MAPE C-C

From Cement to Concrete

C-ADD MAPEI
CEMENT ADDITIVES DIVISION

The **Cement Industry**

The cement industry is facing a radical change in the external scenario: on the one hand, **public authorities** are pushing companies to adopt an **environmentally sustainable approach** (CO_2 reduction, circular economy, etc.) in order to comply with environmental regulations; on the other hand, **customers** (concrete producers, construction companies, public sector clients) are starting to make the same demands, driven likewise by the same regulatory and environmental obligations. The old concept of "saving clinker and energy" to lower production costs (and be competitive) is no longer the main driver causing the change we are witnessing in the cement industry; producing a cement of excellent quality and durability at the lowest possible cost is no longer sufficient in the current scenario. To summarize, it can be said that **the cement industry needs to overcome the public perception of being a high environmental impact sector**.

The **cement industry**'s response is twofold: on the one hand, transforming itself into a **zero-emission** and **energy-balance-neutral industry**, and on the other hand, a radical change in the product portfolio, **removing the most clinker-rich cements from the market**. It is precisely this second aspect that **Mapei** is addressing with the **MAPE C-C technology**.

MAPE C-C from Cement to Concrete

The innovative family of **Process Additives** (i.e., added during cement grinding) **MAPE C-C** represents a major step forward in the production and use of the **new "Low Clinker" cements**. The new cements (standardized in Europe according to EN 197-5) are nothing more than cements with different compositions from traditional cements and containing **high percentages of secondary constituents** such as pozzolan, calcined clays, limestone, ash and slag; these will be joined by other cements with **truly recycled materials**, such as old concrete and bricks from the demolition of buildings and structures. Even with the appropriate differences, the addition to cements of materials other than clinker in high percentages leads to a **deterioration of the classical performance** of the cement itself, in terms of:

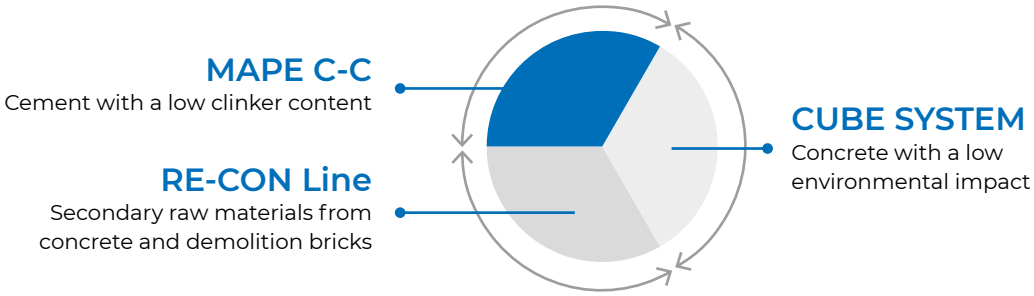
- mechanical strengths;
- water demand;
- workability time.

MAPE C-Cs enable the cement industry to **produce** the new cements with low clinker content because they **increase mechanical strengths** by ensuring that the cements are up to standard, and they enable the concrete industry to use the new cements because they **ensure proper water demand** and **workability**. **MAPE C-C**s form the link between the new **low-clinker** cements and the subsequent low-impact concretes, for which **Mapei** has developed the **CUBE SYSTEM** concrete admixture technology.

MAPE C-C
From **Cement** to **Concrete**

Mapei's integrated approach to the sustainability of the Cement-Concrete-Aggregates supply chain

In the future **low-impact construction industry**, **Mapei** fits in with **two families of products** that connect in a circular mechanism of process technology admixtures: with **MAPE C-C**s, low-clinker but high-performance cements are produced, which will then be used in sustainable, high-performance concrete thanks to **CUBE SYSTEM** admixtures, which will later be recycled as secondary raw materials in future highly sustainable cements and/or concretes thanks to the **Mapei RE-CON** product **line**.
A **perfectly circular mechanism** is thus created in which virgin raw materials are minimized and, in any case, prospectively reused to produce new cements and concretes, in which **Mapei admixtures** play a key role in the entire cement-concrete-inerts chain. It can be summarized by saying that **modern process additives are indispensable for producing sustainable building materials**.



The admixtures in the **MAPE C-C** family are **process additives** added during the **cement grinding stage** composed of selected organic and inorganic raw materials, some of which were developed and patented by **Mapei research laboratories**.
MAPE C-C admixtures encompass three main functions in a single formulation.

- Reduction of water demand and maintenance of workability, visible in both cement mortar and concrete.
- Strength enhancement (chemical activation of cement constituents).
- Grinding aid (like traditional grinding aids, for which they are substitutes).

The first effect is achieved using a special category of **acrylic polymers**, specially developed by the **Mapei laboratories**, which **withstand the temperatures and mechanical stresses** typical of the cement grinding process in ball mills or vertical mills; It should be noted, however, that the acrylic polymers used in most concrete admixtures would deteriorate during the cement grinding process, losing much of their effectiveness.
The polymers contained in **MAPE C-C** keep their characteristics intact during the industrial cement grinding stage, remaining in the finished product, preparing it for subsequent admixture addition in concrete. It should also be noted that **MAPE C-C** are still **compatible with all traditional concrete admixtures** on the market, which can be used normally, although **the best final performance** is obtained in combination with **admixtures from the CUBE SYSTEM range**.
The second and third effects (strength enhancement and grinding aid) are obtained thanks to traditional raw materials added to the **MAPE C-C** formulation and not by the acrylic polymers which have the only effect of reducing the water demand and extending the workability.

Recommended Dosages: 800 – 2,000 g/t of cement to be ground.

Use of **MAPE C-C**

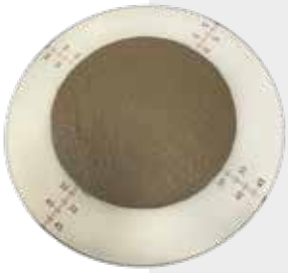
Use of MAPE C-Cs

In two cases, the use of **MAPE C-C**s is particularly effective compared with conventional admixtures.

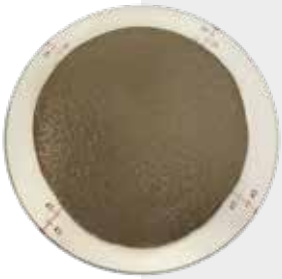
1. Cements that meet standard requirements in mortar (e.g., strengths at 0.5 water/cement ratio) but are disadvantaged in the market because they require too much water or lose workability quickly compared to traditionally used cements (e.g., limestone cements, CEM I, etc.).

2. Cements for which standards allow the water/cement ratio to be varied for determining strengths (e.g., ASTM standards on pozzolanic cements); in this case, **MAPE C-C**s allow the percentage of clinker to be greatly reduced while maintaining excellent mechanical strengths.

The following examples, taken from industrial applications, show the **typical performance** of **MAPE C-C**, keeping in mind that this is a family of products in which the formulations suggested by **Mapei** specialists must be adapted, based on the specific raw materials present in the cements to be treated.



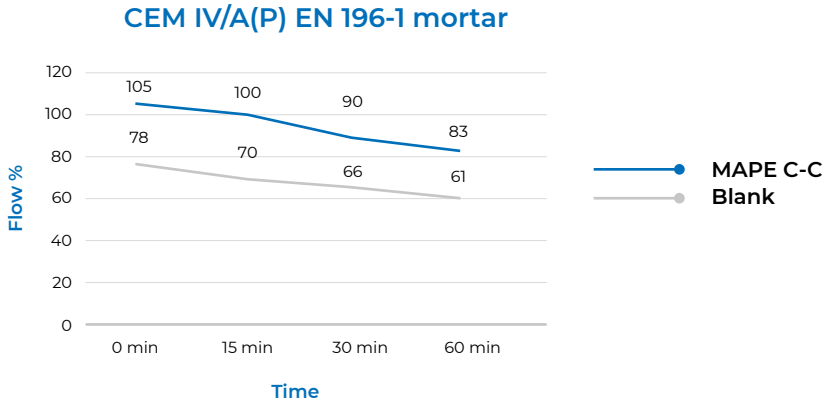
Blank
Mortar



Mortar
with MAPE C-C
at 0.16%

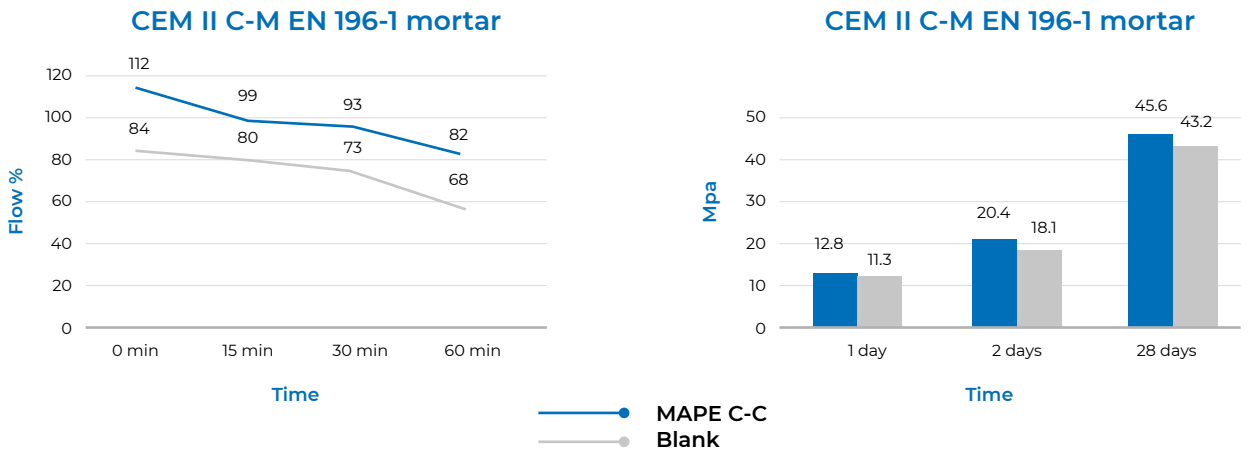
Examples of achievable performance

1.1 **CASE 1.1** - CEM IV/A(P) 42.5 N pozzolanic cement with low workability in mortar, in blank and admixed with **MAPE C-C 5005** at a dosage of 1.6 kg/t. Note that the flow at time 60 min of the admixed cement (83%) is still higher than the flow in the blank at time 0 min (78%). There were no significant changes in setting times.



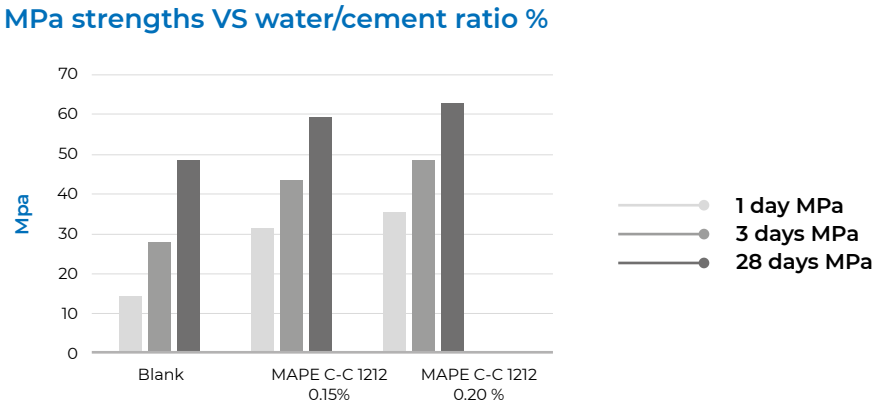
1.2

CASE 1.2 - CEM II C-M(S,P,L) pozzolanic cement according to EN 197-5 with 53% industrially ground clinker, blank and with 1.8 kg/t of **MAPE C-C 4044** at equal fineness, R32µm < 12%. Improved flow and mechanical strengths are required.



2.1

CASE 2.1 - Improvement of mechanical strengths according to ASTM on pozzolanic cement using **MAPE C-C 1212** and a strong reduction of water demand.



CEMENT CEM IV (P)						
BLANK	0.48	4.6	24.3	14.3	27.8	48.6
MAPE C-C 1212 0.15%	0.37	5.2	23.8	31.4	43.6	59.4
MAPE C-C 1212 0.20%	0.34	5.4	24.4	35.7	48.3	62.9
	water/cement ratio %	Air %	Flow cm	1 day MPa	3 days MPa	28 days MPa

In cases where standards allow (ASTM, Indian standards, etc.), the mechanical strengths of cements can be significantly increased using **MAPE C-C**s by reducing the water required to achieve the standard consistency; the resulting reductions in clinker are usually greater than those achievable when acting with incrementing additives at the same water-cement ratio.

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