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Review Article

A LITERATURE REVIEW ON STUDY OF CONCRETE STRENGTH USING PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH AND FINE AGGREGATE WITH CERAMIC POWDER

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ABSTRACT

Concrete is today the largest consumable material in the world that utilizes the natural resources such as sand, crushed stone and water. Due to the depletion of these natural resources for concreting, research is being carried out nowadays to reduce the consumption of these resources. Rapid development of construction in India has resulted in shortage of conventional construction material. In developed country like India use of concrete is higher quantity and availability of raw material is very less. The ceramic industry inevitably generates wastes, irrespective of the improvements introduced in manufacturing processes, in the ceramic industry; about 15%-30% productions goes as waste.

In India during the milling of paddy about 78 % of weight is received as rice, broken rice and bran, the rest 22 % of the weight of paddy is received as husk, the 25 % of the weight of this husk is converted into ash during the firing process, which is known as rice husk ash (RHA). These wastes causes problem in present day society, requiring a suitable form of management in order to achieve sustainable

Proper introduction of ceramic powder and rice husk ash in concrete improves both the mechanical and durability characteristics of the concrete. This paper present literature review on replacement of cement with rice husk ash and fine aggregate with ceramic powder which includes current and future trends in research.

INTRODUCTION

The industrial and economic growth witnessed in recent decades has brought with it an increase in the generation of different types of waste (urban, industrial, construction, etc.) despite the waste management policies which have been adopted nationally and internationally The practice of dumping and / or the inadequate management of waste from the various manufacturing sectors have had a notable impact on the receiving environment, leading to water, soil, air and noise pollution, amongst other complications, and adding to existing environmental problems However, if waste is managed correctly it can be converted into a resource which contributes to savings in raw materials, conservation of natural resources.

For this, the extensive research and development works towards exploring new ingredients are required for producing sustainable and environment friendly construction materials climate, and promotes sustainable development.

Indian ceramic production is 100 Million ton per year. In the ceramic industry, about 15% - 20% waste material is generated from the total production. This waste is not recycled in any form at present. However, the ceramic waste is durable, highly resistant to biological, chemical, and physical degradation forces. The Ceramic industries dump the waste in any nearby pit or vacant spaces, near their unit although notified areas have been marked for dumping. This leads to serious environmental and dust pollution and occupancy of a vast area of land, especially after the powder dries up, so it is necessary to dispose the ceramic waste quickly. The principle waste coming from the ceramic industry is the ceramic powder. Ceramic wastes are generated as a waste during the process of dressing and polishing. It is estimated that 15 to 30% waste is generated during production of raw material, and although a portion of this waste is utilized on-site for refilling excavation pit.

India is a major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for

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processing paddy, producing energy through direct combustion and or by gasification. About 20 million tons of RHA is produced annually. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Lots of ways are being thought of for disposing it by making commercial use of this RHA.

LITERATURE REVIEW

Moyad N, Khalaf Al, Yousif Hana A(1984)[1] concluded that 5-20% replacement of cement with RHA helps the concrete in possessing desirable workability, durability, compressive strength, flexural strength and initial and final setting time.

Mehta, P. K. and Pirtz, D(1992)[2] concluded that the optimum addition of RHA as partial replacement for cement is in the range 0-20%. The compacting factor values of the concrete reduced as the percentage of RHA increased. The Bulk Densities of concrete reduced as the percentage RHA replacement increased. The Compressive Strengths of concrete reduced as the percentage RHA replacement increased.

Saraswathy, V. and Song, H.(2007)[3] studied the effect of the incorporation of RHA up to 30% replacement level reduces the chloride penetration, decreases permeability, improves strength and corrosion resistance properties. From this study it is concluded that the replacement level of RHA is recommended up to 25%.

M.udabai(2009)[4] The chemical analysis done indicated high amount of silica for rice husk ash (68.12%) which is a very good value for workability. The increase in setting time of paste having rice husk ash showed low level of hydration for rice husk ash concrete which result from reaction between cement and water, which liberate calcium hydroxide ($Ca(OH)_{2}$).

Siddesha(2011)[5] Studies on the Effect of Ceramic fine aggregate on the Strength properties of Concrete. The compressive strength of concrete slightly decreases with increase in percentage of ceramic fine aggregate in concrete but there is no much variation in compressive strength of concrete with the variation of cement content. The split tensile strength of concrete slightly decreases with increase in percentage of ceramic fine aggregate in concrete but there is no much variation in split tensile strength of concrete with the variation of cement content. The flexural strength of concrete slightly decreases with increase in percentage of ceramic fine aggregate but there is no much variation in split tensile strength of concrete with the variation of cement content.

Dhavamani Doss Sa and D. Gobinatha(2013)[6] Compressive strength of ceramic waste aggregate was investigated, using 30 specimens tested at 28 or 56 days of curing. Reduction in water cement ratio led to increase in compressive strength upto 85% at 28 days and 95% at 56 days for ceramic waste aggregate concrete. The properties of Ceramic waste (Electrical insulator scrap) and Bottom ash are nearer to the properties of conventional aggregate. Hence it suited for concrete making.

Abdullah Anwar, Juned Ahmad, Meraj Ahmad Khan, Sabih Ahmad, Syed Aqeel Ahmad (2014)[7] concluded marble dust powder has a potential to provide an alternative to cement and helps in maintaining the surroundings every bit well as economical balance. The result obtained for 28-day compressive strength confirms that the optimal percentage for replacement of cement with marble dust powder is about 10%, will post less on the production of carbon dioxide and solving the environmental pollution by cement production; thereby enhances the urban surroundings.

Obilade(2014)[8] The optimum addition of RHA as partial replacement for cement is in the range 0-20%. The compacting factor values of the concrete reduced as the percentage of RHA replacement increased. The Compressive Strengths of concrete reduced as the Percentage RHA replacement increased.

Geeta (2014)[9] studied the industrial waste generation concentrate on discovering substitution of cement in the concrete blend. They found that Marble powder, stone, powder was prior utilized only as substitution of aggregate's small scale Khatib(2014)[10] tested replacement ratios of 25%, 50%, 75% and 100% of fine natural aggregates by fine recycled ceramic aggregates (bricks obtained from demolished structures, which were then crushed in the laboratory) to determine the compressive strength, reported a systematic decrease in compressive strength as the fine recycled brick aggregates content increases. However, for the same replacement level and test age, mixes with brick aggregates achieved higher strength than those with recycled concrete aggregates. Between the age of 28 and 90 days, the rate of compressive strength gain for all mixes containing crushed bricks is higher than that of those containing crushed concrete and natural aggregates only. This result is justified with pozzolanic reactions caused by the silica and alumina contents of crushed bricks

Sumit Bansal(2015)[11] Replacement of cement by rice husk ash showed in M30 grade concrete compressive strength improvement up to the replacement of 10% in all ages .Both concrete mixes at 10% rice husk ash level showed 3 to 10% increase in compressive strength. Rice husk ash levels of 15 to 20% showed reduction in compressive strength in all age.

YogenderAntil (2015)[12] studies reveals that significant improvement in Compressive strength of the Concrete with rice husk ash content of 10% for different grades namely M30 and M60 and at different ages i.e. 7 days and 28 days.

The increase in Compressive strength was of the order of 4.23% to 10.93% for different grades and at different ages.

Alefiya Kachwala(2015)[13] The optimum addition of RHA as partial replacement for cement for better performance is between the range of 0-20%.The compacting factor values of the concrete reduced as the percentage of RHA increased. The Bulk Densities of concrete reduced R.Chitra (2015)[14] Concluded that addition of the ceramic powder and copper slag improves the physical and mechanical properties. As cement cost is going on increasing trend and fine aggregate demand is increasing day by day, the replacement of ceramic powder and copper slag for cement and fine aggregate proves to be economical and an also provides an efficient utilization industrial wastes, it is suggested that replacement of cement and fine aggregate by ceramic powder for 20% and Copper slag for 40% is effective and can be used in the construction activities.

Abdullah Anwar, Sabih Ahmad, Syed Mohd. Ashraf Husain and Syed Aqeel Ahmad (2015)[[15] concluded

1. As compared to conventional concrete, on addition of ceramic waste powder its characteristic strength is decreased. So the ceramic waste powder has been replaced by up to 30% by weight of cement without affecting the characteristic strength of M20 grade concrete. On further replacement of cement with ceramic waste powder decreases the compressive strength.
2. As compared to conventional concrete, on addition of marble dust powder its characteristic strength is decreased. So the marble dust powder has been replaced by up to 20% by weight of cement without affecting the characteristic strength of M20 grade concrete. On further replacement of cement with marble dust powder decreases the compressive strength
3. Concrete on 30% replacement of cement with ceramic waste powder, compressive strength obtained is 23.20 N/mm^2 whereas on 20% replacement of Cement with Marble Dust Powder, Compressive Strength obtained is 24.30 N/mm2. Consequently, ceramic waste becomes more economical as compare to marble dust powder without compromising concrete strength than the standard concrete.
4. Utilization of ceramic waste or marble dust and its application for the sustainable development of the construction industry is the most effective solution and also speak the high value application of such waste.
5. It is the possible alternative solution of safe disposal of the Ceramic waste powder and Marble dust powder thus stepping into a realm of solving the environmental pollution

T.Subramani, B.Suresh(2015)[16] The conclusions drawn are as follows

1. Use of ceramic waste results in the formation of lightweight concrete and also ceramic waste cuts down the cost of construction.
2. Compressive strength of concrete is high when containing ceramic waste 30% in concrete. The Strength of concrete containing ceramic waste of 30 % was high compared with that of the conventional mix.
3. Finally conclude the compressive strength, flexural & split tensile strength was high when containing ceramic waste 30 % in concrete compared with M30 and ceramic waste used in concrete.

G sivaprakash and Lakhi jyoti (2016)[17] concluded that

1. Ceramic waste can be used as a replacement material for river sand in concrete
2. The concrete with 10 and 20% replacement satisfies the compressive strength of M25 grade however higher the percentage addition of ceramic waste reduces the strength of normal concrete
3. The tensile strength of 10, 20, 30% replacements at 14 days shows the consistency in attaining the required range.
4. Hence the replacement of river sand using 30% ceramic waste in concrete gives the required strength and can be considered as optimum percentage.

Abhishek Verma, Jeevan Meena (2017)[18] concluded compressive and split tensile strength of M25 grade concrete increases when the cement is replaced with ceramic power of electric insulator powder up to 20- 30% and further replacement of cement with ceramic powder decreases the strength gradually.

AneeshThankachan, Geethakumari(2017)[19] concluded

1. Ceramic waste initially there is decrease of 23.32% in compressive strength of 7days when partially replacement of 10%, but after that while replacing 20% there is increase of 5.48% and with 30% there is increase of 14.56% increases respectively in initial compressive strength with respect to normal concrete mix
2. Ceramic waste initially there is decrease 16.20% in compressive strength of 28 days when partially replacement of 10%, but after that while replacing 20% there is increase of 4.2% and with 30% there is increase of 14.42% increases respectively in final compressive strength with respect to normal concrete.
3. Initially there is decrease by 39.49% in flexural strength (28days) when partially replacement of 10%, but after that while replacing 20% there is increase of 8.57% and with 30% there is increase of 33.40% increases respectively in flexural strength with respect to normal concrete.

CONCLUSION

The review of earlier studies related to partial replacement of cement with rice husk ash and fine aggregate with ceramic powder reveals that there is a significant change in the strength properties of concrete such as compressive strength, flexural strength and split tensile strength. These experiments were carried out in various grade of concrete to find out the result. From the above literature reviews optimum percentage of rice husk ash varies from 10% to 30% by weight of cement and ceramic powder varies from 10% to 20% by weight of fine aggregate .Up to these percentage replacement improvement in the strength of concrete has been observed in terms of Compressive Strength, Flexural Strength and Tensile Strength. Previous studies also show that utilization of rice husk ash and ceramic powder as partial replacement in concrete enhances the durability of concrete.

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