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Second Generation Heat Processed Recycled Aggregate: A Review

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Review/Article

ABSTRACT Solid waste accumulation is a vital problem globally construction industry is a major source of solid waste generation in the form of construction and demolition waste as well that harms the eco system and increase land occupancy of the solid waste. Construction and demolition waste indirectly responsible for depletion of natural resources that directly raise the cost of the conventional aggregate, in this paper review and focus on the second-generation concrete production from different methods and potential of heat processed recycling of the demolished concrete.

Keywords: Construction and Demolition Waste (C&D Waste); Recycled Concrete Aggregate (RCA); Second-Generation Concrete; Heat-Processed Recycling; Sustainable Concrete.

INTRODUCTION

Concrete is very basic and most ingredient of any structure because its low life cycle and initial cost (V. 2013) , but after completion of the life span it become debris that contribute the solid waste accumulation on the earth surface. In the other hand demand of concrete raises day by day due to continue infrastructural development and reconstruction process hence the demand of coarse aggregate is also increasing which is main cause of the natural resource depletion. (Li 2015)

Concept of sustainability is to fulfill present need without compromising the future needs hence recycling of concrete is very much required for saving the natural resource and reduce the solid waste accumulation on the earth there are many technical concern in recycled concrete but very few conditions show feasibility with real time application depending on the complex procedure of recycling, significant difference in strength and variation in techniques. (Katerusha 2021)

LITERATURE REVIEW

The following factors taken from the previous research work to obtain potential of the second generation of the recycled aggregate.

Concrete recycling can become extremely challenging, which could increase project costs. In this case study, political and technical challenges related to concrete recycling resistances are discussed. In this research analysis, a survey of 27234 construction material recycling companies was conducted, and the results revealed significant cost, scientific development, and resource resistance.

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They use questionnaires to inquire about opposition to the use of recycled aggregate and construction trash. (Katerusha, 2021) Similarly questionnaire over the recycled aggregate is consumption and solid waste utilization in construction industry, they observed and conclude the following:

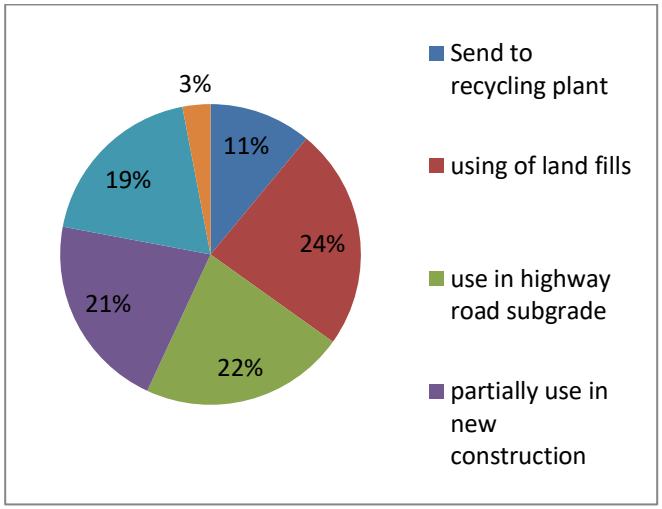


Fig 1 Percentage Chart

Water absorption, specific gravity, bulk density, abrasion resistance, impact value, and crushing value are all significantly improved when RCA is treated with a 10% HCl solution for a whole day in order to remove the layer of impurities (mortar) from recycled coarse aggregate by up to 70%. They use hydrochloric acid to process RCA, which removes up to 10–35% of the mortar and demonstrates the relationship between mortar attachment and water absorption, specific gravity, abrasion resistance, bulk density, impact value, and crushing value. The results are as follows: (i) Water absorption decreases with decreasing mortar attached; (ii) Specific gravity increases with decreasing mortar attached; (iii) Bulk density slightly increases with decreasing mortar attached; (iv) Abrasion resistance slightly decreases with decreasing mortar attached; and (vi) Impact value increases with decreasing mortar attached. (vii)Crushing value - Decreasing with decreasing mortar attached.

Table 1 Details of Properties

S.N.	Property	Results
1.	Duration absorption	24Hours
2.	Mortar removal	35% maximum
3.	Water absorption reduction	70% maximum

R. Senthamil selvi (2019)

Yuksen Esen and alperkurt (2017)- Perform experiment to examination concrete strength with respect to high temperature range on different concrete samples made by using Barite, Diatomite, Silica fume and fly ash. In this experiment was 105 degree centigrade to 800 degree centigrade, for measurement of strength Ultrasonic pulse velocity device is used. They find in Barite reinforced sample rate of decrement of compressive strength is very mild up to 400 degree centigrade but the rate of decreasing of strength was rapid after 400 degree centigrade, In the case of other three samples strength is little increased up to 400 degree centigrade but after 400 degree centigrade strength was decreasing rapidly, shows the curves between mortar percentage and mechanical properties variation.

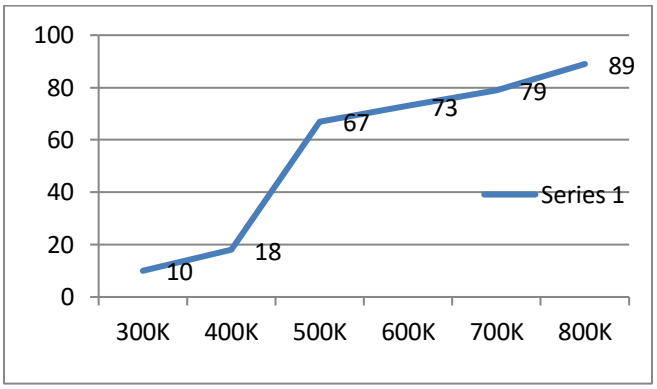


Fig 2 Variation of mortar percentage removal shown above in the chart with respect to the temperature.

The most common material that covers the surface of recycled aggregate is mortar, which is produced from demolition and construction waste. Because mortar is more porous than other materials, it increases water absorption, decreases specific gravity, decreases bulk density, increases impact value, and increases crushing value. Put otherwise,

it lessens the concrete's strength and durability. Yehia Sherif (2014).

Studies the behavior of concrete with respect to temperature rise, this behavior is categories in 8 ranges between 20^0C-1300^0C these are 200^0Cto 400^0C - 350^0C break down of some siliceous aggregates and 374^0C critical temperature observed.

In this research work performance and destruction of the concrete is observed with respect to the very high temperature as following observation take place:

Table 2 Details of Temperature Range

S.N.	Temperature Range	Observation in SAM and XRD
1	20^0C-200^0C	No specific change is observed.
2	200^0C-400^0C	Breakdown of siliceous is observed.
3	374^0C	Critical point for mortar removal

I. Hager (2013)

Uses water wash, nitric acid, sulfuric acid, and hydrochloric acid to treat the RCA and compares the results based on tests of compressive strength, flexural strength, and split tensile strength. This research reveals that nitric acid produced the most notable results, increasing compressive, split tensile, and flexural strength by 11.8%, 5.6%, and 8.77%, respectively, compared to untreated, suggesting that RCA could be used as a substitute for natural aggregate. Murali, G. (2012)

Significant improvements in 28-day compressive strength of 33 N/mm2, 28 N/mm2, 26 N/mm2, and 27 N/mm2 are obtained when recycled coarse aggregate is substituted for natural coarse aggregate by 0%, 30%, 40%, and 50%.

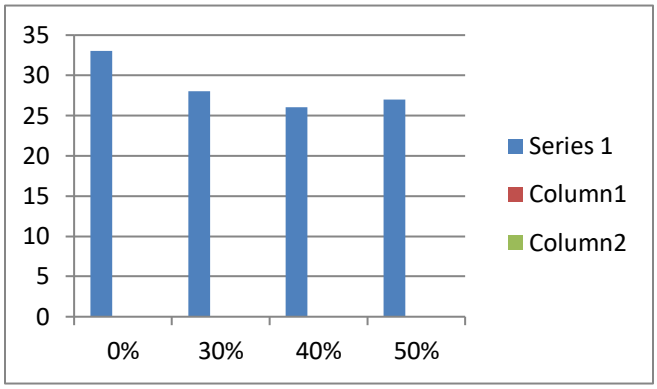


Fig 3 Bar Chart between compressive strength and Percentage of recycled coarse aggregate

Tiwari and Dwivedi (2012)

Investigate about mortar aggregate relationship, they said there is two reasons of mortar aggregate bond one is hydration of cement and another is interlocking between mortar and aggregate.

They use electron microscope to study relation of aggregate and mortar, they find the hydration is done on the aggregate surface this hydration process is completely depend on cement so it gives same strength of bond in every aggregate but additional bond strength produce by crystalline interlocking is varying with respect to aggregate rocks. Suzuki and Mizukami (1975, 1976)

RESULTS ANALYSIS

Concrete is one of the maximum extensively used production substances in the global, and its production is a giant contributor to environmental degradation and useful resource depletion. The recycling of concrete, mainly the elimination of mortar from used coarse combination, is an critical practice that addresses both environmental and economic issues. Mortar, the paste that binds aggregates in concrete, can be a barrier to recycling. However, advancements in technology and a developing focus of sustainable construction have precipitated the development of revolutionary methods to efficaciously separate mortar from coarse aggregates. This essay explores the importance of recycling concrete and the various methods used to put off mortar from coarse aggregates, with a focal point on its environmental and economic blessings

In recycled aggregate main adhesive impurity is mortar, mortar layer is covered the aggregate surface. Basically, there the two phenomenon's in this case first is mortar adsorbed to the surface of aggregate and another is thickness of mortar layer. The mortar layer can be removed with the help of heating the used concrete chus because

binding capacity of the cement starts loosing after 300^0C, coarse aggregate can be heated up to 600^0C after this basalt achieve its homologous temperature. (I. Hager 2013)

CONCLUSION

- Concrete recycling focusing primarily on the removal of sludge from used coarse aggregate is an important process for pursuing sustainable construction and conservation Provides environmental protection environmental benefits, such as CO2 reduction, conservation of natural resources and diversion of waste to landfill. In addition, it creates economic benefits by reducing disposal costs and the need to purchase new materials. As the technology and best practices in recycled concrete continue to evolve, it is important for the construction industry and policymakers to prioritize and encourage the use of recycled materials, thereby contributing to construction sustainable and responsible environment.
- Used coarse aggregate can be use again in second generation concrete by removing the mortar attached on the surface of the used coarse aggregate.
- Mortar from used coarse aggregate can be removed with Muric acid or application of heat as well.

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