

# MAPEFLUID PZ500<sup>®</sup>

## SUPERPLASTICISER FOR CONCRETE WITH POZZOLANIC ACTION

### DESCRIPTION

Powder admixture with pozzolanic and superplasticising action for top quality special concrete.

### WHERE TO USE

MAPEFLUID PZ500 can be used effectively in two ways:

- for top quality concrete resistant to the most severe environmental aggression (for new construction or restoration of deteriorated structures);
- for concrete with special rheological properties that guarantee high thixotropy (cohesive at rest and plastic in motion) during placement.

### Typical applications

MAPEFLUID PZ500 can be used in several different areas:

- new construction: viaducts, bridges, pavements, parking garages, roads, highways, and airports exposed to de-icing salts in winter;
- major repairs to marine construction and highways decayed from aggression by sulfates and chlorides: dry docks, concrete slabs for highways, etc;
- underwater pours with high cohesion combined with high plasticity to protect fresh concrete from washout;
- high-quality shotcrete for tunnel walls; to obtain high thixotropy and bonding,

concrete with MAPEFLUID PZ500 does not require overly high dosages of set-accelerating admixtures which adversely affect the quality of the material used.

- **N.B. MAPEFLUID PZ500 is also available in the "PZ500X" version (formerly MAPEFLUID PZ X) for transporting superplasticised and non-segregable concrete over long distances and for long time-periods (30-120 minutes).**

### TECHNICAL CHARACTERISTICS

The characteristics of MAPEFLUID PZ500 are illustrated in the "Technical Data" table: MAPEFLUID PZ500 is a dark-coloured powder, consisting mostly of amorphous silica in the form of sub-micronic spherical granules (Fig 1). Their extremely small size (in great part less than 0.1  $\mu\text{m}$ ) allows the spherical granules of MAPEFLUID PZ500 to fill the gaps between the larger cement granules (0.1-100  $\mu\text{m}$ ). The result is a notably denser and more compact cement matrix (Fig. 2) which guarantees concrete with plasticity and cohesion when fresh, and impermeability and durability when hardened.

The properties of concrete with MAPEFLUID PZ500 are illustrated in the "Performance Data" Table. The fresh concrete features high thixotropic properties (viscosity at rest and plasticity in motion): the high cohesion of fresh concrete with MAPEFLUID PZ500 is proven by the absence of bleeding even in self-leveling concretes (slump > 220 mm).

Compared to conventional liquid superplasticisers, MAPEFLUID PZ500 greatly improves concrete performance in strength, impermeability and durability.

Fig. 3 shows the penetration of the three principal and most widespread aggressive agents (sulfate, chloride, carbon dioxide) for normal concrete



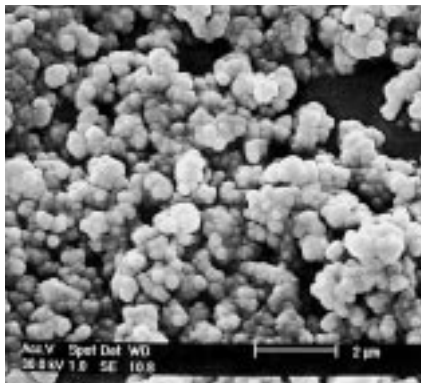


Fig. 1A - MAPEFLUID PZ500 as seen through a scanner electron microscope

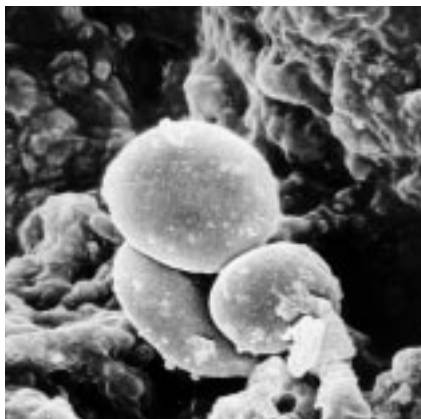
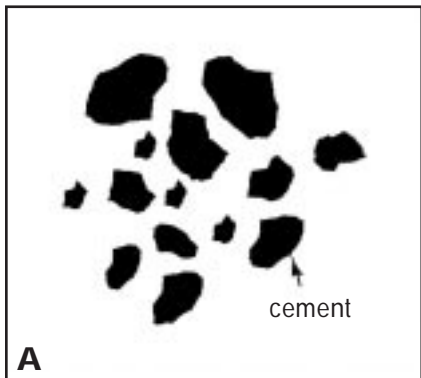


Fig. 1B - MAPEFLUID PZ500 granules in cement mix

### Cement granules



### Cement granules with MAPEFLUID PZ500

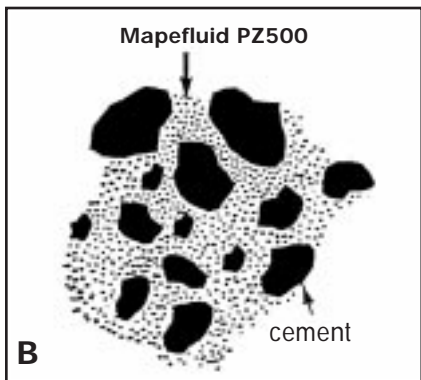


Fig. 2 - Because of their extremely small size, MAPEFLUID PZ500's spherical particles fill the gaps between larger cement granules; in the illustration, cement matrix without (A) and with (B) MAPEFLUID PZ500

Fig. 3 - The penetration of chloride (10% NaCl) sulphate (10%  $MgSO_4$ ) and carbon dioxide (30%  $CO_2$  in air) in concrete with 40 kg/m<sup>3</sup> of MAPEFLUID PZ500 (full line) and ordinary concrete with a w/c ratio of 0.6 (dotted line)

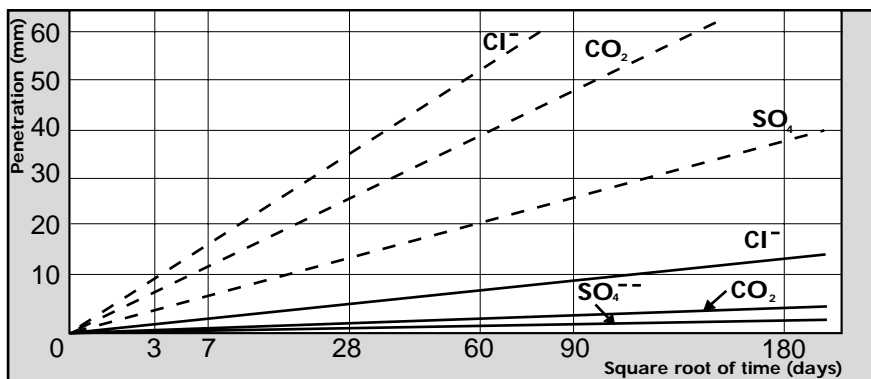


Fig. 4 - The effect of MAPEFLUID PZ500 on degradation caused by deicing salts based on  $CaCl_2$  (30% in water) at 5°C

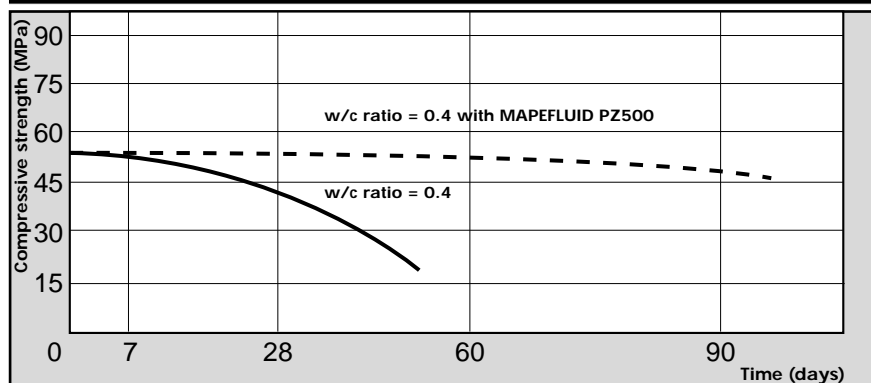


Fig. 5 - The effect of MAPEFLUID PZ500 on the expansion caused by the alkali - aggregate reaction on concrete specimens immersed in a 10% NaCl water solution

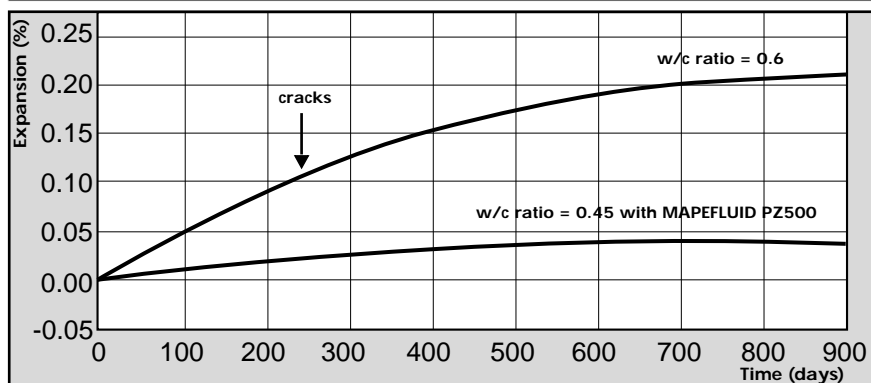
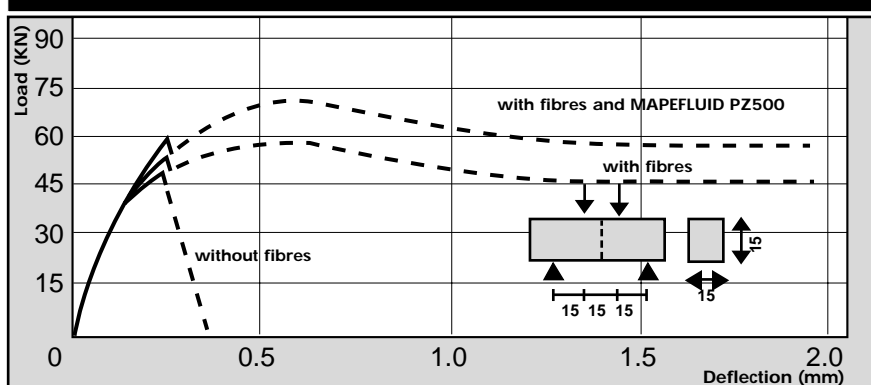


Fig. 6 - The effect of steel fibres and MAPEFLUID PZ500 on the load-deflection curve



( $R_{ck} = 25$  MPa) and for concrete admixed with MAPEFLUID PZ500 (40 kg/m<sup>3</sup>) with  $R_{ck}$  of 60 MPa under particularly severe conditions. Note the scarce penetration of the three aggressive agents in concrete with MAPEFLUID PZ500 even under especially severe conditions (at concentrations much higher than normal) simulated in the laboratory to accelerate test results.

Fig.4 illustrates the behaviour of concrete admixed with MAPEFLUID PZ500 (40 kg/m<sup>3</sup>) compared to a mix with the same compressive strength ( $R_{ck} = 50$  MPa), when both are placed in permanent contact with a saline solution of 30% calcium chloride used as a deicing salt in winter to melt ice already formed. Concrete with MAPEFLUID PZ500 undergoes no mechanical deterioration.

Fig. 5, shows how MAPEFLUID PZ500 counteracts deterioration caused by alkali-aggregate reaction: concrete with and without MAPEFLUID PZ500, both containing reactive aggregates, were kept in contact with an alkaline salt solution (10% NaCl) to simulate conditions in roads, highways, airports and public works exposed in winter to this salt treatment that prevents ice formation. Without MAPEFLUID PZ500, the co-existence of reactive aggregates and alkali (sodium) causes excessive cracks and expansion in the concrete.

MAPEFLUID PZ500 combined with air-entraining agent MAPEPLAST PT1 that generates air micro-bubbles (4-6% by volume) permits preparation of top-quality concrete with the latest technology. The result is concrete that is:

- self-levelling and easy to place;
- cohesive, without segregation and bleeding;
- high-strength;
- impermeable to water;
- resistant to aggression of sulfates, chlorides, alkalis and carbon dioxide;
- resistant to freeze-thaw cycles as required by UNI 9858 and ENV 206;
- protects against corrosion caused by reinforcing bars;

The combination of MAPEFLUID PZ500 with metallic fibres is particularly interesting in terms of performance as well as application; the addition of MAPEFLUID PZ500 to a concrete mix with steel fibres makes for easy pumping of fibre-reinforced concrete because it is possible to plasticise the mix without causing separation of the fibres from the cement matrix (as occurs with liquid superplasticisers).

In shotcrete reinforced with steel fibres, the cohesion of the mix with MAPEFLUID PZ500 greatly reduces or prevents metallic fibres from deflecting off walls sprayed with shotcrete. From the point of view of performance, the load-deflection curve for the fibre-reinforced concrete is improved: the material's maximum bearable load is increased, as is the area subtended by the curve, which is proportionate to the tenacity of the material (fig. 6).

## TECHNICAL DATA:

<b>PRODUCT IDENTIFICATION</b>	
Consistency:	powder
Colour:	dark gray
Specific gravity:	0.6-0.8 kg/lit
Specific action:	pozzolanic
Collateral action:	filler and super-plasticiser
Dry solids:	100%
Chlorides:	no
Classification:	type F acc. to ASTM C-494
Storage:	12 months a dry place in original unopened packaging.
Health hazard sec. 88/379 EEC:	no. The cement content of the product may however cause irritation to the eyes and skin. For further information consult the safety data sheet.
Inflammability:	no
Customs class:	3824 40 00

## PERFORMANCE DATA OF MAPEFLUID PZ500 IN CONCRETE (\*)

Admixture dosage (kg/m <sup>3</sup> ):	0	20	40	60
Water/cement ratio:	0.60	0.50	0.40	0.35
Water reduction compared to concrete without admixture (%):	–	17	33	42
Workability:				
– initial slump (cm)	22	23	24	24
– slump after 30 min. (cm)	16	16	19	20
Compressive strength (MPa) after:				
1 day	8	15	20	25
3 days	15	30	35	45
7 days	25	45	55	60
28 days	35	55	70	80
Compressive strength (MPa) according to UNI 9858 and ENV 206:				
$R_{ck}$ (Control Type A)	30	50	60	60
$R_{ck}$ (Control Type B, $\delta = 5$ MPa)	25	45	60	60
Water penetration (mm) according to DIN 1048 after 28 days of curing:	30	10	5	2
Impermeability to water according to UNI 9858 and ENV 206:	no	yes	yes	yes
Durability: environmental exposure classes of concrete according to UNI 9858 and ENV 206:	1 2a	1 2a, 2b 3 4a, 4b 5a, 5b	1 2a, 2b 3 4a, 4b 5a, 5b, 5c	1 2a, 2b 3 4a, 4b 5a, 5b, 5c

(\*) These data are average values obtained for concrete with 320 kg/m<sup>3</sup> of high-strength Class-425 Portland cement with natural aggregates (max. diam.: 20 mm). For environmental exposure classes 2b, 3 and 4b, air in the form of micro-bubbles must be entrained in a proportion of 5% by volume.





Casting a watertight foundation bed with concrete prepared with MAPEFLUID PZ500 admixture



Detail of casting of foundation bed with superfluid concrete admixed with MAPEFLUID PZ500

## DIRECTIONS FOR USE

MAPEFLUID PZ500 should be added into the cement mixer together with the other ingredients for concrete (cement, aggregates and water) from 20 to 60 kg/m<sup>3</sup> according to the concrete to be produced. To obtain maximum product performance it is necessary to disperse the grains composing MAPEFLUID PZ500 as much as possible. The paste should be mixed for at least 5 minutes.

Also, MAPEFLUID PZ500 must be added to semi-fluid concrete (S<sub>3</sub>) for shotcrete and super-fluid (S<sub>5</sub>) for normal pours. If the amount of MAPEFLUID PZ500 and the water/cement ratio do not achieve the required fluidity, workability can be increased with the addition of superplasticising liquid admixtures (MAPEFLUID N200, R104, IF328, M318) without adding more water.

## RECOMMENDATIONS

- do not use MAPEFLUID PZ500 for concrete with a relatively low

consistency class (S<sub>1</sub> and S<sub>2</sub>): the micro-silica granules might not disperse properly and a homogeneous concrete might not be obtained.

- do not use MAPEFLUID PZ500 for concrete which has not been mixed sufficiently: at least 1 minute in vertical mixers and at least 5 minutes in job-site or truck-mixers.

## Compatibility with other products

MAPEFLUID PZ500 contains an amount of active superplasticising polymers; however, in certain cases it can be useful to combine MAPEFLUID PZ500 with other liquid superplasticisers of the MAPEFLUID line to reduce mixing water further in superplasticised concretes (consistency class S<sub>5</sub>).

MAPEFLUID PZ500 combined with air-entraining agent MAPEPLAST PT1 produces concrete resistant to freeze-thaw cycles.

MAPEFLUID PZ500 can be used with Mapei expansive agent "Admixture AR" to produce high-quality shrinkage compensated concrete for impermeability and durability.

MAPEFLUID PZ500 can be used effectively with steel fibres to produce non-segregable fibre-reinforced pumpable concrete, and shotcrete which bonds better when hardened.

For curing concrete flatwork admixed with MAPEFLUID PZ500, Mapei's MAPECURE E curing compound is recommended.

For stripping formwork with concrete produced with MAPEFLUID PZ500, Mapei's DMA 1000 or DMA 2000 FORM-RELEASE AGENTS may be used.

## DOSAGE

MAPEFLUID PZ500 should be used in dosages from 20 to 60 kg per m<sup>3</sup> of

concrete according to the level of performance required. In general, for impermeability, durability and high strength in top quality concrete, 40 kg/m<sup>3</sup> of MAPEFLUID PZ500 with 350 kg/m<sup>3</sup> of class 425 cement are required.

The dosage may be varied, keeping in mind that 1 kg of MAPEFLUID PZ500 can substituted for 3 kg of cement. Lower dosages (20-30 kg/m<sup>3</sup>) can be sufficient for preparing shotcrete.

## PACKAGING

MAPEFLUID is available in 11 kg bags. It is available in larger bags on request.

## STORAGE

Store in closed containers; protect from extreme temperatures and damp.

## 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.*

**N.B. FOR PROFESSIONAL USE ONLY**

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