CONSTRUCTION CHEMICALS

Overview silicon based products

Jointly advancing better building …

DOWSIL™

silicones by DOW

Version June 2020

Content

Where quality building starts

The highly reliable quality of additives and binders from Dow Construction Chemicals form the heart of many innovative products and systems that have since become industry essentials.

With a broad portfolio of chemistries and brands such as DOWSIL™ Silicones, WALOCEL™ Cellulose Ethers, DOW™ Latex Powders, PRIMAL™ and UCAR™ Acrylic Emulsion Polymers and AQUASET™ Acrylic Thermosetting Resins Dow is a leading supplier to customers manufacturingbuilding and construction products around the world.

Regardless of whether your customers are looking forimproved building material performance, superior durability, high-quality end-product, improved workability or demand a specific performance feature we help you meet theirexpectations. Our experts support you in optimisingformulations in order to design and keep key properties of your end products stable and as required – this is where quality building starts.

Enhancing durability and aesthetics

Nature can be a tough adversary. From the moment we start building a structure, the forces of nature are at work: water intrusion, sunlight, wind and abrasion, attack by organisms, and even spills and stains affect appearance and functionality.

Dow silicone based solutions can help you invent the future of building materials protection through:

- Hydrophobic treatments
- Silicone resin and binding products
- Process aids
- Innovative collaboration to meet your specific needs
  - Solvent-dilutable or water-based
  - Integral protection or surface treatments
  - Low VOCs
  - Ease of use

Choose from a wide range of silanes, siloxanes, resins, additives, blends and emulsions to maximize substrate life, reduce maintenance, improve aesthetics and – most importantly – meet customer demands for enhanced performance.

Materials with increased longevity → Buildings with increased sustainability … → … and durable performance → **Lower maintenance and less impact on the environment**

Discover our solutions

CONCRETE

Alkoxy Silanes
XIAMETER™ OFS-6341 Silane
XIAMETER™ OFS-2306 Silane
XIAMETER™ OFS-6403 Silane
XIAMETER™ OFS-6665 Silane

Formulated water repellents
DOWSIL™ IE-6683 Water Repellent Emulsion
DOWSIL™ IE-6694 Water Repellent
DOWSIL™ Z-6689 Water Repellent
DOWSIL™ IE-6682 Emulsion

WOOD

Additives for wood impregnation sealer
Formulated impregnants
DOWSIL™ Z-6690 Water Repellent
DOWSIL™ 6691 Fluid
DOWSIL™ 1-6184 Water Repellent
DOWSIL™ IE-6683 Water Repellent Emulsion
DOWSIL™ 6696 Emulsion
DOWSIL™ 2-9034 Emulsion

Siliconate
XIAMETER™ OFS-0777 Siliconate

Color enhancer for natural stone substrates
Our impregnation chemistry is invisibly protecting building materials whilst enabling to keep the original appearance. In specific cases a color enhancement can be achieved if desired.

FIBER CEMENT

Integral protection
DOWSIL™ Z-6289 Resin
DOWSIL™ IE 6686
DOWSIL™ BY 16-606

Surface treatment
DOWSIL™ IE-6682 Emulsion
DOWSIL™ 520 Dilutable Water Repellent Emulsion
DOWSIL™ IE-6683 Water Repellent Emulsion

NATURAL STONE, SANDSTONE, GRANITE

Siloxane
DOWSIL™ MH-1109 Fluid

Formulated water repellents
DOWSIL™ 520 Dilutable Water Repellent Emulsion
DOWSIL™ IE-6683 Water Repellent Emulsion
DOWSIL™ IE-6694 Water Repellent
DOWSIL™ Z-6689 Water Repellent
DOWSIL™ MR-2404 Resin

GYPSUM

Siloxane
XIAMETER™ MHX-1107 Fluid, 30CS

Siliconate
XIAMETER™ OFS-0777 Siliconate
XIAMETER™ OFS-0772 Siliconate

Resin
DOWSIL™ IE-2404 Emulsion

EIFS/ETICS, RENDERS, STUCCO, MORTAR, TILE GROUTS

Dry powder
DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder
DOWSIL™ GP SHP 60+ Silicone Hydrophobic Powder

Emulsion
DOWSIL™ IE-2404 Emulsion
DOWSIL™ Z-70 Emulsion
DOWSIL™ IE-6683 Water Repellent
DOWSIL™ IE-2610 Emulsion
DOWSIL™ IE-6687 Emulsion

DECORATIVE AND PRECAST CONCRETE

Surface treatment
DOWSIL™ IE-6683 Water Repellent Emulsion
DOWSIL™ IE-6682 Water Repellent Emulsion
DOWSIL™ 520 Dilutable Water Repellent Emulsion
DOWSIL™ IE-6694 Water Repellent
DOWSIL™ Z-6689 Water Repellent
DOWSIL™ MR-2404 Resin

Integral protection
DOWSIL™ Z-6289 Resin
DOWSIL™ IE-6692 Emulsion
DOWSIL™ IE-6686 Water Repellent Emulsion
DOWSIL™ BY 16-846 Fluid
DOWSIL™ BY 16-606

Product selector for protection of building materials

Integral water repellent

Drymix

Hydrophober

- DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder
- DOWSIL™ GP SHP 60+ Silicone Hydrophobic Powder

Mortar/fiber cement precast concrete

- DOWSIL™ Z-6289 Resin
- DOWSIL™ IE-6692 Emulsion
- DOWSIL™ IE-6686 Water Repellent Emulsion
- DOWSIL™ BY 16-846 Fluid
- DOWSIL™ BY 16-606

Antifoam

- XIAMETER™ AFE-0400 Antifoam Emulsion1)
- XIAMETER™ Antifoam 22101)
- XIAMETER™ AFE-0310 Antifoam Emulsion1)

Surface treatment water repellent

Solvent-dilutable

- DOWSIL™ Z-6689 Water Repellent
- DOWSIL™ MR-2404 Resin
- XIAMETER™ OFS-6341 Silane
- XIAMETER™ OFS-2306 Silane
- XIAMETER™ OFS-6403 Silane
- XIAMETER™ OFS-6665 Silane
- XIAMETER™ OFS-6595 Silane
- DOWSIL™ Z-6690 Water Repellent
- DOWSIL™ 6691 Fluid

Strengthening

- DOWSIL™ OFS-6697 Silane

Water-based

- DOWSIL™ IE-6683 Water Repellent Emulsion
- DOWSIL™ IE-6694 Water Repellent
- DOWSIL™ IE-6682 Emulsion
- DOWSIL™ 520 Dilutable Water Repellent Emulsion
- XIAMETER™ OFS-0777 Siliconate
- XIAMETER™ OFS-0772 Siliconate
- DOWSIL™ 2-9034 Emulsion
- DOWSIL™ 6696 Emulsion
- DOWSIL™ IE-2610 Emulsion

For damp proofing application

- DOWSIL™ 1-6184 Water Repellent
- DOWSIL™ IE-6687 Emulsion

Additives for external wall/render

Binding/hydrophobing

- DOWSIL™ IE-2404 Emulsion
- DOWSIL™ Z-70 Emulsion
- DOWSIL™ IE-6683 Water Repellent Emulsion
- DOWSIL™ IE-2610 Emulsion

1) Pre-selection. Wider range of foams control materials available for specific needs and requirements.

Physical and chemical properties of silicones

Silicones are available in various forms and functionalities and can be used in combination to achieve specific properties.

Silicone chemistry: the unique properties of silicones

Molecular characteristics	Physicochemical properties	Applications
• Highly open, flexible and mobile siloxane backbone: - Si - O - Si - O - Si - O - • High bond strength as compared to organics: 435 kJmol^{-1} Si-O vs. 350 kJmol^{-1} C-C	• Low surface tension and energy • High spreading and wetting capabilities • Permeable to gas and water vapor • Heat and UV stability • Compatibility with organics • Weather resistance	• Lubricant • Anti-fouling • Release agent • Aesthetic feel (softness) • High-temperature processing • Can be sterilized • Hydrophobic/hydrophilic • Breathable – gas-permeable

The following table with relevant glossary shows how various forms of silicon can be developed into formulations that help to protect or enhance your construction products.

Silicon chemistry glossary

Silicon > Silica > Silane > Siloxane	Features
Silicon = Si. Second most abundant element on Earth. Atomic number 14. Able to form four stable bonds like carbon	Unique reactivity allows chemistry similar to carbon, but – especially when bonded to oxygen – forms a longer, stronger, more flexible chemical bond.
Silica = SiO_2. The simplest compound of silicon. Very common as sand or quartz (crystalline) or refined forms such as silica fume, precipitated or fumed silica (amorphous)	Silica is used as a mineral reinforcement for many filled polymer systems and exists in many useful forms. Silica fume (microsilica) is an extremely effective pozzolanic material used in concrete to increase strength and chemical resistance and decrease porosity.
Silane. A molecule comprised of one central silicon atom with four attachments. The attachments can be any combination of organic or inorganic groups.	Alkoxy silanes with attached alkyl groups are efficient and effective water repellent treatments for concrete and masonry. Silanes with both organic and inorganic attachments are used as coupling agents with many useful variations.
Silicone or Siloxane. An oligomeric or polymeric compound with repeating Si-O (siloxane) “units”	Inherently resistant to UV, heat and oxidative degradation, silicones can be made as linear fluids, functional polymers and resins. By varying structure, attachments and molecular weight, they can be made into thousands of useful products.
Silicone Emulsion. In silicone technology, typically a silicone polymer suspended in water by means of stabilizing surfactants. More than one ingredient can be suspended within an emulsion.	Emulsion technology allows waterborne formulations to be used to deliver many types of ingredients that would otherwise require solvents or would be too viscous to use effectively.
Silicon resin are crosslinked, three-dimensional networks of highly branched siloxane polymers.	Silicone resins can be tailored to suit many applications by varying the ratio of branched and linear siloxanes and by attaching different functional groups. In high-performance water repellent formulations and coatings, silicone resins enhance water repellency and weatherability. Some silicone resins can form films and be used to enhance coating formulation based on organic resins.
Formulations and Blends. Multi-ingredient compositions intended for specific uses.	Formulated products can take advantage of more than one type of material in a common package. For example, silane reactivity and penetration can be combined with siloxane mobility and water beading. Blends and formulations can be made with basic fluids, diluted with solvent, made into emulsions or even transformed into powders.

Saving resources and energy through building protection

Prolonging the livespan of building materials

Most siloxanes and silanes are very small molecules and, when applied to the surface of a suitable substrate, penetrate deeply. They react with the substrate and among themselves. When cured, they allow water vapor transmission while preventing liquid water – which could contain dissolved chloride ions or acids – from passing into the substrate. This way Dow silicones contribute to the durability of building materials and help save resources and maintenance.

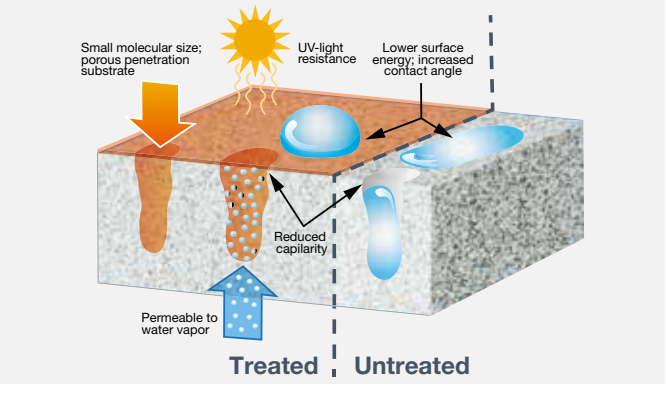


Figure 1. Silicone-based products penetrate deeply, forming a repellent layer within the substrate

SiOH groups formed when the silane reacts with water (hydrolysis) can further react with SiOH groups (via condensation) in the substrate and form chemical attachments. Condensation also occurs between silanes, forming an Si-O-Si polymer. The alkyl groups (R groups) orient away from the surface to very effectively repel water.

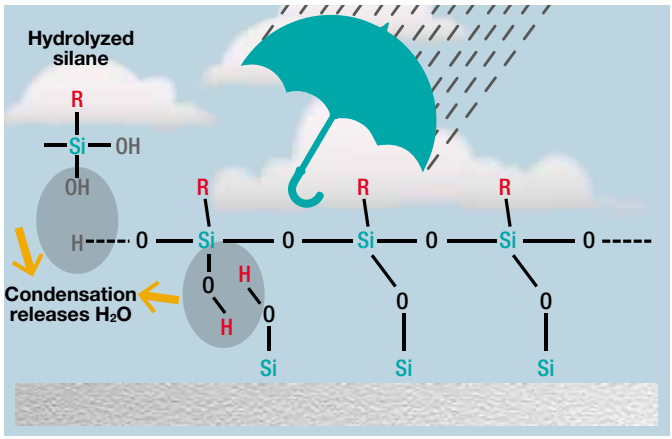


Figure 2. SiOH groups chemically bond to the substrate and condense to form a polymer film on the surface

Protecting buildings saves energy

Beyond the cost and resource savings of longer-lasting buildings, Dow silicone products can be key components for saving energy costs, too. With Dow hydrophobic materials you can help to make your customers' buildings more energy-efficient.

Dow silicones reduce two main causes of structure heat loss:

- **Heat loss from evaporation of absorbed water in untreated materials**
  As water evaporates, changing from liquid to vapor, it draws heat energy, cooling the substrate and structure and increasing energy consumption.
- **Thermal conductivity**
  Testing shows that thermal conductivity of wet material is higher than that of dry material.

Dow hydrophobing technologies help reduce thermal conductivity and increase energy efficiency.

Figure 3. Infrared imaging of treated and untreated substrates

The reduced heat loss from evaporation of treated, dry substrates compared to untreated, wet substrates is visibly demonstrated with infrared imaging.

Figure 4. Illustration of potential benefits of treated versus untreated façades

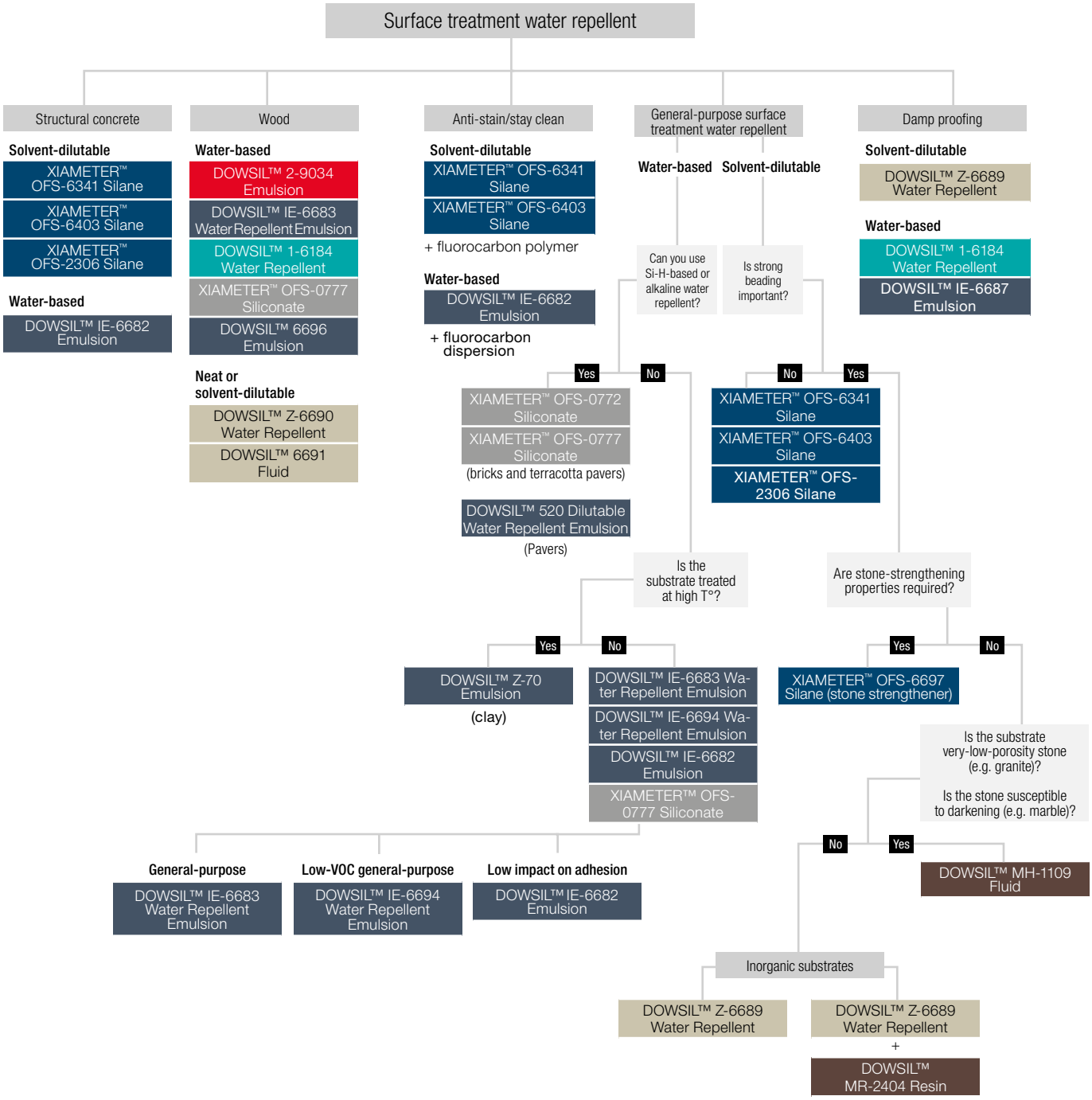
Product properties

Product type	Product name	Dilution system (if needed)	General description
Silane/siloxane emulsions (water-based)	DOWSIL™ 520 Dilutable Water Repellent Emulsion	Water	Silane/SiH siloxane emulsion blend
	DOWSIL™ IE-6682 Emulsion	Water	Silane/alkoxy resin emulsion blend, contains no free siloxane
	DOWSIL™ IE-6683 Water Repellent Emulsion	Water	Silane/siloxane resin blend
	DOWSIL™ IE-6687 Emulsion	Water	Silane/functional resin emulsion blend
	DOWSIL™ IE-6692 Emulsion	Water	Silane/alkoxy resin emulsion blend
	DOWSIL™ IE-6694 Water Repellent	Water	Low-VOC (<100 g/L) silane/siloxane emulsion blend
	DOWSIL™ 6696 Emulsion	Water	Organosiloxane emulsion
	DOWSIL™ Z-70 Emulsion	Water	Silanol-functional siloxane emulsion
Water-based siloxane	DOWSIL™ 1-6184 Water Repellent	Water	Water-soluble siloxane
Silane/siloxane blends (solvent-dilutable)	DOWSIL™ Z-6689 Water Repellent	Solvent	Silane/siloxane blend, no added solvent
	DOWSIL™ Z-6690 Water Repellent	Solvent	Silane/silicone resin blend
	DOWSIL™ 6691 Fluid	Solvent	Silane/silicone resin blend
	DOWSIL™ Z-6695	Solvent	Siloxane/silicone resin blend
Silicone resin emulsion	DOWSIL™ IE-2404 Emulsion	Water	Silicone resin emulsion
	DOWSIL™ IE-6686 Water Repellent Emulsion	Water	Emulsion of silicone resin
Hydrophobic powders	DOWSIL™ GP SHP 50 Silicone Hydrophobic Powder	Dry ingredient	Silane/siloxane-based powder
	DOWSIL™ GP SHP 60+ Silicone Hydrophobic Powder	Dry ingredient	Resin/siloxane-based powder
Specialty fluids	DOWSIL™ BY 16-846 Fluid	Solvent[1]	Functional siloxane
	XIAMETER™ MHX-1107 Fluid, 30CS	Solvent	Linear SiH-functional siloxane
	DOWSIL™ MH-1109 Fluid	Solvent	SiH-functional siloxane
	DOWSIL™ Z-6289 Resin	Solvent[1]	Alkoxy-functional silicone resin
	DOWSIL™ MR-2404 Resin	Solvent	Alkyl-functionalized low-viscosity silicone resin
	DOWSIL™ BY 16-606	Solvent[1]	Functional siloxane
	XIAMETER™ PMX-0930 Silanol Fluid	Solvent	Silanol-functional siloxane
Siloxane/organic emulsion	DOWSIL™ 2-9034 Emulsion	Water	Silane/organic polymer emulsion
Siliconates	XIAMETER™ OFS-0772 Siliconate	Water	Sodium methyl siliconate
	XIAMETER™ OFS-0777 Siliconate	Water	Potassium methyl siliconate
Alkyl alkoxy silanes	XIAMETER™ OFS-6341 Silane	Solvent	Alkyl ethoxy silane
	XIAMETER™ OFS-6403 Silane	Solvent	Alkyl ethoxy silane
	XIAMETER™ OFS-6697 Silane	Solvent	Tetraethoxysilane
	XIAMETER™ OFS-2306 Silane	Solvent	Alkyl methoxy silane
	XIAMETER™ OFS-6665 Silane	Solvent	Alkyl methoxy silane

[1] Products can be used under certain conditions in water-containing mixtures. Please consult Dow R&D or refer to the specific product data sheet for additional details.

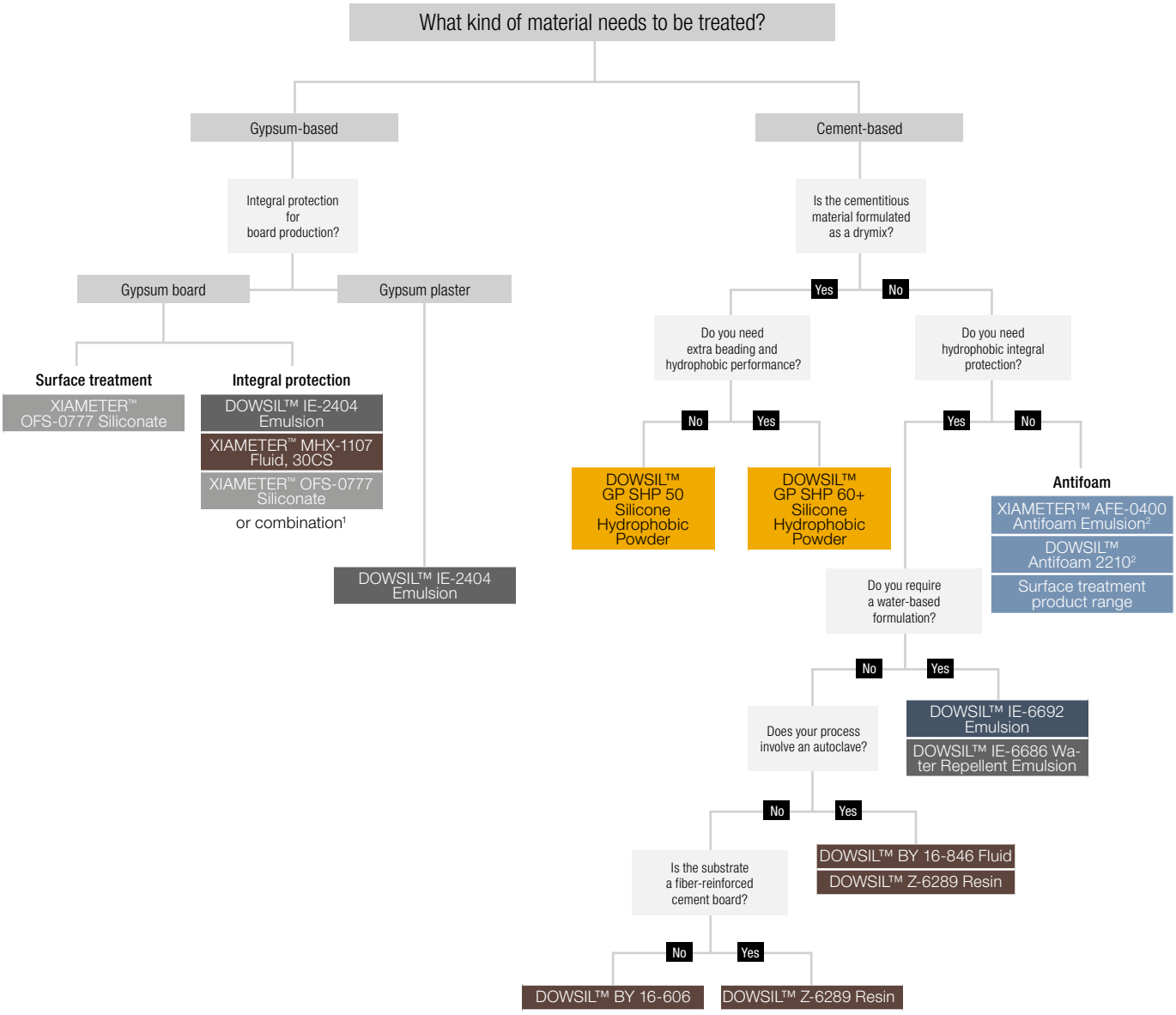
Application/substrate/pH type	Active ingredient %	Typical actives usage level	Specific gravity	Flash point, °C (°F)
Multisurface water repellent; neutral and moderately alkaline substrates; pH 7-10	40	5 to 20	0.99	>100 (212)
Surface treatment (“primer”) for concrete or cementitious materials	52.5	5 to 20	0.95	>100 (212)
Multisurface water repellent; neutral and moderately alkaline substrates; pH 7-10	40	5 to 20	1	>100 (212)
Damp proofing	52.5	5 to 20	0.98	>100 (212)
Integral water repellent	52.5	0.2 to 0.8 vs. cement content	0.95	>100 (212)
Multisurface water repellent; neutral and moderately alkaline substrates; pH 7-10	60	5 to 20	1.02	>100 (212)
Wood	40	5 to 10	0.99	>100 (212)
Hydrophobic additive for paint and render; additive for post-treatment for substrates with pH 7-10	60	0.15 to 0.5	0.99	>100 (212)
pH neutral to 10	>90	3.5 to 7.5	1.05	27 (81)
Multisurface water repellent; neutral and moderately alkaline substrates; pH 7-10	>95	5 to 15	0.96	10 (50)
Wood	>95	5 to 15	1.02	44 (111)
Wood	>95	5 to 15	1.025	100 (212)
Multisurface water repellent; neutral and moderately alkaline substrates; pH 7-10	>95	5 to 15	1.02	44 (111)
Additive for renders/paints/stucco	50	3 to 10	1.02	>100 (212)
Integral water repellent	30	0.2 to 0.8 vs. cement content	0.99	50 (122)
Hydrophobic powder additive in cementitious-based dry mix	20	0.2 to 1	0.61	>100 (212)
Hydrophobic powder additive in cementitious-based dry mix	20	0.1 to 1	0.7	>100 (212)
Additive for integral protection of factory-manufactured autoclave light concrete	>95	0.1 to 0.5	0.92	>100 (212)
Gypsum boards	>95	0.1 to 0.5	1	93 (200)
Natural stone: limestone, sandstone, marble, granite; pH neutral to 12	>95	5 to 30	0.98	30 (86)
Integral protection of fiber cement boards	>95	0.1 to 0.5 vs. dry composition	0.98	>100 (212)
Neutral and alkaline mineral substrates such as brick, sandstone or cement-based materials; additive for post-treatment for substrates with pH 7-10	>95	2 to 10	1.1	95 (203)
Additive for integral protection for neutral and alkaline factory-manufactured ALC boards; for air cure	>95	0.1 to 0.5	0.94	>80 (176)
Siloxane polymer to formulate water repellent material	>95	0.5 to 5	0.98	100 (212)
Hydrophobic additive for wood sealer formulations	50	2 to 8	0.94	>100 (212)
Bricks, wood; pH neutral to 10	32	0.5 to 3	1.25	>100 (212)
Bricks, wood; pH neutral to 10	40	0.5 to 3	1.29	>100 (212)
Alkaline or neutral substrates such as concrete, mortar and brick, stone; pH slightly alkaline to 12	>95	5 to 100	0.88	65 (149)
Alkaline or neutral substrates such as concrete, mortar and brick, stone; pH slightly alkaline to 12	>95	5 to 100	0.88	62 (144)
Alkaline or neutral substrates such as concrete, mortar and brick, stone; pH slightly alkaline to 12; may be used as densifier for concrete	>95	5 to 100	0.93	54 (113)
Alkaline or neutral substrates such as concrete, mortar and brick, stone; pH slightly alkaline to 12	>95	5 to 100	0.92	32 (90)
Alkaline or neutral substrates such as concrete, mortar and brick, stone; pH slightly alkaline to 12	>95	5 to 100	0.91	66.5 (152)

Product selector for surface treatment of building materials



- Silane/siloxane emulsions (water-based)
- Water-based siloxane
- Silane/siloxane blends (solvent-dilutable)
- Silicone resin emulsion
- Hydrophobic powders
- Specialty fluids
- Siloxane/organic emulsion
- Siliconates
- Alkyl alkoxy silanes

Product selector for integral protection of building materials



1 For formulating safe and effective gypsum integral protection, contact your Dow Corning Technical Service associate.
2 Additional antifoam emulsions are available. Please contact your Dow Corning Technical Service associate for assistance.

About Dow

Dow (NYSE: DOW) combines the power of science and technology to passionately innovate what is essential to human progress. The Company is driving innovations that extract value from the intersection of chemical, physical and biological sciences to help address many of the world's most challenging problems such as the need for clean water, clean energy generation and conservation, and increasing agricultural productivity. Dow's integrated, market-driven, industry-leading portfolio of specialty chemical, advanced materials, agrosciences and plastics businesses delivers a broad range of technology-based products and solutions to customers in approximately 180 countries and in high-growth sectors such as packaging, electronics, water, coatings and agriculture. In 2014, Dow had annual sales of more than $58 billion and employed approximately 53,000 people worldwide. The Company's more than 6,000 product families are manufactured at 201 sites in 35 countries across the globe. References to "Dow" or the "Company" mean The Dow Chemical Company and its consolidated subsidiaries unless otherwise expressly noted. More information about Dow can be found at www.dow.com.

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