

Mapeplast PT1

Air-entraining agent for concrete and cementitious mortars



DESCRIPTION

Air-entraining admixture for concrete and mortars exposed to freeze-thaw cycles.

WHERE TO USE

Mapeplast PT1 can be used effectively in the following ways:

- for producing durable concrete exposed to temperature changes around 0°C;
- for lean concrete mixes (with cement factor lower than 250 kg/m³) lacking fine aggregates, to be pumped;
- for concrete with lightweight aggregates, to improve cohesiveness of the mix, workability and placeability;
- for preparation of renders and masonry mortars, to improve thixotropy, plasticity, and bonding, as well as resistance to freeze-thaw cycles when applied to exteriors in cold weather.

Some application examples

- Hydraulic structures such as dams, canals, swimming pools, and reservoirs exposed to cold weather.
- Paving, floor slabs, tunnels, parking-lots exposed to rain and cold weather.
- Lightweight structural concrete panels and underlayments, etc.
- Insulating and thixotropic mortars.

TECHNICAL CHARACTERISTICS

The principal technical characteristics of cement-mixes with air-entraining agents are:

- resistance to freeze-thaw cycles;
- improved pumpability of lean concrete mixes lacking fine aggregates;
- reduced segregation in concrete with lightweight aggregates.

Production of mortar and concrete containing **Mapeplast PT1** is undoubtedly more important in the light of recent Italian (UNI 9858) and European technical standards (ENV 206) which specify entrainment of a certain amount of air volume in concrete mixes for structures exposed to freezing and thawing (Classes 2b, 3, 4b).

Even mortars and concretes produced with a low water/cement ratio that resist chemical aggression (chlorides, sulphates, carbonation, etc.) are not capable of resisting stresses caused by alternating freezing and thawing cycles. In fact, the formation of ice, which occurs with an increase of volume of approx. 9%, causes stresses in mortars and concretes saturated with water, as in hydraulic structures or structures exposed to rain in general (parking-lots, airport runways, tunnels, etc.). In these cases, the most effective preventive measure for fatigue failure caused by freezing and thawing cycles – as per UNI 9858 and ENV 206 standards – is the entrainment of a minimum volume of air (Table 1) in the form of stable micro-bubbles with a diameter of 100-300 µm and a spacing of 100-300 µm (Fig. 1): under these conditions, when

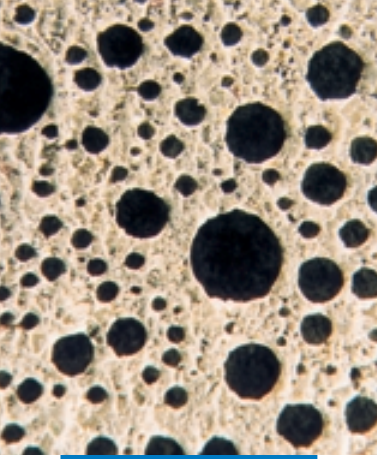


Fig. 1 - Section of cement paste with the addition of Mapeplast PT1 admixture: note the distribution of air micro-bubbles spread throughout the cement matrix

the first ice crystals form, the subsequent increase in volume drives the not yet frozen water into the adjacent micro-bubbles, decreasing internal stress. Because of capillary suction in the thawing phase, water rises from the micro-bubbles toward the pores of the cement paste, leaving the empty micro-bubbles ready to receive water in the freezing phase of the next natural thermic cycle.

Along with the improvement in performance due to protection against cracking caused by freezing and thawing, the entrainment of air causes, however, a weakening in strength of approx. 20%. When this is not compatible with the R_{ck} specified, the water/cement ratio must be reduced in order to restore strength to its original level and compensate for the loss in strength caused by the entrainment of air.

For this reason, **Mapeplast PT1** air-entraining admixture for producing concrete resistant to freezing and thawing should be used in conjunction with a plasticising admixture such as **Mapeplast**, **Mapemix** (versatile admix) or superplasticising **Mapefluid**, depending on the performance level required.

The “**Mapeplast PT1** Concrete Performance Chart” lists several examples of concrete resistant to freeze-thaw cycles with different levels of mechanical strength.

The addition of **Mapeplast PT1**, besides improving durability of concrete in structures exposed to freeze-thaw cycles, does not change the material's permeability to water despite the presence of entrained air. In fact, the air micro-bubbles form a system of discontinuous porosity (Fig.1), and therefore the flow of water under pressure remains determined by the continuous micro-porosity of the capillaries present in the cement paste surrounding the micro-bubbles.

When **Mapeplast PT1** is used in conjunction with one of the water-reducing admixtures of the **Mapeplast**, **Mapemix** or **Mapefluid** line, concrete acquires not only improved resistance to freezing but also better impermeability and increased strength.

As far as other technical characteristics are concerned, because of the development of spherical and deformable air micro-bubbles, **Mapeplast PT1** compensates for the lack of fine aggregates (100-300 μm) indispensable for pumping lean concretes with low cement factor. Moreover, air-entrainment in concrete with expanded clay aggregates or polystyrene reduces the tendency of the aggregates to “float” (segregation) since there is less difference in density between the aggregates and the cement mix, which has also become less dense. The result is greater cohesiveness in the mix and therefore greater uniformity of thermal insulating properties in lightweight concrete.

RECOMMENDATIONS

Do not use **Mapeplast PT1** without checking the volume of air entrained in the concrete with a porosimeter.

Do not use **Mapeplast PT1** in mixes that are too dry (with consistency class S1) because of the difficulty of entraining air under those conditions: the consistency class of the fresh concrete must be at least S2.

DIRECTIONS FOR USE

For producing concrete resistant to freezing and thawing, the dosage of **Mapeplast PT1** must be determined with preliminary evaluations at the batching plant using the same materials (cement, sand, coarse aggregates, etc.) used in the project in order to obtain the volume of air needed based on the maximum diameter of the aggregate (Table 1).

Generally, the dosage of **Mapeplast PT1** varies from 30 to 150 g per 100 kg of binder (cement plus, if needed, fly ash or silica fume). The exact dosage needed to obtain the specified volume of air in the concrete depends on the following parameters:

- shape of the aggregates (natural or crushed);
- gradation of the fine aggregates;
- workability of the mix;
- length of time and thoroughness of mixing;
- transport time;
- method of compacting.

It is recommended to add the **Mapeplast PT1** admixture along with the mixing water and mix thoroughly for a few minutes to facilitate entrainment of the desired air. The air-entraining action, which should be checked with the porosimeter, is much more effective when the concrete is fluid.

When super-plasticising admixtures are used such as **Mapefluid**, or silica fume based products such as **Mapefluid PZ500** or when fly-ash is used, it is necessary to calculate a slightly higher dosage of **Mapeplast PT1** to obtain the same volume of air as in a plain concrete (See “**Mapeplast PT1** Concrete Performance Chart”).

For producing thixotropic masonry mortars, and especially for renders, the recommended dosage of **Mapeplast PT1** is 0.1-0.3% by weight of binder (cement, lime, ash, etc.).

It is recommended to add **Mapeplast PT1** separately from other admixtures.

Compatibility with other products

Mapeplast PT1 is compatible with many other admixtures. Its use is especially recommended with one of the following water-reducers, depending on the level of performance required:

Mapeplast or **Mapemix** (for R_{ck} lower than 30 MPa) or **Mapefluid** (for R_{ck} higher than 30 MPa).

TECHNICAL DATA (typical values)

PRODUCT IDENTIFICATION

Consistency:	liquid
Colour:	brown
Specific gravity:	1.02 ± 0.02 kg/l at +20°C
Active ingredient:	5 ± 0.5%
pH:	10 ÷ 12
Specific action:	air-entraining
Collateral action:	plasticises, facilitates pumping, reduced bleeding
Classification:	ASTM C260
Chlorides:	absent
Storage:	12 months in original closed packaging. Protect from frost.
Hazard classification according to EEC 88/379:	none
Customs class:	3824 40 00

PERFORMANCE DATA OF MAPEPLAST PT1 IN CONCRETE *

Admixture dosages: Mapeplast PT1 (g/100 kg of cement)	-	75	75	100	100
Mapeplast N30 (%)	-	-	0.4	-	-
Mapefluid N200 (%)	-	-	-	1.0	-
Mapefluid IF328 (%)	-	-	-	-	1.5
Air volume (%):	2	6	6	6	6
Water/cement ratio:	0.60	0.57	0.54	0.47	0.42
Water reduction compared to concrete without admixture:	-	5	10	22	30
Workability:					
- initial slump (cm)	22	22	22	22	22
- slump after 30 min. (cm)	14	14	18	15	14
Compressive strength (MPa) after:					
- 1 day	8	6	9	12	16
- 3 days	16	12	15	24	27
- 7 days	24	20	25	30	39
- 28 days	35	29	34	42	49
Compressive strength (MPa) according to UNI 9858 and ENV 206:					
R_{ck} (Type A Control):	30	25	30	37	45
R_{ck} (Type B Control, δ = 5 MPa):	25	20	25	30	37
Water penetration (mm) according to DIN 1048 after 28 days of curing:	30	23	20	12	6
"Impermeability" to water according to UNI 9858 and ENV 206:	no	no	yes	yes	yes
Durability: environmental exposure for concrete according to UNI 9858 and ENV 206:	1	1	1	1	1
	2a	2a	2a, 2b	2a, 2b	2a, 2b
			3	3	3
			4a	4a, 4b	4a, 4b
			5a	5a, 5b	5a, 5b, 5c

* These data are average values obtained for concrete with 335 kg/m³ of cement CEM II/A-L 42.5R, with natural aggregates (max. diam.: 30 mm).

Tab. 1

Minimum volume percentage of air entrained in concrete according to ACI, UNI 9858 and ENV 206			
Maximum diameter of aggregate (mm)	Volume of air according to:		
	American standard ACI	Italian standard UNI 9858	European standard ENV 206
8	–	6	6
10	8	–	–
12.5	7	–	–
16	–	5	5
20	6	–	–
25	5	–	–
32	–	4	4
40	4.5	–	–
50	4	–	–
75	3.5	–	–
150	3	–	–

For curing concrete flatwork (floors or renders) it is recommended to immediately apply **Mapecure E** curing compound after placing the concrete containing **Mapeplast PT1**. For early stripping of concrete formwork (1-3 days), the curing compound must be applied immediately after stripping. Mapei's form-release agents **DMA 1000**, **DMA 2000** and **DMA 3000** are recommended.

DOSAGE

The dosage of **Mapeplast PT1** should be 30 to 150 g per 100 kg of binder.

Slightly higher dosages may be indicated for concrete containing fly-ash, silica fume, and superplasticising admixtures.

PACKAGING

Mapeplast PT1 is available in 200 l drums

and in 10 kg and 25 kg buckets. On request it can be supplied in 1000 l tanks or in bulk.

STORAGE

Store in closed containers; protect from frost and direct sunlight.

WARNING

N.B. Although the technical details and recommendations contained in this report 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 intending 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 use of the product.

