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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

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Agrément Certificate No 05/4216

*Second issue**

Designated by Government to issue European Technical Approvals

XYPEX ADMIX C-1000 NF

Additif pour béton imperméable
Beimischung zur Beton Wasserdichtung

Product

- *THIS CERTIFICATE RELATES TO XYPEX ADMIX C-1000 NF, A REACTIVE CRYSTALLINE ADMIXTURE TO PROVIDE WATERTIGHT CONCRETE.*

The product gives concrete enhanced durability and improved protection against reinforcement corrosion.

- *The system has no detrimental effects on the properties of the concrete.*
- *The system can provide watertight concrete for basements, swimming pools, roofs, tunnels, reservoirs, culverts and other similar structures.*

Regulations

1 Building Regulations 2000 (as amended) (England and Wales)

In the opinion of the British Board of Agrément the use of this product is not subject to these Regulations.

2 The Building (Scotland) Regulations 2004

In the opinion of the BBA, the use of this product is not subject to these Regulations.

3 Building Regulations (Northern Ireland) 2000

In the opinion of the BBA, the use of this product is not subject to these Regulations.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See sections: 6 *Delivery and site handling* (6.1, 6.3 and 6.4), and 13 *Placing* (13.4).

Technical Specification

5 Description

5.1 Xypex Admix C-1000 NF is a powder admixture consisting of blended Portland cement and proprietary chemicals, that when incorporated in concrete enhances the water resistance and durability of the hardened concrete.

5.2 The product is manufactured by a blending process. Quality control is exercised over raw materials, during production and on the final product.

6 Delivery and site handling

6.1 The product is supplied in labelled 20 kg steel pails. The label bears company details, mixing instructions and a hazard label. The product is classified as corrosive and irritant under the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3).

6.2 The product must be stored in sealed pails in a dry environment at a minimum temperature of 7°C and has a shelf-life of one year when stored under these conditions.

6.3 Health and Safety Data Sheets and the Control of Substances Hazardous to Health Regulations 2002 (COSHH) risk assessments for the works should be available to the purchaser and maintained on site.

6.4 When handling, the normal health and safety procedures associated with cementitious materials should be observed.

Design Data

7 General

7.1 Concrete containing the product should be designed in accordance with BS EN 206-1 : 2000 and BS 8500-2 : 2002 for use as all normal types, including precast, pre-stressed, post-tensioned, ready-mixed, reinforced, slip formed, sprayed and pumped concrete.

7.2 The product produces concrete with enhanced durability and improved protection against reinforcement corrosion by providing a physical pore-blocking action that protects resulting concrete against water ingress via hydrostatic pressure.

7.3 The use of the product will produce a concrete with the following properties relative to a control:

- reduced porosity
- reduced permeability
- increased water resistance
- increased corrosion resistance.

7.4 The concrete can be used in structures such as basements, roofs, swimming pools, tunnels, and culverts, without the requirement for additional applied protection. Where exposure to aggressive soil conditions or chemicals is anticipated, a full assessment of the site should be made. In these situations the Certificate holder should be consulted on the suitability of the product.

7.5 The system is compatible with cement blends containing pulverized-fuel ash, ground granulated blastfurnace slag and silica fume blends as defined in BS EN 197-1 : 2000.

7.6 Use of the system with an air-entraining agent is not covered by this Certificate.

8 Construction

8.1 Structures built incorporating the system should be designed to the relevant sections of BS 8007 : 1987, BS 8102 : 1990, BS 8110-1 : 1997, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004.

8.2 Xypex Admix C-1000 NF concrete is suitable for Type B construction as described in BS 8102 : 1990, and it will be suitable for all grades defined in Table 1 of this Standard. For Grades 3 and 4 (where control of water vapour is required), it will be necessary to provide a mix with a sufficiently low vapour permeability in combination with an adequate section thickness (see sections 10.12 and 10.13).

8.3 Basements for dwellings should be designed in accordance with the guidance given in the Approved Document *Basement for dwellings*[1].

(1) Published by the British Cement Association, Document No 48.062.

9 Mix design

9.1 Xypex Admix C-1000 NF concrete is normally supplied as ready-mixed concrete but may be prepared on sites where there is adequate mix control. Concrete prepared on site should be carried out in accordance with BS 8000-2.1 : 1990, the Certificate holder's instructions and this Certificate.

9.2 The product should be added to the concrete mix at the rate of between 1.00% and 1.50% by weight of cement. Advice on the appropriate dosage and mix design for a particular application can be obtained from the Certificate holder.

9.3 The concrete must have a minimum cement content of 325 kgm^{-3} and be batched with a maximum water/cement ratio of 0.5. Further details of suitable mixes can be obtained from the Certificate holder or their approved representatives.

9.4 The product must not be added to wet, mixed concrete as this may cause clumping and thorough dispersion will not occur.

9.5 The workability of concrete can be adjusted using a suitable[1] water reducing or superplasticising admixture that complies with BS EN 934-2 : 2001 to ensure the maximum water/cement ratio given in section 9.3 is not exceeded.

(1) The suitability and compatibility of a water reducing or superplasticising admixture should be evaluated before use and site trials should be carried out to establish the appropriate dose required.

10 Concrete properties

10.1 The effect of the product on the properties of concrete designed to BS EN 480-1 : 1998, Reference concrete 1, are given in Tables 2 and 3.

Table 1 Sample details

Property	Test reference	Control concrete	Xypex Admix C-1000 NF
Xypex Admix C-1000 NF (% wt/wt PC)		—	1.25
Water/cement ratio		0.47	0.45

Table 2 Effects of the Xypex Admix C-1000 NF on the properties of fresh wet concrete

Property	Test reference	Control concrete	Xypex Admix C-1000 NF
Slump (mm)	BS 12350-2		
0 min		65	60
30 min		30	35
Plastic density (kgm^{-3})	BS EN 12350-6	2415	2420
Air content (%)	BS EN 12350-7	0.7	0.8
Setting time (min)	BS 5075-1		
Initial set		170	315
Final set		235	490

Table 3 Effects of the Xypex Admix C-1000 NF on the hardened properties of concrete

Property	Test reference	Control concrete	Xypex Admix C-1000 NF
Water permeability (ms^{-1})	Taywood/ Valenta	3.26×10^{-13}	1.99×10^{-13}
Drying shrinkage (%)	BS 1881-5	0.030	0.023
Wetting expansion (%)		0.019	0.013
Freeze/thaw expansion (%)	BS 5075-2	0.009	0.001
Compressive strength (Nmm^{-2})	BS EN 12390-3		
24 hours		18.0	19.0
28 days		57.8	64.2
Flexural strength (Nmm^{-2})	BS EN 12390-5		
24 hours		2.5	2.4
28 days		6.0	6.4
Modulus of elasticity (Nmm^{-2})	BS 1881-122		
28 days		38500	42000
Water vapour permeability [gm $(Ns)^{-1}$]	BS 3177	690×10^{-12}	440×10^{-12}

10.2 The effect of the product on these properties, for a specific mix and site conditions may be evaluated through site trials prior to use.

Setting and hardening characteristics

10.3 The setting time of concrete mixes containing Xypex Admix C-1000 NF will be retarded when compared to an equivalent plain concrete. The amount of retardation will also depend on the concrete mix design used and ambient temperature during placing and curing.

Drying shrinkage and wetting expansion

10.4 The drying shrinkage and wetting expansion of Xypex Admix C-1000 NF concrete shows a reduction compared to that of an equivalent plain concrete.

Mechanical properties

10.5 The compressive strength of Xypex Admix C-1000 NF concrete will be slightly higher than the equivalent plain concrete with the same slump.

10.6 The flexural strength of Xypex Admix C-1000 NF concrete is similar to the equivalent plain concrete of the same 28-day compressive strength.

10.7 The static modulus of elasticity of Xypex Admix C-1000 NF concrete is higher than the equivalent plain concrete.

Resistance to leaching

10.8 Use of the system will reduce the leaching of lime from the hydrated cement in the concrete.

Potable water

10.9 The product is suitable for use in contact with potable water. It is approved by the Drinking Water Inspectorate under the appropriate Statutory Instruments in connection with the provision of public supplies of water for drinking, washing, cooking or food production purposes and is listed in Section 4.A *Cementitious and Associated Products* of the DWI Approved list.

Water penetration

10.10 Concrete containing the product has significantly greater resistance to water penetration than equivalent plain concretes.

Water vapour permeability

10.11 Xypex Admix C-1000 NF concrete has a significantly lower permeability to water vapour than the equivalent plain concrete.

10.12 Concrete made with a high water/cement ratio can have a water vapour permeability above 3000×10^{-12} gm$(Ns)^{-1}$. The permeability of concrete is strongly dependent on the exact mix design and the figures given in Table 3 indicate the levels that can be obtained using Xypex Admix C-1000 NF.

10.13 The appropriate thickness for concrete with a specific permeability to achieve a water vapour resistance of 200 $MNsg^{-1}$ or 550 $MNsg^{-1}$ (suitable for grades 3 and 4 respectively of BS 8102 : 1990) is given by:

For 200 $MNsg^{-1}$

$$t = 0.2 \times 10^{12} \times p$$

For 550 $MNsg^{-1}$

$$t = 0.55 \times 10^{12} \times p$$

where t = concrete thickness, mm

and p = water vapour permeability in gm$(Ns)^{-1}$ (from BS 3177 : 1959 test).

Reinforcement protection

10.14 The high alkalinity (pH>13) of concrete necessary to prevent corrosion of the reinforcement is maintained in Xypex Admix C-1000 NF concrete.

10.15 Corrosion of reinforcement is normally caused by the ingress of chloride to the steel or by the reduction in alkalinity of the concrete by the diffusion of carbon dioxide. These processes lead to the breakdown of the steel's corrosion-protective passive layer. Reduced permeability of Xypex Admix C-1000 NF concrete slows down diffusion of aggressive agents into the concrete and confers improved protection against corrosion.

Carbonation resistance

10.16 Xypex Admix C-1000 NF concrete has a greater resistance to carbon dioxide diffusion than an equivalent plain concrete due to its reduced permeability.

Frost resistance

10.17 Xypex Admix C-1000 NF concrete has a greater freeze/thaw resistance than equivalent plain concrete.

Sulphate resistance

10.18 The lower permeability of the Xypex Admix C-1000 NF concrete will reduce the ingress of sulphates. However, if sulphate-resistant concrete is required the advice of the Certificate holder should be sought.

Alkali silica reaction (ASR)

10.19 Xypex Admix C-1000 NF concrete should be designed according to BS EN 206-1 : 2000, Section 5.2.3.4 and BS 8500-2 : 2002, Section 5.2.1.

10.20 The sodium oxide equivalent of Xypex Admix C-1000 NF when measured in accordance with BS EN 480-12 : 1998 was 6.81% by mass of admixture.

10.21 This figure should be used when calculating the contribution of the product to the total alkali content of a given concrete mix. In turn, this can be used to assess the susceptibility of that concrete to alkali-silica reaction.

11 Durability

Xypex Admix C-1000 NF concrete is more durable than equivalent plain concrete due to its reduced permeability.

Installation

12 Site mixing

12.1 Xypex Admix C-1000 NF is added at the correct dose (see sections 9.2 to 9.4) to the aggregate and sand, then mixed thoroughly for two to three minutes before adding the cement and water.

12.2 The resulting concrete should be mixed for a further five minutes to ensure even distribution of the product throughout the concrete.

13 Placing

13.1 All aspects of placing must be carried out in accordance with BS 8000-2.2 : 1990, the Certificate holder's instructions and this Certificate.

13.2 Xypex Admix C-1000 NF concrete should not be placed at temperatures of 5°C or below.

13.3 Once mixed, further materials must not be added to the fresh concrete.

13.4 Xypex Admix C-1000 NF concrete should be placed in the same way as normal concrete, in accordance with the Certificate holder's health and safety guidance and the normal routine precautions for handling concrete.

13.5 Xypex Admix C-1000 NF concrete should be fully compacted.

14 Curing

The concrete should be cured strictly in accordance with BS 8110-1 : 1997 and the Certificate holder's recommendations where site specific information exists.

15 Joints

15.1 Joints should be designed with waterstops as recommended in BS 8102 : 1990, to maintain watertightness of the whole structure. The advice of the Certificate holder should be sought on particular applications.

15.2 Penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The advice of the Certificate holder should be sought on suitable systems.

16 Finishes

When water-based products are used to coat the Xypex Admix C-1000 NF concrete, a bonding agent may be needed. For specific cases, advice should be sought from the Certificate holder.

Technical Investigations

The following is a summary of the technical investigations carried out on Xypex Admix C-1000 NF.

17 Tests

Tests were carried out by the BBA to determine:

- characteristics of the admixture including:
  - conventional dry material content
  - pH
  - setting time in cement blended mortars
  - total chlorine
  - water soluble chloride
  - IR trace
  - alkali content
- fresh concrete
  - setting time
  - workability
- hardened concrete
  - compressive strength
  - flexural strength
  - modulus of elasticity
  - bond to steel
  - freeze/thaw resistance
  - drying shrinkage
  - wetting expansion
  - water vapour permeability
  - liquid water permeability
  - efflorescence.

18 Investigations

18.1 The manufacturing process was examined including methods for quality control, details of quality and composition of the materials used.

18.2 A postal user survey was conducted to investigate the performance of the product in service.

Bibliography

BS 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*
BS 1881-122 : 1983 *Testing concrete — Method for determination of water absorption*

BS 3177 : 1959 *Method for determining the permeability to water vapour of flexible sheet materials used for packaging*

BS 5075-1 : 1982 *Concrete admixtures — Specification for accelerating and retarding water reducing admixtures*
BS 5075-2 : 1982 *Concrete admixtures — Specification for air-entraining admixtures*

BS 8000-2.1 : 1990 *Workmanship on building sites — Code of practice for concrete work — Mixing and transporting concrete*
BS 8000-2.2 : 1990 *Workmanship on building sites — Code of practice for concrete work — Sitework with in-situ and precast concrete*

BS 8007 : 1987 *Code of practice for design of concrete structures for retaining aqueous liquids*

BS 8102 : 1990 *Code of practice for protection of structures against water from the ground*

BS 8110-1 : 1997 *Structural use of concrete — Code of practice for design and construction*

BS 8500-2 : 2002 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*

BS EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*

BS EN 480-1 : 1998 *Admixtures for concrete, mortar and grout — Test methods — Reference concrete and reference mortar for testing*
BS EN 480-12 : 1998 *Admixtures for concrete, mortar and grout — Test methods — Determination of the alkali content of admixtures*

BS EN 934-2 : 2001 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions, requirements, conformity, marking and labelling*

BS EN 12350-2 : 2000 *Testing fresh concrete — Slump test*
BS EN 12350-6 : 2000 *Testing fresh concrete — Density*
BS EN 12350-7 : 2000 *Testing fresh concrete — Air content — Pressure methods*

BS EN 12390-3 : 2002 *Testing hardened concrete — Compressive strength of test specimens*
BS EN 12390-5 : 2002 *Testing hardened concrete — Flexural strength of test specimens*

BS EN 1992-1-1 : 2004 *Eurocode 2 : Design of concrete structures. General rules and rules for buildings*
BS EN 1992-1-2 : 2004 *Eurocode 2 : Design of concrete structures. General rules and rules for buildings. General rules. Structural fire design*

Conditions of Certification

19 Conditions

19.1 This Certificate:

(a) relates only to the product that is named, described, installed, used and maintained as set out in this Certificate;

(b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;

(c) is valid only within the UK;

(d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;

(e) is copyright of the BBA;

(f) is subject to English law.

19.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

19.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabrication including all related and relevant processes thereof:

(a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine; and

(c) are reviewed by the BBA as and when it considers appropriate.

19.4 In granting this Certificate, the BBA is not responsible for:

(a) the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product;

(b) the right of the Certificate holder to market, supply, install or maintain the product; and

(c) the actual works in which the product is installed, used and maintained, including the nature, design, methods and workmanship of such works.

19.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.

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In the opinion of the British Board of Agrément, Xypex Admix C-1000 NF is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 05/4216 is accordingly awarded to Xypex (UK) LLP.

On behalf of the British Board of Agrément

Date of Second issue: 26th May 2006

Chief Executive

**Original Certificate issued 24th March 2005. This revised version includes change of Certificate holder's name and contact details and reference to revised Regulations and Standards.*

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