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THE INDUSTRIAL APPLICATION OF FLY ASH: A REVIEW

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ABSTRACT

Fly – ash is a by- product obtained from thermal power plant in large amount. When fly ash is mixed with cement, fly ash gain the property same as cement. Most of research work was done by using fly ash as replacement of cement. In this experiment stone dust and fly ash is used in concrete and behavior of concrete. The primary aim of the use of stone dust and fly ash is to make economical structure with specified strength. In this experiment Sand is partially replaced by stone dust and cement is partially replaced by fly ash for determination of workability, setting time, cohesiveness, ultimate strength and durability as well as solved the problems experiment with concretes today. It mitigates the environmental threats generates employments and industrial weal conserved minerals resources, provide sustainable construction and from the review of the various papers it will beneficial to the industrial application.

INTRODUCTION

Fly ash is one of the industrial products obtained from burning of coal. In the long-ago decades, fly ash obtained from coal burning was simply dumped into the environment which caused many ecological and health hazards. More than 65% of fly ash formed is liable of in landfills. India on your own covers an area of 40,000acres (160 sq.km) with fly ash as landfills. Addition of fly ash stabilizes the soil, which in turn improves engineering routine of soil. On the other hand, Recycling fly ash includes environmental payback such as reducing order for virgin materials that would need quarrying and substituting materials which may be energy intensive to produce. This study has been undertake to explore the opportunity of use of fly ash with addition of stone also the engineering properties of the composite material (fly ash-stone dust) have been studied. The discussion of results includes the possibility of use of fly ash in the assembly of rural roads sub-grades. Improves some of the engineering properties of the clayey soils including hydraulic conductivity as well as strength. Increase in percentage of fly ash mixed with stone dust there will be an increase in (OMD) optimum moisture content and decrease in (MDD) maximum dry density. In present days, about 10% of fly ash is utilized in ash dyke construction and land filling and only 3% of ash is utilized in other construction industries. Stone dust is a kind of solid waste material that is generated from stone crushing industry which is abundantly available. It is estimated that each crusher unit produce 15%-20% stone dust. Disposal of such wastes poses lots of geo-environmental problems such as landfill disposal problems, health and environmental hazards. The best way to eliminate these problems is to make use such waste. Keeping this in view an experimental study was conducted on locally available soil by mixing it with Stone Dust. Disposal of waste is a challenge for all developing countries mainly due to the increasing generation of waste, the high costs associated to its management and the lack of understanding over a diversity of factors that affect the different stages of waste management. Stone dust is also a solid waste material that is generated from stone crushing industry which is abundantly available in India.

We are using material from Sponsor: RattanIndia Power Ltd (Indiabulls Power Ltd) Location: Nandgaonpeth, Amravati district, Maharashtra Status: Phase I, Unit 1: commissioned, Phase I, Unit 2: commissioned, Phase 1, Units 3-5: commissioned, Phase II: Construction, Phase III: Cancelled Capacity: Phase I: 1350 MW (five units, each 270 MW), Phase II: 1350 MW (five units, each 270 MW), Phase III: 1320 MW (two units, 660 MW)Type: Phase I: subcritical, Phase II and III: supercritical. Fly Ash Generation 5.483 (LMT) Fly Ash Utilization 3.269 (LMT) Making of Brick / Blocks / Tiles etc 1.352 (LMT) Ash Dyke Raising 0.950 (LMT) Reclamation of Low Lying 0.887 (LMT) Others 0.080 (LMT) Ash available as on 29/10/18 16:29:30 (in LMT):Pond Ash = 11.3319115 Fly Ash = 0.9610825 Bottom Ash = 0.0396175 Total = 12.3326115

Figure 1: Stone Dust

	Stone dust	Fly ash
Specific Gravity	2.71	2.5
Coefficient of uniformity Cu	11.3	4.0
Coefficient of curvature Cc	1.04	1.0
IS Soil classification	SW	SM
Liquid limit(%)	-	40.0
Plastic limit (%)	-	NP
MDD (g/cc)	2.187	1.387
OMC(%)	5.9	18.2
Soaked CBR(%)	21.0	2.5

APPLICATIONS OF FLY ASH STONE DUST IN CIVIL CONSTRUCTION

Karasawa, A., Suda, S., Naito, H. and Fujiwara, H.(2003) The concrete paving blocks with the fly ash replacement ratio of 25% satisfied the production target value of the plastic deformation (at most 1 mm), at the unit water content which is used as the basis of water control at the factory, where the unit water content ranges from "the unit water content at the moulding limit" through "the unit water content at the moulding limit minus 10 kg/m3." Also, this mix satisfied the target production value of the 7-day flexural strength (at least 6.00 MPa).For the mix with the fly ash replacement ratio of 25%, the dry cast concrete blocks for pavement satisfied the production target value of the plastic deformation (at most 1 mm) for the unit water content which is used as the basis of water control at the factory. The unit water content ranges from "the unit water content at the moulding limit" through "the unit water content at the moulding limit minus 10 kg/m3." From this observation, it is considered that fly ash (25% content) can be used as a substitute for fine aggregate in concrete. For the mix with fly ash replacement ratio of 40%, the dry cast concrete blocks for pavement exceeded the production target value of the plastic deformation at the unit water content

used as a basis of water control at the factory. In addition, this mix did not satisfy the production target value of the 7-day flexural strength. From this finding, fly ash (40% content) is considered inappropriate as a substitute for fine aggregate in concrete.

LITERATURE REVIEW

Physical properties like specific gravity, fineness modulus etc. of stone dust and fine aggregate should be similar in order to use stone dust as a substitute of fine aggregate. Studies shows that best substitute of fine aggregate with stone dust gives maximum compressive strength, durability, flexure strength and other mechanical properties. all precast concrete producers can now use a group of materials called "fly ash" to improve the quality and durability of their products. Fly ash improves concrete's workability, permeability, cohesiveness, finish, ultimate strength, and durability as well as solved many problems experienced with concrete today–and all for less cost. Fly ash, however, must be used with care. Without adequate knowledge of its use and taking proper precautions, problems can result in mixing, setting time, strength development, and durability.

A .Suribabu, DrU.Rangaraju, Dr.M. Ravindra Krishna (2015) River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Quarry rock dust can be an economic alternative to the river sand. Quarry Rock Dust as100% substitutes for Natural Sand in concrete. Mix design has been developed for M25 and M40 grades using design approach IS for both conventional concrete and quarry dust concrete. Tests were conducted on cubes and beams to study the strength of concrete made of Quarry Rock Dust and the results were compared with the Natural Sand Concrete. It is found that the compressive and flexural strength of concrete made of Quarry Rock Dust are nearly 10%more than the conventional concrete. Tests were also conducted on cubes and beams which are exposed to temperatures of 300°C for 1hr, 3hr durations respectively.

Harveer Laura (2014) The paste is generally mixed in a high-speed, shear-type mixer at a w/cm (water to cement ratio) of 0.30 to 0.45 by mass. The cement paste premix may include admixtures such as accelerators or retarders, Super plasticizers, pigments, or silica fume. The premixed paste is then blended with aggregates and any remaining batch water and final mixing is completed with conventional concrete mixing equipment. A mix is to be designed for characteristic strength of 50 N/mm2 at 28 days having target strength of 62 N/mm2 at 28 days. 30% of fly ash is to be included by weight of cementations material. Maximum w/c ratio or w/c + f.a. ratio = 0.4, minimum cement concrete or cement + f.a. content = 400 kg/m3. Slump 50+10 mm. High-energy mixed (HEM) concrete is produced by means of high-speed mixing of cement, water and sand with net specific energy consumption of at least 5 kilojoules per kilogram of the mix. A plasticizer or Super plasticizers is then added to the activated mixture, which can later be mixed with aggregates in a conventional concrete mixer. In this process, sand provides dissipation of energy and creates high-shear conditions on the surface of cement particles. This results in the full volume of water interacting with cement. The liquid activated mixture can be used by itself or foamed (expanded) for lightweight concrete. HEM concrete hardens in low and subzero temperature conditions and possesses an increased volume of gel, which drastically reduces capillarity in solid and porous materials.

INDUSTRIAL APPLICATION OF FLY ASH

Fill Material

Large scale use of ash as a fill material can be applied where Fly ash replaces another material and is therefore in direct competition with that material. Fly ash itself is used by the power generating company producing the fly ash to improve the economics of the overall disposal of surplus fly ash. Fly ash disposal is combined with the rehabilitation and reclamation of land areas desecrated by other operations. Fills can be constructed as structural fills where the fly ash is placed in thin lifts and compacted. Structural fly ash fills are relatively incompressible and are suitable for the support of buildings and other structures. Non-structural fly ash fill can be used for the development of parks, parking lots, playgrounds and other similar lightly loaded facilities.

Concrete

Fly ash in concrete has significant benefits including: 1.increasing the life of concrete roads and structures by improving concrete durability.2.net reduction in energy use and greenhouse gas and other adverse air emissions when fly ash is used to replace or displace manufactured cement.

APPLICATION OF STONE DUST

A studied the water requirements and compressive strength of cement mortar using manufactured sand as FA, with FM ranging from 0.50 to 2.0 and 75% and 100% flow of mortar. Based on the above extensive Experimental investigations, he had concluded that the strength of mortar with manufactured sand is higher than that of the corresponding mix with cement (sand) mortar. He has recommended the use of manufactured sand for mortar and has cautioned the removal of excessive proportions of very fine particles. Studies the performance of concrete, incorporating limestone dust (obtained from limestone quarries after crushing operations) as a partial replacement for natural sand in concrete. Three series of concrete mixes with w/c ratio 0.70, 0.53 and 0.40 respectively, Incorporating lime stone dust from 5-20% were prepared by direct replacement on an equivalent mass of recombined sand basis. The properties of fresh concrete i.e. slump, unit weight and air content (%) were determined. Compressive strength, freezing and thawing, drying and shrinkage, creep was determined for hardened concrete. They have concluded that incorporation of upto10% limestone dust as a partial replacement for FA in concrete with w/c = 0.70 and 5% limestone dust in concrete with w/c = 0.53 does not significantly affect the properties of fresh and hardened concrete. However, there is considerable loss in slump, irrespective of w/c ratios, if lime stone dust is in excess of 10%.

USES OF FLY ASH & STONE DUST AS A COMBINATION

In present study the effect of Fly ash with high replacement of clay mixed with different materials were studied at a constant percentage of cement i.e. 10%. Three Categories of bricks were to be studied namely Plain Fly ash brick (FAB), Treated Fly ash brick (TFAB) and Treated Fly ash stone dust brick (TFASDB).In all the above mentioned categories the quantity of Fly ash was kept constant as 80%. It is found that the compressive strength of plain Fly ash brick (15FAB) and Treated Fly ash brick (15TFAB) was found to be higher with 5% coarse sand and 15% sand combination at 10% cement. The gain in strength continues for Treated Fly ash Stone dust Brick (10TFASDB) and found to be higher with 10% stone dust and 10% sand combination. A variation in the quantity of Fly ash was also attempted and it was found that the 25TFASDB with 50% fly ash, 25% stone dust and 25% sand combination at 10% cement achieved highest compressive strength.

STRENGTH CHARACTERISTICSOF FLY ASH & STONE DUST IN CONCRETE

Investigated practically and concluded that 20% of sand replaced with stone dust is more effective to increase the strength of concrete. work on inclusion of fly ash in concrete. replaces the cement 5% to 50% and concluded that 10% replacement of cement is more suitable for concrete and increases Compressive strength of concrete. investigated that the effect of water cement ratio on properties of cement mortar with partial replacement of river sand by stone dust in designed mortar mix having proportion as 1:2, 1:3 and 1:6 with water cement ratio of 0.5 and 0.55 . He suggested that mortar with 50% replacement of river sand by stone dust give more strength as compared the normal mortar. some mechanical properties concrete containing marble dusts (MD) and limestone dust investigated practically. Seven concrete mixtures were produced in three series with control mixes having 400kg cement content.

These control mixes were modified to 5, 10 and 15% MD and LD in place of river sand. the compressive strength of concrete observed by him after 7, 28, 90 and 360 days. Suggested that the use of fly ash and stone dust in concrete will make the concrete by using their properties in a beneficial way. The decrease in early strength by the addition of fly ash is compensated by addition of stone dust .The decrease in workability by the addition of stone dust is

reduced by the addition fly ash. In his experiment workability and strength characteristics of stone Dust Concrete containing 0% to 30% of fly ash are observed. Based on his experiment he concluded that combined use of stone dust and fly ash can be shown improved strength in concrete and also preserve the environment.

CONCLUSION

A number of environmental problems have been brought to light. Ways to control these problems have been critically analyzed and it was deduced that huge amount of Fly Ash is available as a by-product of coal-based thermal power plants. Its safe disposal is a great problem. At present Fly Ash is dumped in ponds. Use of Fly Ash in civil engineering construction and others have been taken up. Some new materials viz. Fly Ash has become an important material for various industrial and construction applications. It is widely used in manufacturing of bricks, cement, asbestos-cement products and road/embankments. The studies are carried out for improvement in yield of agricultural crops, wastelands, etc. It can also be used in reinforced concrete construction since the alkaline nature will not corrode steel. This not only solves its disposal problems, but also helps in conserving the precious top soil required for growing food crops. On the basis of the studies carried out on Fly Ash utilization, it is sighted that use of Fly Ash in building construction poses great gains. If we make proper arrangement of safe disposal and optimum use in civil engineering construction, agriculture, etc. Utilization of Fly Ash also creates significant benefits in terms of energy saving as well as environment.

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