JUTE FIBRE REINFORCED PLASTIC WASTE AGGREGATE CONCRETE – REVIEW

Kalaivani M[1] Mohamed Thariq A[2], Kanishk M[3], Sathish kumar S[4], Jerlin Jose Y[5]

[1]Assistant Professor, Department of Civil Engineering, K.S.Rangasamy College of Technology, Tiruchengode

[2] UG Student, Department of Civil Engineering, K.S.Rangasamy College of Technology, Tiruchengode

Abstract : Concrete construction industry is one of the major sector utilizing natural resources to produce concrete for building constructions. The demand of natural sand getting increased and construction industry faces major problem with the scarcity of natural sand. On the other hand, the Plastic waste is the major reason of environmental pollution and hence it should be recycled. Utilization of Plastic wastes in concrete for the partial replacement of fine aggregate in concrete will reduce the demand for natural aggregate and also waste can be utilized in effective way. So that the environmental pollution can be minimized. This study investigates the effect of using plastic waste as an alternative for fine aggregate. The jute fibre is one of the natural fibre and it is used in plastic waste concrete to increase the split tensile strength and flexural strength of the concrete. This paper reviews the properties and performance of Jute fibres used in concrete for reinforcement with Partial Replacement of fine aggregate by waste plastic aggregates.

Key Words: Plastic Waste, Jute Fiber.

INTRODUCTION

Polyethylene Terephthalate (PET) is one of the most common consumer plastics used and is widely employed as a raw material to realize products such as blown bottles for soft-drink use and containers for the packaging of food and other consumer goods. PET bottles have taken the place of glass bottles as storing vessel of beverage due to its lightweight and easiness of handling and storage. In recent Years the synthetic fibres like polyester and polypropylene fibres also pollutes the environment. So that the natural fibres with the replacement of synthetic fibres protects the environment from pollution. The use of plastic waste as a natural aggregate substitute in concrete is a relatively recent concept. One of the first significant reviews on the use of waste plastic in concrete focused on the advantages and financial benefits of such use, besides their physical and mechanical properties. And more over use of plastic as aggregate gives a solution to the problems encountered with the quarrying of natural aggregate.

LITERATURE REVIEW

Mariaenrica Frigione (2010) studied the Recycling of pet bottles as fine aggregate in concrete. Substitute in concrete 5% by weight of fine aggregate with an equal weight of PET aggregates manufactured from the waste PET bottles. The PET concretes display similar workability characteristics, compressive strength and splitting tensile strength slightly lower that the reference concrete and a moderately higher ductility. Polyethylene terephthalate (PET) is a thermoplastic polyester with tensile and flexural modulus elasticity of about 2.9 and 2.4 Gpa respectively. The 5% by weight of fine aggregate was substituted in the fraction 0.1 - 5 mm and the test evaluation at the ages 28 and 365 days. The same values of workability of concrete possessing the same w/c ratio. The compressive strength and splitting tensile strength of PET concrete are of 0.4 – 1.9% lower than the reference concretes but with a slightly higher ductility.

Altamashuddinkhan Nadimalla (2019) studied the Polyethylene Terephthalate (PET) Bottles Waste as Fine Aggregate in Concrete. The non-uniform, angular and sharp edges PET bottles aggregates in concrete decreases the slump value of concrete. The smooth-surface and spherical textured PET bottles aggregate increases the concrete slump value. The maximum replacement of 10% replacement of PET aggregates increases the mechanical properties of concrete.After increasing the Percentage replacements of PET aggregates the properties of concrete getting reduced.

Pooja et. Al., (2019) evaluated the behaviour of concrete with partial replacement of fine aggregate with plastic wastes ranging from 15-30% in M20 grade of concrete. The compressive strength of waste plastic concrete blocks has increased compared to conventional concrete blocks. Test to be conducted are slump test, compressive test, water absorption test, water permeability test. Partial replacement is done in different proportion such as 15%,20%,30%,40%,50%Addition of admixture cause dispersion of the cement particle when mixed with water reduce the evolution of heat and reduce the bleeding. It concluded that this could be a substitution of the general concrete used in the above mentioned place and can be reduce the cost of construction up to a great extinct since the amount of sand used is going down.

Sivakandhan et.al (2020) have studied the fabrication of hybrid composites of two natural fibres like sisal fibre and jute fibre combination. The sisal and jute fibre combination was taken and five different kinds of samples were fabricated with the fibre-matrix weight ratio of 35% and 65% of resin. At the same fibre loading, the tensile, the flexural, and compression strength of jute fibre with poxy composites are higher when compared to sisal fibre with epoxy composites. Sisal with epoxy composite showed better impact properties than the jute fibre epoxy composites.

Kalaivani, M & Karthik, S (2016) studied the review on Steel Fibre reinforced concrete beam-column joint. In this the steel fibres which is used for making fibre reinforced concrete have been studied. And the author concluded that the utilisation fibres in combination of micro and macro form gives the ultimate strength when compared to single fibre alone.The flexural properties of fibre reinforced concrete like ductility, Stiffness and energy absorption capacity has increased when compared to conventional concrete.

Thorneycroft et.al (2018) studied the Performance of structural concrete with recycled plastic waste as a partial replacement of sand. It is proposed to process the waste plastic to create a partial replacement of fine sand in a novel mix for structural concrete. Replacing 10% sand by volume with recycled plastic in viable propositions that has the potential to save 820 million tonnes of sand every year. The target strength was chosen to give a realistic structural concrete to determine if plastic can be appropriate sand replacement for such mixes and such have wider use beyond the non-structural concrete . Five type of plastic were used as sand replacement such as PET, HDPP, HDPE, PPF, PPS. Substituting plastic into a concrete mix cause a decrease in compressive and tensile strength due to the poor bond between the plastic and surrounding matrix. The use of graded PET plastic matched to the size of the sand particles it replaces, and at a replacement of 10% by volume, gave the most promising overall performance.

Tanzeem sheikh et.al (2018) Replacement of fine aggregate with plastic in concrete. The strength properties of specimens were observed with the use of plastic waste in various percentages (0%, 10%, 20%, 30%, 40%, and 50%). The utilization of PET wastes due to reduced and light weight and in turn lessens the unit cement weight. The test includes slump, fresh density, dry density, compressive strength and flexural strength. Each mixture consists of 695 kg/m^3 sand, 1133 kg/m^3 coarse aggregate, 465 kg/m^3 cement and a W/C ratio of 0.4. The plastic granule has 0.7826 specific gravity. The result showed that decrease in weight using plastic waste was about 2 - 6% of the normal weight concrete while compressive strength reduced up to 33% compared with the compressive strength of normal concrete.

Md.Abdur Rakib et.al (2019) studied the incorporation of short discrete fibers in concrete has become popular nowadays due to its versatile advantages over plain concrete. Jute is cheap and abundant in Bangladesh. Thus, the combination of jute fiber and concrete may be one of the important approaches to the development of concrete technology. The aim of this study is to investigate the mechanical properties of jute fiber reinforced concrete (JFRC) for different combinations of fiber volume and length and compare the results with plain concrete. Cylinders and prisms of standard sizes containing JFRC were prepared for compressive, split tensile and flexural strength tests and all the tests were carried out after 28 days moist curing. Before mixing with concrete, jute fibers were cut into two different lengths and treated with NaOH solution. It was observed that NaOH treatment reduced the water absorption capacity of fibers. Though the compressive strength of JFRC was found slightly incremental for some combinations of fiber length and volume, significant increment was not observed for other combinations. Moreover, the strength was found decreased for long length and large volume of fibers. It was demonstrated that fibers had no or very little influence on split tensile strength of concrete. Improvement of flexural strength was found by about 10~20% for JFRC specimen as compared to plain concrete. Due to the incorporation of fibers restriction to the catastrophic failure of the FRC specimens was also observed.

Arivalagan et al (2016) examined the use of plastic waste in concrete. Also the waste is increasing day by day, although steps were taken to reduce its consumption. This creates substantial garbage every day which is much unhealthy. A healthy and sustainable reuse of plastics offers a host of advantages. The suitability of recycled plastics as fine aggregate in concrete and its advantages are discussed here. The initial questions arising of the bond strength and the heat of hydration regarding plastic aggregate were solved. Tests were conducted to determine the properties of plastic aggregate such as density and specific gravity. As 100% replacement of natural fine aggregate with plastic fine aggregate is not feasible, partial replacement at various percentage were examined. The percentage substitution that gave higher compressive strength was used for determining the other properties such as modulus of elasticity, split tensile strength and flexural strength. Higher compressive strength was found with 10% natural fine aggregate replaced concrete.

Nabajyoti Saikiaa and Jorge de Britoa (2013), reported the strength behaviour of concrete containing three types of recycled polyethylene terephthalate (PET) aggregate. Results are also analysed to determine the PET-aggregate's effect on the relationship between the flexural and splitting tensile strengths and compressive strength and to know whether the relationships between compressive strength and other strength characteristics given in European design codes are applicable to concrete made with PET-aggregates. The compressive strength development of concrete containing all types of PET-aggregate behaves like in conventional concrete, though the incorporation of any type of PET-aggregate significantly lowers the compressive strength of the resulting concrete. The PET-aggregate incorporation improves the toughness behaviour of the resulting concrete. This behaviour is dependent on PET-aggregate's shape and is maximised for concrete containing coarse, flaky PET-aggregate. The splitting tensile and flexural strength characteristics are proportional to the loss in compressive strength of concrete containing plastic aggregates.

Priyanka Goel et.al (2017) analysed the effect of jute fibre reinforcement on the strength and ductility properties of concrete. Flexural and compression characteristics of the fibre reinforced concrete are measured experimentally. The results of the compression test indicated that the presence of jute fibre tends to reduce the compressive strength of concrete at higher fibre content. Despite the minimal reduction in the compressive strength at higher jute fibre content, there is an improvement of ductility after cracking of concrete. Similarly, the bending test results indicated that the modulus of rupture of concrete increases by 50% at 0.50% jute fibre content. Jute fibre significantly improves the toughness behaviour of concrete.

CONCLUSION

From the literature review, the following points have been observed.

PET Plastic is utilised as a replacement material for fine aggregate which will considerably reduce the land pollution.Reusing the plastic waste can reduce the amount of waste material sent to the land fill.Hence, we partially replace the fine aggregate with plastic waste and evaluate their strength characteristics.From the optimised value, the reinforced concrete beam is strengthened by natural fibre composite laminates.

REFERENCES

[1] Mariaenrica Frigione "Recycling of pet bottles as fine aggregate in concrete", "Journal of the waste management", volume 30 (2010) PP 1101-1106.

[2] Altamashuddinkhan Nadimalla, Siti Aliyyah Binti Masjuki, Asmahani Binti Saad, Kamsiah Binti Mohd Ismail, Maisarah Bt Ali, "Polyethylene Terephthalate (PET) Bottles Waste as Fine Aggregate in Concrete, International Journal of Innovative Technology and Exploring Engineering (IJITEE) I Vol.8(2019), No.6S4, pp 1177-1180

[3] P.Pooja, Manendra vaitla, Bhagyawati.M "Study on behaviour of concrete with partial replacement of fine aggregate with waste plastic", "Journals of civil engineering" vol 8 (2019) PP 182-187.

[4] C. Sivakandhan, G. Murali, N. Tamiloli and L. Ravikumar 2020, "Studies on mechanical properties of sisal and jute fibre hybrid sandwich composite", Materials Today: Proceedings, vol. 21, part 1, pp. 404-407.

[5] Kalaivani, M & Karthik, S 2016, 'Steel Fibre reinforced concrete beam-column joint – A review', International Journal of Engineering, Research and Technology, vol. 5, No. 5, pp. 166-173.

[6] J.Thorneycroft, J.Orr, R.J. Ball "Performance of structural concrete with recycled plastic waste as a partial replacement of sand" "Journal of construction and building materials" vol 161 (2018) PP 63-69.

[7] Tanzeem shaikh, Syed Abdul Zeeshan, Aquib Shakib, "Replacement of fine aggregate with plastic in concrete", "Journal of Advance research, Ideas and Innovations" vol 4 (2018).

[8] Mohammed S. Islam, Syed Ju Ahmed, "Influence of jute fibre on concrete properties" "Journal of construction and building materials" vol 189 (2018) PP 768-776.

[9] Arivalagan,s, "Experimental Investigation on partial replacement of waste plastic in concrete", International Journal of Engineering Sciences & ResearchTechnology, 5(11) 2016, pp.443-449

[10] Priyanka Goel, Mohd. Usman, Sandeep Panchal 2017 " Experimental study of Jute Fibre Reinforced cement based materials" ICETETSM 2017