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Mechanical properties of concrete with foundry sand andcoconut shell as partial replacement for coarse and fine aggregate

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Abstract

Concrete is one of the largest consumer products all over the world. Concrete consumes large quantity of natural ingredients like river sand in the form of fine aggregate and crushed stone or gravel in the form of coarse aggregate. With due consideration for sustainable construction, the concrete can be minimized by utilizing the waste products from various industries as an alternative for components in concrete. This paper deals with reuse of industrial waste foundry sand and agricultural waste coconut shell in biased form for fine aggregate and coarse aggregate [Siddique, R and Kadri, EH (2011)]. From the mechanical properties of concrete containing both the waste products, the optimum replacement levels were arrived at 25 % and 15% for waste foundry sand and coconut shell. The durability properties such as water absorption, porosity, sorptivity and water permeability are found for improvised concrete and compared with normal concrete.

Introduction

Recently, due to rapid urbanisation and increase in the population have led to exponential growth in infrastructure/construction industry. The ease of production of concrete makes it suitable for all types of construction and it is a choice of common man. The concrete is a mixture comprising of aggregate, cement along with water. The need of raw material for concrete production leads to over exploitation of natural resources like river sand and gravel. On the other hand, industrialization brings large amount of waste material in to the society which is being dumped as landfill and also poses serious threats to the environment. Concrete is the only material which is compatible to certain degree for any foreign constituents. The main focus of researcher is to find a substitute and limit the usage of in born substances. The aim is to encourage the usage of waste material in concrete.

The three major players of metal alloy casting industry include India next to China and USA. It is estimated that, India comprises 5100 large, medium and small-scale foundries clustered in 19 regions generates 1.71 million tons of Foundry sand waste [1], [2], [3]. Foundry sand waste (WFS) is a by-product from metal casting industry during the casting and moulding operations. The moulding sand is recycled and reused many times. After that, it is dumped as landfill without any treatments, which causes severe environmental threats like leaching [4], [5].

India is third largest cultivator of Coconut trees covering a cultivation area of 1.77 million hectares. World's total coconut oil output largely depends on four major countries like India, Indonesia, Philippines, and Srilanka [6], [7], [8].. At global level, India is premier producer of coconuts nuts which in turn leads to increase in solid waste generation in the form of coconut shells [9]. A part of generated coconut shell production, coir generation and the remaining are dumped as landfill [10] The squander particles are successfully used as a partial substitute in construction industry which could benefit the economically backward communities presiding near the zone of coconut vineyard and metal casting industry. Many researchers have experimented individually FS as substitute for fine aggregate [11], [12], [13] and Coconut shell for coarse aggregate replacement and also to produce light weight concrete [14], [15], [16]. In order to find a sustainable solution, authors have experimented both waste materials (WFS and WCS) as substitute for both the aggregates in concrete [17].

Section snippets

Materials

The materials used for the used for the current experimental work are Ordinary Portland Cement OPC, Natural rived sand as fine aggregate FA, Crushed stones as Coarse aggregate CA, potable water, waste foundry sand WFS as FA replacement and waste coconut shell WCS as CA replacement [18]. The following section provides details regarding various constituents of the concrete.…

Experimental investigation

The design was carried out following IS: 456 (2000); Table 3 provides details about the mix proportion fixed in this work. The present study has phases of experimentation. In the first stage, FA and CA were replaced with WFS and WCS in different percentages as shown in Table 4, to obtain optimum replacements based on workability and strength results. Fig. 2 represents Slump cone test on Fresh Concrete for combination of WFS-WCS. The second stage of the study focuses on durability…

Slump cone test

The change in slump values with the addition of WFS and WCS is presented in Table 4. From Fig. 3, it is intelligible the value starts decreasing as the addition of WFS and WCS increases. The WFS was pre-soaked for 24 hrs to reach its saturation level but the WFS has water absorption capacity was more than the normal fine aggregate. This could be the reason behind the decrease in slump value which can be compensated by the use of super plasticizer.…

Compressive strength

The outcome are weigh up with conventional…

Conclusion

The recommendation here is usage of waste foundry sand and waste coconut shell as partial replacement material for Fine aggregate and coarse aggregate supports reservation of natural resources. The usage of natural waste and industrial waste safely without any drawbacks supports unwanted dumping of waste products. It also prevents environmental pollution.

- However, the strength results of concrete containing 25% WFS and 15% WCS have strength similar to normal concrete and hence taken as…

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CRediT authorship contribution statement

P.R. Kalyana Chakravarthy: Conceptualization. **T. Ilango:** Validation. **R. Pugazhenthi:** Formal analysis.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

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2022, Materials Today: Proceedings

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>
> …In addition to the application of permeable concrete as pavement, most studies are related to its hydraulic and mechanical performance, its skid resistance, sound absorption, temperature mitigation and air quality improvement [7]. The large production of conventional concrete leads to an overexploitation of natural aggregates and, therefore, the use of alternative materials as aggregates can minimize this scenario [8] being considered a sustainable alternative. In addition, the reuse of alternative materials, that would in principle be discarded, can also prolong the life of landfills.…

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