



Mapegrout FMR



Shrinkage compensated sulphate-resistant thixotropic mortar, fibre-reinforced with flexible metal alloy fibres, particularly suitable for the repair of concrete structures where more workability is required

WHERE TO USE

Repair of damaged concrete structures on vertical or horizontal surfaces or on ceilings.

Some application examples

- Repairing deteriorated areas of concrete damaged by the oxidation of reinforcing rods.
- Reconstruction of reinforcing rod covers in reinforced concrete structures.
- Repairing surfaces subjected to heavy abrasion and impact (canals, industrial floors, ramps, etc.).
- Levelling diaphragm and tunnel walls.
- Repairing viaducts for highways, roads and railways.
- Repairing spillways.
- Repairing sewerage systems.

TECHNICAL CHARACTERISTICS

Mapegrout FMR is a ready-mixed powder composed of high-strength cements, selected aggregates, special admixtures and flexible metal fibres manufactured to a formula developed in the MAPEI research laboratories. The fibres are manufactured with corrosion resistant amorphous metal alloy of iron-chrome having the following properties:

- length/diameter ratio: 125
- length: 30 mm
- tensile strength: > 1,900 MPa

The metal fibres improve the mortar's flexural performance and considerably increase its resistance to impact.

Mapegrout FMR mixed with water becomes an easily workable highly thixotropic mortar, easy to apply on vertical and horizontal surfaces or on ceilings, even in thick layers without needing formwork.

When **Mapegrout FMR** is prepared by adding only

water, it must be cured in a damp environment in order to develop and fully exploit its expansive properties correctly. These conditions are difficult to obtain on site. Therefore, to guarantee its expansive properties, 0.25% of **Mapecure SRA** may be added to the **Mapegrout FMR** mix, in order to reduce the amount of plastic and hydraulic shrinkage.

Mapecure SRA plays a very important role by guaranteeing improved curing of the mortar. When mixed with **Mapegrout FMR**, it may also be considered a technologically advanced system, since the admixture has the capacity of reducing quick evaporation of the water in the blend and helps develop the hydration.

Mapecure SRA acts as an internal curing agent. With its interaction with some of the main components of cement, final shrinkage is reduced by 20-50% compared with the normal shrinkage of the product without admix. This reduces the potential formation of cracks.

Once hardened, **Mapegrout FMR** has the following properties:

- Very high flexural and compressive strength.
- Coefficient of thermal expansion and permeability to water vapour similar to those of high quality concrete.
- Waterproof.
- Excellent adhesion to old concrete, provided that it has been saturated with water beforehand, and also to reinforcing rods, especially when they have been treated with **Mapefer** or **Mapefer 1K**.

Mapegrout FMR meets the requirements defined by EN 1504-9 (*"Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - General principles for the use of products*

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and systems”) and the minimum requirements claimed by EN 1504-3 (“*Structural and non structural repair*”) for structural mortars of class R4.

The expansion of **Mapegrout FMR**, as that of all the products of the **Mapegrout** line, has been calculated to compensate for hygrometric shrinkage. To be effective, the substrate needs to be well abraded. This is a necessary condition because, due to high bonding properties and content of fibres, an internal constraint will be generated in the mortar which will be like that found in concrete by pre-compression. Because of this effect, **Mapegrout FMR** can be used without using a reinforcing metal mesh (which is necessary when using normal repair mortars) even if the thickness of the concrete that needs repair is high.

RECOMMENDATIONS

- Do not use **Mapegrout FMR** on smooth concrete surfaces: abrade them well.
- Do not add water to a mix that has already began to set.
- Do not use **Mapegrout FMR** at temperatures below +5°C.
- Do not use **Mapegrout FMR** if the packaging has been damaged or has been opened beforehand.
- Do not add cement or admixtures to **Mapegrout FMR**.
- Do not use **Mapegrout FMR** to repair structures by pouring into formwork (use **Mapegrout Hi-Flow**).
- Do not use **Mapegrout FMR** for anchoring (use **Mapefill**).

APPLICATION PROCEDURE

Preparing the substrate

Remove deteriorated and loose concrete until the substrate is sound, strong and roughed by at least 5 mm. Any previous repairs that are not fully bonded to the substrate should be removed.

Clean the concrete and reinforcing rods until free of dust, rust, cement, laitance,

grease, oils and previously applied paints, by sand-blasting.

After cleaning, treat the reinforcing rods with **Mapefer** or **Mapefer 1K**, corrosion-inhibiting cement mortars, following the application procedure described in the relevant technical data sheets. When **Mapefer** or **Mapefer 1K** has dried completely then soak the substrate with water.

Wait for the excess water to evaporate before applying **Mapegrout FMR**. To facilitate the elimination of free water, use compressed air.

Preparing the mortar

- Pour into the mixer the amount of water needed to obtain the consistency required for the application (17-18% of the amount of powder).
- Start the mixer and slowly add **Mapegrout FMR** to the water in a continuous flow.
- If curing of the mortar needs to be improved, add 0.25% by weight of **Mapecure SRA** (0.25 kg per 100 kg of **Mapegrout FMR**).
- Mix for 1 to 2 minutes, then check to make sure the mix is well blended. Scrape any unmixed powder from the bottom and sides of the mixer. Mix again for another 2 to 3 minutes.
- Depending on the amount needed, a mortar mixer or a drill fitted with an agitator attachment may also be used. Mix at low speed to avoid air entrainment.
- Avoid mixing manually unless absolutely necessary. If so, mix small amounts at a time for at least 5 to 6 minutes until a completely homogenous paste is obtained. Mixing by hand requires a larger amount of water. This adversely affects several of the mortar’s properties, including mechanical strength, shrinkage, watertightness, etc. **Mapegrout FMR** remains workable for approximately 60 minutes at +20°C.

Applying the mortar

The grout can be applied with a trowel or sprayed using a piston sprayer e.g. Turbosol or Putzmeister (except continuous-mixing type rendering pumps) without formwork even on vertical surfaces or soffits. The maximum thickness per coat must not be more than 50 mm. If a second coat of **Mapegrout FMR** is required, it must be applied before the previous one has completely set. If it has to be applied on a layer which has already hardened, we recommend that the surface of the first layer is left rough and that the substrate is dampened with water.

The mortar can be finished with a wooden or plastic tamper once it has hardened. If a further protective finish is required, remove any fibres that cover the surface with a flat trowel and clean with high pressure water jets before finishing.

PRECAUTIONS TO BE TAKEN DURING AND AFTER APPLICATION

- When preparing the mix, only use bags of **Mapegrout FMR** that have been stored closed on original pallets.



A detail of a concrete surface during repair

TECHNICAL DATA (typical values)

PRODUCT IDENTITY

Class according to EN 1504-3:	R4
Type:	CC
Consistency:	powder
Colour:	grey
Bulk density (kg/m³):	1,350
Maximum aggregate size (mm):	2.5
Dry solids content (%):	100
Chloride ions content: – minimum requirements $\leq 0.05\%$ - according to EN 1015-17 (%):	≤ 0.05

PRODUCT APPLICATION DATA (at +20°C - 50% R.H.)

Colour of mix:	grey
Mixing ratio:	100 parts of Mapegrout FMR with 17-18 parts water (approx. 4.25-4.5 l per 25 kg bag)
Consistency of mix:	plastic-thixotropic
Density of mix (kg/m³):	2,200
pH of mix:	> 12.5
Application temperature range:	from +5°C to +35°C
Pot life of mix:	approx. 1 hour
Waiting time between one layer and the next:	max 1-2 hours

FINAL PERFORMANCE (with 17% mixing water)

Performance characteristic	Test method	Requirements according to EN 1504-3 Standards for R4 class mortar	Performance of product
Compressive strength (MPa):	EN 12190	≥ 45 (after 28 days)	> 20 (after 1 day) > 50 (after 7 days) > 64 (after 28 days)
Flexural strength (MPa):	EN 196/1	not required	8 (after 1 day) 9 (after 7 days) 11 (after 28 days)
Modulus of elasticity in compression (GPa):	EN 13412	≥ 20 (after 28 days)	27 (after 28 days)
Bond strength to concrete (MC 0.40 - type substrate water/cement ratio = 0.40) according to EN 1766 (MPa):	EN 1542	≥ 2 (after 28 days)	> 2 (after 28 days)
Impeded expansion ($\mu\text{m/m}$):	UNI 8147 A method	not required	400 after 1 day
Crack resistance:	"O Ring Test"	not required	no cracks after 180 days
Resistance to accelerated carbonation:	EN 13295	depth of carbonation \leq reference concrete (MC 0.45 type with water/cement ratio = 0.45) according to UNI 1766	test passed
Impermeability to water – penetration depth - (mm):	EN 12390/8	not required	< 5
Capillary absorption (kg/m²·h^{0.5}):	EN 13057	≤ 0.5	< 0.08
Slip resistance of steel rods - bonding stress - (MPa):	RILEM-CEB-FIP RC6-78	not required	> 25
Bond strength measured according to EN 1542 (MPa): – freeze-thaw cycles with deicing salt immersion: – storm cycling: – dry cycling:	EN 13687/1 EN 13687/2 EN 13687/4	≥ 2 (after 50 cycles) ≥ 2 (after 30 cycles) ≥ 2 (after 30 cycles)	> 2 > 2 > 2
Reaction to fire:	EN 13501-1	Euroclass	A1

Note: due to the presence of metallic fibres within the mix it is important to pay particular attention when preparing the samples for flexural strength determination in order to ensure that these fibres are evenly and homogeneously distributed throughout the matrix to achieve reliable and consistent results.

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- During hot weather, store the product in a cool place and only use cold water when preparing the mix.
- During cold weather, protect the product from frost at a temperature of +20°C and use lukewarm water when preparing the mix.
- After applying **Mapegrout FMR**, we recommend that it is cured carefully to avoid rapid evaporation of the mixing water causing surface cracks due to plastic shrinkage, especially in hot, windy weather. Spray water on the surface 8-12 hours after applying the mortar and repeat this process every 3-4 hours for at least the first 48 hours. As an alternative, after tamping the mortar, apply a coat of either **Mapecure E** anti-evaporation agent with a low pressure pump, **Mapecure S** solvent-based curing film for mortar and concrete or **Elastocolor Primer** solvent-based, high penetration sealing base for absorbent substrates and curing agent for repair mortar. As with all top quality products in this category, **Mapecure E** and **Mapecure S** impedes bonding of successive layers. Therefore, if a smoothing compound or paint is to be applied later, they must be completely removed beforehand by sandblasting. If **Elastocolor Primer** is used to reduce evaporation, a final protective layer of **Elastocolor Paint** or **Elastocolor Rasante** may be applied directly on the treated surface without removing it.

Cleaning

Mortar that has not hardened can be removed from tools with water. After setting, cleaning is very difficult and can only be carried out mechanically.

CONSUMPTION

19 kg/m² per cm of thickness.

PACKAGING

Mapegrout FMR is available in 25 bags.

STORAGE

Mapegrout FMR may be stored for up to 12 months in its original packaging. The product is available in special 25 kg vacuum-packed polyethylene bags which

may be stored outside for the entire construction phase of the site. Rain has no effect on its characteristics.

The product complies with the conditions of Annex XVII to Regulation (EC) N° 1907/2006 (REACH), item 47.

SAFETY INSTRUCTIONS FOR PREPARATION AND APPLICATION

Mapegrout FMR contains cement that when in contact with sweat or other body fluids causes irritant alkaline reaction and allergic reactions to those predisposed. It can cause damage to eyes.

In case of contact with eyes or skin wash immediately with plenty of water and seek medical attention.

It is recommended to wear protective gloves and goggles and to take the visual precautions when handling chemical products.

For further and complete information about the safe use of our product please refer to the latest version of our Material Safety Data Sheet.

PRODUCT FOR PROFESSIONAL USE.

WARNING

Although the technical details and recommendations contained in this product data sheet correspond to the best of our knowledge and experience, all the above information must, in every case, be taken as merely indicative and subject to confirmation after long-term practical application; for this reason, anyone who intends to use the product must ensure beforehand that it is suitable for the envisaged application. In every case, the user alone is fully responsible for any consequences deriving from the use of the product.

Please refer to the current version of the **Technical Data Sheet**, available from our website www.mapei.com

All relevant references for the product are available upon request and from www.mapei.com



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