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Literature Review on Concrete Containing Waste as a Construction Material

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Abstract - Concrete is a mixture of different raw materials like cement, fine aggregate, coarse aggregate and water. Concrete is the most widely used construction material. Concrete is used nearly in all type of construction. Waste materials are produced by thermal power plant, different manufacturing industries, etc. Recycling of waste consumes energy and produces pollution. Accumulation and disposal of waste are very dangerous for the environment. Using waste material in concrete production is appropriate method for eliminating waste and prevention of environmental pollution. Leading waste materials that has been used in manufacturing of concrete are fly ash, rice husk ash, silica fume, GGBS (ground granulated blast-furnace slag), glass powder, etc. We study various paper on the use of different waste material which gives idea about the effect of different waste materials on properties of concrete. The objective of this study is to select a waste material which gives desired properties in concrete.

Key Words: waste materials, concrete, pollution, disposal, raw material.

1. INTRODUCTION

Concrete is a mixture of different materials like cement (binder), fine aggregate, coarse aggregate and water. Normal practice of concreting is batching of raw materials, mixing of raw materials, transportation, compaction, finishing and curing of concrete. Concrete is the most widely used construction material in the world because of its compressive strength, durability and workability. It is used nearly in every type of construction including buildings, roads, bridges, homes, airports and subways. Millions of tonnes of waste is produced every year and most part of this waste is not recyclable. Disposal of waste by dumping in ground causing environmental pollution. Recycling of waste is uneconomical as cost of recycling is high. Cement industry is responsible for the 7% of world's total carbon dioxide emission. Using of waste materials in concrete as a partial replacement of cement is helps in reducing high percentage of carbon dioxide. Fly ash which is obtained as a by-product from thermal power plant have good binding property and can be used as the partial replacement of cement in concrete. Utilisation of waste material in concrete production is an appropriate method for achieving three goals: eliminating waste, prevention of environmental pollution and adding positive properties to the concrete. Different waste material that has been used in concrete as a partial replacement of cement are fly ash, silica fume, GGBS (ground granulated blast furnace slag), rice husk ash, glass powder, etc. This paper is based on the review of literature which gives the idea about the use of waste material in concrete.

2. LITERATURE REVIEW

1. Akshatha K.B. (2018) discussed the experimental study of concrete using silica fume. Silica fume is added to concrete to improve the strength and durability of concrete. The experimental investigation involves addition of silica fume in various proportion as 5%, 7.5%, 10% and 12% by weight of cement to the concrete. The M45 grade of concrete was prepared on the guidelines in IS 10262-2009 and IS 456-2000. The targeted slump was selected as 100 and water cement ratio is 0.4. The final mix proportion for control mix of 1:1.68:2.79:0.4 with cement content 410 kg/m^3 was selected. Literaturer concluded that on addition of silica fume the workability of normal concrete tends to decrease whereas the compressive strength, split tensile strength and flexural strength gets enhanced with the use of silica fume.

2. Bhupinderjeet singh and Ritesh Jain (2018) have studied on the use of waste glass in concrete and they stated that waste glass is a non –biodegradable material and disposal of waste glass in soil causing soil pollution. To avoid disposable problems waste glass may be used as a partial replacement of fine aggregate and coarse aggregate in concrete. Waste glass may be added in concrete in powder form or in crushed form. Using of waste glass in concrete makes structure denser, reducing water absorption capacity and enhancing durability of concrete. Waste glass powder used as a partial replacement of fine aggregates in concrete. The percentages of replacement were 10%, 20%, 30% and 40% by weight of fine aggregate in concrete. The maximum compressive strength obtained at 20% replacement of fine aggregate with glass powder. Concrete containing glass powder found to be economical and environment friendly as compared to normal concrete.

3. Vinod Goud & Neeraj Soni (2016) discussed the partial replacement of cement with fly ash and it's effect. Fly ash particles are spherical in shape and size of fly ash particles vary from 0.5 to 100 µm. Two classes of fly ash is defined by ASTM C618: class f and class C fly ash. The 10% to 20% replacement of cement by fly ash show good compressive strength and 30% or more replacement the compressive strength is reduced. There are numerous advantage of using fly ash in concrete. Use of fly ash in concrete will improved workability, reduced permeability, Increased split tensile

strength, reducing bleeding, better surface and reduced heat of hydration.

4. Tapeshwar Kalra & Ravi Rana (2015) with their research reported that cement which is most commonly used construction material is responsible for the 7% of world's total carbon dioxide emission. Author also discussed that the addition of fly ash into concrete in construction is a solution of two environmental problems- first, disposal of large amount of fly ash causing land degradation through large area of land fill and second, reducing the high percentage of carbon dioxide emission in atmosphere from cement industry. Author also mentions that the using fly ash in concrete makes concrete sustainable and fly ash also increases the workability and durability of concrete. The major problem with fly ash is slow strength gain. A detailed mix design procedure for desiging of fly ash concrete to achieve required strength at 28 days is needed.

5. Anurag Jain & P.Y.Pawade (2015) have studied the characteristics of silica fume concrete and they stated that silica fume is a pozzolanic admixture which is improving the properties of concrete and also enhances the chemical durability of concrete. The silica fume used as a partial replacement of cement in concrete. The replacement used in experimental investigation were 5%, 10%, 15%, 20% and 25% by weight of cement. The physical properties of silica fume concrete is compared with standard concrete. From test result it was observed that there is drop in early compressive strength of silica fume concrete but compressive strength is significantly improved after 56 days. The effect of silica fume in concrete is more noticeable in 28 days curing than 7 days curing. It was found that the performance of concrete is optimum at 15% replacement. Silica fume also increases concrete protection towards steel bars corrosion.

6. Gopinandan Dey & Joyanta Pal (2013) reported investigation based on the use of brick aggregates in concrete and check performance at high temperature . Due to unavailability of aggregates burnt clay brick aggregates are used as a replacement of coarse aggregates. Crushed brick can be used to make satisfactorily M25 and M20 grade of concrete with water cement ratio range from 0.35 to 0.40. Adequate workability can also be obtained by addition of superplasticizier 1% by weight of cement. The density of concrete is also in the range of 19750 to 20000 N/mm² which is nearly 85% of the concrete prepared with stone aggregates. Flexural strength is also higher than Indian code recommendation of $0.7\sqrt{fck}$. It was observed that up to 600°C there is gradual increase in compressive strength of concrete but after 600°C temperature compressive strength of concrete drastically reduced and becomes 60% to 70% of the original 28 days strength.

7. M.Iqbal Malik, Muzafar Bashir, Sajad Ahmad, Tabish Tariq &Umar Chowdhary (2013) from their experimental investigation study the concrete involving glass powder as a partial replacement of fine aggregates. In India 0.7% of total waste comprises of glass. Fine aggregates are replaced by glass powder as 10%, 20%, 30% and 40% by weight for M-25 concrete mix. The 20 % replacement of fine aggregates by glass powder show 15 % increase in Compressive strength and 30 % replacement show 9.8 % increase in compressive strength. The percentage water absorption is decreases with increase in waste glass powder content. Workability increase with increase in waste glass powder content and split tensile strength is decreases with increase in waste glass powder content. Literaturer concluded that the use of glass powder in concrete is environment friendly and economical.

8. K.G. Hiraskar & Chetan Patil (2013) carried out study on the use of blast furnace slag aggregates in concrete. Blast furnace slag aggregates from industry are used as a replacement of aggregates in concrete. Use of blast furnace slag aggregate have no negative effect on the properties of hardened concrete. The concrete prepared by using blast furnace slag aggregate show quite similar properties as compared to standard concrete. A blast furnace slag concrete mix of M30 grade of targeted strength of 38.0 MPa is prepared and various test are performed. It was concluded that the water absorption and porosity is reduced on comparison with standard concrete at 28 days whereas the compressive strength is increases as compared to standard concrete at 90 days.

9. DR S.L. Patil, J.N.Kale, S. Suman (2012) reported that fly ash is a waste material obtained from thermal power plant. Around 50% of the fly ash is utilised as a supplement of portland cement in concrete production. The fly ash can be utilised in various proportion from 10% to 50% by weight of cement in step of 5%. Author carried out experimental work to evaluate compressive strength of concrete and replacement of cement by fly ash is done in three percentages(10% ,20% & 30%) of fly ash by weight. Nominal grade M25 concrete for 0.35 w/c ratio. From the test results obtained it is clearly seen that compressive strength of concrete is increases for 10% to 20% replacement of fly ash with weight of cement. If percentage of fly ash is increases then compressive strength of concrete is decreases.

10. Dr.F.S.Umrigar, Dr.L.B.Zala, Jayesh Pitroda (2010) have studied on the utilisation of fly as in indian context and they stated that in india 138 millions tonnes of fly ash is produced and 38% of fly ash is utilised . The utilization areas of fly ash are in production of Portland cement, construction of dam and hydropower projects, fly ash bricks, agriculture, fly ash based polymer, road construction, etc. Use of fly ash helps in environmental prevention and removed the problem of landfill for disposal of fly ash.

3. CONCLUSION

Based on the above literature study we concluded that the various waste materials such as fly ash, rice husk ash, GGBS(ground granulated blast furnace slag) , glass powder, silica fume, etc. are suitable to be used in concrete as a partial replacement of concrete ingredients in varying proportion. Researcher have show that the potential use of waste material in concrete is economically and environmental friendly. Concrete containing waste as a construction material are found to performing better then standard concrete. The properties such as workability, compressive strength, split tensile strength, durability and permeability are improved by using waste materials. Utilisation of waste materials in concrete helps in reducing the problem of disposal of large amount of waste and also helps prevention environmental pollution.

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