
DIRK
POZZOLAN
ACTIVATED IN FIRE...

POZZOLANS

are a broad class of siliceous and aluminous materials which, in themselves, possess little or no cementitious value but which will, in finely divided form and in the presence of water, react chemically with calcium hydroxide Ca(OH) at ordinary temperature to form compounds possessing cementitious properties.
The quantification of the capacity of a pozzolan to react with calcium hydroxide and water is given by measuring its pozzolanic activity.
For definition: DIRK Natural pozzolans originate e.g. from volcanos whereas Artificial pozzolans are based on fly ash from selected Indian thermal power stations. The DIRK POZZOLAN products are classified in sidewind air classification plants -NOT GROUND- and airslides not to damage the ball shape of the particles which influences the water cement ratio in concrete.

Dirk India Fly Ash classification plant in Nashik sold to Ambuja Cements Ltd

THE RESULTING DIRK POZZOLANS ARE

DIRK POZZOLAN A [**]
Grades 40, 60, 63, 100
(processed fly ash), introduced in India and worldwide by Georg Dirk in the year 2000 branded as DIRK Pozzocrete

DIRK POZZOLAN A+
(value added product)[**]
Processed and modified artificial pozzolan

Dirk Natural Pozzolans (NI – Natural Indonesia, NJ Natural Jordan) are based on basalt or depleted bleaching minerals

DIRK POZZOLAN NJ [*]
A basalt based natural pozzolan, fly ash replacement

DIRK POZZOLAN NI [***]
Bleaching earth mineral component, mainly for PPC cement

DIRK HIGHGRADE [**]

Modified artificial pozzolan, a micro silica replacement
DIRK HIGHGRADE is an ultra-fine key ingredient with optimum particle size for manufacturing high-performance concrete. It is primarily manufactured using industrial wastes and thus is a heterogeneous blend of oxides of calcium, silicon, and aluminium with no deleterious impurities. To enhance its physical and chemical properties, it is chemically modified with specialized polymers.

In general: 1% of DIRK Highgrade will reduce 2.5 % of microsilica

In general: 1% of DIRK Highgrade will increase M 30 to M 35.

Or: 1% of DIRK Highgrade will increase the strength by 5 Mpa.

DIRK GROUP

is a group company of Milbank Limited established in 1984 under the control of its chairman Georg Dirk Concern for the environment is at the heart of DIRK's business philosophy. The key focus lies in recycling of power station by-products and solutions for municipal and industrial sludges but also in re-refining of waste oil and toxic waste paper. The permanent strive for highest quality is reflected by the exceptional products and services supplied. The resulting recycling products and processes can be used as complementary solutions for each of these waste streams.

JORDAN PLANT FOR PRODUCTION OF DIRK NATURAL POZZOLANS

DIRK Pozzolan products marked [**] are based on classified Fly Ash an artificial pozzolan sourced from coal fired power stations in India. DIRK Pozzolan products [marked *] are based on basalt quarried in Jordan. Products marked [***] are based on processed bleaching earth.

Technical Data Sheets for all products are attached.

DIRK and Manaseer believe that quality controlled POZZOLANs are the key to maximum and safe utilization of POZZOLANs in the construction industry. Quality is never a one off event, but the definition of quality also covers the consistency at which the quality is provided.

Power generators in India should ensure that artificial POZZOLANs are only handled by competent agencies using reputed third party quality verification systems as well having all statutory permissions to deal with this waste. This is important for their own protection, since a waste producer is never absolved from the responsibility for the waste (from the cradle to the grave). For this purpose a fully automated production control is installed to insure constant quality.

There are various reasons for Ready mix concrete producers to be interested in DIRK POZZOLANs:

- Producing a more consistent finished product that will guarantee customer´s acceptance.
- Giving the ready-mix producer the advantage of offering a wider range of designs to suit every customer´s need.
- Giving high compressive strength at low W/C ratios.
- Increasing setting time.

Testing regime for DIRK POZZOLAN products

The following determination was carried out on DIRK POZZOLAN NJ and Portland cement:

- Determination of sulphur trioxide (SO3) content according to ASTM C114
- Determination of Silicon dioxide (SiO2), Aluminum dioxide (Al203) and Iron dioxide (Fe203) according to ASTM C114
- Loss on Ignition test according to ASTM C311 and ASTM C114
- Determination of moisture content according to ASTM C311
- Determination of Fineness according to ASTM C311 and ASTM C430
- Determination of Strength Activity Index according to ASTM C311 and ASTM C109
- Determination of Water Requirement according to ASTM C311

DIRK POZZOLAN NJ is in full compliance with ASTM C618 specifications for pozzolans used in concrete.
DIRK POZZOLAN NI can be utilized in variety of applications, the pozzolanic property gives it the ability to add superior properties when mixed with Portland cement.

MANASEER GROUP

MANASEER

is a holding company established in the year 1999 in Jordan by Ziad Al Manaseer who is currently its chairman. The Company operates mainly in Jordan and has activity in West Bank as well and manages 24 subsidiary companies related to infrastructure, and energy business solutions.

Understanding how Pozzolans are beneficial in concrete or High Performance Pozzolan Concrete (HPPC)

POZZOLANS are siliceous and aluminous materials which, in themselves, possess little or no cementitious value but which will, in finely divided form and in the presence of water, react chemically with calcium hydroxide Ca (OH)2) at ordinary temperature to form compounds

The benefits of pozzolan use in cement and concrete are threefold. First is the economic gain obtained by replacing a substantial part of the Portland cement by cheaper natural pozzolans or industrial by-products. Second is the lowering of the blended cement environmental cost associated with the greenhouse gases emitted during Portland cement production. The third advantage is the increased durability of the end product.

Blending of Pozzolans with Portland cement is of limited interference to the conventional production process and offers the opportunity to convert waste (for example, fly ash) into durable construction materials.

A reduction of 40 percent of Portland cement in the concrete mix is usually feasible when replaced with a combination of pozzolanic materials. Pozzolans can be used to control setting, increase durability, reduce cost and reduce pollution without reducing the final compressive strength or other performance characteristics.

The properties of hardened blended cements are strongly related to the development of the binder microstructure, i.e., to the distribution, type, shape and dimensions of both reaction products and pores. The beneficial effects of pozzolan addition in terms of higher compressive strength, performance and greater durability are mostly attributed to the pozzolanic reaction in which calcium hydroxide is consumed to produce additional C-S-H and C-A-H reaction products. These pozzolanic reaction products fill in pores and result in a refining of the pore size distribution or pore structure. This results in a lowered permeability of the binder.

The contribution of the pozzolanic reaction to cement strength is usually developed at later curing stages, depending on the pozzolanic activity. In the large majority of blended cements initial lower strengths can be observed compared to the parent Portland cement. However, especially in the case of pozzolans finer than the Portland cement, the decrease in early strength is usually less than what can be expected based on the dilution factor. This can be explained by the filler effect, in which small SCM (Supplemental Cement Materials) grains fill in the space between the cement particles, resulting in a much denser binder. The acceleration of the Portland cement hydration reactions can also partially accommodate the loss of early strength.

The increased chemical resistance to the DIRK Pozzolans is designed for improving concrete quality in the following environments:

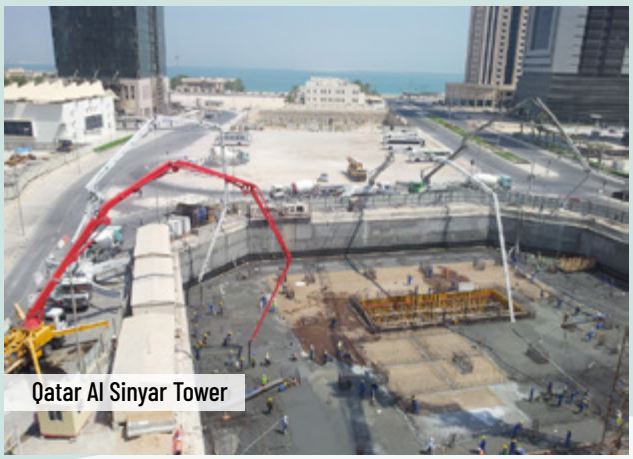
- Mass Concrete Foundations and Sections Due to Low Heat of Hydration.
- High Quality Finishes.
- Potentially Alkali-reactive Aggregates.
- Sulphate-Bearing Environments.
- Water Retaining Structures.
- Chloride-Bearing Environments.
- Effluent Treatment Plants.
- Marine Environments.
- High temperature environment

General product information to enable our customers to make a well informed choice is contained in attached technical Data Sheets for all natural and artificial DIRK POZZOLANS.

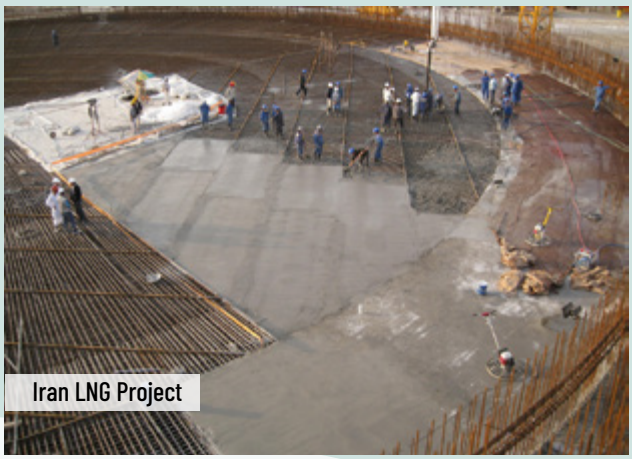
A few Pozzolan A projects

Ghatghar dam India

Middle Vaitarna Dam India



Qatar Al Sinyar Tower



Iran LNG Project

Bahrain Harbour Towers

Kuwait Boubyan Seaport Project - bridge 1

Dubai Burj Khalifa

Kuwait Al Hamra

Nepal Middle Marsyangdi Hydroelectric Power Project

Some facts on concrete... good to remember

Effects of DIRK POZZOLANs on the properties of fresh concrete

Decreasing Concrete Bleeding

Bleeding is a particular form of segregation, in which some of the water from the concrete comes out to the surface of the concrete and accumulates. The biggest factor in bleeding rates is the water to cement ratio. A higher ratio can lead to excessive bleeding, the cement type and fine aggregates can play a role in determining the bleeding rate. The fewer fines you have in your mix, the more bleeding will occur, the use of supplementary cementitious material can decrease bleeding rates especially when using finer blends. POZZOLANs can be effective in reducing bleeding rates and control the speed of migration of water to the surface while inhibiting the settling of solid particles.

DIRK POZZOLANS are able to reduce the concrete bleeding by reducing the number of capillary tubes and number of voids in the cement paste. By this way DIRK POZZOLANs prevent the chemical attacks on the aggressive processes on the surface of concrete.

Effects of Bleeding on Concrete:

- Due to bleeding, concrete loses its homogeneity.
- Bleeding is responsible for causing permeability in concrete
- In the process of bleeding (i. e. while water is in the process of coming to the top), sometimes water gets accumulated below the aggregate. This accumulation of water creates water voids and reduces bonds between the aggregate and cement paste, as a result the strength of concrete is reduced.
- Similarly, water that accumulates below the reinforcing bars, particularly below the cranked bars, reduces the bond between the reinforcement and concrete.

Increasing Setting Time

Setting of concrete is the process of transformation of concrete from a plastic state to a hardened state. Setting is entirely dependent on the setting of cement, that´s why the type of cement used highly influences the setting time.

The main factor which affects the setting time of concrete is the water cement ratio. When the water cement ratio is reduced, the initial and final setting times are increased.

Adding POZZOLANs to concrete mixtures leads to slightly increasing the setting time of concrete which is beneficial for distant transport of concrete and improves surface finish.

Decreasing Heat of Hydration

Reaction between Portland cement and water is an exothermic reaction that generates energy in the form of heat. This heat is referred to as the heat of hydration that results in raising concrete temperature. When higher cement percentages are used in the mixture, more heat of hydration is generated, because it consists of Tricalcium Silicate and Tricalcium Aluminate compounds. These compounds generate high values of heat when the hydration reaction is initiated. Adding POZZOLANs to concrete mixtures leads to a lower heat of hydration, since POZZOLANs will replace a portion of cement as cement contains Tricalcium Silicate and Tricalcium Aluminate compounds and these chemical compounds generate high values of heat. On the other hand POZZOLANs reduce the water demand in the concrete mix. Therefore the quantity of water and the microstructural space available for hydration will be reduced. Thus, reduced heat of hydration will protect the concrete from thermal cracking.

POZZOLANs help to minimize the effect of hot weather without losing any strength and durability features. Since POZZOLANs are able to reduce the heat of hydration, there is no need for cooling systems such as chilled water or shaved ice for concrete mixes that include DIRK POZZOLAN NJ in hot regions. Therefore, POZZOLANs are recommended for the usage in high temperature environments.

Effect of DIRK POZZOLAN NJ on the Properties of Hardened Concrete

Increasing Compressive Strength

Compressive strength is one of the most important properties of concrete, it could be defined as the capacity of concrete to withstand loads applied to it. The compressive strength is measured by applying a force on a specimen of concrete, the maximum load it could bear prior to failure is known as the compressive strength. The strength gain rate of concrete in the first seven days is very high, but afterwards it starts slowing. This strength gain is contributed by the Portland cement, which produces cementitious products upon reacting with water. POZZOLANs possess active silicates that react with the calcium hydroxide freed during the hydration process, and produce more cementitious products that result in acquiring higher compressive strengths. When using POZZOLANs in concrete mixes, it is expected that the rate of strength gain will be lower than conventional concrete in the first seven days. After seven days the concrete with rate of strength gain is highly accelerated, and will exceed that of the conventional concrete. This rate of strength gain is continuous over time, producing dramatically higher ultimate strengths than ordinary cement.

Durability and Permeability of Concrete

Durability of concrete is defined as concrete´s ability to withstand severe weather conditions, hostile chemical attacks and any natural impact it may undergo while maintaining its required properties.

Permeability of concrete is defined as the rate of flow of water through concrete. Permeability and durability of concrete can be significantly enhanced by using POZZOLANs owing to the pozzolanic reaction, whereas it reacts with free lime, producing more cementitious compounds that results in higher density and strength values. It also reduces water demand, which leads to the reduction of internal voids and bleeding channels in concrete. Each one of these factors plays a major role in producing a concrete of low permeability and high durability.

Reducing Alkali/Silica Reactivity

Alkali/silica attack is a reaction that takes place when reactive silicates present in aggregates react with alkalis from any source. It causes an excessive expansion to concrete which causes surface ruptures in addition to interior stresses that might lead to cracking and weakening of concrete.

DIRK POZZOLANs react with and binds alkalis present in cement and aggregates, thus stopping the reaction from happening and enabling fresh concrete paste to maintain its volume after hardening.

Increasing Resistance to Freezing and Thawing

Freeze/thaw deterioration has been and continues to be a problem in the areas of cold weather. Freeze/thaw cycles begin when water enters the voids in concrete and freezes. The expansion of water upon freezing increases the volume of concrete, the extremely high pressure generated exceeds concrete´s capacity to resist it, causing it to be forced apart from within.

DIRK POZZOLANs help to decrease freeze/thaw deterioration by reacting with calcium hydroxide, reducing the amount of calcium hydroxide leached out during the hydration process, thereby reducing voids and channels caused by leaching of calcium hydroxide, so that water could penetrate through concrete.

Increasing Resistance to Sulphate Attack

Precautions usual have to be made to protect Portland cement from sulphates that come from various sources such as soils, ground water and sewage. Using DIRK POZZOLANs in the concrete mix helps to provide the required resistance.

Sulphate Attack is a two-phased process.

Sulphate attack consists of two reactions, the first one that takes place when sulphate reacts with calcium hydroxide to produce calcium sulphate (gypsum), the second one happens when aluminate compounds from Portland cement react with sulphates and calcium to form a compound called ettringite. Both gypsum and ettringite are very fragile and cause weakness in concrete´s structure. DIRK POZZOLANs react with unbound calcium hydroxide and prevents foreign materials containing sulphates from penetrating concrete, accordingly forbidding the sulphite attack from occurring.

DIRK POZZOLANS effectively retards this sulphate deterioration in three important ways:

1. DIRK POZZOLANs react with unbound calcium hydroxide and in return it wouldn´t be available for the sulphate reaction.

2. Using DIRK POZZOLANS will produce a less permeable concrete, preventing sulphates from entering concrete.

3. Using less amounts of Portland cement and replacing a percentage of it with DIRK POZZOLANs results in fewer amounts of aluminium available for the sulphate reaction.

Benefits of using DIRK POZZOLANs

Ready Mix producers, engineers, architects, developers and contractors are all interested in using DIRK POZZOLANs to improve the key properties of concrete, such as compressive strength, durability and permeability while maintaining economic feasibility.

The importance of fly ash in concrete coupled with reduction in fly ash supply has spurred a movement in the concrete sector to identify new sources of SMCs that can fill this gap in the fly ash supply puzzle.

ENVIRONMENTAL BENEFITS

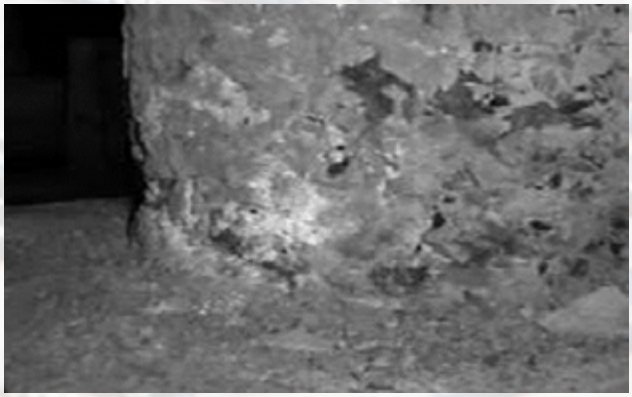
A lot of environmental benefits are obtained using DIRK POZZOLANs. The main important benefits are those associated with the reduction of cement consumption, which translates into reducing the carbon footprint of cement production and saving raw materials such as limestone and coal. Cement manufacturing is an industry that consumes a lot of energy.

The calcination reaction that the clay, limestone and other ingredients undergo occurs at very elevated temperatures (up to 1450 degrees Celsius). Combustion of large amounts of fossil fuels is required to reach this temperature and, as a consequence, high quantities of greenhouse gases are emitted. It is believed that about 1 ton of CO2 is emitted when manufacturing 1 ton of cement.

DIRK NATURAL POZZOLANs are more advantageous than other pozzolans because they are free from heavy metals such as mercury, lead, arsenic, selenium, chromium and cadmium.

Minimizing the quantity of cement used by replacing a portion of it with DIRK POZZOLANs will contribute to a better, cleaner environment.

If you want to see environmental video statement of our Chairman Georg Dirk, use the following QR code.



SUMMARY OF BENEFITS

Reduction heat of hydration
• High temperature environments
• Mass concretes (rafts, shear walls, dams, retaining walls, solid slabs)

Reduction of water requirements
• Mass concrete
• High temperature environments
• Sites lacking water needs

High ultimate strength
• Footings
• Columns, load bearing elements
• Shear walls, retaining walls
• Shells
• Pre-stressed concrete

Provision of needed time for the casting and placement
• Retardation of setting time
• For far destinations and high temperature environments

Better soundness
• In marine environments
• Submerged structures
• Soil stabilization works

Reduction of bleedin
• Effective especially in hot weather environments
• Enhancement of early age strength

Internal cracks are reduced
• Mass concrete
• Marine environments
• Hot weather conditions

Providing high finishability
• For floors, plastering walls
• Improving the finishing of rectangular or square sections due to increase of setting time

Little effect on plastic shrinkage cracking
• Due to less bleeding effect DIRK POZZOLANs have a lower tendency toward PSC

Freeze-Thaw resistance
• Pavements (HMA, bituminous, concrete)
• Environments where temperature difference between night and day is high

Deice-scaling resistance
• For Freeze-Thaw environment
• Improved with lower w/c ration

Reduction of drying shrinkage and creep
• Obtaining high crack control
• Providing resistance to long term deflections
• Beneficial in Cantilevers and suspended elements

Reduction of permeability and absorption
• For walls and floors of factories
• Foundations prone to sulfate attacks
• Structural elements such as tie beams and wall footings in contact with moist soils
• Reduction in soundness of elements prone to permanent contact with water
• Marine environments

Control of Alkali-Aggregate reactivity
• Soil enhancement and stabilization works
• Concrete pavements where large amounts of aggregate are used in pavements layers

Provision of sulfate resistance
• Marin environment
• Open channels
• Water carrying pipes
• Culverts
• Bridge footings
• Wastewater treatment plants and sewers

Reduction of corrosion of embedded steel
• Marine environments
• Water tanks and wells, by preventing segregation and honeycomb appearance

Reduction of carbonation process
• Increasing the compressive strength
• Preventing the occurrence of efflorescence
• Aesthetically finished concrete
• Enhancement of both structural and architectural aspects)

Provides chemical resistance (by reducing permeability)
• Marine environments
• Water treatments plants
• Slabs on grade for factories and concrete pipes

Good rutting resistance and superior friction properties
• Used especially in HMA pavements where it resists stripping and rutting

Provision of weight lightness
• Insulation uses
• Structural uses

Large volume occupancy with low mass
• Mass concrete applications
• Used as filling material

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PRODUCT DATA SHEET

DIRK POZZOLAN A 40 – Cement Replacement

Description Dirk Pozzolan A 40 is a high efficiency pozzolanic material, obtained by selection and processing of power station fly ashes resulting from the combustion of pulverised bituminous coal. Dirk Pozzolan A 40 is subjected to strict quality control.

General Information

Presentation	Finely divided dry powder
Colour	Light grey
Bulk Weight	Aprox. 1.0 metric ton per cubic meter
Specific density	Aprox. 2.3 metric ton per cubic meter
Particle size	Maximum 25 % ROS on 45 micron sieve
Particle shape	Spherical
Package	1 metric ton big-bags and bulk tankers

Recommended uses

Concrete	General purpose plain and reinforced structural concrete
	Mass concrete to reduce the heat of hydration
	Pumpable concrete by providing excellent workability
Cement	Blended cements (Portland Pozzolana Cement), such as sulphate resistant/marine resistant cement.
Mortar	General purpose mortar for plastering and brickwork.
	Specialised mortars for floor / wall tiling work.
	Flowable mortars for use as structural fill in earthworks.
Grout	General purpose grouts for use in earthworks for the treatment of rock cracks.

Recommended dosages

The dosages of Dirk Pozzolan A 40 and the other mix constituents should be determined by appropriate mix design testing. They will depend on required mix properties, grade of cement, admixtures used, etc. The following figures are indicative.

Typical replacement levels with Dirk Pozzolan A 40

	Percentage of total binder	Dosage
Mass concrete	50%	100 – 150 kg/m3

Typical concrete performance with 25% Dirk Pozzolan A 40

Workability	Improved
Setting Time	Increased 30 - 60 min
Long Term Strength	Increased 15% -20%
Early Strength (7 days)	Reduces by 20%
Required Curing	8 to 10 Days
Permeability	Reduced 2 - 5 times
Sulphate Attack	**Substantially Reduced**
Chlorine Penetration	Substantially Reduced
Heat of Hydration	Substantially Reduced
Plastic Shrinkage	Reduced

PRODUCT DATA SHEET

DIRK POZZOLAN A 60 - cement replacement

Description - Dirk Pozzolan A 60 is a high efficiency pozzolanic material, obtained by selection and processing of power station fly ashes resulting from the combustion of pulverised bituminous coal. Dirk Pozzolan A 60 complies to EN 450 class N and is subjected to strict quality control.

General Information

Presentation	Finely divided dry powder
Colour	Light grey
Bulk Weight	Aprox. 1.0 metric ton per cubic meter
Specific density	Aprox. 2.3 metric ton per cubic meter
Particle size	Maximum 18 % ROS on 45 micron sieve
Particle shape	Spherical
Package	30 kg paper bags, 1 metric ton big-bags and bulk tankers

Recommended uses

Concrete	General purpose plain and reinforced structural concrete with 28 day strength levels up to 50 MPa.
	Special purpose concrete, such as mass concrete, pre-cast concrete, pumpable concrete, self-compacting and self-levelling concrete.
Cement	Blended cements (Portland Pozzolana Cement), such as sulphate resistant/marine resistant cement.
Mortar	General purpose mortar for plastering and brickwork.
	Specialised mortars for floor / wall tiling work.
	Flowable mortars for use as structural fill in earthworks.
Grout	General purpose grouts for use in earthworks for the treatment of rock cracks.
	Grouts for earthworks to be used in anchors.

Recommended dosages

The dosages of Dirk Pozzolan A 60 and the other mix constituents should be determined by appropriate mix design testing. They will depend on required mix properties, grade of cement, admixtures used, etc. The following figures are indicative.

Typical replacement levels with Dirk Pozzolan A 60

	Percentage of total binder	Dosage
Low grade concrete (up to 35 Mpa)	23% -35%	80 – 150 kg/m3
Medium grade concrete (35-50 Mpa)	25% - 35%	100–175 kg/m3
Pre-cast concrete	20% - 35%	70 –140 kg/m3
Mass concrete	50%	100 – 150 kg/m3
Pumpable concrete	30% - 35%	100–175 kg/m3
Self compacting/levelling concrete	40%	150 – 200 kg/m3

Typical concrete performance with 25% Dirk Pozzolan A 60

Water Demand	Reduced by 8%
Workability	Improved
Setting Time	Increased 30 - 60 min
Long Term Strength	Increased 15% -20%
28 day Strength	Similar
Early Strength (7 days)	Reduces by 10-15%
Required Curing	8 to 10 Days
Permeability	Reduced 2 - 5 times
Sulphate Attack	**Substantially Reduced**
Chlorine Penetration	Substantially Reduced
Heat of Hydration	Substantially Reduced
Plastic Shrinkage	Reduced

PRODUCT DATA SHEET

DIRK POZZOLAN A 63 – Cement Replacement

Description - Dirk Pozzolan A 63 is a high efficiency class F pozzolanic material confirming to EN 450 class S, BS 3892, IS 3812 and ASTM C618, obtained by selection and processing of power station fly ashes resulting from the combustion of pulverised coal. Dirk Pozzolan A 63 is subjected to strict quality control.

General Information

Presentation	Finely divided dry powder
Colour	Light grey
Bulk Weight	Aprox. 0,90 metric ton per cubic meter
Specific density	Aprox. 2,30 metric ton per cubic meter
Particle size	Maximum 12 % ROS on 45 micron screen
Particle shape	Spherical
Package	30 kg paper bags, 1 metric ton big-bags and bulk tankers

Recommended uses

Concrete — General purpose plain and reinforced structural concrete with 28 day strength levels up to M60 .

Special purpose concrete, such as mass concrete, pre-cast concrete, pumpable concrete, self-compacting and self-levelling concrete.

Cement — To manufacture Blended cements (Portland Pozzolana Cement), such as sulphate resistant/marine resistant cement.

Mortar — General purpose mortar for plastering and brick/block gluing

Specialised mortars for gluing floor/wall tiles.

Flowable mortars for use as structural fill in earthworks.

Grout

General purpose grouts for use in earthworks for the treatment of rock cracks.

Grouts for earthworks to be used in anchors.

Recommended dosages

The dosages of Dirk Pozzolan A 63 and the other mix constituents should be determined by appropriate mix design testing. They will depend on required mix properties, cement grade and properties, admixtures used, etc. The following figures are indicative.

	Percentage of total binder	Dosage
Low grade concrete (up to 30 MPa)	35%	80 – 140 kg/m3
Medium grade concrete (30-60 Mpa)	30%	100 – 150 kg/m3
Pre-cast concrete	20%	60 – 80 kg/m3
Mass concrete	50%	100 – 150 kg/m3
Pumpable concrete	35%	90 – 120 kg/m3
Self compacting/levelling concrete	40%	150 – 200 kg/m3
Portland Pozzolana Cement	35%	
General purpose mortar (indoors)	33%	-----
General purpose mortar (outdoors)	17%	-----
Gluing mortars	25%	-----
Flowable mortars	30% - 95%	-----
Grouts for rock treatment	33%	-----
Grouts for anchors	17%	-----

Typical concrete performance – Replacement 1:1
(compared to plain PC mixes)

	Better	Similar	Worse
Water Demand	Reduced 5% - 8%		
Workability	Improved		
Setting Time	Increased 30 - 60 min		
Long Term Strength	Increased 15% -20%		
28 day Strength		Similar	
Early Strength (7 days)			Reduced 10% - 15%
Required Curing Period		Similar	
Permeability	Reduced 2 - 5 times		
Sulphate Attack	Reduced		
Chloride Penetration	Reduced		

PRODUCT DATA SHEET

DIRK POZZOLAN A 100

For high performance concrete

Description: Dirk Pozzolan A 100 is a very high efficiency pozzolanic material for use as a component of cement with Portland clinker (i.e. as a partial replacement of Portland cement) to yield high performance concrete. It is produced by careful selection, processing and testing of fly ash resulting from the combustion of coal used at electricity generating power stations. It is a top of the range product in terms of all the International Standard specifications for fly ash and is subjected to stringent quality control.

General Information:

Presentation:	Finely divided dry powder
Colour:	Greyish white
Bulk Weight:	0.65 tonne/m^3
Specific density:	2.3 metric ton per cubic meter
Loss on Ignition	< 2.5%
Particle size:-	Less than 5% retained on 25 micron sieve
Particle shape:	Spherical
Package:	30 kg bags
Water demand:	8 to 12% reduction

Recommended uses:

Concrete: General purpose, plain and reinforced structural concrete, with 28 day strength exceeding 70MPa yielding high early strengths as well. Special purpose, such as pre-stressed, pre-cast and high performance concrete for its rheological, engineering permeation and durability properties.

Cement: High grade, sulphate and chloride resistant, as well as low and very low heat, PC/fly ash blended cements.

Grout: Specialised micro-grouts for crack sealing in repair works

Recommended Proportions:

The proportions of DIRK POZZOLAN A 100 and the other mix constituents should be determined
by an appropriate mix design method and testing. The proportion of DIRK POZZOLAN A 100 used would depend on the required concrete properties, type of PC and admixture used.
The following figures are indicative.

Typical Dosage of Dirk Pozzolan A 100

Product	% of Dirk Pozzolan A 100 from total binder content
High Strength Concrete > 70 MPa	8-10
Medium High Strength Concrete (40-70 Mpa)	5-10
Pre-Stressed Pre-cast Concrete	8-10
High Performance Concrete	5-10
High Grade Portland Pozzolana Cement	5-10
Mortars for Concrete Repair	20
Micro-Grouts for Crack Sealing	10-25

Typical concrete performance with 10% Dirk Pozzolan A 100 w.r.t. PC Concrete

Property	Better	Similar	Worse
Water Demand	Reduced, 8 -10%	-	
Workability	Improved	-	
Stability	Improved Greatly		
Plastic Shrinkage	Reduced		
Plastic settlement	Reduced		
Setting Time	Increased 15 - 45 min	-	
Heat of Hydration	Reduced Greatly		
Long Term Strength	Increased 25 - 30%	-	
28 day Strength	Increased 15- 20%	-	
Early Strength (7 days)		Similar	
Required Curing		Similar	
Permeation	Reduced 2 - 5 times		
Sulphate Attack	Reduced Substantially		
Chlorine Penetration	Reduced Substantially		
ASR Risk	Minimised		

PRODUCT DATA SHEET

DIRK POZZOLAN A+ – Cement Replacement

Description Dirk Pozzolan A+ is a high efficiency pozzolanic material, obtained by selection and processing of power station fly ashes resulting from the combustion of pulverised bituminous coal with addition of a polymer. Dirk Pozzolan A+ is subjected to strict quality control.

General Information

Presentation	Finely divided dry powder
Colour	Light grey
Bulk Weight	Aprox. 1.0 metric ton per cubic meter
Specific density	Aprox. 2.3 metric ton per cubic meter
Particle size	Maximum 35 % ROS on 45 micron sieve
Particle shape	Spherical
Package	1 metric ton big-bags and bulk tankers

Recommended uses

Concrete	Everywhere where lower grade concrete is required – M20 to M60
Mortar	General purpose mortar for plastering and brickwork.
	Specialised mortars for floor / wall tiling work.
	Flowable mortars for use as structural fill in earthworks.
Grout	General purpose grouts for use in earthworks for the treatment of rock cracks.

Recommended dosages

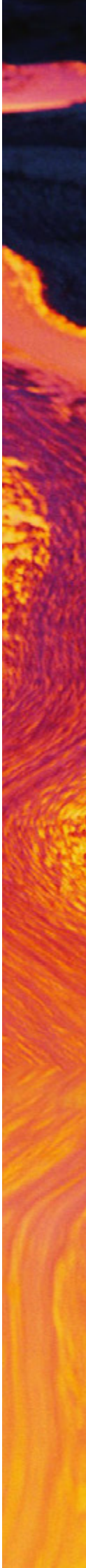
The dosages of Dirk Pozzolan A+ and the other mix constituents should be determined by appropriate mix design testing. They will depend on required mix properties, grade of cement, admixtures used, etc. The following figures are indicative.

Typical replacement levels with Dirk Pozzolan A+

	Percentage of total binder	Dosage
Low grade concrete	15%	50 - 75 kg/m3

Typical concrete performance with 15% Dirk Pozzolan A+

Workability	Improved
Setting Time	Increased 10 – 15 min
Long Term Strength	Increased 15% -20%
Early Strength (7 days)	Increased by 15%
Required Curing	8 to 10 Days
Permeability	Reduced 3 times
Sulphate Attack	**Substantially Reduced**
Chlorine Penetration	Substantially Reduced
Heat of Hydration	Substantially Reduced
Plastic Shrinkage	Reduced



PRODUCT DATA SHEET

DIRK HIGHGRADE – MICROSILICA REPLACEMENT

Description - DIRK HIGHGRADE is an ultra-fine key ingredient with optimum particle size for manufacturing high-performance concrete. It is primarily manufactured using industrial wastes and thus is a heterogeneous blend of oxides of calcium, silicon, and aluminium with no deleterious impurities. To enhance its physical and chemical properties, it is chemically modified with specialized polymers.

General Information

Physical Properties:

Appearance	Finely divided dry powder
Colour	Gray
Specific Gravity	2.26
Bulk Weight (gm/cc)	0.75 ± 0.05
Particle size (%) retention on 45-micron sieve	2.1
Particle shape	Spherical

Chemical Properties:

SiO_2 (%)	47.09
Fe_2O_3 (%)	3.40
Chloride Content	0.03
Available Alkalis as Na_2O (%)	<0.1
Loss on Ignition (%)	<2.5

Recommended uses

Concrete:

- Conventional Concrete mix
  - ✓ 100% replacement of Micro-Silica & Metakaolin.
- High-grade concrete (above M50)
- Low-grade concrete (M20-M50)
  - ✓ 16% cement replacement
  - ✓ Strength jumping by adding (2%, 4% & 6% of DIRK HIGHGRADE)

Cement:

- Sulfate and chloride-resistant cement
- Low and very low heat cement
- Blended cement.

Mortar:

- Flowable mortars for structural fill-in earthworks
- Mortar for plastering and rendering work
- Specially formulated mortars for floor and wall tiles.

Grout:

- Grouts for anchors To Treat rock cracks in earthworks.

Recommended dosages

The dosage of DIRK HIGHGRADE and other mix constituents should be established by performing proper trials of a designed mix. The amount of percentage replacement shall depend on expected mix properties, incorporated admixture, cement grade, and its properties, etc.,

Permeability Test (EN-12390-2009 part-8)

Sr. No.	Product	Cube Weight (kg)	Maximum depth of penetration (mm)	Average depth of penetration (mm)
1.	DIRK HIGHGRADE	8.84	17	17
		8.64	16	
		78.72	17	

RCPT test (ASTM C-1202-19)

Sr. No.	Product	Concrete slice (charge passed in Columbs)	Concrete Slice (Average charge in Columbs)	Chloride Ion penetration
1.	DIRK HIGHGRADE	1497.6	1456	Low
		1558		
		1414.8		

Compressive strength of concrete after Cement Replacement

Grade of Concrete	Mineral Composition	Total Binder	Slump	Compressive strength		
	OPC+DIRK HIGHGRADE+GGBS	kg/Cum	mm	07 Days	28 Days	60 days
M 60	95%+5%+0%	460	95	34.25	52.90	69.35
M 60	70%+5%+25%	450	100	37.55	52.45	66.40
M 60	60%+10%30%	500	100	51.75	62.20	63.95

Comparison of DIRK HIGHGRADE to Microsilica		
Description	Microsilica	DIRK HIGHGRADE
Cementitious considered per m3 in Kg	450	
Replacement to Cementitious in %	5	2
Replacement to Cementitious in Kg	22.5	9
Rate per Kg	20	27
Effective Cost per m3 in INR	450	243
Saving due to DIRK HIGHGRADE per m3 in INR	207	
Compressive Strength in Mpa	61	65
Slump in mm	120	120
W/C Ratio in%	0.35	0.32

PRODUCT DATA SHEET

DIRK POZZOLAN NJ

DIRK POZZOLAN NJ is a newly engineered, mechanically activated **natural** fine pozzolanic material, free from heavy metals such as arsenic, lead, mercury, cadmium, chromium and selenium.

DIRK POZZOLAN NJ is a natural pozzolanic material and it can be used as a replacement or additive material, which highly improves the characteristics of concrete

II – COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT(S) CHEMICAL NAME	CAS REGISTRY NO	% by weight (approx)	MSHA/OSHA PEL	ACGIH TLV-TWA
Silicon Dioxide*, SiO_2	14808-60-7	< 60	(R) 10 mg/m³/(% SiO_2+2) §	(R) 0.025 mg/m³
Aluminum Oxide, Al_2O_3	1344-28-1	10-20	(T) 15 mg/m³,(R) 5 mg/m³	#10 mg/m³
Iron oxide (FeO, Fe_2O_3)	1345-25-1,1309-37-1	2-20	##10 mg/m³	5 mg/m³
Magnesium Oxide, MgO	1309-48-4	1-15	15 mg/m³	10mg/m³
Calcium Oxide, CaO	1305-78-8	5-15	5 mg/m³	2mg/m³
Sodium Oxide, Na_2O	1313-59-3	2-15	-	2mg/m³ as NaOH
Potassium Oxide, K_2O	12136-45-7	0-12	-	-
Titanium Oxide, TiO_2	13463-67-7	0-3	15 mg/m³	10 mg/m³
Manganese Oxide, MnO**	1313-13-9	< 1	(C) 5 mg/m³	0.2 mg/m³
Phosphorus Pentoxide, P_2O_5***	1314-56-3	< 1	0.1 mg/m³	0.1 mg/m³

*: The composition of SiO_2 may be up to 100% crystalline silica. **: Based on Manganese compounds/fume, ***: Based on Phosphorus.(R): Respirable (T): Total, (C): Ceiling limit. §: Crystalline silica is normally measured as respirable dust. The OSHA standard also presents a formula for calculation of the PEL based on total dust: 30 mg/m³ / (% SiO_2 +2). #: Particulate matter containing no asbestos and <1% crystalline silica; ##: Based on Fe_2O_3

The chemical composition of DIRK POZZOLAN NJ is very similar to that of Portland cement. The same compounds exist in DIRK POZZOLAN NJ and Portland Cement.

DIRK POZZOLAN NJ compounds are amorphous (glassy) due to rapid cooling.

Cement compounds are crystalline because of slow cooling.

The main difference between DIRK POZZOLAN NJ and Portland cement is the relative quantity of each of different compounds. Portland cement is rich in lime CaO while DIRK POZZOLAN NJ N is low. Reactive silites are high in DIRK POZZOLAN NJ N while Portland cement has smaller amounts.

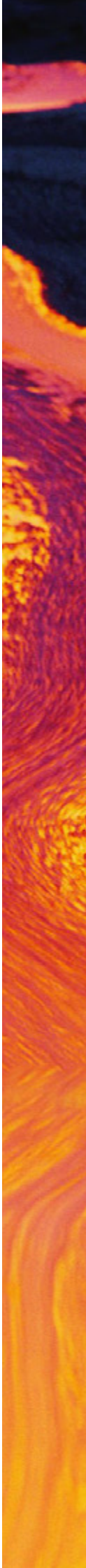
Typical chemical compounds in DIRK POZZOLAN NJ and Portland cement (OPC), in %:

Chemical compound	Dirk Pozzolan NJ	OPC
SiO2 45	79	19,55
AL203	1392	4.68
FE2O3	1448	4.34
CaO	8.55	62.79
MgO	9.50	1.72
SO3	0.76	2.94
NA 2O	2.70	0.44
K2O	0.93	0.40
Cl	0,0100,035	

Fields of application

<u>Ready Mix Concrete</u>

- Mass concrete foundations and sections due to low heat of hydration
- High quality finishes
- Potentially alkali-reactive aggregates
- Sulfate-bearing environments
- Effluent treatment plants
- Marine environments
- High temperature environment as strength development will be accelerated while in cold weather shall be used with care



Construction Chemicals

- Self-leveling screed
- Non shrink grout
- Anchoring grout
- Water proofing
- Floor hardeners
- Dark color tile grout
- Tile adhesives
- Repair mortars
- Cosmetic mortars

Compliance with ASTM C 618- 2017		
Required Test	**Result %**	**Conformity Criteria**
Sulfur trioxide	0.2 – 0.8	4.0% max.
Sum (SiO_2, Al_2O_3, Fe_2O_3)	70.5 – 75.5	70.0% min.
Moisture	0.4 – 1.2	3.0% max
Loss on ignition	0.8 – 1.2	10.0% max.
Fineness (retained on 45 um (No. 325) sieve)	1.7 – 3.3	34.0% max
Strength activity index		
With Portland cement, at 7 days, min, percent of control	77.0 – 82.5	75.0% min
With Portland cement, at 28 days, min, percent of control	77.5 – 83.0	75.0% min
Water requirement	95 – 105	115% max
Autoclave expansion	0.1 – 0.5	0.8% max

Note: The product specifications tested by ACES & Ministry of Energy and Mineral resources.