CHEM-CRETE
TERMINOLOGY HANDBOOK

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This document provides a list of key terms frequently encountered by engineers and researchers when addressing the waterproofing of concrete structures, as well as when reviewing technical and scientific publications related to Chem-Crete technology.

The terminology is presented in a simplified manner and is not intended to be exhaustive. For formal definitions of some terms, users are encouraged to consult relevant ASTM, ACI, and other professional guidelines, with some standard definitions included in this listing.

	Terminology	Brief description
A		
	Absolute humidity	The actual quantity of water vapour per unit volume of air (mass of water vapour (moisture) per cubic meter volume of air).
	Absorption	Taking up of one substance by anther substance, also, the conversion of radiant energy into energy of different form.
	Acid attack	Reactions of cement paste and concrete constituents with acidic solutions which lead to paste degradation and steel corrosion. It also includes carbonation (see carbonation).
	Additives	Materials (in liquid or powder form) that are added to fresh concrete mixture for manipulating certain properties including chemical admixtures, mineral admixture (or supplementary cementitious materials) and other materials such as enhancers.
	Admixture	"A material other than water, aggregates, cementitious material, and fibre reinforcement that is used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing." ASTM C125-15b
	Aggregate	Granular material, such as sand, gravel, or crushed stone used as part of concrete or mortar structure.
	Air entrainment	Small microscopic, regular (e.g. spherical) air voids that are intentionally incorporated in concrete structure (for controlling the impact of freezing and thawing cycles), usually with a volume percentage in the range of 4-8%.
	Air entrainment admixtures	Chemicals (e.g. suitable surfactants) added to enhance the incorporation of small regular air voids in concrete.
	Air entrapment	Large irregular, macro-air voids that are unintentionally incorporated in concrete structure due to mixing and other handling factors, usually 50 μm to 1 mm (or above), with a volume percentage of up to 2%.

	Air permeability	The coefficient of permeation flow of air (and gases) through a medium (concrete) under pressure, which reflects the ease of flow of gases to pass through the medium.
	Air voids	Includes entrained air and entrapped air (see each).
	Algae	A group of microorganisms that grow on concrete by the conversion of carbon dioxide from the atmosphere to organic carbon, utilizing light energy, and consuming calcium and silica from the cement paste. Their growth leads to "Microbiologically Influenced Deterioration" (MID) of the paste and reinforcing steel bars (Microbiologically Influenced Corrosion (MIC)).
	Alkali aggregate reaction (AAR)	Chemical reactions of alkaline content of cement in either mortar or concrete with reactive mineral compounds of reactive aggregates that causes durability problems (including ACR and ASR as defined below).
	Alkali carbonate reaction (ACR)	A type of AAR, that is encountered when using aggregates, containing $CaMg(CO_3)_2$, such as dolomitic rocks, causing concrete deterioration within a time scale of 2-3 years.
	Alkalinity	The level of alkaline (basic) material in cement or concrete.
	Alkali–silica reactions (ASR)	A type of AAR, that involves slow reactions of alkaline content from cement with amorphous or non-crystalline silica content (SiO_2) from reactive aggregates forming an expansive gel that causes cracking/durability problems within a time scale of 10-20 years.
	American Concrete Institute (ACI)	A leading authority and non-profit technical society and standards-developing organization that issues various types of guides, specifications, classifications and other technical resources and educational programs for the concrete industry, including concrete design, construction, materials, etc.
	Autogenous shrinkage	A self-induced drying shrinkage caused by the suction of water from fine gel pores and some capillary pores for the hydration of the unreacted cement leading to destructive effect from the reduction in net volume of cementitious paste due to internal stresses that cause crack development (usually encountered in concrete made with low w/c ratios).
B	**Barrier**	Sheet and/or film forming material (e.g. polymeric material) that produces an external, impermeable protection against water penetration and prevents water ingress to the concrete.

	Bio-deterioration	Destructive effects of microorganism growth on concrete surfaces which may cause durability issues and other effects such as discoloration.
	Biological degradation	Similar to bio-deterioration: Destructive effects (on concrete) from the activity of microorganism that grows on concrete and lead to discoloration and causes durability threats.
	Breathability	The ability to release moisture (as vapor) from concrete which reduces the internal humidity
C	**C3S**	(Tricalcium silicate or $3CaO \cdot SiO_2$): The main constituent of cement $3CaO \cdot SiO_2$ that hydrates with water to produce the main binding material.
	C2S	(Dicalcium silicate or 2CaO·SiO2): The second main constituent of cement $2CaO \cdot SiO_2$ that hydrates with water to produce the main binding material.
	Calcium carbonate	The main constituent of limestone ($CaCO_3$), the powder of which is added to cement, or is generated by the reaction of carbon dioxide with calcium ions in the cement.
	Calcium hydroxide (CH)	The main by-product of the cement hydration ($Ca(OH)_2$) that is responsible for the alkalinity of the paste and is the source of calcium ions.
	Calcium oxide (CaO)	Lime, formed during cement production and combined with silica to form di and tri-calcium silicates. It is also used as binding material in certain pastes.
	Calcium silicate hydrate gel (C−S−H gel)	The product of cement hydration that is formed from the reactions of di and tri-calcium silicates with water and creates stable, fine colloidal, faffy, foil-like crystalline structure which clusters into a gel with binding/cementing characteristic.
	Capillary	Pores which exist between and within C-S-H crystals found in paste, mortar and concrete structure, and provide flow channels for water.
	Capillary absorption	Water penetration through a porous structure (e.g. paste, mortar or concrete) by wicking flow under no, or minimal, hydrostatic pressure.
	Capillary Action	Similar to capillary absorption.
	Capillary blocking	The creation (e.g. precipitation) of particulate materials (e.g. crystals) within the permeable pores of cement paste in concrete.

Capillary pores	The medium to large pores within the cement paste that form connected networks creating channels for water penetration.
Capillary porosity	The fraction of medium to large pores within the cement paste that form connected networks creating channels for water penetration.
Capillary sorption coefficient	The coefficient of water penetration, which reflects the ease of wicking flow of water through under no, or minimal, hydrostatic pressure, through porous structure (e.g. paste, mortar or concrete),
Capillary suction	Similar to capillary absorption: water penetration through porous structure (e.g. paste, mortar or concrete) by wicking flow under no, or minimal, hydrostatic pressure.
Carbonation	The reaction of carbon dioxide with calcium ions in the cement precipitation non-expansive limestone ($CaCO_3$), which is a binding and pore-filling material and altering the level of alkalinity of concrete and thus forms one of the popular acid attacks.
Carbonation shrinkage	A carbonation destructive effect from the reduction in net volume of cementitious paste due to internal stresses that cause crack development and result in a loss of integrity and strength of concrete.
Cement	Reactive hydraulic material composed of inorganic compounds that sets and hardens by chemical reaction with water and is capable of binding material of aggregate particles.
Cement hydration	The reactions of di and tri-calcium silicates (and other cement constituents) with water creating the main binding material of concrete.
Cementitious coatings	The formation of an external, impermeable, thin "film" from cement hydration (in a mixture of cement, sand and active ingredients) for protection against water penetration and preventing or minimizing water ingress to concrete.
Cementitious material	"An inorganic material or a mixture of inorganic materials" that sets and develops strength by chemical reaction with water by formation of hydrates and is capable of doing so under water." (ASTM)
ChemCretex	A one-component, crystalline, capillary-waterproofing cementitious coating composed of a proprietary blend of Portland cement, graded silica sand and active ingredients that sets by reaction with water and builds pore-blocking crystals.

Chemical shrinkage	A natural reduction in net volume of cementitious paste that occurs during hydration because the reaction products occupy less volume than originally occupied by the water and unreacted cement.
Chemical weathering	Changes in the composition, color and/or texture of exposed material to an environment.
Chloride attack	Chloride attack is the consequence of penetrations of chloride ions and water and chemical reactions that lead to destructive effects of paste disintegration (destabilization from chloride binding to the cementitious surfaces such as C-S-H gel) and corrosion of steel bars (destructing the protective film).
Chloride ions penetration	The transport of chloride ions through water-filled concrete capillaries by diffusion (under the effect of concentration difference) and by chloride carrying with water penetration.
Concrete	A composite material that is formed from the hydration of "mixture of hydraulic cement, aggregates, and water, with or without admixtures, fibers, or other cementitious materials." ACI Concrete Terminology
Concrete durability	"The ability of concrete to resist weathering action, chemical attack, abrasion, and other conditions of service." ACI
Consistency	"The relative mobility or ability to flow" (ASTM. (2003). C125215b) and it is determined by measuring slump, using the standard cone test according to ASTM C143.
Contact angle	The angle between the liquid droplet (e.g. water) and a solid surface, which is usually used to classify surfaces into levels of hydrophobicity and hydrophilicity.
Corrosion	Surface destructive chemical attack from reactions of soluble aggressive ions (such as chlorides and acidity) with reinforcing steel bars.
Corrosion-inhibiting admixture	Admixture that is added to concrete mixtures to reduce the rate of steel corrosion due to chemical attack from soluble aggressive ions (e.g., chloride ions) such as amine carboxylates amino ester organic emulsion, chromates, and phosphates.
Cracking	Destructive effect on concrete when internal tensile stresses are induced (by chemical or thermal actions) which restrain the concrete structure and then cause localized rupture when the induced stresses exceed the tensile strength of concrete.

	Crystal growth	Increasing the size of the crystals by the adsorption (binding) with water vapor (for hygroscopic crystals) or by the swelling of water (for the hydrophilic crystals).
	Crystalline admixture	Admixture that is added to concrete mixtures for precipitating crystals within the concrete pores for pore-blocking and reducing water permeability.
	Crystalline waterproofing	Pore-blocking or filling for reducing water permeability through the precipitation of crystals (hygroscopic and/or hydrophilic crystals) within the concrete pores.
	Crystallization process	Precipitation of crystals (hygroscopic and/or hydrophilic crystals) within the concrete pores.
	Curing of concrete	"Action taken to maintain moisture and temperature conditions in a freshly-placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop." ASTM C125-15b.
D	**Dampproofing**	Pore-blocking or filling for reducing water permeability (and/or pore-lining for reducing capillary absorption of water).
	De-wetting	Preventing or minimizing the spread of water on a surface (or wetting) due to water-repellency characteristics.
	Densifiers	A liquid material for treating concrete surface or additions to concrete mixture for increasing the density of concrete through reactions (usually silicate-based) or filling.
	Departments of Transportation (DOT)	A government agency/authority responsible for managing transportation, coordinating transportation-related matters, planning and coordinating related transportation projects.
	Dicalcium silicate	(C2S or $2CaO \cdot SiO_2$): The second main constituent of cement $2CaO \cdot SiO_2$ that hydrates with water creating main binding material.
	Diffusion	The transport of ions or soluble molecules within a medium (e.g. concrete) from a region of high concentration to a region of low concentration which is governed by the atomic or molecular motion of the diffusing species within the medium (or sometimes the ionic mobility).
	Drying shrinkage	Volume reduction (of concrete) which is induced in the cement paste when water evaporates from hardened concrete subjected to conditions of wind flow creating gradients of temperature and humidity, leading to internal stresses and concrete cracking.

	Dual crystallization waterproofing	Pore-blocking or filling for reducing water permeability through the precipitation of two types of crystals (hygroscopic and hydrophilic) within the concrete pores.
	DCE	Dual-crystallization engineered waterproofing (sealer) which refers to Chem-Crete Pavix CCC100 topical treatment.
	Dual-crystallization waterproofing	Dual-crystallization engineered waterproofing which refers to Chem-Crete Pavix CCC100 topical treatment.
	Durability	"The ability to resist weathering action, chemical attack, abrasion, and other conditions of service." ACI
	Durable concrete	Concrete structure that is capable of resisting weathering action, chemical attack, abrasion, and other conditions of service.
E	**Effective porosity**	The relative volume of pores (permeable pores) that are involved in the effective flow channel in the pore structure and it composes about 20-250% of the total porosity, which is responsible for water permeation within concrete.
	Efflorescence	A deposit of (white) salts on a surface (e.g. concrete) from the evaporation of water (by evaporation) when an emerged solution from with the structure is exposed to surrounding air.
	Erosion	A deterioration surface impact (on concrete) from mechanical actions (e.g. abrasion and wear) caused by surface loading of moving mechanical parts over the surface.
	Ettringite	A cement hydration product in the form of weak long crystals ($C_6AS_3H_{32}$) that are produced from the rapid exothermic (heat-releasing) reaction of tricalcium aluminate with the gypsum and causes rapid setting of the cement without a significant contribution to cement strength.
F	**Flammable**	Easy to ignite.
	Fly ash	A type of supplementary cementitious material (SCM) forming a cementing binder and used as a partial replacement of cement including type C (with major content of CaO e.g. 23%) and type F with high content of SiO2. "a finely divided residue that results from the combustion of ground or powdered coal and that is transported by flue gases" (ASTM C618).
	Freezing and thawing cycles	A major durability problem resulting from the sequential events from changes of concrete temperature below freezing and above freezing temperature leading to volume expansion and

		cracking from the induced internal stresses when water freezes, then creating larger pores with a loss in mass when water melts back, leading to a reduction in mechanical characteristics.
	Frost	A thin, icy layer that forms/deposits on a solid surface (e.g. concrete) due to the phase change, "condensation", of water vapor into minute ice crystals when the temperature drops below the freezing-point of water.
	Fungus	A type of organisms that can attack concrete through growth activity.
G	**Gas permeability**	The coefficient of permeation flow of gases through a medium (concrete) under pressure, which reflects the ease of flow of gases to pass through the medium.
	Gel pores	Interlayer micropores (fine pores less than 0.5 nm) that exist within hydration layers and are enclosed in cement hydration crystals (C-S-H gel) with little impact on the mechanical properties or permeability of concrete as they are not open for permeation and do not create flow channels, but they are involved in shrinkage.
	Granite	A very hard crystalline rock, consisting mainly of quartz, feldspar, and hornblendes.
	Granite aggregates	Crushed hard rock of granular structure, from granite rock, used in road and airport constructions.
H	**Hardness**	The resistances of a substance to surface indentation (plastic deformation).
	Hydration	The association (e.g. reaction) of a mineral compound (e.g. a cement constituent) with water leading to cementing/binding effect.
	Hydraulic cement	Cement that sets and hardens by chemical reaction with water (hydration) and is capable of doing so under water (ACI 225R)
	Hydrogen bonding	Attraction between hydrogen in water molecule and an electronegative atom (such as oxygen, chlorine, or fluorine) in another compound, which prompts, for example, absorbing water in gel pores making the water non-flowable and promotes water swelling within pores.
	Hydrophilic crystalline gel	Cluster of crystals that have affinity for water, with fine porous network that promotes water swelling and then gel expansion.
	Hydrophilic crystalline admixture	Material (usually powder) that is added to concrete mixture and then precipitate during concrete curing as crystals within

	concrete pores leading to pore-blocking and reducing water permeability through concrete.
Hydrophilic crystalline waterproofing	Pore-blocking or filling for reducing water permeability through the precipitation of water-absorbing/hydrophilic crystals within the concrete pores.
Hydrophilic crystal	Crystal that has affinity for water with fine pores that promotes water swelling and then gel expansion.
Hydrophilicity	A characteristic of water attraction (water-loving) that promotes water swelling and capillary absorption within porous solids (e.g. concrete).
Hydrophobic admixture	Material (usually powder) that is added to concrete mixture and then reacts at the surface of pores during concrete curing forming a molecular layer with the characteristic of water-repelling that prevents/minimizes surface wetting, water swelling or capillary absorption.
Hydrophobic material	Material that has the characteristic of water-repelling that prevents/minimizes surface wetting, water swelling or capillary absorption.
Hydrophobic impregnation	Liquid material that is applied (e.g. sprayed) at the surface of concrete (as a sealer) and then reacts at the surface of pores forming a molecular layer within a thin surface section with the characteristic of water-repelling that prevents/minimizes surface wetting, water swelling or capillary absorption.
Hydrophobic integral waterproofing material	Material (usually powder) that is added to concrete mixture and then reacts at the surface of pores during concrete curing forming a molecular layer with the characteristic of water-repelling that prevents/minimizes surface wetting, water swelling or capillary absorption.
Hydrophobicity	A characteristic of air-loving behavior (water-repelling) that prevents/minimizes surface wetting, water swelling or capillary absorption within porous solids (e.g. concrete).
Hydrostatic pressure	A uniform pressure exerted perpendicularly on a surface (e.g. concrete) by a homogenous liquid (a head of water) (drives water permeation in concrete).
Hygroscopic crystal	Crystal that interacts with water-vapor such that its size growth with reversible adsorption of moisture at high humidity condition and release it by desorption at low humidity condition.

	Hygroscopic interaction	The reversible adsorption/ desorption of water-vapor allowing crystal growth by adsorbing moisture at high humidity condition and crystal shrink by desorption at low humidity condition.
	Hygroscopicity	A characteristic of water-vapor attraction by a solid through reversible adsorption/desorption allowing crystal growth by adsorbing moisture at high humidity condition and crystal shrinking by desorption at low humidity condition.
I	**Ice adhesion (on concrete)**	The level of attachment/bonding of the build-up of ice to a surface (by physical, mechanical and chemical interactions between the ice and the solid surface) indicated by the work or the free energy required to detach the ice from a surface.
	Icephobicity	Simply, it is "ice-repelling", which reflects the surface resistance to ice adhesion.
	Impermeability of concrete	The total restriction of water flow (permeation) through concrete.
	Impermeable pores	Pores that are not filled with water when the concrete is submerged for a prescribed time period and they do not provide flow channels for water; their water content is usually not-free or non-flowable and is physical attached to the surface (by adsorption and hydrogen bonding).
	Initial Surface Absorption Test (ISAT)	A British Standard test designed to compare the water absorption properties of concretes in situ through an equation describing water absorption through an ISAT geometry circular absorbing surface.
	Integral hydrophobic waterproofing material	Material (usually powder) that is added to concrete mixture and then reacts at the surface of pores during concrete curing forming a molecular layer with the characteristic of water-repelling that prevents/minimizes surface wetting and hence water swelling or capillary absorption.
	Integral waterproofing (of concrete)	The process of redesigning the pore structure by pore-blocking or filling (e.g. by crystallization) and/or pore-lining (e.g. by hydrophobic materials) for reducing water penetration through concrete, which is usually used for additions to concrete mixtures, but can also be used for penetrating treatment.
	Interfacial transition zone (ITZ)	A thin layer (10-50 μm) of the cement paste phase adjacent to the aggregates which is weak, less dense and more porous (and more permeable) than the bulk of the paste.

	Internal waterproofing admixture	Material that is added to concrete mixture for redesigning the pore structure by pore-blocking (e.g. by crystallization) and/or pore-lining (e.g. by hydrophobic materials) for reducing water penetration through concrete.
	Ion exchange	The reversible interchange of ions between a solid and a liquid (solution) surrounding the solid, without a substantial change in structure of the solid.
	Iowa Department of Transportation (Iowa DOT)	A government agency/authority of the State of Iowa that is responsible for managing transportation, coordinating transportation-related matters, planning and coordinating related transportation projects.
	Isolated pores	Pores within the C-S-H gel that cannot be filled with free water when the concrete is submerged; but contains not-free or non-flowable water that is physically attached to the surface (by adsorption and hydrogen bonding).
L	**Lime**	Calcium oxide, CaO; prepared by heating limestone to over 800 ^{o}C.
	Limestone	Sedimentary rock containing mainly calcium carbonate $CaCO_3$.
	Limestone aggregates	A granular material produced from rock deposits (contains a high content of $CaCO_3$) that is used as coarse particles in concrete mix designs.
	Limestone (1L) cement	(Type 1L cement): A blended cement made of Portland cement with a significant percentage of limestone powders inter-grinded, blended or added at the time of mixing concrete at certain percentage (e.g. 15%).
	Liquid admixtures	Chemical solution containing active ingredients that is added to concrete mixture and then interacts with cement for manipulating certain (fresh or hardened) concrete property.
	Liquid membrane	Film forming liquid-applied coatings that sets and hardens by reactions and form nonpermeable film on concrete surface with minimal or no penetration within the pores.
	Lithium (compounds) admixtures	Lithium-based compounds (such as lithium nitrate, nitrite, carbonate, and hydroxide) which are added to concrete mixture for reducing/mitigating the Alkali-Silica Reactions (ASR) through lithium bearing with silicate gel converting it into non-swelling particles and increasing the stability of the reactive silica in aggregate.

M	**Macropores**	Large capillary pores (50 nm-0.5 μm, or up to 3 μm) which exist between C-S-H crystals and provide flow channels for water. It is also used to refer to air entrapped and air-entrained voids.
	Magnesium chloride	Deicing salt ($MgCl_2$) applied over concrete pavements for reducing ice adhesion and easy removal of ice, but it leads to harmful reactions with concrete by its two ions (magnesium and chloride).
	Mass concrete	"Any volume of structural concrete in which a combination of dimensions of the member being cast, the boundary conditions, the characteristics of the concrete mixture, and the ambient conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reduction in the long-term strength as a result of elevated concrete temperature due to heat from hydration." ACI CT-18 (The minimum length varies from 0.5 m to 2.4 m).
	Membrane	Film forming material (usually polymer-based) in the forms of semisolid sheets, polymeric liquids, dispersions, and emulsions that is applied at the concrete surface and form nonpermeable membranes with minimal or no penetration within the pores.
	Microbiologically Influenced Corrosion (MIC)	Biocorrosion of steel through an electrochemical process in which the organisms (corrosion-enhancing bacteria) affect the harshness and progress of corrosion by increasing the acidity (through its bioactivity) that is required for corrosion.
	Microbiologically Influenced Deterioration (MID)	Concrete destructive effect (e.g. disintegrating cement paste) resulting from the growth of microorganisms that creates small cavities and initiates sites for cracks development.
	Mitigating ASR	Lessening or diminishing the Alkali silica reactions in concrete (e.g. using low-alkali cement or incorporating admixtures).
	Mix proportioning	Specifying types and quantities of the ingredients in the concrete mixture.
	Modified concrete	Concrete that includes additives or specific functional admixture for modifying its mechanical, waterproofing and/or durability characteristics.
	Mold growth	Biological activity that drives the development of size and spread of mold-microorganism on concrete and leads to discoloration and causes durability threats.
	Multi-crystallization (crystalline) enhancer	Liquid addition that is added to concrete mixture for precipitating multiple types of crystals within the concrete pores for pore-blocking (reducing porosity and water

		permeability) and pore lining (capillary suction and water absorption).
	MCE	Multi-crystallization (crystalline) concrete waterproofing and enhancer Type S Admixture (see above).
O	**Ordinary concrete**	Concrete that is made using typical mix designs without including additives or specific functional admixture (for modifying its mechanical, waterproofing and/or durability characteristics).
	Ordinary Portland cement (OPC)	The standard cement binder used in typical concrete mixes that is composed of di and tri-calcium silicates (C_3S and C_2S), aluminate (C_3A), and aluminoferrite (C_4AF), all of which react with water and develop a hardened OPC paste.
	Organosilicon compounds	Compounds containing carbon–silicon bonds (e.g. silane – siliconate – siloxane) and used to modify the surfaces of pores to become hydrophobic through reaction in which an OH group (from the compound) combines with an OH group at the cementitious substrate forming a chemical bond.
	Organosilicon hydrophobes	Organosilicon compounds (see above).
	Over-hydrophobicity	High water repelling surface characteristic (of concrete) achieved when the static water contact angle is in the range of 120-150^{o}.
P	**Paste**	The paste is made of cement that hardens with water. Cement paste includes a hardened mixture of hydration products, bound and free water, and possibly other contents and unreacted cement.
	Pavix	Dual (hygroscopic and hydrophilic) crystallization (pore blocking) and hydrophobic (pore lining) topical treatment of concrete (and cementitious surfaces) for reducing porosity and creating impermeable surface and enhancing durability.
	Penetration depth (of a sealer)	The distance within concrete (from the surface) to which a topically applied liquid sealer reaches and modify the pores.
	Penetrating sealer	"A liquid that is applied to the surface of hardened concrete, is colorless, is absorbed by the concrete, leaves little or nothing visible on the surface, and either prevents or decreased the penetration of liquid or gaseous media". CT-18 Concrete Terminology.
	Permeability	The coefficient of permeation flow of a fluid (liquid or gas) through a medium (concrete) under pressure, which reflects the ease of flow of gases to pass through the medium.

Permeability reducing admixtures (PRA)	Admixtures added to concrete mixture for creating pore-blocking or filling effect (and may include pore-lining effect) for reducing water permeability.
Permeability reducing admixtures for hydrostatic pressure (PRAH)	PRA (see above) but specially for reducing permeation flow under hydrostatic pressure (e.g. through precipitation of crystals (hygroscopic and/or hydrophilic crystals) within the concrete pores (reducing porosity and densifying).
Permeability reducing admixtures for nonhydrostatic pressure (PRAN)	PRA (see above) with functionality for reducing capillary absorption or wicking flow (by forming a water-repellent surface) in the absence of hydrostatic pressure (the term "permeability reducing" is used by ACI 212.3R-10 but it may not be valid here).
Permeable pores	The medium to large capillary pores within the cement paste that form connected networks creating channels for water penetration.
Permeation flow	The flow through porous media (e.g. concrete) under a pressure difference (hydrostatic pressure).
Phase change materials (PCMs)	Materials with low melting temperature (such as paraffin, polyglycol, salt hydrates such as sodium and potassium acetates, fatty acids, and stearate compounds) that have the ability to store thermal energy during high temperature surrounding condition and release it back during low temperature condition and hence can mitigate temperature changes (in concrete and in buildings).
Plastic shrinkage	Volume reduction (of concrete) which is induced in the cement paste due to the rapid loss of water that occurs during hot weather concrete casting leading to internal stresses and surface cracking of newly laid concrete.
Polymer-modified cementitious coating	The formation of an external, impermeable thin "film" from cement hydration (in a mixture of cement, sand and active ingredients) which combine polymeric compounds with cementitious materials for improving the mechanical properties of coatings (e.g., strength, resilience, adhesion) (e.g. by creating networking bonding) and water resistance.
Polymeric barrier	Polymer-based materials in the forms of semisolid sheets, polymeric liquids, dispersions, and emulsions that are applied at the concrete surface and form nonpermeable membranes with minimal or no penetration within the pores.

Pore blocking	(Capillary blocking): The creation (e.g. precipitation) of particulate materials (e.g. crystals) within the permeable pores of cement paste in concrete.
Pore filling	(Capillary blocking) or (Pore blocking) see above.
Pore lining	The formation of a molecular layer at the surfaces of concrete pores with the characteristic of water-repelling that prevents/ minimizes surface wetting and water swelling or capillary absorption.
porosity (total versus effective)	The total volume fraction of pores. The total porosity is defined as the total volume fraction of all pores (permeable and impermeable pores). The effective porosity accounts for the connected flow channel in the pore structure and it composes about 20-250% of the total porosity.
Portland cement	Standard cement that is composed of specific reactive hydraulic material which is based mainly on calcium silicate compounds with specified range of composition that sets and hardens by chemical reaction with water and is capable of binding material of aggregate particles.
Portland limestone cement (PLC)	(Type 1L cement): A blended cement made of Portland cement with a significant percentage of limestone powders inter-grinded, blended or added at the time of mixing concrete at certain percentage (e.g. 15%).
Powder coating	Similar to cementitious coating: "An inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with water by formation of hydrates and is capable of doing so under water." (ASTM)
Pozzolanic material	Powdered inorganic mineral material (e.g., fly ash), which is added to concrete mixture, also termed as supplementary cementitious material (or mineral admixture) that contributes to the properties of a cementitious mixture (through pozzolanic activity). Or, "a siliceous or siliceous and aluminous material that in itself possesses little or no cementitious value but will, in finely divided form and in the presence of water, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties." ASTM C125-15b
Pozzolanic reaction	Slow chemical reaction of reactive silica content in the pozzolans with the calcium hydroxide (from cement hydration) and water producing cementitious binding material of hydrated calcium silicate (similar to C-S-H gel).

	Relative humidity (RH)	The percentage of absolute humidity (mass of water vapor (moisture) per cubic meter volume of air) relative to a maximum humidity given the same temperature.
S	**Saturated concrete Scaling**	Surface failure by the break off part of the cement paste (in large concrete flakes) exposing aggregates which is associated with freezing and thawing plus the destructive effect of deicing chemicals in water. Surface scaling is categorized in ACI 201.2R as "the most common form of damage from freezing and thawing in hardened concrete."
	Sealer	"A liquid that is applied to the surface of hardened concrete, is colorless, is absorbed by the concrete, leaves little or nothing visible on the surface, and either prevents or decreased the penetration of liquid or gaseous media" (CT-18 Concrete Terminology).
	Self-healing (of cracks)	Bridging and filling cracks in concrete by hydration-reactions such as crystallization.
	Set-retarding admixture	Material (e.g. organic acids such as carboxylic acids) that is used as an ingredient of a cementitious mixture to increase time of setting or delaying the setting by retarding the initial reactions of cement.
	Sheet membrane	Polymer-based materials in the forms of semisolid sheets (typically made of thermoplastics, vulcanized rubbers, or rubberized asphalts) that are installed onto concrete surfaces by adhesion and form nonpermeable film with minimal or no penetration within the pores.
	Shrinkage	Volume reduction (of concrete) which is induced in the cement paste due to thermal and/or chemical actions leading to internal stresses and concrete cracking.
	Shrinkage-reducing admixtures (SRA)	Multipurpose durability enhancing material (e.g. glycol compounds) that is added to concrete mixture mainly for reducing volume reduction (of concrete) which is induced in the cement paste and can lead to internal stresses and concrete cracking.
	Silanes	Organosilicon compounds/hydrophobes (e.g trimethoxy silane), which react with active sites within the siliceous content of concrete forming water repelling layers at the pore surface and create hydrophobic surface characteristic.

Silica	Silicon oxide (SiO_2) which exists as a main constituent in cement and mineral admixtures (supplementary cementitious materials).
Silica fume (SF)	Micro-silica (supplementary cementitious material) that is composed mainly of SiO_2 (e.g. over 90%). "a very fine pozzolanic material, composed mostly of amorphous silica produced by electric arc furnaces as a by-product of the production of elemental silicon or ferro-silicon alloys" ASTM C1240.
Silicate-based compound	Material (in liquid or powder form) that is added to concrete mixture (or to cementitious coatings and mortars) or sprayed over its surface and then densifies its structure and possibly creates hydrophilic crystals within its pores.
Siliconate	Water solution of organosilicon compound/hydrophobe (e.g. sodium methyl siliconate), which react with active sites at the siliceous content of concrete to form water repelling layers at the pore surface and create hydrophobic surface characteristic.
Siloxanes	Organosilicon compounds/ hydrophobes such as oligomeric alkyl alkoxy siloxanes, composed of short chains of silanes (oligomers) (e.g. poly methyl siloxane, tetra methyl di siloxane) which react with active sites at the siliceous content of concrete to form water repelling layers at the pore surface and create hydrophobic surface characteristic (they are with larger molecular structure than silanes).
Slag	blast-furnace slag: "the non-metallic product, consisting essentially of silicates and aluminosilicates of calcium and other bases that is developed in a molten condition simultaneously with iron in a blast furnace" (ASTM Terminology C 125) (Mainly include SiO_2 and CaO).
Sodium oxide	Main part of the alkaline content in Portland cement (Na_2O) which contributes with additional source of alkalinity (in addition to that from calcium hydroxide from cement hydration), which drives harmful reactions such as alkali silica reactions (ASR).
Sodium silicate	The main constituent of many surface hardeners/sealers (in liquid solution) and powder admixture that is added to concrete mixture (or to cementitious coatings and mortars), which densifies its structure and possibly creates hydrophilic crystals within its pores.
Sofix	Dual (hygroscopic and hydrophilic) crystallization (pore blocking) topical treatment of concrete (and cementitious

	surfaces) for reducing porosity and creating impermeable surface.
Solvent-based material	Solution of organic solvent and active ingredient(s) that are used for certain functionality (e.g. concrete sealer) which usually contains volatile organic compounds (VOC) that have a high vapor pressure (low boiling point) and low water solubility; thus, they create heavy organic odours which are usually harmful to public health.
Sorptivity	Coefficient of capillary absorption of water in concrete that is proportional to the level of hydrophilicity and porosity and reflects the ease of wicking flow of water through concrete or mortars (under no hydrostatic pressure).
Spalling	Surface failure by the break off part of the cement paste exposing aggregates.
Sulfate attack	Deterioration of concrete from its exposure to sulfate compounds (such as sodium, potassium, calcium, and magnesium sulfates e.g. from sea water) by the chemical reactions between the sulfate ions and the constituents of the cement paste which causes destabilization of the cement paste.
Super-hydrophobic surfaces	Surface (of concrete) with extreme water repelling characteristic achieved when the static water contact angle is over 150^{o}.
Super-hydrophobicity	Extreme water repelling surface characteristic (of concrete) achieved when the static water contact angle is over 150^{o}.
Superplasticizer	(Also known as high range water reducer): Chemical solution added to concrete mixture for obtaining high workability and the consistency of concrete mixture (e.g., naphthalene and polycarboxylate) and used for making high-strength concrete or to place self-compacting concrete.
Supplementary cementitious material (SCM)	"An inorganic material that contributes to the properties of a cementitious mixture through hydraulic or pozzolanic activity, or both." ASTM C125-15b
Surface treatment (of concrete)	Topical application of a (penetrating) sealer that redesigns the pore structure within a surface section of the concrete by pore-blocking and/or pore-lining.
Swelling	The absorption of water within a porous (hydrophilic) structure (e.g. concrete) by capillary absorption (under no hydrostatic pressure).

T	**Thawing (in concrete)**	Change (water phase in concrete) from a solid, frozen state to a liquid filling the pores, from the increase in temperature (of the surroundings).
	Thermal conduction (through concrete)	Heat transfer though a solid medium (e.g. concrete) by adjacent molecular (vibrational) energy.
	Thermal conductivity (of concrete)	The coefficient of conduction heat transfer though a solid medium (e.g. concrete) which determines its rate according to Fourier's law.
	Thermal shrinkage	Reduction of volume (of paste in concrete) caused by the existence of an extreme temperature gradient between the outer and inner sections of concrete or within the concrete structures at the early stages of cement hydration due to the variations in the exothermic heat release.
	Tricalcium silicate	C3S or $3CaO \cdot SiO_2$: The main constituent of cement 3CaO·SiO2 that hydrates with water to lead the main binding material.
U	**United States Corps of Engineering CRD-C 48-92**	Standard Test Method for Water Permeability of Concrete which specifies the procedure for determining the water permeability of concrete when subjected to water at a pressure of 200 psi (1.38 MPa) with the calculations based upon an application of Darcy's law for unidirectional flow at constant head.
	UV radiation	Sun radiated waves with a wide wavelength range of 100-400 nm, (which usually destroy the integrity of coatings and disintegrate some surface treatments on exterior concrete surfaces).
V	**Vaporproofing**	Making a surface vapor barrier that can retard transmission of water vapor.
	Volatile organic compounds (VOC)	Organic (carbon-hydrogen-based) compounds that have a high vapor pressure (low boiling point) and low water solubility; thus, they create heavy organic odours which are usually harmful to public health.
W	**Water penetration**	Permeation water flow under hydrostatic pressure and/or capillary absorption of water due to wetting and hydrophilicity
	Water capillary absorption	The penetration of water within porous medium (e.g. concrete) water due to wetting and hydrophilicity.
	Water permeability	The coefficient of permeation flow of water through a porous medium (e.g. concrete) under hydrostatic pressure, which reflects the ease of flow of gases to pass through the medium.

Water repellent admixtures	Material that is added to concrete mixture which upon setting creates the characteristic of hydrophobicity with static water contact angle above 90^{o}.
Water-associated durability problems	Destructive issues in concrete structure that reduce its "ability to resist weathering action, chemical attack, abrasion, and other conditions of service" which are caused by the penetration of water in concrete.
Water-based material	Solution of water and active ingredient(s) that are used for certain functionality (e.g. concrete sealer) but contains no organic solvent of volatile organic compounds (no VOC).
Water-reducing admixture	Material (e.g. liquid solution) that is added to concrete mixture for reducing the required amount of water for certain targeted characteristics of fresh concrete (e.g. consistency and workability) and then affects various other characteristics of cured concrete.
Water-related durability problems	Destructive issues in concrete structure that reduce its "ability to resist weathering action, chemical attack, abrasion, and other conditions of service" which are caused by the penetration of water in concrete.
Water-repellent cement	A cement that upon setting has the characteristic of hydrophobicity with static water contact angle above 90^{o}.
Water contact angle	The angle between water liquid droplet and a solid surface, which is usually used to classify surfaces into levels of hydrophobicity and hydrophilicity.
Water retention	Maintaining moisture within the structure of fresh concrete (available for cement hydration) during concrete curing.
Water to binder ratio (w/b ratio)	The mass ratio of binder (e.g. cement) to mixing water used in the mix design for preparing concrete and mortars which controls most of fresh and cured properties.
Water to cement ratio (w/c ratio)	The mass ratio of cement to mixing water used in the mix design for preparing concrete and mortars which controls most of fresh and cured properties.
Water to cementitious materials ratio (w/cm ratio)	The mass ratio of the total binder (cement and supplementary cementitious materials such as fly ash) to mixing water used in the mix design for preparing concrete and mortars which controls most of fresh and cured properties.

Waterproofing	The process of hindering the permeation flow or the absorption of water or aqueous solutions within the porous structure of cement paste in concrete or mortars.
Watertight concrete	Concrete that is "Impermeable to water except when under hydrostatic pressure sufficient to produce structural discontinuity by rupture." (ACI Concrete Terminology).
Wettability	The ability of spreading water (molecules) over a surface (e.g. concrete) governed by intermolecular interactions between water molecules and the surface and is expressed in terms of the contact angle between the solid and the fluids (hydrophilicity)
Wetting	The spreading of water (molecules) over a surface (e.g. concrete) by the attractive interactions between the water and the surface, driven by hydrophilicity.
Workability (of fresh concrete)	"Property of freshly mixed concrete that affects the ease with which it can be mixed, placed, consolidated, and struck off." ASTM C125 15b.
Yufix	Dual (hygroscopic and hydrophilic) crystallization (pore blocking) and hydrophobic (pore lining) topical treatment of concrete (and cementitious surfaces) for reducing porosity and creating impermeable surface.