A REVIEW: ON PARTIAL REPLACEMENT OF CEMENT, SAND & AGGREGATE WITH WASTE MATERIAL

Viajy Kumar Jangid*1, Anil Kr. Sharma*2

*1PG Student, Arya College Of Engg. & Research Centre, Jaipur-302022 (Rajasthan Technical University) India.
*2Head Of Department, Arya College Of Engg. & Research Centre, Jaipur-302022 (Rajasthan Technical University) India.

ABSTRACT

Rapid urbanization such as industries such as sand, glass and sawdust new and modern are common features of the city. However, very little waste is recycled or reused. The strict environmental laws and the lack of waste disposal in urban areas complicate on the one hand the disposal of industrial waste and on the other make it more difficult to extract raw materials. This work presents the results of an ongoing investigation into the partial settling of cement, fine grains and sawdust, sand and glass chips in concrete. In this research, concrete of class M25 (conventional concrete) was produced in accordance with IS: 10262-2009. The various concrete components are then gradually crushed on the basis of different pieces of industrial waste. Compressive strength was measured on days 7 and 28. Therefore, this study was a mixture of glass chips (0%, 15%, 30% and 45%), concrete with sawdust (0%, 15%, 30% and 45%) and use sand (0%, 15%, 30% and 45%) to make fine aggregate concrete.

Keywords: Concrete, Coarse Glass Pieces (CGP), Sawdust From Timber, Foundary Sand, Coarse Aggregate, Fine Aggregate, Cement.

I. INTRODUCTION

Today the problem of waste disposal has become one of the most important ecological and social problems in all countries. Massive construction and demolition waste made of concrete and other materials is not professionally recycled in our country, but is instead dumped outside. Furthermore, due to the use of faster construction measures, especially river sand as fine aggregate and coarse aggregate, the naturally available materials are rapidly decreasing. Therefore, it makes sense to use construction and demolition waste as recycled material in conventional concrete to solve the problem like other methods. In this study, recycled glass dust, broken glass and sawdust, all obtained from construction and demolition waste, and were used as substitutes for natural materials. In this study, the feasibility of using construction and demolition waste and the partial replacement of raw materials in concrete composite materials was determined. Many old buildings that are being repaired due to aging and cracks are being demolished and the waste generated by these buildings is demolition waste.

In the case of new buildings, building debris is generated as waste. 25% of the solid waste generated by buildings each year comes from old buildings and 75% of solid waste comes from the construction of new buildings. In this work, window glass waste from construction and building debris is used because it has certain pozzolanic properties, for example: concrete. The glass flakes are collected from the waste and crushed into fine particles similar to concrete particles. Likewise, small pieces of wood are often used in floor systems, packaging, lightweight partitions, and kitchen cabinets. It is collected and crushed into a powder and replaced by a fine aggregate. Wood chips have a very high water absorption rate compared to a fine aggregate.

In this study, we used construction and demolition debris in various proportions instead of natural materials, tested the optimal strength of hard concrete and the workability of fresh concrete, and determined the other physical properties of the concrete.

Foundry sand is a by-product of ferrous and non-ferrous metal casting and has long been used as a casting material due to its unique technical properties. In modern foundry practice, sand is typically recycled and reused in many manufacturing processes. According to industry estimates, approximately 100 million tonnes of sand is used for production each year. These four (4) to seven (7) million tons are disposed of annually and can
be used for recycling in other products and industries. The sand used in the foundry is of high quality and is mainly supplied by members of the North American Industrial Minerals Association (IMA-NA). Strict physical and chemical properties must be respected, as lean sand can cause casting defects. Foundries and sand producers invest significant resources in the quality control of their sand systems and in conducting extensive tests to ensure consistency.

Advantage over Normal Concrete:
The normal concrete is vital and economical but the maintenance cost of normal concrete is large on the other hand if the concrete is replaced with C & D waste then maintenance cost is less and also workability, durability, and strength are very precious as compared to normal concrete. Replacement of C & D waste materials with raw materials in concrete improves the compressive strength and workability at less to moderate grade and proportions as compared to normal concrete. C & D waste betters the flow ability and durability at all ages of concrete. It gives the lighter section and less permeability at a hardened state.

II. LITERATURE SURVEY

T.V. Reshma et-al, [2020] the paper is about the replacement of cement with 30% fly ash and river sand with waste foundry sand in varying percentages. It was observed that with increase in percentage of waste foundry sand the slump test value improved, but at 40% of waste foundry sand the value decreased extremely. The addition of waste foundry sand made it workable but only till 30% was added, beyond that the values were not acceptable. Similarly, the compaction factor value reached maximum at 20% addition, beyond that the value was not satisfactory. At 20%, it should better compaction than the concrete itself. Discussing about compressive strength, the maximum strength was observed at 30% addition, beyond that it decreased. In split tensile strength, the ultimate strength reached at 30% replacement of waste foundry sand, further addition decreases the value. In ultrasonic pulse velocity tests, the value increased till 30% replacement only. Based on the results obtained, it was concluded that substitution of cement with only 30% of waste foundry sand along with 30% fly ash gave better results, that any other percentage.

Manoharan Thiruvuvenkitam et-al, [2020] Due to alarming generation of waste, the author decided to use waste foundry sand as a partial replacement of sand in concrete. They replaced the waste foundry sand in varying percentages to obtain their changes in the resultants. The fine aggregate in the concrete was replaced with a varying percentage from 0% to 25% by weight with M30 grade of concrete. A number of tests were conducted on hardened concrete. The compressive strength test showed increased strength only up to 20% by weight replacement of sand. The split tensile strength increased from 5% by weight to 15% by weight. Further change in percentage showed decreased results. In flexural strength test, the results obtained had no major change. The modulus of elasticity increased till 15% by weight replacement if waste foundry sand, later its value decreased. The rapid chloride addition decreased till 20% by weight replacement. Discussing about the economy in replacement of sand, it was observed that replacement of sand with waste foundry sand lowered the cost of materials.

Ashwini R. Patil et-al, [2020] Increment in global warming and generation of thermal waste made the author to use waste materials as a replacement in concrete. The author used fly ash, waste foundry sand and GGBS as a replacement of sand and aggregates in building concrete paver blocks. The replacement was done with different percentages to get better and desired results. A number of tests were conducted like compressive strength, split tensile strength, abrasion resistance, etc. From the entire conducted test it was concluded that replacing cement completely by fly ash has given enhanced results. Also, using 75% of GGBS along with 45% waste foundry sand mixed with 35% of fly ash, this mix also gave good results when compared to the original mix. Also, reusing the waste materials is good for environment and also for the cost cutting.

O.R. Kavitha et-al, [2020] Using of natural discarded materials in construction process is an everyday practice now. In this paper, the author has taken biologically treated used foundry sand as a replacement and untreated waste foundry sand. Both the sand has been used in different percentages to observe the pattern of the results. The percentages taken for them are 10%, 20%, 30%, 40%, 50%. Multiple tests were conducted to determine the difference in the properties between the mixes. It was finally concluded that the replacement turned out to be a fruitful experiment. The strength of concrete increased with the replacements; also the other test result was more enhanced than the conventional cement mix results.
The plastic waste has one of the major concerns of its disposal. In this paper, the author has taken polyethylene terephthalate (PET) as a substitute of sand in the concrete mix. The replacement was in different percentages stages 0%, 10%, 20%, 30%, 40%, 50%. The results were examined on both physical and mechanical properties. Discussing about slump test result, it was found that with the increased replacement percentages the workability of the concrete decreased. Because of the low density of the plastic, the nit weight of the concrete also reduced. The same was for dry unit weight. Due to the weak bond between the adhesive paste and the plastic waste, the compressive strength received lower results. The splitting tensile strength gave negative results with addition of PET. Because of low bond strength, the flexural strength got decreased, even one of the samples got broken during test. The mixes with PET substances exhibited higher combustible nature. They have higher resistance to fire than the original samples. From the above results, the overall conclusion came that recycled PET bottles or other materials can be used as a replacement of sand in concrete mix. It helps in dropping self-weight of concrete and also using recycled waste for a good purpose.

Utilizing natural waste materials in concrete mix, in this paper the author has taken plastic and rubber waste as a replacement in the concrete. The rubber waste was treated chemically to inculcate the lost strength of the rubber. Poly ethylene terephthalate and virgin polypropylene has been sued a plastic waste replacement. For rubber substitutes, vehicle tires have been used. With the use of plastic substitutes the workability if concrete decreased because of their flaky shapes. Same was with the rubber substitute, the higher prevent the of it decreased the workability of concrete. Due the higher density of plastic about 70%, than the concrete, the dry density of concrete was found to be higher. With only 20% of rubber replacement the density value decreased. With the increase in plastic content, the compressive strength lowered its value. Due to rubber’s stiffness, the compressive strength came out to be lower than the normal. The smooth surface of plastic gave negative results in tensile and flexural strength tests. Since, plastic a drubber both are bad conductor of electricity, there was an increase in the electrical resistivity of the concrete after their addition in the concrete mix.

Using natural substitutes in place of cement is a common practice. In the paper, the author has replaced the fine aggregates with saw dust powder and Portland cement with ground granulated blast furnace slag. The saw dust has been added in 5%, 10%, 15%. The ground granulated blast furnace slag has been added in 10%, 20%, 30% partially. Water reducing super plasticizer were also added to gain high workability and strength. The saw dust powder was collected form wooden industry and it was sieved to get evenly fined powder. The tests results indicated that addition of both saw dust powder and ground granulated blast furnace slag enhanced mechanical properties by 10%. They even improved the thermal properties and reduced the carbon dioxide emission. This mix is an initiative towards green concrete and low-cost construction material.

In this paper, the author has taken wood ash and fine sea shell powder as a natural substitute to cement. The grade of concrete taken is M25. The replacement was done in 5%, 10%, and 15% by weight in cement. A number of tests were conducted and the test results were taken and compared at 7, 14, 28 days curing samples. The wood ash was made from the saw dust waste collected from the wooden plant, later the saw dust was burnt in an open place and the wood ash was collected. To obtain a fine material it is sieved through 75-micron sieve. The sea shell was collected from beaches and the burned in the furnace, the residue is then crushed in Los Angeles abrasion machine. Later the powder was washed with water to remove any particles of NaCl. At 28 days, the compressive strength test had maximum values. When content of wood ashes and sea shell powder increased from 0 to 10%, the split tensile strength is to maximum. There was an increment in flexural strength of the mix at 28 days curing. From all the results, the conclusion came out that addition of wood ash and sea shell powder of about 5% will give enhance results and they are better than the normal mix test results.

S. Arivalagan et-al, [2020] usually, the damaged glass and broken glass sheets are discarded as waste. Using glass powder in concrete is also a good substitute. The glass waste powder has been used as a substitute to fine aggregates. They are substituted in 10%, 20%, 30% in the concrete mix. The glass powder is obtained by crushing them and then sieving them through 2.36mm sieve to get a fine powder. The workability of concrete decreased with increase in the percentage of the glass powder. Similarly, the compressive strength gained its
The maximum value at 20% replacement with glass powder. The tensile strength reduced beyond 20% addition. Optimal value of flexural strength was gained with 20% replacement. From all the experiments, it was observed that replacement of 20% of sand with glass powder gave better results. Also, it is good in terms of reducing cost of construction. Also, using of waste glass powder is good for environment.

III. RESULTS AND ANALYSIS

Result of Fresh concrete

Fig 1: Effect of Saw Dust on Slump for Different Grade of concrete

Fig 2: Effect of Glass Pieces on slump for Different Grade of concrete
Fig 3: Effect of Foundary Sand on slump for Different Grade of concrete

Result of Hardened concrete

Fig 4: Compressive Strength of M25 at 7 Days on Different % Replacement of Saw Dust with Cement for Different Grade of Concrete

Fig 5: Compressive Strength of M25 at 28 Days on Different % Replacement of Saw Dust with Cement for Different Grade of Concrete
**Fig 6:** Compressive strength for Different Grade of Concrete at 7 days on different % replacement of replacement of Glass Pieces with CA

**Fig 7:** Compressive strength for Different Grade of Concrete at 28 days on different % replacement of Glass Pieces with CA
Fig 8: Compressive strength for Different Grade of Concrete at 7 days on different % replacement Foundary Sand with FA

Fig 9: Compressive strength of cube at 28 days on replacement of Foundary Sand with FA for Different Grade of Concrete
IV. CONCLUSION

- Using 75% of GGBS along with 45% waste foundry sand mixed with 35% of fly ash, this mix also gave good results when compared to the original mix.
- The overall conclusion came that recycled PET bottles or other materials can be used as a replacement of sand in concrete mix. It helps in dropping self-weight of concrete and also using recycled waste for a good purpose.
- After all the tests resultant discussion it was concluded that using of plastic a drubber waste has better results but had some negative impact also. It abridged the workability and mechanical strength of concrete.

V. REFERENCES


