SAVINEX 29

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Description

Savinex 29 is a Styrene/Butadiene Copolymer Latex.

Summary

Savinex 29 is a Styrene/Butadiene Copolymer Latex that has been specifically designed as a latex admixture for use in cement compositions. The use of Savinex 29 as an admixture offers improved adhesion to substrate, toughness and flexibility, resistance to certain chemicals, excellent water resistance, better resistance to frost as well as dust suppression.

Typical Properties **(Not to be used as a specification)**	
Appearance	Milky white liquid
Solids (±1%)	47
Viscosity[1] (cP)	<100
pH	9.0 - 10.0
Tg[2] (℃)	-2
Specific Gravity	1.00
Freeze/Thaw Stability	Good

1. Typical Value
2. Calculated Value

Features & Benefits

The addition of Savinex 29 confers numerous advantages over untreated mortars and concretes, such as:

1. Greatly improved adhesion to substrates, including dense impervious concrete
2. Excellent resistance to water and water vapour
3. Improved toughness and flexibility
4. Better resistance to frost
5. Improved resistance to certain chemicals
6. Diminishing dust

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Applications

Cement compositions containing Savinex 29 are particularly useful in a number of applications. Some examples are:

1. Water-resistant rendering for interior or exterior walls or basements
2. Damp-resistant layers
3. Levelling floors prior to laying tiles, wood blocks, etc
4. Patching and repairing concreted areas
5. Waterproof flat roofing and balconies
6. Industrial flooring, screeding and topping
7. Nosing for stairs indoors/outdoors
8. Flooring for dairies, food factories, fertiliser stores where improved chemical resistance is required
9. Lining of effluent ducts, tunnels and canals
10. Corrosion protection of steel reinforcing rods in concrete and of steel structures
11. Water-resistant adhesives for tiles, aggregates, glass, steel, etc
12. Screeds for bathrooms and showers

Storage

Savinex 29 can be stored for 12 months in closed, unopened original drums or storage vessels, provided the temperature does not fall below 5 ℃ or exceed 40℃. Keep out of direct sunlight and protect from frost.

Mixing with Savinex 29

Mixing procedure for mortars or concretes containing Savinex 29 is similar to that used for conventional compositions, gauging water being partly or completely replaced by Savinex 29. The quantity of Savinex recommended will depend upon the application and is normally from 9 to 18 litres per 50 kgs of cement. The higher level of latex addition is used for thin screeds where maximum performance is required; levels lower or higher than those quoted may be used in special circumstances. The colour of latex-modified compositions may be a little darker than that of ordinary compositions; if this is undesirable it can be simply remedied by including a proportion of white cement.Typical examples of mortars are given in the appendix. Portland, High Alumina and certain fast setting cements are compatible with Savinex 29 and have been successfully used.

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1. Water/cement ratio

Mortars containing Savinex 29 will have a water/cement ratio slightly lower than that for conventional mortars.

2. Aggregate

Washed sharp sand, free from excessive fibres, should always be used in latex-modified cement mortars. Where a very smooth surface is required a fine sand may be used, but it is important to ensure that there are no very fine clay-like particles present. Many types of aggregate have been successfully used in Savinex 29 modified compositions; typical examples are those conforming to the SABS 1090 - 1976 “Sand for plaster and mortar” as well as granite chippings used in heavy duty flooring.

3. Workability

The workability time is generally slightly increased by the addition of Savinex 29. In cold weather conditions (ie below 10º C) especially when it is also damp, it is desirable to use a rapid or extra-rapid hardening cement. Alternatively, ordinary Portland cement may be used in conjunction with 2% - 4% of calcium chloride (expressed on cement weight); the calcium chloride should be added as a 50% solution in water to the mortar mix.

4. Additives

Workability additives such as fly ash and lime are not necessary as Savinex 29 exerts a considerable plasticising effect of it’s own. Air entraining agents should not be used without adequate testing. The addition of an anti-foaming agent may sometimes be desirable and we have found that Nopco NDW added at the level of 20g per 5 litres of Savinex 29 is an effective material.

5. Cleaning of equipment

All tools should be cleaned immediately after use because hardened Savinex-modified cement compositions have excellent adhesion and are therefore difficult to remove. If this important precaution is overlooked, solvents such as white spirit, solvent naphtha or preferably toluene can be useful in removing hardened latex-modified mortar.

Note on anti-foam

For most applications, addition of anti-foam is not normally necessary when using Savinex 29. Occasionally, it may be desirable to incorporate an anti-foam in some Savinex-modified flooring compositions, eg those containing flint aggregates. If anti-foam is required, we suggest the addition of Nopco NDW added at the level of 14 g antifoam per 5 litres.

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Application of Savinex 29

The next section of this bulletin gives detailed information describing the use of Savinex 29 modified compositions for walls and floors. Also included are some recommendations for water-resistant treatments, patching and heavy-duty floorings. We have extensive knowledge of the use of Savinex 29 in a host of specialised applications, and we are always pleased to make recommendations for individual requirements.

Test results obtained on Savinex-modified compositions are given in separate test data sheets.

A. Wall Renderings

Preparation

It is necessary to ensure that the wall surface is free from crumbly or other unsound areas. Dusty patches and old paint should also be removed. It is usually sufficient to prepare the wall with a wire brush. All surfaces should be dampened an hour or so before priming.

Priming

The application of a priming coat is normally recommended to obtain maximum adhesion of the subsequently applied rendering. The priming coat, consisting of 2 parts of ordinary Portland cement slurried with 1 part of Savinex 29, should be thoroughly brushed on to the prepared wall surface.

The rendering is applied whilst the priming coat is still wet.

Mixing

A general purpose rendering compositions is as follows :-

SABS 1090 - 1976 “plaster sand”	100 kgs
Ordinary Portland cement *	33 kgs
Savinex 29	6 litres
Water	as required to adjust consistency

* see earlier remarks regarding the use of rapid hardening cements or calcium chloride in cold weather conditions.

NOTE

Although fine sand may be used, especially where a very smooth surface is required, it is essential that there should be no ultra fine clay-like material present in the sand.

Mixing should preferably be carried out in a concrete mixer, although hand mixing is permissible where the total weight of the dry batch does not exceed 50 kgs. The usual procedure is to quickly pre-mix the sand and cement in a mixer, pour in the Savinex 29, mix for 2-3 minutes and finally cautiously add water little by little until the required consistency is achieved. Over addition of water causes rapid thinning of latex modified mortars owing to the plasticising effect of the latex.

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Application

The thickness of latex-modified renderings should be restricted to not more than approximately 6mm for each coat. Greater thickness tends to cause sagging or, in the case of soffits, actual fall off of the unset renderings. However, several coats may be applied in fairly rapid succession; it is sufficient to allow each coat time to set-off adequately to receive the subsequent coating. The time required between coats will vary according to conditions but is typically 15 - 30 minutes.

A single trowelling operation is usually sufficient to achieve a moderately smooth finish. If a smoother surface is required, the rendering should be floated using a clean steel or preferably wooden float after a suitable interval has elapsed. This interval is usually about ½ to 1 hour, but is best found by experience.

B. Water Resistant Rendering

Where the main requirement of the rendering is improved water resistance, a modified application technique is recommended.

After preparing the substrate as described above, two sealing coats consisting of approximately two parts of Portland cement slurried with 1 part of Savinex 29 should be thoroughly brushed on to the surface. The second sealing coat may be applied as soon as the first coat is touch dry, ie after approximately 20 to 30 minutes. Ideally, the sealing coats should be applied at right angles across each other, thus ensuring complete coverage of the substrate.

It is emphasised that the thickness of each sealing coat should not exceed 1.6 mm otherwise crazing may occur. Before proceeding further, the double sealing coat system must dry out completely for a period of at least 48 hours.
After the sealing coats have dried thoroughly, a tack coat consisting of two parts Portland cement slurried with one part of Savinex 29 should be applied. The renderings should then be applied whilst the tack coat is still wet.

The amount of Savinex 29 required in the rendering composition depends upon the degree of water resistance required and the conditions prevailing during application, but the addition of 14 litres of Savinex 29 per 50 kgs of cement is usually satisfactory. Where high hydrostatic pressures are anticipated, the level of Savinex 29 normally recommended is 20 litres per 50 kgs of cement.

Because the application of water-resistance rendering is a specialised procedure, we advise each customer to consult us for recommendations appropriate to his individual requirements.

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C. Floor Screeds

Preparation

Where the existing floor is old or dirty, it is essential to remove all contaminant such as oil, grease, paint etc to ensure adequate development of bond when the topping is applied. Any unsound crumbly concrete must also be removed.

An efficient way of preparing an old floor is to use a mechanical scabbler to remove all unsound materials. If the concrete is in reasonably good order light scabbling will suffice, eg to a depth of about 2 - 4 mm.

For new floors, to which for example a levelling screed needs to be laid, it may still be desirable to remove the upper surface to ensure that weak surface latence is not present. Light scabbling to a depth of up to 4mm will normally suffice. Alternatively good results can often be obtained by etching either new or old concrete floors with hydrochloric acid (1 part of concentrated acid diluted with 2 parts of water) followed by a thorough washing to remove all traces of acid.
If screed bars are to be used to define thickness of the screed, these should be positioned after the above preparation.

Priming

The application of a priming coat is normally recommended to obtain maximum adhesion of the subsequently applied screed. The prepared floor should be thoroughly dampened with water, hosing is suggested, followed by removal of excess standing water. A priming coat, consisting of 2 parts of ordinary Portland cement slurried with 1 part of Savinex 29 , would then be thoroughly brushed into the floor using a stiff broom. The topping is applied whilst the priming coat is still wet.

For general-purpose topping, the following composition is suggested :-

SABS 1090 - 1976 “mortar sand”	100 kgs
Ordinary Portland cement	33 kgs
Savinex 29	6 litres
Water	as required to adjust consistency

The mixing procedure is straight forward, and is as described in the section dealing with wall renderings.

Application of topping

Screeds based on the above composition can be laid to any thickness, down to a featheredge if necessary, providing that a sufficiently find grade of sand is used. However, it is essential that there should be no ultra fine clay-like material present in the sand.

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Because Savinex 29 allows “feather-edging” of suitable mortar compositions, it is therefore possible to patch up only the damaged portions of existing concrete floors. These portions must, of course, be prepared and primed as previously described.

After mixing the Savinex, mortar should be poured over the still wet priming coat and struck off. It may then be trowelled to the required finish. An experienced floor layer will readily achieve a finish of satisfactory smoothness without having to do any further trowelling. However, as an alternative procedure it is possible with care to carry out further trowelling after a suitable interval, when initial stiffening of the mortar has commenced. A clean steel trowel is recommended for this operation.

With a little experience, the correct timing at which this retrowelling should be carried out will be properly judged. If insufficient time has been allowed to elapse, a thin surface skin will be present over soft unset material and the skin will be torn giving surface cracking. Too great a time interval on the other hand would result in the mortar having set too much to be smoothed. The whole surface should be trowelled, not just sections of it to avoid variations in shade, texture, etc.

Heavy duty flooring

Savinex 29 may be used with advantage in heavy duty flooring compositions. The procedures for preparing and priming the existing floor and for mixing and application is as described for general purpose floor screeds.

Savinex modified heavy-duty floorings are normally laid as 12 mm toppings. An exception to this is the iron aggregate flooring, which we recommended laying as a 6 mm topping.

A typical heavy-duty composition is as follows :-

Portland cement	100 kgs
SABS 1090 - 1976 “mortar sand”	125 kgs
3mm granite chippings	125 kgs
Savinex 29	18 litres
Water	as required to adjust consistency

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APPENDIX 1

PRACTICAL EXAMPLE OF FORMULATIONS USING DIFFERENT SANDS
(see 2 for grading analysis)

a. **Using Witbank plastering sand**

CEMENT	SAND	DRY SAVINEX 29	TOTAL WATER	CONSISTENCY USING FLOWTABLE ASTM C2 30 (MM)
1	3	0.085	0.48	162
1	4	0.085	0.65	171
1	6	0.085	0.87	163
1	3	0.190	0.41	168
1	4	0.190	0.49	161
1	6	0.190	0.73	162

b. **Using Prosand**

CEMENT	SAND	DRY SAVINEX 29	TOTAL WATER	CONSISTENCY USING FLOWTABLE ASTM C2 30 (MM)
1	3	0.085	0.35	162
1	4	0.085	0.39	163
1	6	0.085	0.62	168
1	3	0.190	0.30	182
1	4	0.190	0.31	163
1	6	0.190	0.41	148

c. **Using a blend of Prosand 60% with TMS pit 40%**

CEMENT	SAND	DRY SAVINEX 29	TOTAL WATER	CONSISTENCY USING FLOWTABLE ASTM C2 30 (MM)
1	3	0.085	0.44	193
1	4	0.085	0.52	182
1	6	0.085	0.62	188
1	3	0.190	0.36	195
1	4	0.190	0.41	171
1	6	0.190	0.62	184

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Summary of results

The control samples had adhesion values between 0 and 350 kPa depending upon test conditions. Incorporation of Savinex 29 markedly improved adhesion to concrete, even at low levels of addition; the advantage of using this latex under both dry and wet conditions are clearly illustrated.

These results give definite indication of the benefit of using Savinex 29 as an admixture to cement for flooring screeds, wall renderings and adhesive layers.

APPENDIX 2

SAMPLE DESCRIPTION		PROSAND	TMS PIT	PLASTERING SAND
Relative density		2.66	2.60	2.65
Bulk density :	loose (air dry) kg/m³	1570	1360	1240
	consolidated (air dry) kg/m³	1710	1570	1470
SCREEN ANALYSIS			per cent passing (by mass)	
SABS screens				
4 750 um		100	100	
2 360	"	99	99	
1 180	"	91	95	100
600	"	59	83	98
300	"	21	58	68
150	"	1	22	21
75	"	0.1	8.5	4.5
AVERAGE PARTICLE SIZE FM		**2.30**	**1.43**	**1.14**

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Test data sheet no 1
Tensile strength and flexural strength of cement mortar compositions - effect of latex admixtures.

Test data sheet no 2
Adhesion to concrete and adhesion to steel of cement mortar compositions - effect of latex admixtures.

Test data sheet no 3
Adhesion to concrete - the effect of adding various levels of Savinex 29 to cement mortars.

Test data sheet no 4
Shrinkage of cement mortars during the drying process - effect of latex admixtures.

Test data sheet no 5
Effect of heat ageing upon physical properties of cement mortars.

Test data sheet no 6
Resistance to water penetration of cement mortars containing Savinex 29.

Test data sheet no 7
Freeze-thaw resistance of cement mortar blocks - effect of Savinex 29.

Test data sheet no 8
Effect of chemical re-agents on the flexural strength of cement mortars.

Test data sheet no 9
Co-efficient of linear expansion of cement mortar blocks - effect of Savinex 29.

Test data sheet no 10
Effect of temperature on the workability time of cement mortars containing Savinex 29.

Test data sheet no 11
Savinex 29 cement admixture in modified concretes where resistance to salt (sodium chloride) solutions is required.

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SAVINEX 29 TEST DATA SHEET NUMBER 1

TENSILE STRENGTH & FLEXURAL STRENGTH OF CEMENT MORTAR COMPOSITIONS - EFFECT OF LATEX ADMIXTURES

Test method

Mortar compositions based on 3 parts BS 12 sand to 1 part Portland cement were prepared. The following samples were compared in wet and dry tests on tensile and flexural strengths :-

Control	no admixture
Savinex 29	as admixture at 40 parts per 100 parts cement by weight
vinyl acetate copolymer	as admixture at 40 parts per 100 parts cement by weight

Treatment of the test pieces prior to testing were as follows :-

Dry testing

1 day drying + 6 days immersion in water + 21 days drying.

Wet testing

1 day drying + 6 days immersion in water + 14 days drying + 7 days immersion in water.

RESULTS

TEST METHOD		UNMODIFIED MORTAR (CONTROL)	MORTAR MODIFIED WITH SAVINEX 29	MORTAR MODIFIED WITH VINYL ACETATE COPOLYMER
Test conditions		kPa	kPa	kPa
tensile strength	dry	3050	4350	3300
	wet	1800	7950	175
flexural strength	dry	7100	10600	11300
	wet	5800	9600	1050

Summary of results

Savinex 29 gives marked improvement in both tensile and flexural strengths in comparison with the control.

Savinex 29 has special advantages under wet conditions. In this respect, it is much better than the vinyl acetate copolymer.

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SAVINEX 29 TEST DATA SHEET NUMBER 2

ADHESION TO CONCRETE & ADHESION TO STEEL OF CEMENT MORTAR COMPOSITIONS - EFFECT OF LATEX ADMIXTURES

Test method

Mortar compositions based on 3 parts BS 12 sand to 1 part Portland cement were prepared. The following samples were compared in wet and dry tests to adhesion to concrete and to steel :-

Control	no admixture
Savinex 29	as admixture at 40 parts per 100 parts cement by weight
vinyl acetate copolymer	as admixture at 40 parts per 100 parts cement by weight

The tests were carried out on “air-cured” samples because wet-curing can lead to unreliable results in tests of this nature. Treatment prior to testing was as follows :-

Dry testing

28 days air-drying.

Wet testing

21 days air-drying + 7 days immersion in water.

TEST METHOD		UNMODIFIED MORTAR (CONTROL)	MORTAR MODIFIED WITH SAVINEX 29	MORTAR MODIFIED WITH VINYL ACETATE COPOLYMER
Test conditions		kPa	kPa	kPa
Adhesion	dry	70	3450	2140
to concrete	wet	310	1380	480
Adhesion	dry	0	1590	1170
to steel	wet	0	1310	0

Summary of results

Savinex 29 gives excellent adhesion to concrete and to steel under both dry and wet conditions. It offers particular advantages over the vinyl acetate copolymer under wet conditions.

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SAVINEX 29 TEST DATA SHEET NUMBER 3

ADHESION TO CONCRETE - EFFECT OF ADDING VARIOUS LEVELS OF SAVINEX 29 TO CEMENT MORTARS

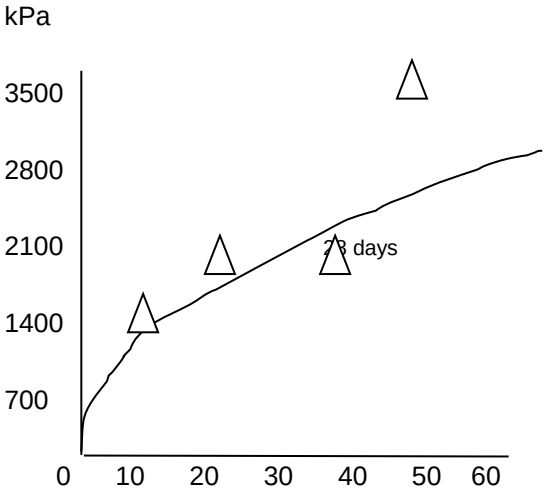
Test method

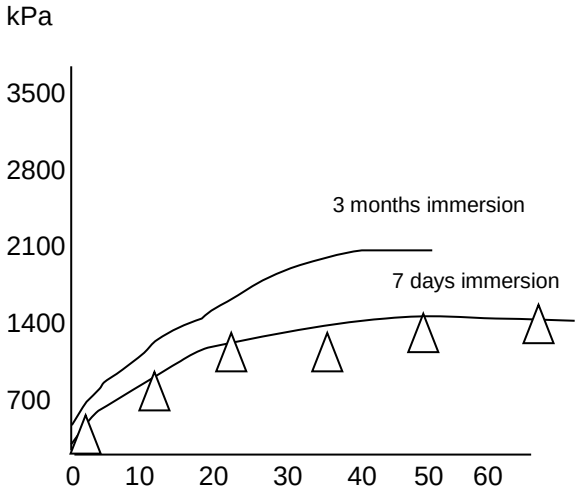
Cement mortars, based on 3 parts BS 12 sand to 1 part of Portland cement, were prepared for the test. Mortars, containing various amounts of Savinex 29 were compared with control samples without admixture. After thoroughly drying the test pieces, adhesion to concrete was determined :-

a. On dry samples
b. On wet samples, after 7 days immersion in water
and
c. On wet samples, after 3 months immersion in water.

Results are shown in the graphs below.

ADHESION TO CONCRETE





Level of SAVINEX 29 (% on cement weight)

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SAVINEX 29 TEST DATA SHEET NUMBER 4

SHRINKAGE OF CEMENT MORTARS DURING THE DRYING PROCESS - EFFECT OF LATEX ADMIXTURES

Test method

To test for shrinkage on setting, a mild steel mould 25 cm long x 2,5 cm wide x 2,5 cm deep was used, and the inner surfaces of the mould were lightly smeared with petroleum jelly before filling with mortar. The mortars under test were tamped down, levelled and left to dry for 28 days at room temperature. The longitudinal shrinkage of the mortars was measured at the end of this period using a travelling microscope.

All mortars testes were based on 3 parts BS 12 sand and 1 part Portland cement. Control samples without admixture were compared with mortars containing various levels of Savinex 29

Results

CONTROL	AMOUNT OF LATEX ADDED (PARTS PER 100 PARTS OF CEMENT)	WATER / CEMENT RATIO	SHRINKAGE (%)
	NONE	0.40	0.07
SAVINEX 29	20	0.34	0.02
	30	0.34	0.01
	40	0.30	0.01

Summary of results

In formulating Savinex 29 for admixture to cement, one of the properties, which have been optimised, is resistance to shrinkage during setting of the modified cement. The above test results show that Savinex 29 gives a great improvement in resistance to shrinkage - this is in accordance with qualitative observations on large areas.

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SAVINEX 29 TEST DATA SHEET NUMBER 5

EFFECT OF HEAT AGEING UPON PHYSICAL PROPERTIES OF CEMENT MORTARS

Introduction

Heat ageing tests are employed to obtain data, which have a bearing on long-term performance. A general guide used in the rubber industry is that one week at 70°C approximates to 5 years of normal service life.

Test method

Cement mortars were prepared based on 3 parts BS 12 sand and 1 part of Portland cement.

Control	no admixture
Savinex 29	as admixture at 40 parts per 100 parts cement by weight
all acrylic	as admixture at 40 parts per 100 parts cement by weight

Flexural strength was evaluated on "wet-cured" test pieces which had been treated as follows :- 1 day drying + 6 days immersion in water + 21 days drying, prior to ageing.

Adhesion to concrete was measured on "dry-cured" samples because wet curing can lead to unreliable results in this test. The test samples were simply dried for 28 days before ageing and testing.

RESULTS

Heat ageing at 70°C

	FLEXURAL STRENGTH (kPa)			
	INITIAL	**1 MONTH**	**3 MONTHS**	**12 MONTHS**
CONTROL	7100	4800	5500	5200
Savinex 29	10600	15700	14800	14400
All acrylic	11900	43000	18500	10100

	ADHESION TO CONCRETE (kPa)			
	INITIAL	**1 MONTH**	**3 MONTHS**	**12 MONTHS**
CONTROL	70	Nil	Nil	nil
Savinex 29	3450	2690	1790	2550
All acrylic	2920	2830	2480	2280

Summary of results

The tests show that Savinex 29 retains its effectiveness in cement mortar compositions over long periods of heat ageing, showing marked improvements over unmodified samples. It compares favourably with the all-acrylic polymer. Savinex 29 may therefore be expected to remain effective throughout the normal service life of cement compositions treated with it.

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SAVINEX 29 TEST DATA SHEET NUMBER 6

RESISTANCE TO WATER PENETRATION OF CEMENT COMPOSITIONS CONTAINING SAVINEX 29

Scope

Two distinct water-resistant treatments using Savinex 29 were evaluated viz :-

1. A Savinex 29/cement slurry sealing coat system sandwiched between two layers of conventional cement mortar.

2. Cement mortar, based on 3 parts of sharp sand to 1 part of Portland cement, using various levels of Savinex 29 as admixture.

Test method

Preparation of samples

Annular, mild steel bands (85mm internal diameter and 15mm depth) were used as moulds for the mortar test samples. Methods of preparation of the two sets of samples are described below :-

1. Savinex 29/cement sealing coats as a water-resistant treatment

   Moulds were filled to half depth with a conventional cement mortar (3 parts of sharp sand to 1 part of Portland cement) and left to dry for 3 days at 20°C.

   After 3 days, a sealing coat consisting of 2 parts of Portland cement slurried with 1 part of Savinex 29 was brushed on to the upper surface of the dry mortar, ensuring that all brush stroked were made in the same direction. After 1 hour, a second sealing coat was applied with brush strokes at right angles across the strokes of the first coat.

   The coated test pieces were allowed to dry for various periods of time : 24, 48 and 72 hours.

   A third coat of fresh slurry was then applied as an adhesive tack coat. Whilst the third coat was still wet and tacky, a conventional mortar (3 parts of sharp sand to 1 part of Portland cement) was placed on the tack coat, filling the remaining half of the mould. The "sandwich" test pieces thus obtained were allowed to dry for 7 days at 20°C prior to testing.

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2. Savinex 29 as a water-resistant admixture in the mortar

Cement mortars, based on 3 parts of sharp sand to 1 part of Portland cement, containing respectively 0, 20, 30 and 40 parts of Savinex 29 per 100 parts of cement were prepared. Annular moulds, as described above, were completely filled with each composition.

The mortars were allowed to dry for 7 days at 20°C prior to testing.

Testing

Each mortar disc, retained in it's mild steel band, was clamped into a test apparatus designed to apply water pressure, equivalent to a 30 metre head of water, to one face of the disc. The other face (ie the underside) of the disc was open to the atmosphere.

Throughout the test, a constant water pressure was maintained, and the water pressure gauge monitored for any reduction in pressure. Pressure drop, which in this test indicated sample failure, was corrected where necessary. Any water which did pass through was collected in a measuring cylinder and the volume recorded.

Testing was continued until either a measurable volume of water passed through the sample, or where no water penetrated, for a period of 3 weeks. On completion of the test, the underside of each sample which withstood 3 weeks testing was carefully examined to ensure that there was no sign of water penetration.

Results

Results, expressed in mls of water passing through the samples, are shown in the following tables :-

1. **Savinex 29/cement sealing coats as a water-resistant treatment**

DRYING TIME OF SEALING COAT SYSTEM (HRS)	VOLUME OF WATER PASSING THROUGH SAMPLE (MLS)		
	3 HRS	3 DAYS	3 WEEKS
24	5	28	-
48	NIL	NIL	NIL
72	NIL	NIL	NIL

Note

The conventional cement mortar compositions used to "sandwich" the Savinex/cement sealing coats tested above were based on BS 882 Zone 2 sand.

Another conventional mortar composition, based on BS 12 sand, was also used in these experiments. Here, the sealing coat system was tested after 72 hours drying only. Again, no water penetrated after 3 weeks.

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2. **Savinex 29 as a water-resistant admixture in the mortar**

LEVEL OF SAVINEX 29 ADDED (PARTS PER 100 PARTS OF CEMENT BY WEIGHT)	VOLUME OF WATER PASSING THROUGH SAMPLE (MLS)		
	3 HRS	3 DAYS	3 WEEKS
0	71	-	-
20	23	-	-
30	NIL	NIL	NIL
40	NIL	NIL	NIL

Note

These mortar compositions were prepared using BS 882 zone 2 sand. Another composition, based on BS 12 sand and containing 40 parts of Savinex 29 per 100 parts of cement was also tested. No water penetrated after 3 weeks.

Summary of results

The results of these tests show that the following treatments provide effective water resistance for cement mortars :-

1. Two sealing coats plus one tack coat using Savinex 29 /cement slurry
   Portland cement (2 parts) is slurried with Savinex 29 (1 part) and two coats of the slurry are applied at right angles across each other on the surface to be treated.

   Following this, at least 48 hours drying is allowed, and then a fresh slurry of cement and Savinex is applied at a tack coat for the surfacing mortar.

2. Mortar modified with Savinex 29
   40 parts of Savinex 29 per 100 parts of cement gives a water-resistant mortar (3 parts sand to 1 part of cement) using a suitable sand.

   For optimum results, the system of two sealing coats plus one tack coat of Savinex/cement slurry (1) may be combined with the Savinex modified mortar (2); see alto Technical Bulletin No GEN TB25 page 3.

   Because water-resistant treatments are specialised procedures, we advise each customer to consult us for recommendations appropriate to his individual requirements.

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SAVINEX 29 TEST DATA SHEET NUMBER 7

FREEZE-THAW RESISTANCE OF CEMENT MORTAR BLOCKS - EFFECTS OF SAVINEX 29

Test method

Test pieces were prepared from mortars based on 3 parts BS 12 sand and 1 part of Portland cement. Savinex 29 was used at the level of 40 parts latex to 100 parts cement (by weight) and compared with controls without admixture. All test pieces were dried for 24 hours, immersed in water for 7 days, then dried for 21 days before testing.

The samples were frozen in a 10% aqueous solution of sodium chloride - this was chosen in preference to water to accelerate deterioration. Each freeze-thaw cycle was as follows :-

Frozen for 20 hours in a 10% sodium chloride solution at -18°C.

Thawed and examined.

Test pieces were subjected to a number of freeze-thaw cycles, allowed to dry out, then tested for flexural strength.

Results

The results are compared with figures obtained on samples not subjected to freeze-thaw treatment :-

	LEVEL OF LATEX ADDITION (PARTS) PER 100 PARTS CEMENT	FLEXURAL STRENGTH (kPa)		
		BEFORE FREEZE-THAW TREATMENT	AFTER 15 FREEZE-THAW CYCLES	AFTER 60 FREEZE-THAW CYCLES
CONTROL NO LATEX	NONE	7100	4500	-
SAVINEX 29	275	10600	-	10400

Summary of results

The control samples could not be tested for flexural strength after more than 15 freeze-thaw cycles because of severe deterioration. On the other hand, the Savinex 29 modified test pieces showed no visible signs of deterioration after 60 cycles, thereby confirming the efficiency of Savinex 29 in combating freeze-thaw damage to concrete.

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SAVINEX 29 TEST DATA SHEET NUMBER 8

EFFECT OF CHEMICAL REAGENTS ON THE FLEXURAL STRENGTH OF CEMENT MORTAR

Test method

Mortar blocks, based on 3 parts of BS 882 Zone 2 sand to 1 part of Portland cement were prepared.

Control	no admixture
Savinex modified mortars	incorporating 25 parts of Savinex 29 per 100 parts of cement by weight

Prior to testing all mortar blocks were cured as follows :-
1 day drying + 6 days immersion in water + 21 days drying.

Flexural strength was determined

1. Immediately after curing and
2. After prolonged submersion in various chemical reagents, followed by rinsing in clean water and drying for 7 days at room temperature.

Results

1. Flexural strength values obtained immediately after curing were as follows :-

control mortar	7250 kPa
Savinex modified mortars	13200 kPa

2. The flexural strength values obtained after prolonged submersion of samples in various chemical reagents are shown in the following table :-

SECTION A

	FLEXURAL STRENGTH (kPa)			
	AFTER 3 MONTHS SUBMERSION		AFTER 6 MONTHS SUBMERSION	
REAGENT	CONTROL MORTAR	SAVINEX MODIFIED	CONTROL MORTAR	SAVINEX MODIFIED
10% POTASSIUM HYDROXIDE SOLUTION	9000	9450	6150	12350
10% MAGNESIUM SULPHATE SOLUTION	8400	10300	4350	13300

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SECTION B	5% LACTIC ACID SOLUTION	6150	9750	5950	8000
	10% SUCROSE SOLUTION	7050	11500	5950	9200
	5% HYDROCHLORIC ACID SOLUTION	2400	4900	0	2200
	20% AMMONIUM NITRATE SOLUTION	5250	8300	2550	4850
SECTION C	PETROLEUM SPIRIT	7400	8400	7750	7500

Summary of results

REAGENTS	REMARKS
SECTION A	
* Potassium hydroxide * Magnesium sulphate Lactic acid Sucrose	Definite advantages may be gained by using Savinex - modified mortars. Note the high flexural strength figures after 6 months for chemical marked *.
SECTION B	
Hydrochloric acid Ammonium nitrate	Savinex 29 is of some benefit. Nevertheless, after 6 months, flexural strength is seriously impaired.
SECTION C	
Petroleum spirit	Savinex modified mortars offer no advantages in the presence of petrol or related fuels/oils

These results represent only a small, selected cross-section of chemical resistance test data obtained in our laboratories. It is stressed that the results, which were obtained on small mortar blocks prepared and tested under laboratory conditions, are offered only as a guide to performance.

We can supply information regarding the behaviour of Savinex-modified mortar in the presence of chemicals other than those listed above. And we will be pleased to discuss the requirements of the individual customer.

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SAVINEX 29 TEST DATA SHEET NUMBER 9

COEFFICIENT OF LINEAR EXPANSION OF CEMENT MORTAR BLOCKS - EFFECT OF SAVINEX 29

Test method

Cement mortars, based on 3 parts of sharp sand to 1 part of Portland cement, were prepared for the test. Control samples were compared with samples containing Savinex 29 (added at the level of 30 parts Savinex per 100 parts of cement).

Mild steel moulds, 10,7cm long x 5cm deep were constructed for the test and the linear surfaces lightly smeared with petroleum jelly before filling with mortar. The mortars under test were tamped down, levelled and removed from the moulds after 24 hours drying. The test pieces were then cured by immersion in water for 3 days followed by drying for 24 days before testing in the laboratories of an independent group of testing engineers and consultants.

The co-efficient of linear expansion was determined in the following temperature ranges :-

1. - 20°C to + 20°C
2. +20°C to + 60°C

Results

The results obtained are shown in the following table :-

		CO-EFFICIENT OF LINEAR EXPANSION	
	WATER / CEMENT RATIO	TEMPERATURE RANGE -20°C TO 20°C	TEMPERATURE RANGE 20° TO 60°C
CONTROL SAMPLES	0.40	12.7 X 10 –6	12.8 X 10 -6
SAVINEX MODIFIED SAMPLES	0.30	12.8 X 10 –6	12.9 X 10 -6

Summary of results

The use of Savinex 29 as a latex admixture has no effect on the coefficient of linear expansion of this typical cement mortar composition.

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SAVINEX 29 TEST DATA SHEET NUMBER 10

EFFECT OF TEMPERATURE ON THE WORKABILITY TIME OF CEMENT MORTARS CONTAINING SAVINEX 29

Test method

Mortar compositions based on 3 parts of BS 882 Zone 2 sand to 1 part of cement were prepared for the test. Savinex 29 was included as admixture at the level of 40 parts Savinex per 100 parts cement by weight, and the water/cement ratio adjusted to 0.31. Mortars were prepared using two different types of cement.

- Ordinary Portland cement
- Rapid Hardening cement

The workability time of each type of cement mortar was assessed at various ambient temperatures within the range 1 to 32°C.

Results are shown in the graph overleaf.

Summary of results

Savinex-modified cement mortars were found to have practicable workability times at temperatures ranging from about 30°C down to 20°C. Ordinary Portland cement gave satisfactory results at temperatures down to 7°C, whereas rapid hardening cement was more suitable for the low temperature range, i.e. 2 - 7°C.

The British Standard Code of Practice CP114: Part 2: 1969 recommends that concreting should not be carried out unless “the concrete has a temperature of at least 4°C and that the temperature of the concrete is maintained above 2°C until it has thoroughly hardened”. Similarly we would not recommend the application of Savinex-modified mortars and concretes unless the above recommendations can be met. When applying the modified mortar or concrete at temperatures between 2 and 10°C, a rapid hardening cement should be used.

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SAVINEX 29 TEST DATA SHEET NUMBER 11

SAVINEX 29 CEMENT ADMIXTURE IN MODIFIED CONCRETES WHERE RESISTANCE TO SALT (SODIUM CHLORIDE) SOLUTIONS IS REQUIRED

Test results

	WATER/ CEMENT RATIO	CHLORIDE CONTENT 1/16" TO 1/2" DEPTH		CHLORIDE CONTENT 1/2" TO 1" DEPTH	
		AVERAGE	RANGE	AVERAGE	RANGE
SAVINEX MIX	0.4	5.9	2.92 – 9.44	0.59	0.07 – 1.58
CONTROL	0.4	12.4	10.8 – 15.7	2.25	1.43 – 3.27
CONTROL	0.5	13.7	12.2 – 15.8	3.85	2.80 – 4.44

Test details

Four test samples 12 x 12 x 1¼" of each mix were prepared by normal techniques, using reasonable vibration by rodding and mould wall tapping. The samples were covered with dry burlap (hessian-like material) and polythene sheet for 24 hours. Samples were then de-moulded and cured for a further 19 days at 70 ± 2 °F at 50 ± 5% relative humidity.

The top surface of the cured samples was dry abraded by grinding or sandblasting to reduce the height by 1/16 – 3/16". Dams, ¾" high by ½" wide were placed around the top edges of three of each set of four samples. The three samples were covered with ½" of 3% aqueous sodium chloride solution. During 'ponding' the samples were kept at 70 ± 2 °F and 50 ± 5% relative humidity.

At the end of 90 days, the solution was removed. After drying the surfaces of the samples were wire brushed until all salt build-up had been removed.

Three samples of concrete were taken from each specimen (including the 'unponded' ones) by dry coring (1½" minimum diameter) and the cores cut to obtain specimens.

A. 1/16" - ½" depth from the surface and
B. ½" - 1" depth from the surface.

These sections were crushed and analysed for chloride content. The average value obtained from the 'unponded' samples was subtracted from the average value obtained from the 'ponded' samples, and the result expresses as pounds of chloride (Cl) per cubic yard of concrete. (Although not yet officially specified, a maximum acceptable value of chloride in the ½" to 1" depth is less than 1.2 lb of chloride per cubic yard. Usual values in the 1/16" to ½" depth sections are 5 to 9 lbs of chloride per cubic yard).

Mix design

The mix design used in the tests was as follows:-

	lbs
Portland cement - type 1	94
Concrete sand	275
Coarse aggregate, 8	180
Savinex 29	29.4

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Water: added as required to give water/cement ratio of 0.40 with a slump of 4-6" and air content of less than 6%.

Control mixes (no 29) were made with water/cement ratios of 0.40 and 0.50.

Concrete sand gradation was:-

100%	< 12.5 mm
85 - 100%	< 9.5 mm
10 - 30%	< 4.75 mm
0 - 10%	< 2.36 mm

Coarse aggregate (8) gradation was:-

100%	< 9.5 mm
95 - 100%	< 4.75 mm
80 - 100%	< 2.36 mm
50 - 85%	< 1.18 mm
25 - 60%	< 0.06 mm
10 - 30%	< 0.03 mm
2 - 10%	< 0.015 mm

Conclusion

Savinex 29 gave very good results in these tests showing a great improvement compared with the controls. It has been approved by the US Federal Highway Administration for use in Highway Systems, particularly in bridge decking.

Savinex 29 may also be recommended for use in other concretes and mortars where protection from salt erosion or damage is required.

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