

A REVIEW ON APPLICATION OF WASTE FOUNDRY SAND AS PARTIAL REPLACEMENT OF FINE AGGREGATE

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Abstract — Metal foundries use large amount of sand as a part of the metal casting process. Use of foundry sand is a byproduct of ferrous and nonferrous metal casting industries. Foundry sand recycled and reuse many times in metal casting industries. When sand cannot be reuse again, it is removed from foundry and it known as waste foundry sand. Replacement of natural sand by waste foundry sand is varies by some percentage. This paper contains overview of some of the research published on usage of waste foundry sand in concrete. Effect of waste foundry sand on concrete properties such as compressive strength, splitting tensile strength, modulus of elasticity is presented.

Keywords- Metal foundries, Ferrous-nonferrous, Waste foundry sand, compressive strength, splitting tensile strength, modulus of elasticity

I. INTRODUCTION

Concrete is economical, strong, and durable material. Although concrete technology across the industry continues to rise to the demands of a changing market place. The construction industry recognizes that considerable improvements are essential in productivity, product performance, energy efficiency and environmental performance. The industry will need to face and overcome a number of institutional competitive and technical challenges. One of the major challenges with the environmental awareness and scarcity of space for land-filling is the wastes/byproducts utilization as an alternative to disposal.



Figure 1 Foundry sand

Foundry industry produces a large amount of by-product material during casting process. The ferrous metal casts in foundry are cast iron and steel, nonferrous metal are aluminum, copper, brass and bronze. Over 70% of the total by-product material consists of sand because molds usually consist of molding sand, which is easily available, inexpensive, resistance to heat damage, easily bonded with binder, and other organic material in mold. Foundry industry use high quality specific size silica sand for their molding and casting process.

This is high quality sand than the typical bank run or natural sand. Foundries successfully recycle and reuse the sand many times in foundry. When it can no longer be reused in the foundry, it is removed from the industry, and is termed as waste foundry sand (WFS). It is also known as spent foundry sand (SFS) and used-foundry sand (UFS).

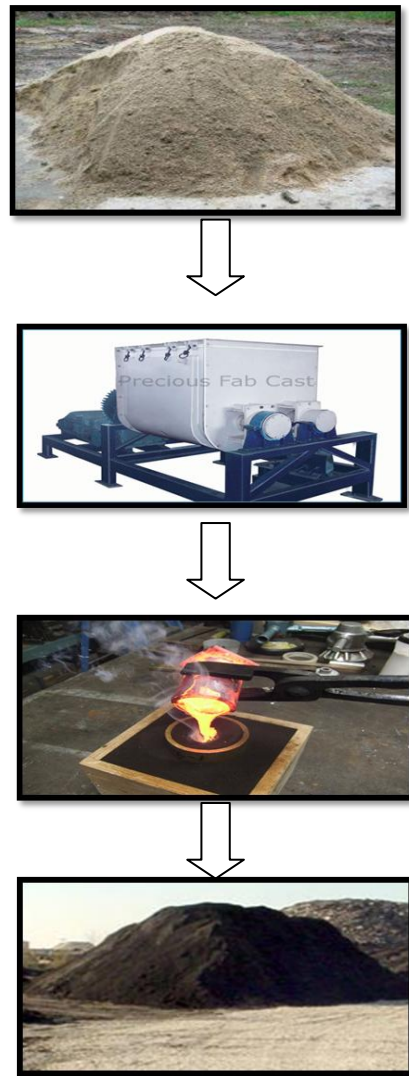


Figure 2 Source of foundry sand

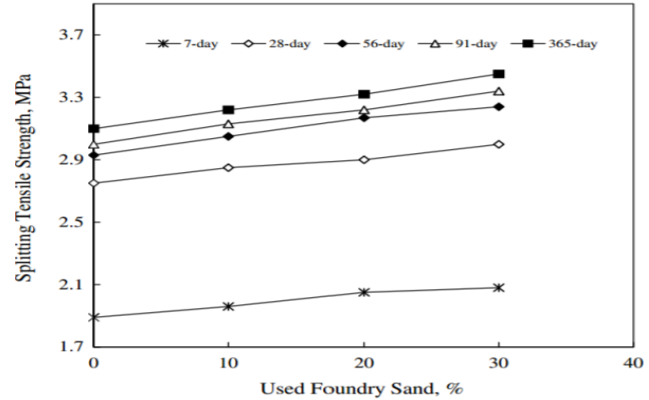
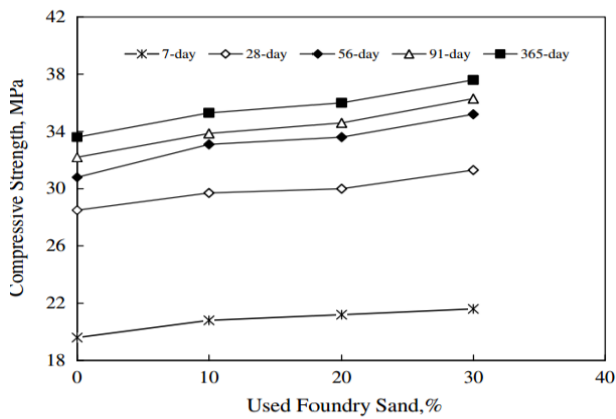
Classification of foundry sand depends upon the type of binder system used in metal casting. Two types of binder systems are used, and on the basis of that foundry sand is categorized as clay-bonded sand (green sand) and chemically bonded sand. Green sand is most commonly used molding media by foundries. Green sand is composed of naturally occurring materials, which are blended together such as high-quality silica sand (85-95%), bentonite clay (4-10%) as a binder, a carbonaceous additive (2-10%) to improve the casting surface finish and water (2-5%).

II. LITERATURE REVIEW

A. Albert Noumowe, Rafat Siddique Effect of used foundry sand on the mechanical properties of concrete, Construction and building material 23(2009)976-980

Used-foundry sand is a by-product of ferrous and nonferrous metal casting industries. Foundries successfully recycle and reuse the sand many times in a foundry. When the sand can no longer be reused in the foundry, it is removed from the foundry and is termed used/spent foundry sand. In an effort to utilize used-foundry sand in large volumes, research is being carried out for its possible large-scale utilization in making concrete as partial replacement of fine aggregate. This paper presents the results of an experimental investigation carried out to evaluate the mechanical properties of concrete mixtures in which fine aggregate (regular sand) was partially replaced with used-foundry sand (UFS).

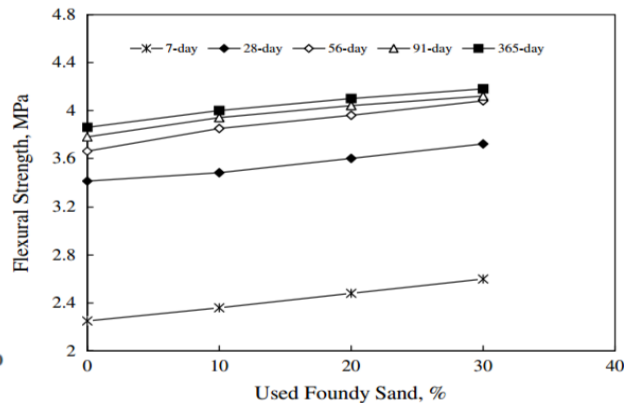
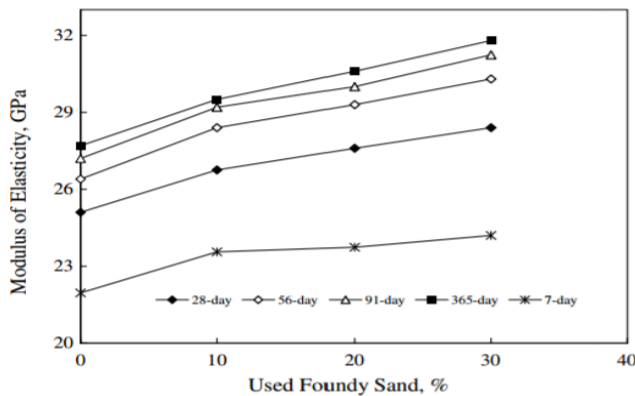
Fine aggregate was replaced with three percentages (10%, 20%, and 30%) of UFS by weight. Tests were performed for the properties of fresh concrete. Compressive strength, splitting- Tensile strength, flexural strength, and modulus of elasticity were determined at 28, 56, 91, and 365 days. Test results indicated a marginal increase in the strength properties of plain concrete by the inclusion of UFS as partial replacement of fine aggregate (sand) and that can be effectively used in making good quality concrete and construction materials. Results are as follows:.



(a)

(b)

Figure 3 (a) Compressive strength (b) splitting-tensile strength, in relation to used foundry sand



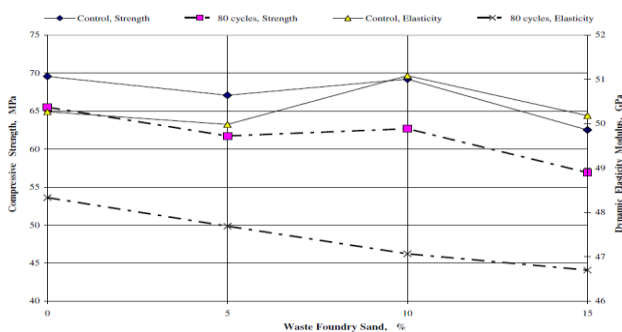
(a)

(b)

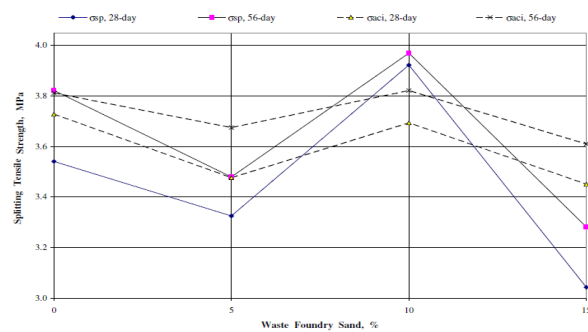
Figure 4 (a) Modulus of elasticity (b) Flexural strength, in relation to used foundry sand

B. Yacel Guney, Yasin Dursun Sari, and Musin Yalcin Re-use of waste foundry sand in high-strength concrete, Waste Management 30 (2010) 1705-1713

In this study, re-use of waste foundry sand in high-strength concrete production was investigated. The natural fine sand is replaced by waste foundry sand by 0%, 5%, 10%, & 15% percentage. The test result shows that reduction in compressive and tensile strength, and elasticity modulus which is directly related to percentage of waste foundry sand in concrete. The slump and workability of the fresh concrete decreases with increase of the waste foundry sand ratio. And the freezing and thawing significantly reduces the mechanical and physical properties of the concrete.



(a)



(b)

Figure 5 Effect of WFS content on (a) Compressive strength & Modulus of elasticity (b) Splitting tensile strength

C. Rafat Siddique, Gurdeep Kaur, Anita Rajor Waste foundry sand and leachate characteristics, Resource, Conservation and Recycling 54 (2010) 1027-1036

Solid waste management has become one of the global environmental issues, as there is continuous increase in industrial by-products and waste materials. Due to lack of land filling space and its ever increasing cost, utilization of waste material and by-products has become an attractive alternative to disposal. Waste foundry sand (WFS) is one of such industrial by-product which could be used in various applications including construction materials such as Controlled Low-Strength Material (CLSM) and concrete. The beneficial use of such by-products in construction materials results in reducing the cost of construction materials' ingredients and also helps in reducing disposal problem.

The leach ate obtained from such materials may contain hazardous compounds, which may possibly effect the environment. So, it is important to know the characteristics of leach ate obtained from waste foundry sand. Understanding the leach ate characteristics offsets essential in its disposal, environmental impact, and potential development for beneficial utilization towards solid waste management. This paper describes the physical, chemical properties of WFS, various leaches ate test methods, and research published on leach ate characteristics of waste foundry sand.

D. Yacel Guney, Yasin Dursun Sari, and Musin Yalcin Re-use of waste foundry sand in high-strength concrete, Waste Management 30 (2010) 1705-1713

The development of automobile, vessel, rail road, and machine industry leads an increase of foundry production used as their components, which cause a by-product, WFS. The amount of the WFS produced in Korea is over 700,000 tons a year, but most WFS has been buried itself and only 5-6% WFS is recycled as construction materials. Therefore, it is necessary for most WFS to research other ways which can be used in a higher value added product. In this study two types of WFS were used as a fine aggregate in concrete. Compressive strength of hardened concrete at each ages and tensile strength of it at the age of 28 days were measured. The test results are as follows:

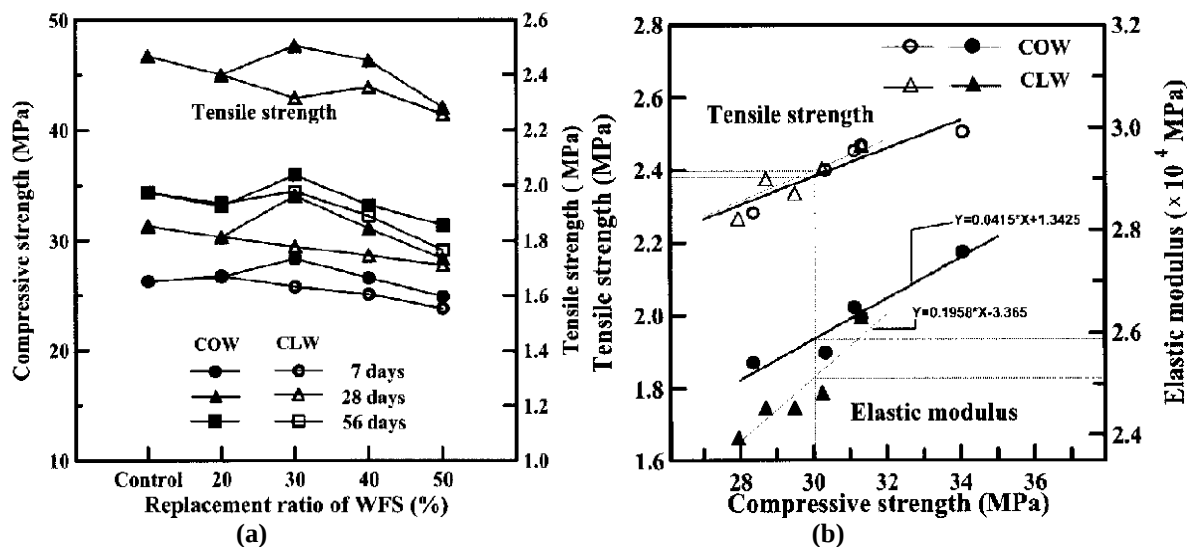


Figure 6 (a) Compressive strength & tensile strength of concrete (b) Modulus of elasticity of concrete

CONCLUSION

From the above literature we conclude that

1. Waste foundry sand can be used as a partial replacement for regular sand in making concrete or concrete products.
2. Strength properties of concrete mixtures increase with increase in foundry sand contents and also with the age.
3. Strength properties results indicate that waste foundry sand could be very conveniently used in making good quality concrete and construction materials.

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4. Yacel Guney, Yasin Dursun Sari, and Musin Yalcin Re-use of waste foundry sand in high-strength concrete, Waste Management 30 (2010) 1705-1713