Silicones Simplified

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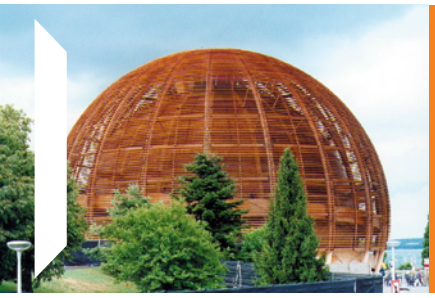
XIAMETER® from DOW CORNING



Water Repellents
Selection Guide Europe

Benefits of the use of silicones in construction substrates

All construction materials are exposed to damaging environments ranging from water ingression, to abrasion by air-borne particles, attack by organisms, to accidental spillages. The XIAMETER® brand has a range of products for use in formulations applied to a diverse range of substrates including:

- Structural Concrete
- Pavers/Flagstones
- Sandstone
- Limestone/Marble
- Bricks/Tile
- Wood

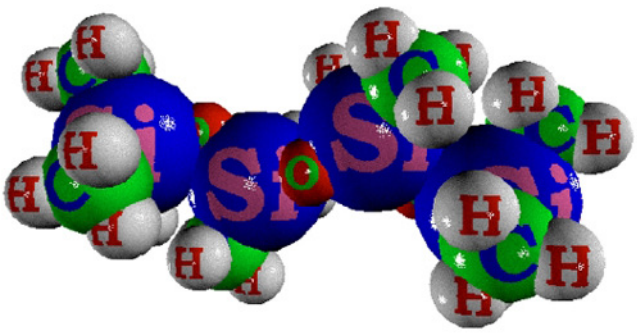
For use either as preventative or remedial treatment for Façade, OEM or Damp Proof Course (DPC).

They provide a variety of benefits:

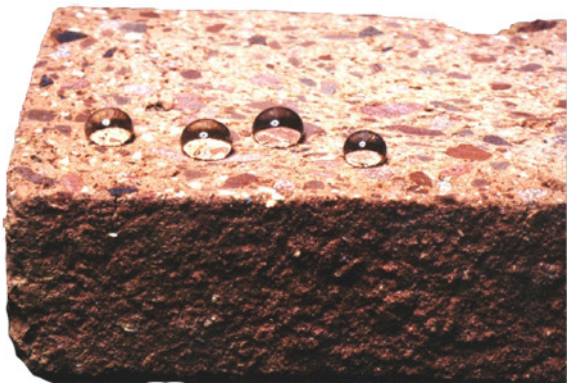
- Improved long term protection
- Reduced maintenance time/costs
- Reduced efflorescence
- Reduced Spalling (freeze-thaw damage)
- Strengthening fragile masonry
- Reduced staining/easier cleaning
- Dimensional stability of wood

Through unique properties of silicone based technology:

- Repellency to water and oil, depending on attached groups
- Permeable to water vapour



Silicone molecule



Brick treated with *Dow Corning*® Z-6689 Water Repellent

Concrete treated with *Dow Corning*® Z-6689 Water Repellent

- Durable; chemically reacts with substrate and itself
- Deep penetrating; small molecular size
- Low surface tension
- UV stable

Wood protected with *Dow Corning*® 2-9034 Emulsion

1.1 Performance aspects of silicones

Protection

Silicones are capable of penetrating and forming a protective repellent layer several millimetres deep within the substrate, with little appreciable effect on the water vapour transmission rate through pores and capillaries. As the depth of treatment is significant, abrasion of the surface has little or no effect on performance. Other treatments to give repellency block or seal only the very top of these pores and capillaries. This results in greater reductions of vapour transmission, together with less abrasion resistance, as the depth of protection is significantly less.

XIAMETER® MHX-1109 Fluid protection against efflorescence in limestone

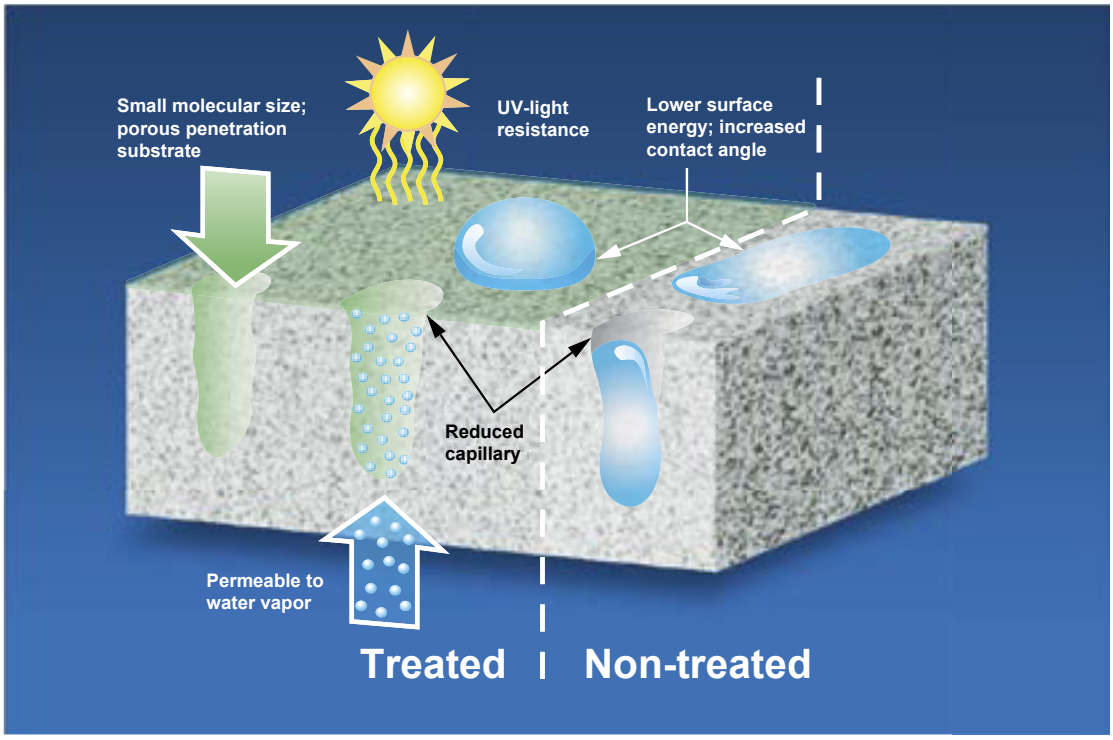


Figure 1 – *Silicone-based water repellents when delivered to the surface penetrate deeply. They chemically react with the substrate and themselves to provide durability protection, also they allow moisture vapour to pass.*

1.2 Physical and Chemical properties of Silicones

Silicones are present in many forms and are often used in combination to give the specifi c properties required for effective treatments.

1.2.1 Silanes

Silanes are the smallest silicone ensuring good Depth of Penetration into substrates. They react with themselves and any hydroxy (OH) groups within the substrate when moisture is present, forming a silicone resin network. This formation of strong chemical bonds provides the durability attributed to siloxane treatments.

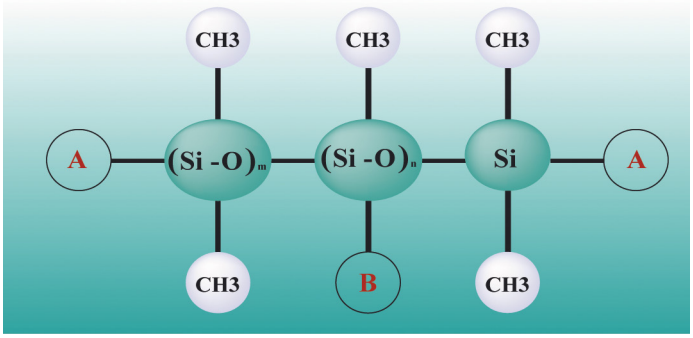
1.2.2 Polymers

Silicone linear polymers are helical in shape, providing a lot of free space within their structure for individual water vapour molecules to pass through, whilst water droplets are repelled by the hydrophobic methyl (CH_3) groups which orientate to the outside, giving repellency to liquid water.

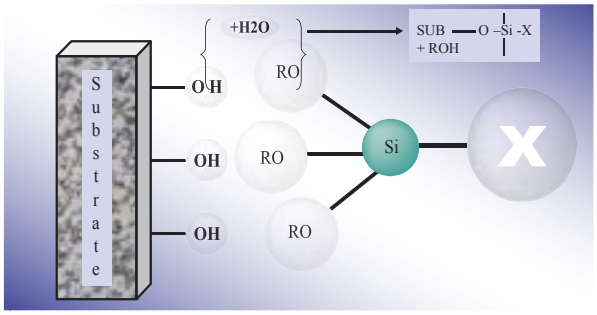
The low surface tension of the methyl groups enables silicones to spread easily, forming a molecular layer penetrating into the substrate.

Various groups can be substituted onto the polymers enabling chemical reactivity with the substrate and other silicone molecules.

Polymers can be linear or cyclic, with various groups substituted into the positions shown below.



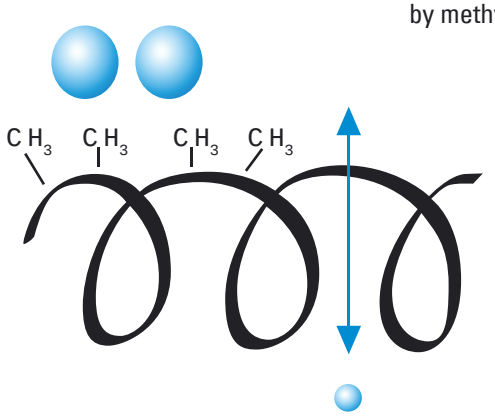
A and B are substituted groups.



Where **RO** *is an* ***alkoxy*** *group, typically methoxy or ethoxy, with the capability to react with hydroxy* (OH) *groups on the substrate*

X *is an* ***organic*** *group such as butyl or octyl to give hydrophobicity. To give oil repellency* **X** *would contain fluorine containing groups*
For strengthening **X = RO**

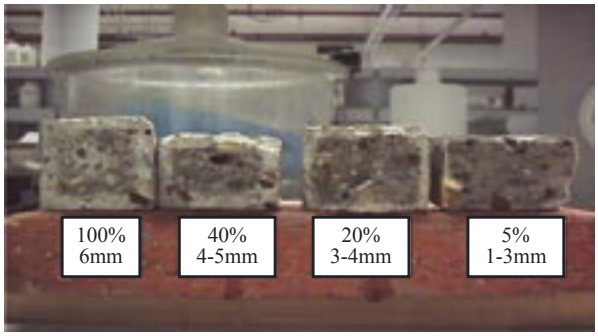
Water Beading – droplets repelled by methyl groups



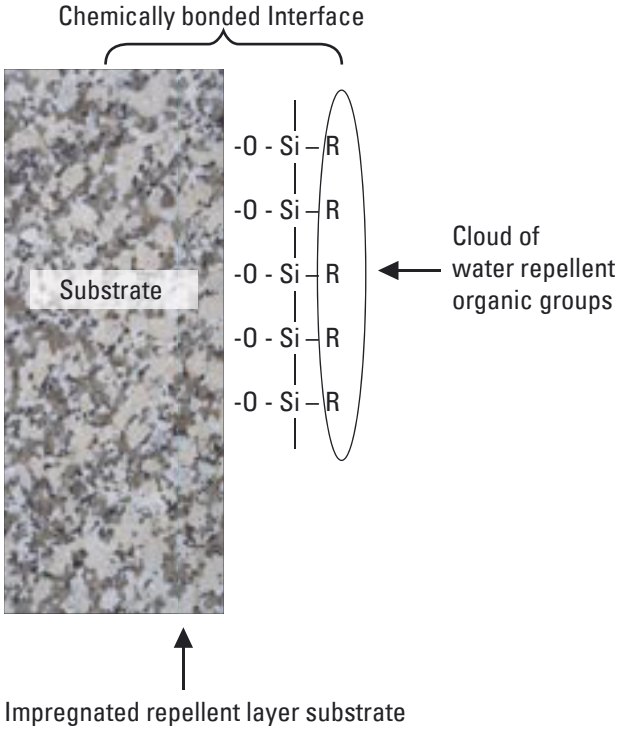
Water vapour – can pass through the open silicone structure

Group	Position	Reactive	Function
Alkyl	A or B	N	Water repellency
Fluoroalkyl	B	N	Oil and Water repellency
Amino	A or B	N	Catalytic
Alkoxy	A	Y	X-linking
Hydroxyl	A	Y	X-linking
Hydrogen	B	Y	X-linking

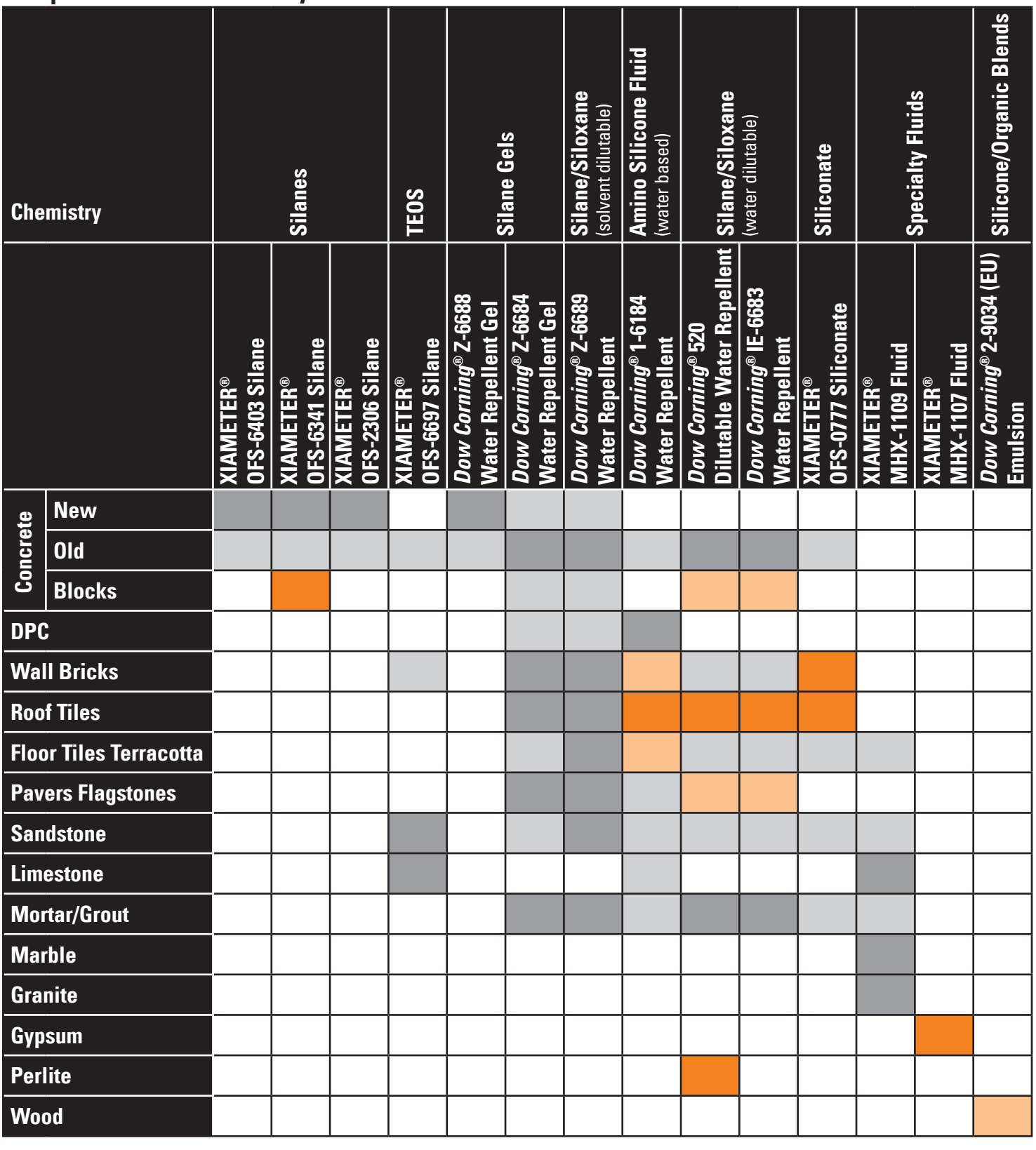
Recommendations of suitability of products for use on various substrates in the following pages are based on consideration of the polymer type and blend required to achieve optimum performance.



XIAMETER® OFS-6341 Silane:
DOP at Various Concentrations



European Selection Guide by substrate



European Selection Guide by properties

Chemistry		Solvent	Chemistry	Substrate pH/ type	Active ingredients	Typical active usage level	Specific gravity	Flash point
		Water	Official tests & approvals		%	%	Kg/l	ºC(F)
Silanes	XIAMETER® OFS-6403 Silane		Butyl triethoxysilane	12 to 14	98	40 or 100	0,88	31
			Protection Against Chloride ion intrusion in to concrete NCHCRP Nº 244					
	XIAMETER® OFS-6341 Silane		Octyl triethoxysilane	12 to 14	98	40 or 100	0,88	63
			Approved at Swedish National Road Administration for Surface tretament of concrete according to 'Bro 2002'					
	XIAMETER® OFS-2306 Silane		Butyl trimethoxysilane	12 to 14	96	40 or 100	0,92	35
			The Department Transport (UK), Technical Report N0 20002 (1991) BE28/14/026					
TEOS	XIAMETER® OFS-6697 Silane		Tetra ethoxysilane	neutral to 10	>99	70 to 100	0,93	46
Silanes Gel	*Dow Corning*® Z-6688 Water Repellent Gel		Octyl triethoxysilane	12 to 14	80	80	0,91	>62
			Approved at Swedish National Road Administrtion for Surface tretament of concrete according to 'Bro 2002'					
	Dow Corning® Z-6684 Water Repellent Gel		Octyl triethoxysilane	neutral to 12	45	45	0,87	>61
Silane/ Siloxane Blends (solvent dilutable) Amino Silicone Fluid (water dilutable)	*Dow Corning*® Z-6689 Water Repellent		Solventless silane/ siloxane blend	neutral to 10	98	5 to 15	0,96	65,5
			CSTC (Belgian Building Research Institute) 'Initial effectiveness, secondary effects and durability of water repellents' HD-340/133-143					
	Dow Corning® 1-6184 Water Repellent		Amino silsesquioxane	neutral to 10	65	3.5 to 7.5	1,05	27
			Rising moisture in masonry test. WBA at IBAC, Aachen Germany					

European Selection Guide by properties (cont.)

Chemistry		Solvent Water	Chemistry	Substrate pH/ type	Active ingredients	Typical active usage level	Specific gravity	Flash point
		Water	Official tests & approvals		%	%	Kg/l	°C(F)
Silane/ Siloxane Emulsions (water dilutable)	*Dow Corning*® 520 Dilutable Water Repellent		Silane/siloxane emulsion blend	slightly alkaline to 12	40	5 to 20	0,99	>100
			Water Exclusion ASTM C642/c67					
	Dow Corning® IE-6683 Water Repellent		Silane/siloxane emulsion blend	slightly alkaline to 12	40	3 to 10	0,99	>100
Siliconates	XIAMETER® OFS-0777 Siliconate		Potassium Methyl Siliconate	neutral to 10	40	0.5 to 3	1,29	>93
Specialty Fluids	XIAMETER® MHX-1109 Fluid		Functional methyl siloxane	neutral to 12	100	5 to 30	0,98	30
			CSTC (Belgian Building Research Institute) 'Initial effectiveness, secondary effects and durability of water repellents' HD-340/133-142					
	XIAMETER® MHX-1107 Fluid		Polymethylhydrogen siloxane	admixture	100	0.05 to 1	1	93
Silicone/ Organic Blends	*Dow Corning*® 2-9034 (EU) Emulsion		Organo-siloxane emulsion	N/A	50	2 to 8	0,94	100
			Water repellency swellometer Test ASTM 4446 QUV Durability Test G53					

European Selection Guide by materials

Material	Application	Chemistry	Delivery form	Products
Steel re-inforced concrete	Bridges, Parckdecks	Silanes	In solvent or 100% solids or Gel	**XIAMETER® OFS-2306 Silane (IBTMS)**
				XIAMETER® OFS-6341 Silane (NOTES)
				XIAMETER® OFS-6403 Silane
				***Dow Corning*® Z-6688 Water Repellent Gel**
Concrete non-reinforced "fresh concrete"	Facade, Pavers, Flagstones, Roof tiles	Silanes	In solvent or 100% solids or admixture	**XIAMETER® OFS-2306 Silane (IBTMS)**
				XIAMETER® OFS-6341 Silane (NOTES)
Concrete non-reinforced "aged concrete"	Facade, Pavers, Flagstones, Roof tiles	Silanes/Siloxane blend	In solvent or as Emulsion water-based	***Dow Corning*® Z-6689 Water Repellent**
				***Dow Corning*® Z-6684 Water Repellent Gel**
				***Dow Corning*® 520 Dilutable Water Repellent**
				***Dow Corning*® IE-6683 Water Repellent**
Natural Stones, Clays, Terracotta	Natural Stone, Clay Bricks, Tiles	Self-catalyzing Siloxanes & Siliconates	Solvent/water-based	***Dow Corning*® Z-6689 Water Repellent**
				***Dow Corning*® 1-6184 Water Repellent**
				XIAMETER® OFS-0777 Siliconate
Natural Stone, Marble, Limestone	High porous substrates protection & reinforcement	Fluid, TEOS	Solvent	**XIAMETER® MHX-1109 Fluid**
				XIAMETER® OFS-6697 Silane
Brick Walls	Wall injection against rising Damp (DPC)	Self-catalyzing Siloxanes & Siliconates	Water	**XIAMETER® OFS-0777 Siliconate**
Wood Pressure or post treatment	Exterior wooden articles	Silane/siloxane/ Organic mix	Water	***Dow Corning*® 2-9034 EU Emulsion**
Gypsum	Gypsum plaster boards	Fluid	Admixture	**XIAMETER® MHX-1107 Flui d**

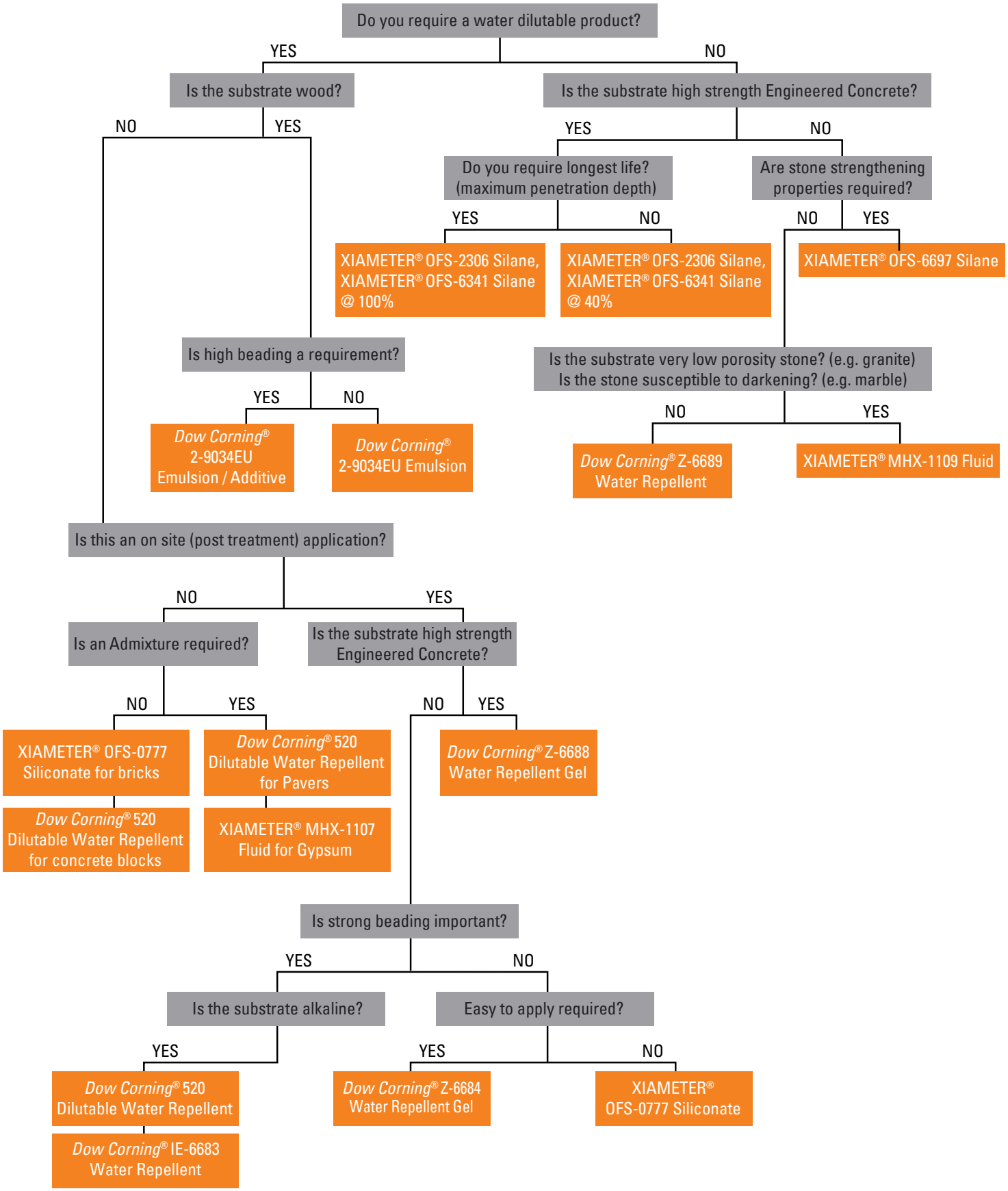
List Products & Benefits

Products	Chemistry	Dilution system	Substrate	Benefits
***Dow Corning*®** **IE-6683 Water Repellent**	Silane/siloxane emulsion	Water based	Alkaline or neutral substrates such as concrete, mortar and brick, stone	Deeply penetrates surface without changing appearance of substrate
***Dow Corning*®** **Z-6689 Water Repellent**	Silane/siloxane blend + catalyst	Solvent based	Neutral and moderately alkaline substrates such as brick, stone and aged concrete	Quick-forming and enduring beading effect, bonds chemically to the surface
***Dow Corning*®** **520 Dilutable Water Repellent**	Silane/siloxane emulsion	Water based	Alkaline or neutral substrates such as concrete, mortar and brick, stone	Deeply penetrates surface without changing appearance of substrate
XIAMETER® OFS-6697 Silane	Tetra ethoxy silane	Solvent based	Natural stone and neutral substrates	Its similar chemistry to the natural stone substrates make ideal as stone strengthener without change the aesthetics and breathability of the substrate.
***Dow Corning*®** **2-9034 EU Emulsion**	Nonionic organosilicone emulsion	Water based	Can be applied to pretreated or untreated wood, and for formulations used in pressure treatment processes.	High and enduring level of water repellence. Used to partially replace CCA.
XIAMETER® MHX-1107 Fluid	Fluid	Solvent based	Gypsum	Unique product to provide hydrophobicity to gypsum plaster boards.
XIAMETER® MHX-1109 Fluid	Fluid	Solvent based	Natural stone: limestone, sandstone, marble and granite.	Unique product providing excellent hydrophobicity on difficult substrates. Does not migrate giving outstanding durability and protection.

List Products & Benefits (cont.)

Products	Chemistry	Dilution system	Substrate	Benefits
***Dow Corning*® Z-6688 Water Repellent Gel & *Dow Corning*® Z-6684 Water Repellent Gel**	Alkoxy silane water emulsion	Water based gel	Concrete & neutral building substrates	Rheology of the gel allows the application on vertical or overhead surfaces. Solvent free.
XIAMETER® OFS-6341 Silane	Silane (NOTES)	Solvent based	Alkaline substrates such as new concrete.	Small molecule that allows deep penetration and provide water repellency by chemical bonding with the substrate.
XIAMETER® OFS-2306 Silane	Silane (IBTMS)	Solvent based	Concrete	Protect Reinforced Concrete from chlorine attach. Methyl releases, fast reaction.
XIAMETER® OFS-0777 Siliconate	Siliconate	Water based	Neutral, bricks, ceramics	Water dilutable solution gives water repellency to a variety of substrates

Decision tree
Water repellents



Contact Us

Visit www.xiameter.com to learn more about the many product options available to you from the XIAMETER® brand.

Photos: AV07433, AV15018, AV13022, AV05806, AV05807, AV05808

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