



TECHNICAL INFORMATION MANUAL

Sika MonoTop[®] -4400 MIC

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BUILDING TRUST



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1 SCOPE

This technical information manual describes the step by step procedure for repairing and protecting concrete structures affected by biogenic corrosion or microbial induced corrosion (MIC) using the Sika Monotop®-4400 MIC.

2 PRODUCT DESCRIPTION

Sika MonoTop®-4400 MIC is a one component, ready to use, high performance, 100% calcium aluminate mortar specially designed for the repair and protection of new or existing sewer infrastructures from biogenic sulphuric acid corrosion.

USES

Sika MonoTop®-4400 MIC is particularly suitable for the repair and protection of:

- Sewer infrastructures
- Manholes
- Lift stations, pumping stations
- Main trunk sewers, collectors
- Sewer pipes
- Waste water treatment plants
- Sika MonoTop®-4400 MIC must not be used to protect concrete in bio-reactor tanks or digester tanks.

CHARACTERISTICS/ ADVANTAGES

- 1-component product (only add water)
- Excellent resistance to pure water, salt water, sulphated soils and several diluted acids
- Does not contain chlorides or other corrosion promoting additives
- Suitable for machine application (low pressure wet spray technique)
- High bond strength
- High early compressive strength
- Fast return to service (within 1 hour if Sikagard®-230 MIC Surface Hardener is used)

2.1 LIMITATIONS

- Sika MonoTop®-4400 MIC must only be mixed with potable water.
- Do not add Portland cement or additional aggregates.
- Wet spraying equipment must be clean and free of Portland cement contamination to avoid premature setting and reduced corrosion resistance behaviour.
- Avoid application under direct sun and/or strong air currents.
- Do not add water over the recommended dosage.
- Apply only to a sound, prepared substrate.
- Do not add additional water during the surface finishing as this will cause discolouration and cracking.
- Products shall only be applied in accordance with their intended use.
- The most recent and relevant local Product Sheet (PDS) and Material Safety Data Sheet (MSDS) shall apply.
- For specific construction/build information refer to the Architects', Engineer's or Specialist's details, drawings, specifications and risk assessments.
- All work shall be carried out as directed by a Supervising Officer or a Qualified Engineer.
- This technical information manual is only a guide and shall be adapted to suit local products, standards, legislations or other requirements.

3 PRODUCTS

Sika MonoTop®-4400 MIC	1-component, ready to use, repair and protection mortar against biogenic corrosion
Sikagard®-230 MIC	Water based surface hardener for Sika MonoTop®-4400 MIC

3.1 SYSTEM BUILD-UP

Concrete Repair and Protection Mortar	
Sika MonoTop®-4400 MIC	Calcium aluminate mortar for concrete repair and protection
Surface Hardener	
Sikagard®-230 MIC	Quick surface hardener for fast applications

3.2 MATERIAL STORAGE



Materials shall be stored properly in undamaged original sealed packaging, in dry cooled conditions. Refer to specific information contained in the product data sheet regarding minimum and maximum storage temperatures.

4 EQUIPMENT

4.1 MATERIALS

Sufficient quantities of Sika® materials	Refer to section 10
Sufficient clean water	For mixing 1-component, pre-wetting substrate and cleaning
Sufficient lubricating agent for the pump	For facilitating the pumping avoiding blockages and reducing equipment wear (e.g. SikaPump-Start 1)

4.2 ESSENTIAL EQUIPMENT

Hand tools	Trowels, brushes for mortar finishing
Damaged concrete removal	Traditional tools, hammer-drill or suitable mechanical equipment for removing damaged or contaminated concrete in small areas. For large repair jobs refer to section 7
Measuring cylinder or jar	For accurate measurement of mixing water
Sponge or pressurised air (oil free)	Wipe/blow away excess water from substrate
Mixing equipment	Refer to section 4.5
Pumping and/or spraying equipment	Low pressure wet spray method. Refer to section 4.6
Cleaning Equipment	Suitable for removing deteriorated concrete or coatings. Refer to section 4.4
Curing	Water or Sikagard®-230 MIC. Refer to section 9.6
Cleaning	Brush, low pressure water to clean the used tools.
Waste disposal	For paper bags and excess material

4.3 ADDITIONAL EQUIPMENT

Inflatable plug	For stopping the sewage flow during the refurbishment works
pH measuring paper and demineralized water	For checking if the substrate has been prepared properly
Water plug or injection material	For stopping water infiltrations before the application of the mortar
Sealant	For sealing equipment or pipe penetrations

4.4 SUBSTRATE PREPARATION EQUIPMENT

A suitable cleaning method must be used for the substrate preparation. The choice will depend on the concrete damage and the depth of contaminated concrete.

Note: in general, when the concrete has already been affected by biogenic corrosion leaving the aggregates visible, it is recommended to prepare the surface with a jet water pressure of 300 bar to achieve the required roughness and cleanliness.

If the contamination is present deep in the substrate, higher water pressure must be used (up to 2400 bar) until sound and clean concrete is achieved.

4.5 MIXING EQUIPMENT

Use professional equipment for mixing Sika MonoTop®-4400 MIC. Examples of individual mixers:



Single mixer with spindle paddle
For very small quantities



Double mixer with spindle paddles
For small quantities



Planetary mixer
For large quantities

4.6 PUMPING AND SPRAYING EQUIPMENT

Use low pressure wet spray equipment for spraying the Sika MonoTop®-4400 MIC. Do not use a continuous mixing process.



Roto-stator worm compact pump, e.g. MTEC P20 400 V. With a maximum pressure of 30 bar and maximum 30 m of hose. It may require an external mixer.
For small repairs, e.g. 1 manhole ($\varnothing < 1$ m)



Roto-stator worm pump, e.g. Putzmeister P11 SP 16.2 KW. With a maximum pressure of 30 bar and maximum 52 m ($\varnothing 50$ mm) of hose. No external mixer required
For large repairs



Spin Casting Machine. For manholes where no bends or irregular shaped portions are found.
Only for repair of manholes

ACCESSORIES FOR PUMPING

Suitable hoses for pressures up to 40 Bar



- $\varnothing 25$ mm hose:
5 m length for small manholes (3 m depth and $\varnothing < 1$ m)
- $\varnothing 35$ mm hose:
Up to 26 m length
- $\varnothing 50$ mm hose:
Up to 57 m length (4 x 13 m of $\varnothing 50$ mm + 5 m of $\varnothing 35$ mm)

Spray Nozzle:



Use a conventional spray nozzle suitable for low pressure wet spray process with a 12 mm rubber nozzle tip

Air compressor:

Minimum flow rate required is 400 l/min at 7 bars.
Compressed air is used to project the mortar at high velocity onto the substrate. Refer to the machine manufacturer's requirements. Air from the equipment shall be clean, dry and free from oil or contamination. The air shall remain continuous at not less than the operating pressure and volume rate specified by the machine manufacturer.

5 HEALTH AND SAFETY

5.1 RISK ASSESSMENT

The risk of working in confined spaces shall be properly assessed, including areas deficient in oxygen, flammable gases and toxic gases, like hydrogen sulphide.

The risk of entering in areas with potential gaseous and chemical hazards associated with sewer lines shall be properly assessed.



The risk to health and safety from falling objects or defects in the structure shall be properly assessed.

Platforms and temporary structures shall provide a stable and safe area to work. Do not take any unnecessary risks!

5.2 PERSONAL PROTECTION



Work Safely!

Handling or processing cement products may generate dust which can cause mechanical irritation to the eyes, skin, nose and throat.

Appropriate eye protection shall be worn at all times while handling and mixing products.

Approved dust masks shall be worn to protect the nose and throat from dust.

Safety shoes, gloves and other appropriate skin protection shall be worn at all times.

Always wash hands with suitable soap after handling products and before food consumption.

FOR DETAILED INFORMATION REFER TO THE MATERIAL SAFETY DATA SHEET

5.3 FIRST AID



Seek immediate medical attention in the event of excessive inhalation, ingestion or eye contact causing irritation. Do not induce vomiting unless directed by medical personnel.

Flush eyes with plenty of clean water occasionally lifting upper and lower eyelids. Remove contact lenses immediately. Continue to rinse eye for 10 minutes and then seek medical attention.

Rinse contaminated skin with plenty of water. Remove contaminated clothing and continue to rinse for 10 minutes and seek medical attention.

FOR DETAILED INFORMATION REFER TO THE MATERIAL SAFETY DATA SHEET

6 ENVIRONMENT

6.1 CLEANING TOOLS / EQUIPMENT

Clean all tools and application equipment with water immediately after use. Hardened material may only be removed mechanically.

Follow the spraying equipment cleaning process recommended in section 9.3.

6.2 WASTE DISPOSAL



Do not empty surplus material into drains. Avoid runoff onto soil or into waterways, drains or sewers. Dispose unwanted material responsibly through licensed waste disposal contractor in accordance with local legislation and/or regional authority requirements.

FOR DETAILED INFORMATION REFER TO THE MATERIAL SAFETY DATA SHEET

7 SUBSTRATE PREPARATION

7.1 CONCRETE

The concrete substrate shall be thoroughly clean, in a good sound condition and free from dust, loose material, surface contamination and materials which reduce bond. Delaminated, weak, damaged and deteriorated concrete shall be removed by suitable means.

A suitable cleaned concrete substrate can be evaluated by the surface measurement of the pH. A minimum pH value of 10 is mandatory for the substrate before starting the application.

Note: For an already affected concrete by biogenic corrosion, a high pressure (> 300 bar) water jet cleaning can be sufficient to get a rough prepared substrate exposing the aggregate. However, if the appropriate roughness of the surface is not achieved or the pH value remains below 10, an additional cleaning must be done by appropriate means (sandblasting, hydro-sandblasting, mechanical roughening, hydro-demolition (pressure up to 2500 bar)).

Micro cracked or delaminated concrete, including damage caused by cleaning, roughening or removal techniques, shall be removed or repaired if they might reduce bond or structural integrity. Micro cracks can be detected by wetting the surface and allowing it to dry. Dark lines on the dried surface indicate cracks as they retain the water.

The finished surface shall be visually inspected prior to application and can be tapped lightly using a metal hammer to detect delaminated concrete. The supervising officer or qualified engineer shall be informed immediately of any loose, cracked or damaged surfaces. In these circumstances the Sika MonoTop®-4400 MIC shall not be applied without prior written consent of the supervising officer or qualified engineer.

7.2 STEEL REINFORCEMENT

The steel reinforcement shall be thoroughly clean and free from rust, scale, mortar, concrete, dust and other loose and deleterious material which reduces bond or contributes to corrosion. Tie wire and nails shall also be removed.

The whole circumference of the bar shall be uniformly cleaned, except where structural considerations prevent this. Cleaning shall not damage in anyway the structural integrity of the steel. Immediately notify the supervising officer or qualified engineer if there is a possibility of damaging the steel by cleaning.

Loss of steel area on reinforcement due to corrosion, or due to any other damage, shall immediately be brought to the attention of the supervising officer or qualified engineer prior to any further work. Any further action such as replacing reinforcement bars shall only be carried in accordance with the direct instruction of the supervising officer or qualified engineer. The scope of this technical information manual does not include replacement of steel reinforcement bars.

7.3 PRE-WETTING SUBSTRATE

Concrete surfaces shall be saturated with clean low pressure water for some hours before the application of Sika MonoTop®-4400 MIC until a saturated surface dry (SSD) is obtained.

Just before application, remove excess water, e.g. using a clean sponge for small areas or air pressure for large areas. Ensure there is no standing water on the surface. The surface shall achieve a dark matt appearance without glistening and surface pores and pits shall not contain water (SSD). Use pressurised air (oil free) to blow away excess water in difficult to reach areas. The surface shall not be allowed to dry before application.

7.4 WATER INFILTRATIONS

If any water infiltration is observed once the surface preparation is completed, it must be treated using the appropriate Sika water plug or injection material. Please refer to your local Sika Technical Department.

8 MIXING

The mixing of the Sika MonoTop®-4400 MIC must be done only with clean potable water, without any other additional product. The mixing ratio of the Sika MonoTop®-4400 MIC is between 2.8 and 3.2 litres of water per 20 kg of powder. Do not use water beyond these stated maximum and minimum limits.

The Sika MonoTop®-4400 MIC can be mixed with a low speed (< 500 rpm) hand drill mixer or using a force action mixer. Pour the minimum recommended water in a suitable mixing container. While stirring slowly, add the powder to the water and mix thoroughly for a minimum of 5 minutes, adding additional clean water if necessary to the maximum specified amount and adjust to the required consistency.

The consistency must be checked after every mix before carrying out any application.

Mixing shall always be carried out in accordance with the recommendations contained in the latest product data sheet (PDS).

9 SPRAYING PROCEDURE

Working space shall be clean and tidy with no obstructions.

Record the substrate, ambient temperature and relative humidity. Check pot life information on bag or in the product data sheet and allow for climatic conditions e.g. high/low temperatures and humidity.

External applications shall be adequately protected. Do not apply the repair mortar in direct sun, windy, humid or rainy conditions or if there is a risk of frost within 24 hours in unprotected areas.

Calculate the required volume for the application and then using the equation in section 10 of this technical information manual, calculate the yield of the product. Make sure there is enough material on site to carry out the work.

9.1 PREPARATION OF THE SPRAYING EQUIPMENT

- The mixer and the hopper of the machine must be completely clean.
- To evidence no obstructions in the hoses, pass the cleaning sponge balls twice through the hoses.
- If several lengths of hoses are required, connect a first length of 50 mm diameter hose before connecting the other smaller diameters.
- Check that there is no water inside the hoses.
- Adjust the stator of the pump to reach a water pressure between 15 and 20 bar when using a 40 bar machine.
- Check that the 12 mm rubber tipped nozzle is perfectly clean.
- Confirm that the rubber of the nozzle is correctly fixed. Use a steel hose clamp if necessary.
- The air hose has to be adjusted at 12- 13 mm from the rubber tip.
- Pre-wet the equipment and hoses before spraying. It is recommended to use calcium aluminate cement slurry or a lubricating agent, e.g. SikaPump®- Start 1. Dispose the out coming material until the mortar with correct viscosity starts to pump out.
- Before starting the pumping of the mortar, check the pressure showed in the closed valve of the machine with water.

9.2 SPRAYING

The minimum layer thickness of the Sika MonoTop®-4400 MIC for a standard manhole ($\varnothing < 1.5$ m) is 15 mm. In case of larger structures, e.g. bigger manholes ($\varnothing > 1.5$ m), pumping stations or discharge chambers, the minimum layer thickness must be 25 mm.

When spraying overhead, it is recommended to split the 25 mm in two layers.

Spray the first 10 – 15 mm and use a notched trowel to level the surface. Note not to overwork the surface to avoid de-bonding problems. Apply the remaining thickness wet on wet. This would be approximately within 1 hour, depending on the ambient conditions during application.

Construction joints shall be avoided whenever possible. If it is not possible, then a straight edge shall be created and allowed to harden. After hardening, clean the joint with high pressure air and pre-wet before spraying the adjacent layer.

Do not overwork the finishing of the surface.

9.3 CLEANING REGIME DURING SPRAYING

The following cleaning recommendations shall be done to avoid any blockage during the pumping and spraying operations.

- Clean the hopper and the feeding screw every 15 minutes
- Clean or change the nozzle every hour
- Clean the outlet of the rotor screw at least every 2 hours
- Clean the complete pump and the hoses at least every 3 hours

The temperature of the stator of the pump must be checked on a regular basis. If the temperature increases too fast, the stator must be cleaned immediately to avoid blockages.

9.4 APPLICATION UNDER WARM CONDITIONS (> +25 °C)

The application temperature range of the Sika MonoTop®-4400 MIC is from +5°C to +25°C, with +20 °C being the optimum.

If the ambient temperature is higher than +25 °C the following measures must be taken:

- Keep the pallets of Sika MonoTop®-4400 MIC away from the direct sunlight
- Keep the pump in the shade to avoid direct sunlight
- Protect the hoses from direct sunlight or cool them down with cold water
- Use cold water for the mixing.

9.5 FINISHING THE SURFACE

Once the spraying of the mortar is done, it is recommended to use a brush to finish the surface before it starts to harden. This will avoid hairline cracks. Do not overwork the surface, especially when spraying overhead.

Do not apply additional water on the surface as this will cause discolouration and cracking.

9.6 CURING



Curing is essential to avoid premature drying that could lead to cracking and de-bonding problems.

Cure the Sika MonoTop®-4400 MIC with Sikagard®-230 MIC as soon as the finishing works of the surface are completed. If Sikagard®-230 MIC is not applied, water curing must be done for at least 8 hours after spraying ensuring that the air is kept moist saturated.



In environments with low humidity or with strong air currents, the effect of the Sikagard®-230 MIC has to be complemented as soon as possible with water curing (sprinkler, water mist or water fog) for at least 8 hours after the spraying of the Sika MonoTop®-4400 MIC.

The application shall be protected from wind, rain, frost and direct sunlight. The curing period is dependent on ambient conditions. In warm temperatures with low humidity the application shall be kept moistened to avoid premature drying.

9.7 TIME FOR RETURN TO SERVICE

The Sika MonoTop®-4400 MIC needs to be hard before being exposed to sewage water.

If a fast return to service is required (approx. 1 hour if the water flow is moderate and slow), Sikagard®-230 MIC must be applied on the surface. If not, the complete hardening of the Sika MonoTop®-4400 MIC will take between 6 to 9 hours depending on the ambient conditions.

9.8 APPLICATION LIMITS

- Do not add Portland cement or additional aggregates.
- Wet spraying equipment must be clean and free of Portland cement contamination to avoid premature setting and reduced corrosion resistance behaviour.
- Avoid application in direct sun and/or strong air currents.
- Do not add water over the maximum recommended dosage. Mix consistency must be checked after every mix prior to application.
- Always check the material's pot life.
- Apply only to a sound, prepared substrate.
- Do not add additional water during the surface finishing as this will cause discolouration and cracking.

10 YIELD AND CONSUMPTION

The yield of a product can be determined from the following equation (assuming no wastage).

$$\text{Equation:} \quad \text{yield (litres)} = \frac{\text{weight of powder (kg)} + \text{weight of water (kg)}}{\text{density of mixture (kg/l)}}$$

Given: weight of water 1 litre = ~1 kg

Example:

Calculate consumption of a bag weighing 20 kg mixed with 3.2 litres of water, when the density of the fresh material is 2.2 kg/l.

$$\text{1 bag of 20 kg yields:} \quad \frac{(20 + 3.2)}{2.2} = \sim \mathbf{10.5 \text{ litres of mortar}}$$

Therefore, the number of bags required for 1 m³ of mortar will be:

$$\begin{aligned} \text{N}^{\text{of}} \text{ bags required per 1m}^3 &= (1/\text{yield}) \times 1000 \\ &= (1/10.5) \times 1000 = \sim \mathbf{95 \text{ bags}} \end{aligned}$$

Consumption of a product can be calculated as follows:

Calculate how many kg of powder is required to cover a 25 mm thick application over an area 1 m² (assuming no wastage)

$$\begin{aligned} \text{Weight of mixed mortar (kg)} &= \text{volume (m}^3\text{)} \times \text{density (kg/m}^3\text{)} \\ &= (1 \text{ m}^2 \times 0.025 \text{ m}) \times 2200 \\ &= 55 \text{ kg of mixed mortar (total)} \end{aligned}$$

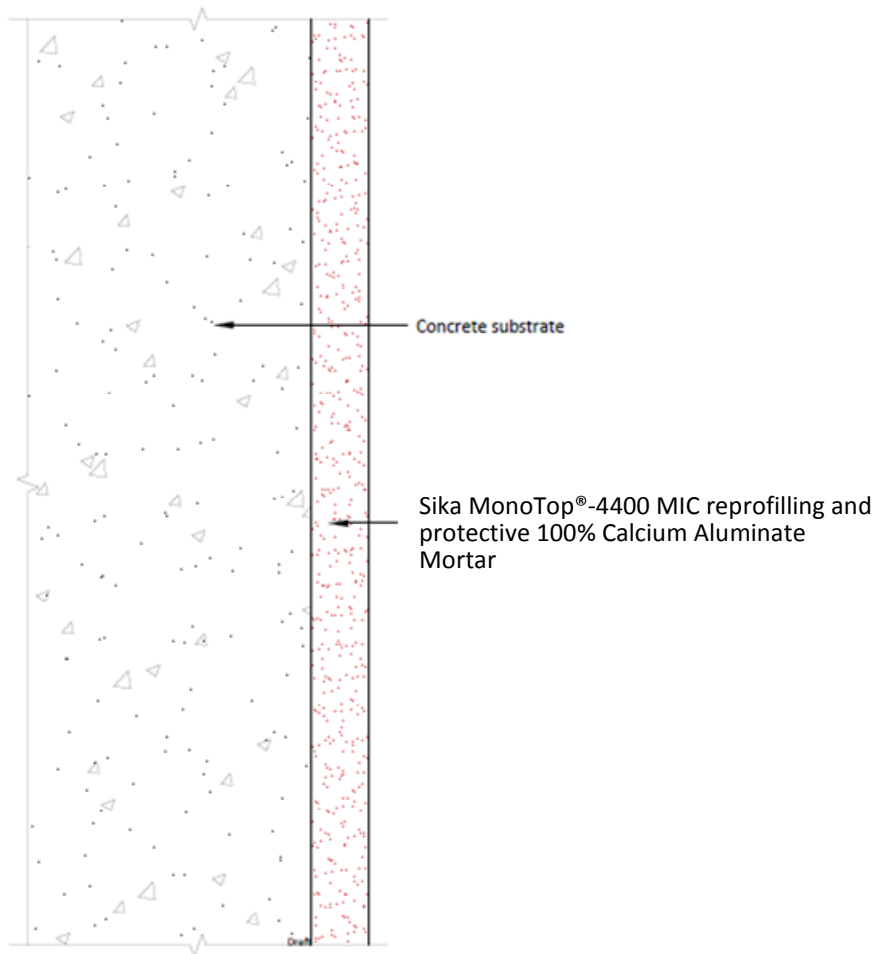
Less weight of water;

$$\begin{aligned} \text{If water to powder mixing ratio*} &= 16 \% \text{ then;} \\ \text{Required weight of powder} &= 55 / ((100+16)/100) \\ &= \sim \mathbf{47.4 \text{ kg powder}} \end{aligned}$$

* refer to PDS for exact figure

11 TYPICAL DRAWING SHOWING SYSTEM BUILD UP

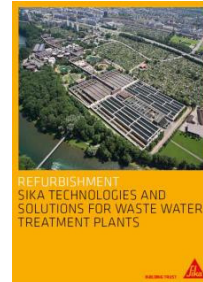
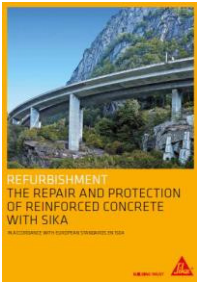
This detail is for illustration purposes only and shall not be used as a construction drawing.



12 LEGAL NOTE

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika's recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the products suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

FOR MORE Repairing Concrete Using Sika Ready to use Mortars INFORMATION:



13 KEY WORDS

Refurbishment, method, statement, process, sewer, collector, pumping station, sewerage, biogenic corrosion, MIC, microbial induced corrosion, Sika MonoTop, Sikagard, concrete, repair, damage, mechanical, spray, curing, pre-mix

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SIKA LTD
Watchmead
Welwyn
Garden City
AL7 1BQ
gbr.sika.com

Version given by
S Hardy
Mail : hardy.steven@uk.sika.com