Construction and Building Materials 201 (2019) 651–661

Contents lists available at ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Durability Studies on Concrete Containing Treated Used Foundry Sand

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HIGHLIGHTS

- Silica in the sand is enriched by treating and called as TUFS.
- Water absorption and permeability characteristics of TUFS concrete are investigated.
- Effect of TUFS concrete on exposure to various environments.
- Optimum TUFS content is found to be 30% by weight.

ARTICLE INFO

Article history:
Received 27 July 2018
Received in revised form 1 January 2019
Accepted 3 January 2019

Keywords:
TUFS
Water absorption
RCPT
Acid resistance
Sulphate resistance

ABSTRACT

Use of waste products from foundry industry in concrete not only makes it economical, but also helps in reducing disposal problems and environmental degradation. The waste materials required for the replacement of fine aggregate are processed to the required specifications that could match with the properties of fine aggregate to be used in concrete. Such type of industrial waste by-product namely waste foundry sand was treated and used as partial replacement material for fine aggregate in concrete. Experiments were conducted to study the durability characteristics of Treated Used Foundry Sand (TUFS) as partial replacement for fine aggregate. Fine aggregate was replaced with various percentages of TUFS by weight. Tests were conducted for water absorption, sorptivity and Rapid Chloride Permeability. Further these concrete specimens were exposed to chemical solutions and marine environment for 7, 28, 56 and 90 days. After the exposure period, these specimens were tested for loss in weight and compressive strength. Test results indicated better performance of concrete with TUFS than control specimen and established that concrete with 30% TUFS is more impermeable than control concrete with better durability properties also proved that TUFS can be effectively used in making good quality concrete.

1. Introduction

Concrete is the most widely and universally used construction material in construction industry. Slightly more than a ton of concrete is produced every year for every human being on the planet. Over the past several decades, the demand for concrete has been increasing rapidly due to infrastructure development. Between 1900 and 2010, the global volume of natural resources used in buildings and transport infrastructure increased 23-fold [1]. Sand and gravel are the largest portion of these primary material inputs (79% or 28.6 gigatons per year in 2010) and are most extracted group of materials worldwide. Comparative evolution of the post-World War II (WWII) global cement, steel, and plastic productions (Top), and same data plotted as material use per capita vs world population (Bottom) are shown in Fig. 1.

The concrete constitutes various ingredients like cement, fine aggregate and coarse aggregate. Out of these, river sand is used as a fine aggregate in concrete production for several decades. The demand for river sand increased due to depletion of sand. The production of aggregates (including both coarse and fine aggregates) reached about 40 billion tonnes in the year of 2014 [3] At present, many researches are carried out to overcome the stress and the demand for river sand by using industrial wastes like foundry sand, fly ash, bottom ash and slag which can result in significant improvement in overall energy efficiency and environmental performance [4].

In industries, numerous waste materials are generated during manufacturing processes. The increasing awareness about environment has tremendously contributed in the disposal of generated wastes. With the scarcity of space for land filling and unavailability

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https://doi.org/10.1016/j.conbuildmat.2019.01.014
0950-0618/