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**Agrément Certificate  
No 01/3843**

## PRODUCT SHEET 1 — PUDLO CWP (CEMENT WATERPROOFING POWDER)

### PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Pudlo CWP (Cement Waterproofing Powder), a hydrophobic, pore-blocking admixture to provide watertight concrete or render.

#### AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

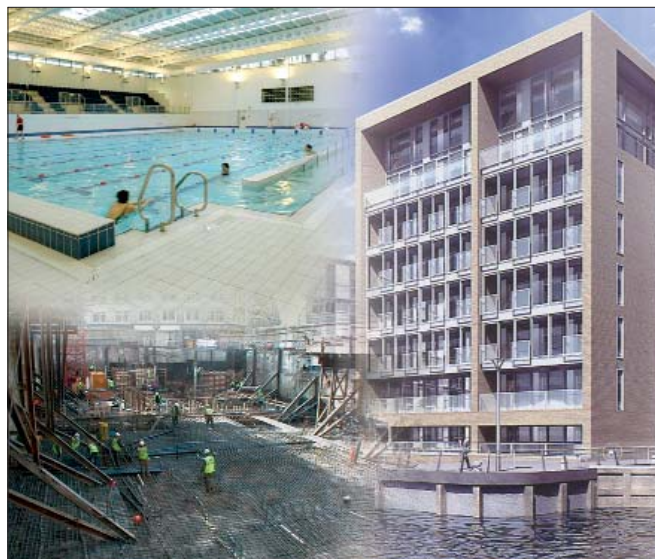
#### KEY FACTORS ASSESSED

**Resistance to water penetration** — concrete and render containing the product will have reduced permeability when compared to the equivalent plain concrete (see sections 4 and 5).

**Reinforcement protection** — concrete containing the product will have enhanced resistance to reinforcement corrosion when compared to the equivalent plain concrete (see section 6).

**Mechanical properties** — the mechanical properties of the concrete and render will not be adversely affected by the incorporation of the product (see section 7).

**Durability** — concrete containing the product is more durable than the equivalent plain concrete mix due to its reduced permeability (see section 15).



The BBA has awarded this Agrément Certificate for Pudlo CWP (Cement Waterproofing Powder) to David Ball Group plc as fit for its intended use provided it is installed, used and maintained as set out in this Agrément Certificate.

On behalf of the British Board of Agrément

Date of First issue: 8 August 2001

Date of Third issue: 19 February 2008

Head of Approvals  
— Materials

Chief Executive

*The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at [www.bbacerts.co.uk](http://www.bbacerts.co.uk)*

*Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.*

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# Regulations

In the opinion of the BBA, Pudlo CWP (Cement Waterproofing Powder) is not subject to these Regulations:



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



**The Building (Scotland) Regulations 2004 (as amended)**



**The Building Regulations (Northern Ireland) 2000 (as amended)**

**Construction (Design and Management) Regulations 2007**

**Construction (Design and Management) Regulations (Northern Ireland) 2007**

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections:

2 *Delivery and site handling* (2.1, 2.4 and 2.5) and 19 *Placing* (19.1).

## Non-regulatory Information

### NHBC Standards 2007

In the opinion of the BBA, there are no requirements in these Standards relating to Pudlo CWP (Cement Waterproofing Powder).

### Zurich Building Guarantee Technical Manual 2007

In the opinion of the BBA, the use of Pudlo CWP (Cement Waterproofing Powder) when installed and used in accordance with this Certificate is capable of satisfying the requirements of the *Zurich Building Guarantee Technical Manual, Section 5 Internal/external works, services & finishes, Sub-sections External works and Concrete mixes – General*.

## General

This Certificate relates to Pudlo CWP (Cement Waterproofing Powder), a hydrophobic, pore-blocking admixture to provide watertight concrete or render.

The product produces concrete with enhanced durability and improved protection against reinforcement corrosion by providing a hydrophobic action that protects resulting concrete against water ingress via absorption and hydrostatic pressure.

The use of the product therefore, will, produce a concrete or render with the following properties relative to a control:

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

The product does not have detrimental affect on the properties of the concrete or render.

The product complies with the requirements of BS EN 934-2 : 2001, Table 9, and the product packaging has CE Marking accordingly.

## Technical Specification

### 1 Description

1.1 Pudlo CWP (Cement Waterproofing Powder) is a cementitious powder admixture that when incorporated in to concrete or render enhances the water resistance and durability of the hardened product.

1.2 Pudlo Self-Compacting Admixture (SC) is also available and is a blend of Pudlo CWP and a superplasticising admixture, used to produce watertight flowing concrete. The self-compacting characteristic of the resultant concrete has not been assessed by the BBA and is outside the scope of this Certificate.

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

### 2 Delivery and site handling

2.1 The product is packaged in 1 kg tubs, 2 kg, 2.5 kg, 8 kg and 25 kg bags.

2.2 Each container bears the batch number, weight and CE Marking label in accordance with BS EN 934-2 : 2001.

2.3 The product must be stored in sealed containers in a dry environment and protected from rain or other sources of moisture.

2.4 The product is classified as 'irritant' under The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (CHIP3).

2.5 The normal health and safety procedures associated with cementitious materials should be observed.

## Assessment and Technical Investigations

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

## Design Considerations

### 3 Use

3.1 Pudlo CWP (Cement Waterproofing Powder) is satisfactory for use in concrete mixes at an addition rate of 2% by weight of cement to provide watertight concrete for basements, roofs, swimming pools, tunnels, and culverts, without the requirement for additional applied protection and of 3% by weight of cement for sand/cement renders.

3.2 Concrete containing the product should be designed in accordance with BS EN 206-1 : 2000 and BS 8500-2 : 2006 for use as all normal types, including precast, pre-stressed, post tensioned, ready-mixed, reinforced, slip formed, sprayed and pumped concretes.

3.3 The product 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.

3.4 The use of the product with an air-entraining agent is not covered by this Certificate.

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

3.9 The product is suitable for use in contact with potable water and has been approved by the Water Regulations Advisory Scheme for this purpose.

### 4 Water penetration and absorption

4.1 Concrete containing the product has significantly greater resistance to water penetration than an equivalent plain concrete.

4.2 Concrete containing the product shows significantly reduced water absorption than an equivalent plain concrete.

4.3 Use of the product will increase the weather resistance of a render by improving its resistance to water penetration.

### 5 Water vapour permeability

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

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

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

$$\text{For } 200 \text{ MNsg}^{-1} \quad t = 0.2 \times 10^{12} \times p \qquad \text{For } 550 \text{ MNsg}^{-1} \quad t = 0.55 \times 10^{12} \times p$$

where  $t$  = concrete thickness in mm and  $p$  = water vapour permeability in  $\text{gm(Ns)}^{-1}$ .

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

### 6 Reinforcement protection

6.1 The high alkalinity ( $\text{pH} > 13$ ) of concrete necessary to prevent corrosion of the reinforcement will not be adversely affected by the incorporation of the product.

6.2 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. The reduced permeability of concrete containing the product will slow down diffusion of aggressive agents into the concrete and so confer improved protection against reinforcement corrosion.

## 7 Mechanical properties

7.1 The compressive strength of concrete containing the product will be higher than the equivalent plain concrete with the same slump. Higher compressive strength may be obtained with the use of a suitable water-reducing or superplasticising admixture complying to BS EN 934-2 : 2001.

7.2 The flexural strength of concrete containing the product is similar to that of an equivalent plain concrete.

7.3 The static modulus of elasticity of concrete containing the product is similar to an equivalent plain concrete.

7.4 The use of the product in sand/cement renders will not affect the strength, stability or impact resistance of the hardened material.

## 8 Drying shrinkage and wetting expansion

The drying shrinkage of concrete containing the product shows a slight reduction compared to that of an equivalent plain concrete. The wetting expansion is significantly reduced compared to that of an equivalent plain concrete.

## 9 Setting characteristics

9.1 The setting time of concrete or render mixes containing the product will be similar to equivalent plain concrete or render.

9.2 The effect of the product for a specific mix and site conditions should be evaluated through site trials prior to use.

## 10 Carbonation resistance

Concrete containing the product has a significantly greater resistance to carbon dioxide diffusion than an equivalent plain concrete.

## 11 Frost resistance

Concrete containing the product will not have a detrimental affect on the frost resistance of the hardened concrete.

## 12 Sulfate resistance

The lower permeability of the concrete containing the product will reduce the ingress of sulfates. However, if sulfate-resistant concrete is required, the advice of the Certificate holder should be sought.

## 13 Alkali silica reaction (ASR)

13.1 Concrete containing the product should be designed according to BS EN 206-1 : 2000, Section 5.2.3.4, and BS 8500-2 : 2006, Section 5.2.

13.2 The sodium oxide equivalent of the product when measured in accordance with BS EN 480-12 : 2005 was 1.76% by mass of admixture.

13.3 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.

## 14 Resistance to leaching

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

## 15 Durability

15.1 Under normal conditions of service, concrete containing the product is more durable than an equivalent plain concrete due to its reduced permeability.

15.2 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.

# Installation

## 16 General

16.1 Structures built incorporating Pudlo CWP (Cement Waterproofing Powder) 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.

16.2 Concrete containing the product is suitable for Type B constructions as defined in BS 8102 : 1990, and can meet the requirements 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 5.2 and 5.3).

16.3 Basements for dwellings should be designed in accordance with the guidance given in the Approved Document *Basement for dwellings*<sup>(1)</sup>.

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

16.4 Rendering should be carried out in accordance with BS EN 13914-1 : 2005, the Certificate holder's instructions and this Certificate.

## 17 Mix design

17.1 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.

17.2 The concrete must have a minimum cement content of  $350 \text{ kgm}^{-3}$  and be batched with a maximum water/cement ratio of 0.4. Further details of suitable mixes can be obtained from the Certificate holder or their approved representatives.

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

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

17.5 The workability of concrete can be adjusted using a suitable<sup>(1)</sup> water reducing or superplasticising admixture complying with BS EN 934-2 : 2001 to ensure the maximum water/cement ratio given in section 17.2 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.

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

## 18 Site mixing

18.1 The product is added at the correct dose (see section 3.1) and pre-mixed with dry concrete or render constituents.

18.2 When a superplasticiser is required, it should be added after the addition of the product.

18.3 The resulting concrete should be mixed in accordance with the Certificate holder's instructions to ensure even distribution of the product throughout the concrete.

18.4 Where the product is to be prepared on site, care must be taken to ensure that adequate mix control is available.

## 19 Placing

19.1 Concrete containing the product should be placed in the same way as normal concrete, in accordance with BS 8000-2.2 : 1990, the Certificate holder's health and safety guidance and the normal routine precautions for handling concrete.

19.2 Concrete containing the product should not be placed at temperatures of  $5^{\circ}\text{C}$  or below.

19.3 Concrete containing the product should be fully compacted.

## 20 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.

## 21 Joints

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

21.2 Penetrations of the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The Certificate holder can advise on suitable systems.

## 22 Finishes

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

# Technical Investigations

## 23 Tests

23.1 The effect of the Pudlo CWP (Cement Waterproofing Powder) on the properties of concrete designed to the mix specification given in Table 1 is given in Table 2.

**Table 1** Test mix details and properties of fresh wet concrete<sup>(1)</sup>

Component/Property	Quantity (kgm <sup>-3</sup> )	
	Control concrete	Pudlo CWP/ Admix 500 concrete
Portland cement (BS 12, Class 42.5 N)	375 <sup>(2)</sup>	375 <sup>(1)</sup>
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) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site trial prior to use.

(2) ±10 kgm<sup>-3</sup>

**Table 2** Effects of the Pudlo CWP on the hardened properties of concrete<sup>(1)</sup>

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) <sup>-1</sup> ] permeability	BS 3177	790 x 10 <sup>-12</sup>	490 x 10 <sup>-12</sup>
Water permeability (ms <sup>-1</sup> )	Taywood/Valenta	3.2 x 10 <sup>-15</sup>	0.64 x 10 <sup>-15</sup>
Drying shrinkage (%)	BS 6073-1	0.035	0.032
Wetting expansion (%)	BS 1881-5	0.017	0.009
Compressive strength (Nmm <sup>-2</sup> ) 28 days	BS 1881-116	63	82
Capillary absorption (gmm <sup>-2</sup> x 10 <sup>-3</sup> ) 7-day cure	BS EN 480-5 <sup>(1)</sup>		
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) The specific effect of the product on these properties, for a particular mix and site conditions, should be evaluated through site trial prior to use.

23.2 Tests were carried out by the BBA to determine:

**characteristics of the admixture including:**

- specific gravity
- particle sizing
- pH of an aqueous solution

**fresh concrete**

- workability
- wet density

**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
- 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

23.3 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 diffusion
- chloride diffusion
- carbonation
- freeze/thaw
- drying shrinkage
- water absorption
- initial surface absorption
- electrical conductance
- capillary absorption

**24 Investigations**

24.1 The manufacturing process and quality control procedures were examined and details were obtained of the quality and composition of the materials used.

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

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

24.4 Data on concrete made with this product were examined and the mix design and curing regime assessed.

24.5 An assessment was made of the product's:

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

## Additional Information

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

## Bibliography

- 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 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 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 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*
- BS EN 197-1 : 2000 *Cement — Composition, specifications and conformity criteria for common cements*
- 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 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 and requirements, conformity, marking and labelling*
- 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*
- BS EN 13914-1 : 2005 *Design, preparation and application of external rendering and internal plastering — External rendering*
- BS EN ISO 9001 : 2000 *Quality management systems — Requirements*

## 25 Conditions

25.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English law.

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

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

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

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

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

25.5 Any information relating to the manufacture, supply, installation, use and maintenance of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used and maintained. It does 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; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any 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 manufacture, supply, installation, use and maintenance of this product/system.