e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

OPTIMISATION OF ZEOLITE AND RECYCLED CONCRETE AGGREGATE IN GREEN CONCRETE PAVEMENTS

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ABSTRACT

Recycled concrete aggregates are made from building and demolition debris that is either disposed of in landfills or only sometimes utilized as filler. These aggregates are only used in a restricted number of applications due to drawbacks including excessive water absorption and permeability, poor compressive strength, etc. The mortar of the preceding concrete matrix that was bonded to it is what gives it these terrible qualities. With fresh mortar producing a weak inter-transitional zone, the old mortar fails to make a firm link. This study examines the improvement in recycled aggregate qualities when zeolite serves as a partial cement substitute. Due to the high silica concentration of zeolite, it combines with $Ca(OH)_2$ to generate additional C-S-H gel, which reduces pores and increases the durability of concrete. Zeolite at a concentration of 5% has given compressive, and flexural strength approximately equal to Normal mix for 7 days. The strength qualities declined when zeolite was added more and more.

Keywords: Compressive Strength, Flexural Strength, Recycled Concrete Aggregate, Zeolite, Optimisation.

I. INTRODUCTION

The most typical engineering material is concrete due to the fact that it is considerably less costly, can be shaped into any size, and is abundant with the exception of being excavated and made. Due to the present scenario of urbanization and expanding population, the demand for raw materials in the building sector depletes the environment's natural resources [1]. The destruction of several mines and quarries in the pursuit of raw materials has an impact on the environment and poses a threat to biodiversity. Accumulation of dust-filled air also harms the ecosystem by contaminating nearby water reservoirs and the soil, which might have serious health effects. Finally, the majority of building sites are situated in heavily inhabited regions, whereas quarries are shoved away from cities to reduce noise and dust accumulation [2]. Tonnes of obtained materials are often transported by vehicles or lorries from quarries to production facilities, and then to building sites in cities. Pavements are damaged, and more energy or fuel is used than is necessary [3]. On the other side, there is waste created when constructions are demolished for various causes. After the destruction, most of the garbage is heaped beside the pavement or disposed of in landfills [4]. Numerous research has been conducted over the last ten years to better understand the characteristics and use of RC. In general, as the replacement ratio of RAC rises, so does its compressive strength. The mechanical characteristics of concrete with 100% substitution of recycled aggregate were reported by N.K. Bairagi [5]. When RCAs are utilized, some research has shown that the strength is reduced by 10% after 28 days, but after 28 days of curing, the strength starts to increase and is competitive with the traditional mix [6]. Concrete composed entirely of RCA has occasionally had a 20–25% lower compressive strength than regular concrete. The RCA, which consists of aged aggregates with connected mortar made of weak hydrated and unhydrated cement, is the cause of this decline in strength [7]. Zeolite has been discovered to be quite effective in increasing the RAC's strength and durability when used as Pozzolana. Zeolite is an alumina-silicate structure made up of multiple tiny holes that can absorb water and then use it to cure internally. High silica and alumina content interact with CaOH to produce additional calcium silicate hydrates (C-A-H) and alumina hydrates (C-S-H), increasing concrete density and preventing the occurrence of microcracks [8].

II. METHODOLOGY

Materials

In this study, OPC 53 grade cement is used as binding material, river sand is used as fine aggregate, and HBG metal of 19 mm size is used as Coarse aggregate. Zeolite is used as a partial replacement to cement and recycled concrete is the replacement for coarse aggregate. Zeolite is replaced in the levels of 5%, 10% and 15%. Recycled concrete is replaced in the levels of 25%, 50% and 75%.

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Methodology

9 mixes were prepared and these results are compared with Normal concrete. Cubes are cast to get compressive strength. Cubes are cast in 150mm * 150mm * 150 mm. Cubes are tested for 7 days and 28 days. Prisms are cast to determine the flexural strength. Prisma are cast in 500mm * 100 mm * 100mm moulds. Prisms are tested after 7 days and 28 days of curing. Cubes and prisms are cast for M30 grade concrete.

III. RESULTS AND DISCUSSION

Compressive Strength

This test was conducted on 7 days and 28 days under compression testing machines having a uniform loading rate of 140 kg/cm^2/min.

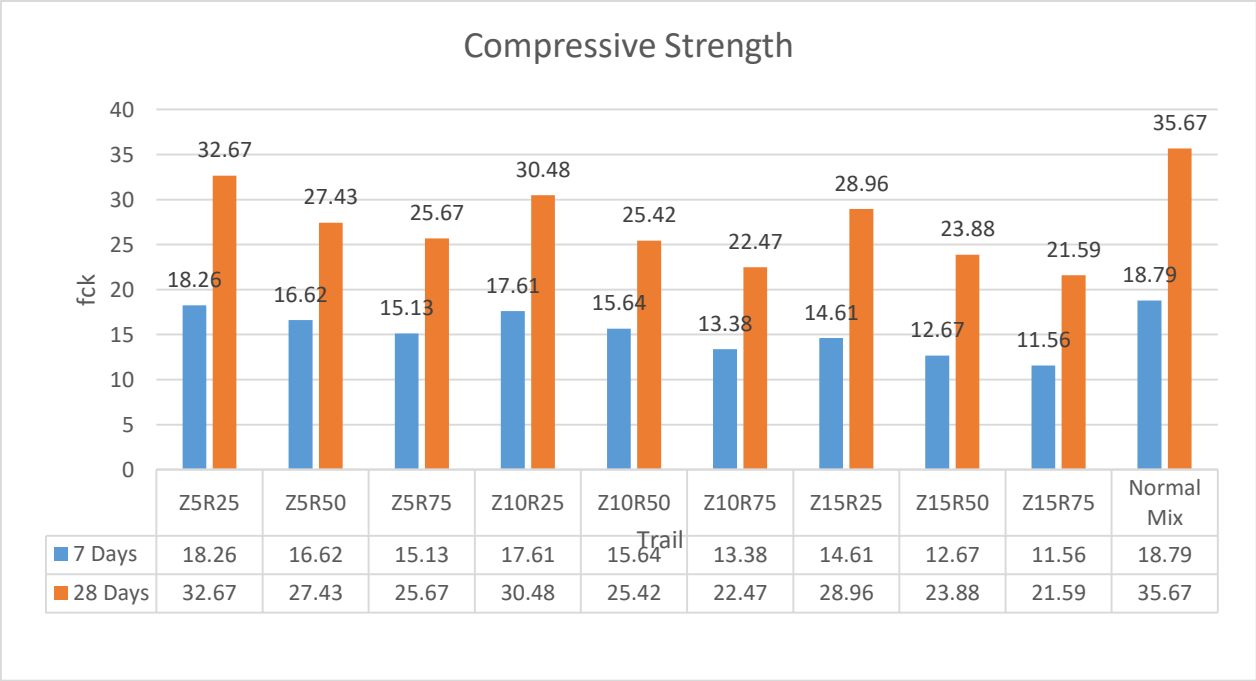

Figure 1: Compressive strength of cubes for 7 days and 28 days

Flexural Strength

Flexural tests were conducted on prisms for 7 days and 28 days under a flexural testing machine loading rate of 1.8 KN/m^2 / min.

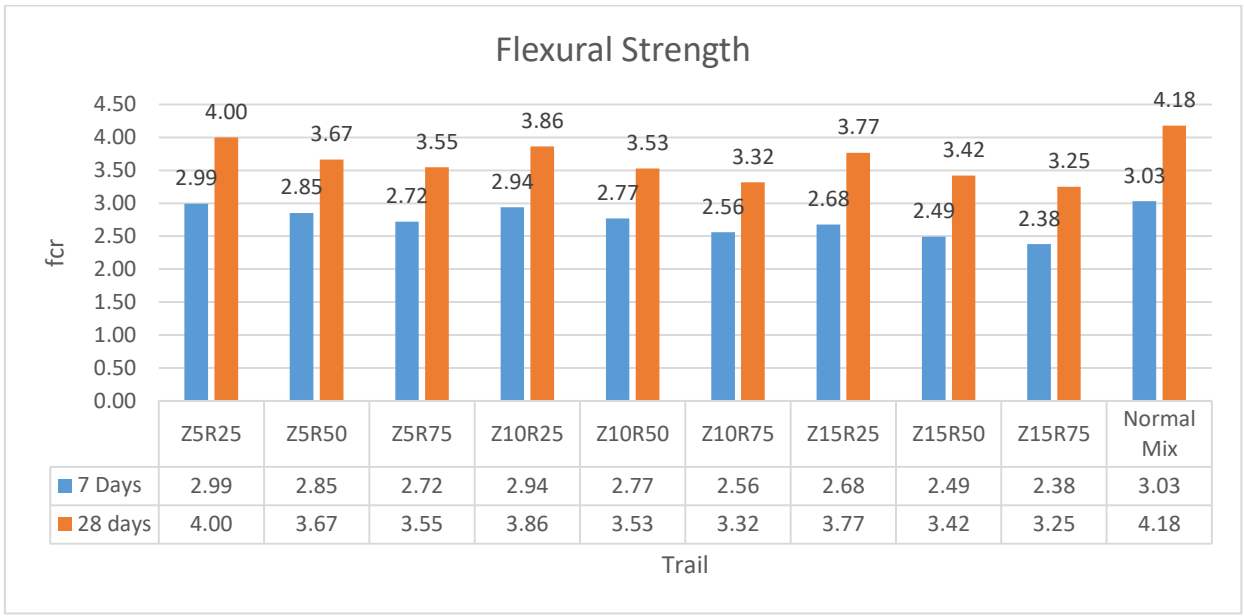

Figure 2: Flexural Strength of Concrete

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IV. CONCLUSION

- Zeolite at a concentration of 5% has given compressive, and flexural strength approximately equal to Normal mix for 7 days.
- For 28 days increasing of zeolite and RCA reduces the strength of concrete by 10%.
- The strength qualities declined when zeolite was added more and more.

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