KALMATRON® KF-A

Class Upgrading Concrete Admixture

the choice
for durable
concrete

AGITATION OF CEMENT HYDRATION

Actual hydration of cement occurs by superficial absorption of water on the depth of cement grain at 16% during one year. Unaccomplished cement hydration causes immaturity of concrete structure depending on purity of environment for decades. Therefore, the speed and depth of cement hydration are major factors of concrete durability.

• *"For a cement particle that measures 50 µm across, the depth of hydration is 4 µm at 28 days and 8 µm after a year. Full hydration has only been obtained by grinding cement in water continuously for five days. The standard average across measurement of a cement particle is over 90 µm."* [1]

• *Diminishing size of hydrating cement particle has only be obtained by KALMATRON® KF-A admixture providing decay-hydration of the cement grain from 100 µm to 10 µm in a first 20 minutes. Completed hydration expected to be observed during of hardening hours when augmentable water is available.* [2]

This property propagated KALMATRON® KF-A for advanced replacements of ISOLATIONS, FIBERS, SILICA FUME, MICROCEMENTS, etc. KF-A is a cost-effective solution that provides a transformation of conventional concrete mix to High Performance Concrete. For instance, concrete or mortar made with KF-A has no shrinkage cracks, impermeable to the liquids and resistant to known types of corrosion.

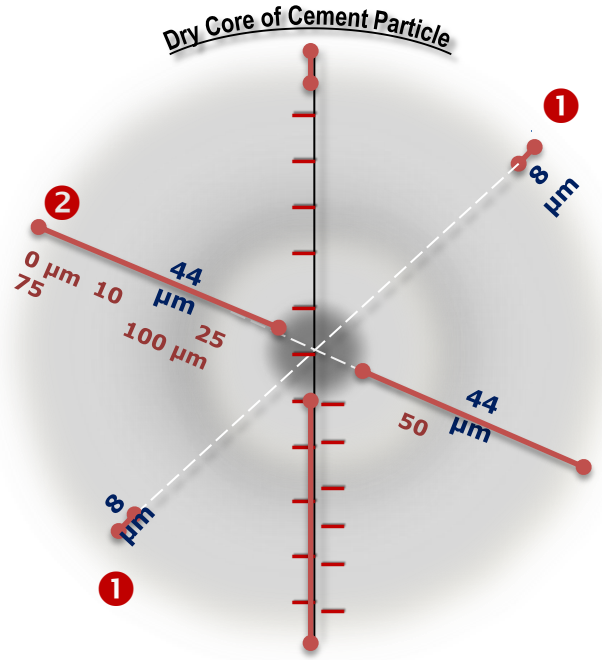


Fig.1 Model of comparative cement hydration

1 – Depth of cement hydration after a year

2 – Depth of cement decay-hydration after 20 min agitated by KALMATRON® KF-A

KF-A acts by four ways after adding into the concrete batch:
1. As a Water Reducer during of mixing and pumping time;
2. As a Plasticizer during of transportation and placement time;
3. As a Shrinkage controlling and Curing Compounds during of setting time;
4. As a Strength gainer and Impermeability performing agents of hardening time.

KF-A applicable by:
- 8.5 LB/CY or 5Kg/m3 into conventional concrete mix;
- 13 LB/ CY or 7.5Kg/m3 into pre-cast concrete mixes;
- 17 LB/CY or 10Kg/m3 into the plaster and shotcrete mixes.

Low slump and viscous workability are resulting in a properties of High Performance Concrete of conventional concrete mix with KALMATRON® admixtures.

Low cost per unite of application brings new economy to the concrete technologies with twice longer terms of inter repair durability.

[1] Properties of Concrete , § 14 Portland cement, A. M. Neville, 1993 Third Edition
[2] www.kalmatron.com

The highest concrete features performance is available by the three major innovations of 20-th century in the concrete industry:

- the water to cement ratio;
- the use of properly entrained air by admixtures;
- the invention of the high-range water-reducing admixture to increase slump. Obviously, they are dedicated to imitate natural functions of cementitious paste.

KALMATRON® KF-A admixture is functioning as a cement hydration agitator by decay-hydration reactions resulting in maximum volume of cementitious paste as a continuous solid phase in which the aggregates are embedded.

HOW IT WORKS

KALMATRON® KF-A provides a four-step chain reaction with cement grain:

- Initial dissolution of cement grain by hydration;
- Oxidation of metal-containing elements;
- Colloidation of free molecules of water;
- Stabilization of the gel into the cement rock.

Reduced W/C performs low slump with high workability.

BENEFITS

No curing is required

No shrinkage cracks ever

No efflorescence appearing

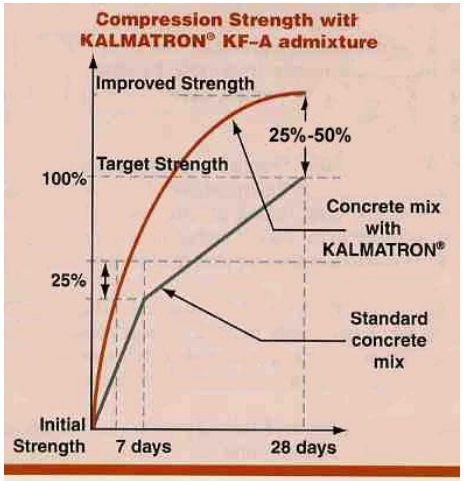
No dilatation cuts of regular slabs

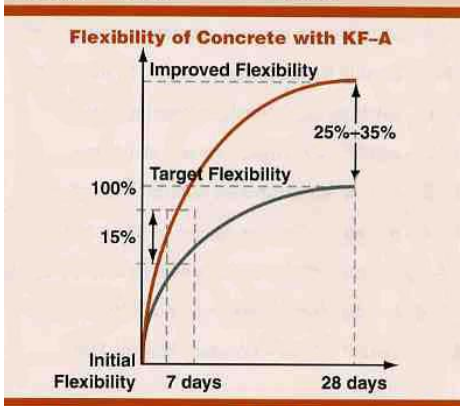
No edges curling even for thin slabs

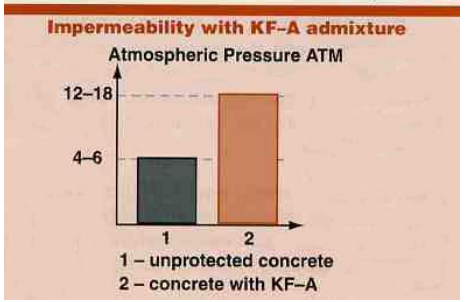
No filled up in precast & one step stucco

No liquid penetration from both sides

No isolating or shielding decay coats







Modern *High Performance Concrete is recognized by High Compressive Strength with densification of concrete structure by gravimetric compaction of water-insoluble ingredients.*

KALMATRON® High Performance Concrete is recognized by Continuous Structural Density with accomplished structure forming process by chemical compaction of water-insoluble and soluble ingredients.

Resistance to the given environmental conditions is created by non-reactive concrete embodiments and generic gas-liquid impermeability.

Any concrete should not be cracked, permeable to liquids, contradicted to rebar presence and dependent on environment.

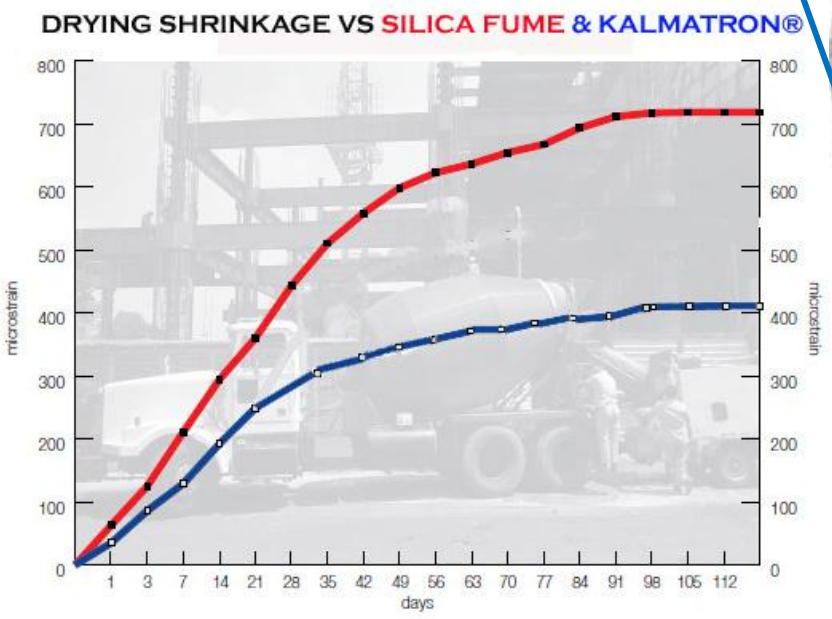
There is no HPC any more. Concrete means stable quality just as it sounds.

How to recognize concrete structure with and without of KALMATRON® KF-A?

Wash the surface with water to see the difference

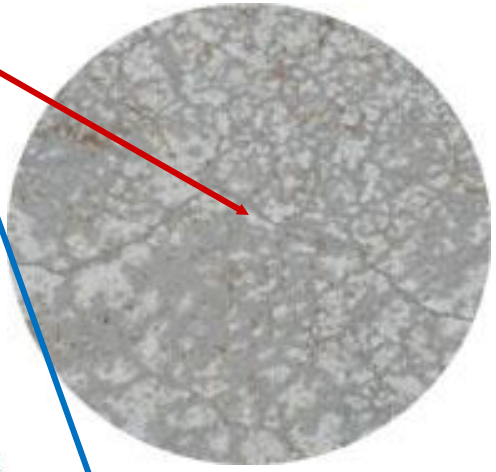
Unhydrated cement grain becomes an active sorption center for liquids even in post maturing concrete age.

Decay-Hydration reaction results in the continuous non-reactive cementitious paste.



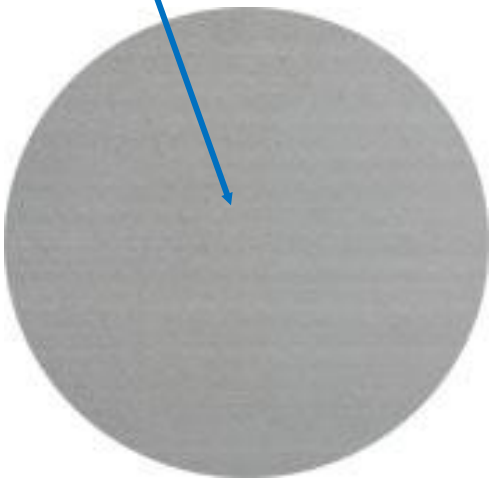
KALMATRON® KF-A physically alters the concrete and also acts on an ionic level providing speeded hydration of the cement grains.

The gas, normally associated with concrete hydration is Carbon Dioxide, creating 70% of the macro pores and 30% of the micro pores. Acetylene gas is produced when KF-A is added to the concrete, resulting in 97% micro pores and only 3% macro pores.



Typical shrinkage cracks as a result of retarded structure forming process.

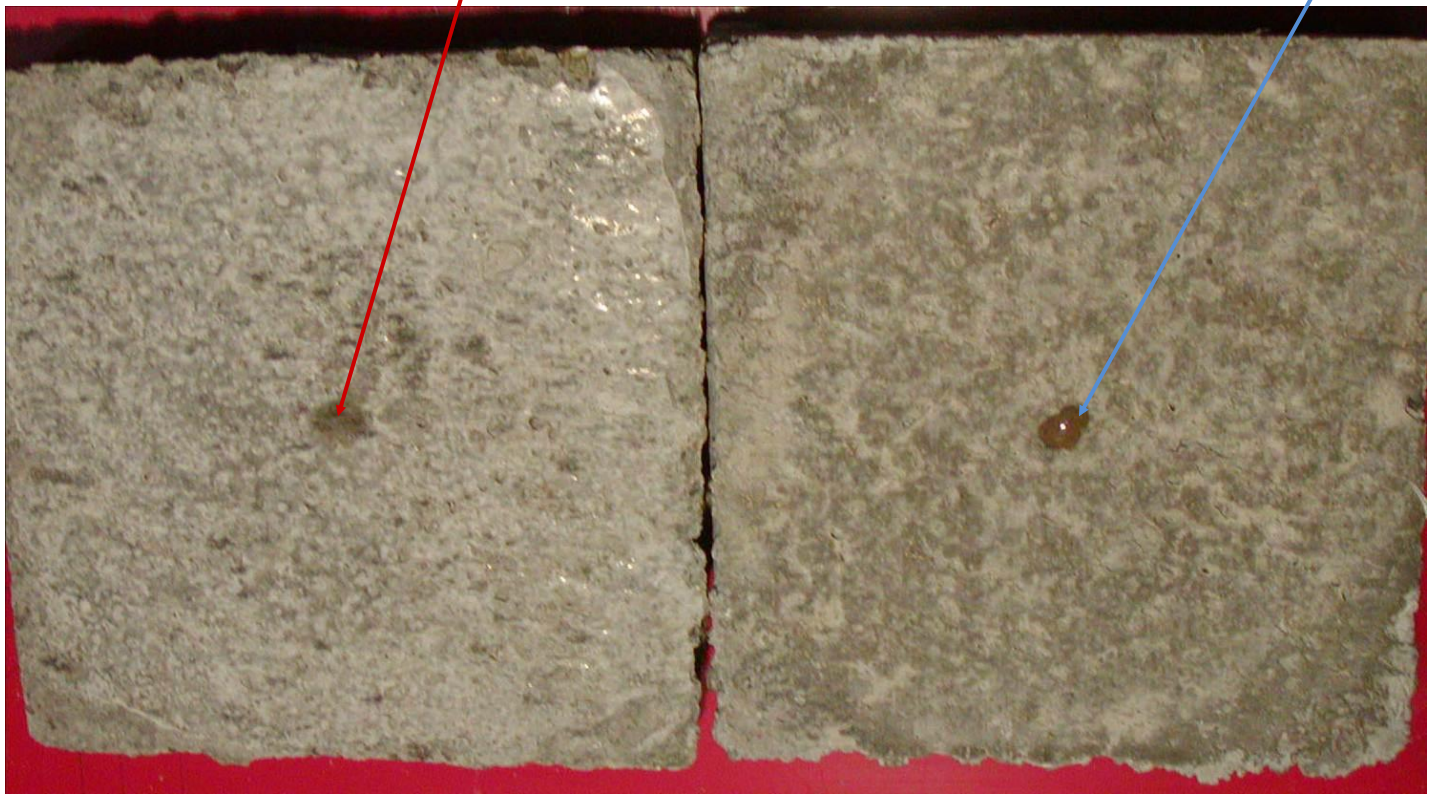
Intact surface of concrete with lowered shrinkage development.



Or: Drop vinegar on the concrete samples with and without KF-A.

Without KF-A the drop of vinegar disappears into concrete being dissolved in a reaction with Ca(OH)2 in a couple of minutes.

With KF-A the drop of vinegar will remain until it dries out naturally.



Therefore, KALMATRON® KF-A provides a chemical reaction with "free lime" where that product becomes a useful ingredient in the structure forming process. It greatly benefits in efflorescence elimination, corrosion resistance and gas-liquid impermeability.

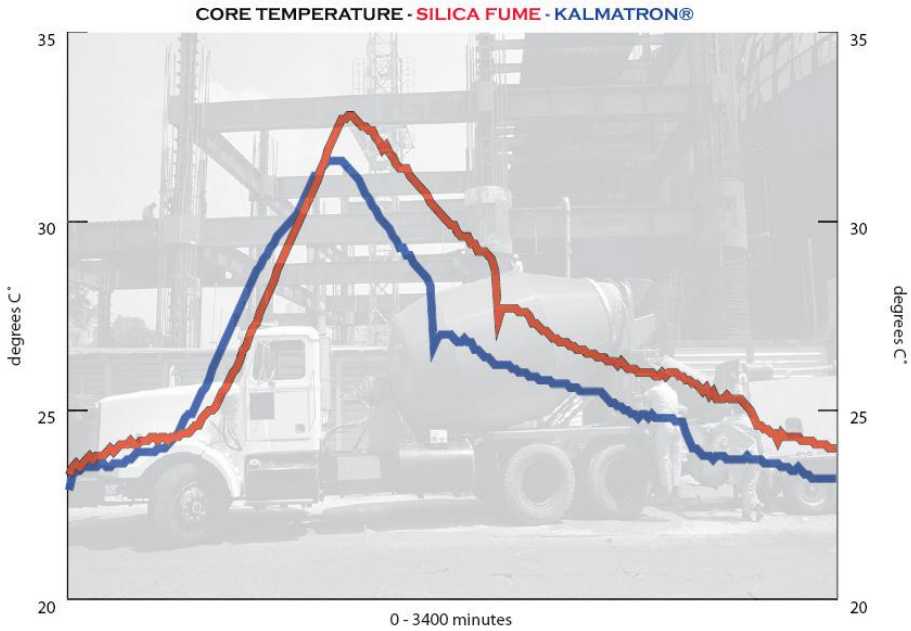
How to recognize concrete mix with KALMATRON® KF-A?

Exothermic heat is lower by at 25% to 50%

- Hydration process goes faster by Decay-Hydration reaction with weakening of molecular tensions of water by KF-A electrolyte. Actually, this reaction is similar to the function of magnetized water. The distinguishing part is that the KF-A admixture provides a stable residual magnetic effect. This reaction results in attenuation of exothermic heat by 25% to 50%.

Reduction of exothermic heat has many practical benefits:

- provides stable reduction of water to cement ratio at 0.38 and lower;
- results in retardation of shrinkage dynamic in the first days;
- no need for hydro-thermal curing;
- thermal joints are not required for most concrete applications;
- no cooling devices or supplementary materials for massive applications;
- no other chemicals for shrinkage reduction.



Comparative analyze of exothermic heat of concrete with and without KALMATRON® KF-A. University of Technology, Sydney, Australia.

Shotcreting with KALMATRON® KF-A of irrigation system canals in Mojave Desert, California over of 100 °F without curing and isolation.

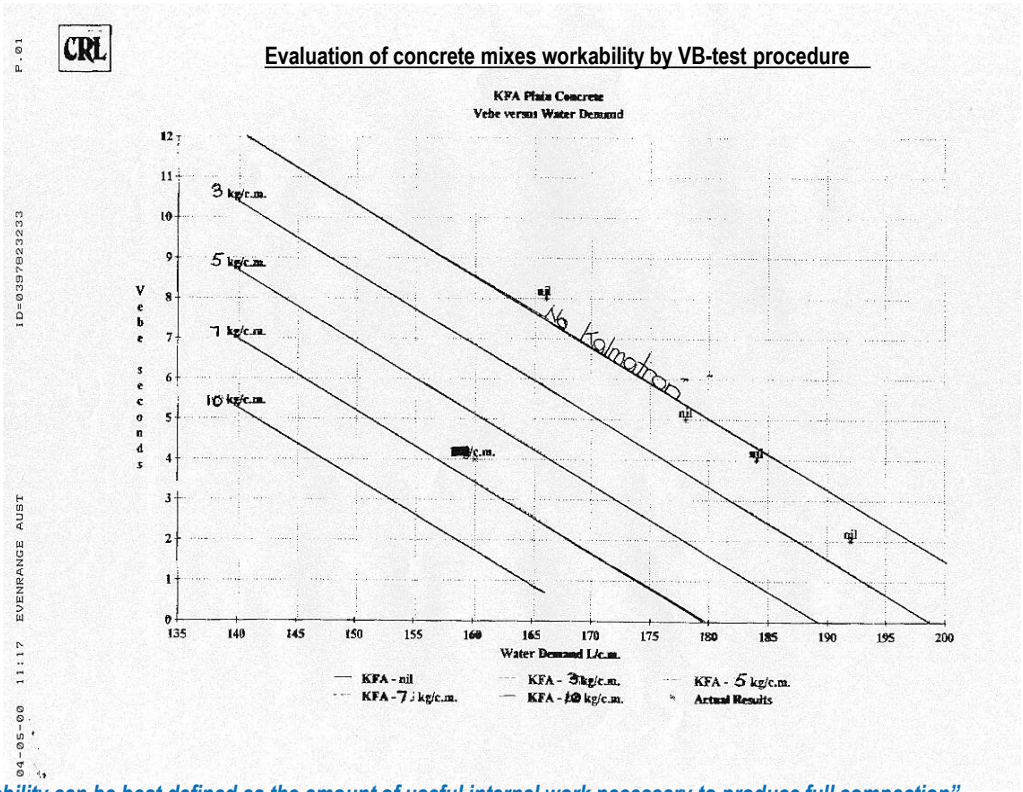
Various slump have equal workability

Conventional concrete flow

Concrete flow with KF-A

Shotcrete flow with KF-A

- **WORKABLE SLUMP** The application of the same concrete mix with 8.5 LB/CY or 5 Kg/m3 of KF-A varies with slump, needs less water and does not depend on cement quality and fineness of aggregates.
- Water solution of cement with KF-A is a viscous electrolyte, giving low slump with high workability, pumpability and finish ability.
- With slump ranging from 2 ½" to 3" it has the same workability, casting sufficiency and pumpability as conventional concrete with 5"-6" slump.
- It needs no hydro-thermal curing, less labor time for vibration and finishing jobs.
- Reliable "raw compaction" and plasticity of concrete batch was awarded by our customers with the new term, "Concrete Creamy Effect".



"Workability can be best defined as the amount of useful internal work necessary to produce full compaction". Definition of slump is"... the slump test does not measure the workability of concrete, but is very useful in detecting variations in the uniformity of a mix of given nominal proportions" - Dr. A. Nevill "Properties of concrete"

Slump 2.5"

Slump 3.5"

Slump 5"

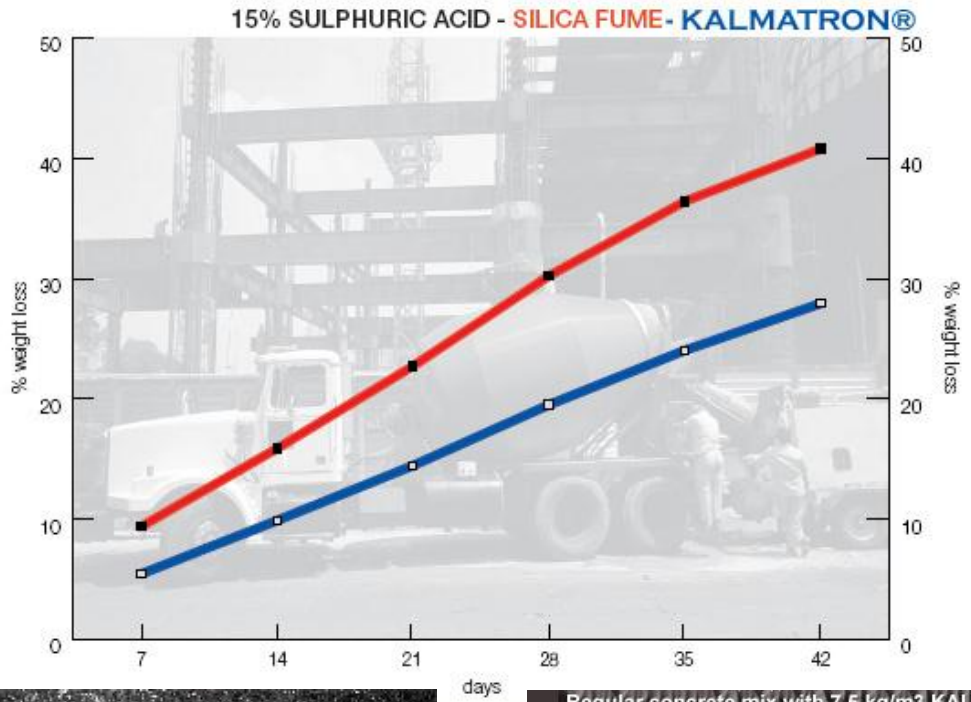
Resistance to chemical corrosion

- The absence of unhydrated cement grains and unsolved minerals including free lime as centers of high sorption ability enable higher resistancy of concrete to withstand to any type of corrosion.
- Resistance to the given environmental conditions is created by non-reactive concrete embodiments and generic gas-liquid impermeability.

Trial samples after 45 days

Trial samples after 90 days

Control samples after 45 days

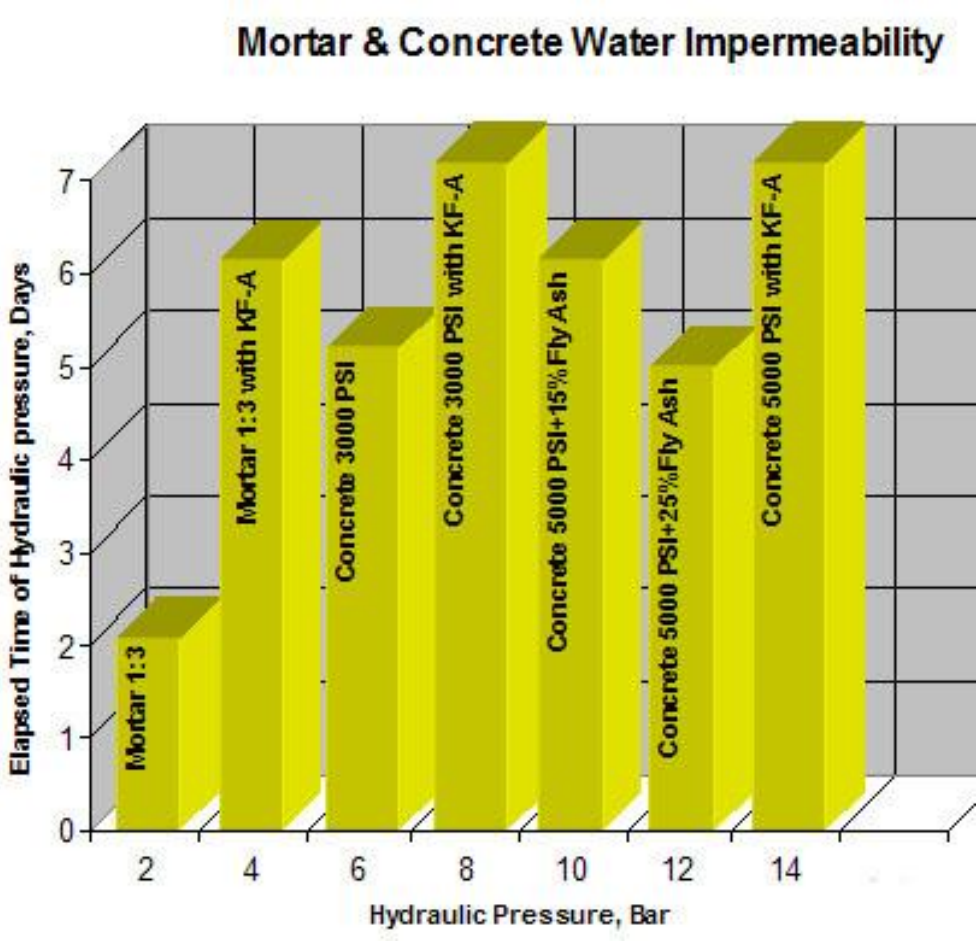


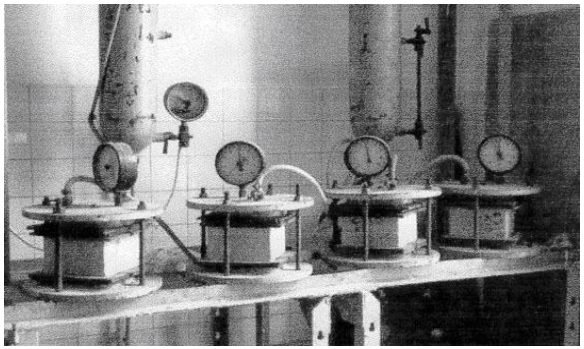
"Korvest Engineering" LTD Galvanizing Plant, AU: "Cement matrix with KALMATRON® KF-A has been stronger than coarse aggregate." Repair of concrete floor damaged by hydrochloric acid and ammonium chloride solution by coating with concrete containing KALMATRON® KF-A

Concrete floor of sulfuric acid dripping area after 9 months. Shown comparative application of concrete with 7.5 Kg/m3 of KALMATRON® KF-A and concrete with 500 Kg/m3 of High Alumina Cement R51, Lafarge.

Water-Vapor Resistance Penetration

- KALMATRON® KF-A is not a pore blocker. Since the smallest diameter of a pore even in cement paste is 500Å to 10,000 Å and a molecule of water has a diameter of 4 Å, we don't believe in pore blockers. Therefore, the diameter of concrete pores is not critical for liquid impermeability but a function of pore gradation eliminating hydraulic thresholds into concrete structure.
- Because of this, the pore gradation is as low as two groups only instead of the regular seven once. They are 3% of macro-pores and 97% of micro-pores which reduces hydraulic thresholds and tensile tensions.
- This means that the hydro-thermic balance between the outside humidity and the interior of the concrete subsurface is completely achieved. It is the best hydro-seal, as seen working in natural rock, where the one group of pores is dominant.
- In regular concrete, hydro-thermic balance depends on outside changes. That's why it leaks seasonably.





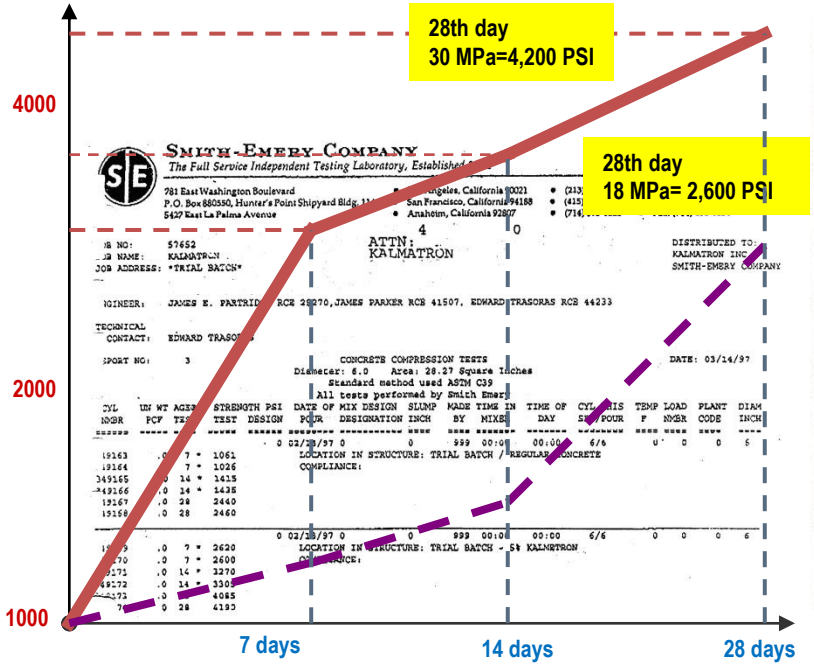
Standard equipment for evaluation of concrete impermeability under hydraulic pressure up to 14 Bar.

The concrete cube with 7.5 Kg/m3 of KALMATRON® KF-A has been under water for 17 days. Immediately after taking out of the water it was sawed by half where only the sides absorbed water, the inner area is completely dry.

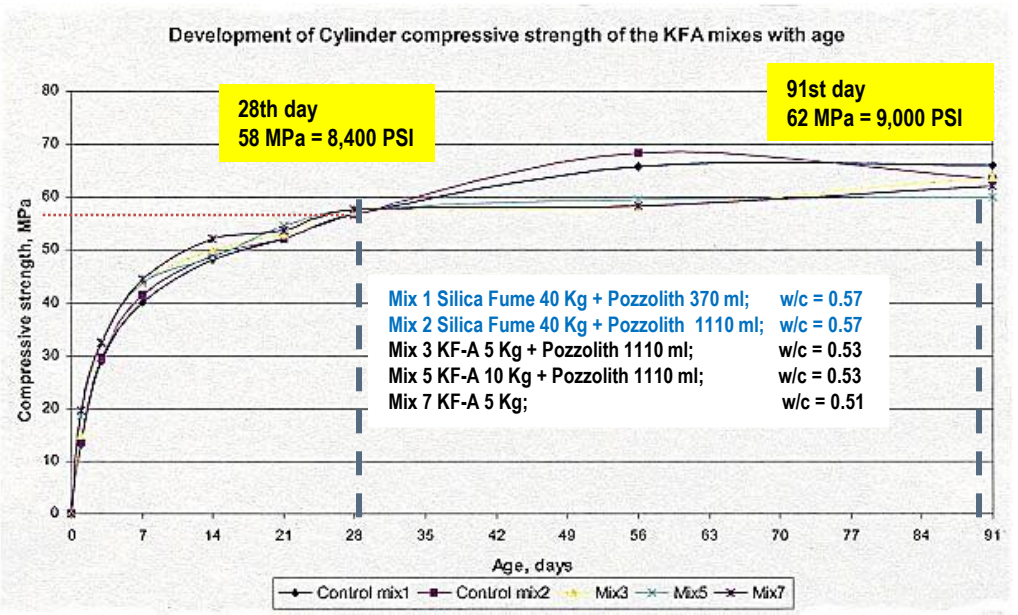
Compressive strength

- The durability of a concrete structure depends on Compressive Strength relevant to its Tensile Strength. Self destructive processes and physical types of corrosion such as inter-porous new-growths of salts, ice, etc. may achieve tensile tensions up to 5 Mpa exceeding concrete tensile resistance strength as it shown on the table below.
- The chart below (at left) shows comparative test results for a conventional 2,000 PSI concrete mix with and without KF-A application.
- The most important and vivid conclusion is that the chart's functions are opposite, which tells about KF-A's faster hydration development.
- Remarkable comparative test results were obtained as well when Silica Fume was replaced by KALMATRON® KF-A, where chemically complicated and expensive High Performance Concrete was replaced by a regular mix design containing 5 Kg/m3 of KF-A (see mix 7). Further analyses of corrosion resistance, shrinkage development, impermeability, showed distinctive advantages of concrete mixes containing KF-A only.

Standard Resistance to Rupture for concrete with Compressive Strength, MPa												
Compressive Strength	5	10	15	20	25	30	35	40	50	55	60	65
Tensile Strength	0.55	0.78	1.17	1.76	1.95	2.7	2.8	3.1	3.5	3.85	4.2	4.55



Comparative test results of 2,000 PSI targeted compressive strength concrete without and with KALMATRON® KF-A (7.5 Kg/m3)

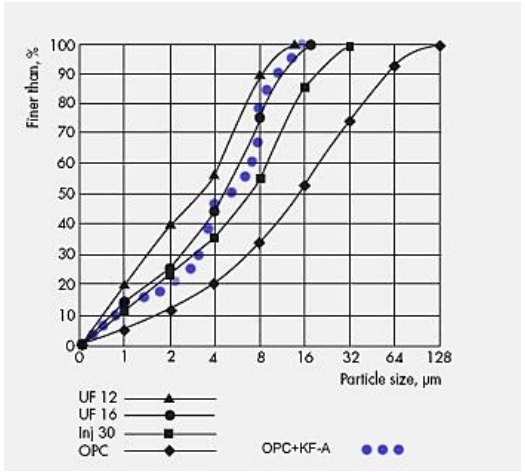


Comparative test results of High Performance Concrete containing Silica Fume (40 Kg/m3) and KALMATRON® KF-A (5 Kg/m3)

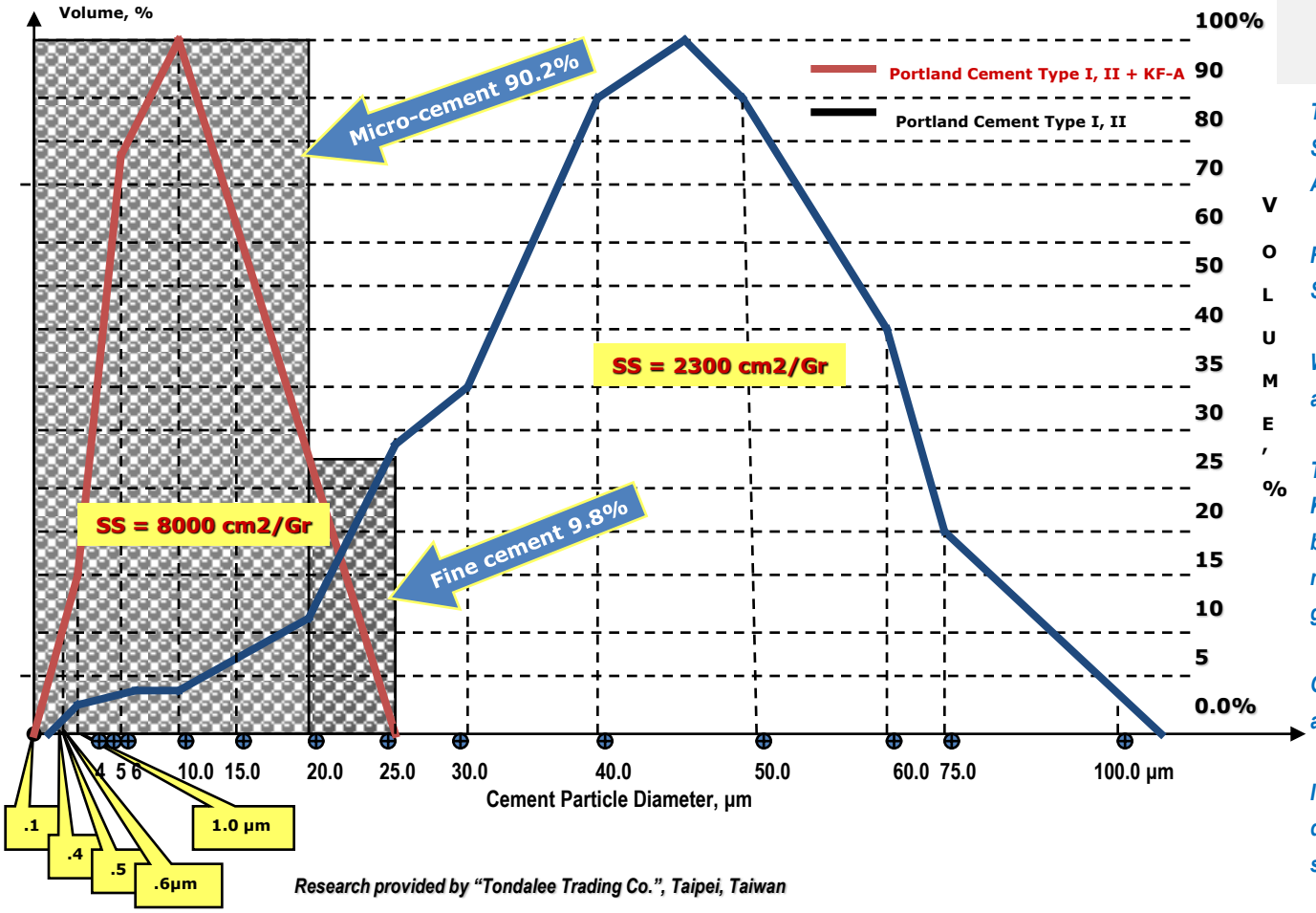
Micro-cement Replacement by KALMATRON® KF-A' Cement particles size reduction

The fineness of cement grinding is a vital property of the cement's value, determining the field of application, durability and price. Fine cements with particle diameters of 5 µm to 20 µm are the best for injections into the micro cracks of damaged structures, enforcement and restoration of the soil formed structures, architectural and sculptural elements.

The property of KF-A admixture to decay-hydrate cement grain results in the cement particle size reduction that allows it to replace Micro-Cements. Premix of KF-A into regular Portland Cement Type I; II obtains maximal volume of cement particles with diameter up to 25 µm, where dominating median size is at 5 µm to 15 µm. The same cement without KF-A has dominating median size at 40 µm to 60 µm.



CEMENT PARTICLES SIZE DISTRIBUTION



Research provided by "Tondalee Trading Co.", Taipei, Taiwan

The Wagner's method was chosen for Specific Surface (SS) evaluation with turbidimeter by ASTM C 115-79a.

For the specimen of Portland Cement Type I; II, the SS is 2,300 cm2/gr.

With KF-A admixture, the same cement specimen achieves at 6,000 cm2/gr to 8,000 cm2/gr.

The variety of the SS development with KF-A admixture depends on the speed and time of blender rotation within 5 to 10 minutes only. No more expensive kiln and hard grinding required to get micro-cement.

Obviously, the median size of the cement particles and Specific Surface are inversely related features.

It is effectively performed by KALMATRON® KF-A decay-hydration reactions with 10 times cement size reduction.

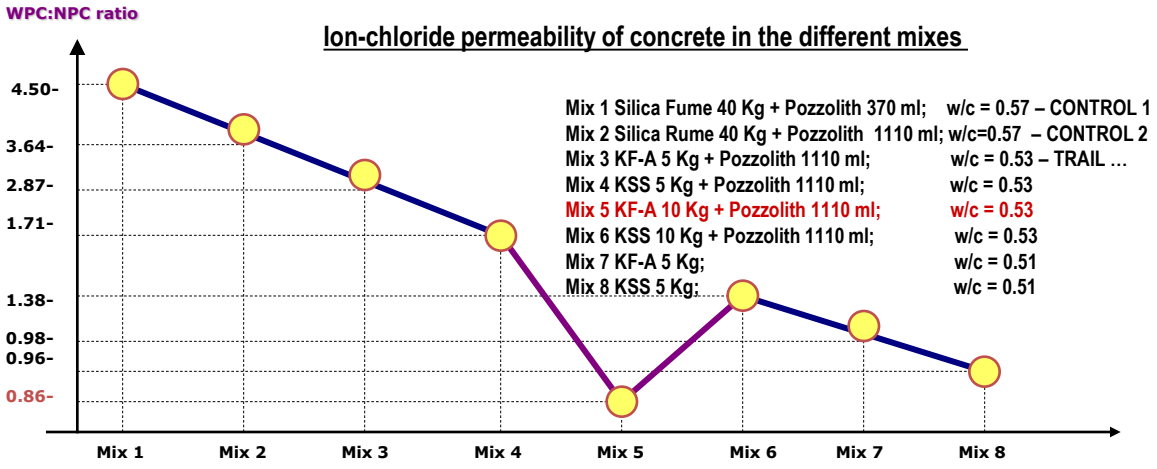
Chloride Permeability

The electric conductivity of cement paste is 10 to 15 times higher than that of concrete paste. Therefore, the more cement paste develops in the concrete batch, the higher the electric conductivity of the concrete structure. Usually, after 60 to 90 days electric conductivity levels return to normal. The chloride test permeability was conducted by ASTM C1202 for control specimens, containing Silica Fume, and trial specimens with KALMATRON®
KF-A. It was shown that the initial current for the test with water of trial specimen was more than ten times of that noted with the control concrete. It also proves higher cement paste yield provided by KF-A and 10-x correlation of electric conductivity between cement paste and concrete.

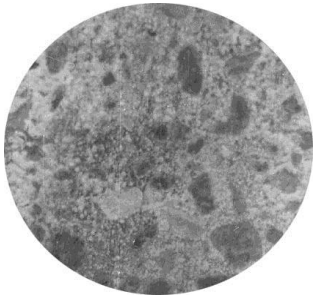
Total passed coulomb in the different mixes

Mixes	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6	Mix 7	Mix 8
Water passed coulomb **WPC** (1)	1116.18	1070.1	4423.14	3461.22	2561.94	2934.9	2536.7	2556.27
Chloride passed coulomb (2)	1364.04	1363.86	5964.07	5490.27	5533.11	5062.68	5134.91	5221.35
Net passed coulomb **NPC** (2-1)	241.86	293.86	1540.93	2029.05	2971.17	2127.78	2598.21	2665.08
WPC : NPC ratio	**4.50**	**3.64**	**2.87**	**1.71**	**0.86**	**1.38**	**0.98**	**0.96**

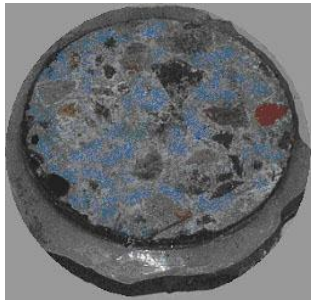
Performance of 10 Kg/m3 KALMATRON® KF-A is the best for resistance to chloride permeability and greater over 5 times than control specimens with Silica Fume.
A performance oriented test, which simulates the in-service conditions more closely, allows us to observe the advantages of trail specimens in chloride permeability, as shown on pictures at right.



Professor S. L. Bakoss "Investigations into the Effects of KALMATRON®" admixtures on concrete properties" - Centre for Built Infrastructure Research. University of Technology, Sydney, 2000



Typical look of concrete test specimen chloride penetration after drying. An abundance of salt crystals is visible. The surface of concrete is flaky with easily removable aggregates' particles.



KALMATRON® test specimen after completion of test of chlorides penetration. After specimens dried, the blue colored substance appeared on a specimen surface. This is a solid insoluble film of Tetracalcium Aluminoferrite deposits, a sub- product of cement and KF-A reaction with chlorides. The surface of concrete is solid with substantial structural integrity.

U.S.A. Patent 5,728,208
U.S.A. Patent 5,728,428

K100® is a liquid version of KALMATRON® KF-A

Certified to NSF/ANSI 61

Nonfood Compounds
Registration No. 136880
Category Code: R2, RX-2

Nonfood Compounds
Registration No. 143075
Category Code: R2, RX-2

K100 is a liquid version of KF-A developed due to variety of concrete application technologies providing Concrete Class Upgrading properties to the concrete mixes. Supplied in the standard buckets and commercial totes for manual application and automatic dispensers.

KALMATRON® KF-A and K100® falls under the classification of the following types of ASTM C 494:

- Type C – cement hydration accelerator;
- Type F – high range water-reducing admixture;
- Type S – specific performance admixture.

K100® awarded by European Committee for the best performance in 2011

Made in the U.S.A.