MCH C-C:

From Cement to Concrete

C-ADD MAPEI
CEMENT ADDITIVES DIVISION

The **cement industry**

The cement industry is facing radical changes: Public authorities are pushing companies to adopt an environmentally sustainable approach (CO_2 reduction, circular economy, etc.) in order to comply with environmental regulations. Likewise, customers (concrete producers, construction companies, public sector clients) are starting to make the same demands, driven 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. Suddenly, producing a cement of excellent quality and durability at the lowest possible cost is no longer sufficient in the current marketplace. 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: Transforming itself into a zero-emission and energy-balance-neutral industry, while at the same time undergoing a radical change to standard product portfolios, 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 MCH C-C technology.

MCH C-C: From cement to concrete

An innovative family of Process Additives (which are added during cement grinding), MCH C-C represents a major step forward in the production and use of new "low-clinker" cements. The new cements (standardized in Europe according to EN 197-5) are nothing more than cements with different composition from traditional cements. The new cements contain 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 typical performance of the cement itself, in terms of:

- Mechanical strength.
- Water demand.
- Workability time.

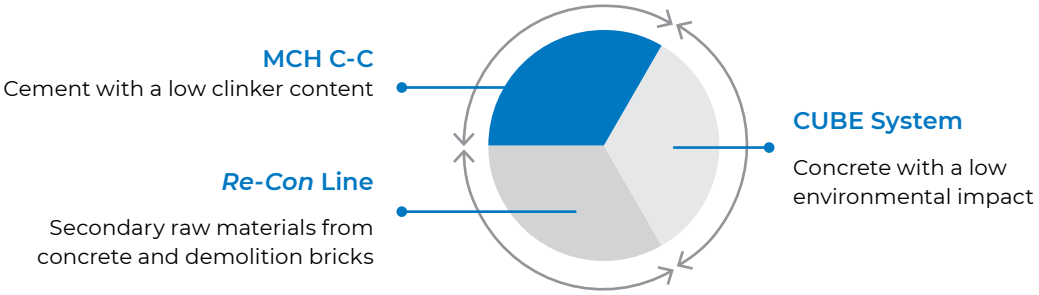
MCH C-C additives enable the cement industry to produce the new cements with low clinker content because they increase mechanical strength, ensuring that the cements are up to industry standards. The additives also ensure proper water demand and workability of the new cements. MCH C-C products form the link between the new low-clinker cements and the subsequent low-impact concretes, for which MAPEI has developed the CUBE System concrete admixture technology.

MCH 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 MCH C-Cs, 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* line of products.

A perfectly circular mechanism is thus created in which virgin raw materials are minimized and prospectively reused to produce new cements and concretes, in which MAPEI admixtures play a key role in the entire cement-concrete-inerts chain. In other words, modern process additives are indispensable for producing sustainable building materials.



The process additives in the MCH C-C family are added during the cement grinding stage and composed of select organic and inorganic raw materials, some of which were developed and patented by MAPEI research laboratories.

MCH C-C additives 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 function is achieved using a special category of acrylic polymers, specially developed by the MAPEI laboratories, that 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 MCH C-C keep their characteristics intact during the industrial cement grinding stage, remaining in the finished product and preparing it for subsequent admixture addition in concrete. It should also be noted that MCH C-C additives are compatible with all traditional concrete admixtures on the market and can be used normally, although the best final performance is obtained in combination with CUBE System admixtures.

The second and third functions (strength enhancement and grinding aid) are achieved due to the addition of traditional raw materials to the MCH C-C formulation and not from the acrylic polymers, which only have the effect of reducing water demand and extending workability.

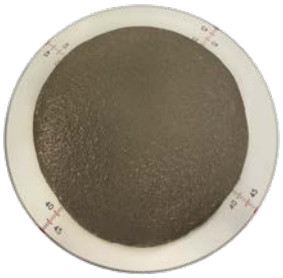
Recommended Dosages: 0.08% – 0.20%

Use of
MCH C-C additives

In two cases, the use of MCH C-C additives is particularly effective when compared to conventional admixtures:

1 Cements for which standards allow the water/cement ratio to be varied for determining strengths (such as ASTM standards for blended cements). In this case, MCH C-C additives allow the percentage of clinker to be greatly reduced while maintaining excellent mechanical strengths.

Control W/C = 0.51



With MCH C-C at 0.16% W/C = 0.51

With MCH C-C at 0.16% W/C = 0.46

2 Cements that meet standard requirements in mortar (such as strengths at a 0.5 water/cement ratio) but are disadvantaged in the market because they require too much water or lose workability quickly when compared to traditionally used cements (such as limestone cements and CEM I).

The following examples, taken from industrial applications, show the typical performance of MCH C-C additives. Depending on the type of cement, a unique formulation from the MCH C-C family of products will be recommended by MAPEI specialists based on the specific raw materials present in the cements to be treated.

Examples of achievable performance

1.1 **CASE 1.1** - Up to 10% clinker reduction keeping equal strength on T-IP. W/C ratio reduction according to ASTM C109 permitted such an outstanding achievement with MCH C-C 1001.

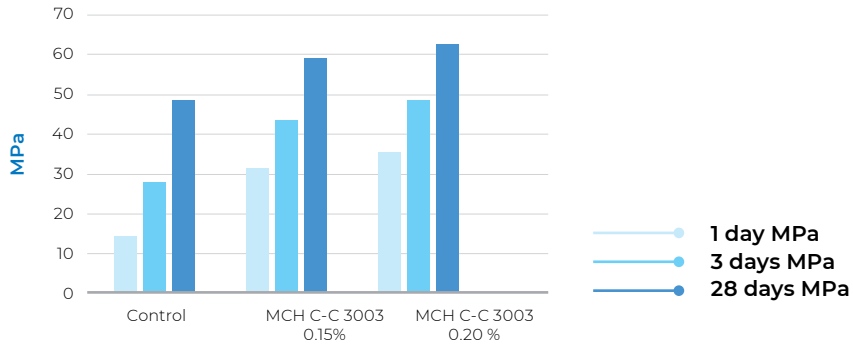
CEMENT T-IP						
CONTROL	0.48	109	77%	14.3	24.9	43.6
MCH C-C 1001 0.15%	0.40	111	70%	14.6	25.0	43.7
MCH C-C 1001 0.20%	0.38	112	67%	15.1	25.2	43.6
	W/C	Flow	Clinker	1D MPa	3D MPa	28D MPa

1.2

CASE 1.2 - Outstanding strength boost on ternary blended cement T-IT (L10)(P10) thanks to the use of MCH C-C 3003 at two different dosages. Clinker % remained the same in this case.

MPa strengths vs. water/cement ratio %

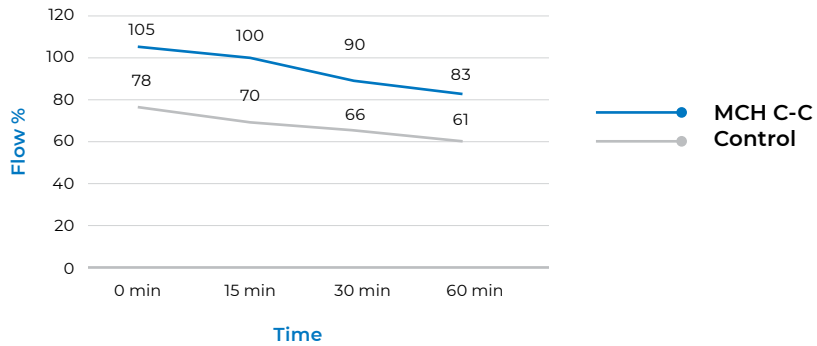
CEMENT T-IT						
CONTROL	0.49	111	76.3%	14.7	27.9	48.6
MCH C-C 3003 0.15%	0.41	113	76.3%	31.2	43.3	59.0
MCH C-C 3003 0.20%	0.39	109	76.3%	34.9	48.1	61.8
	W/C ratio	Flow	Clinker	1D MPa	3D MPa	28D MPa



2.1

CASE 2.1 - CEM IV/A(P) 42.5 N with poor workability in mortar, in control and admixed with MCH C-C 5005 at a dosage of 0.16%. Note that the flow at 60 minutes of the admixed cement (83%) is still higher than the flow in the control at 0 minutes (78%). There were no significant changes in setting times.

CEM IV/A(P) EN 196-1 mortar



The MCH C-C family is ASTM C465 certified, so it can be used as an organic process addition to any cement type and in particular for T-IP, T-IS and T-IT, for which ASTM C109 allows W/C ratio adjustment.

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