# Product presentation: “Pyramid” brand Fly Ash

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## What is Fly Ash?

Fly ash is finely divided by product resulting from the combustion of ground or powdered coal. They are generally finer than cement and consist mainly glossy spherical particles as uses as residences of hematites and magnetite of char and some crystalline places formed during cooling.

It is essentially a silicon or aluminous material or both which while in itself possess no cementations properties, which will, when in finely divided form in presence of moisture react with calcium hydroxide liberated in the hydration process at ordinary temperature to form compounds which possess cementious properties.

The important features as fly ash for civil engineering are.

1) Spherical & Glossy shape.
2) Silicon & aluminous contents.
3) Very low calcium oxide content about 1 to 3%.

Standards of usage of Fly ash

1) IS 456:2000 & IS 3812 & IS 1489: 1991
2) British standard BS: 3892
3) ASTM - 618, D 579, ASTMC - 595, ASTMC – 311

Physical & Chemical requirements IS 3812

IS 3812 Pyramid test
Table – 1.
Phy. Chem requirement report.

| | | |
|---|---|---|
| 1) Sicilon dioxide (SIO2) aluminum oxide (AI2O3)& $Fe_2O_3$, | 70.00 | 95 |
| 2) Sicilon Dioxide (SiO2) % by mass Minimum. | 35.00 | 62 |

| | | |
|---|---|---|
| 3) Magnesium Oxide ( Mgo)% by mass Maximum. | 5.00 | Trace |
| 4) Total Sulfur as sulfur trioxide (So3)% maximum. | 2.75 | 0.20 |
| 5) Available Alkalies as sodium oxide (Na2O) Maximum. | 1.5 | 1.00 |
| 6) Loss of ignition % by mass (Maximum) | 05.00 | 1.20 |
| 7) Fineness - Specific in M3/kg by Blaine permeability Method Minimum. | 325.00 | $400^{+}$ |
| 8) Lime reactivity Avg Com strength in N/M Minimum. | 4.00 | 5.9 |
| 9) Soundness: Auto clave Method (Max) % | 0.8 | 0.05 |
| 10) Drying shrinkage percentage Maximum. | 0.15 | 0.04 |

**Why Fly Ash in Concrete?**

Concrete is a composite material, which essentially consists of two components aggregates and cementatious paste. To produce good concrete it is extremely important to have a smooth gradation of material from rock down to finest particles. Ideally it is best to have as much volume possible filled with durable strong aggregate particle and with enough cementatious paste to coat every particle. Also voids should be minimized for strength & durability. It is to be realized that strength and durability are not synonymous, where we talk about concrete. Durability is the ability maintains integrity and strength over period of time. Strength is only means the ability to sustain load at a given point of time. Two concrete mixes with equal strength can vary widely in their permeability, resistance to cracking, resistance to freeze thaw damages, chemical attacks and genral deterioration overtime, all of which are important for durability.

Cement paste is weaker than average aggregate in normal concrete with rare exception when very soft aggregates are used. The paste is more permeable that any mineral aggregates. It is paste which susceptible to chemicals attacks, the lesser the quality as such weak materials, the better will be concrete, Hence it become very necessary to improve the quality of cement paste & remove the harmful contents of the by product reaction of hydration.

The weakest by product of hydration reaction is free lime or calcium hydroxide ($Ca(OH)_2$). It is harmful in the following manner:

1) It increases the 'PH' Value of concrete.
2) Crystals of free lime are larger than the products of hydration leading to weaker transition zone.
3) Free lime $Ca(OH)_2$ leaches out after a period of lime leaving the upper crust of the concrete weak & permeable.

4) Free lime Ca $(OH)_2$ reacts with sulphates & chlorides to make the concrete a feeble mass over a period of time.
5) Leached out Ca $(OH)_2$ is very dangerous for reinforcement in the concrete.

The quality of cement paste can be improved very easily by pozzalanic reaction:

Ca $(OH)_2$ + $Sio_2$ -> $(Casio_2)_3$

The cheapest & most silica ($Sio_2$) rich pozzalana is 'Fly Ash", provided it is graded & classified as per IS 3812, ASTM 618 & BS 3892.

## BOGNES COMPOUNDS

| | |
|---|---|
| Tricalcium silicate | $3CaO\text{-}SiO_2 - C_3S$ |
| Diacalcium silicate | $2CaO\text{-}SiO_2\text{-}C_2S$ |
| Tricalicum Aluminate | $3CaOAl_2O_3\text{-}C_3A$ |
| Tetra calcium aluminoferrite | $4CaOAl_2O3Fe_2O_3\text{-}C_7AF$ |

## Reaction with water

| | |
|---|---|
| Tricalcium silicate | $2C_3S+6H_2O \rightarrow (CaSIO_2)_3 + 3Ca(OH)_2$ |
| Diacalcium silicate | $2C_2S+4H_2O \rightarrow (CasiO_2)_2+2Ca(OH)_2$ |
| Tricalicum Aluminate | $2C_3A+ 6H_2O \rightarrow CaAl_2O_3 : H_2O$ |
| Tetra calcium aluminoferrite | $2C_4AF+8H_2O \rightarrow C_4ASH_{18}$ or calcium monosulphate. |

## POZZOLANIC REACTION

$Ca(OH_2) + SiO_2 \rightarrow CaSiO_2+H_2O$