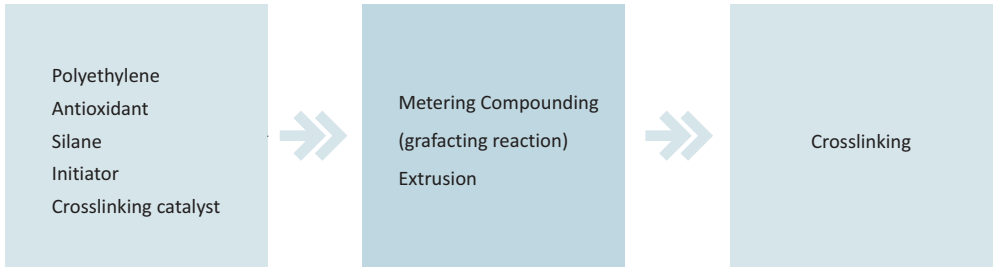
SiSiB Silanes for Crosslinking PE

Three main technologies have been developed for crosslinking polyethylene.
These are peroxide, radiation and silane. Our purpose is to highlight the comparative advantages of the incorporation of silanes in crosslinking.

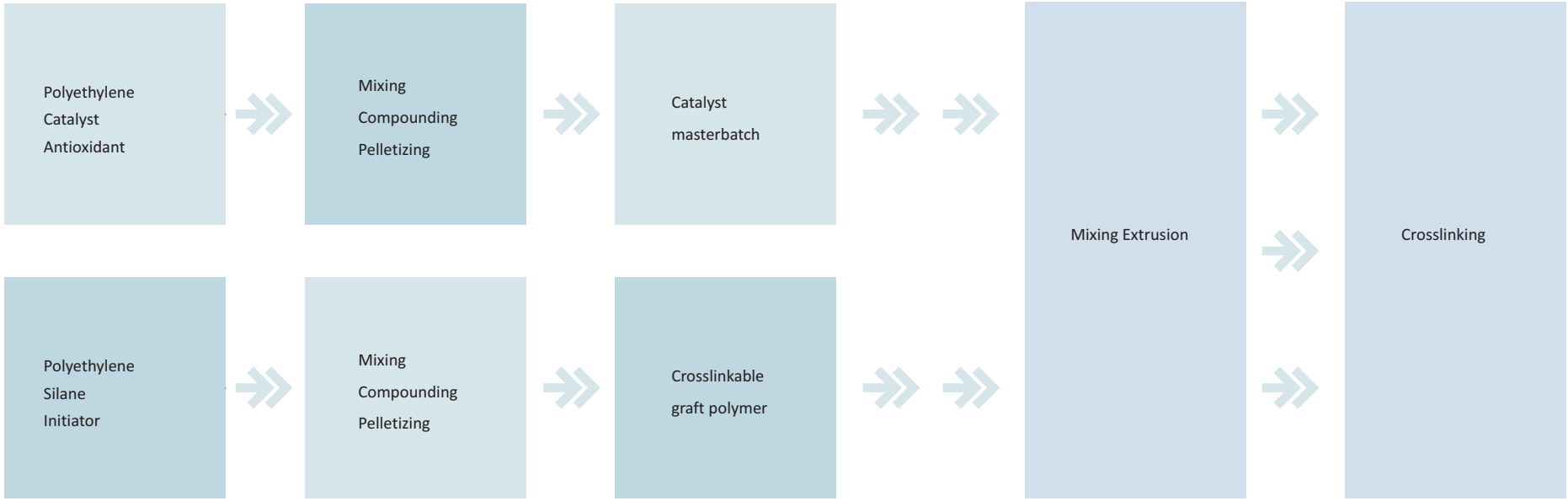
Comparison of several major cross-linking methods

Method	Silane	Peroxide	Radiation
Process flexibility	Very good	Small	Very good
Operation	Easy	Difficult	Difficult
Extruder	Standard	Special	Standard
Production rate	High as for PE	Low	High as for PE
Cost of post treatment	Low	-	High
Capital investment	Low	High	High
Diameter	No limit, thickness limited by speed of cross-linking	Difficult to achieve big diameters because of output	Limited by penetration depth of electron
Scrap rates	Low	High scrap	
Raw material costs	Slightly high	Low	Low
Levels of attainable cross-link density		High	Probability of variation
Other	Wider scope for formulation through broad processing window, recyclability	Energy intensive	Clean (pipe) because of fewer additives

MONOSIL



SIOPLAS



MONOSIL (ONE-STEP) PROCESS

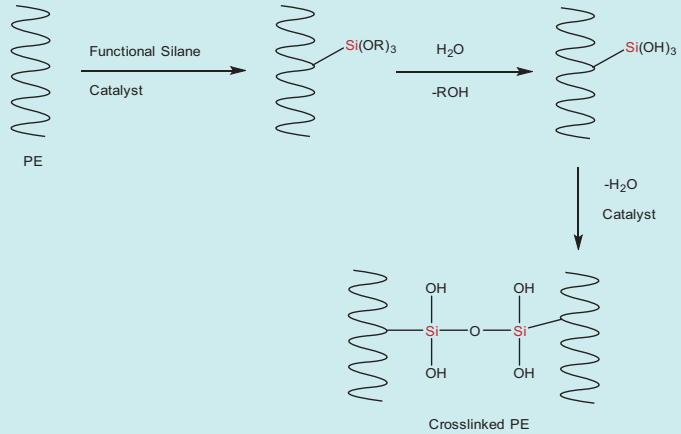
MONOSIL process is an onestep process by using a specially designed extruder with a high L: D ratio, silane is grafted onto polyethylene and the product is cross-linked in presence of moisture.
In this process, polyethylene, peroxide, silane, tin catalyst and other compatible additives or fillers are added in one continuous extrusion step. This single-step process combines the raw materials, accomplishes the grafting reaction and continuously forms a fabricated part such as wire and cable or pipe.

SIOPLAS PROCESS

In this method, a mixture of silane and peroxide is added to molten polyethylene, leading to silane grafting reaction, which is a classical free radical chain reaction involving a catalyst.
When it is intended to produce the final product, a catalyst masterbatch (consists of polyethylene, a catalyst, an antioxidant, a proper stabilizer, and an internal lubricant) is mixed with the above mentioned pellets in a typical weight ratio of 5:95, and the resultant mixture is melted, followed by extruding into the product.

SiSiB Silanes for Crosslinking PE

Principal reactions involved in silane cross-linking of polyethylene.

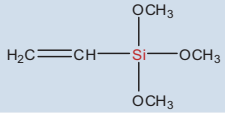
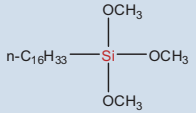


Comparison of the technologies of moisture cure.

Process	Advantages	Disadvantages
Sioplas	Fast curing Versatility of base resins (i.e. LDPE, EVA, EPR, DPE ,etc.) Low capital investment No need to special equipment	Two step technology Limited shelf life Higher raw material costs Risk of pre-crosslinking on the surface of pellets during storage
Monosil	Low material cost Versatility of base resins Fast curing Shelf life not an issue	Limited use of some additives Handling of hazardous liquid chemicals High scrap rates High capital investment Specific equipment required
Dry-Silane	Potential low material costs Ease of storage Improved safety and handling Versatility of base resins Fast curing Good homogeneity Less gels and fish eyes	Use of additives limited or impossible Moderate capital investment Limited shelf life

PURE SILANE

SiSiB® PC6110 is used for silane crosslinking and the production of crosslinkable polyolefin compounds. Silane SiSiB® PC5861 is used as water scavenger and precuring retarder. They can increase shelf life as well as safety in handling and processing of silane crosslinkable compounds

Product	Chemical Name	CAS No.
SiSiB® PC6110	Vinyltrimethoxysilane	2768-02-7
		
SiSiB® PC5861	n-Hexadecyltrimethoxysilane	16415-12-6
		

MULTI-COMPONENT SILANE

SiSiB PC6110Sxxx formulated silanes are fully formulated multi-component systems containing peroxide, catalyst and additives.

SiSiB	Silane	Peroxide	Catalyst	Antioxidant	Metal Deactivator
PC6110S001	x	x	x		
PC6110SHE	x	x	x		
PC6110SHS	x	x	x	x	
PC6110S735	x	x	x	x	x
PC6110S758	x	x	x		
PC6110S870	x	x	x	x	x
PC6110S928	x	x	x	x	x
PC6110S963	x	x	x	x	x
PC6110S966	x	x	x	x	x

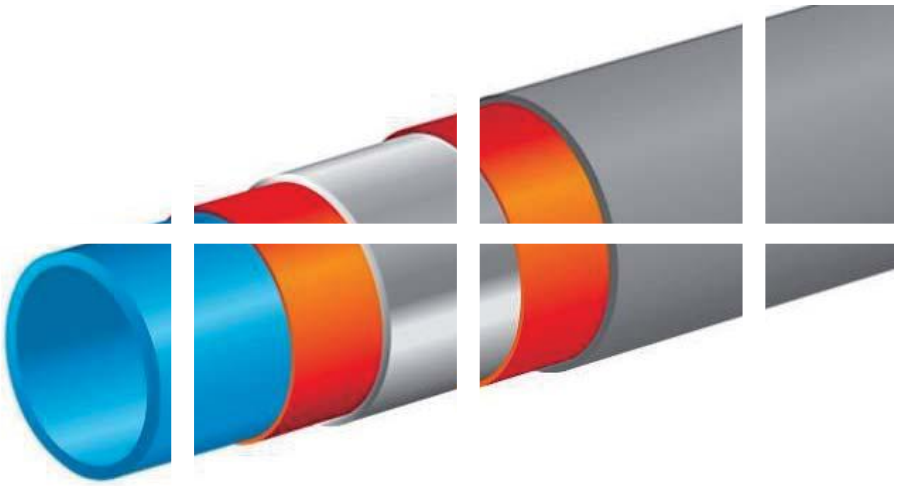
SiSiB	Application
PC6110S001	General use system for stabilized resins. (Monosil Process, Cables)
PC6110SHE	High efficient system for LLDPE resins
PC6110SHS	General use system for stabilized resins. (Monosil Process, Cables)
PC6110S735	For low or medium volume cables on copper conductor.
PC6110S758	For Monosil Process pipes.
PC6110S870	For halogen-free flame retardant cables and semi conductive compounds containing carbon black.
PC6110S928	For low or medium voltage cables on copper conductor. Provides higher grafting density and faster moisture-curing than 6110S735
PC6110S963	For low or medium volume cables on copper conductor.
PC6110S966	For low or medium voltage cables on copper conductor.

DRY SILANE

It is similar to Monosil except that instead of using liquid additives, the silane, initiator, and catalyst are absorbed into a porous resin (typically polypropylene, ethylene vinyl acetate (EVA), high- or low density polyethylene). The Drysilane masterbatches are available with different silane loadings in the range 40 to 70 wt%. Dry-silane technology can be used for a wide range of LDPE and LLDPE grades.

SiSiB	Application	Silane	Peroxide	Catalyst	Antioxidant	Metal Deactivator
SIPOR-30	Cable	x	x	x		
SIPOR-50	Copper Cable	x	x	x	x	x
SIPOR-60	Pipes	x	x	x		
SIPOR-70	HFFR	x	x	x	x	x

SiSiB	Application
SIPOR-30	Designed for stabilized resins, or used in association with stabilized masterbatches.
SIPOR-50	Designed for copper cables. Contains full package of stabilizers and metal deactivator.
SIPOR-60	Designed for pipe application, to be used with HDPE.
SIPOR-70	For halogen free, flame retardant, ATH-filled compounds.



SiSiB Silanes for Crosslinking PE