PROTECRETE®
CONCRETE'S BEST SOLUTION

Top 20 Advantages to Using Mix Water Conditioner

1. Higher quality concrete at a fraction of the usual cost
2. Improved microstructure means incredibly strong concrete
3. Quicker and easier placement (save finishing time!)
4. Less shrinkage and cracking
5. Virtually no bleed water when properly mixed
6. Greatly improved durability
7. Greater density and less permeability
8. Reduced leaching and efflorescence
9. Greater freeze-thaw resistance
10. Stronger bond of concrete-to-steel
11. Increased compressive strength
12. Increased flexural strength
13. Reduced honeycombing and laitance
14. Better surface abrasion resistance
15. Lower internal chemical reaction potential
16. Less slab curl
17. Reduced internal/external dusting potential
18. More acid/chemical resistance
19. Reduced rate of absorption
20. Less cementitious material waste

Don't you owe it to yourself to use Mix Water Conditioner in your next project?

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MIX WATER CONDITIONER
Technical Data

1. Product:
PROTECRETE-MWC
Mix Water Conditioner

2. Manufacturer:
Applied Concrete Technology, Inc.
1840 North Fernandez Avenue
Arlington Heights, IL 60004
847.253.0496 or 800.228.6694
FAX 847.253.6954
WWW.PROTECRETE.COM

3. Description/Basic Use:
PROTECRETE-MWC is a water-clear, environmentally neutral, non toxic, odorless, non-VOC or VOS liquid.

PROTECRETE-MWC added to Portland cement concrete's mix water, produces an extraordinarily strong, dense, hard and impermeable concrete.

PROTECRETE-MWC accomplishes this in various ways, initially by enhancing the by-product quality of hydration's hydrolysis reaction. PROTECRETE-MWC provides to mix water the ability to initiate hydration without the usual cement potency loss normally ascribable to mix water dilution. It will ensure that the freshly produced cement paste that first contacts and coats concrete's aggregates is the highest attainable quality. This improvement of concrete's paste-to-aggregate bond quality further increases its strength and durability.

Secondly, the calcium hydroxide residue quality produced during hydrolysis, becomes greatly improved through the use of PROTECRETE-MWC. It provides a more efficient calcium lamination of silicate polymer particles/strands/chains, further reducing the volume of unused calcium hydroxide in the finished concrete installation. It provides ingredients that prompt prolific formation/extending/branching of silicate polymer particles/strands/chains, which are vital constituents of tobermorite gel, the main strength component of concrete.

Thirdly, PROTECRETE-MWC increases usage of the mix's already included cement ingredient, providing additional cement paste (cementitious material) volume per cement particle. The increased cementitious material content allows the use of additional mix water volume, yet still produces a low water-cement ratio quality concrete. Furthermore, PROTECRETE-MWC produces an extremely homogenous fine textured cement paste containing smaller than usual, and more uniform pore sizes. This improves workability through increased lubricity with less surface bleed-water volume.

Finally, PROTECRETE-MWC precipitates a significant reduction in the size of leftover cement particle cores that are left to act as aggregates in the concrete. The smaller than usual particle cores ultimately become an unmatchable filler aggregate sized somewhere between sand and cement grain sizes. This provides extraordinary filler benefits similar to that of silica fume, resulting in a denser, stronger and more impermeable concrete. This higher integrity concrete is less susceptible to contaminate pollution, freeze damage, chloride-induced imbedded steel corrosion, etc.

PROTECRETE-MWC provides to Portland cement concrete many unique benefits, yet requires no special handling, storage, mixing, finishing or curing techniques.

4. Some Advantages:
- Adds workability by increased lubricity
- Alleviates/eliminates plastic cracking
- Reduces bleed water volume
- Improves strengths
- Increases density
- Increases impermeability and durability
- Improves surface abrasion resistance
- Improves freeze damage resistance
- Lowers internal chemical reaction potential
- Eliminates capillary action potential
- Lowers/eliminates potential for dusting
- Lowers chloride induced corrosion potential
- Lowers/eliminates slab curl potential
- Increases acid/chemical resistance
- Decreases cementitious material waste

5. Technical Data:
Physical: Liquid
Color: Water-clear
Odor: None
pH: ± 12
Flash Point: None
Toxicity: None
Pollutants: None
Hazardous Vapors: None
Spill Cleanup: Dilute/Flush using water
Environmental Impact: None/neutral
User Status: Friendly
Abrasion Resistance: Excellent

6. Dry Batching Directions:
a. Determine volume needed at 10 ounces of Mix Water Conditioner per 100 pounds of portland cement.

b. Prior to dry batching concrete, pour predetermined volume of Mix Water Conditioner into rinsed, water evacuated transit mixer truck. (If truck is not clean, add 90% of water prior to adding Mix Water Conditioner.)

c. Pull truck under plant for loading.

d. With mixer turning in its mixing mode, load approximately 90% of the total mix water BEFORE loading cement and aggregate.

e. Load cement, aggregates (in any order) and balance of mix water.

f. ***There must be at least 110 revolutions on the transit mixer before concrete is placed at pour site or product may not perform as it should!***

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g. Slump may be adjusted at job site using plain water, followed by 5 minutes of additional mixing.

7. For Central Batch Mixing:

a. Determine volume needed at 10 ounces of Mix Water Conditioner per 100 pounds of portland cement.

b. Pour or pump the calculated volume of product into mix water premeasuring tank as you add the mix water (additional blending or stirring of the mix water is not required). Then batch concrete as usual.

c. After concrete is batched, extra mixing time will be needed. *You must add 50 percent more mixing time for best results.* For example, if 3 minutes mixing time are normally required, then mix for 4-1/2 minutes.

d. Slump may be adjusted at job site using plain water, followed by 5 minutes of additional mixing by transit mixer.

8. Dosage for Continuous Mixing:
Calculate volume needed at 10 ounces of Mix Water Conditioner per 100 pounds of portland cement. Calculate amount of mix water needed per 100 pounds of portland cement. This will provide your ratio of Mix Water Conditioner to mix water. (For example, if calculations show that 5 gallons of mix water are required per 100 pounds of cement, then the water in the tank should be treated at the rate of 10 ounces of product per 5 gallons of water.)

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How Mix Water Conditioner creates better concrete

A technical explanation of how Mix Water Conditioner uses the leftover mix water to create more cement paste and thus, a better quality concrete

What it does:

PROTECRETE-MWC utilization results in the production of more cement paste per cement particle. It creates concrete with lower void percentages. It provides greater impermeability and increased strengths. It improves workability through increased lubricity. It reduces plastic separation and surface bleed water volume. It improves surface abrasion resistance. It reduces cementitious material waste.

How it works:

During Portland cement concrete manufacturing, and upon introduction of mix water to cement, reactions immediately occur between the mix water and cement. These reactions are part of cement's hydration processes, called hydrolysis. During hydrolysis varying molecular portions of cement's tricalcium and dicalcium silicate are split-off, producing varying quantities of calcium hydroxide residue. Hydrolysis, along with the dilution caused by the mix water quickly lowers the cement's potency. Whenever PROTECRETE-MWC has been added to the mix water, the cement's potency loss (normally ascribable to mix water dilution/hydrolysis) either becomes very minimal or is completely eliminated. This creates hydrolysis by-products of much-improved quality, ultimately improving the concrete's silicate hydrate components. The highest attainable cement paste quality, at this point in time, is far more important than is sometimes realized. During initial hydration/hydrolysis, as mix water comes into contact with cement, the freshly-produced cement paste begins to coat concrete's aggregates. At the same time, hydrate envelopes begin being formed around each grain of dry cement. PROTECRETE-MWC uses concrete's mix water as its vehicle to get at its cement ingredient at exactly the same time as its mix water before hydrolysis. PROTECRETE-MWC provides ingredients to the mix water which ensure that only the highest quality cement paste, feasibly attainable, is being initially produced. This greatly improves the concrete installation's ultimate paste-to-aggregate bond quality.

As initial hydration continues, following hydrolysis, the produced calcium hydroxide begins laminating silicate polymer particles/strands/chains, resulting in a hardened gel mass, containing crystalline products, referred to as calcium silicate hydrate or C-S-H gel. This gel is capable of binding inert particles, such as aggregates, including unused cores of the cement particles, into a coherent mass known as concrete. During manufacturing where PROTECRETE-MWC is ***not*** utilized, significant portions of the included mix water does not participate in cement hydration since some mix water is used to make concrete workable. For example, assume ***no*** water loss agents or plasticizers are used and 5 gallons of mix water fully hydrates 100 lbs. of cement with a water-cement ratio of 0.42. In this example, only 2.88 gallons of mix water actually chemically combines with cement, while the remaining 2.12 gallons, following surface finish (after workability is no longer needed), just occupies capillary spaces until used for production of hydration products, or is later evaporated leaving void capillaries.

Mix water volume containing PROTECRETE-MWC, left to be evaporated, is greatly reduced or completely eliminated, due to the increased cement particle saturation of mix water. This significantly lowers void capillary percentages, translating to greater impermeability. Increased mix water and cement particle utilization of the already-included cement, through using PROTECRETE-MWC, allows additional mix water volume to be used while raising concrete's cementitious material content. The end result is concrete that will still exhibit low water-cement ratio quality, or even better. Very importantly, through increase of cement particle utilization, significantly smaller and variously-sized cement particle cores are left remaining in the concrete. They become very excellent filler aggregate that is between sand and cement grain size and provides additional impermeability and density. This action causes the concrete to be even more resistant to chloride-induced rebar corrosion and freeze-thaw damage, etc. PROTECRETE-MWC's benefits are similar to those of micro silica or silica fume, only it does ***not*** require special storage, handling, mixing, finishing or curing techniques, as does silica fume.

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Answers to the most commonly asked questions about Mix Water Conditioner

Q. What is PROTECRETE-MWC (Mix Water Conditioner)?

A. It is an environmentally safe, user friendly, nontoxic, odorless, non-petroleum, liquid product that provides to mix water the ability to enhance Portland cement concrete. It provides concrete with values capable of preventing or alleviating most, if not all, of concrete's potential ailments that could lower or destroy its integrity. PROTECRETE-MWC readily solublizes with water, using concrete's mix water as its vehicle to get at the mix's cement ingredient during mix water introduction. PROTECRETE-MWC is an effective and hassle-free alternative to using silica fume or microsilica. It has no special requirements for storage, handling, mixing, finishing, and curing, as does silica fume. PROTECRETE-MWC provides mix water the ability to upgrade conventional concrete mix designs, without risky, complicated, expensive or labor intensive measures.

What technique is best to introduce PROTECRETE-MWC into mix water?

PROTECRETE-MWC can be added into mix water using a mix water holding tank at the site of batching or if the holding tank method is not practical, PROTECRETE-MWC can be put directly into a rinsed clean mixer, just prior to putting mixer under batching plant. With the mixer running in its mixing mode, load approximately 90% of the total planned mix water volume, then begin loading cement, aggregate, and remainder of mix water in the usual order. The slump factor may be increased using PROTECRETE-MWC treated mix water or plain untreated water.

Does PROTECRETE-MWC use require special mixing procedures other than the one above?

No. However, for best benefits/results, concrete should be mixed for an adequate period of time, prior to placement whether using PROTECRETE-MWC or not. Optimal mix time for concrete utilizing PROTECRETE-MWC in its mix water should be equivalent to a cumulative total of approximately 110 revolutions in a transit mixer drum. Mix water volume should be calculated, without allowing any water reduction for water loss agents, plasticizers, or super plasticizers, where they are not to be used. PROTECRETE-MWC implements easy shear of the cement particle hydrate envelopes, making adequate mix water volume and mixing time very important, especially since the easy shear actions also increase concrete's cementitious material to water ratio, resulting in a concrete with low water-cement ratio quality, or even better.

How does PROTECRETE-MWC improve concrete?

Initially, PROTECRETE-MWC, in mix water, greatly decreases Portland cement potency loss and its adverse effects caused by dilution and hydrolysis during mix water introduction. A reduction in initial cement potency loss significantly improves hydrolysis by-product quality, specifically, the subsequently produced calcium hydroxide residue, and ultimately concrete's hydrated silicates. Through utilization of PROTECRETE-MWC during mix water introduction, PROTECRETE-MWC's ingredients contact concrete's cement ingredient at the exact same time as the mix water prior to hydrolysis. Hydrolysis is responsible for the splitting off of varying molecular portions of cement's tricalcium and dicalcium silicate components, producing varying quantities of calcium hydroxide residue. PROTECRETE-MWC ingredients ensure that the hydrolysis' by-products are favorably affected. Particularly the calcium hydroxide quality, since calcium hydroxide is utilized to laminate the cement paste's silicate polymer particles/strands/chains during setting. Subsequently it provides strength to concrete's tobermorite gel, the main strength component of concrete. Another result of PROTECRETE-MWC enhancing concrete's calcium hydroxide quality is that a more efficient lamination is achieved. It further increases flexural and compressive strengths, while significantly decreasing the volume of calcium hydroxide residue left in the concrete. The residue could potentially later on participate in detrimental internal chemical reactions that could erode or even destroy the integrity of the installation. As hydration continues, following

saturation by the mix water, PROTECRETE-MWC enhances concrete through implementing increased cement particle saturation by the mix water, generating an increased volume of cement paste per cement particle. This increased saturation effectively increases the concrete's cementitious material content volume, producing a paste volume increase using the already-included cement content, improving concrete's performance in many ways. It produces a fine-textured cement paste with smaller, more uniform-sized porosity. It improves freeze-thaw damage resistance. It improves workability through increased lubricity. It decreases separation to lower surface bleed water volume. It increases surface abrasion resistance, lowering cementitious material waste and etc. Since concrete's aggregates begin being coated by cement paste immediately following mix water introduction to cement, PROTECRETE-MWC provides ingredients that will ensure that only the highest attainable quality cement paste is available during this aggregate coating process. This improved paste-to-aggregate bond quality even further enhances its flexural and compressive strengths.

Does PROTECRETE-MWC contain anything that could harm our environment?

No. PROTECRETE-MWC is environmentally neutral.

Can PROTECRETE-MWC be used in mixes containing silica fume/microsilica?

Yes. However, where utilizing PROTECRETE-MWC in a concrete containing silica fume or microsilica, most if not all of the silica fume or microsilica may be omitted with little or no loss to objective performance values. If however, total silica fume or microsilica deletion is undesirable, the silica fume or microsilica content may be reduced by up to 75% without objective performance value loss. PROTECRETE-MWC provides numerous benefits to concrete similar to those of silica fume or microsilica, including their fine solids effect. The fine solids effect in concrete utilizing PROTECRETE-MWC is achieved through increased utilization of each cement particle. This result in smaller than usual particle cores to act as aggregates. These cement particle cores that are left behind in the concrete to act as filler aggregate, are smaller than usual, between sand and cement grain sizes. The concrete becomes more impermeable and resistant to chloride-induced corrosion, as with silica fume or microsilica. PROTECRETE-MWC's ability to reduce free calcium hydroxide content was previously explained.

Should PROTECRETE-MWC be used in concrete containing fly ash?

Yes. Fly ash is a pulverized fuel ash (PFA) and is the most widely used artificial pozzolan in the manufacturing of concrete. Fly ash is generally obtained from flue gases of furnaces, particularly at coal fired stations, through electrostatic or mechanical means. Fly ash particles are spherical in shape and are at least as fine as Portland cement particles. This makes fly ash's silica component readily available for reaction. Fly ash is a finely divided admixture, as is silica fume and microsilica, and is generally not needed in concrete mixes utilizing PROTECRETE-MWC. However, should fly ash be utilized for whatever reason, PROTECRETE-MWC provides numerous benefits to concrete, even where fly ash is included.

Can PROTECRETE-MWC be used in mixes containing air entrainment chemicals?

Yes. Air entrainment is generally used in concrete mixes to provide improved durability and resistance to freeze-thaw damage, to discourage plastic particle separation or to improve workability. However, air entrainment over and above the actual percentage needed for such improvements, serves only to weaken concrete needlessly. For example, tests show that air entrainment in concrete mixes without any other mix proportion changes, decrease strength proportional to its air content up to a level of eight (8) per cent. However, PROTECRETE-MWC added to mix water, produces concrete that has significantly improved impermeability. Greater impermeability serves to lower, or eliminate penetration of water into concrete. This reduces or eliminates the need for purposely entraining air for freeze damage resistance. PROTECRETE-MWC provides concrete a small amount of purposely entrained air and when combined with the unavoidable incidental air gained during batching air percentage should be adequate, especially when PROTECRETE-MWC takes into account the other reasons to purposely entrain additional air, such as workability and particle separation.

Can PROTECRETE-MWC be used in concrete's containing water loss agents, or super plasticizers?

Yes. Water loss agents or water reducers often contain ingredients such as hydroxylated carboxylic acid or lignosulphonic acid, while superplasticizers may contain sulphonated formaldehyde condensates. Neither of these agents are necessary if utilizing PROTECRETE-MWC. PROTECRETE-MWC provides all of the desired benefits of water loss agents, water reducers, or superplasticizers without the undesirable effects. Instead of discouraging mix water absorption by dry cement particles to lower mix water volume requirements, as do water reducers and superplasticizers, PROTECRETE-MWC encourages absorption instead. Consequently, it utilizes more mix water volume instead of less, while at the same time utilizing significantly higher percentages of the already included cement. This effectively raises concrete's cementitious material content volume and results in concrete with low water-cement ratio performance values, or even better. PROTECRETE-MWC provides concrete the desired particle charge effect usually afforded by water reducers and superplasticizers. It produces extremely homogenous plastic concrete mixes. PROTECRETE-MWC in the mix water improves plastic concrete's workability by increasing its lubricity.

How does PROTECRETE-MWC increase concrete's impermeability?

Permeability is the ease with which liquids or gases can travel through set concrete. Permeability can be measured in a laboratory test by sealing the sides of a concrete specimen, then applying water pressure to its top surface while measuring volume of water flow through the specimen once flow rate stabilization has occurred. In concrete with normal weight aggregate, permeability is governed by tobermorite gel porosity and the presence of larger capillary porosity, that originally formed as mix water pockets. Generally, permeability is a function of capillary porosity, governed by water-cement ratio and degree of hydration. PROTECRETE-MWC provides mix water with ingredients to significantly improve the mix water's degree of hydration. This is achieved through greater cement particle saturation. This works to ensure optimal mix water volumes are absorbed by the cement, even to beneath the cement particles' hydrate envelopes. This facilitates easier shear of these hydrate envelopes, which were formed around each dry cement particle upon introduction of the mix water. PROTECRETE-MWC's ingredients also ensure that only minimal amounts of mix water are left in the concrete, to later on be evaporated and leave behind capillary voids. PROTECRETE-MWC encourages acceleration of the cement's strong initial hydration processes. It encourages concrete to fill its own porosity with internally produced hydration product. This results in smaller than usual, more segmented capillary porosity that creates very impermeable concrete. Since higher volumes of the already included cement and mix water are utilized using PROTECRETE-MWC, each cement particle core is significantly reduced in size. They become smaller than usual, cause the cement particle cores left behind in the concrete to act as aggregates and become an unmatchable filler between concrete's sand and cement grain sizes.

What is the recommended dosage volume of PROTECRETE-MWC?

When mixing at a dry batch facility, 10 fluid ounces per CWT (100 pounds) of cement should be used. If the mix water holding tank method is utilized for various cement content batching, 10 fluid ounces per 4 gallons of mix water is recommended. For continuous mixing such as concrete unit manufacturing, gunite, shotcrete, or flowcrete, PROTECRETE-MWC is recommended to be used at the rate of 10 fluid ounces per 3 1/2 gallons of mixing water, added or injected into mix water, prior to combining with cement.

How does PROTECRETE-MWC eliminate plastic cracking of concrete?

Plastic cracks usually develop between 1 and 8 hours following concrete placement, and are in the form of shrinkage or settlement cracks. Shrinkage cracks may result as cement paste contracts while still in a plastic state. This type of cracking is fairly common. They usually occur as a result of surface weakness, generally due to work-in excessive surface bleed water volume. This creates a weakened layer of concrete at the surface. Shrinkage cracks also can result from too-rapid water evaporation at the surface. However, all of the many reasons for shrinkage cracking such as surface water suction by dry concrete below, excessive bleed water volume, too-

rapid water evaporation, etc. are alleviated/eliminated when utilizing PROTECRETE-MWC. A related form of plastic cracking is surface crazing, which takes place when the surface layer of concrete has more water content than the concrete's interior. Conditions creating surface crazing do not exist when utilizing PROTECRETE-MWC. Settlement cracking, in plastic concrete, is usually due to particle desegregation/settlement and uneven settlement. This crackage sometimes occurs due to the presence of an obstruction such as imbedded steel. This type of cracking is not likely to occur when using PROTECRETE-MWC due to its production of an extremely homogenous plastic mix, discouraging particle segregation/ settlement. As always, normal safe concreting practices should also be observed, in plastic cracking prevention, such as applying a proper cure at the proper time etc.

How does PROTECRETE-MWC eliminate slab curl?

Slab curl occurs around the slab's perimeter or at the joints, usually with the corners curling most. This is generally because concrete near the top and edges dry first, the corners drying fastest and concrete near the top cools while the mass below remains warm. PROTECRETE-MWC prevents slab curl by creating an extraordinarily homogenous plastic concrete mix which discourages particle separation and promotes uniform wetness, uniform hydration, uniform setting, uniform drying and uniform internal humidity, effective with or without a vapor barrier.

How does PROTECRETE-MWC work to prevent dusting?

Cement concrete surfaces usually only dust excessively if the mix was poured too wet or its surface troweled too soon while excessive bleed water was laying on it, or if surface dried completely before being properly cured prior to covering, or the surface was exposed to carbon dioxide while still plastic. PROTECRETE-MWC added to mix water allows concrete to be poured, even at very high slumps, without particle separation. It subsequently produces very low volumes of surface bleed water, virtually eliminating the potential for excessive amounts of bleed water to be troweled into the surface to encourage dusting.

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Mix Water Conditioner

Would a . . .

- **More workable**
- **Less permeable**
- **More defect-free**
- **Stronger**
- **Harder (but not brittle) and**
- **More durable**

. . . concrete sound good on your next construction project?

PROTECRETE-MWC (Mix Water Conditioner) adds all these benefits without any additional effort in mixing, placing or curing. And there is minimal cost adjustment (if any) per cubic yard. Its ingredients promote the lowest permeability in the shortest period of time. You get the smallest, most segmented capillaries possible using your own mix design. Due to **PROTECRETE-MWC**'s unique cement hydration capability, it utilizes more of the already included cement content. It generates extraordinary volumes of cementitious material and it greatly improves the concrete's permeability factor rating.

Why should lower permeability be important to concrete?

The disintegration of integrity of the concrete is usually caused by either external agents arising from the environment or by internal agents from within the concrete mass. The permeability factor of concrete is directly responsible for whether pollutants or contaminates such as sulfates, acids, sea water, chlorides, etc. are allowed to readily penetrate concrete.

Concrete permeability should be of critical interest since internal agent attack must come from within the concrete. The attacking agent(s) must be able to penetrate throughout the permeable concrete. Internal agent attack is aided by internal transport of agents by diffusion due to internal gradients of moisture and temperature and by osmosis. Permeability is sometimes inadvertently increased even more by using porous aggregate, or placing of concrete without benefit of a proper cure applied in a timely manner.

However, for concrete made with normal weight aggregate, permeability is governed by the cement paste porosity, but the relationship is not as simple as that since the pore size distribution is a factor. For example, although cement gel porosity is 28%, its permeability is still very low (permeability coefficient is 2.3 x -1015 feet per second) because of the extremely fine texture of the gel and the very small size of the gel pores (gel's texture fineness is even further enhanced where PROTECRETE-MWC is used).

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The permeability of hydrated cement paste as a whole is greater because of the presence of larger capillary pores. In fact, its permeability is generally a function of capillary porosity. Since capillary porosity is governed by the water/cement ratio and by the degree of hydration (factors enhanced by PROTECRETE-MWC), permeability is lower for pastes with low water/cement ratios. Especially a water/cement ratio below about 0.6, which is the point capillaries begin becoming segmented or discontinuous. For a given water/cement ratio, the permeability decreases as the cement continues to hydrate, further increasing the mix's cementitious material content. This provides hydrate product that fills the original water space (actions also greatly enhanced by PROTECRETE-MWC).

The reduction in permeability is faster the lower the water/cementious material ratio (a factor made even more extraordinary by PROTECRETE-MWC ingredients). Consequently, a concrete mix made with a low water/cement ratio is advantageous because the stage where water capillaries become segmented is achieved following a shorter time period of curing. From the durability viewpoint, it is very important to achieve low permeability as quickly as possible, and without a doubt, permeability of concrete is the dominant key to overall durability.

Why should more defect-free concrete be important to a concrete installation?

Concrete generally is considered to be under attack from the environment from the moment it is placed. Crack prevention of newly-placed concrete should be of the utmost importance in preserving its long-range integrity. Basically, with newly-placed concrete there are three intrinsic visible types of cracking to be concerned with:

- plastic cracks
- early-age thermal cracks
- drying shrinkage cracks

All of these leave the concrete surface more vulnerable to contaminant ingress. PROTECRETE-MWC provides built-in ingredients to concrete mix water which work to counteract the causes of these three types of visible cracking.

However, surface-visible cracking is not the only defect that can cause concrete integrity inferiority. There are internal defects to also be considered, such as cracking in the aggregate-paste contact zone. Along with permeability, aggregate-paste contact zone cracking has a tremendous effect on concrete's permeability/durability factor and reinforced concrete's vulnerability to steel corrosion. Very often, concrete will initially develop internal defects in the form of microcracks in the contact zone between the aggregates and the cement paste matrix. This causes it to be weaker and become more permeable to moisture, oxygen, and other aggressive media.

The aggregate paste zone contact is very often the weakest link in the concrete structure, because of (1.) bleed water voids, (2.) microcracking due to shrinkage and (3.) the elastic mismatch between the cement paste and the aggregate. The production of the cement paste that ultimately winds up in the aggregate paste contact zone begins immediately upon the contact between mix water and cement. It almost immediately begins coating or absorbing into the aggregates of the mix. However, this aggregate coating is later very often interfered with by bleed-water coming from within the aggregate.

This problem is alleviated/eliminated when PROTECRETE-MWC is added to mix water prior to exposing aggregates to the mix water. And since bleed-water coming to the aggregate surface will tend to be mix water initially absorbed by the aggregate instead of residual water, it will contain PROTECRETE-MWC ingredients to encourage additional hydration of present unhydrated cement particles. Even to beneath particle hydrate envelopes, significantly improving paste quality inside aggregate-paste contact zones.

PROTECRETE-MWC ingredients also promote extraordinary homogeneity of the paste itself. During consolidation and setting, where internal bleed-water is present, there is a possibility that bleed-water migrating upward can become trapped under horizontally stratified grain surfaces of aggregates. Bleeding and inefficient packing of cement paste around affected aggregate can cause voids to be formed. These type voids are not filled during hydration, creating a zone that can be more porous than the entire matrix would have been without the presence of these voids.

This situation even further promotes existence of initial bond microcracks at interfaces between aggregates and cement paste. When microcracking in concrete remains localized and is not continuous, this is not an extremely serious situation initially, except from the probable low compressive strength standpoint. However, over time, volume changes, freeze-thaw cycles, wetting/drying cycles, fatigue, alkali/aggregate reactions, etc., all tend to

increase interior and possibly exterior cracking. These crack networks serve to facilitate permeation of liquid contaminants, ions and gases which destroy concrete integrity and corrode reinforcement steel.

A more defect-free concrete is produced when PROTECRETE-MWC is utilized in the mix water. This is due to the significant improvement in the makeup of cement paste mortar. Since PROTECRETE-MWC is added to mix water prior to mixing with cement, it has the distinct advantage of being present at the exact same moment water and cement make contact. This greatly improves the hydrolysis reaction's by-product quality, such as calcium hydroxide, etc. The use of PROTECRETE-MWC ensures that only the finest quality cement paste attainable is being initially produced. Paste which almost immediately begins coating aggregates. The higher-quality PROTECRETE-MWC paste significantly improves the concrete's final paste-to-aggregate bond quality. The improved paste-to-aggregate bond quality helps to increase the concrete's flexural and compressive strength values. It ultimately produces a much higher quality more durable concrete installation both externally and internally.

Why should additional compressive strength to an already adequate strength concrete mix design be good for concrete, even though the added cubic yard price increase (if any) is low?

Note: Concrete mix designs should reflect what is thought to be the most economical and practical combination of aggregate, cement and water that produces concrete of adequate workability, strength and durability under specific service conditions.

Even where additional compressive strength is not needed, PROTECRETE-MWC coincidentally provides additional compressive and flexural strengths as a direct result of improvements to the concrete mix quality. It is not MWC's main conceptual objective and higher strengths may or may not be needed depending on the concrete installation's intended purpose. However, every concrete needs the benefit of crack-free construction, especially when the additional expense (if any) is very low and the added complexity of mixing, placing, finishing and curing is nil. PROTECRETE-MWC adds extra benefits which extend the useful lifespan of the concrete, further improving crack resistance and raising the performance quality of an installation.

As an example, let us focus on slab construction. PROTECRETE-MWC significantly improves the resistance of slabs to curling, cracking, scaling, dusting, steel corrosion and other problems associated with flatwork. In many instances, slightly higher strengths are not needed for most slabs. It is important to be aware that flexural strength developed in a concrete is usually automatically proportional to the compressive strength developed. As a matter of fact, flexural strength of high integrity concrete is approximately 11.7 times the square root of its compressive strength. This means that ordinary concrete of 4000 psi compressive strength would develop approximately 740 psi flexural strength. PROTECRETE-MWC added to the mix water of the very same mix design, (omitting water loss agent if applicable) will easily attain at least an 800 psi flexural strength. However, remember that flexural strengths of various mix designs can vary considerably due to aggregate type, size and gradation, cement type, water-cement ratio, etc.

Abrasion, erosion, wear and cavitation can also have similar effects on concrete. An example of wear in building construction is abrasion from forklifts or other hard wheeled traffic. Another example is production operations where heavy objects may be dropped on the concrete.

Concrete compressive strength at the wearing surface is an indicator of potential wear resistance. Higher strengths usually result in greater wear resistance.

Why is durability of concrete so important?

The durability of a material is that property which indicates whether or not the material will endure even though it may not be subjected to loads sufficient to destroy it. Durability of Portland cement concrete is defined as its ability to resist weathering action, chemical attack, abrasion or any other process of deterioration. Durable concrete will retain its original form, quality and serviceability when it is exposed to its environment. Durability of concrete is one of its most important properties. It is essential that concrete be capable of withstanding the conditions it has been designed for throughout the life of the structure.

Durability of concrete is affected by innumerable factors such as alternating wetting and drying, heating and cooling, freezing and thawing, aggressive sulfates exposure, capillary water, abrasion, corrosion of steel and other imbedded materials, dissolving of certain constituents (principally calcium hydroxide) by percolating water, dissolving of cement by certain acids, etc. Each and every one of these problems potentially affecting concrete

Durability is addressed using PROTECRETE-MWC as a mixing water conditioner.

PROTECRETE-MWC added to concrete mix water produces a concrete which is extraordinarily strong, hard and impermeable. This is accomplished in several ways beginning with improvement in hydrolysis by-product quality. Particularly calcium hydroxide which later provides a more efficient lamination. This minimizes the volume of leftover unused calcium hydroxide residue remaining in the concrete installation, thus lowering the potential for detrimental internal chemical reactions. PROTECRETE-MWC provides mix water the ingredients to initiate cement hydration without the turbulence and violence associated with hydrolysis. This includes cement potency loss ascribable to mix water dilution of the cement. This action at the point of hydrolysis also works to ensure that only the finest quality cement paste attainable is absorbing into and coating the aggregates during this critical event. This greatly improved cement paste in the aggregate-cement paste contact zone significantly improves the final paste-to-aggregate bond quality.

PROTECRETE-MWC utilizes a much greater volume of the already included Portland Cement, which in turn increases the cementitious material content of a mix. This action tremendously improves durability by producing smaller and more segmented capillaries, thus more permeability. Since PROTECRETE-MWC increases utilization of the already included Portland cement, this means that more of each cement particle will be utilized. This greatly decreases the size of each particle leftover to act as filler aggregate. These particles ultimately become sized somewhere between sand and cement grain sizes. It causes them to perform as silica fume would, except without the brittleness. This action alone causes concrete integrity to increase. The concrete becomes even denser, stronger and less susceptible to contaminate pollution, freeze-thaw cycle damage, imbedded steel corrosion, etc. Factors which translate to greater durability.

Concrete durability is further enhanced in many other ways through this increase of already included cement:

- The production of very fine-textured cement paste that has extremely small uniformed-size gel pores.
- Improved workability through increased lubricity.
- Less particle separation during placing and finishing, resulting in less surface bleed water.
- The provision of a surface much harder and more abrasion resistant.
- Utilization of all capillary water, leaving none to later evaporate and increase void percentages.

These are all durability factors which serve to increase concrete's overall integrity, compressive and flexural strengths, decrease its permeability and extend the useful lifespan of the concrete.

Why isn't PROTECRETE-MWC considered an admixture?

PROTECRETE-MWC is not considered a concrete admixture since its conceptual function is to enhance water's cement hydration capabilities. It focuses on providing additional overall quality to Portland cement concrete without targeting one specific area of improvement. Basic materials of concrete are cement, mineral aggregate and mixing water. An admixture is defined as a substance or agent that can be added into a concrete mix to enhance certain desired properties. An admixture is not considered concrete material in the proper sense as is mixing water. It should also be mentioned, ASTM recommends the use of potable water where possible and practical as mix water for Portland cement. Water of any other quality should be adequately tested for approval prior to mixing with it. PROTECRETE-MWC added to already good concrete mixing water improves it to extraordinarily excellent concrete mixing water status. PROTECRETE-MWC has no VOC content. PROTECRETE-MWC added into potable water still remains potable.

The number one rule-of-thumb for producing extraordinary concrete from any mix design is to always use a low water-cementious materials ratio to receive dense concrete with the lowest permeability. This feat is accomplished each and every time with PROTECRETE-MWC added to the mix water following approval of your mix design.