Buzzi Unicem

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# next

user manual

Hydraulic binder made with
Calcium Sulpho Aluminate clinker

Special Products

Buzzi Unicem

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## Contents

# Buzzi Unicem Next

## the line of binders made with Calcium Sulpho Aluminate

Buzzi Unicem identifies with the name **Next** a family of innovative binders made in Italy capable of opening a new frontier in the field of constructions and, specifically, of hydraulic binders with high performances.
The hardening of each one of these binders is mainly due to the hydration reaction of the Calcium Sulpho Aluminate (CSA), unlike Portland cements and aluminous cements for which hardening takes place following the hydration of Calcium Silicates and Calcium Aluminates.
**Next** binders are recommended in the pre-mix dry mortar and precast sectors, which require quick setting, fast development of strength, use at low temperatures, low shrinkage and resistance to sulphate attacks.


## 1.0 Sulpho aluminate clinker

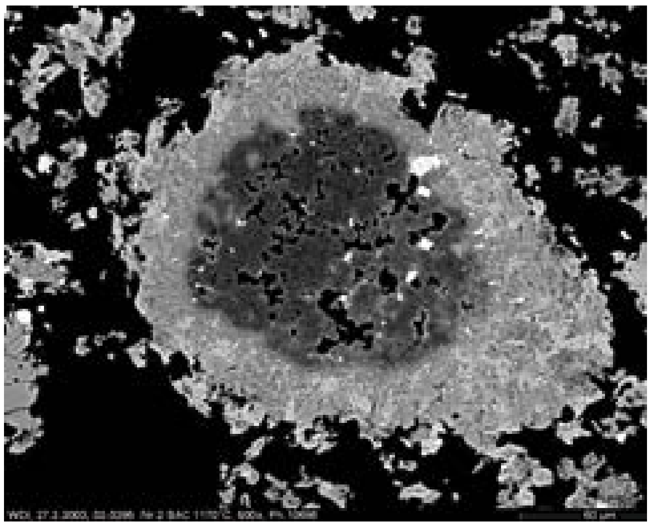
Calcium Sulpho Aluminate clinker is obtained by burning Bauxite, Gypsum and Limestone in an industrial rotating kiln at a temperature of approximately 1,300°C and by subsequently grinding it.

**Below is the composition of the raw materials:**

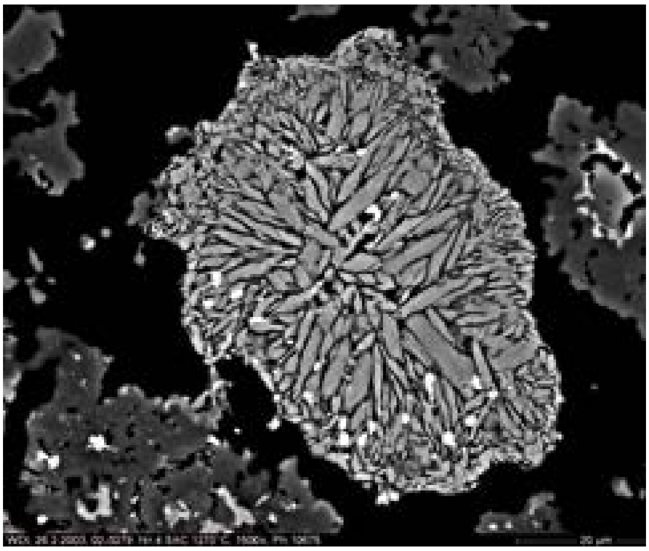
| | | |
|---|---|---|
| Limestone ≈ 30 % – 40 % | –> | main source of CaO |
| Bauxite ≈ 35 % – 45 % | –> | main source of $Al_2O_3$ , $Fe_2O_3$ and $SiO_2$ |
| Gypsum ≈ 20 % – 30 % | –> | main source of $CaSO_4$ |

The main mineralogical phase obtained from the burning process is Calcium Sulpho Aluminate:

**$4CaO + 3Al_2O_3 + SO_3$ –> $4CaO\ 3Al_2O_3\ SO_3$**
(Yeelimite)



Electron microscope scanning of one grain of Calcium Sulpho Aluminate observed during the formation phase at a temperature of approximately 150°C less than the optimal firing temperature. Three areas can be clearly observed: the dark internal area, rich in Aluminium Oxide ($Al_2O_3$), the lighter external area rich in Calcium Sulphate ($CaSO_4$), and the intermediate one in which the Calcium Sulpho Aluminate has already formed ($4CaO\ Al_2O_3\ SO_3$).



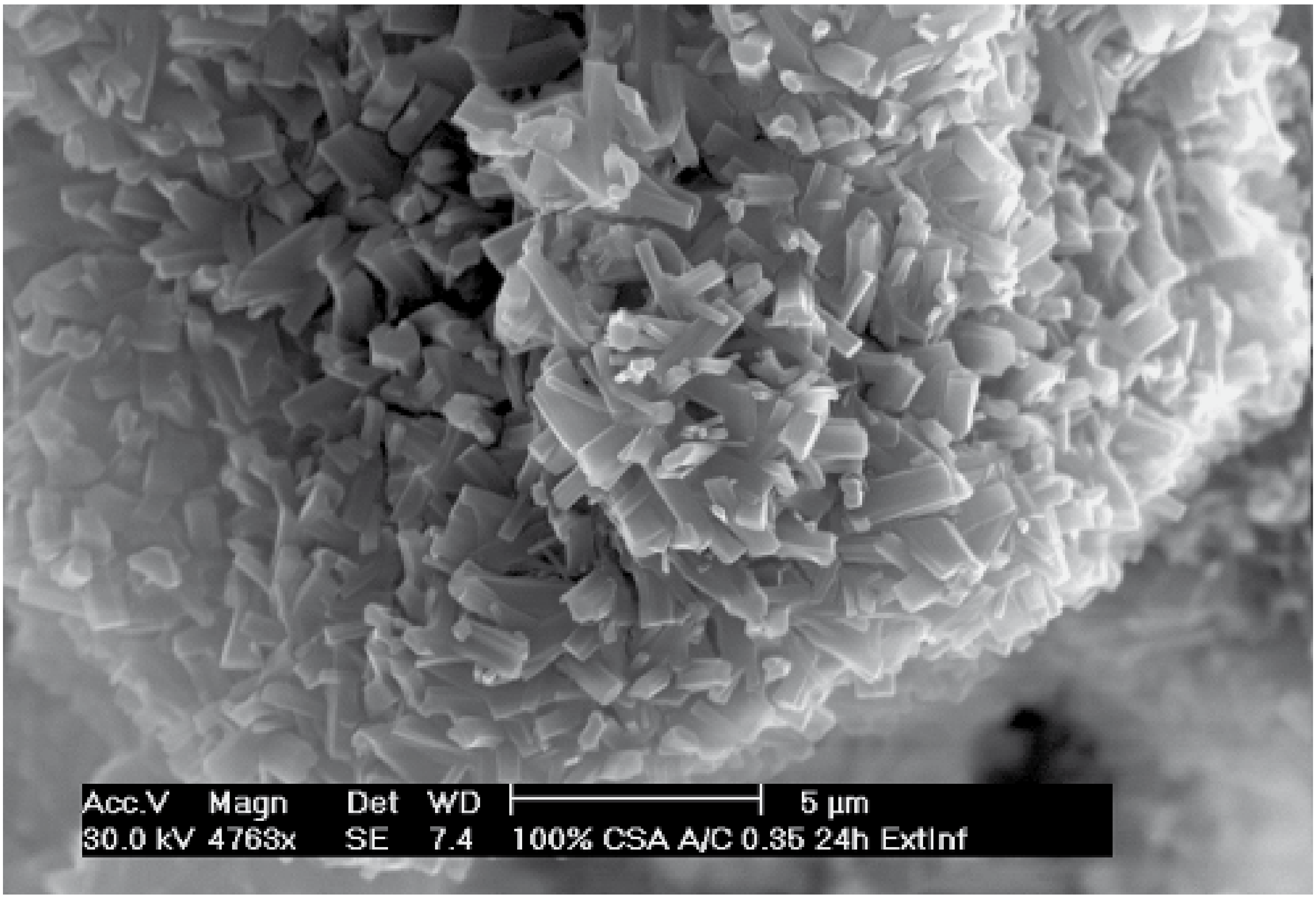
Belite Dicalcium Silicate crystal ($C_2S$) under electron microscope scanning; Belite represents the mineralogical phase which hydrates during long curing periods in CSA cement.

The hydration reaction of the Calcium Sulpho Aluminate leads to the quick formation of non-expansive Ettringite, Hydrate Monocalcium Sulpho Aluminate and, partially, amorphous Aluminium Hydroxide. In order for this reaction to fully develop, the presence of Calcium Sulphate is necessary, as indicated in the following formula:

$$C_4A_3\hat{S} + 2C\hat{S} + 38H \rightarrow C_6A\hat{S}_3H_{32} + 2AH_3 \quad (1)$$

Where:

| | |
|---|---|
| $C\hat{S}$ | Calcium Sulphate |
| $C_4A_3\hat{S}$ | Calcium Sulpho Aluminate |
| $C_6A\hat{S}_3H_{32}$ | Ettringite |
| $AH_3$ | Aluminium Hydroxide |
| H | water |




Scanning carried out on **Next base** using an electron microscope 24 hours after the hydration: it can be clearly observed that the crystals of non-expansive Ettringite with their typical prismatic shape whose reaction is described by formula (1).

At ordinary water/cement ratios (0.40 < w/c < 0.55), mortar and concrete prepared with CSA clinker show an extremely reduced capillarity together with a very fast drying of the hardened paste, as a result of the quick hydration reaction.
Moreover, it is interesting to note how the quick formation of Ettringite prismatic crystals (which take up approximately twice the space occupied by the CSA molecule that generates it) is responsible for the formation of a much less porous and more compact structure in short curing periods compared to the one produced by the Calcium Hydrate Silicate crystals (C-S-H) in ordinary Portland cements. In the long term, we can say that the microstructure of the two systems looks very similar.
The sulfoaluminate clinker made by Buzzi Unicem has the following average characteristics.

### Mineralogical composition

| | |
|---|---|
| $C_4A_3\hat{S}$ | > 52% |
| $C_2S$ | < 25% |
| $C\hat{S}$ | < 6% |

### Chemical analysis

| | |
|---|---|
| CaO | 40-46% |
| $Al_2O_3$ | 25-31% |
| $SiO_2$ | 8-12% |
| $SO_3$ | 7-12% |
| $Cl^-$ | < 0,1% |
| Cr VI | < 2.0 ppm |

| | |
|---|---|
| **Density** | 2,800 kg/m$^3$ |
| **Spec. surface Blaine** [ UNI EN 196-6 ] | 5,900 ± 500 cm$^2$/g |
| **Colour** | light grey |

## Differences between aluminous cements and **Next clinker**

The raw materials of both binders include bauxite which, when burned industrially, yields calcium aluminate compounds (mainly CA and $C_{12}A_7$) in aluminous cement and calcium sulpho aluminate in **Next clinker**. In the presence of water and calcium sulphate, both react quickly to form ettringite. Both binders can be used to accelerate Portland cements or to prepare quick-setting or low-shrinkage ternary products mixed with Portland cement and anhydrite. Below is a list of the main differences between the two binders, many of which are transferred to the formulations in which they are used.

**1.** **Next clinker** keeps longer than aluminous cements in both its original packaging or when added to other products without any significant loss of its performance characteristics with the passage of time.

**2.** **Next clinker**, is lighter grey in colour which persists over time, particularly in formulations mixed with cement, due to its lower iron content than aluminous cements.

**3.** **Next clinker** is burned at a lower temperature than aluminous cement, thus reducing environmental impact.

**4.** It should be pointed out that, unlike some categories of aluminous cements, **Next clinker** cannot be used as a binder in refractory materials.

# Environmental sustainability

Binders made with Calcium Sulpho Aluminate can be considered eco-sustainable for the following reasons:

- The production cycle is characterized by reduced $CO_2$ emissions in the environment for the low content of Calcium Carbonate among raw materials and for the lower fuel consumption during the firing phase.
- Compared to Portland cement, the energy impact is lower, since the temperatures reached in the kiln during meal firing are approximately 200°C less than the temperatures used for the production of regular Portland clinker.
- CSA clinker requires less grinding energy compared to Portland clinker.
- The following table can be used to compare $CO_2$ emissions in terms of m tons of $CO_2$ per m ton of binding product. The values are expressed as percentages with respect to Portland cement.

| | CEM I 42,5 R | Next base | Next binder |
|---|---|---|---|
| Emissions for calcination | 100% | 36% | 56% |
| Total emissions | 100% | 56% | 65% |

# 2.0 Next base

ETA13/0417

## 2.1 The characteristics

Buzzi Unicem indicates with the name of **Next base** a binder consisting of a mix of CSA clinker and Anhydrite at a ratio guaranteeing that all the $C_4A_3\hat{S}$ content, if hydrated, turns into non-expansive Ettringite.
Product performances are characterized by constant quality over time, a result of the fact that **Next base** is a product obtained through mixing. In fact, through the measured dosing of specific mineral admixtures, the natural variability of the raw material of which it is made up can be compensated. The properties thus obtained make it possible to use **Next base** both by itself as a fast binder and in ternary systems in order to obtain a high number of products characterized by low shrinkage and fast development of mechanical strength.

The average values of the physical and chemical characteristics of **Next base** are specified below.

| Major constituents of the hydraulic binder | |
|---|---|
| Clinker CSA | (81± 5)% |
| $CaSO_4$ | (19 ± 5)% |

| Major constituents of the hydraulic binder | |
|---|---|
| $C_4A_3\hat{S}$ | (45± 5)% |

**Major chemical constituents**

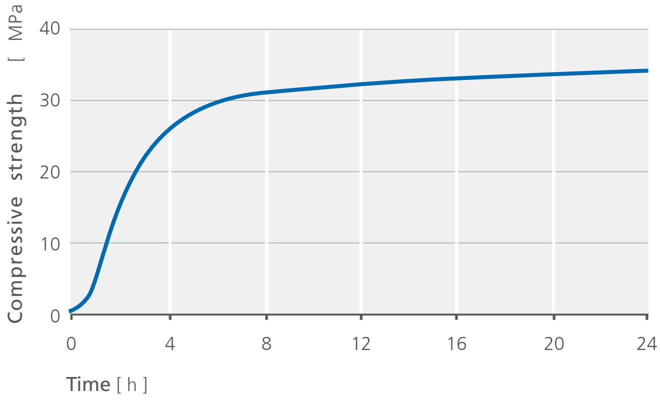
| | |
|---|---|
| CaO | 41-45% |
| $Al_2O_3$ | 22-26% |
| $SiO_2$ | 8-9% |
| $SO_3$ | 17-19% |
| $Cl^-$ | < 0,1% |
| Cr VI | < 2,0 ppm |

| | |
|---|---|
| **Density** | 2,800 kg/m³ |
| **Spec. surface Blaine** [ UNI EN 196-6 ] | > 4.000 cm²/g |
| **Colour** | light grey |

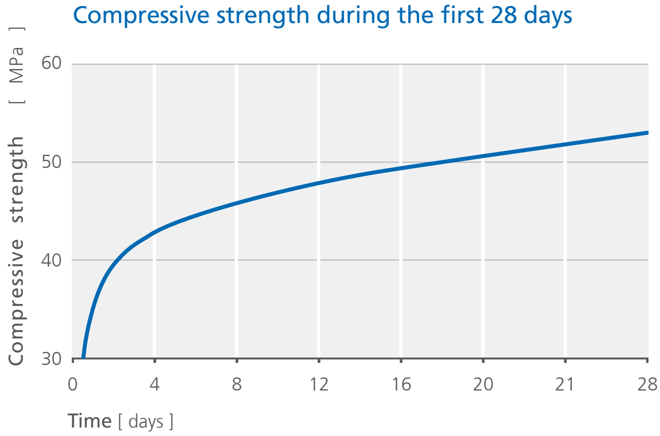
## Mechanical performances

Graphs that show the average development of strength of standard mortar prepared with **Next base** are stated below.con **Next base.**

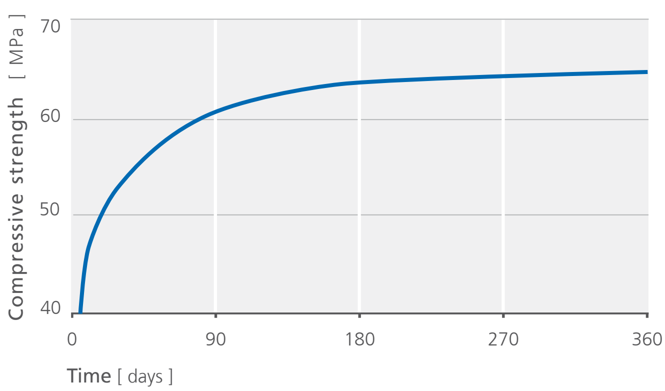
Compressive strength during the first 24 hours



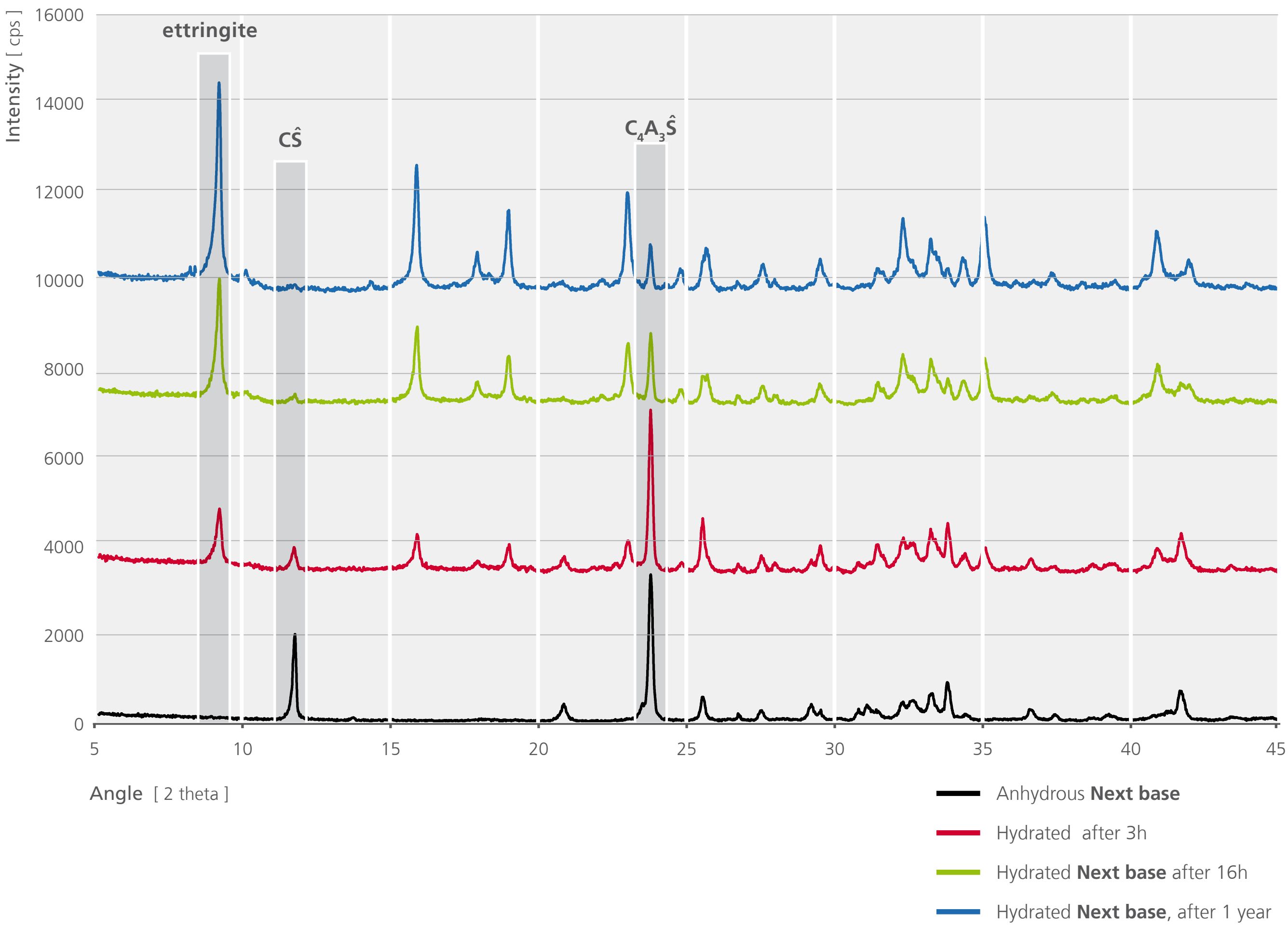

Compressive strength during the first 28 days




Compressive strength during the the first year



The graphs show that the values of compressive strength, calculated in standard mortar, reached after just a few hours are values that traditional Portland cement reaches after one week. Strength continues to increase at a slower rate but gradually as time goes by.
It is however possible to change the mortar performaces by varying the water/binder ratio (using water-reducing admixtures) or using accelerator admixtures (Lithium Carbonate) and retarder admixtures (Citric Acid and Tartaric Acid).
The performances offered by  stay constant over time, with no risk of loss of strength in the long term or of dimensional changes caused by delayed formation of Ettringite (expansions) or shrinkages.
The diffractograms below show the results of the analysis carried out using an X-Ray Diffractometer (XRD*) on a sample of non-hydrated  and 3h, 16h and 1 year after the hydration: it can be seen that 16 hours after the mixing with water, the free Calcium Sulphate has practically disappeared and that the diffractogram obtained after only 16 hours (green) does not differ much from the one obtained after about one year (blue).



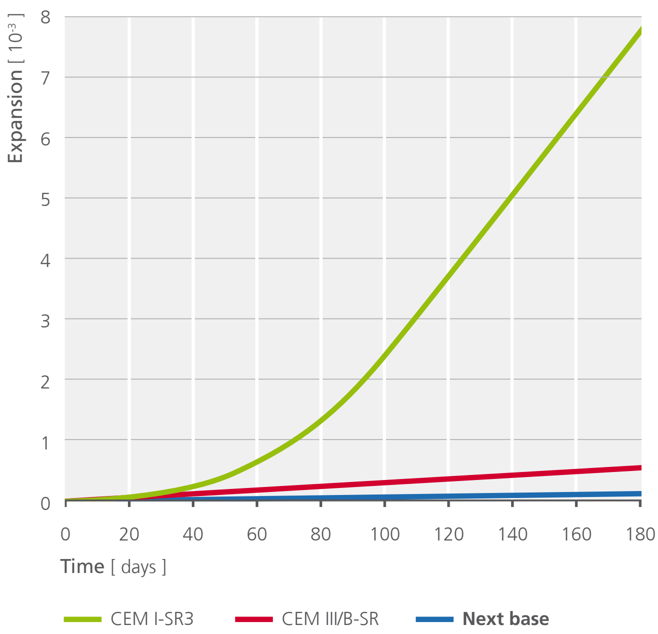

* ***XRD (X-Rays Powder Diffraction)*** *is an instrumental technique used to determine the mineralogical composition of a crystalline material: in the diffractograms shown above, the abscissa identifies the diffraction angle while the ordinate refers to the diffraction intensity of a specific mineralogical phase.*

## Other performances

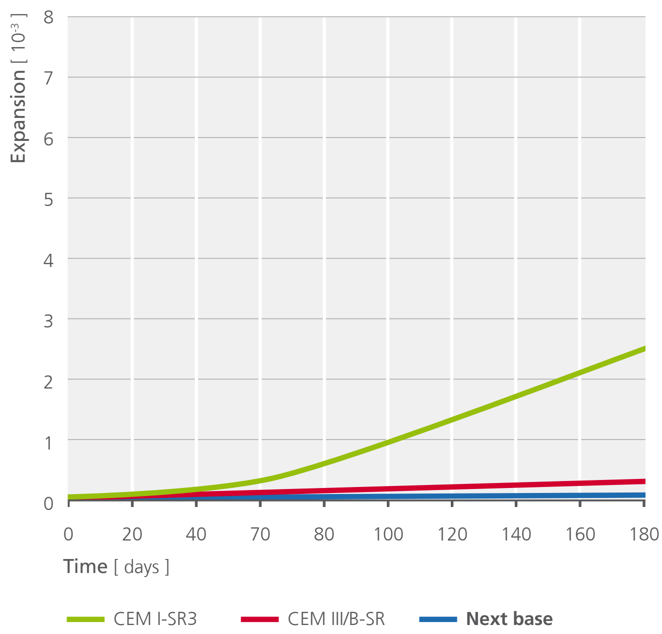
**Next base** is also synonymous of a durable material for the following reasons.

- **Next base** shows an increase in physical-mechanical strength in the long term: the fast transformation of Ettringite does not inhibit the development of medium and long-term strength due to hydration of the Dicalcium Silicate ($C_2S$), similar to what happens in Portland cements.
- The dense crystalline structure, created during the initial moments of hydration, reduces the capillary porosity of the hardened paste, making it poorly permeable to the inlet of water and of aggressive substances coming from the surrounding environment, which is a sign of excellent durability of the element poured with **Next base**. Low permeability to water makes the application using CSA clinker resistant to attacks by aggressive substances and to freezing and thawing cycles. The test conducted in compliance with standard UNI CEN/TS 12390-9 shows that after 100 freezing and thawing cycles, the cubic sample of concrete (binder content = 300 kg/m$^3$ and w/b ratio = 0.6) shows a weight reduction of less than 0.5%.
- The reduced formation of Calcium Hydroxide during the hydration reaction makes the hardened product extremely resistant to sulphate attacks, as demonstrated by the diagrams provided here below. The tests, carried out with the method of flat prism samples 10x40x160 mm in compliance with standard SVA Flat Prism Method at 5° and at 20°C, show how the mortar samples prepared with **Next base** are more resistant to sulphate attacks even compared to those prepared with a sulphate-resistant blast furnace cement (RS according to UNI EN 197-1:2011).
- **Next base**, just like all the other **Next** products, is more resistant to aging (prolonged direct contact with the environment) compared to all binders prepared with aluminous cements, which are more susceptible to water.

Sulphate-attack resistance accelerated test at 5°C




Sulphate-attack resistance accelerated test at 20°C



## 2.2 Ternary binders prepared with **Next base**

The paragraphs above describe **Next base** as a ready-to-use, high performance binder but in the premix and precast industries it is mainly used in Portland cement mixes. In these applications, **Next base** accelerates setting times when used in quantities ranging between 10% to 30%. By increasing the amount to 40% to 60% of the total weight of the binder, the following products can be obtained.

These binders, made by mixing **Next base** (binary binder made of CSA clinker and Anhydrite) and Portland cements are known as ternary binders as they are made of Calcium Sulpho Aluminate clinker, Anhydrite and Portland cement.

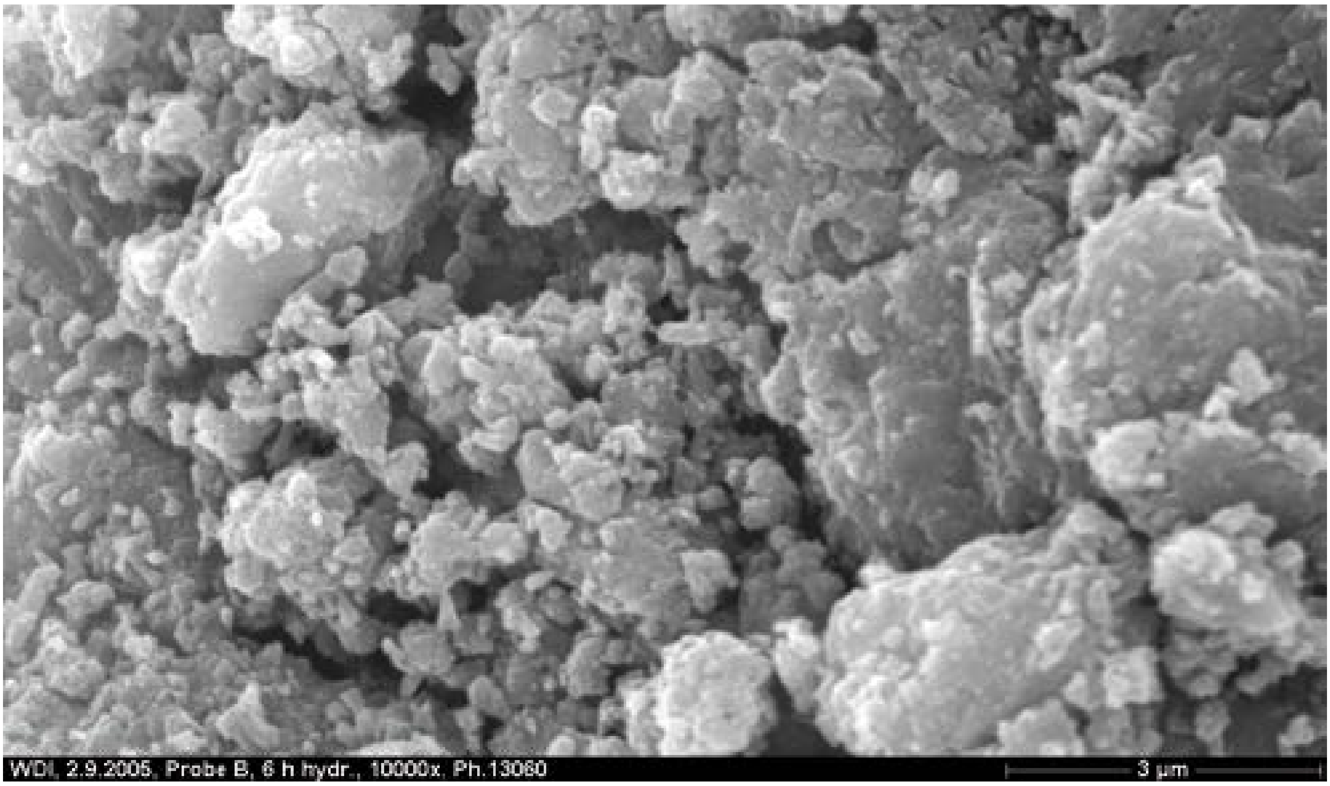
Portland cement mixed with **Next base** significantly changes the hydration processes of Calcium Sulpho Aluminate: the fast transformation of Portlandite caused by the hydration of the $C_3S$ contained in Portland cement, activates the precipitation of expansive Ettringite according to the hydration reaction illustrated here below:

$$C_4A_3\hat{S} + 6CH + 8C\hat{S} + 90H \rightarrow 3C_6A\hat{S}_3H_{32} \qquad (2)$$

Where:

| | |
|---|---|
| $C_4A_3\hat{S}$ | Calcium Sulpho Aluminate |
| **CH** | Portlandite - Calcium Hydroxide |
| $C\hat{S}$ | Calcium Sulphate |
| $C_6A\hat{S}_3H_{32}$ | Ettringite |

Reaction (2) requires a greater quantity of water and Calcium Sulphate compared to the one that generates non-expansive Ettringite (reaction 1); Moreover, each amount of Calcium Sulpho Aluminate yields 3 amounts of Ettringite, unlike what happens in the hydration reaction with no Portlandite (1). Once the reaction ends, its products remain dimensionally stable.



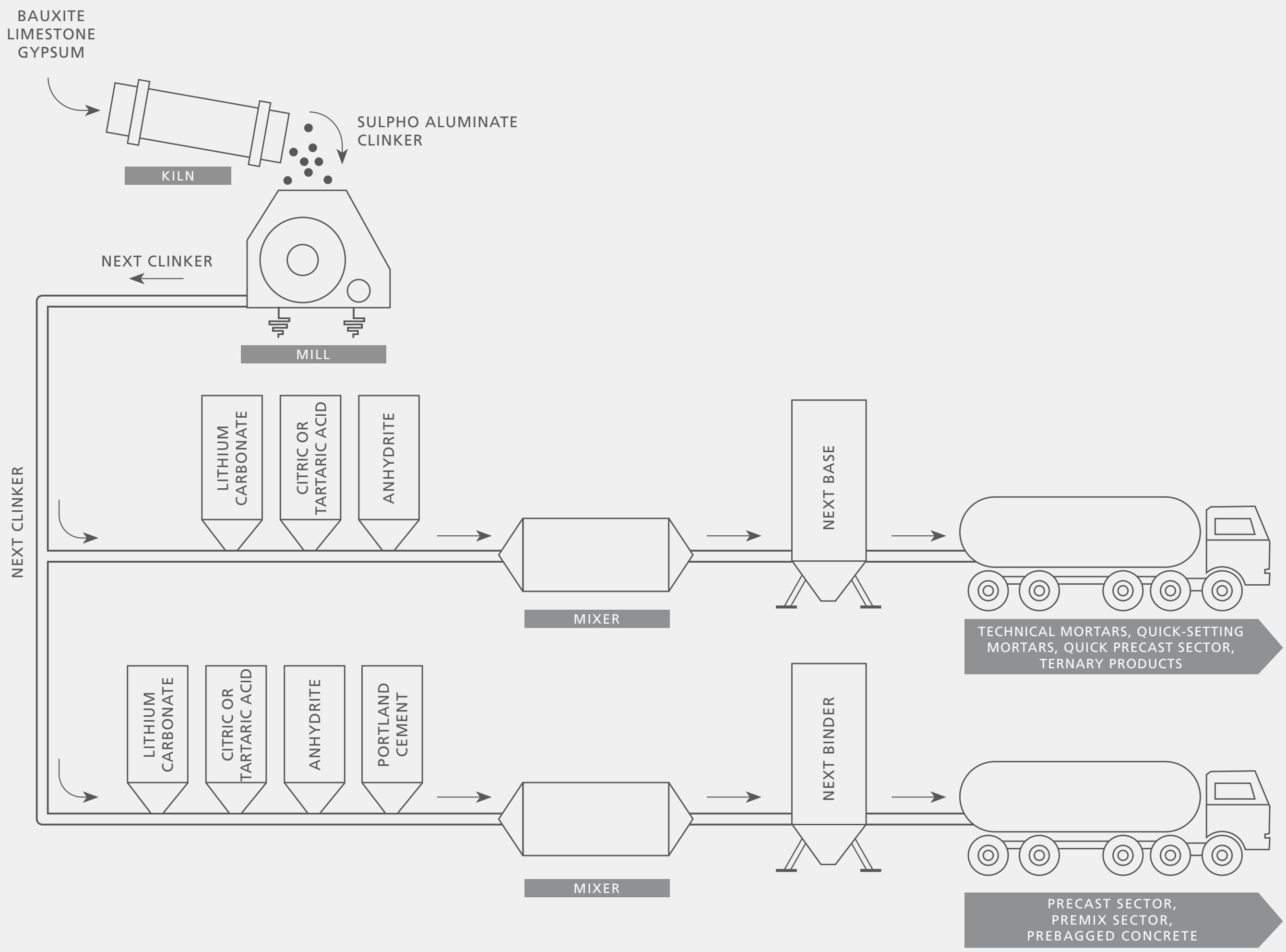

Electron microscope scanning of **Next base** in a mix with Portland cement 6 hours after hydration. The diffused formation of small ettringite crystals capable of compensating for the shrinkage can be observed.

In this case too, the performances (setting time and development of strength) can be modified by using retarder and accelerator admixture, such as Citric Acid, Tartaric Acid, Lithium Carbonate and Calcium Oxide. The binder obtained with this method can be used in combination with all materials and admixtures commonly used in the construction industry.

**Next binder** is Buzzi Unicem's own line of ready-to-use ternary binders that have been formulated to meet the needs of any application in the premix, precast and prebagged concrete industry.

The diagram below shows how you can go from one formulation to the other, making it easier to understand the relationships that bind the various formulations.

## Production process diagram of **Next** formulations



## 2.3 Fields of application of **Next base**

**Next base** is the ideal binder for a large number of applications in the precast and premix industry, and can be used like any ready-to-use cement to prepare high performance technical mortars. However, it is mainly used in Portland cement mixes as an accelerant if used in quantities ranging between 10% and 30%, or as a binder if used in quantities ranging between 40% and 60%.

These formulations can be used to prepare mixes that require fast development of strength, low shrinkage, and high resistance to sulphate attacks and freezing and thawing cycles. It should also be noted that premixed and prebagged mortars and grouts retain their performance longer than the same products made with aluminous cements once the bag has been opened.

**Next base** meets the standards of ETA n° 13/0417 issued by EOTA (European Organization for Technical Approvals), and can thus be used in Italy to produce structural concrete poured on-site or at the plant for making precast elements. Similarly, **Next base** is also approved for use in premixed products that require the use of a cement that meets EN 197-1 standards as a hydraulic binder.

All the binders prepared with **Next base** are compatible with most liquid and powder admixtures that are readily available on the market, such as setting regulators (lithium carbonate and citric acid), fluidifiers (naphthalene sulphonates and polycarboxylate ethers), aerators, anti-foaming agents, water retention agents, viscosifiers, polymers, etc. Similar to traditional cements, the addition of any of these elements should be adequately tested to verify the expected level of performance, especially in view of the large number of cements and admixtures currently available on the market.

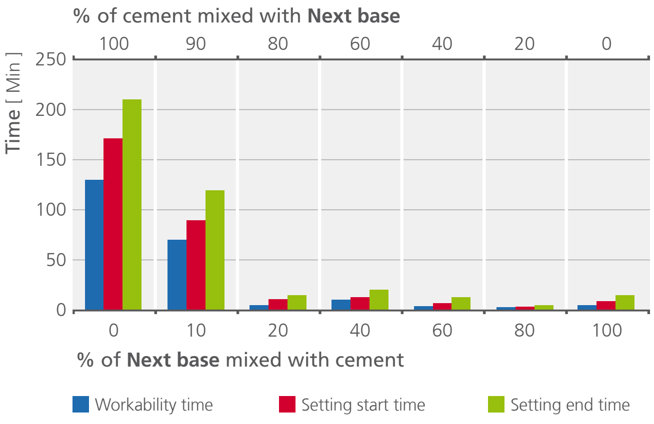
Buzzi Unicem is available to help its customers design their ternary systems through its technical services department.

# **Next base**-Portland cement diagrams

The diagrams below illustrate the various main characteristics of the binders obtained by mixing **Next base** with a CEM II/A-LL 42.5 R cement. It can be observed that the mechanical performances and the shrinkage of the premixed products are better than those of the single binders with which they were prepared.

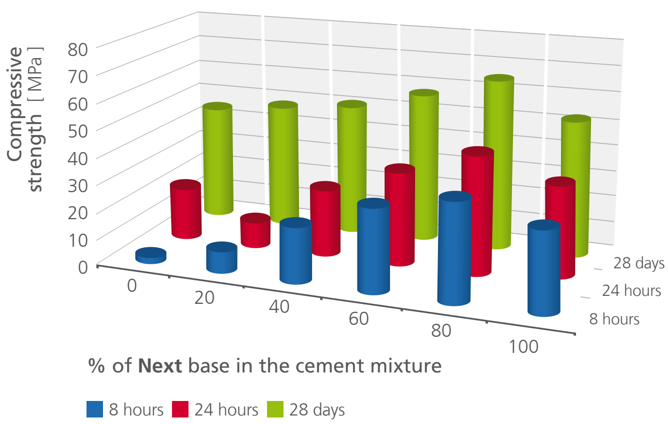
- **Diagram 1**
  The setting and workability times are greatly reduced when the quantity of **Next base** in the binder is increased. The values reported were measured with a penetrometer in standard mortar samples.

Setting times measured with a penetrometer



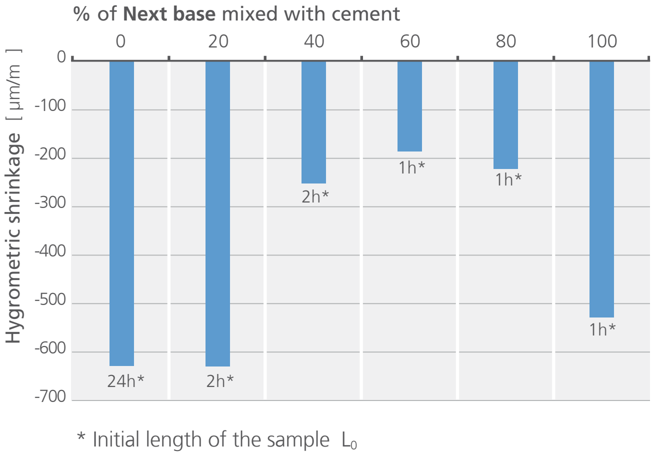

- **Diagram 2**
  Shows the development of compressive strength measured in standard mortar over a short curing time (8 hours), medium curing time (24 hours) and a long curing time (28 days) with various percentages of **Next base** in Portland cement mixtures.
  The strength at 8 hours increases considerably when the percentage of **Next base** is increased. The strength at 24 hours is not affected if the percentage of **Next base** is increased by less than 40%.
  The strength at 28 days increases with the percentage of **Next base**. The tests were performed in accordance with UNI EN 196-1.

Compressive strength at different curing times




- **Diagram 3**
  Shows that shrinkage was minimal for **Next base** in quantities of 40% and 80% in Portland cement mixtures. The test was performed on standard mortar in accordance UNI 6687-73, with the distinction that the initial size of the sample ($L_0$) was measured in accordance with the hardening speed of the binder: 24h for the samples made with 100% Portland cement, 2h for 20% and 40% of **Next base** and 1h for the remaining binders.

Shrinkage at 28 days




* Initial length of the sample $L_0$

## Applications

Several applications are listed below.

### Use of Next base as an accelerator for Portland cements.

Adding **Next base** to Portland cement in quantities of 10%-20% is sufficient to substantially reduce setting times (Diagram 1).
Corresponding with this reduction is a similar development of strength over short curing times (8 hours) and long curing times (28 days) (Diagram 2). This property can be used to accelerate plasters (see attached example) or in the precast sector where formwork must be removed quickly so they can be used again but the finished element does not have to be handled or moved.

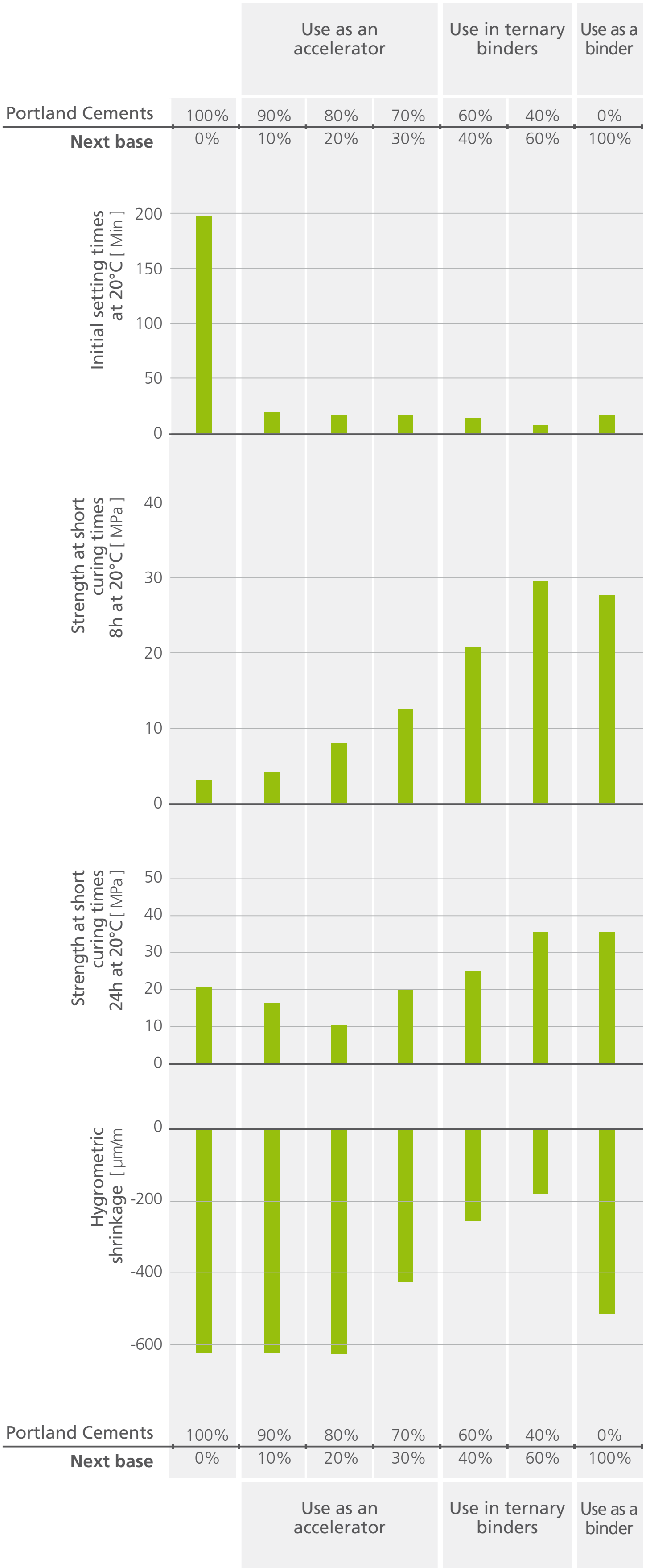
### Use of Next base as a quick, low shrinkage binder.

Elements made from a combination of **Next base** and Portland cement in percentages of 40%-60% and 60%-40% are characterized by high mechanical strength at all curing times and low shrinkage rates. Very much in demand in the precast and premix sectors, these binders are described in paragraph 4.

### Use of Next base as a main binder.

**Next base** can be used in technical mortars or in specialized applications in the precast sector due to its very high mechanical performances.

The table on the right shows the applications and performances of the binders obtained with the various percentages of **Next base** Portland cement.



## **Next base** as accelerator for cement products

When used in Portland cement mixtures in percentages ranging between 10% and 30%, **Next base** accelerates setting and initial hardening times, allowing it to be used in premix products that will be used in winter.
The example below shows the results of a plaster application that was prepared for the sake of convenience without the use of admixtures usually used as aerators or water retention agents.

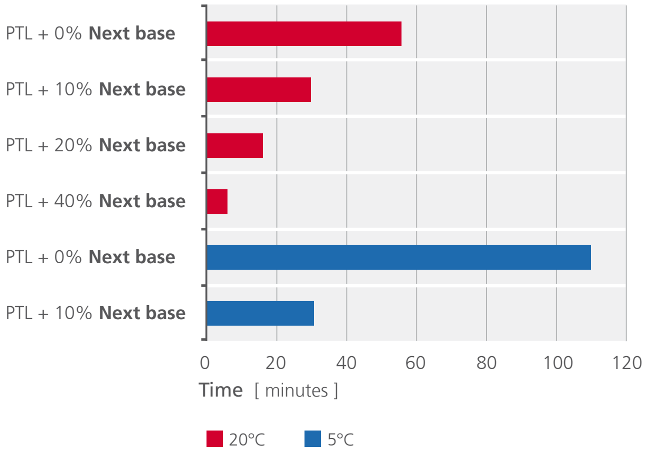
### Materials

| | |
|---|---|
| sand | 86% |
| CEM II/A-LL 42,5 R | 10% |
| hydrated limestone | 4% |
| water | 11% |

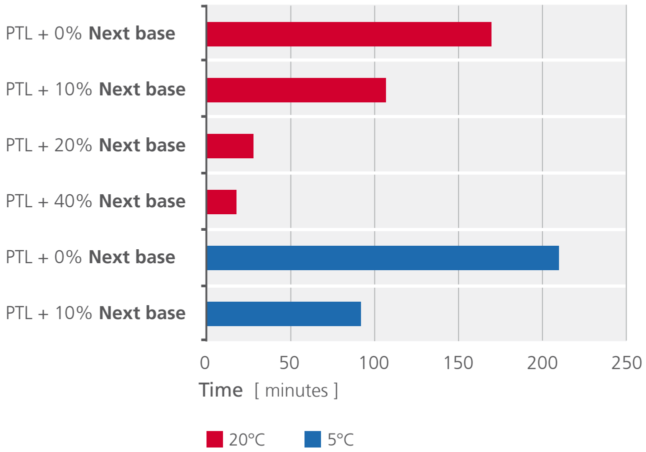
Setting times can be accelerated even at low temperatures by gradually adding larger quantities of **Next base**, as shown in the figure at (right or left). At a temperature of 5°C, 10% **Next base** in the total quantity of Portland cement is sufficient to reduce workability times by up to 70% and setting times by up to 60% of the values for mortar that has been prepared only with Portland cement.

This characteristic makes plaster easily manageable even at low temperatures.

Workability time measured in plastering mortar




Setting time measured in plastering mortar



ETA13/0418 ETA13/0419

**Next binder** is a family of hydraulic binders in which the percentages of CSA clinker, calcium sulphate, Portland cement and setting-regulator admixters have been optimized depending upon the specific application. These formulations are suitable for preparing premix mortars and adhesives as well as structural and non-structural elements poured on-site or at the plant for applications requiring the fast development of strength and low shrinkage. The line of premix, controlled ternary binders allows the user to prepare grouts, mortars and concrete with a smaller amount of raw materials and thus reduce the actual complexity of managing their physiological variability.

**Next binder** products can be used to prepare mixes with low shrinkage, fast development of mechanical strength and quick drying properties. Similar to standard cements, these ready-to-use binders can be mixed with the same admixtures used to produce concrete such as fluidifiers, aerators, viscosifiers, etc.

**Next binder** products meet ETA 13/0418 and 13/0419 standards and bear the CE mark so they can be used in Italy for structural and non-structural applications.
Buzzi Unicem offers due formulations to meet the needs of the fast precast and premix markets.

**Next binder** SL05 is used in the precast, premix and prebagged concrete sectors for applications that require fast development of strength, low shrinkage and fast drying properties.

**Next binder** SL05NF at low temperatures is used for constructing precast elements in precompressed reinforced concrete (PRC) without using accelerated steam curing and for elements in a semi-dry consistence concrete which must be handled quickly.

## Next binder SL05

Of the two binders, **Next binder** SL05NF has the broadest range of applications because its controlled setting speed allows it to be used at low and average temperatures. As opposed to traditional Portland cements, **Next binder** SL05 confers mixes with low shrinkage and fast hardening and drying properties so it can be used in any premix application where these characteristics are required, such as the preparation of mortars for self-levelling screeds, adhesives and repair mortars.

**Next binder** SL05 can also be used in the prebagged concrete industry to construct structures that require quick demoulding in cold climates and to restore and grout deteriorated structures due to its low shrinkage rate and durability.

## 3.1 Next binder and the precast sector

Buzzi Unicem offers a range of ternary products to meet all the needs of the fast precast industry, having designed binders for any type of technology used to construct precast structural and non-structural elements.

**Next binder** SL05 is used to construct elements in self-compacting concrete or concrete with a consistency class of S4 and S5, such as basins, tanks, wells, channels, panels, Jersey barriers, etc.

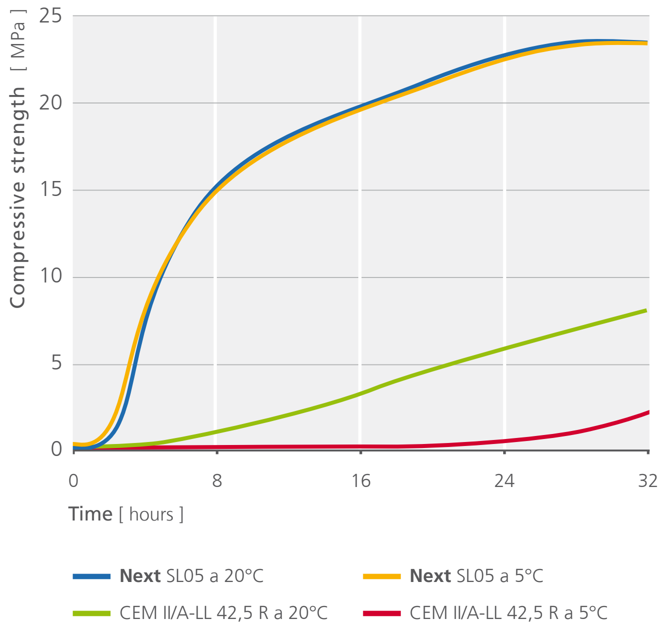
**Next binder** SL05NF is a high performance binder designed to construct elements in precompressed reinforced concrete (PRC) that require fast demoulding of the formwork, including in winter, similar to that achieved with Portland cement class 52.5 R cured at a high temperature, avoiding the use of accelerated steam curing. It is also used to construct elements in a semi-dry consistence such as kerbs, pipes, extruded floors, blocks, culverts, etc.

The examples below provide an indication of the hardening speed at low temperatures of **Next** binders compared to the Portland cements typically used in the precast sector.

| | Unit of Measure | Next binder SL05 | | CEM II/A-LL 42,5 R | |
|---|---|---|---|---|---|
| **Test temperature** | | 20°C | 5°C | 20°C | 5°C |
| **Mix design** | | | | | |
| binder | kg/m³ | 310 | | 310 | |
| aggregates | kg/m³ | 1.740 | | 1.740 | |
| limestone filler | kg/m³ | 215 | | 215 | |
| fluidifier | % | 2,1 | | 2,1 | |
| water | l/m³ | 150 | | 150 | |
| water/cement ratio | | 0,48 | | 0,48 | |
| **Expansion** [ standard UNI EN 12350-8 ] | | | | | |
| t = 0 minutes | mm | 720 | 720 | 700 | 700 |
| t = 30 minutes | mm | 650 | 680 | 700 | 700 |
| t = 60 minutes | mm | 600 | 630 | 690 | 680 |
| **Compressive strength** [ standard UNI EN 12390-3 ] | | | | | |
| 8 hours | MPa | 15 | 14 | - | - |
| 24 hours | MPa | 23 | 21 | 5 | - |
| 7 days | MPa | 28 | 29 | 40 | 30 |
| 28 days | MPa | 47 | 45 | 44 | 43 |

The diagram below shows the compressive strength curve during the first 32 hours, which shows that at 5°C the use of a concrete prepared with **Next binder** SL05 achieves a compressive strength of over 20 Mpa at 24 hours, while the hydration reaction has barely started in same mix prepared with a traditional limestone cement CEM II/A-LL 42.5 R.
At 20°C the use of a concrete prepared with **Next binder** SL05 achieves the same compressive strength 4 hours after pouring as concrete prepared with a traditional limestone cement CEM II/ALL 42.5 R after 32 hours. Conversely, the binder requires less than 60 minutes to apply because the fast development of strength reduces the workability and initial setting times.

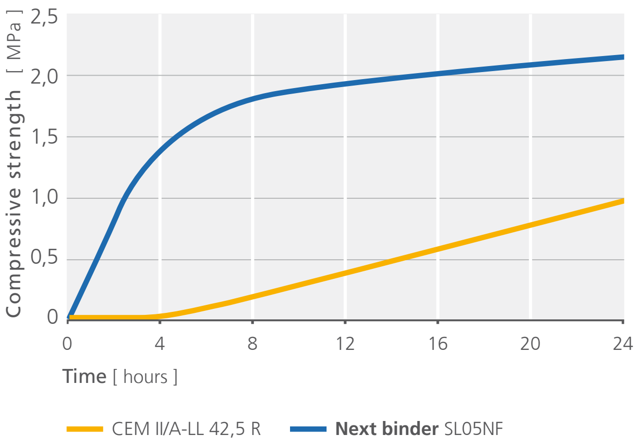
Concrete strength comparison




## Next binder SL05NF for precast elements in damp earth consistency: kerbs and pipes

**Next binder** SL05NF binder has been formulated to take advantage of the properties of clinker sulpho aluminate-based ternary products in mixes with very low quantities of water that are typical of a damp-earth consistency. In winter, precast elements can be handled after only a few hours without jeopardising the medium- and long-term strengths due to the high strength that develops very quickly despite the low temperatures.
The diagram below compares the data obtained from bending strength tests performed in the same production facility on kerbs made with 330 kg/ m3 of Portland cement class 42.5 R to others made with the same quantity of **Next binder** SL05NF. The elements were produced and cured at approximately 8°C, keeping the amount of plastifying agent, intensity of vibration and water content constant. The bending strength test was performed in accordance with appendix F of UNI EN 1340 on kerbs with S marking (bending strength class 1).

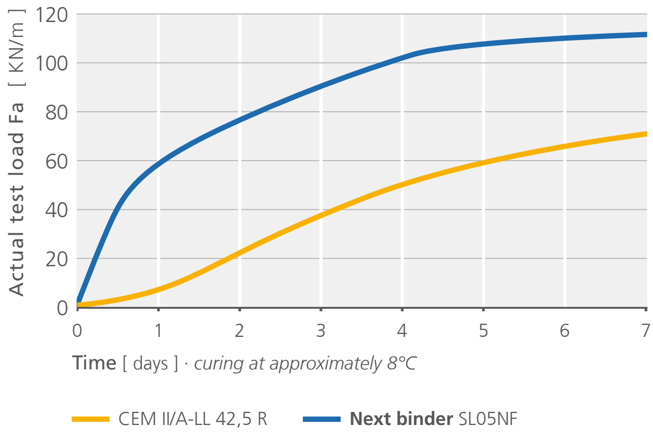
Strength development of kerbs at 8°C




You can see that at low temperatures, the kerbs prepared with **Next binder** SL05NF developed the same bending strength at 3 hours as those made with Portland cement after 24 hours.

Similarly, the diagram below compares the curves of the data obtained from crushing strength tests performed in the same production plant on pipes prepared with 330 kg/m3 of Portland cement class 42.5 R to others made with the same quantity of **Next binder** SL05NF. The elements were produced and cured at approximately 8°C at the same plant, keeping the amount of plastifying agent, intensity of vibration and water content constant. The crushing strength test was performed in accordance with appendix C of UNI EN 1916 on unreinforced pipes with a nominal size of 600 mm, 2,500 mm long and strength class 135 kN/m.

Crushing strength test at 8°C




You can see that at low temperatures, the pipes prepared with **Next binder** SL05NF developed the same crushing strength at 24 hours as those made with Portland cement after 5 days.

### **Next binder** SL05NF precompressed precast elements

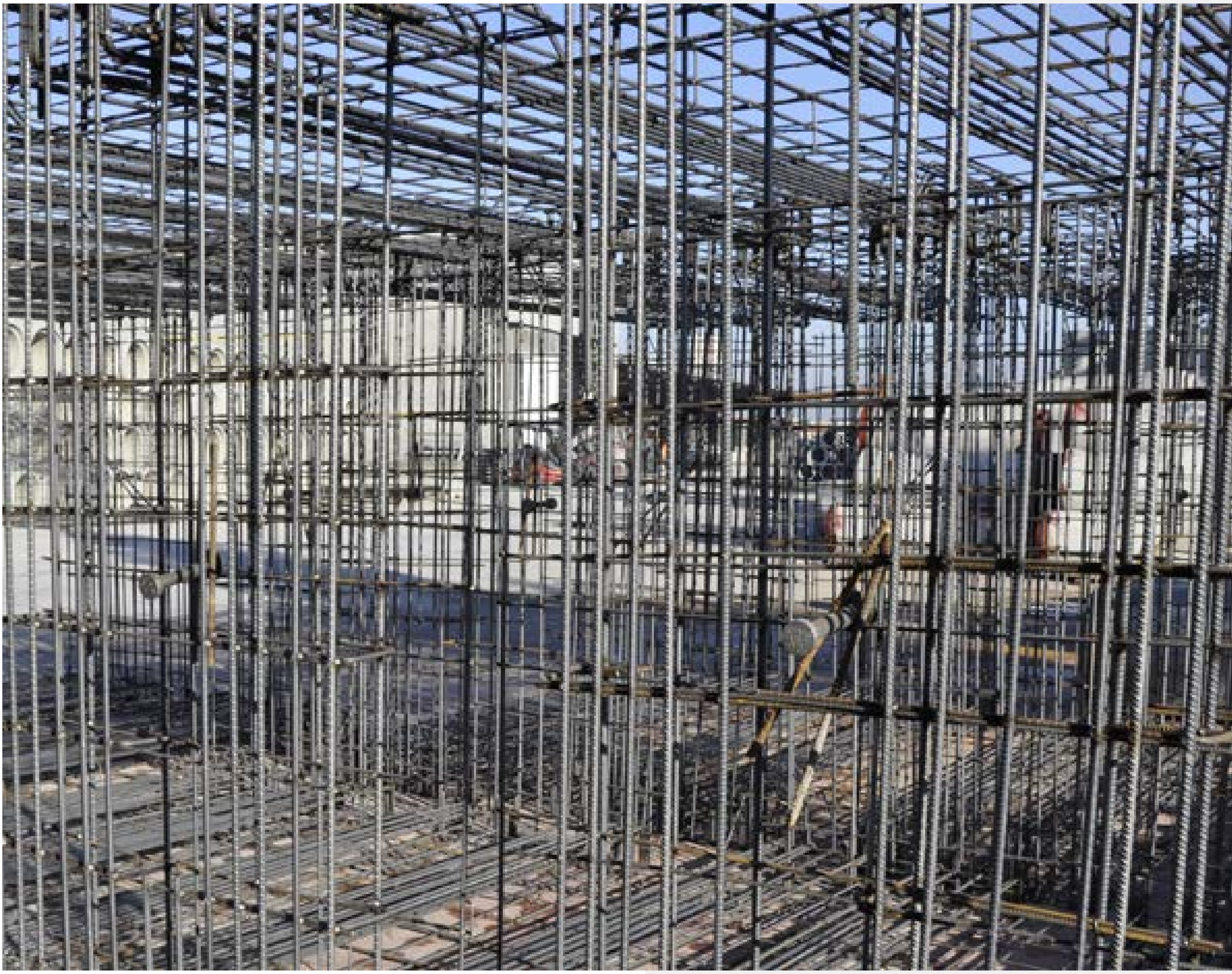
In order to meet the needs dictated by the productivity of the formwork and production shifts, the precast PRC sector requires special equipment to accelerate curing that is used mainly in winter when the cold weather considerably slows down the hydration reaction of the CEM I 52.5 R cement normally used.

**Next binder** SL05NF has been specifically designed for concrete that develops strength quickly even in low temperatures without the use of accelerated curing.

The concrete prepared with **Next binder** SL05NF is not only unaffected by the low temperature but also achieves much higher strength at 18 hours.

It is also important to note that the shrinkage of the concrete prepared with **Next binder** SL05NF is clearly less than that of the concrete made with CEM I 52.5 R cement, which is a characteristic feature of **Next binder** products.

Conversely, the binder requires at 5°C less than 60 minutes to apply because the fast development of strength reduces the workability and initial setting times.



# 4.0 CE marking of **Next** binders page

Buzzi Unicem obtained the CE mark in June 2013 for most of the products in the **Next** line, thus becoming the first company in Europe to achieve this milestone for sulpho aluminate cements, which are not yet regulated by international standards. Obtaining the CE mark shows that strict standards in terms of composition, performance and durability similar to Portland cements can also be obtained with concrete.

Next binders meet the standards of ETA n° 13/0417, 13/0418, 13/0419 issued by EOTA, and can thus be used in Italy to produce structural concrete poured on-site or at the plant for making precast elements, and ensure compliance with the standards below.

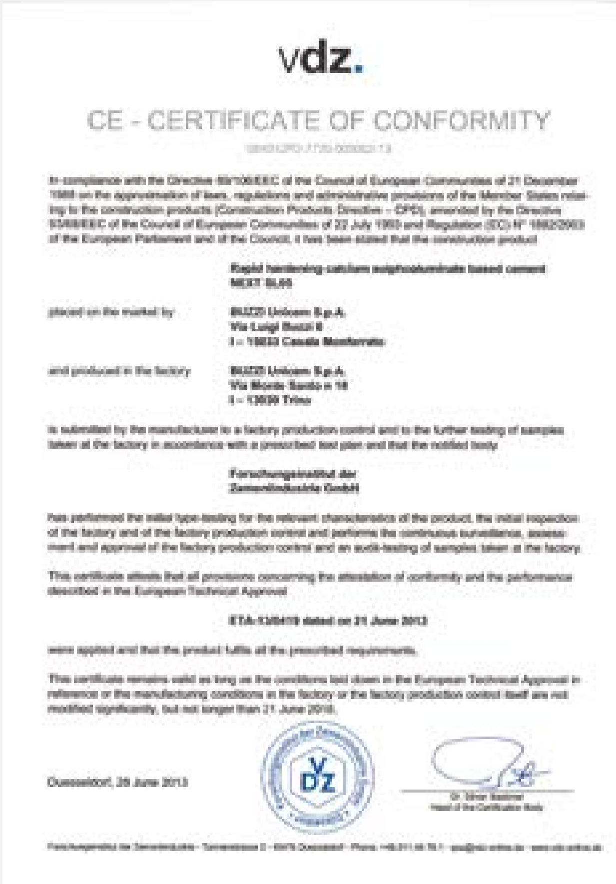
## ETA n° 13/0417, 13/0418, 13/0419 standards

| | |
|---|---|
| EN 206 - 1 | Concrete – Specification, performance, production and conformity |
| EN 490 | Concrete roofing tiles and fittings for roof covering and wall cladding – product specifications |
| EN 516 | Precast accessories for roofing – Installations for roof access. Walkways, treads and steps |
| EN 1168 | Precast concrete products – Hollowcore slabs |
| EN 1317 | Road restraint systems |
| EN 1340 | Concrete kerb units – Requirements and test methods |
| EN 1520 | Prefabricated reinforced components of lightweight aggregate concrete with open structure with structural or non-structural reinforcement |
| EN 1857 | Chimneys. Components. Concrete flue liners |
| EN 1858 | Chimneys. Components. Concrete flue blocks |
| EN 1916 | Concrete pipes and fittings, unreinforced, steel fiber and reinforced |
| EN 1917 | Concrete manholes and inspection chambers, unreinforced, steel fiber and reinforced |
| EN 12446 | Chimneys. Components. Concrete outer wall elements |
| EN 12737 | Metallic materials. Determination of plane-strain fracture toughness |
| EN 12839 | Precast concrete products. Elements for fences |
| EN 12843 | Precast concrete products. Masts and poles |
| EN 12951 | Precast accessories for roofing. Permanently fixed roof ladders. Product specification and test methods |
| EN 13084 | Free-standing chimneys |
| EN 13224 | Precast concrete products. Ribbed floor elements |
| EN 13877 | Concrete pavements. Materials |
| EN 13978 | Precast concrete products. Precast concrete garages. Requirements for reinforced garages monolithic or consisting of single sections with room dimensions |
| EN 14843 | Precast concrete products. Stairs |
| EN 14844 | Precast concrete products. Box culverts |
| EN 14992 | Precast concrete products. Wall elements. Product properties and performance |
| EN 15037 | Precast concrete products. Beam-and-block floor systems |
| EN 15258 | Precast concrete products. Retaining wall elements |
| EN 15435 | Precast concrete products. Normal weight and lightweight concrete shuttering blocks. Product properties and performance |
| EN 15498 | Precast concrete products. Wood-chip concrete shuttering blocks. Product properties and performance |

The ETA standards refer to structures constructed of concrete prepared with binders from the **Next** line with a useful lifetime of 50 years, so they meet Italian and European construction standards. Mortars prepared with **Next** products are recognized as the same as those made with cement conforming to standard EN 197-1.
In order to correctly design and build structures with a useful life of 50 or 100 years, current Italian and European regulations require a thorough analysis of the environment in which each element will be built, the correct combination of exposure classes in accordance with UNI EN 206-1, the associated requirements and construction of concrete covers and the appropriate installation and curing as required by the Technical construction standards of 2008, UNI EN 1992-1-1 and UNI EN 13670-1.

## ETA and the CE mark

The procedure for obtaining the CE mark took over 3 years, and involved the efforts of significant company resources and international institutions. EOTA (European Organization of Technical Approval) is the European entity that coordinates the procedural applications developed for requesting the ETA (European Technical Approval) which fills the regulatory void for new products. Buzzi Unicem initiated the procedure for the ETA by submitting the request to DIBt-Deutsches Institut für Bautechnik, German member of EOTA, responsible for the initial evaluation tests and issuance of the ETA based on an evaluation document that sets strict control standards on composition and performance. The German certification agency VDZ (Forschungsinstitut der Zementindustrie GmbH) issued the conformity certificates for the corresponding ETAs and CE marking for each formation in the **Next** line.
The **Next binder** SL05 certificate issued da VDZ is shown below as an example.


vdz.

CE - CERTIFICATE OF CONFORMITY

[illegible]

In compliance with the Directive 89/106/EEC of the Council of European Communities of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to the construction products (Construction Products Directive – CPD), amended by the Directive 93/68/EEC of the Council of European Communities of 22 July 1993 and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council, it has been stated that the construction product

Rapid hardening calcium sulphoaluminate based cement
NEXT SL05

placed on the market by BUZZI Unicem S.p.A.
Via Luigi Buzzi 6
I – 15033 Casale Monferrato

and produced in the factory BUZZI Unicem S.p.A.
Via Monte Santo n 18
I – 13039 Trino

is submitted by the manufacturer to a factory production control and to the further testing of samples taken at the factory in accordance with a prescribed test plan and that the notified body

Forschungsinstitut der
Zementindustrie GmbH

has performed the initial type-testing for the relevant characteristics of the product, the initial inspection of the factory and of the factory production control and performs the continuous surveillance, assessment and approval of the factory production control and an audit-testing of samples taken at the factory.

This certificate attests that all provisions concerning the attestation of conformity and the performance described in the European Technical Approval

ETA-13/0419 dated on 21 June 2013

were applied and that the product fulfils all the prescribed requirements.

This certificate remains valid as long as the conditions laid down in the European Technical Approval in reference or the manufacturing conditions in the factory or the factory production control itself are not modified significantly, but not longer than 21 June 2018.

Duesseldorf, 28 June 2013

Head of the Certification Body

[illegible]

Buzzi Unicem

next

user manual

10/2023

**Note:** The instructions provided above are the result of our best experience and are merely indicative. No responsibility is taken for defects or damages caused by misuse of the product or when the conditions of its use differ from our instructions. The Technical Assistance Department is always available for any advice and suggestions concerning proper use of the product and for the performance of technical tests.

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