Original Research Paper

Volume - 10 | Issue - 11 | November - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Engineering

ASSESSMENT OF PHYSICAL PROPERTIES OF CONCRETE WITH FLYASH, RICE-HUSK ASH, QUARRY DUST AND RUBBER

Mohammed Faheemuddin*	M.Tech Scholar, Depart of Civil Engineering, R.V.R & J.C College of Engineering, Chowdavaram, Guntur, Andhra Pradesh, India. *Corresponding Author
S.V. Satyanarayana	Assistant Professor, Depart of Civil Engineering, R.V.R & J.C College of Engineering, Chowdavaram, Guntur, Andhra Pradesh, India.

ABSTRACT Billions of tons of non-hazardous solid waste materials are generated each year. Scrap tyres are one of those solid wastes. Disposal of these scrap tyres has always been a trouble to the environment. Several studies have been carried out to reuse scrap tyres in a variety of rubber and plastic products, thermal incineration of waste tyres for production of electricity, or as fuel for cement kilns, and use in asphalt concrete. Studies in this project show that workable rubberized concrete mixtures can be made with appropriate percentages of tyre rubber. This report presents an overview of the project carried out in an effort to utilize scrap tyres in Portland cement concrete. Tests are carried out on cement concrete specimens with partial replacements up to 15% coarse aggregate with scrap rubber and the properties of the concrete obtained is studied. Along with this replacement we are studying the mechanical properties of concrete with replacement of the other ingredients of concrete like cement with Fly ash & Rice husk ash, fine aggregate with quarry dust. It is observed that the compression strength of completely replaced concrete decreased by 20% than that of the conventional concrete.

KEYWORDS : Rubberized concrete, Fly ash, rice husk ash, fine aggregate, quarry dust.

INTRODUCTION

Over the years, disposal of tyres has become one of the serious problems in environments. Landfilling is becoming unacceptable because of the rapid depletion of available sites for waste disposal. For example, France, which produces over 10 million scrap-tyres per year, will have a dwindling supply of landfills starting from July 2002, due to a new law that forbids any new landfill in the country. Used tyres are required to be shredded before landfilling. Innovative solutions to meet the challenge of tyre disposal problem have long been in development. The promising options are:

1. Use of tyre rubber in asphaltic concrete mixtures
2. Incineration of tyres for the production of steam and
3. Reuse of ground tyre rubber in a number of plastic and rubber products.

The use of recycled tyres as partial aggregate in concrete has been considered for several years. Previous research conducted show dramatic changes in the mechanical properties of concrete when rubber is introduced to the mix [3]. A tyre is a composite of complex elastomer formulations, fibres and steel/fibre cord. Rubber is the principal element of tyre, making up about 85% of the tyre where both synthetic and natural rubbers may be used Natural rubber is an elastic hydrocarbon polymer which occurs as a milky colloidal secretion in the sap of several varieties of plants. Rubber can also be produced synthetically, as a thermoset polymeric material in which individual monomer chains are chemically linked by covalent bonds during polymerization.

Concrete containing rubber aggregate has a higher energy absorbing capacity referred to as toughness. Investigation on the comparison of the toughness of a control concrete mixture with that of a rubber containing concrete mixture, data showed that the presence of rubber in concrete increases toughness. Thus far the use of recycled rubber as aggregate in concrete has not given results that could indicate the possibility of its use as structural material. It is thought that the main cause of the decrease of strength in rubber concrete is due to the weak bond between the recycled rubber particles and the cement. This investigation intents to further explore this issue by comparing OPC control mix with a mix of different amount of natural coarse aggregate replacement (15%, 10%), by tyre rubber and one with addition of fly ash rice husk ash with OPC replacement along with natural fine aggregate replacement (15%), by quarry dust.

II. LITERATURE SURVEY

Many scientists and interested research scholars worked in this field and gave many positive outputs. Their results indicate that the size, proportion, and surface texture of rubber materials affect the strength of concrete prepared using this scrap tyre rubber as a replacement.

Bieland Lee had used recycled tyre in concrete mixtures made with magnesium oxychloride cement, where aggregate was replaced by fine crumb rubber up to 25% by volume. Their results of compressive and tensile strengths indicated that there is a better bonding when Magnesium Oxychloride cement is used. They discovered that structural applications could be possible if the rubber content is limited to 17% by volume of the aggregate [3].

Naik et al studies concluded that among the surface treatments tested to enhance the hydrophilicity of the rubber surface, a sodium hydroxide (NaOH) solution gave the best results. The particles were surface treated with NaOH aqueous solutions for 20 min. before using them in concrete. Then, Scanning Electron Microscopy (SEM) and measurements of water absorption, density, flexural strength, compressive strength, abrasion resistance, modulus of elasticity, and fracture energy tests were performed, using test specimens (water to cementitious materials ratio of 0.36) containing 10% of powdered rubber or rubber treated with 10% NaOH. The test results showed that the NaOH treatment enhances the adhesion of tyre rubber particles to cement paste, and mechanical properties such as flexural strength and fracture energy were improved with the use of tyre rubber particles as addition instead of substitution for aggregate. Some reduction in the compressive strength (33%) was observed, which was lower than that reported in literature [8].

Hernandez-Oliveres in [9] have tried to gain different advantages from the use of waste tyre in concrete. High-strength concrete (HSC) with silica fume was modified with different amounts of crumbed truck tyres. They were aiming to reduce the stiffness of HSC to make it compatible with other materials and building elements, unexpected displacement of building foundations and improving the fire performance of the buildings. They found that since water vapor can escape through the channels left as the waste tyre particles are burned, the inclusion of low volume fractions of rubber would reduce the risk of explosive spalling of HSC at high temperature. This was very desirable since HSC was more susceptible to explosive spalling when subjected to rapid heating than normal strength concrete. Samples containing 0%, 3%, 5% and 8% waste tyres were made. Mechanical, destructive and non-destructive tests were performed on the samples and it was found that volume fractions up to 3% do not significantly reduce the strength of the composite although it does reduce the stiffness. Higher volumes of rubber result in a reduction of strength but improve the dynamic behavior of the concrete.

III. PROPOSED METHOD

The constituent materials that are used in this study are as follow:

A. Ordinary Portland cement (OPC)

Ordinary Portland cement (OPC) is manufactured in the form of different grades, the most common in India being Grade-53, Grade-43, and Grade-33. OPC is manufactured by burning siliceous materials like limestone at 1400 degree Celsius and thereafter grinding it with gypsum. Expert opinions and directions from technicians and engineers are a must in this regard. With a good distribution network this cement is available most abundantly in Gujarat. The chemical components of Ordinary Portland Cement are Magnesium (Mg), Alumina (Al2O3), Silica (SiO2), Iron (Fe2O3) and Sulphur trioxide (SO3). Some of the big companies involved in OPC manufacture are Tata Chemicals, Ultratech Cement, and ACC cement. Ordinary Portland cement is in great demand in India and will continue to be used in Indian infrastructural up gradation and other constructions.

B. Coarse Aggregate

The coarse aggregate is the aggregate which has a large particle size; coarse aggregate is defined as the aggregate containing a high proportion of particles retained on a 5mm (0.197 in.) sieve in the US and elsewhere a 4.75mm (0.187 in.) sieve is used as the limit. According to IS 383 (1970) machine crushed hard granite chips passing through 20mm sieve and retained on 12.5mm sieve and chips passing 12.5mm sieve and retained on 10mm sieve were used as coarse aggregate throughout the work.

C. Fine Aggregate

Fine aggregate consists of natural or manufactured sand with particles sizes up to 4.75mm. It consists of inert natural sand conforming to IS 383 that does not contain more than a total of 5% by weight of the shale, silt and structurally weak particles. Fine aggregates provide support function to the finer solids by producing voids of a size which do not contain or support the finer particles. Particle shape affects the behavior of the water, harsh angular aggregates not packing well and resulting in high void content. Such aggregates may have a high surface area, but because of a lack of contact between the particles, it does not effectively control the finer particles. The realization of the usefulness and effect of fine aggregate on the strength of concrete and Sand in the building and construction industry has put into the minds of engineers and researchers to lay more emphasis into the study of civil engineering properties and its usefulness.

D. Scrap Tyres

They can be managed as a whole tyre, as slit tyre, as shredded or chopped tyre, as ground rubber or as a crumb-rubber product. A typical automobile tyre weighs 20lb; whereas a truck tyre weighs about 100lb. The following table gives the major materials used to manufacture tyres by percentage of total weight of the finished tyre that each material represents.

Table 1: Composition Of Scrap Tyre

COMPOSITION	AUTOMOBILE TYRE	TRUCK TYRE
Natural rubber	14%	27%
Synthetic rubber	27%	14%
Carbon black	28%	28%
Steel	14-15%	14-15%
Fabric, filler, and anti-ozonants	16-17%	16-17%

E. Fly Ash & Rice Husk Ash

A fine, glass powder recovered from the gases of burning coal during the production of electricity is fly ash. These micron sized earth elements consist primarily of silica, alumina and iron. The combustion of powdered coal in thermal power plants produces fly ash. The high temperature of burning coal turns the clay minerals present in the coal powder into fused fine particles mainly comprising of aluminium silicate. Fly ash produced thus possesses both ceramic and pozzolanic properties.

Rice husk can be utilized for a broad variety of actual and practical industrial purposes. When it is burnt, energy will be released, which may be recovered for heat and power. As the silica content of the husk is high (about 20%), combustion results in a high yield of rice husk ash (RHA) which contains around 95% silica. Inclined-step grate boilers are the traditional design for rice husk burning. In normal use without close control of operation these units burn the husk at high temperature (above say 700°C) under conditions which result in the formation of crystalline ash. In general, it appears that the ash from traditional step-grate furnaces.

F. Quarry Dust

A well processed manufactured sand as partial or full replacement to river sand is the need of the hour as a long-term solution in Indian concrete industry until other suitable alternative fine aggregate are developed. Crushed stone dust a waste from the stone crushing unit accounts 25% of the final product from stone crushing unit. This crushed stone dust which is released directly into environment can cause environmental pollution. To reduce the impact of the crushed stone dust on environment and human, this waste can be used to produce new products or can be used as admixture in concrete so that the natural resources are used efficiently and hence environmental waste can be reduced.

G. Water

While any potable water can be used for mixing, the amount of water is critical for the formation of the voids in pervious concrete. Water-to-cement ratios can range from 0.27 to 0.30 with ratios as high as 0.40. Careful control of water is critical. A mix design with little water can create very weak binder. This will create a very dry mix that is susceptible to spaling and crumbling. A mix design with too much water can collapse the void space, making an almost impenetrable concrete surface (NRMCA2004).

IV. RESULTS

The concrete specimens of 28 days were tested on the compressive, spilt tensile and flexural strength testing and the results are tabulated as shown below, it is compared with the different replacement mixes of the concrete. The compression, spilt tensile and flexural strength test loads with the different trail mix replacements are tabulated as below table (2) and are compared with replacements of the concrete.

Table 2: Trails Of Cement With Different Replacements

Trail Mixes	Replacements	Comp-ressive Load (KN)	Split Tensile Load (KN)	Flex-ural Load (KN)
M1	Conventional concrete	810	297	14
M2	Cement replaced with 30% Flyash and 10% Rice husk Ash	433	175	12
M3	Fine aggregate replaced with 15% Quarry Dust	765	247	11
M4	Coarse aggregate replaced with 15% scrap rubber	522	330	10
M5	Partially replaced concrete. Cement with 30% Flyash and 10% Rice husk Ash, Fine aggregate with 15% Quarry Dust, Coarse aggregate with 15% rubber	351	160	12.5
M6	Cement replaced with 20% Flyash and 10% Rice husk ash	765	264	13
M7	Cement replaced with 25% Rice husk ash	600	221	8
M8	Coarse aggregate replaced with 10% rubber	810	305	10.5
M9	Partially replaced concrete. Cement with 20% Flyash and 10% Rice husk Ash, Fine aggregate with 15% Quarry Dust, Coarse aggregate with 10% rubber	720	280	13

The compressive strength for the specimens of the concrete cured for 28 days were tested with the different trail mixes is tested and the comparison of the compressive strength of the different mixes is shown in Figure (1).

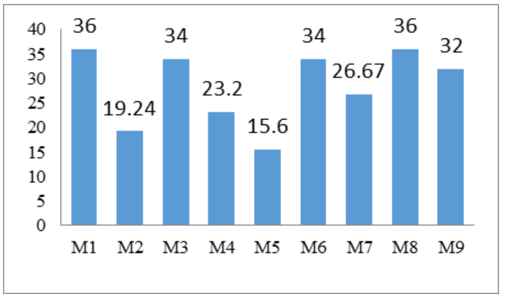

Fig 1: Comparision Of Compressive Strength (m.pa) Of Concrete With Different Replacements

The split tensile strength for the specimens of the concrete cured for 28 days were tested with the different trail mixes is tested and the comparison of the split tensile strength of the different mixes is shown in Figure (2).

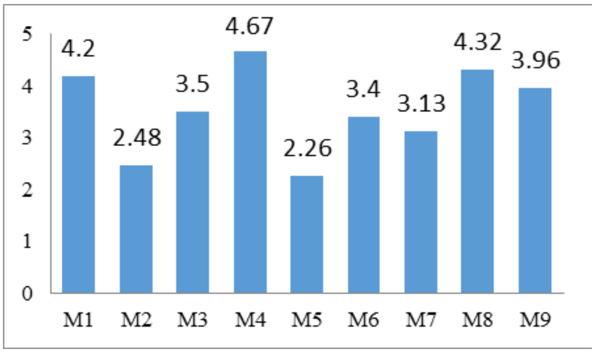

Fig 2: Comparision Of Split Tensile Strength (m.pa) Of Concrete With Different Replacements

The flexural strength for the specimens of the concrete cured for 28 days were tested with the different trail mixes is tested and the comparison of the flexural strength of the different mixes is shown in Figure (3).

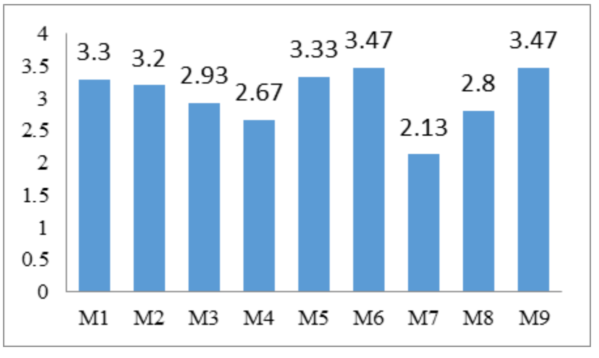

Fig 3: Comparision Of Flexural Strength (m.pa) Of Concrete With Different Replacements

V. CONCLUSION

In this paper, Assessment of physical properties of cement with fly ash, rice-husk ash, quarry dust and rubber is done. Practical application of fly ash, rice-husk ash, quarry dust and rubber on pervious concrete can be done with different replacements. The concrete strength was increased by the use of mixed designation with those different replacements of fly ash rice-husk ash, quarry dust and rubber. From the results it can be concluded that, the partially replaced concrete i.e., cement with 20% fly ash and 10% rice husk ash, fine aggregate with 15% quarry dust, coarse aggregate with 10% rubber is having strength of 88% when compared with the conventional concrete. The compressive strength of the conventional concrete is nearly equal with the concrete replaced of cement with 10% rice husk ash and 20% flyash. The split tensile strength of the concrete for the concrete replaced with the 15% rubber for coarse aggregate is increased by 11% with the conventional concrete. The flexural strength of the concrete with the replacement of the all contents (M9) in the mix is reaches 90% of the strength to the conventional concrete.

VI. ACKNOWLEDGEMENT

The authors are greatly acknowledged DST-FIST (Govt. of India) for funding to setting out the research computing facilities at R.V.R & J.C College of Engineering.

VII. REFERENCES

[1] G. Kim, J. Jang, H. Khalid and H. Lee, "Water purification characteristics of pervious concrete fabricated with CSA cement and bottom ash aggregates", *Journal of Applied Acoustics*, no. 8, pp. 1-8, 2017.
[2] Lisha, C.M.R., & G. Sunilaa, "Corrosion Resistance of Reinforced Concrete with Green Corrosion", International Journal of Engineering Science Invention Research & Development, 2017.
[3] BieLand Lee, "Rubberized concrete (rubcrete)", A novest approach 2015.
[4] McNeil K, Kang TH-K. Recycled concrete aggregates: a review. Int J Concr Struct Mater 2013;7(1):61–9.
[5] Butler L, West JS, Tighe SL, "The effect of recycled concrete aggregate properties on the bond strength between RCA concrete and steel reinforcement", CemConcr Res 2011;41(10):1037–49.
[6] AlirezaNajiGivi, Sauraya Abdul Rashid, Farah Nora, Aziz A, Mohammed AmranMohdSalleh,(2010), ―Contribution of Rice Husk Ash to the Properties of Mortar and concrete Journal of American Science.
[7] Dubai M U, Muhammad C, Bagudo B U and Musa A (2009).Studies on the Effect of Rice Husk Ash as Cement Admixture ,Nigerian Journal of basic and applied science (2009), 17(2)252-256
[8] Naik et al 2004 Properties of Concrete Containing scrap rubber- An Overview.
[9] F.Hernández-Olivares et al, Static and dynamic behaviour of recycled tyre rubber-filled concrete Author links open overlay panel, 2002.
[10] Khatib, Z.K., Bayomy F.M. 1999, Rubberized Portland cement concrete, ASCE Journal of Materials in Civil Engineering.