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Agrément Certificate
16/5330
Product Sheet 1

BENTONITE WATERPROOFING SYSTEM FOR STRUCTURES

BENTOSHIELD MAX LM

This Agrément Certificate Product Sheet⁽¹⁾ relates to Bentoshield MAX LM, a polymer-modified, sodium bentonite geosynthetic clay liner, with a low-density polyethylene (LDPE) laminated barrier, for use in waterproofing and damp-proofing underground reinforced concrete structures.

(1) Hereinafter referred to as 'Certificate'.

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 and water vapour — the product, including joints, will resist the passage of moisture into the structure (see section 6).

Resistance to mechanical damage — the product is resistant to damage and has the ability to self-seal if punctured (see section 7).

Durability — when fully protected, the product provides an effective barrier to the transmission of moisture for the life of the structure in which it is incorporated (see section 12).



The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 28 June 2016

John Albon — Head of Approvals
Construction Products

Claire Curtis-Thomas
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

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, Bentoshield MAX LM, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	A1	Loading
Comment:		Application of the product will not adversely affect a structure's ability to transmit loadings and will contribute to satisfying this Requirement. See section 9 of this Certificate.
Requirement:	C2(a)	Resistance to moisture
Comment:		The product, including joints, will enable a structure to satisfy this Requirement. See section 6 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The product is acceptable. See section 12 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	Durability, workmanship and fitness of materials
Comment:		The product can contribute to a construction satisfying this Regulation. See section 12 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	1.1(a)(b)	Structure
Comment:		Application of the product will not adversely affect a structure's ability to transmit loadings, with reference to clause 1.1.1 ⁽¹⁾⁽²⁾ . See section 9 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		The product, including joints, will contribute to enabling a structure to satisfy clauses 3.4.1 ⁽¹⁾⁽²⁾ , 3.4.2 ⁽¹⁾⁽²⁾ , 3.4.5 ⁽¹⁾⁽²⁾ , 3.4.6 ⁽¹⁾⁽²⁾ and 3.4.7 ⁽¹⁾⁽²⁾ of this Standard. See section 6 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The product can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		All comments given for the product under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i)(iii)b(i)	Fitness of materials and workmanship
Comment:		The product is acceptable. See section 12 and the <i>Installation</i> part of this Certificate.
Regulation:	28	Resistance to moisture and weather
Comment:		The product, including joints, will enable a structure to satisfy the requirements of this Regulation. See section 6 of this Certificate.
Regulation:	30	Stability
Comment:		Application of the product will not adversely affect a structure's ability to transmit loadings and will contribute to satisfying the requirements of this Regulation. See section 9 of this Certificate.

Construction (Design and Management) Regulations 2015

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

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

See section: 1 *Description* (1.1 and 1.2) of this Certificate.

Additional Information

NHBC Standards 2016

NHBC accepts the use of Bentoshield MAX LM, provided it is installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards, Part 5 Substructure, ground floors, drainage and basements, Chapters 5.1 Substructure and ground bearing floors and 5.4 Waterproofing of basements and other below ground structures.*

Where Grade 3 protection is required and the below ground wall retains more than 600 mm (measured from the top of the retained ground to the lowest finished floor level), the product should be used in accordance with *NHBC Standards Chapter 5.4*, including in combination with either a Type B or Type C waterproofing protection.

CE marking

The Certificate holder has taken the responsibility of CE marking the product, in accordance with harmonised European Standard BS EN 13491 : 2004. An asterisk (*) appearing in this Certificate indicates that data shown are given in the manufacturer's Declaration of Performance.

Technical Specification

1 Description

1.1 Bentoshield MAX LM is a factory-assembled structure of geosynthetic materials, in the form of a sheet in which the barrier function is essentially fulfilled by clay (bentonite) with a low-density polyethylene (LDPE) liner. The total weight per unit area of the bentonite is $5.0 \text{ kg}\cdot\text{m}^{-2}$.

1.2 The membrane is available in the following sizes:

- widths of 1.10, 1.25, 2.50 and 5 m
- lengths of 5, 25 and 40 m.

1.3 Ancillary items necessary for installation of the product and included in this assessment are:

- BentoPaste — a sodium bentonite paste used for sealing around penetrations passing through the Bentoshield MAX LM membrane and at corner transitions
- BS Granules — sodium bentonite granules used between lap joints and at critical areas in the Bentoshield MAX LM membrane
- BS SS50 Butyl Bonding Tape — a single-sided, extruded butyl tape laminated with a fixed polyester liner.

1.4 BS SS50 Butyl Bonding Tape has the following nominal characteristics:

Dynamic shear adhesion ($\text{N}\cdot\text{cm}^{-2}$)	10
90° peel adhesion ($\text{N}\cdot\text{cm}^{-1}$)	9
180° peel adhesion ($\text{N}\cdot\text{cm}^{-1}$)	10
Specific gravity ($\text{g}\cdot\text{cm}^{-3}$)	1.6
Moisture vapour transmission rate ($\text{g}\cdot\text{m}^{-2}\cdot 24\text{hr}^{-1}\cdot\text{mm}^{-1}$)	0.15
Water vapour resistance ($\text{MN}\cdot\text{s}\cdot\text{g}^{-1}$)	3800
Service temperature range ($^{\circ}\text{C}$)	-40 to +90.

2 Manufacture

2.1 Bentoshield MAX LM is manufactured by a needle-punching process, in which the fibres of the lower non-woven geotextile are pushed through the bentonite layer and secured in the retaining upper woven layer. This process links the geotextiles and contains and confines the bentonite. Following the needle-punching process, an LDPE sheet is laminated to the needle-punched geotextile through a hot-melt glue application line.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management systems of Geomas Geokompozit Sanayi Muhendislik Ticaret A.S have been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by FQC (Certificate 01.15.4656.10173.D).

2.4 The product is manufactured by the Certificate holder and marketed/distributed in the UK by Geomasuk Limited, Unit 21A, Kinsley Industrial Estate, Hoyle Mill Road, Kinsley, West Yorkshire, WF9 5JB, tel: 0800 009 6141, email: info@geomas-uk.com, website: www.geomas-uk.com

3 Delivery and site handling

3.1 Rolls of Bentoshield MAX LM are wrapped in a plastic covering, and bear the label detailing the company, weight of the roll, lot number and CE marking information.

3.2 Small rolls (1.1 x 5 m) are supplied on pallets of 30-35 rolls, covered with polythene. The pallet is covered by a rigid box.

3.3 BentoPaste is supplied in 15 kg pails.

3.4 BS Granules are supplied in 25 kg bags.

3.5 Rolls of BS SS50 Butyl Bonding Tape are packaged in cardboard boxes, eight rolls per box. Each roll is 25 m long.

3.6 The membrane and components should be stored in dry conditions, under cover and away from the possibility of damage or premature contact with water.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Bentoshield MAX LM.

Design Considerations

4 Use

4.1 Bentoshield MAX LM is satisfactory for use as a fully-bonded Type A waterproofing protection as defined in BS 8102 : 2009 for the waterproofing of new and existing structures.

4.2 The product can be used externally on horizontal floor slabs and vertical walls to provide an effective barrier to the transmission of liquid water where Grades 1 to 3 waterproofing protection are required, as defined in Table 2 of BS 8102 : 2009.

4.3 Where Grade 3 waterproofing protection is required, the environment must also be controlled by use of ventilation, dehumidification and/or air conditioning (as appropriate) to ensure that dampness does not occur.

5 Practicability of installation

The product is designed to be installed by contractors experienced with this type of product.

6 Resistance to water and water vapour



The product, including joints, when completely sealed with BS SS50 Butyl Bonding Tape, will adequately resist the passage of moisture into the structure.

7 Resistance to mechanical damage

The membrane is robust and resistant to normal site activities. The dropping of heavy objects will normally have no damaging effect on the membrane. Any accidental cuts will self-heal when the membrane is hydrated following correct installation, provided that bentonite material is not lost from the edges of the cut. If the damage is more extensive, or material is lost from the membrane, or the LDPE is damaged, it must be repaired (see section 17).

8 Chemical resistance

8.1 The gelling sodium bentonite is adversely affected by the presence of electrolytes (particularly trivalent ions) and may also be affected by the presence of soluble cations such as those found in chalk or lime soils. In such cases advice should be sought from the Certificate holder.

8.2 The membrane is not affected by organic contaminants.

9 Resistance to loading



Provided that the product is adequately confined, properly hydrated and not subjected to point loading, an installation beneath a foundation slab will transmit dead and imposed loads to the ground safely without excessive deformation. In situations where point loading is anticipated, the Certificate holder's advice should be sought.

10 Adhesion

When concrete is cast against the membrane, the free ends of the needle-punched fibres become embedded in the concrete, creating a permanent bond between the concrete and membrane.

11 Maintenance

As the product is confined by the concrete and has suitable durability (see section 12), maintenance is not required. Any damage occurring during installation must be repaired in accordance with section 17.

12 Durability



Bentoshield MAX LM, when fully protected and subjected to normal service conditions, will provide an effective barrier to the transmission of moisture for the life of the structure in which it is incorporated.

Installation

13 General

13.1 Bentoshield MAX LM must be installed in accordance with the relevant requirements of BS 8102 : 2009 and the Certificate holder's instructions.

13.2 To ensure satisfactory adhesion of BS SS50 Butyl Bonding Tape, the product must be applied to a dry surface with a temperature between 5°C and 40°C.

13.3 Once installed, the product is unaffected by most site conditions, including sub-zero temperatures and heavy rainfall. Under wet conditions the product can withstand light construction traffic without significant extrusion of the bentonite. Slight losses at the exposed edges of a lap joint will not impair the watertightness but may have an adverse effect on site safety. Excess pressure should be avoided once the membrane is hydrated.

13.4 The product must be installed on flat, smooth surfaces, without wrinkles or folds in the membrane that could cause it to sag during concrete placing. The Certificate holder can advise on suitable surfaces for a particular installation.

13.5 All surfaces to which the membrane is to be applied must be sound and solid to ensure that no movement occurs during the pouring of concrete.

13.6 The membrane is installed with the woven geotextile facing uppermost (horizontal) or facing the structure vertically, ensuring that it will be in contact with the fresh concrete when it is poured.

13.7 The membrane is easy to handle and can be cut using a sharp knife.

13.8 The membrane will swell on contact with moisture and must be confined to ensure a watertight seal is achieved in service. The Certificate holder should be consulted for a particular application to ensure that this is adequately achieved and the operation properly supervised.

13.9 The membrane and components must never remain permanently exposed.

14 Joints

14.1 It is recommended that laps be staggered by a minimum of 300 mm to avoid four sheets overlapping in one location. All lap joints are sealed with BS SS50 Butyl Bonding Tape.

14.2 Overlaps should be planned to ensure that they all run in a uniform direction. The concrete should be placed on top of the membrane following the direction of the overlaps, to avoid folding of the membrane during concrete placing.

15 Penetrations and sealing

Sealing around protrusions through the membrane, eg at details such as piles and service pipes, is achieved by cutting a hole in the membrane, fitting the membrane over the protrusion and sealing around the protrusion on top of the membrane with BentoPaste or a paste created by mixing BS Granules with water.

16 Procedure

Horizontal surfaces

16.1 Following the required groundwork preparation, a blinding layer (of thickness according to the engineer's specification) consisting of lean concrete, sand or gravel is placed, compacted and levelled. Soil substrates should be compacted to a minimum 85% Modified Proctor. This layer should be free from debris and have a smooth surface. The Certificate holder should be consulted if a blinding layer is not being used.

16.2 The membrane is rolled out manually or, to assist handling of larger rolls, with a spreader bar, and trimmed to fit.

16.3 Bentoshield MAX LM adjacent sheets must be lapped by a minimum of 100 mm. The geotextile clay barrier from each adjacent sheet of Bentoshield MAX LM is peeled back 100 mm to expose the polyethylene laminated sheet. The sheets are lapped by 100 mm and sealed with BS SS50 Butyl Bonding Tape.

16.4 At the edge of the slab, between the horizontal and vertical joint, the membrane is turned up by 90° and nailed to the vertical shuttering. A sufficient length of membrane should be left to ensure the formation of the recommended overlap joint with the vertical member. All floor to wall joints must be sealed with BS SS50 Butyl Bonding Tape.

16.5 If expansion joints are required, a suitable BBA-approved water bar should be used.

16.6 The concrete slab to be poured should have a minimum thickness of 150 mm.

Vertical surfaces

16.7 In vertical applications, Bentoshield MAX LM is fixed to the concrete substrate (ie secant/contiguous pile wall) using washer-headed fasteners every 300 mm around the perimeter of the membrane and at 300 mm centres within the membrane. Bentoshield MAX LM adjacent sheets must be lapped by a minimum of 100 mm. The geotextile clay barrier from each adjacent sheet of Bentoshield MAX LM is peeled back 100 mm to expose the polyethylene laminated sheet. The sheets are lapped by 100 mm and sealed with BS SS50 Butyl Bonding Tape.

16.8 When fixed to the inside face of shuttering, the membrane is aligned vertically, ensuring that all laps face down, away from the flow of the poured concrete. The overlaps are secured to the shuttering using staples at 300 mm centres. After the formwork is removed, BS SS50 Butyl Bonding Tape is firmly applied over the 100 mm exposed polyethylene laps.

16.9 A minimum overlap of 300 mm should be ensured between the kicker and the wall. The upper liner should overlap the lower, to prevent ingress of soil and debris during backfilling. All floor to wall joints must be sealed with BS SS50 Butyl Bonding Tape.

16.10 Backfilling should be carried out as soon as possible after placing the membrane. Backfill material should be free from builders' debris and angular aggregate, and should be compacted to a minimum 85% Modified Proctor.

Protection boards can be installed to prevent soil or debris from damaging the installed liners. The Certificate holder can advise on suitable products.

16.11 After backfilling, the application of the membrane is continued. The membrane should not be installed above the intended final ground level and should be terminated at that point on the concrete structure.

17 Repair

Where material is lost from the membrane, a patch of Bentoshield MAX LM should be applied. The patch is secured using BS SS50 Butyl Bonding Tape, ensuring that the patch extends a minimum of 100 mm on each side. If the damage is more extensive, the membrane should be replaced with fresh Bentoshield MAX LM.

Technical Investigations

18 Test

Tests were conducted and the results assessed to determine:

- resistance to hydrostatic pressure (BS EN 1928 : 2000, Method B)
- resistance to water at lap joint
- thickness
- length, width, straightness and flatness
- mass per unit area
- resistance to puncture and ability to self-seal
- bond strength between Bentoshield MAX LM and poured concrete
- strength of internal structural junctions
- index flux
- tensile strength
- resistance to water vapour transmission.

19 Investigations

19.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

19.2 An assessment was made of the practicability of installation of the product.

Bibliography

BS 8102 : 2009 *Code of practice for protection of structures against water from the ground*

BS EN 1928 : 2000 *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of watertightness*

BS EN 13491 : 2004 *Geosynthetic barriers — Characteristics required for use as a fluid barrier in the construction of tunnels and underground structures*

BS EN ISO 9001 : 2008 *Quality management systems — Requirements*

20 Conditions

20.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- 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.

20.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

20.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and 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.

20.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

20.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- 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
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

20.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal 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, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue 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.