Enhancement of Mechanical properties of recycled Green sand by addition of Alumina

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Abstract

Foundries for the metal-casting industry plays a vital role to generate by- products such as used foundry sand. Metal foundries use large amounts of the metal casting process. Foundries successfully recycle and reuse the sand many times in a foundry but by using repeated usage of Used foundry-sand vary due to the type of equipment used for foundry processing, the types of additives, the number of times the sand is reused, and the type and amount of additives which may lead to depletion of the quality of the casted product. In this study additive like Bentonite, this promotes good green strength, moderate dry and hot compression strength. Carbon which provides a reducing atmosphere and a gas film during pouring that protects against oxidation of the metal and reduces burn. Saw dust which controls sand expansion and to broadens the allowable water content was properly mixed to recycled sand to obtain the standard green sand composition. In addition to the said composition, alumina which is a refractory material which improves green, dry compression strength and permeability of the recycled sand.The results were compared with green sand and recycled green sand and found that addition of alumina in improving the mechanical properties.

Key words: Recycled green sand, green sand, alumina, compression strength.

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1. INTRODUCTION

The foundry industry generates a number of byproducts, of which the largest volume is"spent sand" that consists of silica or olivine sand with residuals of phenolic resin, clay or no-bake binders etc. There is increasing demand and interest in aggregates from non-traditional sources such as from industrial by-products and recycled construction and demolition (C&D) wastes. Charnnarong saikaew and Makino [1] Studied about the proportions of clay and water to recycled moulding sand were optimised using a mixer experimental design RSM (Response Surface Method) and POE (Propagation of Error) in order to reduce defect appearance on iron casting. The proportion of the components significantly influenced the property of the moulding sands and the surface quality of the iron casting. The optimal proportion of components was obtained that 93.3% mass of one time recycled moulding sand, 5% of mass of bentonite and 1.7% mass of water. This mixture yielded the optimal green compression strength of 53090 $N/m^{2.}$ The optimal permeability of 30 AFS permeability numbers and overall desirability of 72%.

Dushyant ramesh [2] found the evaluation of used foundry sand for use as a replacement of fine aggregate material begins with the concrete testing with the control concrete,i.e 10%, 30% and 50% of fine aggregate is replaced with used foundry sand. The three cubes samples were cut on the mould of size 150 x 150 x150 mm for each 1:1. 48:3. 21 concrete mix with partial replacement of fine aggregate with W/C ratio as 0.50 were also cast , and after 24hrs specimens were demoulded and water curing was continued and tested after 7,14 and 28 days the resulted that water absorption decreases up to 50% replacement of fine aggregate by using foundry sand.

Richardo Magnani [3] studied the calcination process at moderate temperatures (450 - 500˚c), ie increase in compressive strength of reuse foundry sand after 450˚c of curing time (20hrs), either using inorganic calcination additives or coupling additives are associated with the leaching process is effective interms of regenerating the initial properties of foundry sand. Observed that water leaching process is efficient for the regeneration of initial properties of the previously calcinated sands. And utilization of both silica anchoring additives based on amines silanes, and inorganic calcinations additives were shown to be efficient in the regeneration of the mechanical property of the foundry sand.

Fatai olufemi et al. [4] found that the sieve analysis results showed that the grain fineness index falls within the acceptable range according to AFS (American foundry system) standard as stated in foundry sand 40-330 average fineness is suitable for foundry application. The recycled ilaro sand has an average fineness number of 50 and is therefore coarse in nature. The green sand strength increases in bentonite and dextrin in moulding sand by mixing content of bentonite content 24 grams and as increases in green sand strength by 90 KN/m^2. The recycled sand can still be reused by minimum addition of binders. Optimum green strength and permeability of recycle sand were achieved when 2 grams of bentonite and 8 grams of dextrin, 12 Cm^3 of water were added to 200 grams of recycle sand.

Gurpreet Singh and Rafat Siddique [5] conducted the experimental investigation to evaluate the strength and durability properties of concrete mixtures, in which natural sand was partial replaced with waste foundry sand (WFS). Natural sand was replaced with five percentage (0%, 5%, 10%, 15%, and 20%) of WFS by weight. A total of five concrete mix proportions were made with and without WFS were developed, and found that the result indicate a marginal increase in strength and durability properties of plain concrete by inclusion of WFS as a partial replacement of fine aggregate. Zhang et al. [6] the effect of diffusion loading was studied by replacing the Portland cement with fly ash (FA) at three percentages (20%, 30% and 40%) respectively. It found that 20–40% FA replacement results higher diffusion loading. spirutova and Jaroslav [6] studied about the green sand system (GGS) and the core sand under annealed temperature (350 ˚C). At this temperature it can be assumed that the start of thermal decomposition of the resin and the binding capacity bentonite may be the mechanism of bentonite passivation (a kind of sorption), the result showed that decrease in active bentonite due to deactivation caused by the pyrolysis generated during heat exposure of the cores, this showed influence of mechanical property of the mixer& the synthesis have been decreased on average by 20% to 40%. The deterioration of the mechanical property higher for Ashland CB cores. An extension of the sample preparation time (from 6min to 12min) caused an increase in the mixture mechanical property (strength). Yet, know work was has been published recycled green sand with Alumina.

2. EXPERIMENTAL PROCEDURE

Experiments were conducted regarding the recycled green sand with Alumina. The cylindrical specimens as per American Foundry society (AFS) were made which was shown in the Figure 1. The variation of varied proportions of alumina at 0.6%, 0.4%, 0.2% with used foundry sand (UFS) undergone for compression strength which is shown in Figure 2 and Table 1 shows the mixtures get higher pouring temperatures, and provide greater refractoriness. The permeability and compression strength test were conducted for the prepared mould sand at 99.8%, 99.6% and 99.4% UFS.

Table. 1 Composition of UFS with alumina

Exp. No	% Composition of used foundry sand (UFS)	% Composition of Alumina
1	99.4	0.6
2	99.6	0.4
3	99.8	0.2

Fig. 1 Specimen of UFS prepared for compression strength.

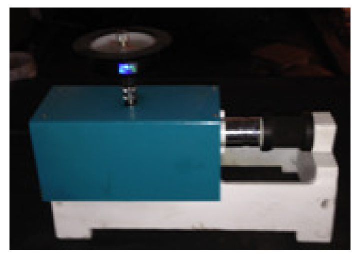

Fig. 2 Compression strength of used Foundry Sand.

3. RESULTS AND DISCUSSION

The experiments were performed with UFS a sample mixture has been prepared for green and dry moulds. Alumina was used, in order to observe the mechanical properties i.e., permeability and compression results were obtained which was furnished in the Table 2.

The influence of the Alumina over the UFS mould sand with various proportions was depicted in the Table 2 experimental results shown that minimum addition of the Alumina at 5% demonstrated excellent mechanical Properties.

Table. 2 Test results Permeability, Green and dry compression strength.

Exp. No	Permeability No.		Green compression strength (gm/cm^2)	Dry compression strength (gm/cm^2)
	Pressure	Large orifice		
1	0.73	1350	773	1960
2	0.46	2450	820	2360
3	0.4	2450	880	3300

The cases were briefly described and shown the Figures 3, 4 and 5.

Case I: It was observed that for the sample I, at 0.6% alumina addition the permeability was 1350; Green compression strength was 773 gm/cm^2 and Dry compression strength 1960 gm/cm^2

Case II: It was observed that for the sample II, at 0.4% alumina addition the permeability was 2450; Green compression strength was 820 and Dry compression strength 2360 gm/cm^2.

Case III: It was observed that for the sample III, at 0.2% alumina addition the permeability was 2450; Green compression strength was 880 and Dry compression strength 3300 gm/cm^2.

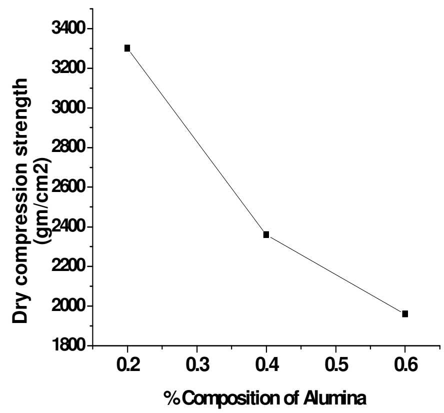

Fig. 5 Shows the Dry compression strength of UFS.

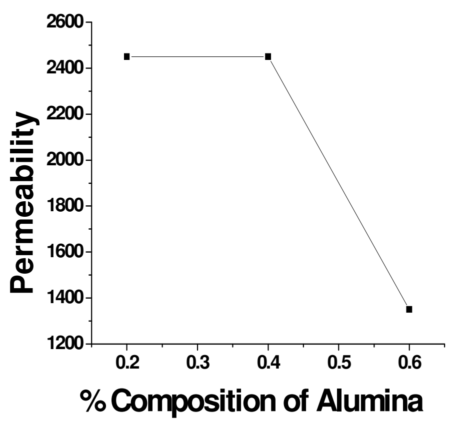

Fig. 3 Shows the Permeability of UFS.

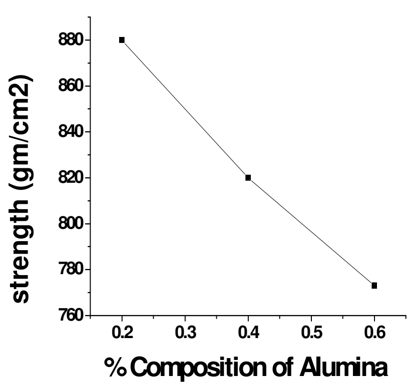

Fig. 4 Shows the Green compression strength of UFS.

4. CONCLUSION

From the experiments analysis, the effects of Alumina addition to the UFS with various combinations which are furnished below.

1. An increasing in the proportion of used foundry sand (UFS) with decreasing in Alumina vital increment in the Green and Dry Compression Strength. Similarly, the Permeability number was increased.
2. As it is recommended for the foundry industries for recycling the (UFS) with alumina addition to enhance the mechanical Properties.

5. REFERENCES:

[1] Charnnarong saikaew, makino, optimization of moulding sand composition for recycling moulds by varying proportions of clay and water, *Indian foundry journal*, **49:** 27-36, 2012.

[2]] Dushyant R bhimani, Jayesh Kumar pitroda, Jay dev j and Bhavsar Used foundry sand: opportunities for development of ecofriendly low cost concrete, *Internatiopnal journal of advanced engineering and technology*, IV: 63-66, 2013.

[3] Richardo magnani Andrade,Sergio cava,sidiney nasimento silva, Foundry sand recycling in the troughs of blast furnaces, *Journals of materials processing technology*,**189:** 25-134, 2005.

[3] Fatai olufemi, Sunday and Davis oladayo, Optimizing the moulding properties of recycled ilaro silica sand, *Leonordo Journal of sciences*, **19:** 39-102, 2011.

[4] Gurpreet Singh and Rafat Siddique, Effect of waste foundry sand (WFS) as partial replacement of sand on the strength, ultrasonic pulse velocity and permeability of concrete, *Construction and Building Materials* **26:** 416–422, 2012.

[5] Wu-manZhang,Heng-jing Ba Shang-jiang Chen, Effect of fly ash and repeated loading on diffusion coefficient in chloride Migration test, *Construction and Building Materials,* **25:** 2269–2274, 2011.

[6] Nikol spirutova, Jaroslav beno, Alternative utilization of the core sand for a green sand system, *Materials and technology,* **47:** 557–561, 2013.