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A Literature Review on Foundary Sand Concrete

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ABSTRACT

The abstract is the précis of the complete work presented in the Dissertation. It should be concise but at the same time should provide information about the work done and the methodologies used. The same should begin with a "one tab space". The abstract may be written in the 1.5 line spacing paragraph format. The present work investigated the influence of waste foundry sand as partial replacement of fine aggregate (sand) on the properties of two grades (M20 & M30) of concrete. On the basis of the results from the present study, following conclusions are drawn.5.2 STRENGTH PROPERTIES5.2.1 Compressive Strength Compressive strength of both grades of concrete mixes (M20 and M30) increased due to replacement of fine aggregate with waste foundry sand. However, compressive strength observed for both grades of concrete mixes were appropriate for structural uses. M20 grade concrete mix obtained increase in 28-day compressive strength from 25.0MPa to 30.20MPa on 15% replacement of fine aggregate with WFS, whereas it increase was from 36.6MPa to 42.8MPa for M30 grade of concrete mix. Maximum strength was achieved with 15% replacement of fine aggregate with WFS. Beyond 15% replacement it goes to decrease for both grades of concrete, but was still higher than control concretes At 15% replacement of fine sand with WFS, M20 Grade of concrete showed better percentage increase than M30 Grade of concrete by 9% at 28 days, 19.5% at 90 days Effect of inclusion of WFS was better effect on M20 grade of concrete mixes rather than M30 grade of concrete mixes. The rate of gain of strength for M20 grade of concrete mixes observed to be more than M30 grade of concrete mixes at all percentage replacement.

INTRODUCTION OF FOUNDRY SAND

The industrial by products which have been disposed earlier are now being considered for beneficial use. Beneficial use can reduce our nation's carbon production and consumption of virgin material and result in economic gains. It is important component of nation's solid waste management hierarchy that first promotes source reduction and waste prevention followed by reuse, recycling, energy recovery and disposal. Researches all over the world today are focusing on ways of utilizing either industrial or agricultural wastes as a source of raw materials for the industry. These wastes utilization would not only be economical, but may also result to foreign exchange earnings and environmental pollution control. The utilization of industrial and agricultural waste produced by industrial process has been the focus of waste reduction research for economical, environmental and technical reasons.

This is because over 300 million tons of industrial wastes are being produced per annual by agricultural and industrial process in India. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste materials are found suitable in concrete making not only cost of construction can be cut down, but also safe disposal of waste material can be achieved. The cement of high strength concrete is generally high which often leads to higher shrinkage and greater evaluation of neat of hydration besides increase in cost. A partial substitution of cement by an industrial waste is not only economical but also improves the properties of fresh and hardened concrete and enhance the durability characteristics besides the safe disposal of waste material thereby protecting the environment form pollution This paper deals with partial replacement of fine aggregate with the industrial waste from China Clay industries. The compressive strength, split tensile strength and flexural strength of conventional concrete and fine aggregate replaced concrete are compared and the results are tabulated.

The most critical problem we are facing now a day is the deficiency of artificial resources for the construction purpose. The reason behind this is the ban of on extraction of sand ordered by government. To solve this problem, we are using solid waste from industries as a replacement material for fine aggregate i.e. used foundry sand. The foundry industry is diverse and complex. Although there are differences in some specific operations, the basic foundry processes vary only slightly from one foundry to another. The main foundry process produces metal or alloy castings by pouring molten metal into moulds. The moulds may be made of moulding sand and core sand or may be of a permanent type made of metal and a refractory lining. After hardening, the castings are removed from the moulds, processed and finished. The raw materials (sands) used for making foundry moulds are usually recycled. However, after multiple uses, they lose their characteristics, thereby becoming unsuitable for further use in manufacturing processes, and all the raw materials are then discarded as waste.

LITERATURE REVIEW

GENARAL

Due to ever increasing quantities of waste materials and industrial by-products, solid waste management is the prime concern in the world. Scarcity of land-filling space, because of its ever increasing cost, recycling and utilization of industrial by-products and waste materials has become an attractive proposition to disposal. There are several types of industrial by-products and waste materials. The utilization of such materials in concrete not only makes it economical but also helps in reducing disposal concerns. Natural sand is getting depleted due to large scale construction. So it is important to find out an alternative of natural sand, which can be used as partial replacement of natural sand (fine aggregate). There are several types of waste material/byproducts, which have been explored for possible use in concrete as a partial replacement of fine aggregate. Such types of materials are coal bottom ash, recycled fine aggregate, sewage sludge ash, stone dust and glass cullet, and waste foundry sand, etc.

Celik et al. (1996), Sahu et al. (2003), Tripathy and Barai (2006) and Shi-cong et al (2009) have reported the use of stone dust (SD) as partial replacement of fine aggregate. Celik et al. (1996) reported that increasing the dust content up to 10% improve the compressive strength and flexure strength of concrete. Sahu et al. (2003) concluded that there is significant increase in compressive strength, modulus of rupture and split tensile strength of concrete when sand was partially replaced by stone dust up to 40 percent. Tripathy and Barai (2006) investigated the compressive strength of mortar made with crusher stone dust (CSD) under normal, hot water curing and autoclaving curing. They concluded that up to 40% cement replacement by crusher stone dust and autoclave curing of mortar mix, gave same or better compressive strength than the control mortar mix (without CSD and normal curing). Shi-cong et al (2009) investigated the properties of concrete with crushed fine stone (CFS), furnace bottom ash (FBA) and fine recycled aggregate (FRA) as a fine aggregate. The test results showed that when furnace bottom ash and CSD was used as a fine aggregate to replace natural aggregates, the concrete exhibited higher compressive strength, lower drying shrinkage and higher resistance to the chloride-ion penetration. Cyr et al. (2007) used sewage sludge ash (SSA) in cement based materials. They observed that compressive strength of mortars containing 25% and 50% of SSA was always lower than those of reference mortars but it shown that SSA has a long term positive effect which might be related to a slight pozzolanic activity.

Aggerwal et al. (2007), Kim et al. (2011) and Bilir (2012) reported the effect of coal bottom ash as replacement of fine aggregate in concrete. Aggarwal et al. (2007) carried out experimental investigation to study the effect of bottom coal ash. Compressive strength, flexural strength and splitting tensile strength tests were carried out with 0% to 50% replacement. They concluded that compressive strength of concrete containing 50% bottom ash is acceptable for most structural application. Kim et al. (2011) investigated the mechanical properties of high strength concrete. The compressive strength was unchanged and the flexural strength of concrete almost linearly decreased as the replacement ratio of the fine bottom ash was increased. The modulus of rupture was decreased to 19.5% and 24.0% in accordance with 100% replacement of normal aggregates with coarse bottom ash (CBA). It was also found that compressive strength was not affected by the replacement of fine aggregate with CBA. Bilir (2012) investigated the effect of non-ground coal bottom ash (NGCBA) and non-ground granulated blast furnace slag (NGGBFS) on durability properties of concrete. He concluded that replacement of fine aggregate up to 40% NGGBFS and up to 30% NGCBA, concrete has very low chloride permeability.

Khatib (2005), Rakshvir and Barai (2006), Evangelista et al. (2007), Rao et al. (2007) and Soutsos et al. (2011) studied the properties of concrete incorporating recycled aggregate. Khatib (2005) used recycled fine aggregate to study mechanical properties. The fine aggregate in concrete was replaced with 0, 25, 50 and 100% recycled aggregate. Beyond 28 days of curing, the rate of strength development in concrete containing recycled aggregate was higher than that of the control mix indicating cementing action in the presence of fine recycled aggregate. Rakshvir and Barai (2006) studied on recycled aggregate based concrete. They studied various physical and mechanical properties of recycled concrete. It was observed that compressive strength showed a decrease up to 10% with the increase in recycled aggregate content Evangelista et al. (2007) concluded that the use of fine recycled concrete aggregates does not jeopardize the mechanical properties of concrete, for replacement ratios up to 30%. Rao et al. (2007) reported the use of aggregate from construction and demolition waste in concrete. They reported that the use of these waste is suitable for making good qualityconcrete. Soutsos et al. (2011) concluded that compressive and tensile splitting strength of paving blocks made with recycled demolition aggregate determined levels of replacement which produced similar mechanical properties to paving blocks made with newly quarried aggregates.

Objective:

1. To economize the cost of construction without compromising with quality.
2. To investigate the utilization of Used Foundry Sand as Fine aggregate and influence of UFS on the Strength on concrete made with different replacement levels.
3. To check the effect of Used Foundry Sand in concrete on properties of fresh concrete & compressive strength.
4. To check the suitability of Used Foundry Sand as an alternative construction material.
5. To effectively utilize the waste material from the Foundries.
6. To reduce the problem of disposal of Foundry Waste.
7. To prove that the Foundry waste from Foundries can be a replacement for fine aggregate.
8. To study the physical properties of Foundries waste and are the ingredients in concrete.
9. To replace the fine aggregate by Foundry waste in different ratio such as 10,30,50,& 100 % in M20 mix concrete
10. To determine the compressive strength and compare it with the conventional concrete.

CASTING OF SPECIMENS

All the specimens were cast having mix proportions. For these mix proportions, required quantities of materials were weighed. The mixing procedure adopted was as follows:

1. The cement and foundry sand were dry mixed in a tray for about 5 minutes. A uniform color was obtained without any clusters of cement, foundry sand.
2. Weighed quantities of coarse aggregates and sand were then mixed in dry state.
3. The mix of cement and foundry sand was added to the mix of coarse aggregates and sand and these were mixed thoroughly until a homogeneous mix was obtained.
4. Water was then added in three stages as given below:

- 50% of total water to the dry mix of concrete in first stage.
- 40% of water and super plasticizer to the wet mix.
- Remaining 10% of water was sprinkled on the above mix and it was thoroughly mixed in the mixer.

All the moulds were properly oiled before casting the specimens. The casting immediately followed mixing, after carrying out the tests for fresh properties. The top surface of the specimens was scraped to remove excess material and achieve smooth finish. The specimens were removed from moulds after 24 hours and cured in water till testing or as per requirement of the test.

CONCLUSIONS

The present work investigated the influence of waste foundry sand as partial replacement of fine aggregate (sand) on the properties of two grades (M20 & M30) of concrete. On the basis of the results from the present study, following conclusions are drawn.

Compressive Strength

1. Compressive strength of both grades of concrete mixes (M20 and M30) increased due to replacement of fine aggregate with waste foundry sand. However, compressive strength observed for both grades of concrete mixes were appropriate for structural uses.
2. M20 grade concrete mix obtained increase in 28-day compressive strength from 25.0MPa to 30.20MPa on 15% replacement of fine aggregate with WFS, whereas it increase was from 36.6MPa to 42.8MPa for M30 grade of concrete mix. Maximum strength was achieved with 15% replacement of fine aggregate with WFS. Beyond 15% replacement it goes to decrease for both grades of concrete, but was still higher than control concretes
3. At 15% replacement of fine sand with WFS, M20 Grade of concrete showed better percentage increase than M30 Grade of concrete by 9% at 28 days, 19.5% at 90 days

4. Effect of inclusion of WFS was better effect on M20 grade of concrete mixes rather than M30 grade of concrete mixes. The rate of gain of strength for M20 grade of concrete mixes observed to be more than M30 grade of concrete mixes at all percentage replacement.
5. Compressive strength also increased with increase in age for both grades of concrete. The rate of compressive development of waste foundry sand concrete mixes were higher compared to no waste foundry sand concrete mixes.

Splitting Tensile Strength:

1. Concrete mixes obtained linear increase in 28-day splitting tensile strength from 2.62MPa to 2.96MPa for M20 grade of concrete mix (M-1) and 3.95MPa to 4.36MPa for M30 grade of concrete mix (M-6) on replacement of 15% of fine aggregate with waste foundry sand.
2. Splitting tensile strength of all concrete mixes for both grades of concrete (M20 and M30) was found to increase with increase in with varying percentage of waste foundry sand.
3. At the age of 28 days, splitting tensile strength of M20 grade of concrete mix (M-1) increased by 12.8% whereas increase was 10.4% for M30 grade of concrete mix (M-6) at same age. Development of splitting tensile strength was more in M20 grade mixes than M30 grade mixes.
4. At 15% replacement, M20 Grade of concrete mix (M-4) achieved higher percentage increase. It means that, particle size distribution of M20 Grade of concrete mixes with 15% WFS has more adherence than M30 Grade concrete mixes
5. Maximum increase in splitting tensile strength was observed at 15% replacement of fine aggregate with waste foundry sand at all age for both grades of concrete mixes (M20 and M30).

STUDIES FOR UPCOMING TIMES

- Further study can be made by use of different type of waste materials like silica fume, fly ash, furnace slag etc.
- Different types of fibres like synthetic fibre, carbon fibres, or glass fibres may also be used for future investigation.
- Durability aspects such as permeability, sulphate resistance, freezing and thawing and shrinkage of concrete can be investigated
- Further study can be done on concrete mixes of different grades containing waste materials subjected to elevated temperatures.

REFERENCES

[1] **Aggarwal P, Aggarwal Y, Gupta S M.** Effect of bottom ash as replacement of fine aggregate in concrete. Asian Journal of Civil Engineering 2007; 8(1):49-62.
[2] **Agarwal SK.** Utilization of industrial waste and unprocessed micro-fillers for making cost effective mortars. Construction and Building Materials 2006; 20:999-1004.
[3] ASTM 1202 C-97. Standard test method for electrical induction of concrete, s ability to resist chloride ion penetration, American Society for Testing and Materials International, West Conshohocken.
[4] ASTM C 3301. Standard specification of concrete aggregate .American Society for Testing and Materials International, West Conshohocken.
[5] Basheer P.A.M. Permeability tests for assessing the durability of concrete, Ph.D. Thesis, The Queen's University of Belfast 1991; 438.
[6] Braham A. The use of blended recycled foundry sand in hot mix asphalt. Interim Report, University of Wisconsin – Madison, Asphalt Research Group 2002.
[7] BIS: 383-1970. Specifications for coarse and fine aggregates from natural sources forconcrete. Bureau of Indian standards. New Delhi, India.
[8] BIS: 516-1959. Indian standard code of practice- methods of test for strength of concrete. Bureau of Indian Standards. New Delhi, India.
[9] BIS: 1199-1959. Indian standard methods of sampling and analysis of concrete. . Bureau of Indian Standards. New Delhi, India.
[10] BIS: 1237-1980. Method for testing abrasion resistance of concrete. Bureau of Indian Standards. New Delhi, India.
[11] BIS: 1489(Part 1): 1991. Portland pozzolana Cement Specification, Fly Ash Based. Bureau of Indian Standards. New Delhi, India.
[12] BIS: 5816-1999. Splitting tensile strength of concrete-Test method. Bureau of Indian standards. New Delhi, India.
[13] BIS: 10262-1982. Recommended guidelines for concrete mix design. Bureau of Indian standards. New Delhi, India.
[14] BIS: 13311 (part 1)-1992. Non- Destructive testing of concrete methods of test (Ultrasonic Pulse Velocity). : Bureau of Indian standards. New Delhi, India.
[15] BIS: 13311 (part 2)-1992. Non- Destructive testing of concrete methods of test (Rebound hammer). Bureau of Indian standards. New Delhi, India

[16] Colombo P, Brusatin G, Beranerdo E, Scarinci G. Inertization and reuse of waste material by Vitrification. Current Opinion in Solid State and Material Science 2003; 7:225-239.

[17] Dayton EA, Whitacre SD, Dungan RS, Basta NT. Characterization of physical and chemical properties of spent foundry sands pertinent to beneficial use in manufactured soils. Plant Soil 2010; 329:27–33.

[18] Deng AN, Tikalsky PJ. Metallic characterization of foundry by-products per waste streams and leaching protocols. Journal of Environmental Engineering 2006; 136(6):586–96.

[19] Fagerlund G. Critical moisture contents at freezing of porous materials, Second CIB RILEM symposium on moisture problems in buildings, Bouwcentrum, Rotterdam, Netherlands 1974; 1-17.

[20] Foundry Industry Recycling Starts Today (FIRST). Foundry sand facts for civil engineers. Washington DC, USA: Federal Highway Administration Environmental Protection Agency; 2004.

[21] Foundry cluster in India – an overview. Metal World 2007:17–8.

[22] Gunny Y, Sari YD, Yalcin M, Tuncan A, Donmez S. Reusage of waste foundry sand in high strength concrete. Waste Management 2010; 30:1705-1713.

[23] Idir R, Cyr M, Hamou AT. Pozzolanic properties offine and coarse color-mixed glass cullet. Cement and Concrete Research 2011; 33(1):19-29.

[24] Javed S, Lovell CW. Use of foundry sand in highway construction. Joint Highway Report No C-36-50N, Department of Civil Engineering, Purdue University, Indiana, USA 1994.

[25] Khatib JM. Properties of concrete incorporating fine recycled aggregate. Cement and Concrete Research 2005; 35:763-769.

[26] Marchand J, Pleau R and Gagne R. Deterioration of concrete due to freezing and thawing Material Science of Concrete, American Ceramic Society 1995; (4):283-354.

[27] Mast DG, Fox PJ. Geotechnical performance of highway construction using waste foundry sand. Geotechnical Special Publication 1998; 79:66-85.

[28] Misra S, Yamamoto A, Tsutsumi T and Motohashi K. Application of rapid chloride permeability test to quality control of concrete. special publication. American Concrete Institute 1994; 145:487-502.

[29] Naik TR, Kraus RN, Chun YM, Ramme WB, Siddique R. Precast concrete products using industrial by-products. ACI Mater J 2004; 101(3):199–206.

[30] Naga SM, El-Maghraby A. Industrial waste as raw materials for tile making. Silicates Industrials 2003; 68:89–92.

[31] Ontario Ministry of Transportation. Resistance of fine aggregate to degradation by abrasion in the micro-deval apparatus. LS-619. Ontario, Canada: Ontario Ministry of Transportation; 1996.

[32] Park SB, Lee BC, Kim JH. Studies on mechanical properties of concrete containing waste glass aggregate. Cement and Concrete Research 2004; 34:2181-2189.

[33] Rakshvir M and Barai S.V. Studies of recycled aggregate based concrete. Waste Management Research 2006; 24(3):225-223.

[34] Rao A, Jha K, Misra S. Use of aggregates from recycled construction and demolition waste in concrete. Resources Conservation and Recycling 2007; 50(1):71-81.

[35] Shayan A, Xu A. performance of glass properties as a pozzolanic material in concrete. A field trial on concrete slab. Cement and concrete research 2006; 36:457-468.

[36] Siddique R, Noumowe A. Utilization of spent foundry sand in controlled low-strength materials and concrete. Resources, Conservation and Recycling 2008; 53:27–35.

[37] Siddique R, Khatib JM. Abrasion resistance and mechanical properties of high volume fly ash concrete. Material and Structures 2010; 43: 709-718.

[38] Siddique R, Kaur G, Rajor A. waste foundry sand its leachate characteristics. Resources Conservation and Recycling 2010; 54(12):1027-1036.