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# Strength and Durability Studies of Concrete Containing Waste Foundry Sand

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**ABSTRACT**

Due to ever increasing quantities of waste materials and industrial by-products, solid wastemanagement is the prime concern in the world.Scarcity of land-filling space and because of itsever increasing cost, recycling and utilization of industrial by-products and waste materials hasbecome an attractive proposition to disposal.There are several types of industrial by-productsand waste materials. The utilization of such materials in concrete not only makes it economical,but also helps in reducing disposal concerns. One such industrial by-product is Waste FoundrySand (SFS). WFS is major byproduct of metal casting industry and successfully used as a landfillingmaterialformanyyears.Butuseofwastefoundrysand(WFS)forlandfillingisbecoming a problem due to rapid increase in disposal cost. In an effort to use the WFS inconstructionmaterials,researchhasbeingcarriedoutforitspossible utilizationinmakingconcrete as partial replacement of fine aggregate. In India, approximately 1.71 million tons ofwaste foundry sand and in Punjab region, approximately 0.17 million tons of waste foundry isproducedyearly.

This experimental investigation was performed to evaluate the strength and durability propertiesof M20 (30 MPa) and M30 (40 MPa) grades of concrete mixes, in which natural sand was partialreplaced with waste foundry sand (WFS). Natural sand was replaced with five percentage (0%,5%, 10%, 15%, 20%) of WFS by weight. A total of ten concrete mix proportions M-1, M-2, M-3, M-4 and M-5 for M20 grade of concrete and M-6, M-7, M-8, M-9

and M-10 for M30 grade ofconcrete with and without WFS were developed. Compression test, splitting tensile strength testandmodulusofelasticitywerecarriedouttoevaluatethestrengthpropertiesofconcreteattheage of 7, 28, 91 and 365 days. In non destructive testing, rebound hammer and ultrasonic pulsevelocity test were conducted at the age of 28, 91 and 365 days. In case of durability property,abrasion resistance, rapid Chloride Permeability and deicing salt scaling resistance was evaluatedattheageof28,91and365days.Statisticalanalysisandcomparativestudybetweenstrengtha nd durability properties of both grade of concrete (M20 and M30) were carried out at the age of28, 91 and 365 days. XRD study was done to identify the presence of various compounds in M20gradeof concrete withfoundrysandinvaryingpercentagesreplacement of fineaggregate.Test results showed that there is increase in compressive strength, splitting tensile strength andmodulus of elasticity for both grades of concrete mixes (M20 and M30) with inclusion of wastefoundry sand (WFS) up to 15% replacement. Resistance of concrete against abrasion (wear),rapid chloride permeability and deicing salt scaling were also improved for bothgrades ofconcrete mixes. Quality of concrete in term of homogeneity and uniformity were also improved.Results showed that there was better enhancement in strength and durability properties at 15%replacementoffineaggregate with WFS.

## INTRODUCTION

Concrete is the most widely used man-made construction materials in the world. Slightly morethanatonofconcreteisproducedeachyearforeveryhumanbeingontheplanet

Fundamentally, concrete is economical, strong, and durable.Although concrete technologyacross the industry continues to rise to the demands of a changing market place. The

constructionindustryrecognizesthatconsiderableimprovementsareessentialinproductivity,productperformance, energy efficiency and environmental performance. The industry will need to faceand overcome a number of institutional competitive and technical challenges. One of the majorchallengeswiththeenvironmentalawarenessandscarcityofspaceforland-fillingisthewastes/byproductsutilizationasanalternative todisposal.Throughout theindustrialsector,including the concrete industry, the cost of environmental compliance is high. Use of industrialby-productssuchasfoundrysand,flyash,bottomashandslagcanresultinsignificantimprovementsinoverallindustryenergyefficiencyandenvironmentalperformance.

Theconsumptionofalltypeofaggregateshasbeenincreasinginrecentyearsinmostcountriesat a rate far exceeding that suggested by the growth rate of their economy or of their constructionindustries. Artificially manufactured aggregates are more expensive to produce, and the availablesource of natural aggregates may be at a considerable distance from the point of use, in whichcase, the cost of transporting is a disadvantage. Theother factors to be considered are thecontinued and expanding extraction of natural aggregates accompanied by serious environmentalproblems.Oftenitleadstoirremediabledeteriorationofthecountryside.Quarryingofaggregates leads to disturbed surface area etc., but the aggregates from industrial wastes are notonly adding extra aggregate sources to the natural and artificial aggregate but also preventenvironmental pollution.

Foundry industry produces a large amount of by-product material during casting process.Theferrousmetalcastsinfoundryarecastironandsteel,nonferrousmetalarealuminum,copper,

brass and bronze. Over 70% of the total by-product material consists of sand because mouldsusuallyconsistofmoldingsand,whichiseasilyavailable,inexpensive,resistancetoheatdamage, easily bonded with binder, and other organic material in mould. Foundry industry usehigh quality specific size silica sand for their molding and casting process.This is high qualitysand than the typical bank run or natural sand. Foundries successfully recycle and reuse the sandmany times in foundry. When it can no longer be reused in the foundry, it is removed from theindustry, and is termed as waste foundry sand (**WFS)**. It is also known as spent foundry sand(SFS)and used-foundrysand (UFS).

## OBJECTIVE OF THEWORK

Witheverincreasingquantitiesofindustrialbyproductsandwastematerials,solidwastemanagement has become the principal environmental concerns in the world.Scarcity of land-filling space and due to its ever increasing cost, utilization/recycling of byproducts/waste hasbecome an attractive alternative to disposal.Several types of byproducts and waste materials aregenerated.Each of these waste products has specific effects on the properties of cement-basedmaterials. The utilization of such materials in concrete not only makes it economical, but also dohelp in reducing disposal problems. Reuse of bulk wastes is considered the best environmentalalternative for solving the problem of disposal. One of such industrial byproducts is Wastefoundry sand (WFS). Waste foundry sand is a by-product of ferrous and nonferrous metal castingindustries. Foundries successfully recycle and reuse the sand many times in a foundry. When thesand can no longer be reused in the foundry, it is removed from the foundry and is termed aswaste foundrysand.

**Result:-**

The findings of experimental investigations were discussed. Various tests wereconducted to determine the effect of waste foundry sand on strength and durability properties ofbothgradesofconcrete(M20andM30).Innondestructivetesting,reboundhammerandultrasonic pulse velocity test was performed. Natural sand was replaced with waste foundry sandby0to20%atanintervalof5%.Inthisinvestigationitwasfoundthatat15%replacement,WFS showed considerable improvement on strength properties (compressive strength, splittingtensile strength and modulus of elasticity) and durability properties (abrasion resistance, rapidchloride penetration resistance and deicing salt surface scaling resistance) of both grades ofconcrete.

## Conclusion-

The conclusion is based of the findings of strength and durability propertiesof both grades of concretes.Inclusion of waste foundry sand as a partial replacement of fineaggregate in concrete improved the strength and durability properties of both the grades ofconcrete. Further, concrete made with 15% replacement of natural sand with WFS could suitablebeusedformakingstructural concretes.

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