KALMATRON® KF-A

Class upgrading admixture for concrete mix
from conventional to High Performance Concrete

the choice for durable concrete

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 imitating the natural behavior of cementitious paste.

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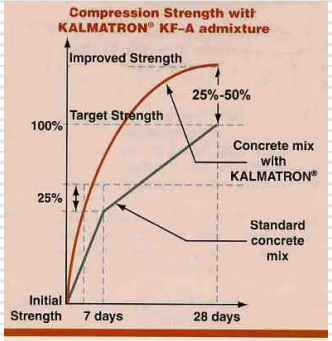
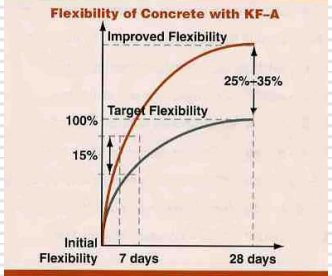
U.S.A. Patent 5,728,208
U.S.A. Patent 5,728,428

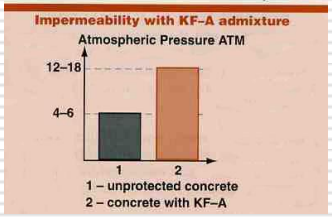
KALMATRON® KF-A admixture is a conceptually new product patented in the USA patents #5,728,208 and #5,728,428. It is an inorganic oxidizer of micro/macro metal elements contained in the cementitious materials providing electro-chemical decay of cement grain by electrolysis between inversely charged particles of electrolyte and cement grain. Decay-hydration reactions result 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 of the cement rock.
These reactions allow a reduced dosage of water, 10% to 30% less than the standard requirements with lower slump and even better workability.







www.kalmatron.com
www.builditstrong.com
www.shieldcrete.com

EXPECTED RESULTS

Early strengthening on 3rd to 7th day;
Higher compressive strength at 25% and higher;
Highest adhesion to most known porous materials;
Shrinkage is lower by 2 to 3 times. Just no cracks at all.
Exothermic heat is lower at 25% to 50%.
No flakes, efflorescence, dusty spots, and slid areas.
Water impermeability is 100% beginning from 50 mm or 2" of concrete thickness.
Highest resistance to chemical and climate corrosions.
Increase in frost-resistance up to 35%;
Yield of concrete mix is higher by 3% to 6%.

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

Transforming conventional concrete mixes into high performance concrete with low cost, KALMATRON® KF-A brought a new economical vision to the concrete industry. Any concrete should not be cracked, permeable to liquids, contradictory to rebar presence and to be priced by the nature of application. There is no HPC any more. Concrete means stable quality just as it sounds.

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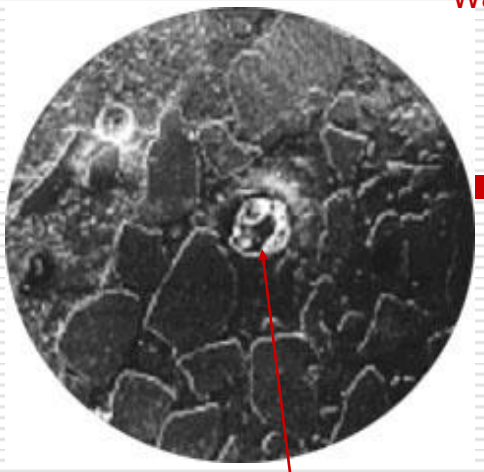
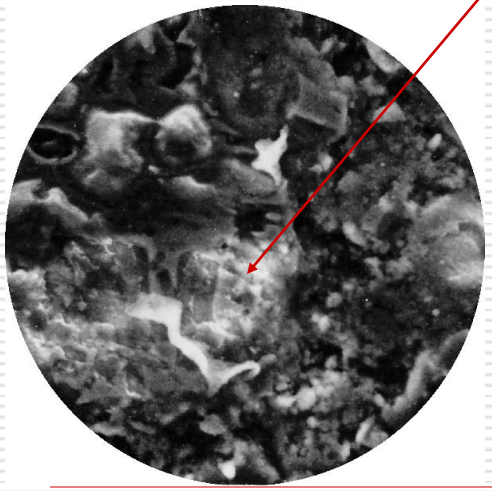
How to recognize concrete structure with KALMATRON® KF-A?

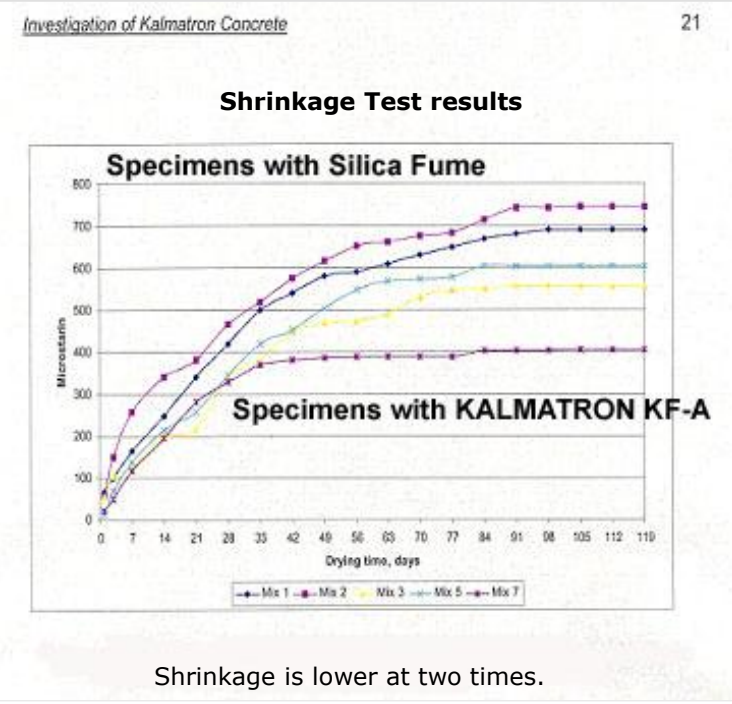
Wash the surface with water and see the difference



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

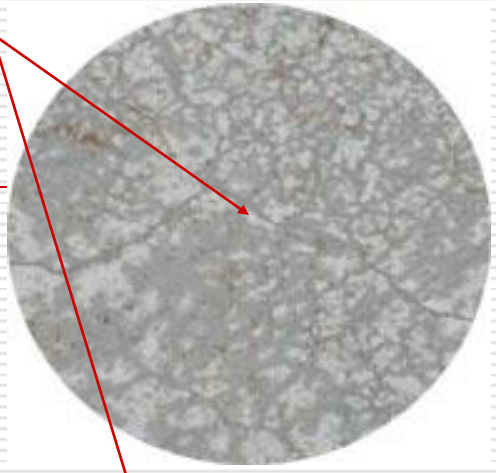
Decay-Hydration reaction results in the continuous non-reactive cementitious paste.





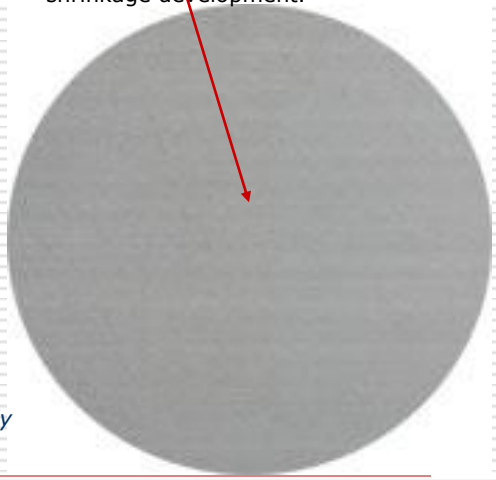
Shrinkage is lower at two times.

"For instance, after 28 days in contact with water, grains of cement have been found to have hydrated to a depth of only 4 μm, and 8 μm after a year. Dr. Powers calculated that complete hydration under normal conditions is possible only for cement particles smaller than 50 μm, but full hydration has been obtained by grinding cement in water continuously for five days." The size of a regular cement grain is over 90 μm.



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

Intact surface of concrete with lowered shrinkage development.



KALMATRON® KF-A physically alters the concrete and also acts on an ionic level. The four stages include: speeded hydration of ALL of the cement grains, oxidation of the metal containing elements, colloidation of the free molecules of water, and stabilization of the gel of the cement paste. 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.

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Or:

Drop vinegar on a concrete sample with KF-A. The drop of vinegar will remain until it dries out naturally.
The same vinegar drop on any other concrete dissolves in a reaction with Ca(OH)2 in a couple of minutes.

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.

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

Extensive KALMATRON® studies were carried out by the most notable universities. This product's performance allows these results to be seen even on a job site with the most common tools.

Exothermic heat is lower by 25% to 50%

- **Hydration process goes faster by Decay-Hydration reaction with weakening of molecular tensions of water by positively charged KF-A artificial minerals. 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.**

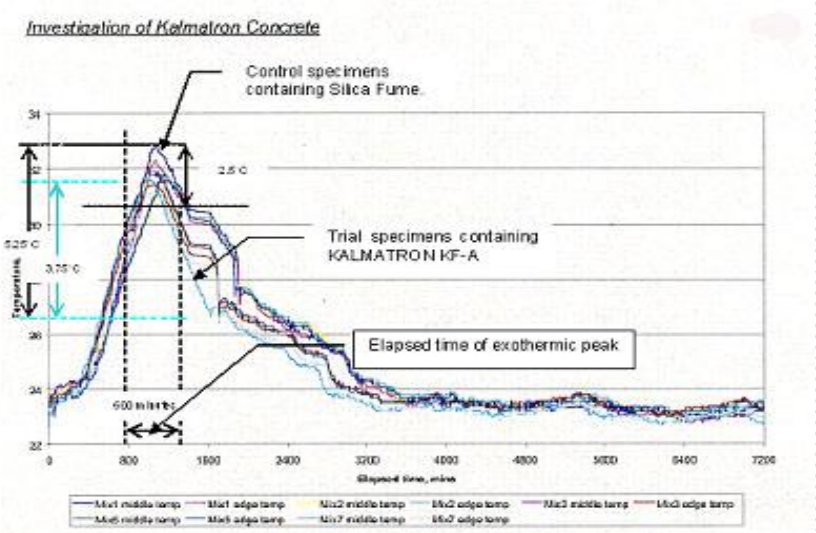

Figure 9 : Development of core temperatures in 200mm cube specimens with time from the time of casting (KFA mixes)

University of Technology, Sydney, Australia.

This concrete roof was made without joints or any isolations in the year 2000 in Melbourne, AU.

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Various slump have equal workability

Conventional concrete flow

- **WORKABLE SLUMP The application of the same concrete mix with 8.5 Lbs/cu. yd. 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.**

Slump 2.5"

- **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".**

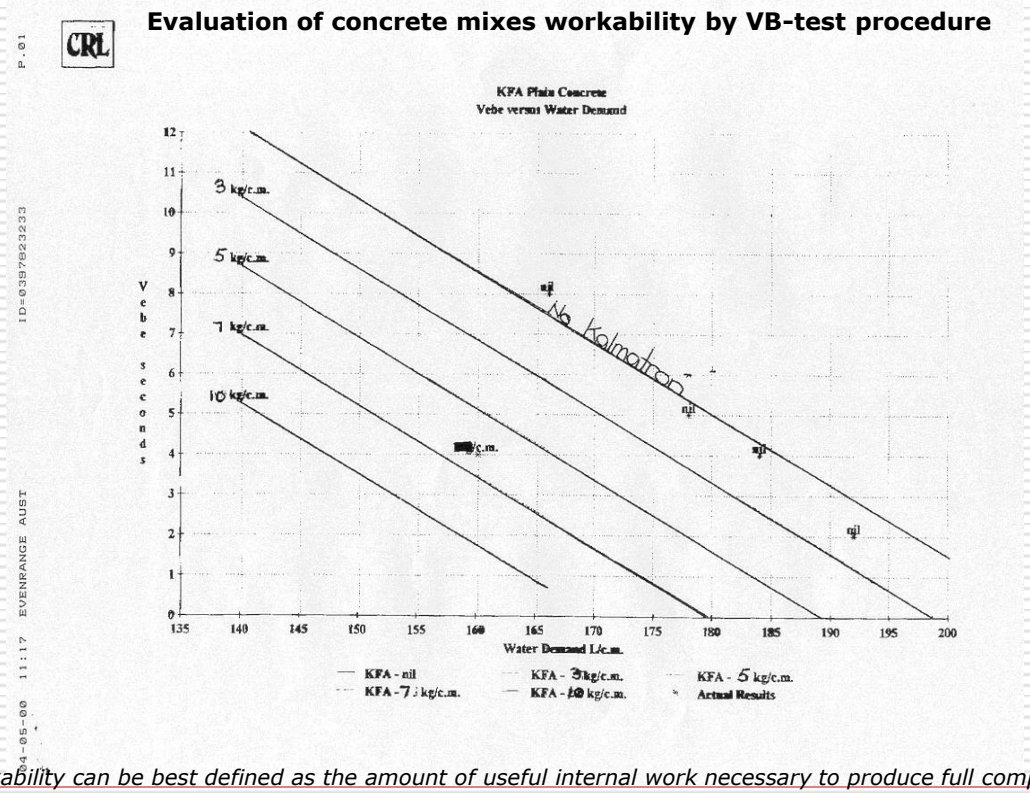
Concrete flow with KF-A

Slump 3.5"

Shotcrete flow with KF-A

Slump 5"

Evaluation of concrete mixes workability by VB-test procedure



"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"

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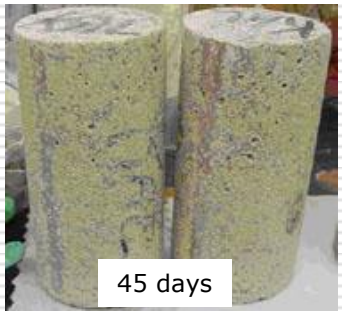
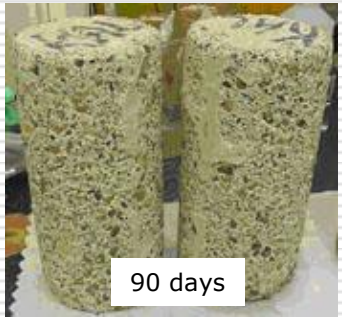
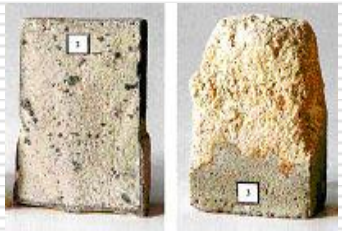
Resistance to chemical corrosion

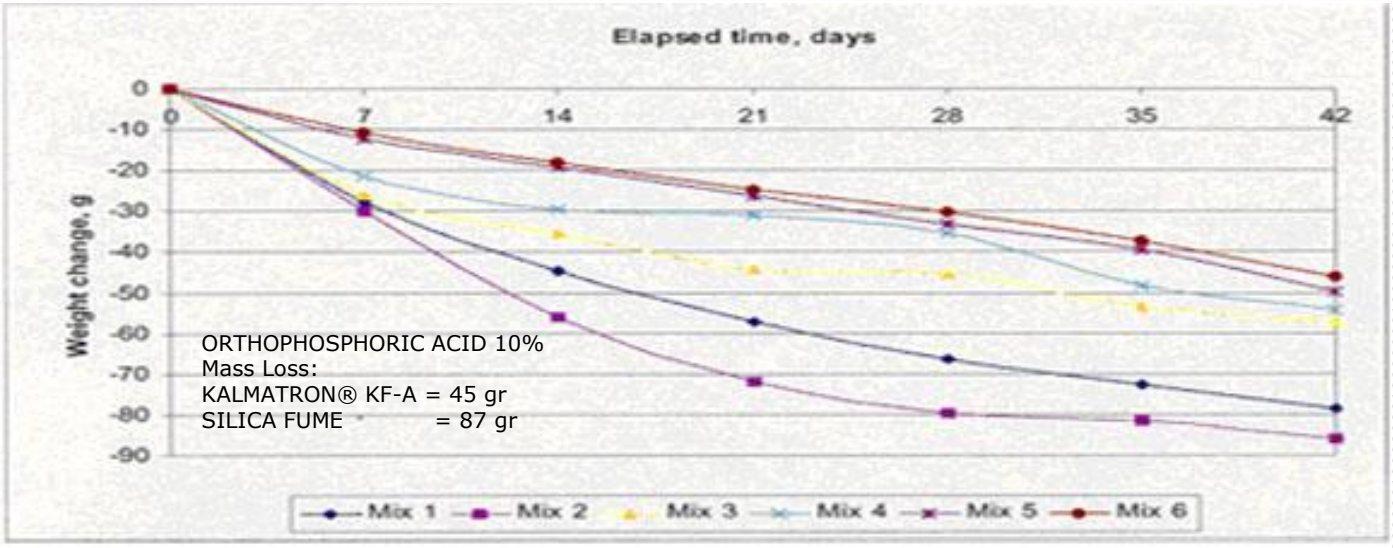
- **Viscous electrolyte of "water-cement-KF-A solution" hardens as a homogenous paste where most of the cement grains are hydrated. Darker color of concrete with KF-A indicates increasing of cementitious paste.**
- **The absence of unhydrated cement grains and unsolved minerals including free lime as centers of high sorption ability enable High Resistant Concrete to withstand any type of corrosion.**
- **Resistance to the given environmental conditions is created by non-reactive concrete embodiments and generic gas-liquid impermeability.**







Concrete with KF-A (at left) and control specimens after 45 days In a 25% solution of Sulfuric acid treatment.



"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.

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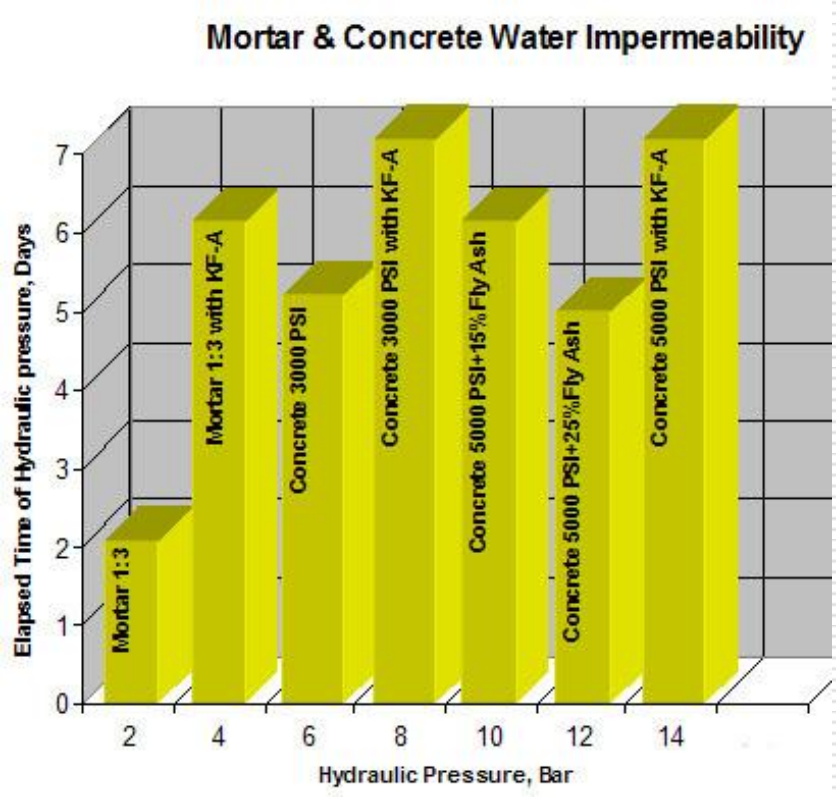
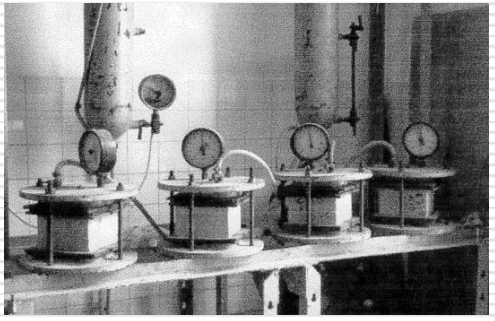
Water-Vapor Resistance Penetration

- **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 only, 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 and the viscosity of inter porous solutions.**
- **KALMATRON®KF-A provides complete decay-hydration of cement which results in additional cement paste and increased viscosity of inter porous solutions. Also, the benefit of these solutions is freeze-thaw resistance.**
- **Because of this, the pore gradation is as low as two groups only instead of the regular seven. They are 3% of macro-pores and 97% of micro-pores which reduces hydraulic thresholds and tensile tensions.**
- **This means that the hydro-thermical 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-thermical balance depends on outside changes. That's why it leaks seasonably.**



Comparative test results of concrete and mortar water impermeability



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

The simplest experiment was provided by our customer. They poured KF-A shotcrete mix into a pail at 1/3 its depth with inserted garden hose adapter. They kept it for 15 days under water pressure at 70 PSI or 5 Bar. Specimen was dry.

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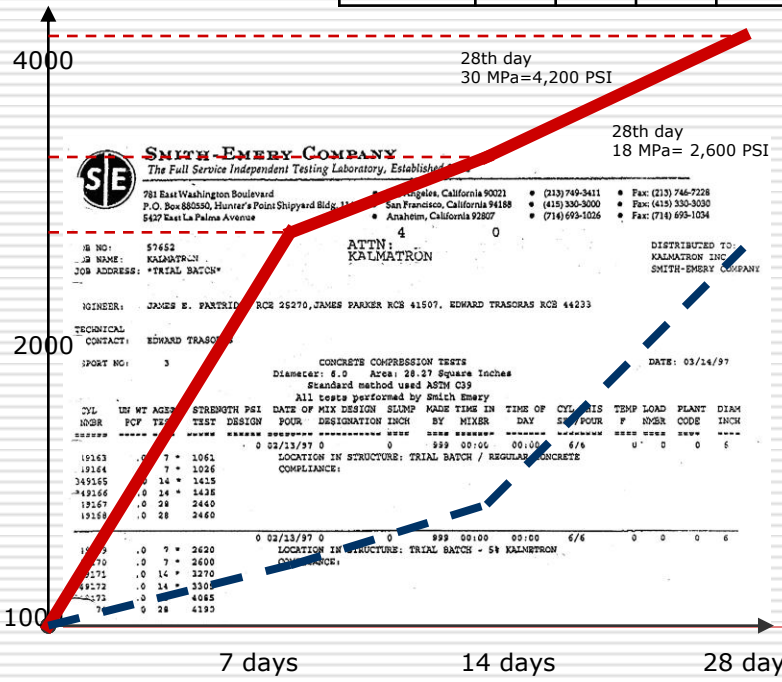
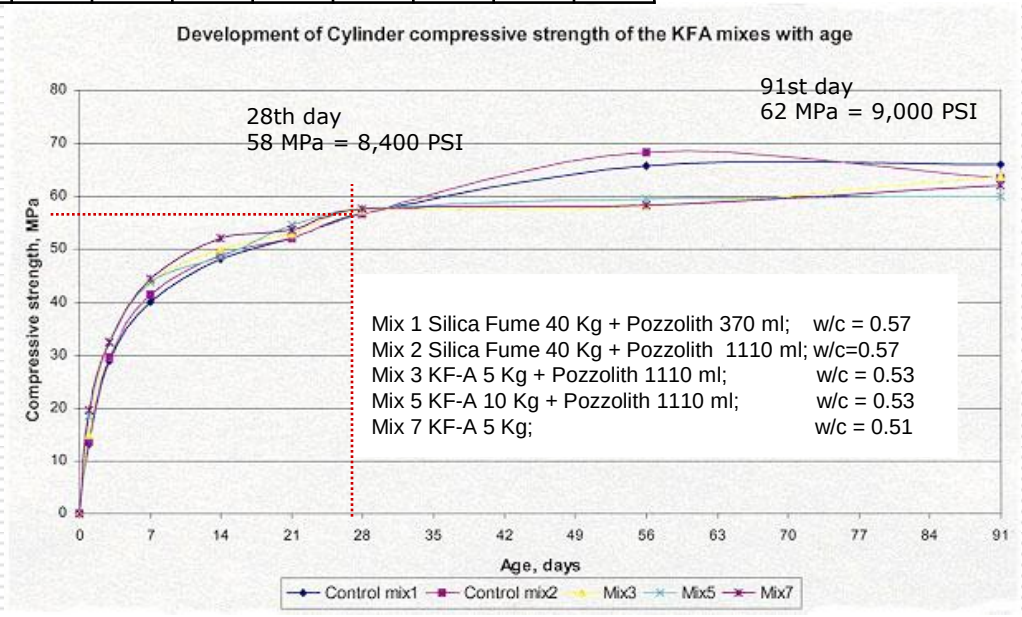
Compressive strength

- 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.
- The table below shows standard Resistance to Rupture of concrete with Compressive Strength, respectively. Every data of Tensile Strength is below 5 MPa, which directs industry on densification of concrete matrix.
- The densification of the concrete structure by increasing the cementitious part increases its Compressive Strength.
- 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 with and without 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)

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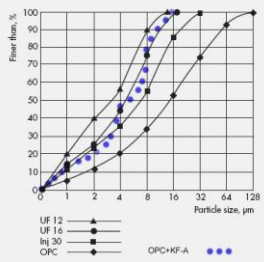
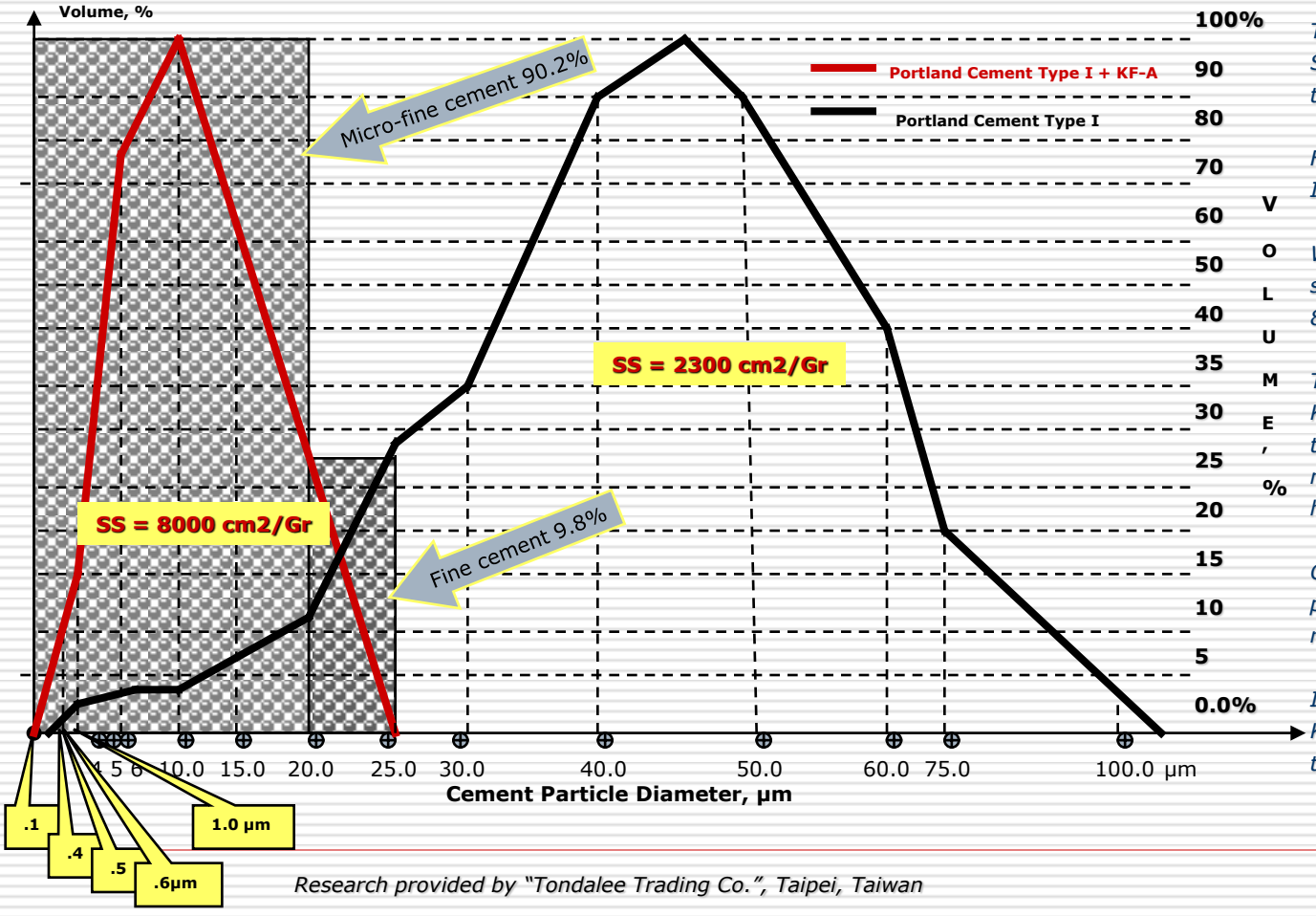
Micro-cement Replacement by Cement particles size reduction



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



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.

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

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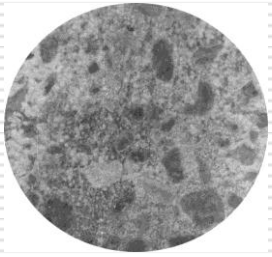
Chloride Permeability

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.

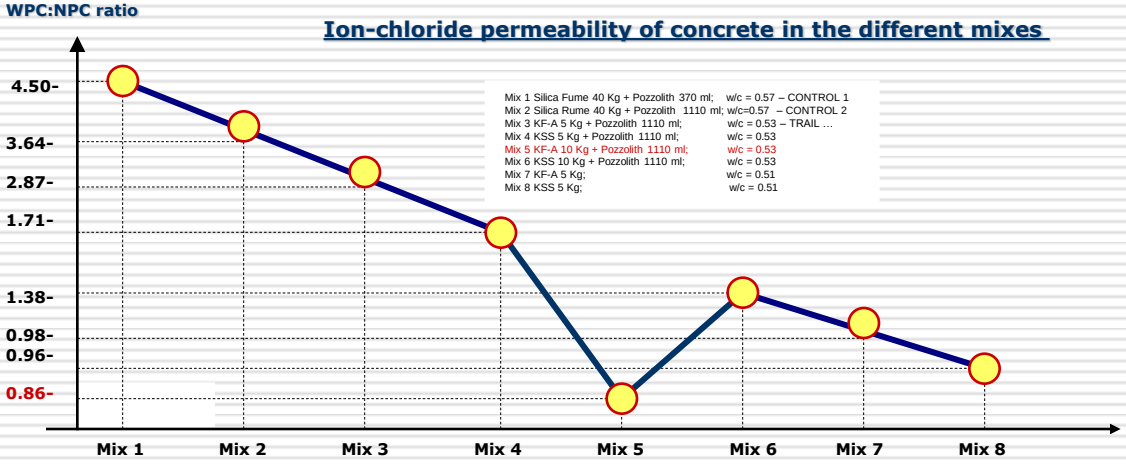
Total passed coulomb in the different mixes

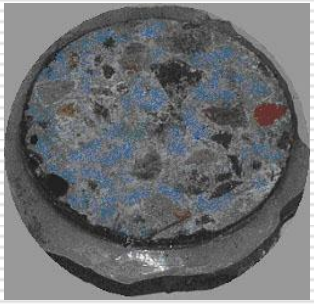
Mixes	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6	Mix 7	Mix 8
Water passed coulomb **WPC** (1)	1116.18	1070.1	4423.14	3461.22	2561.94	2934.9	2536.7	2556.27
Chloride passed coulomb (2)	1364.04	1363.86	5964.07	5490.27	5533.11	5062.68	5134.91	5221.35
Net passed coulomb **NPC** (2-1)	241.86	293.86	1540.93	2029.05	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.

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.





Chloride penetration KALMATRON® test specimen after completion of test. The blue colored substance appeared after specimens dried. 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.

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

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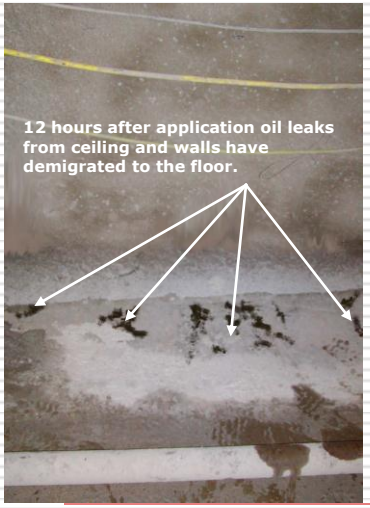
Unique Applications of KALMATRON® KF-A

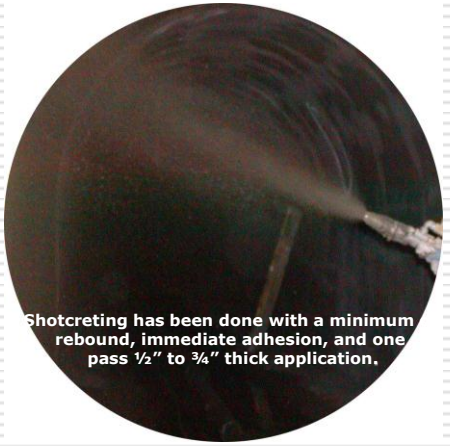
200 Miles through the Mojave Desert

The Aqueduct Water Supply System of Los Angeles City was built in the early 1900's and suffered from water leaks and penetration of natural crude oil from overlying geological deposits through the concrete walls and ceilings.

- The mix design is simple –a traditionally rationed blend of sand, cement, KALMATRON® KF-A and water. Application was provided by shotcrete technology. The significance of this application is that the leaks of water and crude oil were stopped without preliminary patching and plugging jobs. With limited time per shift, it greatly economized labor expenses and construction time. For severely leaking spots an accelerator was applied to the end of the nozzle.
- The application was provided by the staff of the "Department of Water & Power of the City of Los Angeles."



Internal view of the aqueduct 12 months after application. The oil leaks have demigrated to the floor completely. The currents of water have colored the surface of the walls with brownish patterns by natural organic contaminations. Despite the hydraulic pressure of the entering waterfall, which is over 50 Bar, not one indication of damage was observed.



For more details visit web site www.shieldcrete.com

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SHOTCRETE TECHNOLOGIES, INC.

Union Pacific Railroad

Lining of a deteriorated 42 inch culvert pipe with a high strength shotcrete. A 1 inch thick lining was applied to 2500 LF of this pipe. Lining was applied at 400 to 500 LF a day. A 1 inch lining shotcrete with KALMATRON KF-A admixture obtaining 7000 PSI will exceed the railroads mandatory H80 load requirements.

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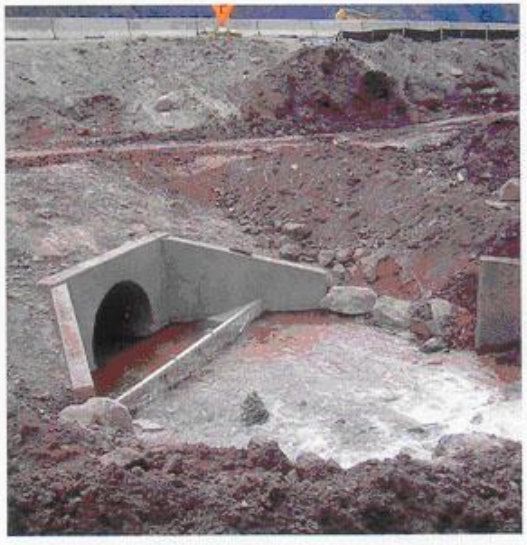
Black Hole

Sinkhole Swallows I-70 in Colorado, Closing 24 Miles of Highway

Crews with the Colorado Dept. of Transportation and American West Construction, Denver, were working nonstop last week to reopen one lane in each direction of Interstate 70 near Vail after a 22-ft-wide sinkhole opened up in the westbound lanes. Runoff from heavy rains washed out a 60-in. culvert, causing the sinkhole to form and closing 24 miles of roadway. CDOT spokesperson Stacy Stegman says there is no cost estimate yet, but "we're looking at several hundred thousand dollars." Restoring the full four lanes will take several weeks, says Stegman.

June 9, 2003 • ENR • 11

I-70 Vail Pass Sinkhole Repair
CDOT - American West Construction
Commercial Shotcrete, Inc. &
Shotcrete Technologies, Inc.
July, 2003



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KALMATRON IN A HEARTH -HEAT ENVIRONMENT

Unique application of KALMATRON® KF-A and KF-F was done for repair of a clinker's kiln foundation in Poland. Concrete mix with KF-A admixture was applied in an environment with a temperature at 185°F (85 °C) with perfect adhesion and zero material loss. Non-cracking KF-A appeared in a smooth and solid, renewed foundation. No one had ever performed such a job before, and the workers had to be in special heat resistant suits and tents.

Damaged concrete of the clinker's kiln foundation at a cement plant, was repaired with KALMATRON® KF-A admixed to the concrete. KF-F was applied as a final coat.

Detail of structure

Perfect job, to the amazement of the owner of the plant, and it was finished quickly creating brand new looking concrete structures.

The following information and photographs were kindly presented by a KALMATRON® distributor in Poland, "JEDYNKA S.A. Co." (www.jedynka.opole.pl). Application was done by "BioEkoTech" S.C." (bioekotech@tlen.pl) which provided an outstanding quality workmanship by using KALMATRON®, that is being acknowledged by specialists in Europe.

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Polar Bear Shores. Sea World, Gold Cost, Australia. Completed – December 2000
Construction company – Streetscapes. Application: 30 MPa concrete mix with 7.5 Kg/m3 of KALMATRON®KF-A, W/C=0.41
Description – artificial rock enclosure for polar bears in cooled sea-water.
Result: after four years no signs of concrete degeneration. Typically degeneration begins to show after the first year.

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