A SEMINAR
ON
ALTERNATIVE CONSTRUCTION MATERIALS

BY:

KHAZI MOHD NADEEMULLAH (14571A0120)

ABDUL SAMI SIDDIQUI (14571A0106)

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CIVIL ENGINEERING

SVITS COLLEGE

FLYASH

INTRODUCTION

The Fly ash is a fine powder thrown out as a waste material in large quantities at the modern thermal power stations in our country. Fly ash is one of the residues generated in the combustion of coal. It resembles a pozzolana (i.e.) substances which constituents which combine with the lime to form a material having cementing properties.

FLYASH

In India, coal will continue to remain a major source of fuel for power generation. At present, about 60% power is produced by using coal as fuel, which results in the production of about 112 million tons of flyash per annum. Considering the tremendous growth required in the power sector for the development of Indian economy, it is expected that ash generation will reach 225 million tons by 2017.

flyash

Fly ash is a byproduct from burning pulverized coal in electric power generating plants. During combustion, mineral impurities in the coal (clay, feldspar, quartz, and shale) fuse in suspension and float out of the combustion chamber with the exhaust gases. As the fused material rises, it cools and solidifies into spherical glassy particles called fly ash.

1. **Class F fly ash**
2. **Class C fly ash.**

The chief difference between these classes is the amount of calcium, silica, alumina and iron content in the ash. The chemical properties of fly ash are largely influenced by the chemical content of the coal burned (i.e. anthracite, bituminous, Ignite)

CLASS F FLY ASH :-

The burning of harder, older anthracite and bituminous coal typically produces class F fly ash. This fly ash is pozzolanic in nature and contains less than 10% lime possessing pozzolanic properties, the glassy silica and alumina of class F fly ash requires a cementing agent such as Portland cement, quick lime or hydrated lime, with the presence of water in order to react and produce cementation compounds. Alternatively the addition of a chemical activator, such as Sodium Silicate to a class F fly ash can lead to the formation of a geo polymer

class F flyash

CLASS C FLYASH:-

Fly ash produced from the burning of sub bituminous coal, in addition to having pozzolanic properties, also has some self cementing properties. In the presence of water, Class C fly ash will harden and generally contains more than 20% lime. Unlike class F, self cementing class C fly ash does not require any activator. Alkali and sulphate contents are generally higher in class C fly ashes.

Fig 3.3: class C flyash

PROPERTIES OF FLYASH:

Physical properties of fly ash :-

The main physical properties which influences the properties of fly ash are :

1. Fineness
2. Particle shape

Fineness**: -** As the particles size decreases, the surface area of unit mass increases and makes the fly ash effective. This is the most important property, which decides the usefulness of a particular Fly ash for a particular job. Fineness can be determined by sieve analysis or by hydrostatic method.

Particle shape: **-** The quality of fly ash depends on the shape of particles and properties such as workability, water retention, binding etc. depends on the particle shape. Generally fly ash contains angular as well as rounded, glassy particles of quartz, hematite etc. Particle shape is determined with the help of polarizing microscopes.

Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators. Fly ash particles are generally spherical in shape and range in the sizes from 0.5 um to 100um.

They consist mostly of silicon oxide which is present in two forms.

1) Amorphous: which is rounded and smooth crystalline; which is sharp pointed.

2) hazardous: aluminum oxide and iron oxide. Fly ashes are generally highly heterogeneous, consisting a mixture of glassy particles with various identifiable crystalline phases.

POZZOLANIC PROPERTIES OF FLY ASH:-

The presence of chemical constituents like alumina, silica, lime, Iron oxide, magnesium oxide, sulphur trioxide etc. imparts pozzolanic properties of fly ash. As such fly ash becomes suitable for use as pozzolana, if it satisfies the suitable requirement as per the test results.

A test called fratini test is conducted to decide a property of fly ash called "Reactivity test strength".

Fly ash having reactivity test strength of not less than 40 Kg/cm are considered suitable for use as pozzolana in brick making.

3.5 : FLY ASH UTILIZATION AREAS:

1) Research and development (R&D) efforts and gainful utilization of fly ash have been undertaken in India and other parts of the world during the last two decades.

Fig:**3.5**: Flyash used in construction

MAJOR AREAS OF FLY ASH UTILIZATION WHICH HAVE BEEN ESTABLISHED THROUGH CONTINUED R&D EFFORTS IN OUR COUNTRY:

1) Soils like Black cotton soils are highly expansive, sticky and susceptible to moisture, as such they are not fit for brick making. The same black cotton soil can be made fit for the manufacturing of the bricks by adding fly ash as an admixture in required proportion.
2) Fly ash alone can be mixed with lime and gypsum in suitable properties and can be used for manufacturing the bricks without burning.

3) Fly ash is also used for soil stabilization and for production of light weight aggregates for use in concrete.

3.6 USES OF FLYASH:

The research conducted in India and a broad indicates that the fly ash can be used in many profitable applications, and out of the possible general uses, the following three practical applications are briefly discussed.

1. Addition to mass concrete
2. Cellular concrete blocks
3. Fly ash building bricks

ADDITION TO MASS CONCRETE:

The addition of fly ash to the mass concrete works or ready mixed concrete plants works as an admixture for concrete and imparts the following properties to the concrete.

Aggregate reaction: - The addition of fly ash reduces the cement aggregate reaction.

Heat evolution: - There is low heat evolution when fly ash is used for the preparation of concrete.

Placing & finishing: - The fly ash permits easier placing of concrete and have good workability and finishing because of the improvement in plasticity and cohesiveness of the mixture.

Strength: - The addition of fly ash improves the strength of concrete. The fly ash usually replaces 20 to 25% of cement by weight or volume. The strength of such mixture equals or exceeds at a later stage than the strength of non fly ash mixture because of the pozzolanic action of the fly ash.

Water requirement:-

It is found that the use of fly ash results either in small reduction or no change in the quantity of mixing water required per m^3 of concrete for a given consistency or slump.

CELLULAR CONCRETE BLOCKS:

This is a light weight building material produced by auto clawing a set mix of a fine siliceous material such as fly ash and binder in the form of lime. The cellular concrete blocks posses many technical advantages

Fig 3.6: cellular blocks

:-

- Such as better strength to weight ratio
- Better sound insulation
- Stability to variation in temperatures & humidity.
- Resistance to fire
- Low thermal conductivity.
- Resistance to water seepage etc.

FLY ASH BUILDING BRICKS:

The process involves the use of fly ash, lime, sand and a small quantity of magnesium chloride as chemical accelerator. The fly ash, sand and lime are mixed approximately in the ratio: 13:7. The hydraulic press is used for making these bricks and semi dried bricks are cured in a stream chamber at appropriate pressure and temp

B. SILICA FUMES

4.1 : INTRODUCTION

Silica fume is a by product of producing silicon metal & ferrosilicon alloys. Silica fume is also called as “micro Silica”. Silicon metal and alloys are produced in electric furnaces. Silica fume is captured in fume hoods installed on top of the metal production furnaces. After larger elements are removed through a cyclone process the remaining material is captured in filters, densities packaged and shipped. Dow Corning’s Simcala (US) site currently captures and sells 16,000 tons of silica fumes annually.

particles, large surface area and the high SiO_2 content Silica fume is very reactive pozzolana when used in concrete

. **Fig 4.1:** silica fumes

4.4 : SILICA FUME: EARLY STRENGTH AND REDUCED PERMEABILITY:

Silica fume can make a significant contribution to early age strength of concrete. One pound of silica fume produces about the same amount of heat as a pound of Portland cement, and yields about three to five times as much compressive strength.

1) Silica fume improves concrete in two ways, the basis pozzolanic reaction, and a micro filler effect. Addition of silica fume improves bonding within the concrete and helps reduces permeability, it also combines with the calcium hydroxide produced in the hydration of Portland cement to improve concrete durability.

2) As micro filler, the extreme fineness of the silica fume allows it to fill the microscopic voids between cement particles. This greatly reduces the.

Fig 4.9: silica fume in concrete

4.10 : FUNCTIONS OF ADDING SILICA FUME:

Increase durability

Reduces concrete permeability.

Improves resistance to corrosion.

Shortcrete – lower rebound

Increases durability and workability of reinforced concrete.

4.11 : WORKING OF SILICA FUME IN CONCRETE:-

In cementations compounds, silica fume works on two levels. The first one described here is a chemical reaction called the "pozzolanic" reaction. The hydration (mixing with water) of Portland cement produces many compounds, including calcium silicate hydrates and calcium hydroxide. The calcium silicate gel is known to be the source of strength in concrete.

When silica fume is added to fresh concrete it chemically reacts with the calcium hydroxide to produces additional calcium silicate hydrates. The benefit of reaction is two fold, increased compressive strength and chemical resistance. The bond

COMPARISON OF FLYASH AND SILICA FUMES

FLYASH:

1. It is a fine powder thrown out as a waste material from thermal power plants.
2. When coal is combustion fly ash releases.
3. It is collected as bottom ash from the thermal power plants and coal furnaces and is collected by electrostatic precipitators.
4. It is used in concrete as a cement replacement.
5. It is used as a mineral admixture in concrete. The fly ash itself contains cementing properties.

SILICA FUME

1. It is the by product of product of producing silicon metal and ferrosilicon alloys.
2. When silica material is burned silica fume releases.
3. It is captured in fume heads installed at top of the metal production furnaces.
4. It is used in concrete as a property enhancer.
5. The most important use of silica fume is a mineral admixture in concrete & it is a cementations material.

INTRODUCTION

INTRODUCTION

Sand was used as early as 6000 B.C. to grind and polish stones to make sharpened tools and other objects. The stones were rubbed on a piece of wetted sandstone to hone the cutting edge. In some cases, loose sand was scattered on a flat rock, and objects were rubbed against the sandy surface to smooth them.

In the United States, sand was used to produce glass as early as 1607 with the founding of the short-lived Jamestown colony in Virginia. The first sustained glass-making venture was formed in 1739 in Wistarburgh, New Jersey, by Caspar Wistar. The production of sand for construction purposes grew significantly with the push for paved roads during World War I and through the 1920s. The housing boom of the late 1940s and early 1950s, coupled with the increased use of concrete for building construction, provided another boost in production.

Today, the processing of sand is a multi-billion dollar business with operations ranging from very small plants supplying sand and gravel to a few local building contractors to very large, highly automated plants supplying hundreds of truckloads of sand per day to a wide variety of customers over a large area.

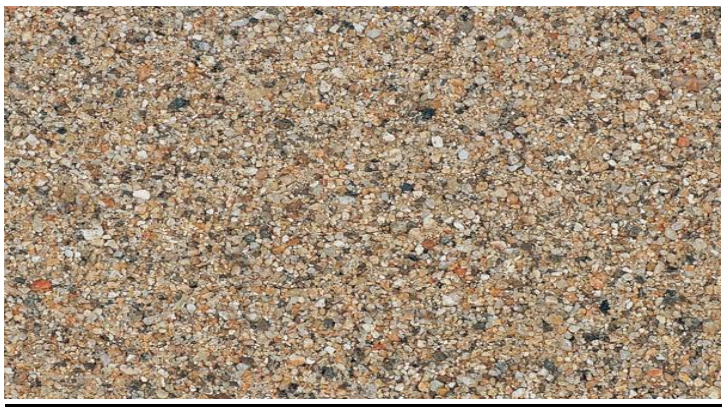


Fig 1.1:NAT`URAL SAND

NATURAL SAND

DEFINITION: Sand which is the result of natural disintegration and abrasion of rock

The natural river sand was the cheapest resources of sand. However the excessive mining of river bed to meet the increasing demand for sand in construction industry has lead to the ecological imbalance in the state. Now the sand available in the riverbed is very coarse and contains very high percentage of silt and clay. The silt and the clay presence in the sand reduce the strength of the concrete and holds dampness.

ADVANTAGES

1. Dams are constructed on every river hence these resources are erasing very fast.
2. It is cheapest source.
3. It is artificially available

DISADVANTAGES

1. Fine particles below 600 microns must be up to at least 30% to 50% for good results. At present these particles are not present in river sand up to the required quantity.
2. Digging the sand, from riverbed is hazardous to environment. The deep pits dug in the riverbed, effects on ground water level. Erosion of the nearby land is also due excess sand lifting. Government has banned for lifting Sand from riverbed in many areas. The sand available and allowed to lift is of inferior quality.
3. The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities are present in the river sand.
4. The increase of these impurities above certain percentage makes the sand useless for concrete work.
5. For getting required fineness module the sand should be sieved. In routine average wastage of sieving are about 35% and extra Labor cost involved.

MANUFACTURED SAND

A fine aggregate that is produced by crushing stone, gravel, or slag.

The manufactured sand produced by proper machines can be a better substitute to river sand. The sand should be sharp, clean and course. The grains should be of durable material. The grain sizes must be such that

Properties of M-sand in concrete

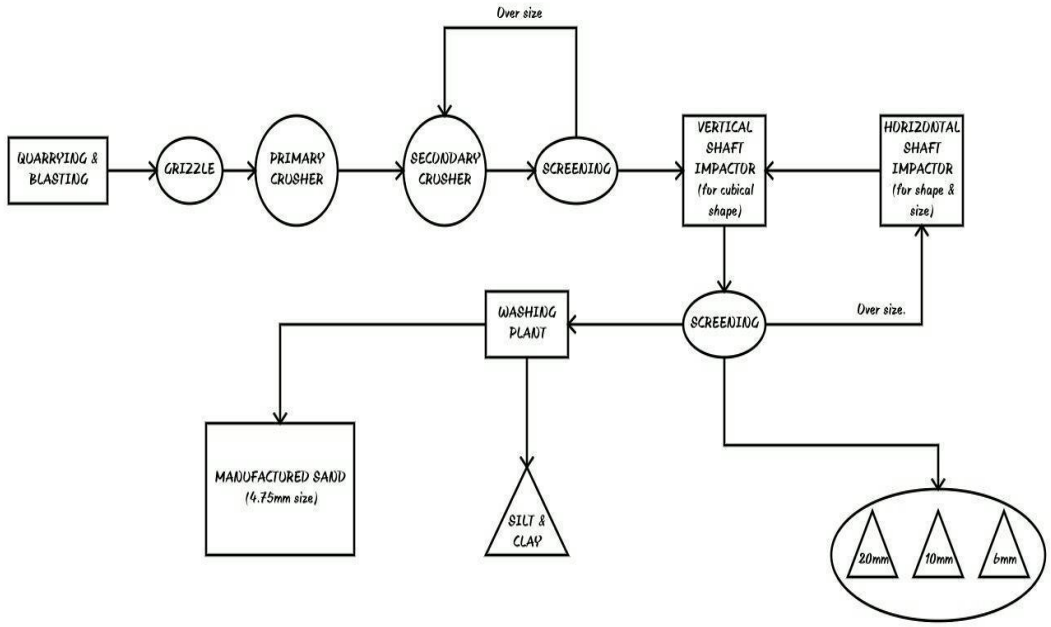
1 High strength of concrete

t The manufactured sand has required gradation of fines, physical properties such as shape, smooth surface textures and consistency which makes it the best sand suitable for construction. These physical properties of sand provides greater strength to the concrete by reducing segregation, bleeding, honeycombing, voids and capillary. Thus required grade of sand for the given purpose helps the concrete fill voids between coarse aggregates and makes concrete more compact and dense, thus increasing the strength of concrete.

2 Durability of concrete

Since manufactured sand (M-Sand) is processed from selected quality of granite, it has the balanced physical and chemical properties for construction of concrete structures.

MANUFACTURING PROCESS OF M-SAND



Quarrying

Quarrying is a form of mining similar to open-pit mining, involving the extraction of useful natural stone from a man-made open pit called a quarry by cutting, digging, or blasting. Rock is either quarried as solid blocks or slabs, or crushed and broken. Minerals produced from quarries include coal, clay, gypsum, marble, grit stone, limestone, sand, and sandstone.[1] The industry is distinguished by dimension-stone and crushed-stone quarrying. The dimension-stone process involves the quarrying of solid blocks or slabs of stone used for decorative and ornamentation purposes. In the crushed-stone process, materials such as granite, limestone, sandstone, and basaltic rock are crushed for use in concrete aggregate or road stone for road construction.

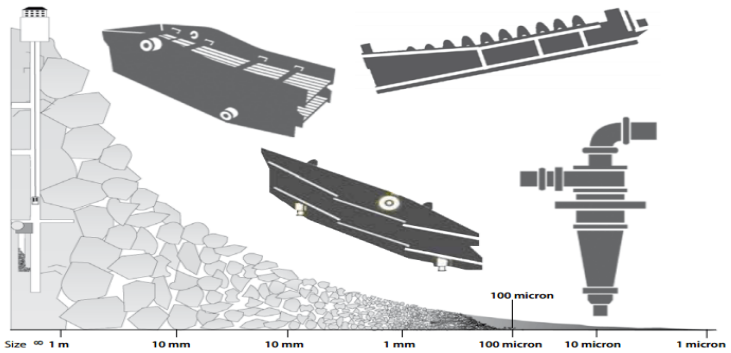
FIG: 3.1 Quarrying

primary crusher

The term "primary crusher," by definition, might embrace any type and size of crushing machine. The term implies that at least two stages of crushing are involved, but in many cases the machine which performs the function of initial crusher is the only crusher in the plant.

The following factors all have a more or less important bearing upon the choice of the primary crusher.

1. Characteristics of the material.
2. Average daily, or hourly, capacity required.
3. Product size, or crusher discharge setting.
4. Type and size of quarry equipment.
5. Methods employed in drilling and blasting.



COMPARISION OF MANUFACTURING SAND WITH OTHER SAND

Comparison between M-Sand and Crusher Dust

SL. NO.	M-SAND	CRUSHER DUST
01. Color	Grey	Grey
02. Particle Shape	Cubically Shaped	Flaky
03. Product	Manufactured as per IS, BS, ASTM Standards	Elongated (Shapeless) a) It is fractured dust of jaw crusher b) a waste product in production process of stone crusher
04. Manufacturing Process	Internation technology controlled manufacturing process through imported machines	No controlled manufacturing process as it is the by-product of stone crusher
05. Gradation	As per IS 383 - 1970 Zone-II	Does not adhere to IS 383 - 1970 or any other standards
06. Suitability for concreting	Recommended for usage in concrete & masonry works worldwide by the concrete technologists. Confirms international standards	Not recommended for use in concrete or masonry works. Does not have quality.

CONCLUSIONS

With an advancement of Technology and curiosity of the Researcher, the waste materials otherwise were converted into the useful engineering construction materials. Though this material seems simple but proves to be difficult to engineering students as it is very descriptive nature.

It is known that, every Engineers, Designer and builder have the idea that Fly ash and silica fume is the waste product from the Industries, but it is obvious that it is not much used in the field due to less production which would not meet the hungry demand in the construction industries.

This material reveals great advantages being very economics as well as gives good strength and durability to the concrete

The bulk specific gravity (BSG) and absorption capacity are the physical properties that are required to make the calculation of a mix design and can also be used to evaluate the consistency of a source of material

The effect on the use of manufactured sand on early age and long term volumetric properties, such as shrinkage and creep respectively, are not available and should be studied.