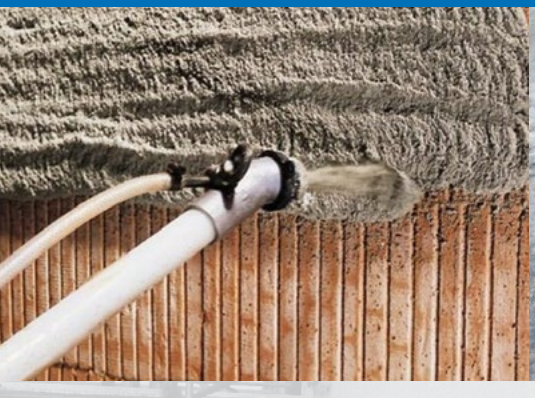
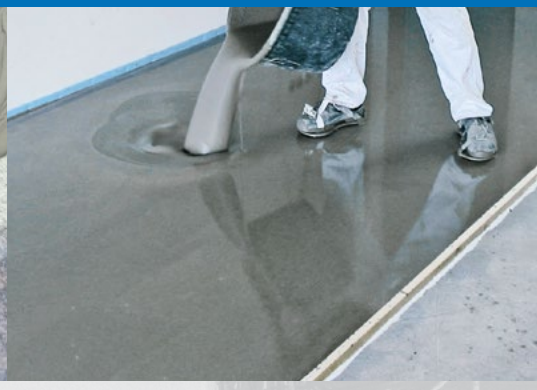
Dyckerhoff

Dyckerhoff BUILDING MATERIALS

for the dry mortar industry





Dyckerhoff BUILDING MATERIALS
for plasters and mortars

Standard mortars

The German Duden dictionary defines plaster as a "mixture of sand, water and binders used to plaster exterior walls for protection against weather conditions and interior walls as preparation for wallpapering or painting."

In Germany, plasters and mortars have been differentiated for many years by assignment to plaster mortar groups on the basis of the binders that they contain:

P I Slaked lime mortar, hydraulic lime mortar, mortar with hydraulic lime
P II Lime cement mortar, mortar with highly hydraulic lime or with plaster and masonry binders
P III Cement mortar with or without added hydrated lime
P IV Gypsum mortar and mortar containing gypsum

Industrially manufactured products with precisely adjusted properties cover all requirements and are differentiated by function and type of use in accordance with EN 998-1.

GP general purpose plastering mortar
Mortar without special properties
NOTE: can be manufactured as mortar in compliance with mix designation and/or as mortar in accordance with the suitability test

LW lightweight plastering mortar
Mortar in accordance with suitability test with a hardened mortar dry bulk density ≤ 1,300 kg/m³

CR colored rendering mortar
Colored plastering mortar
NOTE: The color is achieved with pigments or colored aggregates.

OC one coat plastering mortar for external use
Mortar in accordance with suitability test, which is applied in one coat and fulfills the same functions required for a multi-layer exterior plaster system and is normally colored.
NOTE: One coat plastering mortars for external use may be manufactured with normal and/or lightweight aggregates.

R plastering mortar for renovation
Mortar in accordance with suitability test that is appropriate for plastering damp masonry containing water-soluble salts.
NOTE: This mortar exhibits high porosity and water vapor diffusion as well as reduced capillary conductivity.

T thermal insulating plastering mortar
Mortar in accordance with suitability test with specific thermal insulating properties.

Finish plasters that aesthetically shape exterior and interior walls while providing lasting, durable protection are particularly valuable. Finish plasters consist of standard-compliant mineral binders and natural aggregates. Coloring is provided by pigments that are firmly bound into the matrix during plaster hardening.

Mineral finish plasters are non-fading, weather resistant, recyclable, water vapor permeable and ecologically safe, because no environmentally harmful solvents or preservatives are used in their manufacture. The addition of admixtures allows an appropriate adjustment for different plaster bases and the limitation of water absorption.

Special mortars

In addition to the standard mortars described previously, numerous special mortars with special requirements have been established.

Adhesive mortar and grout for ceramic tiles, slabs and natural stone
Leveling compounds for smoothing floors before installation of coverings
Grout, injection and anchor mortar for strong bonding of construction components and
grouting mortar for filling voids.

Dyckerhoff offers a wide range of cements and binders for the manufacture of mineral cementitious standard and special mortars.

White cement
in accordance with EN 197:
CONTACT for additive and filler-rich fine and coarse mortar mixes
DECOR for finish plaster systems
SPEED for accelerated systems
STRONG for high strengths

Special binders:
DRIVE (white blast furnace cement) for high sulfate resistance
CSA cement (calcium sulfoaluminate):
Next base for accelerated plaster and mortar systems

Gray cement
in accordance with EN 197

Premium cements in accordance with EN 197:
SULFADUR high sulfate resistance
VARIODUR high resistance against aggressive attacks

Ultrafine cements for improvement of dry mortar systems:
MIKRODUR P based on Portland cement (16; 9.5 µm)
MIKRODUR R based on fine-ground granulated blast furnace slag (16; 9.5; 6 µm)

Self-leveling floor screed based on calcium sulfoaluminate cement

Dyckerhoff GRAY CEMENTS
CEM I, CEM II, CEM III

Amöneburg cement plant

Deuna cement plant

Lengerich cement plant

Dyckerhoff Portland cement (CEM I)

The raw lime-rich marl material is loosened in opencast mining by blasting and/or hydraulic excavators and brought to the crusher by heavy-duty trucks. Depending on its composition, the raw material is adjusted with lime and/or sand components to so-called raw meal before drying and grinding takes place. Heated by the kiln exhaust in the preheater towers to approximately 800 °C, the raw meal is then burned to cement clinker in the approximately 1,500 °C sintering zone of the rotary kiln.

Nowadays, the kilns are no longer primarily powered by fossil fuels such as coal and gas, but also use the energy potential of numerous waste materials as secondary fuels. Used tires, fiber and plastic waste, solvents, etc. are utilized in an environmentally friendly manner. The entire combustion process is carefully monitored for compliance with legal emission limits. The cement clinker is then ground together with additives as set regulator to a specified fineness, which gives the Portland cement (CEM I). The urgently needed reduction in carbon dioxide (CO_2) emissions associated with the production of cement clinker has led to the increasing use of high-quality granulated blast furnace slag, fly ash or fine limestone meal in cement grinding and thus to a change in the structure of cement types. However, Portland cement clinker is still required as the primary component of Portland composite and blast furnace cements.

Sustainability

CO_2 is released in the clinker production process which is not only caused by emissions from fuel combustion, but especially by the calcination of limestone. Therefore, CO_2 emissions can be significantly reduced by using additives with different properties. The early strength development of Portland-limestone and Portland-composite cements is comparable to ordinary Portland cement although they have a markedly lower clinker content. A particular benefit of blast furnace and Portland-slag cements is a continuous strength development with low heat generation and good subsequent hardening after 28 days.

Dyckerhoff composite and blast furnace cements (CEM II and CEM III)

‘Normal’ strength class 32.5
‘Doppel’ strength class 42.5
‘Dreifach’ strength class 52.5

Cements with several main components have increasingly been established as binders for standard applications in all areas of concrete construction. They exhibit different specific properties corresponding to their raw material base that can be used selectively to meet the specific requirements in concrete construction.

The most important CEM II and CEM III cements are:
Portland-limestone cement
Portland-composite cement
Portland-slag cement
Blast furnace cement

Göllheim cement plant

Geseke cement plant

Neuwied grinding plant

Portland-limestone cements combine the rapid strength development of Portland cements with excellent processing behavior due to the fine limestone meal. This is especially advantageous in the manufacture of concrete elements, precast components and ready-mixed concrete.

Portland-composite cements also contain fine limestone meals and selected granulated blast furnace slag or fly ashes. This is associated with steady-rate strength development, which is advantageous for many applications in ready-mixed concrete and concrete products.

Portland-slag cements have been state-of-the-art for a long time. In addition to the well-known 42.5 N and 52.5 N strength classes, there are also Portland-slag cements with rapid early strength development, indicated by the letter R in the standard designation. Especially noteworthy is Dyckerhoff COMFORT Dreifach CEM II/A-S 52.5 R, which combines the highest level of rapid strength development with even solidification and subsequent hardening.

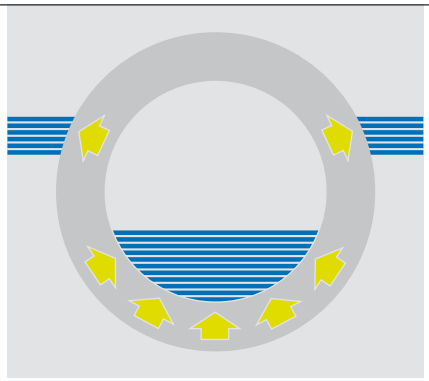
Blast furnace cements are recommended for applications where medium to slow strength development and low hydration heat are required. This reduces the risk of temperature-induced crack development considerably, especially in massive construction components. The suitability for special applications with regard to use of alkali-sensitive aggregates is indicated by (na) in the standard designation.

Dyckerhoff AQUADUR blast furnace cement with low hydration heat

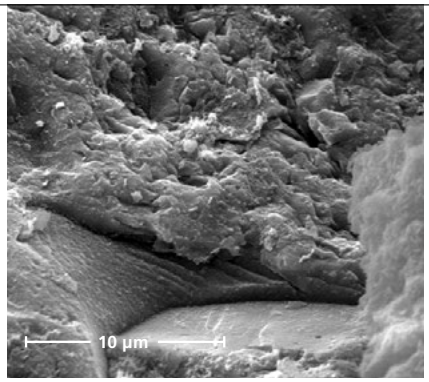
Dyckerhoff AQUADUR CEM III/B 32.5 N-LH/SR (na) has been manufactured with Portland cement clinker and a high content of granulated blast furnace slag for over 45 years. Today, AQUADUR Doppel CEM III/A 42.5 N-LH/SR (na) is available in a higher strength class as a further development. Because of its selected composition, together with an optimized grain size and balanced sulfate phase content, Dyckerhoff AQUADUR exhibits good workability properties together with low hydration heat. The strength development is initially moderate, but is distinguished by good subsequent hardening over many months.

- LH cement for concrete with low hydration heat (e.g. for massive building components).
- SR cement for concrete with high sulfate resistance (see FMPA test report).
- NA cement for concrete containing alkali-sensitive aggregates (in accordance with DAfStb Guideline "Preventive Measures Against Harmful Alkali Reaction in Concrete").

33 years of sulfate storage!
Concrete prisms that were produced with AQUADUR were undamaged after storage in a sodium sulfate solution for 33 years. Shape, edge sharpness and cement skin remained almost unchanged from the time of manufacture. The samples were also apparently crack-free. Findings from tests of dynamic modulus of elasticity, flexural and compressive strengths summarized in the short report from the Otto-Graf-Institut, Stuttgart, 1996, confirm the outstanding properties of the concrete.



High resistance against sulfate attack



Microstructure of a mortar with SULFADUR after 40 years of storage in Na_2SO_4 solution!

Concrete pipes with SULFADUR

Dyckerhoff SULFADUR Doppel premium cement

Dyckerhoff SULFADUR Doppel has been manufactured using special C_3A-free clinkers (in accordance with Bogue) for more than 50 years, reliably meeting the requirements on cement with high sulfate resistance.

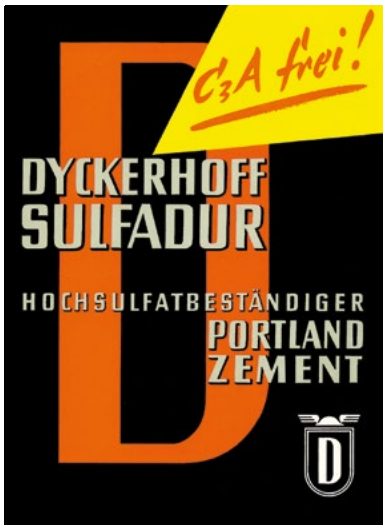
The cement standard EN 197 specifies a special clinker base for Portland cements in order to meet the limit values listed below. The combination of well-specified composition and optimized grain size leads to good workability and strength properties.

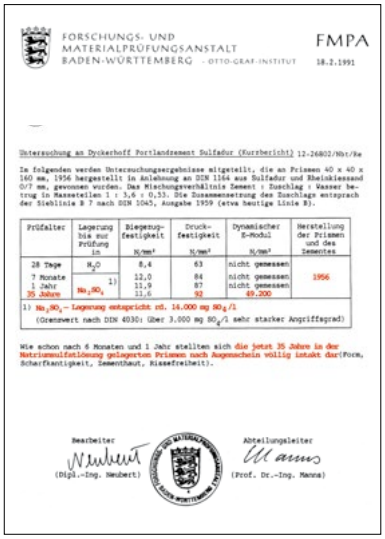
CEM I 42.5 R-SR 0 has proven for more than half a century as reliable Portland cement in applications against sulfate attack.

Extract from test report 12-26802:
“4x4x16 mm concrete prisms were manufactured in the Otto Graf Institute from Dyckerhoff SULFADUR Doppel – a Portland cement with high sulfate resistance – and 0/7 mm Rhine gravel sand in 1956. Since that time, the prisms have been stored in 2.1% sodium sulfate solution under laboratory conditions.

Using standard DIN 4030 – Assessment of Water, Soil and Gases for their Aggressiveness to Concrete – as the evaluation standard, this solution, with approximately 14,000 mg SO_4/l, amounts to more than four times the standard limit value of > 3,000 mg SO_4/l.

The results of a realistic long-term test of SULFADUR Doppel cement are now available. Realistic long-term results of this kind are likely to give the best information about behavior in practice.”




FORSCHUNGS- UND MATERIALPRÜFUNGSANSTALT BADEN-WÜRTTEMBERG – OTTO-GRAF-INSTITUT
FMPA
18.2.1991

Untersuchung an Dyckerhoff Portlandzement Sulfadur (Kurzbericht) 12-26802/Nbr/Ke

Im folgenden werden Untersuchungsergebnisse mitgeteilt, die an Prismen 40 x 40 x 160 mm, 1956 hergestellt in Anlehnung an DIN 1164 aus Sulfadur und Rheinkiessand 0/7 mm, gewonnen wurden. Das Mischungsverhältnis Zement : Zuschlag : Wasser betrug in Massenteilen 1 : 3,6 : 0,53. Die Zusammensetzung des Zuschlags entsprach der Sieblinie B 7 nach DIN 1045, Ausgabe 1959 (etwa heutige Linie B).

Prüfalter	Lagerung bis zur Prüfung in	Biegezug-festigkeit N/mm²	Druck-festigkeit N/mm²	Dynamischer E-Modul N/mm²	Herstellung der Prismen und des Zementes
28 Tage	H_2O	8,4	63	nicht gemessen	1956
7 Monate	1)	12,0	84	nicht gemessen	
1 Jahr	Na_2SO_4	11,9	87	nicht gemessen	
35 Jahre		11,6	92	49.200	

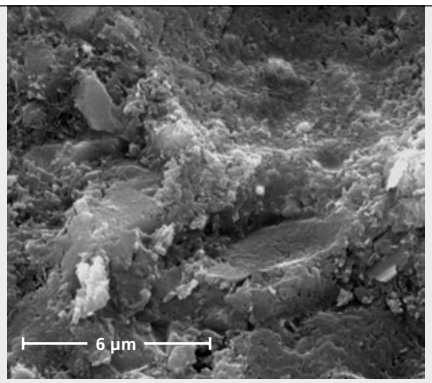
1) Na_2SO_4 – Lagerung entspricht rd. 14.000 mg SO_4/l
(Grenzwert nach DIN 4030: über 3.000 mg SO_4/l sehr starker Angriffsgrad)

Wie schon nach 6 Monaten und 1 Jahr stellten sich die jetzt 35 Jahre in der Natriumsulfatlösung gelagerten Prismen nach Augenschein völlig intakt dar (Form, Scharfkantigkeit, Zementhaut, Rissefreiheit).

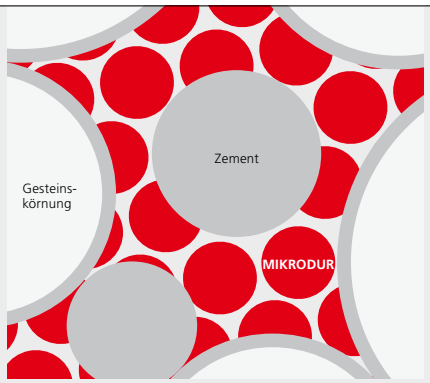
Bearbeiter (Dipl.-Ing. Neubert) Abteilungsleiter (Prof. Dr.-Ing. Manns)

FMPA test report 12-26802

Durability confirmed in the laboratory and in practice



High-performance concrete with MIKRODUR Technology



Dense structure and high durability due to ground granulated blast furnace slag from MIKRODUR Technology

Dyckerhoff VARIODUR premium cement

These cements are created by specified granulometric composition from ultrafine cement and/or ground granulated blast furnace slag particles in combination with particularly suitable standard cements. The technological starting point is the long-proven MIKRODUR product line that was previously used primarily as a binder for injections in geotechnical engineering and concrete repair.

Dyckerhoff premium cements with MIKRODUR Technology are
– special products with individual adjustability of properties,
– standard-compliant due to exclusive use of standardized cement components,
– robust, since there are no admixtures/ additives,
– to be processed in the same way as normal cements.

In the meantime, the use of MIKRODUR Technology for the manufacture of special cements has produced consistently impressive results in the laboratory and in practice. In a unique manufacturing process, defined fineness grades are obtained from individual separating Portland cement clinker and ground granulated blast furnace slag components. Special characteristics such as high final strength, rapid strength development and resistance to acid attack can be varied through targeted incorporation of these ultrafine, graduated grain components in proven standard cements.

Through exclusive use of standardized cement constituents, the new, special premium cement products maintain their standard character and can therefore be used immediately without costly approval procedures. In comparison to conventional modulation of special properties using additives and/or admixtures, no problems due to incompatibility or raw material fluctuations are expected with this new cement concept.

Premium cements in accordance with EN 197
VARIODUR 30 CEM II/B-S 52.5 R
VARIODUR 40 CEM III/A 52.5 R
VARIODUR 50 CEM III/A 52.5 N-SR (na)

In the dry mortar industry, premium cements can be used as the basic cement for special mortars, or either solely or mixed with other cements to achieve specific properties.

Application examples:
Renovation of the masonry at the Einsiedelstein Bridge on the federal highway BAB 1.

A grout based on Dyckerhoff VARIODUR was used for the listed Höllenbachtal structure.

Dyckerhoff WHITE CEMENTS
CONTACT, DECOR

Good workability of adhesives based on Dyckerhoff Weiss CONTACT on wall and floor

Mineral finish plasters based on Dyckerhoff Weiss DECOR show colors to their best advantage

Dyckerhoff's state-of-the-art production facility for white cement at the Amöneburg location

Dyckerhoff Weiss CONTACT is optimized with regard to use in additive and filler-rich fine and coarse mortar formulations, making it suitable for customers who primarily manufacture chemical construction products.

It is well-known that fine mortar formulations with high superplasticizer content require an adequate quantity of dissolved sulfate ions. A mix of sulfate phases that consists primarily of quickly soluble hemihydrate and anhydrite is therefore added during grinding. This enables CONTACT to achieve outstanding additive compatibility. It exhibits high effectiveness, especially in combination with superplasticizers and air-entraining agents. This positively influences the rheological properties in flow compounds. The consistently low water demand results in low shrinkage.

CONTACT applications:
– Leveling compounds
– Finish plasters
– Adhesive mortars
– Additive-rich formulations

Dyckerhoff Weiss DECOR was developed for finish plaster systems and is perfect for mixed binders based on lime and cement.

Thanks to the uniformly dehydrated gypsum, the processing conditions of the plaster are constant. The fine clinker used in manufacturing ensures a low water demand (approx. 28%) and good cement workability, making it especially suitable for calcareous products. Above all, the resulting lower shrinkage reduces the susceptibility to cracking of mortars and plasters manufactured with DECOR.

Adjusted sulfate phase content (primarily by addition of anhydrite and hemihydrate during grinding) enables uniform setting. Mortars with this base can be easily solubilized, have short mixing times and are very suitable for machine processing or spraying

DECOR applications:
– Finish plasters
– Adhesive mortars
– Grouts
– Repair mortars
– Masonry mortars
– Slurries

The white Portland cements Dyckerhoff Weiss **CONTACT** and Dyckerhoff Weiss **DECOR** are produced with special production processes and comply with EN 197-1 (in-house and third-party monitoring) under the standard designation CEM I 42.5 R (dw).

Properties:
– flat grading curve
– no yellow or green tint
  (a = approx. -0.7; b = approx. 2.9)
– setting behavior of the cement paste is optimized for moderate setting times
– high level of whiteness (L*= approx. 93)
– high color brilliance of colored finish plasters
– low and even pigment consumption

Dyckerhoff WHITE CEMENTS
SPEED, STRONG

Early-high-strength adhesive mortars and grouts based on Dyckerhoff Weiss SPEED under large format concrete paving

Plaster and mortar systems based on Dyckerhoff Weiss STRONG impress with high early strengths

Without additives, Dyckerhoff Weiss products made from selected, very pure raw materials are low in chromate

Dyckerhoff Weiss SPEED was developed for special applications, especially accelerated formulations.

SPEED is a modification of the white DECOR Portland cement with an identical sulfate phase composition, which corresponds to a CEM I 42.5 R (dw) in accordance with EN 197-1 (in-house and third-party monitoring).

To prevent undesirable interactions between the individual components of mortar systems with many reactive and non-reactive components, a clinker with significantly reduced free lime content is used during grinding of the cement. This produces a controlled solidification process, even in formulations containing calcium aluminate cement.

SPEED applications:
– Adhesive mortars
– Leveling compounds
– Grouts
– Repair mortars

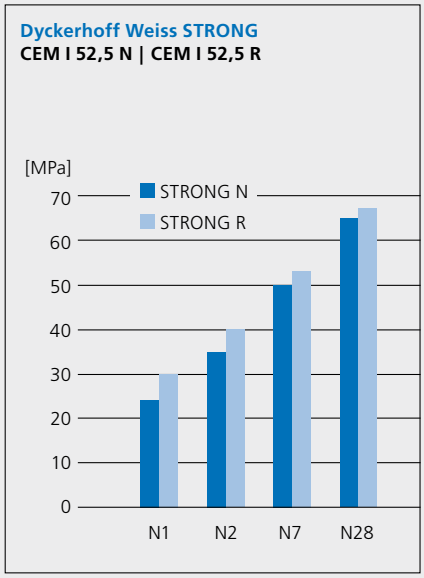
Dyckerhoff Weiss STRONG is used in chemical construction product formulations.

The white STRONG Portland cements are produced with special production processes and comply with EN 197-1 (in-house and third-party monitoring) under the standard designations CEM I 52.5 N and CEM I 52.5 R.

Grinding on a separator mill results in a steeper grading curve. STRONG type cements therefore have high early strengths. The two available STRONG N and STRONG R products differ with respect to their strength in the N1 to N28 range. STRONG R exhibits significant high early strength.

STRONG applications:
– Masonry mortars
– Adhesive mortars
– Grouts

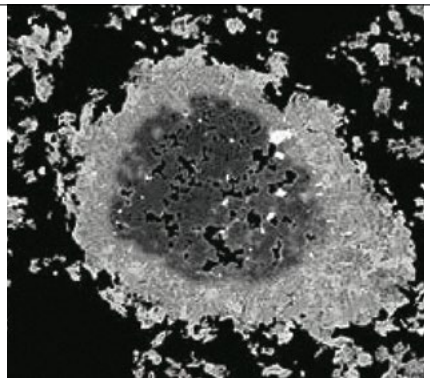
In the plaster and mortar industry, the high early strengths are specially valued in the production of grouts and adhesives.



High strength development already at an early stage

Next base bag in striking color scheme

Production plant in Trino, Italy



CSA grain in scanning electron microscope

Buzzi Unicem Next base

Binder based on **C**alcium **S**ulfo**A**luminate clinker with ye'elimite as reacting phase

Next base is used in the field of dry mortars and can also be used in the precast and ready-mixed concrete industry. The use of CSA increases early strength, enables use at low temperatures or sulfate attack and results in a lower shrinkage.

Calcium sulfoaluminate clinker is obtained by firing bauxite, gypsum and lime in rotary kilns at a temperature of approximately 1,300 °C. Approximately 60 % reactive ye'elimite ($C_4A_3\bar{S}$) is produced.

Next base is manufactured by precise dosing and grinding calcium sulfoaluminate clinker and anhydrite together. The manufacturer can balance the variability of raw materials by the precise dosing of mineral additives.

Properties
Next base products are distinguished by low shrinkage and rapid development of mechanical strength.

Average values
Density
approx. 2.8 kg/dm³

Specific surface (Blaine value)
approx. 5,000 cm²/g

Color (brightness L*)
Light gray (approx. 70)

Mineralogical composition
Calcium sulfoaluminate $C_4A_3\bar{S}$
approx. 50 %

Calcium sulfate $C\bar{S}$
approx. 18 %

Hydration
Hydration of the ye'elimite results in rapid formation of ettringite, monosulfate and aluminum hydroxide. In order for this reaction to take place completely, a sulfate source in the form of gypsum or anhydrite must be present.

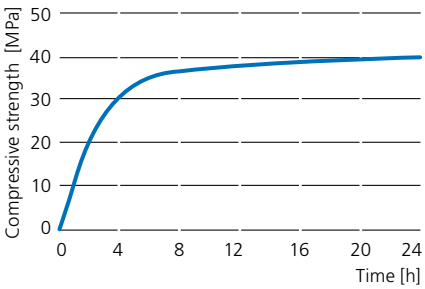
$$C_4A_3\bar{S} + 2C\bar{S} + 38H \rightarrow C_6A\bar{S}_3H_{32} + 2AH_3$$

Formula abbreviations:
$C\bar{S}$ calcium sulfate
$C_4A_3\bar{S}$ ye'elimite (calcium sulfoaluminate)
$C_6A\bar{S}_3H_{32}$ ettringite
AH_3 aluminum hydroxide
H water

At water/cement ratios between 0.40 and 0.55, CSA-based mortars and concretes exhibit faster setting and a reduced proportion of capillary pores as a result of hydration.

The rapid formation of prismatic ettringite crystals in comparison with Portland cement results in the development of a denser matrix.

Next base properties
Strength development in the first 24 hours in accordance with EN 196-1:



Ettringite crystals after 24 hours of hydration

CSA binders – environmentally friendly and sustainable

Low shrinkage, faster setting and drying

Retardation of Next base setting
Fast-setting cement systems have short working times. This applies to both the use of Next base binders and mixtures of Next base with cements in accordance with EN 197-1.

The setting time, and thus the working time, can be extended by up to 2 hours through the addition of organic acids such as citric or tartaric acid. Citric and tartaric acid can be added individually to the dry binder as powder or dissolved in the mixing water. Addition in powder form can extend the working time compared to adding as a liquid.

Mixtures of citric and tartaric acid are advantageous (optimal mixture ratio 60:40).

Mixtures with Portland cements
Depending on requirements, widely varying amounts of Next base can be mixed with cements in accordance with EN 197-1. Next base accelerates the strength development as a result of rapid ettringite formation due to the CSA cement. In addition to increased early strength, a dosing of 40 – 60% reduces the shrinkage. The reaction of Portland cement results in calcium hydroxide (portlandite), which continues to react with ye'elimite and sulfate to form expansive ettringite.

$$C_4A_3\bar{S} + 6CH + 8C\bar{S} + 38H \rightarrow 3C_6A\bar{S}_3H_{32}$$

Formula abbreviations:
$C\bar{S}$ calcium sulfate
$C_4A_3\bar{S}$ ye'elimite (calcium sulfoaluminate)
$C_6A\bar{S}_3H_{32}$ ettringite
CH portlandite
H water

Next base contents > 60 % result in very high early strength (high ettringite content).

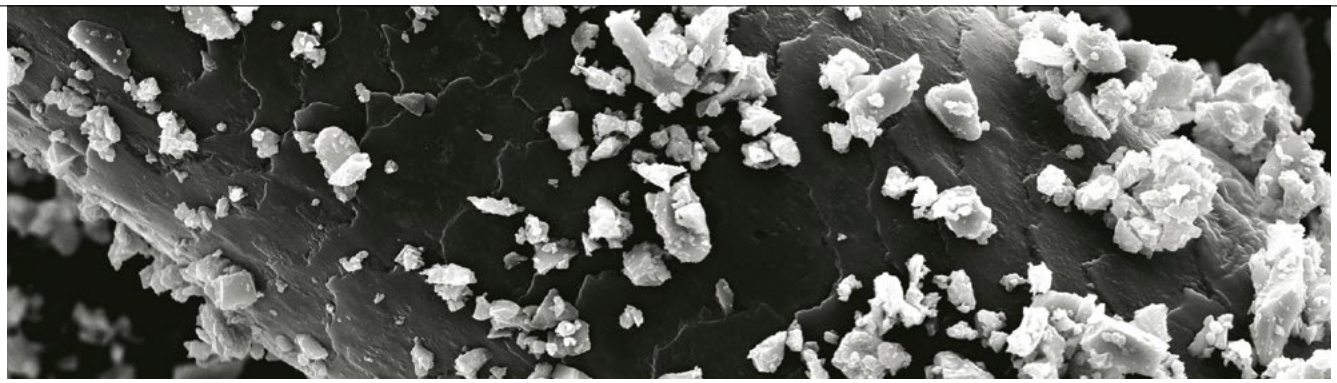
Basically, the user must test the properties of combinations of cements with Next base in his own trials.

Application examples
Next base can be used alone or in combination with cements in accordance with EN 197 for many chemical construction products, such as rapid-hardening dry mortar, shotcrete/spray mortar, screeds and repair mortars, as well as injection mortars and slurries.

Next base is especially suitable for use
– at low temperatures,
– with high levels of sulfate exposure,
– with risk of ASR reaction.

Environmental compatibility and sustainability
CSA-based binders are environmentally friendly and sustainable for the following reasons:
– reduced CO_2 emissions in the manufacturing process due to a low proportion of calcium carbonate in the raw materials and low fuel consumption,
– approx. 200 °C lower firing temperature during manufacture in comparison to Portland cement.

Dyckerhoff ULTRAFINE CEMENTS
MIKRODUR



MIKRODUR on a human hair in the scanning electron microscope

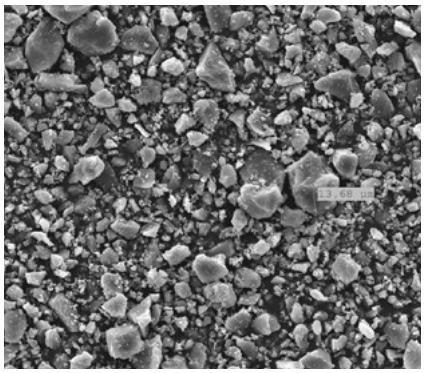
MIKRODUR are ultrafine cements with a maximum grain of $d_{95} \leq 6$ µm to $d_{95} \leq 16$ µm based on Portland cement clinker (type **P**) or granulated blast furnace slag (type **R**) that are manufactured with separate grinding of the primary components granulated blast furnace slag and Portland cement clinker.

After separating for the required fineness, homogenization into the various MIKRODUR grades takes place according to specified formulations, using gypsum as a setting regulator. **MIKRODUR P** ultrafine cements comply with CEM I Portland cement and **MIKRODUR R**, based on finely ground granulated blast furnace slag, complies with CEM III/C blast furnace cement with high sulfate resistance in accordance with EN 197.

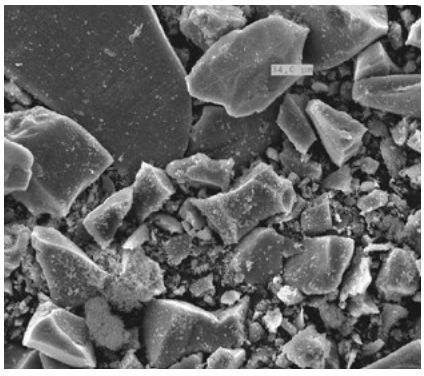
The main applications are injections in geotechnical engineering (loose and compact rock) and in construction engineering (filling cracks and voids in concrete, masonry, etc.)

The specification of the specific surface in cm²/g according to Blaine is not useful for ultrafine cements, since no information about grain distribution can be derived from this value. Limitation of the largest grain, which distinguishes ultrafine cements from standard cements, is important for the selection of suitable products for the optimization of the grain distribution of standard cement or mortar formulations, in order to improve performance characteristics.

The adjacent images, enlarged by 1,000 times in the scanning electron microscope, show products with a specific surface of 12,000 cm²/g, measured in accordance with Blaine. Clear differences can be seen in comparison to the finest standard cement in strength class CEM I 52.5 R.



MIKRODUR Grade F

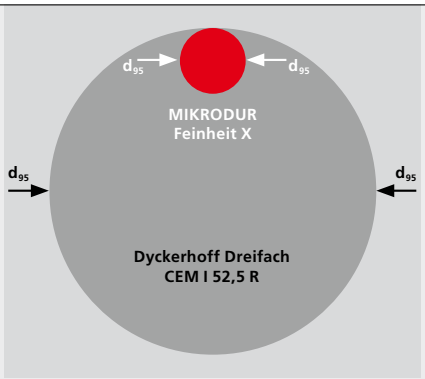


Common blend of binder with ultrafine filler

MIKRODUR ultrafine cements are primarily used to increase early strength and/or improve the rheology of mortars and concretes in different product areas in the dry mortar industry: Adhesives and grout, leveling compounds and casting mortar, grout, injection and anchoring mortar.

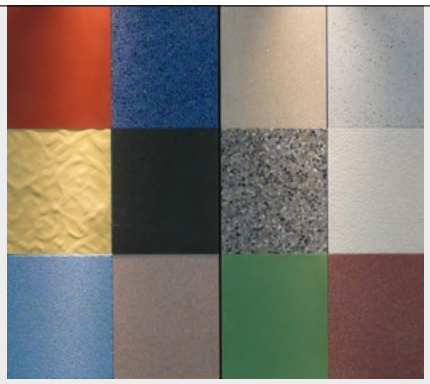
Cape Canaveral, Florida, USA: stabilization of the foundation

St. Basil's Cathedral, Moscow, Russia: masonry repair



Grain size comparison with CEM I 52.5 Portland cement

MICROFOND high-performance grouting mortars



High-performance concretes for artificial stone with FLOWSTONE

Dyckerhoff Mikrodur P and R

	CEM I		CEM III/C		
Type	**P-U**	**P-F**	**R-X**	**R-U**	**R-F**
True density [g/cm³]	~ 3,1	~ 3,1	~ 2,9	~ 2,9	~ 2,9
Grain size [µm]					
d_{95}	≤ 9,5	≤16	≤ 6	≤ 9,5	≤16
d_{50}	≤ 3,5	≤ 5	≤ 2,5	≤ 3,5	≤ 5
Setting times* [min]					
Start	~ 120	~ 150			
End	~ 180	~ 200			

* Dyckerhoff MSH liquid additive (FM), producer: GCP Germany GmbH, 32676 Lügde, Germany

The essential mechanism is an increase in packing density of the cementitious construction material systems, which significantly improves both mechanical properties and durability.

Dyckerhoff uses this property in the manufacture of its own special mortars such as **MICROFOND** for grouting semi-rigid asphalt pavements and **FLOWSTONE** as a binder premix for high-performance concretes for artificial stones and façade elements.

Application example 1

The semi-rigid pavement consists of uniform grain asphalt with a void content of > 25 % by volume and **MICROFOND** high-performance pouring mortar, which penetrates this matrix and completely fills the voids.

This construction method combines the positive characteristics of the asphalt layer (high elasticity and joint-free installation) with those of the concrete layer (high strength and durability). Limitation of the maximum particle size and the excellent flowability of Dyckerhoff MICROFOND ensures complete filling of voids in the asphalt matrix.

The low water/solid material ratio and adjusted grain distribution of individual Dyckerhoff MICROFOND components enables production of a mortar with an extremely dense microstructure that achieves very high compressive strengths after only one day.

Application example 2

The **FLOWSTONE** binder premix, which enables production of self-compacting, highly flowable concretes in combination with suitable aggregates, was developed for high-performance concretes under realistic conditions.

The hardened concrete is characterized by high density in both the microstructure and surface.

The water/cement ratio (w/c ratio) is significantly below 0.4 and the flexural strengths can be up to 15 MPa, depending on the aggregate used. The compressive strengths normally exceed 100 MPa. This allows concrete building components to be manufactured with sharp edges, great durability and high wear resistance.

Recommendations for use
Summary of standard cements

Gray cements

Strength classes of Dyckerhoff gray cements:
'Normal' strength class 32.5
'Doppel' strength class 42.5
'Dreifach' strength class 52.5

Portland cement
high to very high early strength and hydration heat with normal subsequent hardening

Portland-limestone cement
good early strength, normal hydration heat and subsequent hardening

Portland-composite cement
good early strength, normal hydration heat and increased subsequent hardening

Portland-slag cement
normal early strength, hydration heat and subsequent hardening

Blast furnace cement
slow strength development, low hydration heat and good subsequent hardening

Premium cements

SULFADUR Doppel CEM I 42.5 R-SR 0
especially suitable for the manufacture of mortars and concretes with high sulfate resistance.

Special application with building components in contact with soil in cases of water and soil containing sulfate.

Low-C_3A basic binder for the manufacture of dry mortars for high-strength and ultra-high-strength concretes.

VARIODUR are blended cements in accordance with EN 197-1 with ultrafine ground granulated blast furnace slag.

VARIODUR 30 CEM II/B-S 52.5 R
VARIODUR 40 CEM III/A 52.5 R
VARIODUR 50 CEM III/A 52.5 N-SR (na)

Mortars and concretes with VARIODUR are characterized by:
– high early and final strength,
– low hydration heat,
– high resistance to aggressive media,
– high durability.

White cements

Dyckerhoff WEISS are Portland cements in accordance with EN 197-1 and are equally suitable for all concrete strength classes. The outstanding quality is demonstrated by the lasting brilliance of colors and resistance to environmental influences.

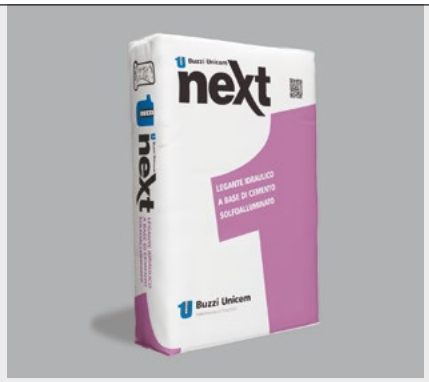
Special white cement types with precise control of the sulfate phase and different strength classes meet customer requirements.

CEM I 42.5 R (dw)
high early strength, normal hydration heat and subsequent hardening

CEM I 52.5 N or **CEM I 52.5 R**
high early strength, high hydration heat and normal subsequent hardening

CONTACT white and colored fine mortars
DECOR white and colored finish plasters and mortars
SPEED rapid products in the special construction chemicals field
STRONG N/R
high early and final strength

Recommendations for use
Summary of special binders



Deutsches Institut für Bautechnik DIBt

Next base hat eine allgemeine bauaufsichtliche Zulassung
Nr. Z-3.15 2130

Next base ist CE-gekennzeichnet

CE ETA 13/0417

MIKRODUR

MIKRODUR are separated ultrafine cements used for the optimization of the packing density of different mortar and concrete formulations.

Fineness grades
F – d_{95} < 16 µm
U – d_{95} < 9.5 µm
X – d_{95} < 6 µm

MIKRODUR P – Portland cements
MIKRODUR R – blast furnace cements

MIKRODUR P is produced in grades F and U and is especially recommended for controlling the reactivity of mortars and concretes as well as increasing (early) strength.

MIKRODUR R is produced in all grades and its advantages lie in the increase of packing densities and thus the resistance and final strength of mortars and concretes.

Also available in a mix with fine limestone meal as **MIKRODUR R/Eplus**.

Next base

Next base is a rapid-hardening binder based on **C**alcium **S**ulfo**A**luminate clinker (CSA).

Next base can be used alone as a rapid-hardening binder or in combination with standard cements in accordance with EN 197-1. A 40 – 60 % dosing of Next base can have a positive effect on shrinkage.

The properties of the mortar can be modified by additives (lithium carbonate, tartaric or citric acid) or a lower w/c ratio in combination with any desired superplasticizer.

Retarding organic acids should be used with maximum 0.8 M.% of total cement. Otherwise, early strength development will be affected negatively.

Next base is especially suitable with
– low temperatures,
– high levels of sulfate exposure,
– ASR exposure.

Next base approvals

Next base = Next SR03 has European approval ETA-13/0417, corresponding to DIBt Z-3.15-2130 and thus has general building approval for the following areas of application:
Under the conditions of this general building authority approval, concrete and reinforced concrete in accordance with EN 206-1 with "Next SR03" rapid hardening cement according to ETA-13/0417 may only be manufactured in conjunction with standard DIN 1045-2. "Next SR03" rapid hardening cement may be used in the following exposure classes in accordance with DIN 1045-2:
XO
XC1, XC2
XF1, XF3
XA1 to XA3

In addition, "Next SR03" rapid hardening cement may be used as cement with high sulfate resistance (SR cement) in case of chemical attack by sulfate.

"Next SR03" rapid hardening cement may be used for the manufacture of cement-bound grouting concrete and mortar.

The **Concrete Sustainability Council** (CSC) awarded the **Gold** seal to Dyckerhoff GmbH's Amöneburg, Deuna, Geseke, Göllheim, Lengerich, Neuss and Neuwied cement plants in Germany for responsible environmental, social and economic action.

For further information and individual consultation contact us at:

White cement sales
Dyckerhoff GmbH
Biebricher Straße 68
65203 Wiesbaden, Germany
Phone +49 611 676-1171 /-1172
Fax +49 611 609092
weisszement@dyckerhoff.com

Gray cement sales region Northwest, Netherlands and Belgium, Denmark
Dyckerhoff GmbH
Lienener Straße 89
49525 Lengerich, Germany
Phone +49 5481 31-327 /-436
Fax +49 5481 31-590
verkauf-nordwest@dyckerhoff.com

Gray cement sales region Southeast, Switzerland
Dyckerhoff GmbH
Biebricher Straße 68
65203 Wiesbaden, Germany
Phone +49 611 676-1237 /-1241
Fax +49 611 676-61237 /-61241
verkauf-suedost@dyckerhoff.com

Sales region Luxembourg, France
Cimalux S.A.
B.P. 146
L-4002 Esch-sur-Alzette, Luxembourg
Phone +352 55 25 25 297
Fax +352 42 08 44
info@cimalux.lu
www.cimalux.lu

You can obtain information about certifications for Germany and international markets at www.dyckerhoff.com (White Cement and Gray Cement) or at www.cimalux.lu (Produits).

Gestaltung: wellKOM, Kommunikationsdesign GmbH Stand: 06/2022

Dyckerhoff GmbH, Product Marketing
P.O. Box 2247, 65012 Wiesbaden, Germany
Phone +49 611 676-1187
marketing@dyckerhoff.com www.dyckerhoff.com