



David Ball Group plc

Huntingdon Road
Bar Hill
Cambridge CB3 8HN
Tel: 01954 780687 Fax: 01954 782912
e-mail: sales@pudlo.com
website: www.davidballgroup.com

**Agrément
Certificate
No 01/3843**
Second issue*

Designated by Government
to issue
European Technical
Approvals

PUDLO CWP (CEMENT WATERPROOFING POWDER)

Additif pour béton imperméable
Beimischung zur Beton Wasserdichtung

Product



- THIS CERTIFICATE RELATES TO PUDLO CWP (CEMENT WATERPROOFING POWDER), A HYDROPHOBIC, PORE-BLOCKING ADMIXTURE TO PROVIDE WATERTIGHT CONCRETE OR RENDER.
- The product reduces the voids and capillaries of the hardened cement matrix.
- The product gives enhanced durability and improved protection against reinforcement corrosion.
- The product has no detrimental effects on the properties of the concrete or render.
- The product can provide watertight concrete for floors, basements, swimming pools, roofs, tunnels, culverts, wastewater treatment plants and other similar structures.

Regulations

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



In the opinion of the British Board of Agrément the use of Pudlo CWP (Cement Waterproofing Powder) is not subject to these Regulations.

2 The Building (Scotland) Regulations 2004



In the opinion of the British Board of Agrément the use of Pudlo CWP (Cement Waterproofing Powder) is not subject to these Regulations.

3 The Building Regulations (Northern Ireland) 2000



In the opinion of the British Board of Agrément the use of Pudlo CWP (Cement Waterproofing Powder) 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 and 6.3), 13 Placing (13.5), and 17 Rendering (17.2).

Technical Specification

5 Description

5.1 Pudlo CWP (Cement Waterproofing Powder) is a chloride-free cementitious powder admixture for Portland cement concrete and sand/cement render enabling a significant reduction in the water/cement ratio of the mix while enhancing the workability. When incorporated in concrete it enhances the water resistance and durability of the hardened concrete.

5.2 The product is used with a suitable water reducing or superplasticising admixture that complies with BS EN 934-2 : 2001. The water reducing or superplasticising admixture is used to further lower the water/cement ratio or improve the fluidity of the mix.

5.3 The product is manufactured by a blending process. Quality control checks are carried out on the raw materials, during the production processes and on the final product.

6 Delivery and site handling

6.1 The product is packaged in 1 kg, 2 kg, 2.5 kg, 8 kg or 25 kg bags.

6.2 The product is not flammable. It should be stored in dry conditions and has a minimum shelf-life of one year.

6.3 The product should be handled on site using the normal health and safety procedures associated with cementitious materials.

Design Data

7 General

7.1 Concrete containing Pudlo CWP can be designed in accordance with BS EN 206-1 : 2000 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:

- minimising the water/cement ratio of the concrete mix resulting in the reduction of the capillary network of the cured concrete, and
- providing hydrophobic action that protects resulting concrete against water ingress via absorption or hydrostatic pressure.

7.3 Compared to similar plain concrete, use of the system promotes:

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

7.4 These properties enable the concrete structure, when built using waterstops as described in section 15, to remain watertight without the requirement for additional applied protection.

7.5 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.

7.6 A render made using the product will also be water resistant and less permeable.

7.7 The product is compatible with Portland cements, pulverized-fuel ash, ground granulated blastfurnace slag, silica fume blends and other regular concreting materials.

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

7.9 The product is not intended for use with gypsum-based plasters.

8 Construction

8.1 Concrete structures built incorporating the product should be designed to the relevant sections of BS 8007 : 1987, BS 8102 : 1990, and BS 8110-1 : 1997.

8.2 Concrete containing the product 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 10.14 to 10.16).

8.3 Basements should be designed in accordance with the guidance given in the Approved Document, *Basements for dwellings*⁽¹⁾.

(1) Published by The Basement Information Centre, 2004.

8.4 Walls to be rendered should be prepared in accordance with BS 8000-10 : 1995 and BS 5262 : 1991 and BS EN 13914-1 : 2005 or BS 5492 : 1990 and BS EN 13914-2 : 2005.

9 Mix design

9.1 Concrete containing the product 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 2% by weight of cement.

9.3 The concrete must have a minimum cement content of 350 kgm⁻³ and be batched with a

maximum water/cement ratio of 0.4. Further details of suitable mixes can be obtained from the Certificate holder.

9.4 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.

9.5 For sand/cement render mixes the product should be used at the rate of 3% by weight of cement.

10 Concrete properties

10.1 The effect of the product on the properties of concrete designed to the mix specification given in Table 1 are given in Table 2.

Component/Property	Quantity (kgm ⁻³)	
	Control concrete	Pudlo CWP/ Admix 500 concrete
Portland cement (BS 12, Class 42.5 N)	375 ⁽¹⁾	375 ⁽¹⁾
Slump (mm)	50	45
Water/cement ratio	0.45	0.35
Sand	720	725
Gravel (Thames Valley)	1090	1145
Pudlo CWP (kg)	-	7.5
Admix 500 (kg)	-	1.5

(1) ±10 kgm⁻³

Property	Test reference	Control (plain) concrete	Pudlo CWP Admix 500 concrete
Water absorption (%) 28 days	BS 1881-122	2.42	1.25
Water vapour [gm(NS) ⁻¹] permeability	BS 3177	790 x 10 ⁻¹²	490 x 10 ⁻¹²
Water permeability (ms ⁻¹)	Taywood/ Valenta	3.2 x 10 ⁻¹⁵	0.64 x 10 ⁻¹⁵
Drying shrinkage (%)	BS 6073-1	0.035	0.032
Wetting expansion (%)	BS 1881-5	0.017	0.009
Compressive strength (Nmm ⁻²) 28 days	BS 1881-116	63	82
Capillary absorption (gmm ⁻² x 10 ⁻³) 7-day cure	BS EN 480-5 ⁽¹⁾		
1-day absorption		2.6	0.62
7-day absorption		4.0	0.62
90-day cure			
1-day absorption		3.9	1.1
7-day absorption		7.0	1.7
28-day absorption		8.4	2.6

(1) To the regime given in this standard and using the mix given in Table 2 of this Certificate.

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

Setting and hardening characteristics

10.3 The setting and hardening characteristics of concrete containing the product or render are similar to the equivalent plain material.

Drying shrinkage and wetting expansion

10.4 The drying shrinkage of concrete containing the product shows a small reduction compared to that of an equivalent plain concrete (see Table 2). The wetting expansion is about half that of the equivalent plain concrete, enhancing the dimensional stability of the concrete with respect to moisture changes.

Mechanical properties

10.5 The compressive strength of concrete containing the product will be higher than the equivalent plain concrete with the same slump.

10.6 The flexural strength of concrete containing the product is similar to that of the equivalent plain concrete of the same 28-day compressive strength.

10.7 The static modulus of elasticity of concrete containing the product is similar to the equivalent plain concrete of the same 28-day compressive strength.

10.8 The use of the product in sand/cement renders will not alter their strength, stability or impact resistance.

Resistance to leaching

10.9 Use of the product will reduce the leaching of lime from the hydrated cement in the concrete.

Potable water

10.10 The Certificate holder should be consulted if it is proposed to use the system in contact with potable water.

Water absorption

10.11 Concrete containing the product shows significantly reduced water absorption characteristics over plain concrete (see Table 2). Initial Surface Absorption (ISAT) values were too low to measure.

Water penetration

10.12 Concrete using the product has significantly greater resistance to water penetration than equivalent plain concretes (see Table 2).

10.13 Use of the product will increase the weather resistance of a render by improving its impermeability.

Water vapour permeability

10.14 Concrete containing the product has a significantly lower permeability to water vapour than the equivalent plain concrete.

10.15 Concrete made with a high water/cement ratio can have a water vapour permeability above $3000 \times 10^{-12} \text{ gm(Ns)}^{-1}$. The permeability of concrete is strongly dependent on the exact mix design and the figures given in Table 2 indicate the levels that can be obtained.

10.16 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).

10.17 The water vapour permeability⁽¹⁾ of a 2.5 : 1 sand/cement render was reduced from $1300 \times 10^{-12} \text{ gm(Ns)}^{-1}$ to $860 \times 10^{-12} \text{ gm(Ns)}^{-1}$ when the product was used in the mix.

(1) To BS 3177 : 1959.

Reinforcement protection

10.18 The high alkalinity ($\text{pH} > 13$) of concrete necessary to prevent corrosion of the reinforcement is maintained in Pudlo CWP concrete.

10.19 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 concrete containing the product slows down diffusion of aggressive agents into the concrete and confers improved protection against corrosion.

Carbonation resistance

10.20 Concrete containing the product has a significantly greater resistance to carbon dioxide diffusion than an equivalent plain concrete due to its reduced permeability.

Frost resistance

10.21 The admixtures used in the product entrain a small amount of air, this will help to improve the frost resistance of the concrete.

Sulphate resistance

10.22 The lower permeability of concrete containing the product will reduce the ingress of sulphates, however, if sulphate-resistant concrete is required, the Certificate holder should be contacted.

Alkali silica reaction (ASR)

10.23 Concrete containing the product should be designed according to BS EN 206-1 : 2000, Section 5.2.3.4.

11 Durability

Pudlo CWP concrete is more durable than equivalent plain concrete due to its reduced permeability.

Installation

12 Site mixing

12.1 The product is added at the correct dose (see sections 9.2 and 9.5) and is pre-mixed with the dry concrete or render constituents.

12.2 The water reducing or superplasticiser should be added after the addition of the product in accordance with the manufacturer's instructions.

12.3 A water reducing/superplasticising admixture is not used for renders.

12.4 Concrete containing the product can be supplied as ready-mixed concrete or added to the truck mixer on site. Allow one minute mixing time for each cubic metre of concrete.

12.5 Where the product is to be prepared on site, adequate mix control must be available.

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

13.3 Concrete containing the product should be fully compacted.

13.4 Concrete containing the product should not be placed at temperatures of 5°C or below.

13.5 Concrete containing the product should be placed in the same way as plain concrete, in accordance with the Certificate holder's health and safety guidance and the normal routine precautions for handling fresh concrete.

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 product, a bonding agent may need to be applied. For specific cases, advice should be sought from the Certificate holder.

17 Rendering

17.1 Rendering should be to BS 5262 : 1991 and BS EN 13914-1 : 2005. The use of Pudlo CWP in the render at the rate specified in section 9.5 will not affect the normal rendering procedure.

17.2 Application should be in accordance with the manufacturer's health and safety guidance and normal routine precautions for handling cementitious renders.

Technical Investigations

The following is a summary of the technical investigations carried out on Pudlo CWP (Cement Waterproofing Powder).

18 Tests

18.1 Tests were carried out by the BBA to determine:

- *characteristics of the components*
 - specific gravities
 - particle sizing
 - pH of aqueous suspension
- *fresh concrete*
 - workability
 - wet density
- *hardened concrete*
 - compressive strength
 - flexural strength
 - modulus of elasticity
 - bond to steel
 - freeze/thaw resistance
 - sulphate resistance
 - drying shrinkage
 - wetting expansion
 - water vapour permeability
 - liquid water permeability
 - initial surface absorption
 - water absorption
 - capillary absorption
 - efflorescence
 - surface bond of other materials
 - leaching resistance
- *render*
 - water vapour permeability
 - impact resistance
 - impermeability to liquid water.

18.2 An examination was made of test data from independent laboratories relating to:

- compressive strength
- flexural strength
- dynamic modulus
- hardened density
- sorptivity
- liquid water permeability
- oxygen diffusivity
- chloride diffusion
- carbonation
- freeze/thaw
- drying shrinkage
- water absorption
- initial surface absorption
- electrical conductance
- capillary absorption.

19 Investigations

19.1 Data on the concrete made with this product were examined and assessed for:

- mix designs
- curing regime.

19.2 An assessment was made of the product's:

- range of use
- durability
- requirements for surface finishes
- maintenance and repair requirements
- compatibility with other regular concreting materials.

19.3 A visit was made to an existing site where the product had been used.

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

19.5 A user survey was conducted to assess the performance of the product in use.

Additional Information

The management systems of David Ball Group plc have been assessed and registered as meeting the requirements of ISO 9001 : 2000 by National Quality Assurance Ltd (Certificate No 2899).

Bibliography

- BS 12 : 1996 *Specification for Portland cement*
- BS 1881-5 : 1970 *Testing concrete — Methods of testing hardened concrete for other than strength*
- BS 1881-116 : 1983 *Testing concrete — Method for determination of compressive strength of concrete cubes*
- 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 5262 : 1991 *Code of practice for external renderings*
- BS 5492 : 1990 *Code of practice for internal plastering*
- BS 6073-1 : 1981 *Precast concrete masonry units — Specification for precast concrete masonry units*
- 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 8000-10 : 1995 *Workmanship on building sites — Code of practice for plastering and rendering*
- 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 EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*
- BS EN 480-5 : 1997 *Admixtures for concrete, mortar and grout — Test methods — Determination of capillary absorption*
- BS EN 934-2 : 1998 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions and requirements, conformity, marking and labelling*
- BS EN 13914-1 : 2005 *Design, preparation and application of external rendering and internal plastering — External rendering*
- BS EN 13914-2 : 2005 *Design, preparation and application of external rendering and internal plastering — Design considerations and essential principles for internal plastering*
- ISO 9001 : 2000 *Quality management systems — Requirements*

Conditions of Certification

20 Conditions

20.1 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.

20.2 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.

20.3 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.

20.4 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.

20.5 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.



In the opinion of the British Board of Agrément, Pudlo CWP (Cement Waterproofing Powder) is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 01/3843 is accordingly awarded to the David Ball Group plc.

On behalf of the British Board of Agrément

Date of Second issue: 6th September 2005

Chief Executive

**Original Certificate issued 8th August 2001. This amended version includes change of product name, reference to revised national Building Regulations, subsequent text changes, change of product specification, and Certificate layout, increase in cement content specification and new Conditions of Certification.*

Electronic Copy

British Board of Agrément

P O Box No 195, Bucknalls Lane
Garston, Watford, Herts WD25 9BA
Fax: 01923 665301

©2005

e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk



For technical or additional information,
contact the Certificate holder (see
front page).
For information about the Agrément
Certificate, including validity and
scope, tel: Hotline 01923 665400,
or check the BBA website.