Bitumen thick film Sealants for Waterproofing below ground structures

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Positive side waterproofing with bitumen thick film sealants for below ground structures (foundation slabs and walls).

1.2 REFERENCES

A. CE / EN 15814:2012 Polymer modified bitumen thick film sealant (PMB) for the waterproofing of underground structures
B. Official test certificate for approval authorities P-2005-4-3472/02 by the MPA for construction engineering in Dresden, Waterpoofing against pressurized and non-pressurized water.
C. Official test certificate by MPA Dresden – according to the guideline of the Association of the German Chemical Industry “Guideline for the design and the application of waterproofing of construction members with ground contact using polymer thick sealants” in accordance with DIN 18195.
D. Official test certificate by the AMPA Hannover – slotted disk water pressure test.
E. Radon impermeability test – University of Saarland
F. System brochure – External basement waterproofing

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

1.4 PERFORMANCE REQUIREMENTS

The base of waterproofing system shall be a crack bridging, 2 component polymer modified, elastic, polystyrene-free, fibrated, bitumen thick film sealant for the safe waterproofing of building structures. It should be resistant to pressurized water, radon-proof with ability to bridge cracks up to 2 mm. The

waterproofing system shall be KÖSTER Deuxan 2K, manufactured by KÖSTER Bauchemie AG, Aurich, Germany. Primer shall be a thin coat of a low viscous, substrate solidifying, hydrophobizing combination product on a polymer / silicate basis KÖSTER Polysil TG 500 applied to the substrate. For detail waterproofing around the pile heads waterproofing system shall be a cement based mix containing chemicals which penetrate with moisture into the capillary tracts and activate to form crystals which close the capillaries to produce the waterproofing effect. For such purpose, cementitious waterproofing system KÖSTER NB1 Grey should be used. Prior to beginning the waterproofing all wall – floor junctions has to be rounded by installing fillets using KÖSTER Repair Mortar Plus.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have no less than five years experience in manufacturing polymer modified bituminous and crystallizing cementitious waterproofing systems. The system shall be specifically formulated and marketed for waterproofing. System design shall not have changed for a minimum of five consecutive years prior to start of the work.

B. Installer Qualifications:

1. Applicator shall be approved by the manufacturer, experienced in surface preparation and application of the material and shall be subject to inspection and control by the manufacturer.

2. Installer shall have no less than three years experience installing the specified waterproofing systems, or have been factory certified and trained in the KÖSTER Training Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the job site in their original unopened containers, clearly labeled with the manufacturer's name and brand designation.
B. Store products in an approved ventilated dry area; protect from contact with soil, dampness, freezing and direct sunlight.
C. Handle products in a manner that will prevent breakage of containers and damage to products.
D. Liquids should not be stored in areas with temperatures over than + 30 ºC or below + 5ºC.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
   1. Do not apply bituminous and cementitious waterproofing to unprotected surfaces in wet weather or to surfaces on which ice, frost or water is visible.
   2. Do not apply bituminous and cementitious waterproofing when the temperature is lower than + 5 ºC or expected to fall below this temperature within 24 hours from time of application.

3. Do not apply bituminous and cementitious waterproofing in rain, snow, fog or mist.

B. Protection: Protect bituminous and cementitious waterproofing to prevent damage from active rain for a minimum period of 24 hours from time of application. Protect bituminous waterproofing to prevent damages due to backfilling, all according to manufacturer's data sheet.

1.8 WARRANTY

A. Installer of waterproofing system shall provide standard installation warranty for workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturer: KÖSTER BAUCHEMIE AG • Dieselstraße 1-10 • D-26607 Aurich • Tel. 04941/9709-0 • Fax -40 • info@koester.eu • www.koester.eu
B. Substitutions: Not permitted.
C. Requests for substitutions will be considered in accordance with provisions section.
D. Provide the materials of one manufacturer throughout the project as specified.

2.2 SYSTEM - POSITIVE SIDE WATERPROOFING WITH BITUMEN THICK FILM SEALANTS FOR WATERPROOFING BELOW GROUND STRUCTURES (FOUNDATION SLABS AND WALLS)

A. Two component, polystyrene-free, fibrated, polymer modified bitumen thick film sealant, crack bridging, resistant to pressurized water and radon-proof.

1. Product: KÖSTER Deuxan 2C

2. Physical Properties:

a. Material base: bitumen / rubber with a reactive powder
b. Density of the mixture: 1.07 g/cm3.
c. Heat resistance: 70 °C.
d. Elongation at break: approx.. 100 %.
e. Waterproof after full cure: up to 5 bar.
f. Curing time: 24 h.
g. Effectiveness against radon: gas radon gas-proof.
h. Watertightness: Class W2A.
i. Crack bridging ability: class CB2.
j. Resistance against water: No discoloration of the water / No debonding of the inlay
k. Bending properties at low temperatures: No cracks.
l. Reaction to fire: Class E.
m. Compressive strength: Class C2A.
n. Durability of watertightness and reaction to fire: passed.

2.3 ADDITIONAL PRODUCTS

A. KÖSTER NB 1 Grey. Cementitious, crystallizing cement-based mix containing chemicals which penetrate with moisture into the capillary tracts and activate to form crystals which close the capillaries to produce a cementitious waterproofing system that becomes a permanent, integral part of the structure and is non-toxic, inorganic and free of added chlorides and added sodium-based compounds. Use for positive and negative side waterproofing of pile head details and wall-floor junctions before installation of fillets.

B. KÖSTER SB Bonding Emulsion. Use where recommended by manufacturer to increase elasticity, flexibility, reduce water absorption, and improve bonding to steel. Do not use in case of drinking water contact where certification is required.

C. KÖSTER Repair Mortar Plus. Watertight, fast setting, slightly expanding repair mortar with excellent adhesion. With the addition of KÖSTER SB Bonding Emulsion, it can be used as a PCC (polymer-modified cement concrete) mortar. Use for installing fillets or levelling the surface.

D. KÖSTER Polysil TG 500. Thin fluid, deeply penetrating primer based on a polymers and silicates, used as primer beneath polymer modified bitumen thick film sealants, in order to consolidate, strengthen, and to protect mineral substrates and to reduce their absorbency.

E. KÖSTER Glass Fibre Mesh. Highly tear resistant mesh for the reinforcement of waterproofing layers especially in the case of pressurized water, areas in danger of cracking as well as connections, wall / floor junctions and fillets. Resistant to dislocation, alkalis, plasticizer-free.

F. KÖSTER Joint Tape 20 / 30. Thermoplastic tape for sealing expansion and dilatation joints and irregular cracks.

G. KÖSTER KB-Pox Adhesive. Two component, epoxy based, High performance adhesive specially designed for fastening KÖSTER Joint Tapes to mineral, wooden and metal substrates.

H. KÖSTER BE Rainproof. Liquid accelerator forming a water-repellent film on bitumen coatings and protects fresh bitumen coatings against rain.

I. KÖSTER Universal Cleaner. Solvent free cleaning agent for bituminous materials and epoxy resins.

J. KÖSTER SD Protection and Drainage Sheet 3-400. Green HD-PE based notched protection board which combines 3 functions in one product: (1) mechanical protection of the waterproofing layer (e.g. when backfilling the construction pit) according to DIN 18195, (2) decoupling of the waterproofing layer from any ground movement, (3) the hollow core leads seepage and backwater safely to the drainage.

K. KÖSTER SD Edge Profile. Finishing profile for protection and drainage sheets.

L. KÖSTER SD Fixing Element. Steel nails and mounting heads for the fixing of protection and drainage sheets.

PART 3. EXECUTION

3.1 EXAMINATION

A. Do not begin installation until concrete substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Concrete surface should be:
   - sound and solid
   - level, free of large breakouts, nests and ridges
   - absorptive
   - dry
   - clean, free of adhesion inhibiting soiling like dust, oil, grease etc.
   - free of gaping cracks
   - corners have to be broken
   - wall floor junctions have to be rounded out by the installation of fillets
   - protrusions and recesses have to be kept to a minimum

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. All concrete surfaces must be solid, sound, and free of all laitance, oils, grease, curing agents, or other foreign materials which might affect the bonding adversely.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Clean surfaces to receive bituminous or cementitious waterproofing, chip or abrasive blast to a CSP-3 (ICRI Guideline 3102R13) profile to remove defective materials and foreign matter such as paint, dirt, grease, curing agents, form release agents, and mineral salts. Suitable surface cleaning methods are cleaning with water jet (300 to 500 bar), sandblasting and water jet (100 bar) or shot blasting. In case there is form work release oil on the surface, apply a suitable detergent to the surface before cleaning with the water jet. If concrete surface has been previously treated with other agents, notify manufacturer before proceeding.
D. Test quality of the surface cleaning and preparing:
   1. Pull-off test: Pull-off strength must be > 1.5 N / mm² tested with an Elcometer surface adhesion tester or similar precision instrument. Test the substrate at least once for every thousand square meters. Only results with failure in the concrete substrate (min 3 mm deep) are accepted. Failures in the adhesive must have values > 2.0 N/mm² for acceptance. Document where and when testing was carried out and document the results obtained.
   2. Scratch test: Scratch the substrate with a nail or something similar. If particles come off the surface or if the fingernail can penetrate the substrate, remove the entire sinter layer.
   3. Wipe test: Wipe with your hand over the substrate. If no particles become detached and if the hand remains clean, then the substrate is acceptable.
   4. Water test: To evaluate the absorptiveness of the substrate, wet the substrate. Water which is applied to the substrate must not roll off the surface but it must distribute within a short period of time.
E. Repair cracks, expansion joints, control Joints, and open surface honeycombs.
   1. Use KÖSTER SB Bonding Emulsion with manufacturer approved concrete repair

materials. (Such as the KÖSTER Repair Mortar Plus). Comply with requirements listed in manufacturer's technical data information. No exceptions.

2. Moving joints and cracks are treated and detailed as expansion joints. Install an elastic sealant and corresponding primer in accordance with sealant manufacturer's instructions.

F. Honeycombed areas, cavities, recesses and chipped out areas where form ties have been cut or removed must be routed/bush hammered to sound base and repaired according to manufacturer's instructions and patched flush with KÖSTER Repair Mortar Plus with 20 % KÖSTER SB Bonding Emulsion added to the mixing water.

G. All holes, voids, defects etc. in the substrate have to be leveled before applying KÖSTER Deuxan 2C:

1. Large holes, deeper or wider than 5 mm: Uneven surfaces must be first rendered flush with KÖSTER Repair Mortar Plus with 20 % KÖSTER SB Bonding Emulsion added to the mixing water.
2. Small holes, shallower or narrower than 5 mm: There are two methods to close small holes.
   i. Slurry coat made of KÖSTER NB 1 Grey: Small holes up to a width or depth of 5 mm can be closed using the waterproofing slurry KÖSTER NB 1 Grey. If used for this purpose, apply one layer of KÖSTER NB 1 Grey with a consumption of approx. 2.0 kg / m² by brush.
   ii. Scratch coat with KÖSTER Deuxan 2C: When applying KÖSTER Deuxan 2C, you must be able to reach all areas and ensure a uniform coat which is free of pinholes and other irregularities.

H. Treatment of construction joints: All joints subjected to potential movements have to be sealed with KÖSTER Joint Tape 20 or 30, thermoplastic tapes for sealing expansion and dilatation joints (up to 12 or 20 cm width). The joint tape system consists of KÖSTER Joint Tape and KÖSTER KB-Pox Adhesive, a high performance adhesive for fastening the joint tape to mineral substrates. Joint sealing should be done according manufacturer's technical data information and instructions.

I. Fillets and Coves between Horizontal and Vertical Areas: In order to reduce the tensions on the waterproofing layer, 90° angles at wall-floor junction must be rounded out by the installation of fillets. Mortar fillets should be made out of KÖSTER Repair Mortar Plus with 20 % KÖSTER SB Bonding Emulsion added to the mixing water. Rounded mortar fillets should have a leg length of 4 to 6 cm. Fillets can also be made out of KÖSTER Deuxan 2C. Fillets made of KÖSTER Deuxan 2C should have a leg length of approx. 2 cm. Greater leg length will lead to a higher layer thickness of the KÖSTER Deuxan 2C which can lead to cracking of the fillet. KÖSTER Deuxan 2C should be applied in a maximum layer thickness of 8 mm. Allow the fillet to cure sufficiently before coating it over. Curing time of the fillet will depend on the ambient weather conditions. Protect the freshly installed fillet form rain.

J. Where fillets or coves are specified it is desirable that the cementitious waterproofing be applied behind the cove strip (such as KÖSTER NB 1 Grey).

K. Breaking the corners: To prevent damage to the membrane due to mechanical stresses, all corners need to be broken at a 45° angle with a grinding tool. In new construction it is recommended to install a triangular wooden molding onto the top edge of the form work for the foundation slab.

3.3 INSTALLATION - POSITIVE SIDE WATERPROOFING WITH BITUMEN THICK FILM SEALANTS FOR WATERPROOFING BELOW GROUND STRUCTURES (FOUNDATION SLABS AND WALLS)

A. Install in accordance with manufacturer's instructions.

B. On horizontal surfaces, after drying of blinding concrete layer, all the pile head details and reinforcement penetrations details should be waterproofed against ground moisture, and non-pressurized and pressurized water using cementitous mineral waterproofing with subsequently crystallizing agents (such as KÖSTER NB 1 Grey). After removing of all protrusions and cleaning the pile head, surface between reinforcement is smoothed with KÖSTER Repair Mortar Plus and fillets are installed between pile-head and blinding concrete layer with the same mortar. Complete surface of pile head together with an additional position of future overlap with KÖSTER Deuxan 2C on blinding layer (minimum of 10-15 cm) is than waterproofed with KÖSTER NB 1 Grey, in 2-3 layers by brush.

C. Application – Priming the surface:

1. Fillets must have dried completely before primers are applied.
2. The substrate should be dry or slightly damp, (no visible water), frostfree, free of tar and oil and free of loose particles.
3. Priming the substrate:
   - i. Scratch coat with KÖSTER Deuxan 2C: The substrate can be primed by applying a scratch coat of KÖSTER Deuxan 2C. If a scratch coat of KÖSTER Deuxan 2C was applied to the substrate to level unevenness, then no further priming is necessary. A scratch coat of KÖSTER Deuxan 2C cannot be counted as a waterproofing layer. The first waterproofing layer should be applied on top of the scratch coat as soon as the scratch coat has sufficiently cured. Curing time depends largely on the environmental conditions.
   - ii. Priming with KÖSTER Polysil TG 500: Mineral substrates always have to be primed with KÖSTER Polysil TG 500 (approx. 100 – 130 g / m²). Strongly absorbent surfaces may require up to 250 g / m². KÖSTER Polysil TG 500 leads to a reduction of the pore volume. It increases the chemical and mechanical resistance of mineral building materials. KÖSTER Polysil TG 500 acts strengthening and hydrophobizing. KÖSTER Polysil TG 500 is applied in 1 layer. The finished coating of KÖSTER Polysil TG 500 must be uniform. Suitable methods of application are brush or spray application.
4. Priming is not necessary on polystyrene substrates.

D. Application - General:

1. Do not apply KÖSTER Deuxan 2C at air temperatures below + 5 °C or above +35 °C.
2. Do not apply KÖSTER Deuxan 2C if substrate temperatures are below + 5 °C or above +30 °C.
3. Application at very high temperatures: When processed in high ambient temperatures, KÖSTER Deuxan 2C may show a reduced pot life.
4. Application at low temperatures: Temperatures must be above +5°C at all times during application and also remain above + 5°C until KÖSTER Deuxan 2C has completely cured.
5. Touch-up, repair or replace damaged products before Substantial Completion.
6. Do not expose the material to frost, rain and water or to direct sunlight until it has fully cured.

E. Mixing:

1. Add the powder to the liquid component in portions and continually mix both components intensively with each other using a slow rotating stirring device until the material becomes a paste-like, lump-free, homogeneous mass (mixing time is min. 3 minutes).

F. Application:

1. A waterproofing made of KÖSTER Deuxan 2C is always applied in 2 layers.
2. The layers have to be applied shortly after each other. Each finished layer must be uniform, even in thickness, free of pinholes and free of any other defects.
3. Total consumption must be at least 3.0 kg / m² and maximally 7.0 kg / m². KÖSTER Deuxan 2C should be applied in a maximum thickness of 8 mm.
4. The material is applied by trowel. Either a 10 mm toothed trowel is used or a special layer thickness trowel (available in 3 mm and 4 mm) is used.
   i. Toothed trowels: Use a standard trowel to remove the ready mixed material from the bucket and then apply it to the substrate with the toothed side of a toothed trowel. When applying the material with the toothed trowel, the trowel is held at an angle to the substrate so that the resulting thickness of the “toothed” layer will be approx. 6 mm. After a uniform “toothed” layer has been applied, the layer is smoothed with the flat side of the trowel. The result is a uniform layer with a thickness of approx. 3 mm.
   ii. “Layer thickness” trowels: “Layer thickness” trowels were developed especially for the application of bitumen thick film coatings. Disks with the radius of 3 mm or 4 mm are welded to one edge of the trowel so that the layer of the bitumen thick film coating which is applied with that trowel will have the thickness of the radius of the disk. A coating which has been applied with a “layer thickness” trowel has small tracks in it from the disks of the trowel. After a layer of KÖSTER Deuxan 2C has been applied, the tracks are closed using the straight edge of the trowel that has no disks.
5. In areas which are in danger of cracking, the coating should be reinforced with KÖSTER Glass Fiber Mesh. This mesh is embedded into the first fresh coat of KÖSTER Deuxan 2C. Immediately after KÖSTER Deuxan 2C has been applied to the wall, a piece of KÖSTER Glass Fiber Mesh, precut to the required size, is placed in front of the fresh material and pushed into the fresh coating with the straight edge of a trowel. If the mesh is embedded in larger areas, make sure to overlap individual pieces by approx. 10 cm.
6. In case of horizontal waterproofing of floor areas, embed KÖSTER Glass Fiber Mesh into the complete waterproofing area.
7. The waterproofing layer of the wall area has to extend at least 10 cm onto the front of the floor slab or foundation. External waterproofing has to be connected in all areas to the existing horizontal waterproofing.
8. Pipe penetrations must be waterproofed with special care. First clean and then roughen the outside of the penetrating pipe. This can be done using e. g. sandpaper. Then the fillet made of KÖSTER Deuxan 2C is installed and allowed to cure. Into the first fresh layer of the area waterproofing made of KÖSTER Deuxan 2C, KÖSTER Glass Fiber Mesh is embedded. It is necessary to make sure that the material of the installed parts is compatible with the waterproofing material.
9. The waterproofing layer has to be free of flaws, even and in the required thickness. The actual layer thickness must nowhere be less than the required minimum thickness and in no case exceed it by more than 100 %.

10. Testing layer thickness: Controlling the layer thickness of the coating has to be carried out in the fresh state by measuring the wet layer thickness (at least 20 measurements per project or at least 20 measurements per 100 m²). The measuring points should be distributed diagonally. Depending on the details of the construction member, the amount of measuring points is increased e. g. in the area around penetrations, transitions, connections, etc. If two layers are applied with embedded reinforcement mesh, the layer thicknesses of both layers have to be controlled separately. Take the KÖSTER Layer Thickness Tester and stick the cut-out side into the wet layer of bitumen thick film sealant. Pull it back out and read off the layer thickness. When waterproofing according to DIN 18195-5 and DIN 18195-6, the testing of the layer thickness (amount, position, result) as well as the testing of the complete drying has to be documented in a test report.
11. Should testing on the coated structure be required after curing, then the dry layer thickness can be determined using the wedge cut method.
12. The minimum dry layer thickness must be:
    i. 3 mm thick in case of waterproofing against ground moisture and nonretained seepage as well as non-pressurized water (wet layer thickness 4.0 mm = 4.0 kg / m²). Embed KÖSTER Glass Fiber Mesh at corners, fillets and areas strongly in danger of cracking.
    ii. 4 mm thick in case of waterproofing against retained seepage (wet layer thickness 6 mm = 6 kg / m²). Embed KÖSTER Glass Fiber Mesh into the first layer.
13. Curing: The waiting time between the first and the second layer is as long as it takes the first layer to cure enough not to be damaged by application of the second layer. This usually takes at least 24 hours but in adverse ambient conditions, a longer waiting time may be required. High humidity and low temperatures will slow down or respectively speed up the curing time of KÖSTER Deuxan 2C.
14. The fresh layer of KÖSTER Deuxan 2C must be protected from water, especially from rain, until it has cured far enough to be able to resist it. To prevent a fresh coat of KÖSTER Deuxan 2C from getting damaged by rain, KÖSTER BE Rainproof can be sprayed onto the fresh coating. It will cause the coating to immediately form a rainproof surface. It does not cause the complete curing of the entire layer. The coating must still be allowed to cure afterwards. If KÖSTER BE Rainproof is applied to the first layer, it must be washed off with water after the layer has completely cured. Otherwise, it will impair bonding and application of the next layer. If KÖSTER BE Rainproof is applied to the final layer, it must not be removed.
15. On horizontal surfaces, after the whole area is waterproofed with KÖSTER Deuxan 2C, cover the area waterproofing with two layers of PE-foil to act as a gliding layer and then a 5 cm protective screed of unreinforced concrete is installed. On such prepared protection layer, the foundation slab and the rising walls can be built.
16. Prior to backfilling, the fully cured coating must be protected from mechanical damage with the use of KÖSTER Protection and Drainage Sheet 3-400. Polystyrene drainage boards and perimeter insulation are to be fully bonded. In order to avoid vertical movement of the waterproofing when backfilling the excavation pit, the surface of the protection or respective drainage boards should be covered with a gliding layer of polyethylene. All cases allow for bonding with KÖSTER Deuxan 2C. Avoid stress points on the waterproofing. Dimple sheets, corrugated boards and the like are not suitable protection layers. Make sure not to damage the fillets when backfilling and compacting non-cohesive soils.
17. In case of soils with low permeability as well as in case of retained seepage, a drainage has to be installed.