



A Subsidiary of PETRONAS Chemicals Group

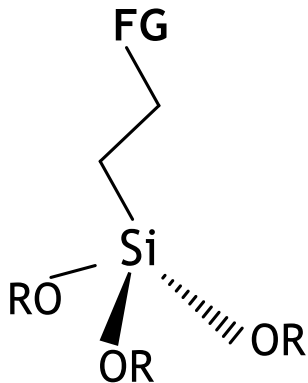
Applications of Silanes

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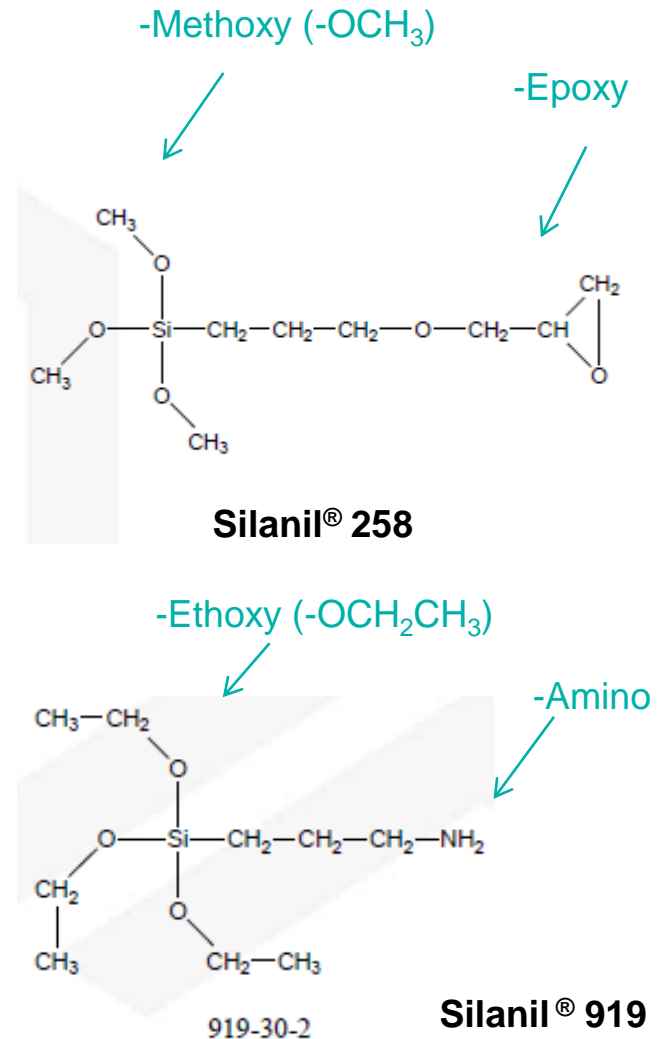
Silane Structure

FG = Functional Group (Organo Type)
e.g. -Vinyl, -Glycidoxo (Epoxy),
-Amino, -Methacryloxy, -Aky, etc.



OR = Alkoxy, Acetoxy, Oxime
e.g. -Methoxy (-OCH₃),
-Ethoxy (-OCH₂CH₃), etc.

e.g.

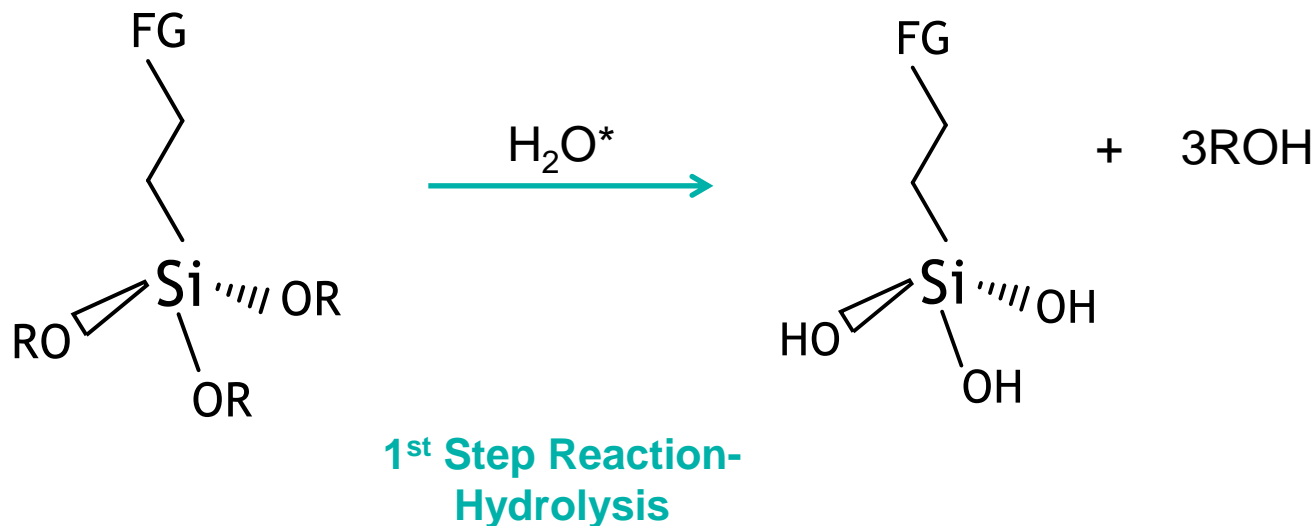


How Silanes Work

Silanes are 2 step Reaction Chemical which most of them are monomer. When store under inert gas (N_2), Silanes will be non-reactive monomer in form of FG-Si-OR which -R or Akyl is non-reactive group.

However, **Silanes can be hydrolyzed by moisture** which -Si-OR will be changed to -Si-OH called “**Silanol**” group and be ready to react or bond to the substrates or the fillers.

The change of -Si-OR to -Si-OH is called “Hydrolysis” which is the 1st step of silane reaction.

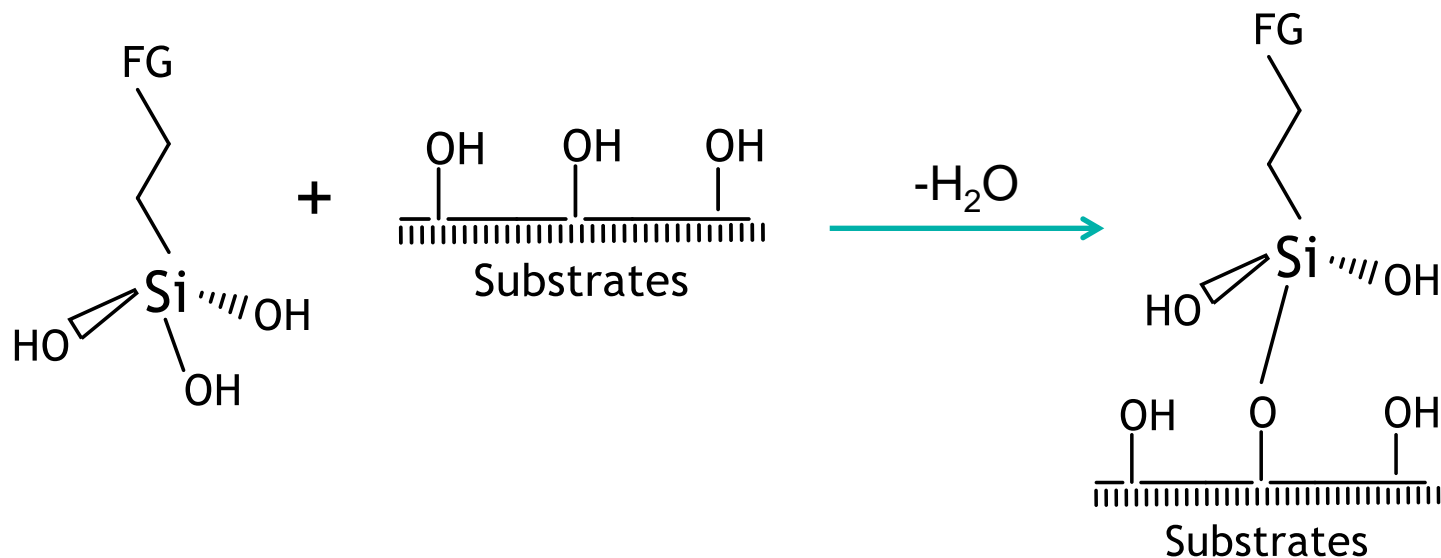


* H_2O can come from atmosphere/air.

How Silanes Work

2nd step of the reaction is “**Condensation**”. After Hydrolysis, Silane contains “Silanol” group or Si-OH which is very reactive and ready to bond to substrates or fillers.

This bonding step is called “**Condensation**” which is function of adhesion promoter to the substrates or coupling/dispersing agent to the fillers.



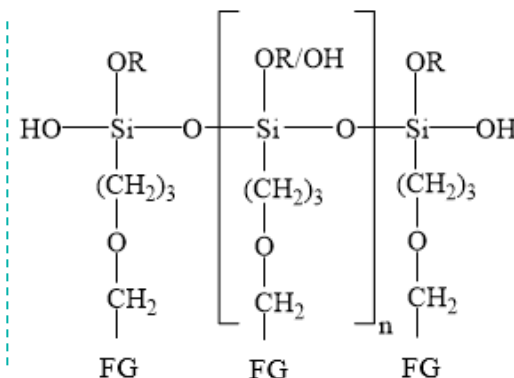
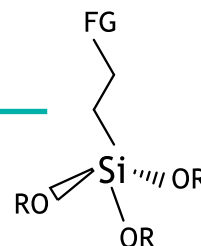
2nd Step Reaction-Condensation

* e.g. Application of Glass Fiber Surface Treatment

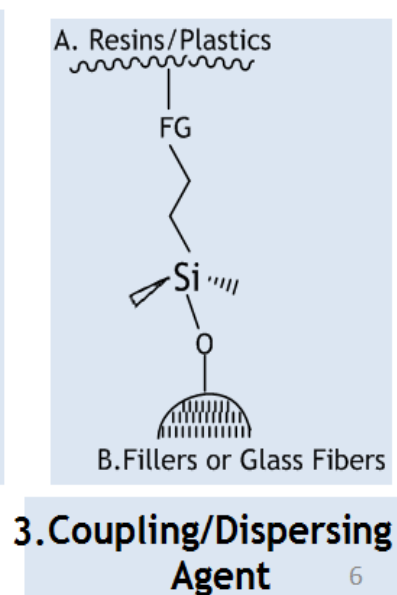
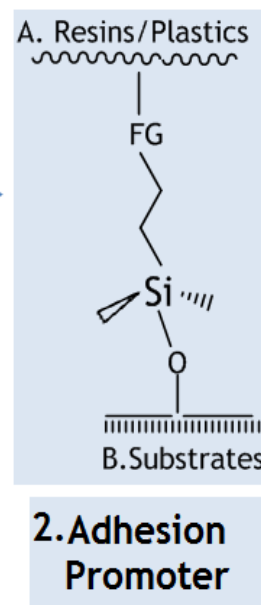
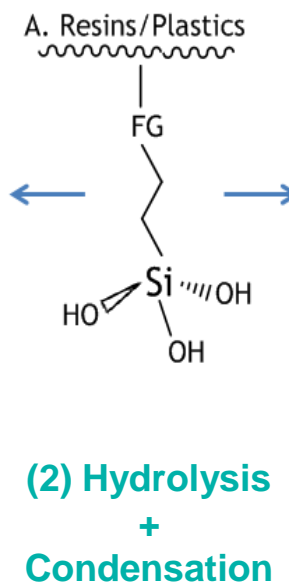
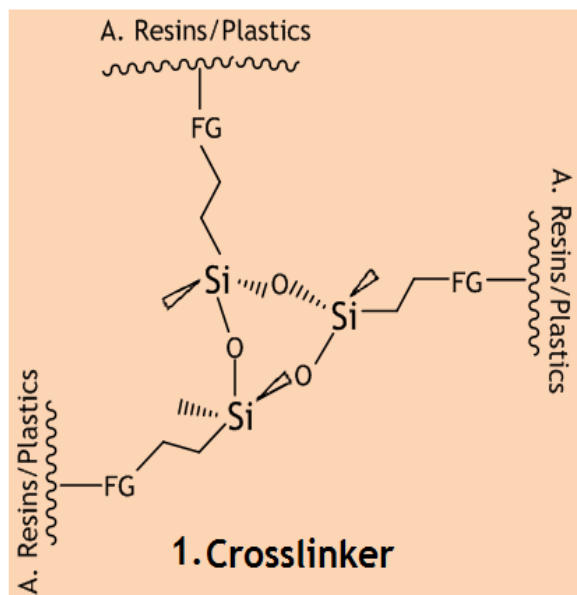
Functions of Silanes

A. Resins/Plastics

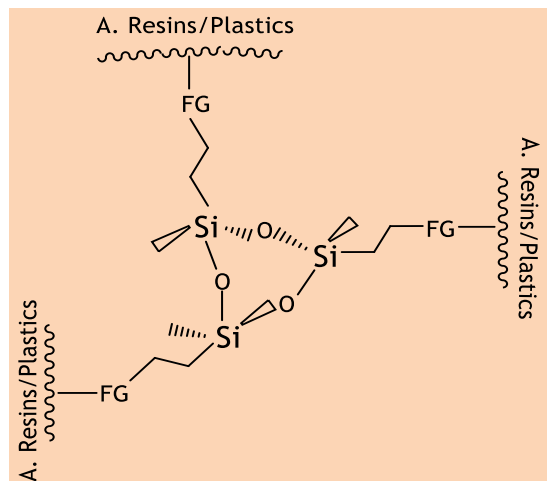
(1) Graft or Interact



Silane Monomer or Silane Oligomer

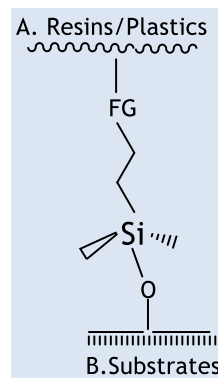


Benefits of Silanes in Each Function



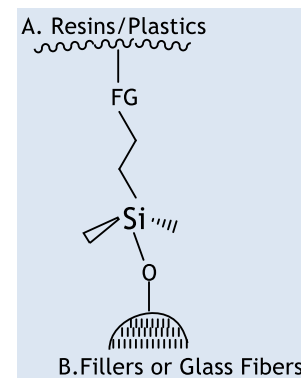
Crosslinker

- Create net work structure in Polymer
- Increase strength and hardness
- Provide longer service life of product
- Provide higher temperature resistance
- Increase scrub/scratch resistance



Adhesion Promoter

- Enhance adhesion performance btw resins and substrates
- Improve corrosion resistance and prevent corrosion's spreading from crack line



Coupling/Dispersing Agent

- Link between resins and fillers, stay together as one system
- Optimize strength of composites
- Able to add higher filler loading
- Improve filler's dispersion in resins

Storage Recommendation for Silanes

Since Silanes are moisture sensitive chemical, storage condition will be Affected to purity and performance Silanes.

- Inert gas likes N_2 gas is required to purge into the container for blanket before and after filling Silanes.
- In case of small bottle of sample and do not have N_2 gas, less air space in the container is recommended and the cap must be closed tightly. More air space left in the container may cause Silane's self-crosslinking.
- Sampling equipment should be cleaned with ethanol/methylated spirits and dried completely before use.
- Stainless steel, glass or Teflon® is recommended for any transferring equipment (like piping, valves, pump etc.) or any parts that comes in direct contact with Silanes.
- Glass or steel container (with internal coating such as epoxy inside steel container) is recommended in order to have less moisture permeability to Silanes.
- Some Silanes such as Silanil 250 is recommended to keep in amber or opaque container to avoid sun light.

Silanes in Each Industry



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Silanes for Adhesives and Sealants



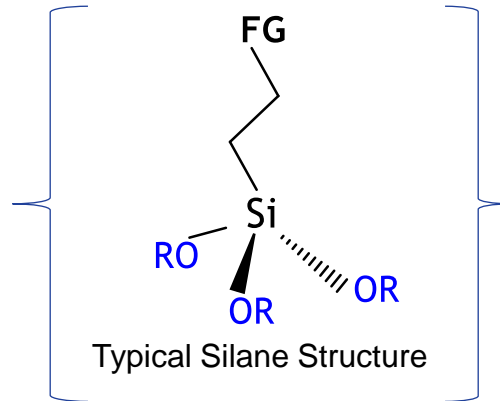
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Functions of Silanes in Adhesives and Sealants

Adhesion Promoter
between Substrates
and Resins

Crosslinker in
Resin Matrix

Coupling Agent
between Resins
and Fillers



Dispersing Agent
between Resins
and Fillers

Moisture Scavenger
in Moisture Cure
Resin System

Primer for Surface
Pretreatment

-FG

- Organofunctional group, e.g., -Amino, -Epoxy (Glycidoxy), -Vinyl, -Methacryloxy.
- Function of reaction or interaction with resins, influencing to **adhesion performance and mechanical properties of adhesives.**

-OR

- Alkoxy group, e.g., -Methoxy, -Ethoxy.
- Function of hydrolysis and condensation, influencing to **tack free time, curing time, and shelf life.**

Application in Adhesives and Sealants

Example of Silanes in Typical Ingredients

- Resins
- UV stabilizers
- Plasticizers
- **Moisture scavengers** > Silanil® 276
- Fillers (CaCO₃, etc.)
- Thixotropic agents (Fumed silica or additives)
- Pigments/Colorants
- **Adhesion promoters***
> Silanil® 176, 919, 258, 533 silane oligomer, etc.
- Catalysts
- Other additives
- May be solvents
- Also **curing agents** for “Silicone Sealants”
> Silanil® MOS, VOS, MTAS, ETAS

* Dosage of Silanes in the range of 0.2-2% on resin solid wt., please contact BRB for specific technical enquiries.

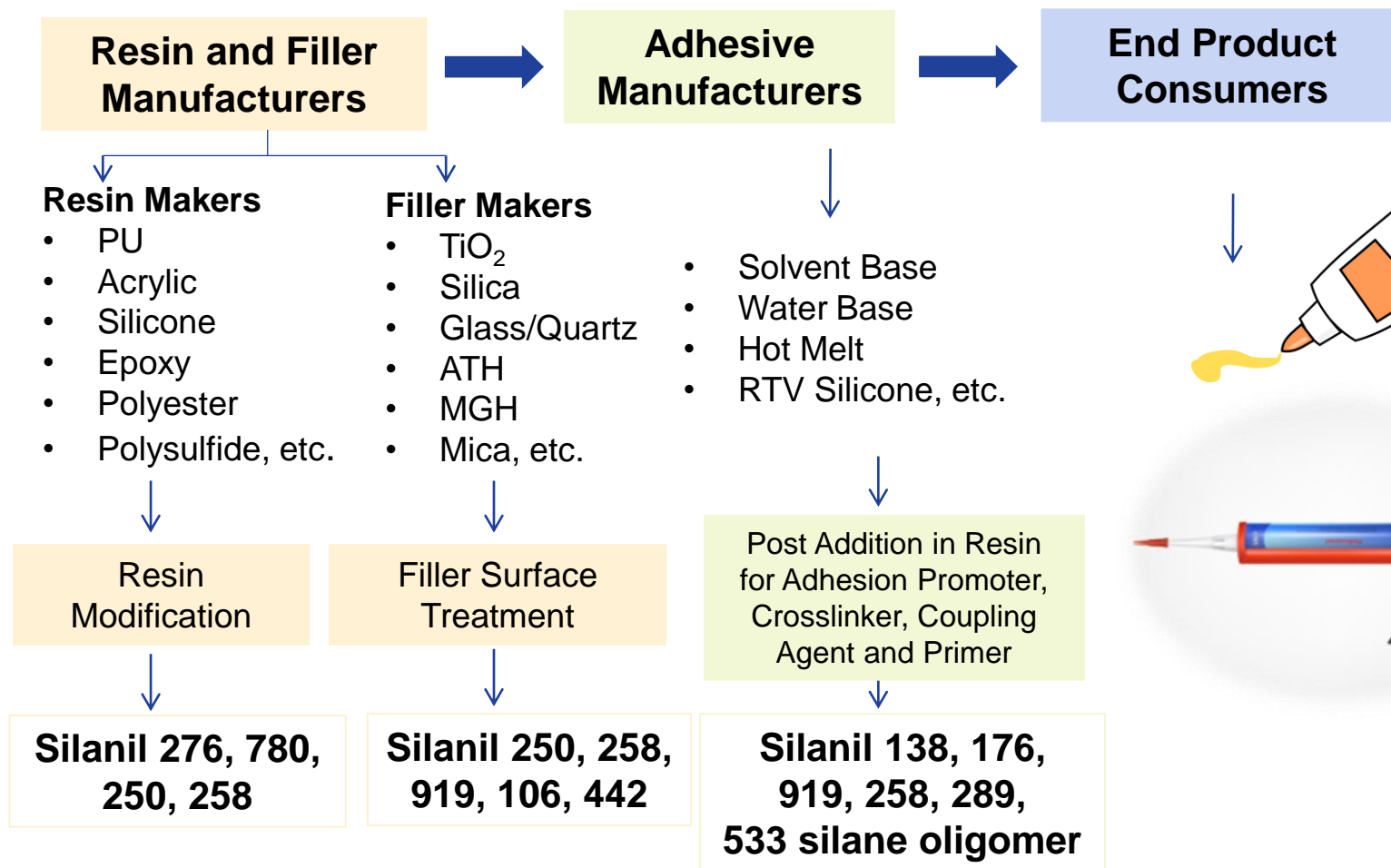


for High Viscosity
Mixing

Filling
Process



Customer Chain for Adhesives and Sealants



By Organofunctional Group Matching

Acrylic	Polyurethane 1K	Polyurethane 2K	Epoxy	Silicone	Polysulfide	Silyl Polymer
Silani [®] 250	Silani [®] 258	Silani [®] 258	Silani [®] 258	Silani [®] 176	Silani [®] 258	Silani [®] 176
Silani [®] 258	Silani [®] 260	Silani [®] 919	Silani [®] 919	Silani [®] 919	Silani [®] 442	Silani [®] 919
Silani [®] 533	Silani [®] 533	Silani [®] 176	Silani [®] 176	Silani [®] 780	Silani [®] 919	Silani [®] 276
Silani [®] 919		Silani [®] 138	Silani [®] 289		Silani [®] 533	
Silani [®] 276		Silani [®] 533	Silani [®] 533			
Silani [®] 780						

By Functions

Adhesion Promoter	Crosslinker	Coupling Agent	Moisture Scavenger	Curing Agent for RTV
Silani [®] 919	Silani [®] 250	Silani [®] 919	Silani [®] 276	Silani [®] MOS (Oxime)
Silani [®] 176	Silani [®] 276	Silani [®] 176		Silani [®] VOS (Oxime)
Silani [®] 138	Silani [®] 780	Silani [®] 138		Silani [®] MTAS (Acetoxy)
Silani [®] 307	Silani [®] 258	Silani [®] 307		Silani [®] ETAS (Acetoxy)
Silani [®] 258	Silani [®] 289	Silani [®] 258		Silani [®] 118 (Alkoxy)
Silani [®] 289	Silani [®] 533	Silani [®] 289		Silani [®] 203 (Alkoxy)
Silani [®] 533		Silani [®] 442		
Silani [®] 442				

* The sequence of silane addition in formulation affects the function of silane.

Remark: Recommendation is based on testing and historical experience data.

Silanes for Paints and Coatings



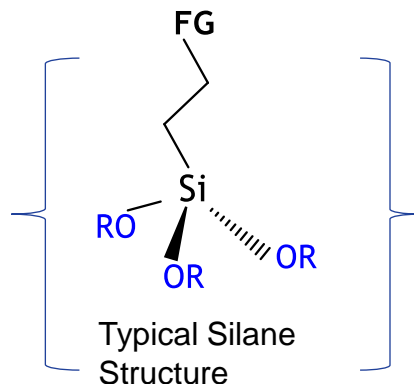
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Functions of Silanes in Paints and Coatings

Adhesion Promoter
between Substrates
and Resins

Crosslinker in
Resin Matrix

Coupling
Agent
between
Resins and
Fillers



Dispersing Agent
between Resins
and Fillers

Primer for
Surface
Pretreatment

-FG

- Organofunctional group, e.g., -Amino, -Epoxy (Glycidoxy), -Vinyl, -Methacryloxy.
- Function of reaction or interaction with resins, influencing to **polymer structure, adhesion performance, and mechanical properties, e.g., scrub resistance, hardness, film strength, etc.**

-OR

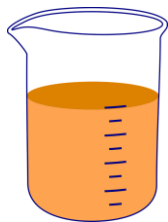
- Alkoxy group, e.g., -Methoxy, -Ethoxy.
- Function of hydrolysis and condensation, which **generally provides adhesion on substrate and controls reactivity by size of molecule (Ethoxy (bulkier) has a slower reaction rate than methoxy).**

Application in Paints and Coatings

Primer

2-5% Silanil® 919 and/or 307
+
4-5% DI Water
Solvents (Alcohol/Toluene)

↓
Cold
Blend



Silane as Adhesion Promoter

Polymerization

Monomers to
produce Resin

+



Silanes
(e.g. Silanil®
276, 250 at
0.5-2% in WB,
Up to 10% in SB)



↓
Polymerization



Silane as Crosslinker

Post Addition

Resin+ Silanes
(e.g. Silanil® 919, 258, 533
at 0.2-2% wt. of resin solid)



↓
Induction time at
least overnight

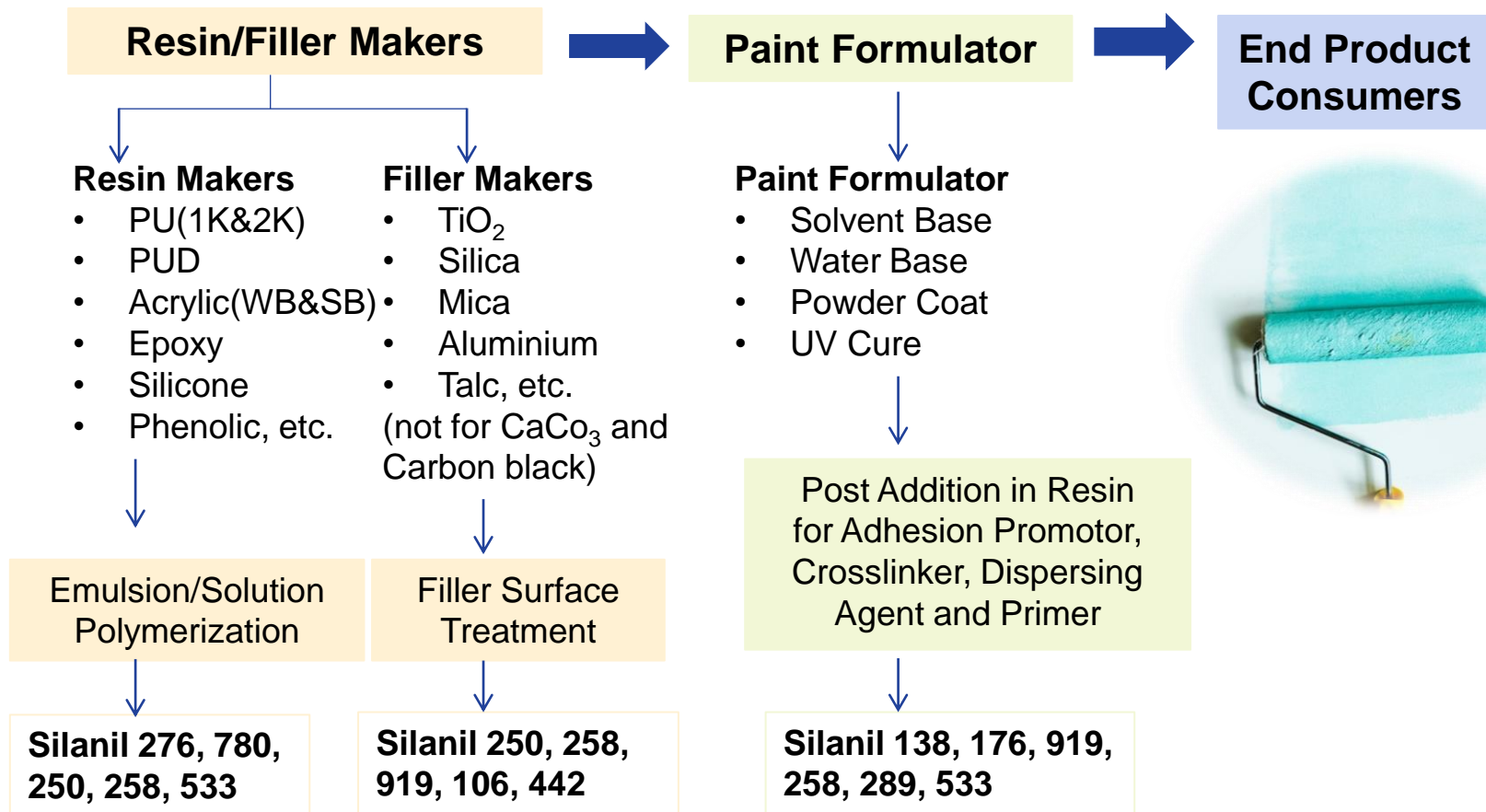
Other Additives/Fillers added
+ Mill-base



Paint

Silane as Crosslinker, Coupling Agent, and/or Adhesion Promoter

Customer Chain for Paints and Coatings



Recommendation in Paints and Coatings

By Functional Group Matching

Acrylic	PU 1K	PU 2K	Epoxy	Alkyd	Polyamide	Phenolic	PBT	Polyester	PUD	Silicone
Silanil 250	Silanil 258	Silanil 258	Silanil 258	Silanil 176	Silanil 176	Silanil 258	Silanil 258	Silanil 250	Silanil 258	Silanil 176
Silanil 258	Silanil 260	Silanil 533	Silanil 289	Silanil 919	Silanil 919	Silanil 533	Silanil 919	Silanil 780	Silanil 289	Silanil 919
Silanil 289	Silanil 533	Silanil 919	Silanil 533			Silanil 919	Silanil 176	Silanil 276	Silanil 260	Silanil 780
Silanil 533		Silanil 176	Silanil 919			Silanil 307			Silanil 533	
Silanil 919		Silanil 138	Silanil 250			Silanil 176			Silanil 919	
Silanil 276										
Silanil 780										

By Functions

Crosslinker		Adhesion Promoter	Coupling/Dispersing Agent	Primer
Process: Polymerization	Process: Post Addition*	Process: Post Addition	Process: Post Addition	Process: Cold Blend
Silanil 250	Silanil 258	Silanil 919	Silanil 919	Silanil 919
Silanil 276	Silanil 289	Silanil 176	Silanil 176	Silanil 138
Silanil 780	Silanil 533	Silanil 533	Silanil 138	Silanil 176
		Silanil 258	Silanil 258	
		Silanil 289	Silanil 289	

* The sequence of silane addition in formulation affects the function of silane.

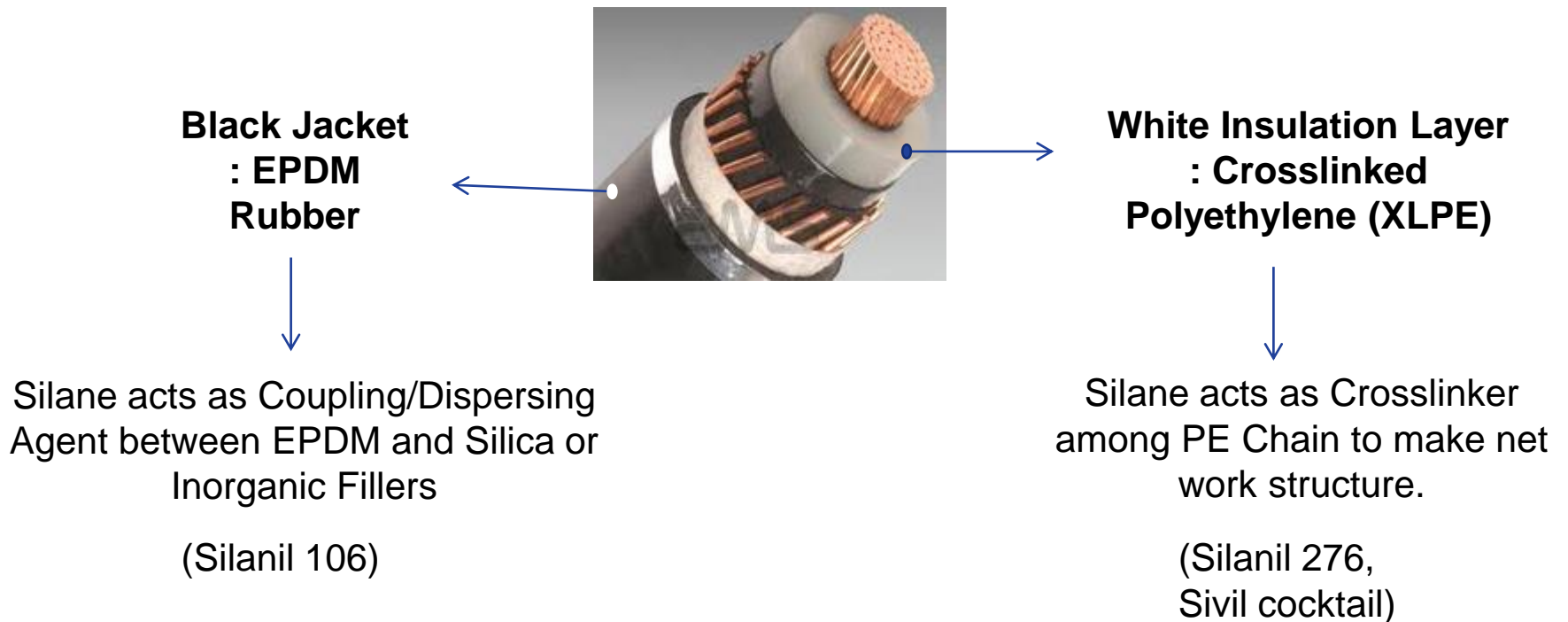
Remark: Recommendation is based on testing and historical experience data.

Silanes for Wires and Cables



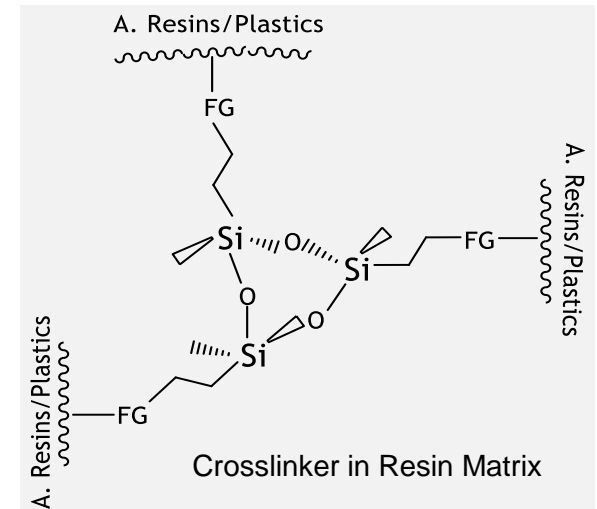
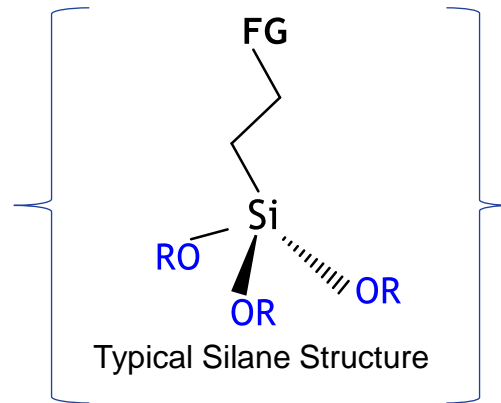
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Two Applications in Wires and Cables



Functions of Silanes in XLPE Wires and Cables

Crosslinker in Resin Matrix



-FG

- Organofunctional group e.g. -Vinyl (C=C)
- Function of **Grafting on Polyethylene Chain** .

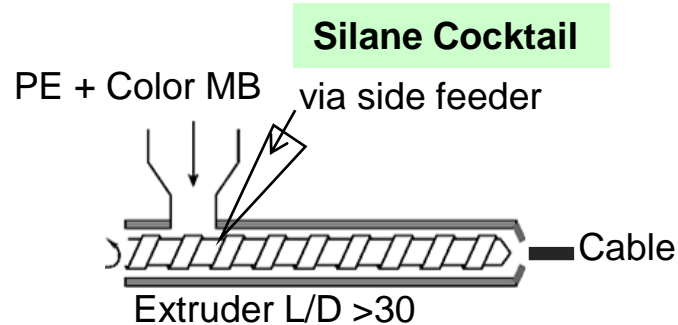
-OR

- Alkoxy Group, e.g. Methoxy
- Function of Crosslinking by -Si-O- to bond between PE chains and transform thermoplastic to thermoset which is higher mechanical properties ,creep resistance, hardness, impact strength, solvent resistance, and heat resistance.

XLPE Commercial Processes

- Monosil
 - Siloplas
 - Soaking
 - Reactor Graft (Copolymerization)
 - Dry Silane Masterbatch
- Widely used

XLPE by Monosil Process (One Step Process)



May have 2 kinds of Silane Cocktails

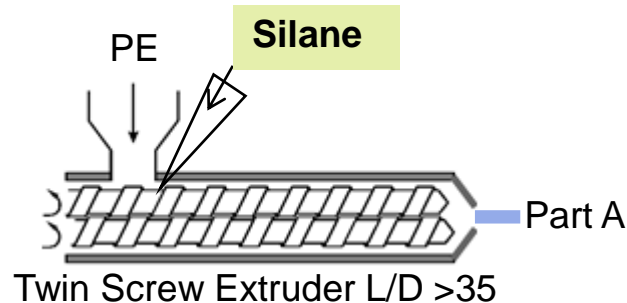
Regular Cocktail
(**BRB Silanil® 276**
+ Peroxide + Catalyst)

Cocktail with Additives

May contain :
Vinyl Silane
Peroxide
Tin Catalyst
Antioxidant
Metal Deactivator , etc.

XLPE by Siloplas Process (Two Step Process)

1st Step- PE Grafting



Silane for Siloplas

BRB Silanil[®] 276

Peroxide is required as initiator for PE free radical.

BRB Sivil Cocktail

No need additional Peroxide.

Recommended :

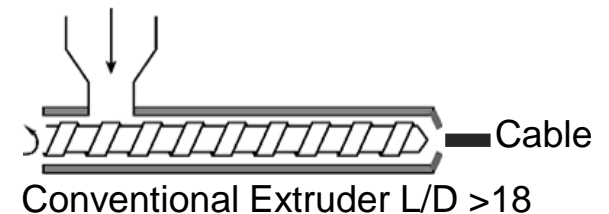
Stabilized LLDPE/LDPE 100 wt.

Silanil276 1.5-2.2 wt.

DC Peroxide 0.18-0.25 wt.

2nd Step- Crosslinking

Part A + Part B + Color MB + Additives



Part B = Catalyst MB (Masterbatch)

May contain

LLDPE/LDPE 98 part wt.

DBTDL (Tin) 1 „

Processing Aid 1 „

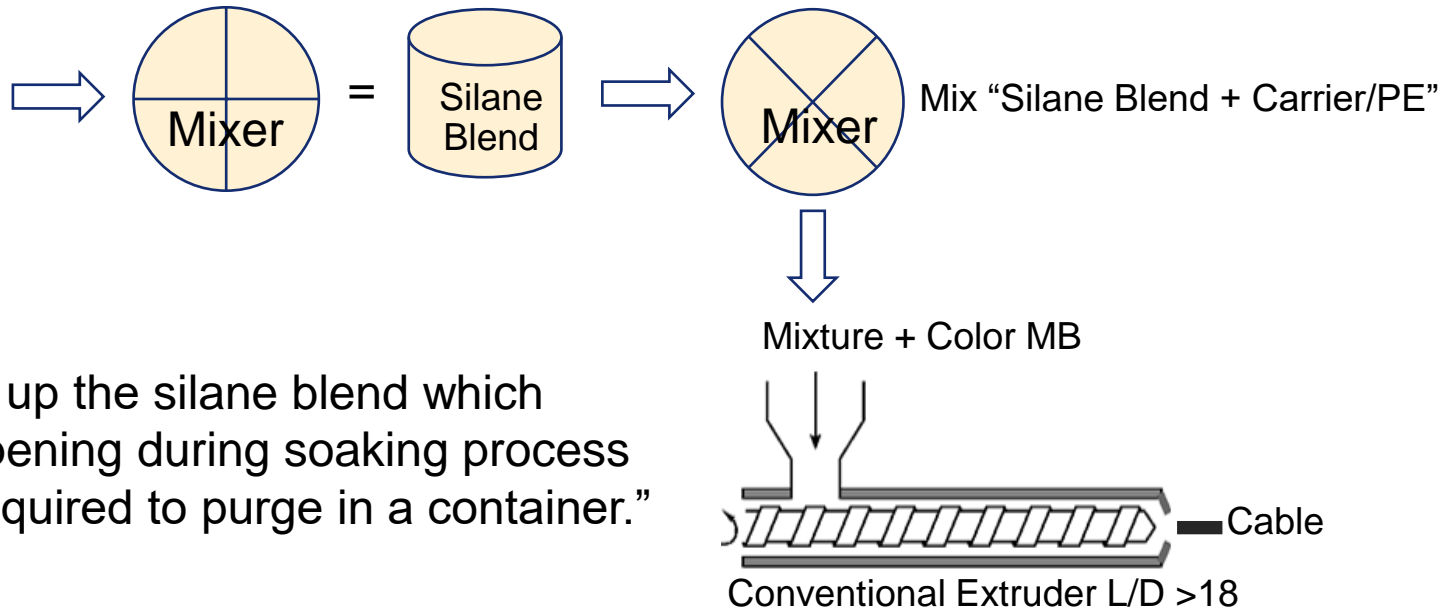
Dosage of Part A:B

Can be used 5-5.5 % total wt. e.g. A:B = 95:5

XLPE by Soaking Process

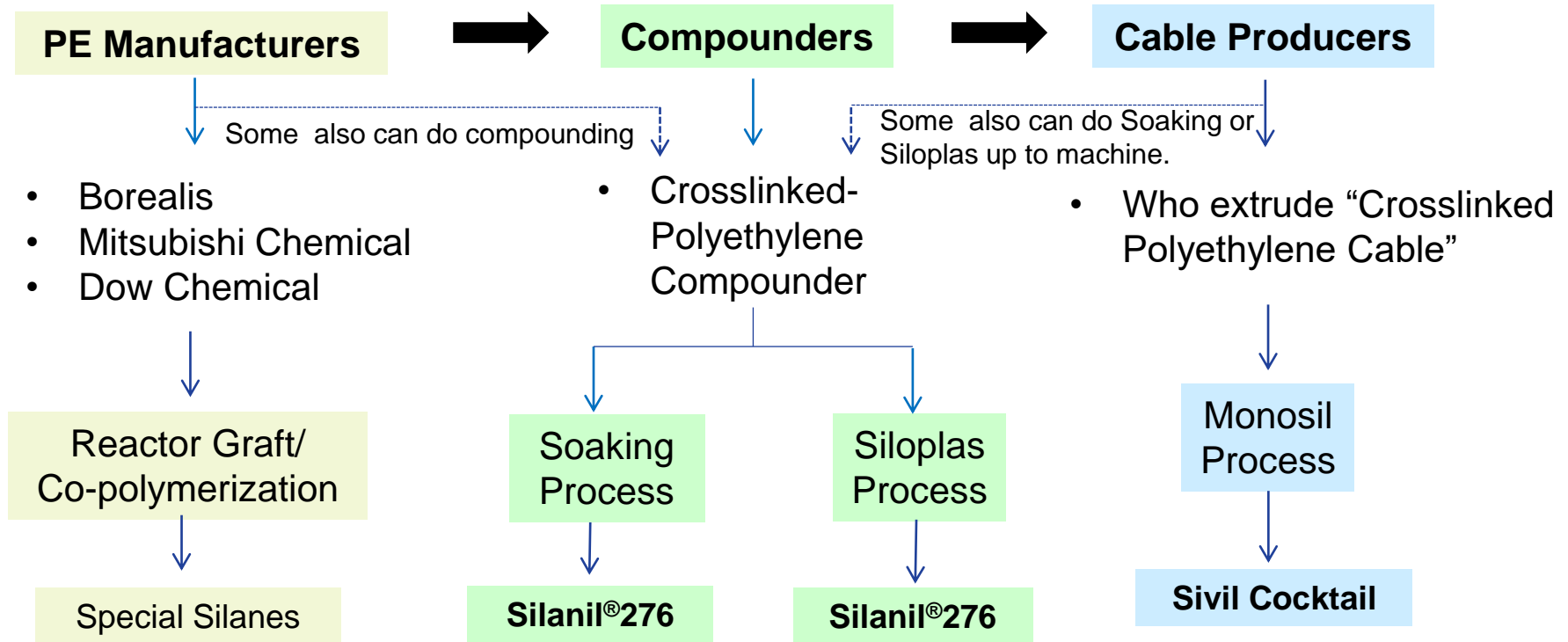
Vinyl Silane BRB Silanil® 276

- + Peroxide
- + Tin Catalyst
- + Additives



“Carrier will soak up the silane blend which no reaction happening during soaking process ,so inert gas is required to purge in a container.”

Customer Chain for XLPE Wires and Cables



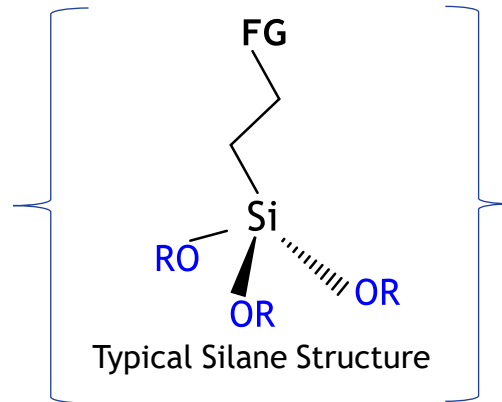
Silanes for Rubber Compound



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Functions of Silanes in Rubber Compound

Coupling Agent
between Silica/
Inorganic Fillers
and Rubber



Dispersing Agent
between Silica/
Inorganic Fillers
and Rubber

-FG

- Organofunctional group, e.g. -Vinyl, -Mercapto
- Function of **reaction or grafting on rubber, influencing to mechanical properties, abrasion resistance, and durability of compounds.**

-OR

- Alkoxy group, e.g. - Methoxy , -Ethoxy
- Function of Hydrolysis and Condensation, where **acts as a bridge to bond between inorganic fillers (silica) and resins/plastics/rubber.**

Application in Rubber Compound

Rubber
+ Silica
+ **Silanes**
e.g. **Silanil 442, 106**
+ Other Additives /Fillers



Compounding →



Peroxide Cure Rubber

- **EPDM**

(Ethylene Propylene Diene Monomer Rubber)

Silanil 106, 780 is recommended.

Sulfur Cure Rubber

- **SBR**

(Styrene Butadiene Rubber)

- **NBR**

(Nitrile Butadiene Rubber)

- **Natural Rubber**

(Polyisoprene)

Silanil 442 is recommended

End Product Process

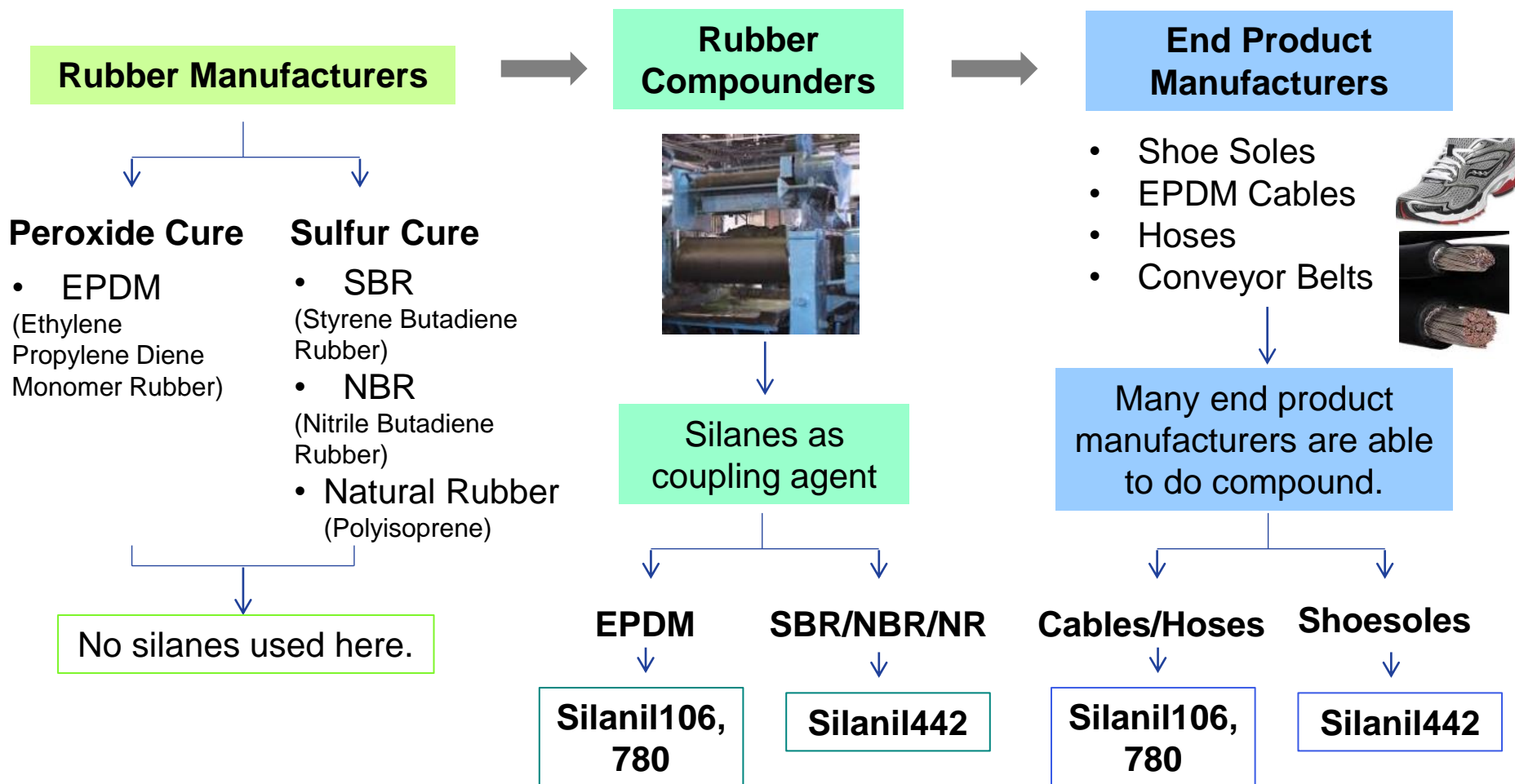
- Compression Molding
- Injection Molding
- Extrusion



Shoe Soles
Hoses
Cables
Conveyor Belts
Etc.



Customer Chain for Rubber Compound



Recommendation in Rubber Compound

By Functional Group Matching

Coupling Agent			
EPDM	SBR	NBR	Isoprene Rubber
Silanil 106	Silanil 442	Silanil 442	Silanil 442
Silanil 780			

Remark: Recommendation is based on testing and historical experience data.

Silanes for Glass Fibers and Fabrics

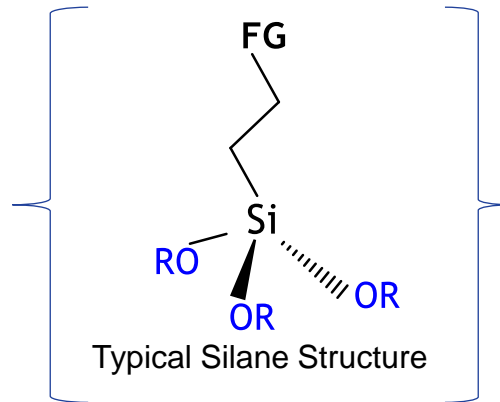


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Functions of Silanes in Glass Fibers and Fabrics

Coupling agent on glass
when used in
composites

By Glass surface treatment



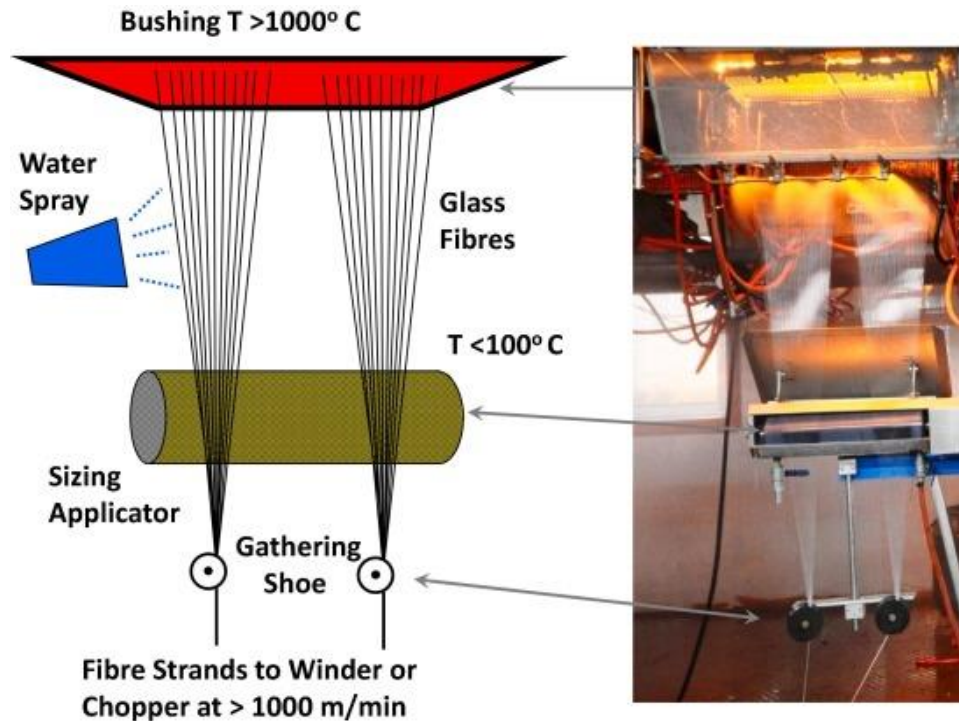
-FG

- Organofunctional group, e.g., -Amino, -Epoxy (Glycidoxy), -Methacryloxy
- Function of **glass surface modification**, to create “**Functional Group**” on **glass surface for interaction with “Plastics” or “Resins”**.

-OR

- Alkoxy group, e.g., -Methoxy, -Ethoxy
- Function of hydrolysis and condensation, where **silanol is bonded on glass surface**.

Application in Glass Fibers and Fabrics



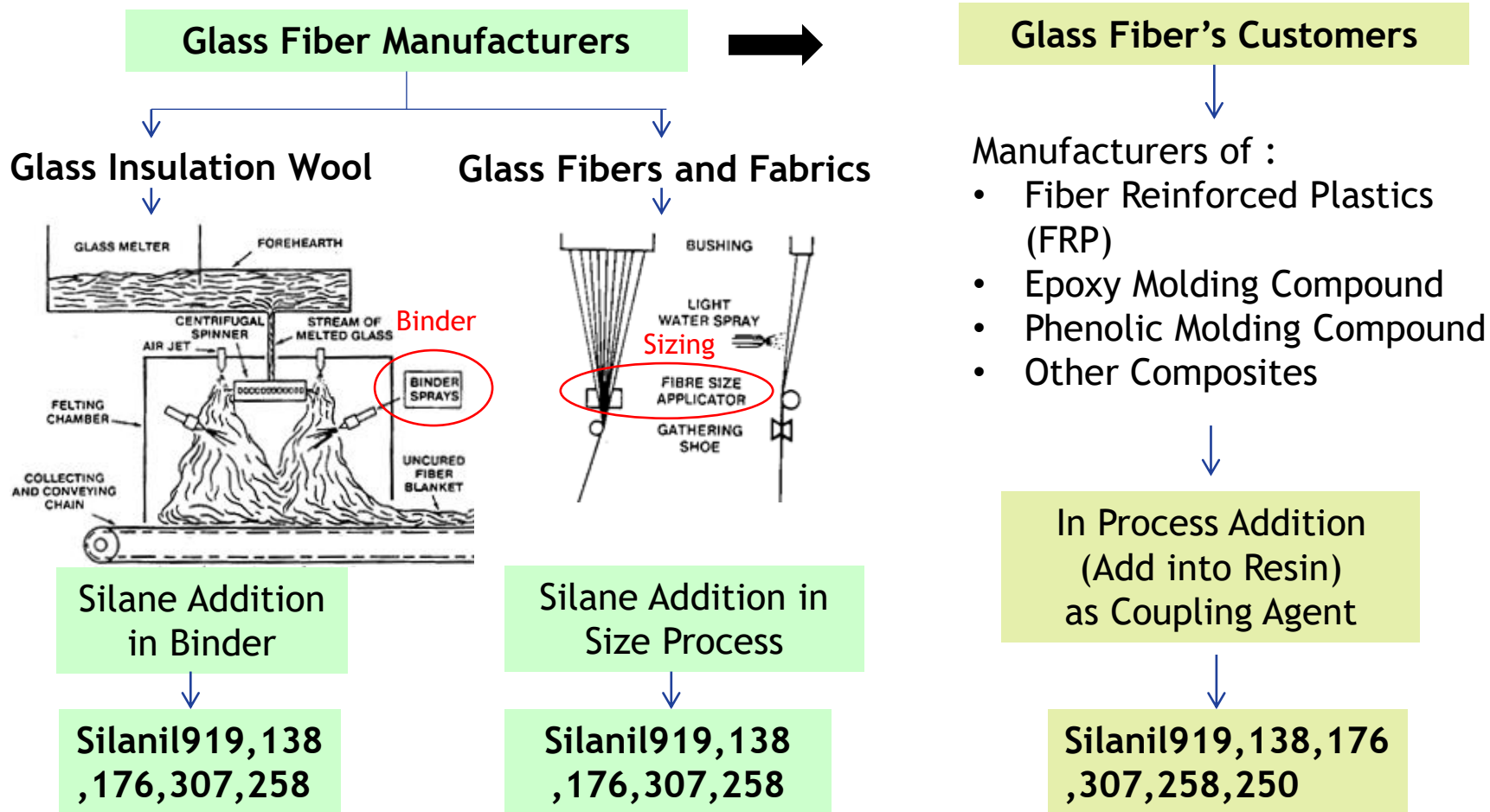
Picture Ref. : Thomason, J. L. (2019). Glass fibre sizing: A review. Composites Part A: Applied Science and Manufacturing, 127, 105619.

Size Process

- The individual filaments receive a coating of size at the forming stage.
- After they leave the bushing. This size, made up of organic products dispersed in water, is designed to give the glass strand certain characteristics necessary for the end application.
- For some applications, special sizes may contain film formers and **silane as "coupling agent,"** which enhances the mechanical and ageing properties of the end product.

Size bath: silane is added at 0.3-1% based on total weight.

Customer Chain for Glass Fibers and Fabrics



Recommendation in Glass Fibers and Fabrics

By Functional Group Matching

Glass Surface Modification to Match with Resin					
Acrylic	EPDM	SBR/NBR	Epoxy	Phenolic	Unsat. Polyester
Silanil® 250	Silanil® 106	Silanil® 442	Silanil® 919	Silanil® 919	Silanil® 250
Silanil® 258	Silanil® 780		Silanil® 258	Silanil® 258	Silanil® 919
Silanil® 919			Silanil® 260	Silanil® 138	

Remark: Recommendation is based on testing and historical experience data.

Silanes for Fillers and Pigments

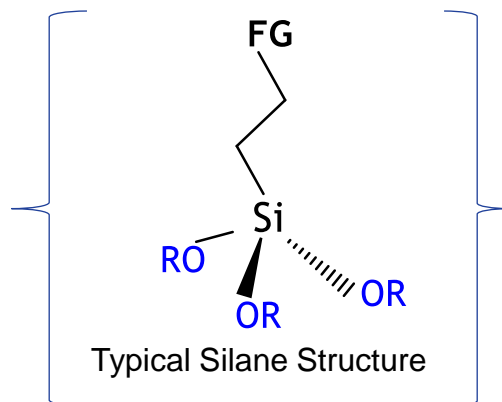


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Functions of Silanes in Fillers and Pigments

Coupling Agent on
fillers/pigments when
used in resins/plastics

By filler surface treatment



Dispersing Agent on
fillers/pigments when
used in resins/plastics

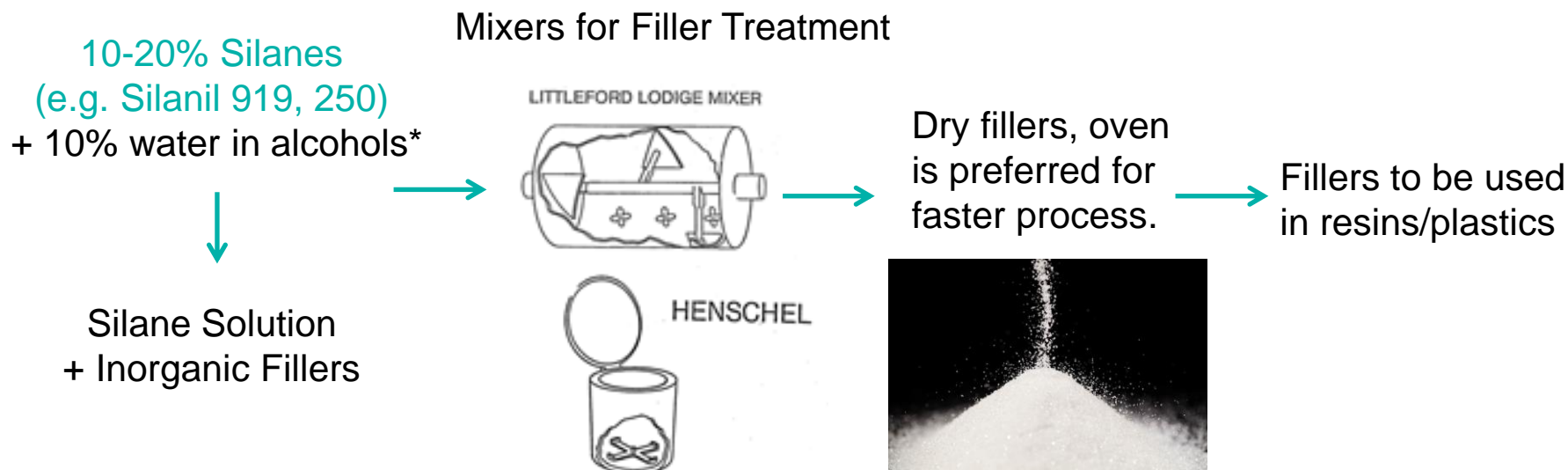
-FG

- Organofunctional group, e.g., -Amino, -Epoxy (Glycidoxo), -Methacryloxy
- Function of **filler surface modification to create “Functional Group” on glass surface for interaction with “Plastics” or “Resins”.**

-OR

- Alkoxy group e.g. -Methoxy, -Ethoxy
- Function of Hydrolysis and Condensation, where **silanol is bonded on glass surface.**

Filler Treatment by Silanes



* Small amount of acetic acid may be added to increase reactivity.
4.5 pH is recommended.

** Amino silane does not required for pH adjustment.

Application in Fillers and Pigments

Fillers Recommended for Silanes

Best

Silica
Quartz
Glass
Aluminum
Copper
Alumino-Silicates (Clays)
Mica
Talc
ATH
MGH
TiO₂
Steel/Iron
Asbestos

Fair

Not Recommended for Silanes

CaCO₃
Gypsum (CaSO₄)
Barytes (BaSO₄)
Graphite
Carbon Black

Customer Chain for Fillers and Pigments

Filler&Pigment Manufacturers

- Silica/Quartz
 - Glass
 - Aluminum
 - Copper
 - Alumino-Silicates (Clays)
 - Mica
 - Talc
 - TiO_2
 - Fe_2O_3
 - ATH
 - MGH
 - Steel/Iron
 - Asbestos
- (Silanes are not for CaCO_3 , Gypsum, Barytes, Graphite and Carbon black)

↓

Surface Treatment by
Silane Solution

↓

**Silanil 138, 176, 919,
581, 258, 250**

Filler&Pigment's Customers

Manufacturers of:

- Paints and Coatings
- Plastics and Composites
- Adhesives and Sealants
- Rubber Compound

↓

In Process Addition
for Coupling Agent

↓

**Silanil 138, 176, 919,
581, 258, 250**

Recommendation in Fillers and Pigments

By Functional Group Matching

Filler Surface Modification to Match with Resin					
Acrylic	EPDM	PVC Plastisols	Epoxy	Phenolic	Unsat. Polyester
Silanil 250	Silanil 106	Silanil 442	Silanil 258	Silanil 258	Silanil 250
Silanil 258	Silanil 780	Silanil 919	Silanil 919	Silanil 919	
		Silanil 176			

Remark: Recommendation is based on testing and historical experience data.

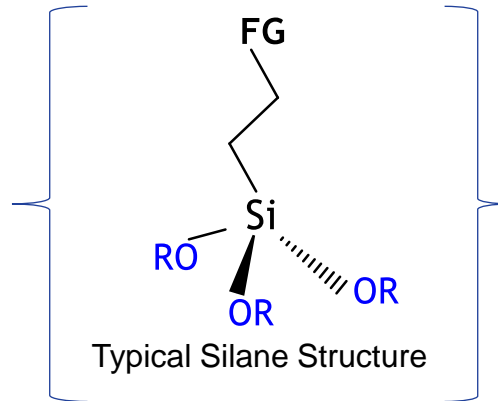
Silanes for Fiber Reinforced Plastics (FRP) and Composites



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Functions of Silanes in Fiber Reinforced Plastics (FRP) and Composites

Coupling Agent between
Resins/Plastics/Rubber
and Glass
Fibers/Inorganic Fillers



Dispersing Agent
between Resins
and Fillers

-FG

- Organofunctional group, e.g., -Amino, -Epoxy (Glycidoxo), -Methacryloxy
- Function of reaction or interaction with resins/plastics/rubber, **influencing to mechanical properties of resin composites such as hardness, tensile strength, impact strength, etc.**

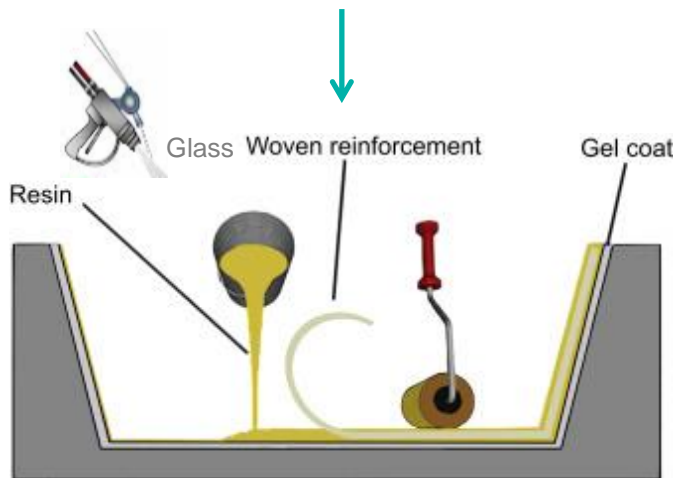
-OR

- Alkoxy group, e.g., -Methoxy , -Ethoxy.
- Function of Hydrolysis and Condensation, where **acts as a bridge to bond between inorganic fillers and resins/plastics/rubber.**

Applications in Fiber Reinforced Plastics (FRP)

Process: Spray-up, Hand lay-up, Sheet Molding Compound (SMC), etc.

0.2-1% Silane (e.g. Silanil® 919)
added in resin as a coupling agent**



Thermoset Resins

- Unsat. Polyester (UPE)
- Phenolic
- Epoxy
- etc.

Glass Fibers
→

Final Products

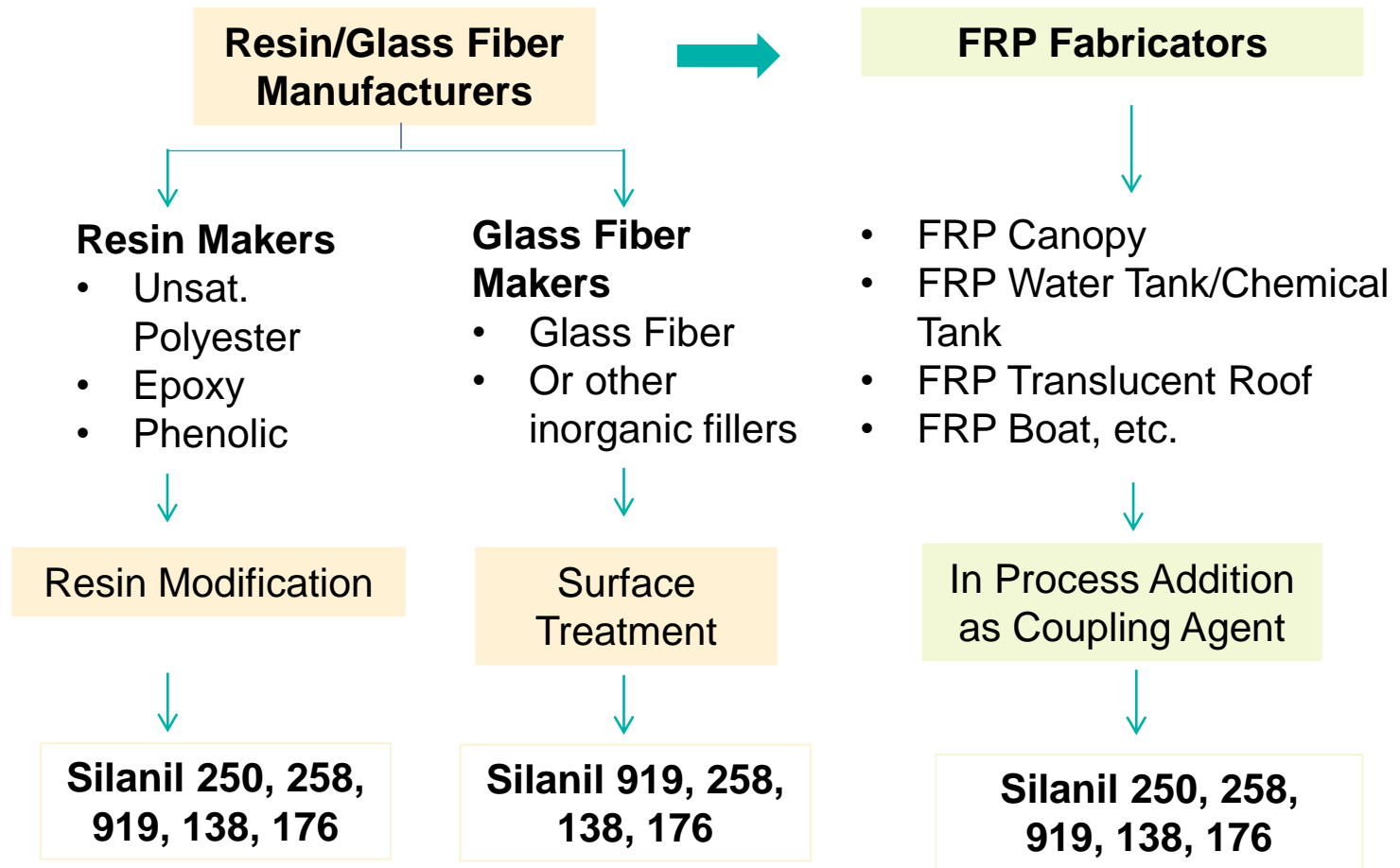
- Small Truck Canopy
- Boat
- Water Tank
- Roof etc.



** More benefit on higher glass loading when silane is used.

Picture Ref.: Jawaid, M., Thariq, M., & Saba, N. (Eds.). (2018). Woodhead Publishing.

Customer Chain in Fiber Reinforced Plastics (FRP)

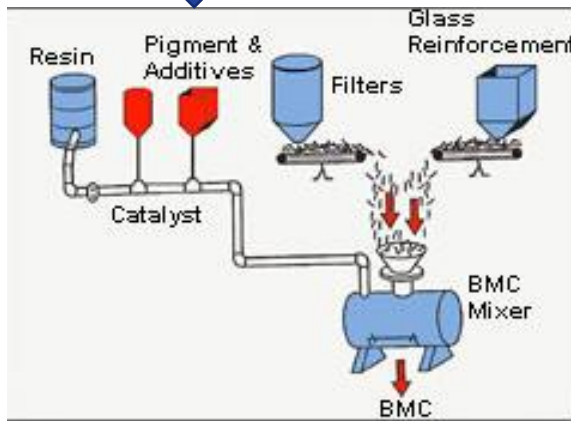


Application of Silanes in Bulk Molding Compound (BMC)

Bulk molding compounds (BMC) or bulk molding composites are glass fibers, organic fillers, or/and inorganic fillers reinforced thermoset plastics primarily used in injection and compression molding .

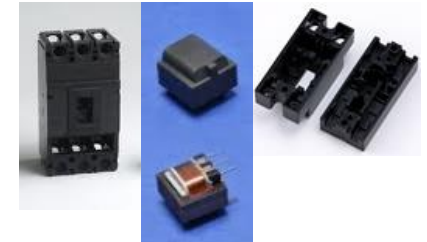
Generally, BMC is manufactured by mixing chopped glass fibers in a mixer with thermoset resin .

Silane 0.5-2% on fillers wt. added into resin as a coupling agent



Thermoset Resins

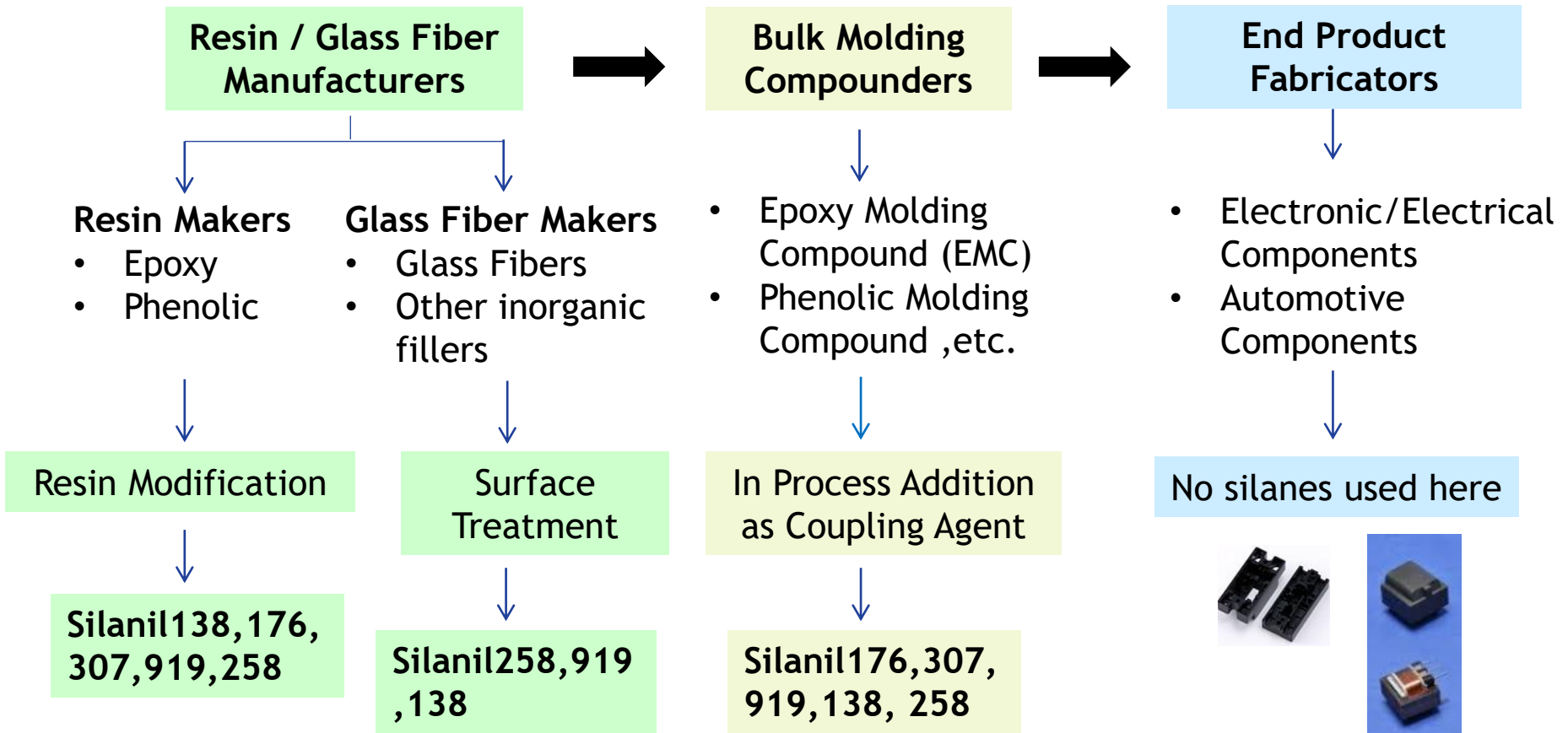
- Unsat. Polyester (UPE)
- Phenolic
- Epoxy ,etc.



Final Products

- Electronic Components e.g. Connector, Breaker Circuit, etc.
- Electric Components
- Automotive Mechanical Components

Customer Chain for BMC



Recommendation in FRP and composites

By Functional Group Matching

Coupling Agent		
Unsat. Polyester	Epoxy	Phenolic
Silanil 250	Silanil 258	Silanil 919
Silanil 919	Silanil 289	Silanil 138
Silanil 138	Silanil 260	Silanil 176

Remark: Recommendation is based on testing and historical experience data.

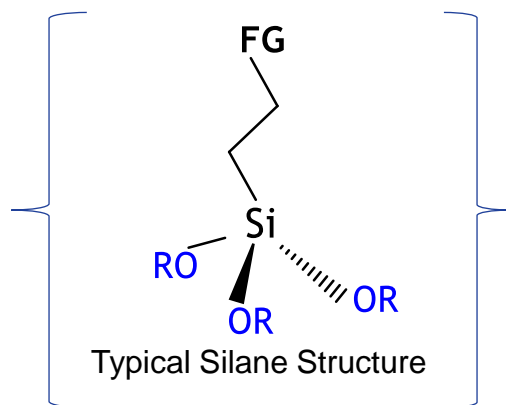
Silanes for Artificial Marble and Stone



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Functions of Silanes in Artificial Marble/Stone

Coupling Agent
between Resins
and Fillers



Dispersing Agent
between Resins
and Fillers

-FG

- Organofunctional group, e.g. -Amino, -Epoxy (Glycidoxy), -Methacryloxy.
- Function of reaction or interaction with resin, **influencing to mechanical properties of resin composites such as hardness, tensile strength, impact strength, etc.**

-OR

- Alkoxy group, e.g., -Methoxy, -Ethoxy.
- Function of Hydrolysis and Condensation, where **acts as a bridge to bond “Natural Stones or Inorganic Fillers” and “Resins”**

Application in Artificial Marble and Stone

Unsat. Polyester Resin
+ Silane at 0.2-1% on Filler
wt.

e.g. Silanil® 250



+ Natural Stones/Inorganic
Fillers



Mix well

+ Peroxide*

+ Other Additives/
Colorants/Waxes

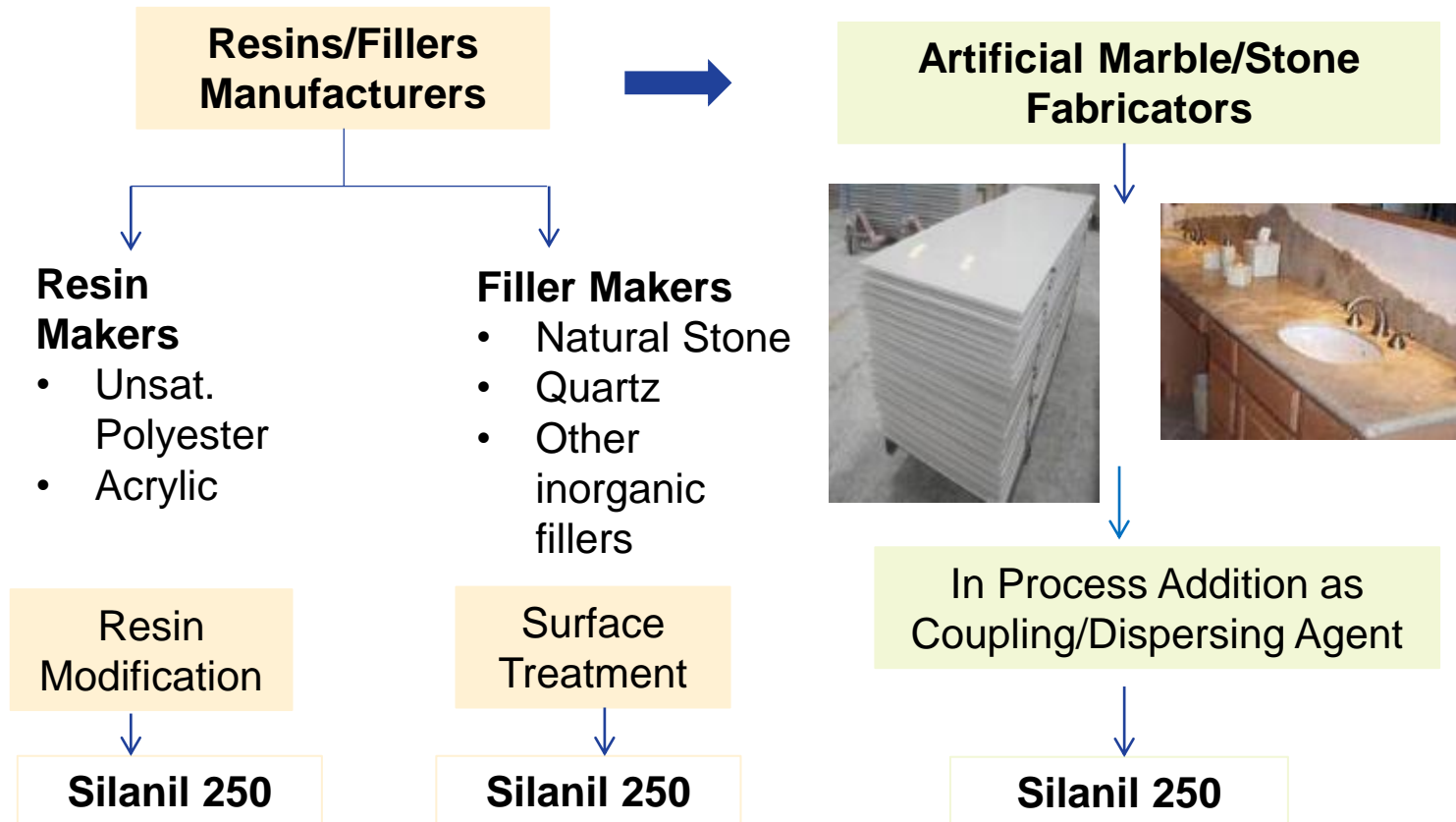
* Peroxide may be added before
Natural Stones for homogeneous
mixing purpose.
Anyway, do not add Silanes directly
into Peroxide.



Marble Casting Process

More benefit on higher filler loading ability
when silane is used.

Customer Chain in Artificial Marble/Stone



Recommendation in Artificial Marble/Stone

By Functional Group Matching

Coupling Agent	
Unsat. Polyester	Acrylic
Silanil 250	Silanil 250

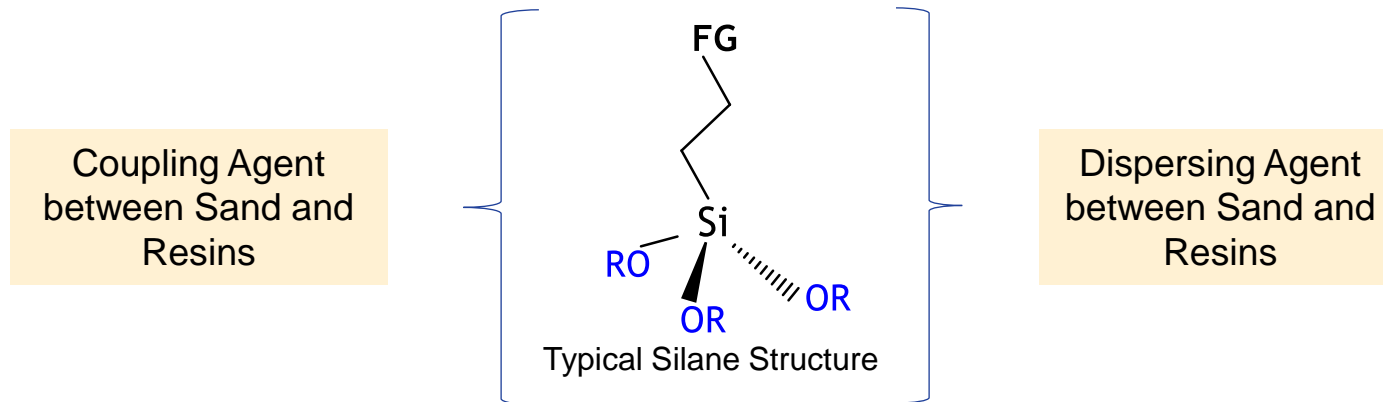
Remark: Recommendation is based on testing and historical experience data.

Silanes for Foundry Molds



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Functions of Silanes in Foundry Molds



-FG

- Organofunctional group e.g. -Amino, -Epoxy (Glycidoxy).
- Function of **reaction or interaction with resin, which provides better mechanical strength and allows higher filler loading (lower resin loading).**

-OR

- Alkoxy group e.g. -Methoxy, -Ethoxy.
- **Function of Hydrolysis and Condensation, where bonds to “Sand Surface” and provides moisture resistance to mold.**

Application in Foundry Molds

Resins + Silanes
(e.g. Silanil® 919, 307, 176
and Si40 (TEOS)) → + Sand,
Ceramic
Materials → Mixture/
Compound

Type of Foundry Molds

No Bake Molding

- Phenolic (Novolac)
- Urea formaldehyde
- Furan

Cold Box Molding

- Urethane
- Phenolic

Hot Box Molding

- Phenolic
- Furan

Shell Molding by Investment Casting

- Colloidal Silica
(Silica Sol)

Compound



Patterns are placed
into Mold.



Molten metal is
poured into the
closed mold.



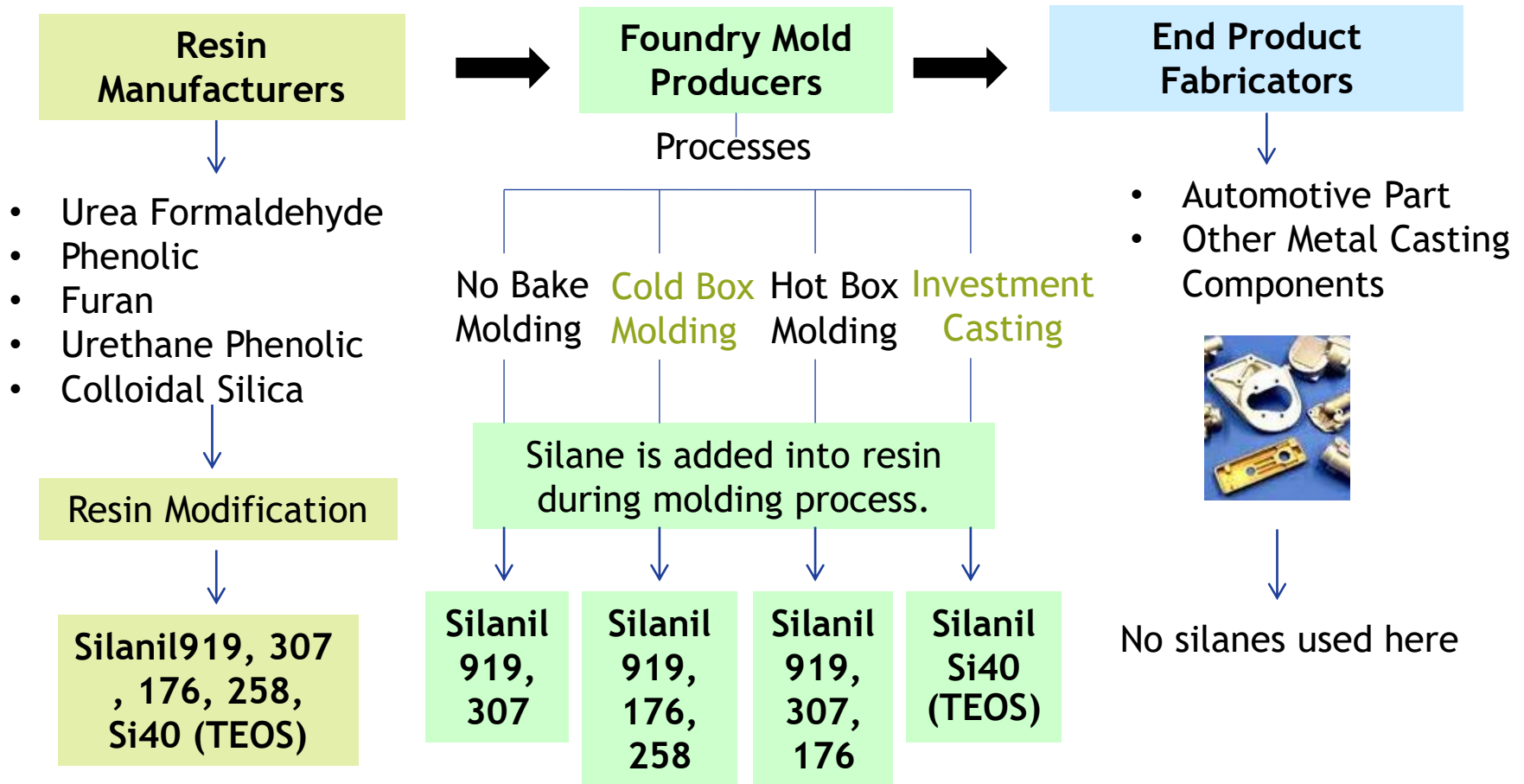
Ceramic mold by
investment casting

TEOS is used for binder
(colloidal silica) in investment
casting.



Workpiece from
investment shell

Customer Chain for Foundry Molds



Recommendation in Foundry Molds

By Functional Group Matching

Coupling Agent			
Phenolic	Furan	Urea Formaldehyde	Urethane Phenolic
Silanil 258	Silanil 919	Silanil 919	Silanil 919
Silanil 919	Silanil 307		Silanil 176
Silanil 307	Silanil 176		
Silanil 176			

Remark: Recommendation is based on testing and historical experience data.

Silanes for Sol Gel Coatings

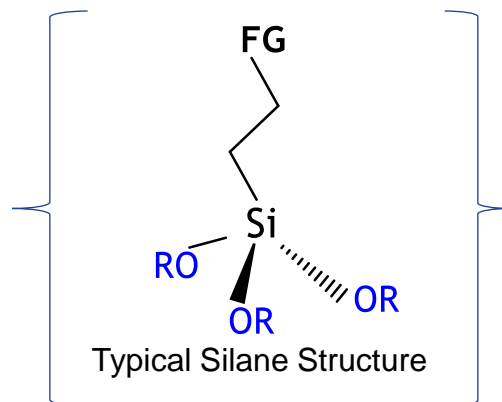


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Functions of Silanes in Sol Gel Coatings

Primer/Surface Pretreatment on Inorganic Substrates

- Act as Adhesion Promoter Layer to Organic Coatings
- Form Hydrophobic or Hydrophilic Layer up to FG of Silanes.



Also Coupling Agent between Organic Coatings and Inorganic Fillers

-FG

- Organofunctional group e.g. -Vinyl, -Methacryloxy, -Epoxy and -Amino
- Function of **hydrophobic or hydrophilic characteristic forming on inorganic substrates** such as metal or glass and **interaction with inorganic coatings.**

-OR

- Alkoxy group e.g. -Methoxy, -Ethoxy, etc.
- Function of Hydrolysis and Condensation, which **bond to inorganic substrates or fillers for adhesion or coupling purpose.**

Application in Sol Gel Coatings

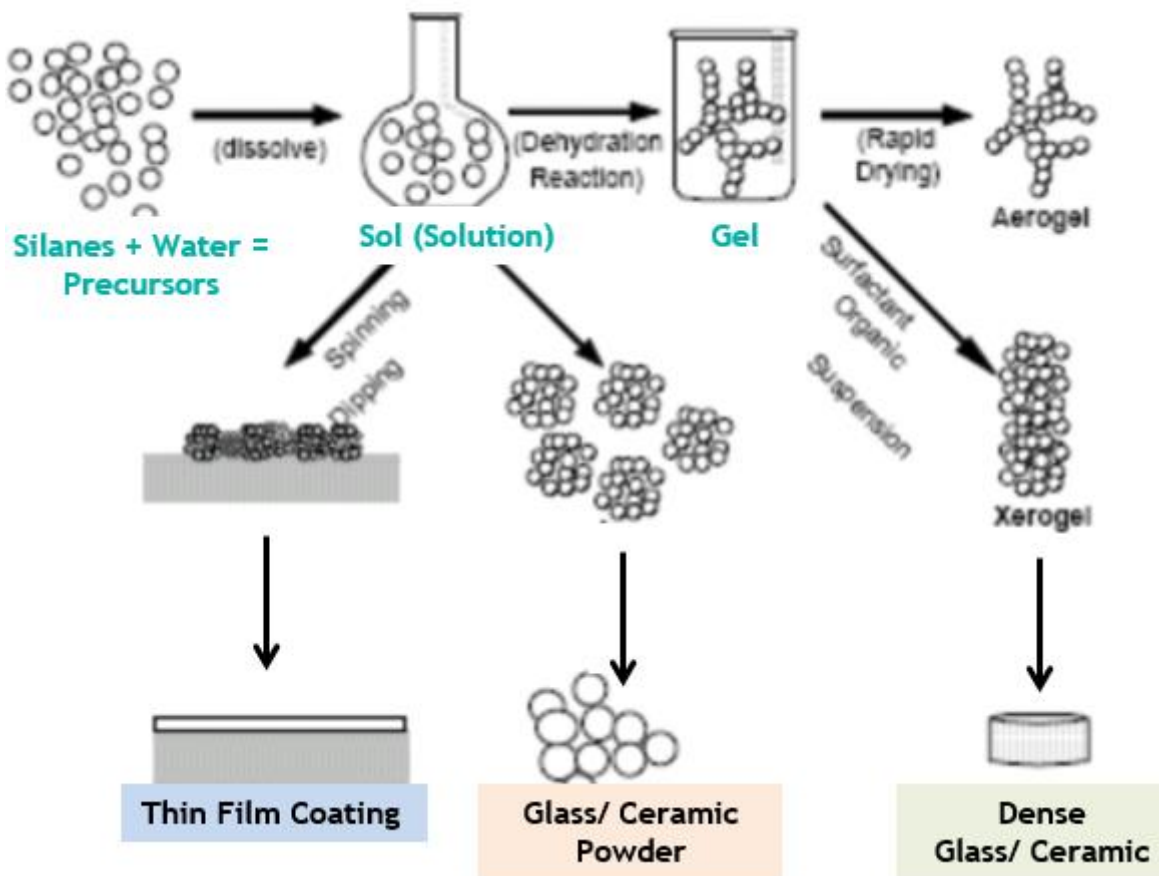
The sol gel process is the method for producing solid materials by monomer conversion to the **colloidal solution (Sol)** that acts as the precursor for an integrated network or gel.

Applications for Sol Gel-derived products are numerous, especially for thin film formation and capable to modify structure by utilizing an organically modified precursors

e.g. Organofunctional Silanes + Water = Precursors

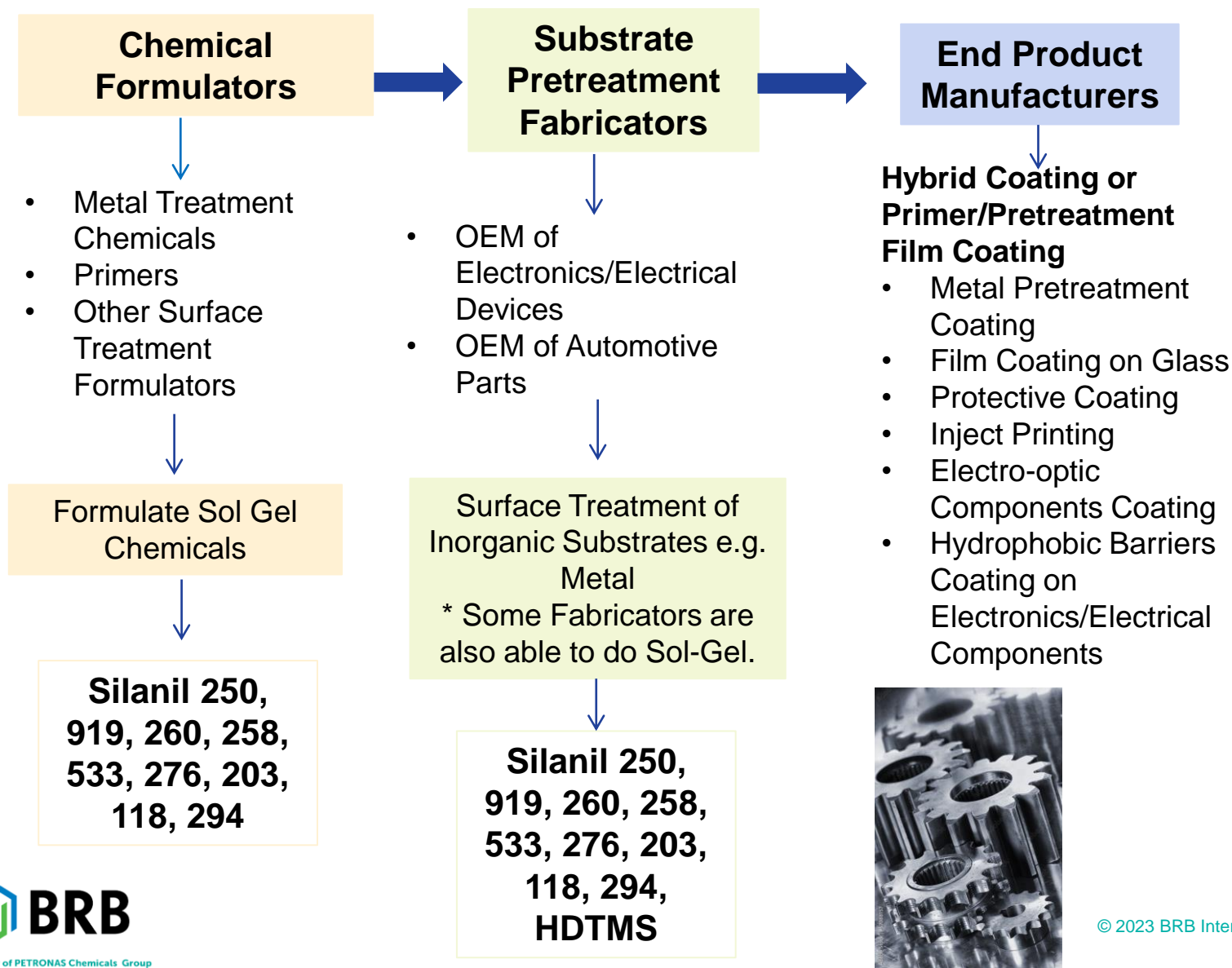
Which Precursors are added into Sol, then transform to Gel per Sol-gel process.

Silane used in Sol (Solution) is called “Silane Sol Gel System”



Picture Ref. : Kavitha, B., Nirmala, M., & Pavithra, A. (2016). Annealing effect on nickel oxide nanoparticles synthesized by sol-gel method. *World scientific news*, (52), 118-129.

Customer Chain for Sol Gel Coatings



Recommendation in Sol Gel Coatings

Organic-Inorganic Hybrid Coating or Primer		Organic Surface Pretreatment
Adhesion Promoter	Coupling Agent	Hydrophobic Modification
Silanil 250	Silanil 250	Silanil 203
Silanil 919	Silanil 919	Silanil 118
Silanil 260	Silanil 260	Silanil 294
Silanil 258	Silanil 258	Silanil HDTMS
Silanil 533	Silanil 533	
Silanil 276	Silanil 276	

* The sequence of silane addition in formulation affects the function of silane.

Remark: Recommendation is based on testing and historical experience data.



BRB

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