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Effect of Different Additives on Some Selected Properties of Green Sand Mould

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ABSTRACT:-

The features of castings obtained from a green sand mould depends on its characteristics such as permeability, green compression strength, green shear strength, dry compression strength and dry shear strength, etc. Additives play a very important role to enhance specific properties of the sand mould. The present study aims to investigate the influence of different additives namely, bamboo dust, coir fibre, coal dust at different proportions on the properties of sand mould. It was found that the permeability, green compression strength, green shear strength, dry compression strength and dry shear strength were maximum on addition of 2% additives in sand mould. The permeability number of coir fibre containing sand mould was found to be highest as compared to bamboo dust, coal dust. However, the strengths of coal dust containing sand mould were found to be maximum.

Keywords: Green Sand Mould, Compression Strength, Shear strength, Permeability Number.

1. INTRODUCTION

Metal casting is one of the oldest known processes to create metallic parts. In the period of 4000-3000 BC, the first metal casting was produced. Since then, a variety of casting methods have been evolved. Casting is done by pouring liquid melt into a cavity, may be a die or mould, which corresponds to the required profile of the part to be produced. Then, the casting is solidified and taken away from the mould [1].

Though sand casting is the least accurate casting process, yet it is very common and most widely used for manufacture of parts. It involves the pouring of molten metal into a sand mould which is made from approximately 80% silica sand, (5-10) % clay binders, (2-6) % tempering water and a collection of additives. Moulding sand which contains moisture is known as green moulding sand [2].

Sand is the main component in constructing green sand mould which is used for ferrous and non-ferrous casting as it posses the characteristics important for foundry application. Clay is used to provide consistency to the moulding sand mixture. It also provides superior strength to the moulding sand [3]. Olasupo and Omotoyinbo [4] investigated about the different desirable moulding sand properties made from Nigerian silica-clay mixture. The authors found that the mixture of Igbokoda silica sand and Ijero-Ekiti clay acquired fine mould strength as well as permeability.

Ademoh [5] found that river Niger sand behind Ajaokuta steel plant possessed sound mechanical properties when it was mixed with kaolin clay or bentonite. Kaolin clay gives improved bonding characteristics as compared to bentonite clay. It was found that a combination of 2.5% bentonite clay, 1% kaolin clay and 2% moisture content was suitable for non-ferrous alloy.

Fo et al [6] investigated the moulding properties of Onitsha beach Niger sand bonded with Ukpor clay. The authors found that the green and dry compression strengths of the sand mould increased remarkably with increase in binder percentages from 10% to 12% and further the strength increased gradually with increase in binder percentages from 12% to 22%. High mouldability percentages (90.57% to 97.36%) were obtained with increase in addition of clay percentage from 14% to 22%. Permeability number decreased from 11.00 to 7.00 with increase of clay content from 10% to 22%.

Lanre et al [7] investigated the foundry properties of Ilorin sand. Researcher found that the green compression strength values lied between 36 KN/m^2 and 60 KN/m^2 and also, permeability and shatter index values lied between 47 and 68.3, and 31 and 84, respectively. From the above findings, the authors concluded that Ilorin sand is appropriate for sand casting of ferrous and non-ferrous metals and alloys.

Additives play a very important part to enhance specific mould properties of the green sand mould like green compression strength, dry compression strength, green shear strength, dry shear strength and permeability. Chavan et al [8] examined the sand moulding properties of olivine sand affected by addition of different additives like flyash, coconut shell ash, tamarind powder. The authors found that the mould permeability was highest in the sand mould containing flyash and also, the compression strength was maximum in the sand mould containing coconut shell ash as compared to flyash and tamarind powder.

Seidu and Kutelu [9] investigated the effect of sawdust, coal dust and iron fillings on the properties of sand mould. It was found that the sawdust containing sand mould showed higher green strength, whereas coal dust containing sand mould exhibited improved sand porosity and permeability thereby reducing the defects in casting. Green shear strength value was highest at addition of 25% of coal dust, sawdust and iron filling on the moulding sand.

From the literature survey, it has been found that the properties of sand mould could be enhanced by addition of few additives. However, permeability number of the sand mould should be increased to reduce the casting defects. Mould strength is not an important issue for aluminium casting. In the present study, the authors have tried three different additives i.e. bamboo dust, coir fibre, coal dust separately in the green sand mould so as to study their effect on the responses namely, green compression strength, dry compression strength, green shear strength, dry shear strength and permeability number.

2. MATERIALS AND METHODS

The materials used were silica sand, bentonite clay, bamboo dust, coir fibre, coal dust. The percentage of additives was limited to 3.5%. The equipments used were Rammer, Universal Testing Machine and Permeability meter. Chemical analysis of silica sand was done using X-Ray Fluorescence (XRF) spectroscopy technique and it is shown in Table 1. It is seen that SiO_2 percentage is maximum which is essential for mould's improved strength and impact resistance.

Table 1. Chemical analysis of silica sand

Key Constituents	**SiO_2**	**Al_2O_3**	**K_2O**	**NaO**	**MgO**	**CaO**	**Fe_2O_3**	**TiO_2**
Wt %	95.61	1.74	0.31	0.01	0.01	0.02	0.62	0.04

First, green sand and different additive powders were weighed using an electrical weighing balance. Once the desired moisture content was achieved, the standard specimens (2 inch height × 2 inch diameter) were prepared using a sand ramming machine.The green compression strength, dry compression strength, green shear strength, dry shear strength and permeabilityof the standard sand specimen were measured using a Universal Testing Machine and Permeability meter. For measuring the dry compression and shear strengths, each specimen was heated in an oven at 105ºC for 2 hr so as to eliminate the moisture from it. Standard sand specimen was placed in the Universal Testing Machine to test the dry compression and shear strengths.

3. RESULT AND DISCUSSIONS

The influence of additive percentage on various responses of the sand mould is shown in the form of graphs. Fig. 1 shows the variation of different additives verses (vs) Permeability no. obtained for the green sand mould. It is found from the figure that as the percentage of additive content increased up to 2%, the permeability no. increased, then it gradually decreased. Coir fibre reinforced sand mould showed the highest permeability no. of 406 as compared to that of bamboo dust and coal dust. It happened because coir fibre added to the moulding sand was comparatively coarser in size than the other two additives and the coarse particle size leads to increased mould permeability, whereas fine particles decrease mould permeability.

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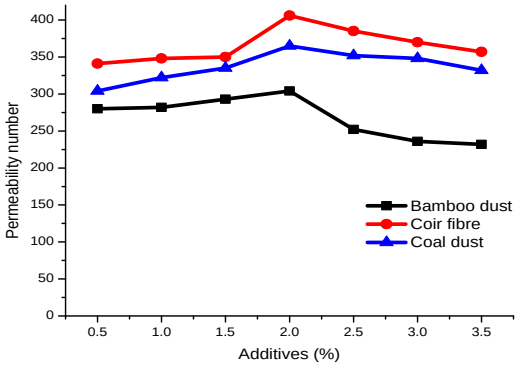

Fig. 1 Variations of additives vs Permeability number

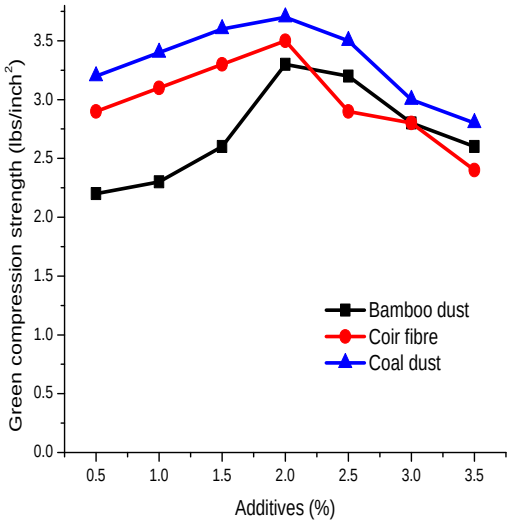

Fig. 2 Variations of additives vs Green comp. strength

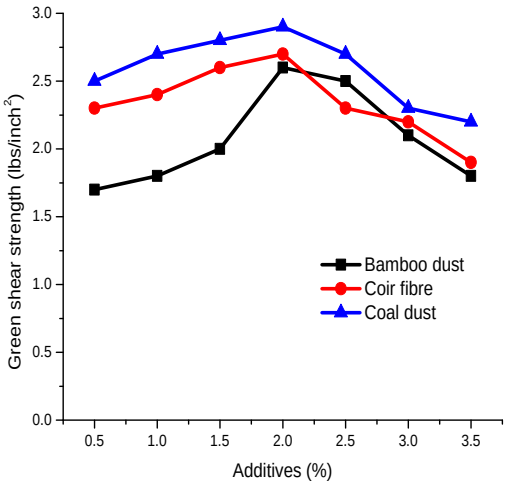

Fig. 3Variations of additives vs Green shear strength

Fig. 2 shows the variation of different additives vs green compression strength. It is seen that at 2% additive percentage, the green compression strength is highest and thereafter, it decreased. The green compression strength was found to be highest in coal dust containing sand mould as compared to coir fibre and bamboo dust containing sand moulds. The green compression strength gradually increased with increase of additive percentage from 0.5% to 2% and then, the strength decreased. Figs. (3-5) shows the variation of different additives vs green shear strength, dry compression strength and dry shear strength.

It is seen that the green shear strength, dry compression strength and dry shear strength are maximum at 2% of additives. Results revealed that the coal dust containing sand mould exhibited highest green shear strength, dry compression strength and dry shear strength at 2% addition of additives as compared to other two modified moulds because of finer size and moisture absorption capacity of the sand.

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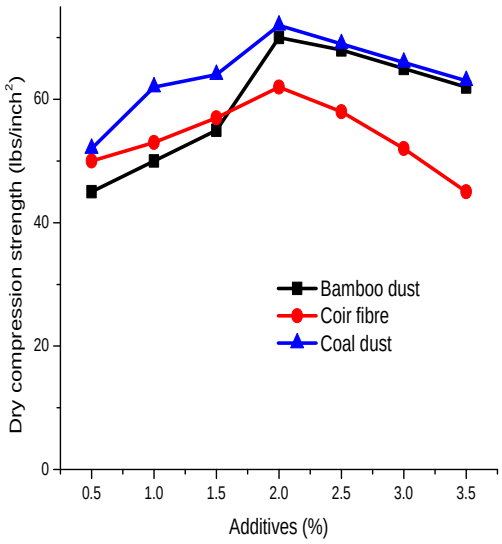

Fig. 4Variations of additives vs Dry comp. strength

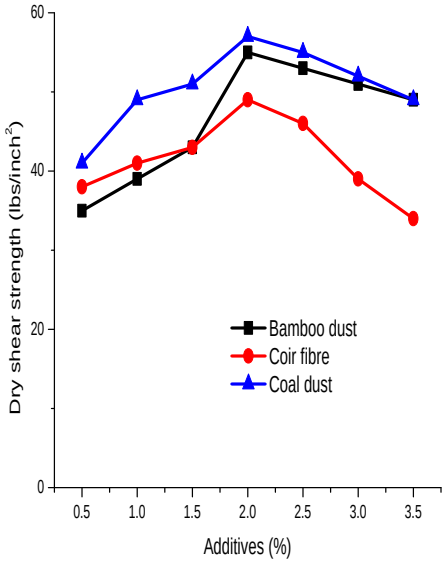

Fig. 5Variations of additives vs Dry shear strength

4. CONCLUSIONS

The following conclusions are drawn on the basis of obtained results:

- The moulding sand containing coir fibre exhibited highest permeability as compared to other additives. So, when the permeability property of mould has to be increased, then coir fibre is the best additive among the three to be incorporated in the mould.
- The moulding sand containing coal dust gave the highest green compression strength, dry compression strength, green shear strength and dry shear strength on addition of 2% additives.

REFERENCES

1. Sulaiman, S., Hamouda, A.M.S., 2004.Modelling and experimental investigation of solidification process in sand casting. Journal of Materials Processing Technology 155–156, 1723–1726.
2. Roskill Information Services Ltd, 2005. The Economics of Bentonite 0 86214 501 5.
3. Abolarin, M.S., Lawal, S.A., Salawu, A., 2010. Effect of moisture content on the moulding properties of river Niger sand using Tudun-Wada clay as a binder. AU J.T. 13(3), 170-174.
4. Olasupo, O.A., Omotoyinbo, J.A., 2009. Moulding properties of a Nigerian silica-clay mixture for foundry use. Applied clay science, 45, 244-247.
5. Ademoh, N.A., 2008. Evaluation of the foundry properties of river Niger sand behind Ajaokuta steel company limited, Ajaokuta, Nigeria. American-Eurasian journal of scientific research. 3(1), 75-83.
6. Fo, E., Ju, O., Ee, N., 2015. Effect of Ukpor clay content on the properties of synthetic moulding sand. International journal of research in advanced engineering and technology, vol. 1, issue 3, 12-16.
7. Lanre, S.Y., Olumodeji, J.O., 2014. Analysis of Ilorin sand moulding properties for foundry applications. International journal of engineering research & technology, vol. 3, issue 1, 1520-1525.
8. Chavan, T.K., Nanjundaswamy, H.M., 2013.Effect of Variation of Different Additives on Green sand Mold Properties for Olivine sand . IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 4, ISSN: 2320 – 8791.
9. Seidu,O.S., Kutelu, B.J., 2014. Effects of additives on some selected properties of base sand.Journal of Minerals and Materials Characterization and Engineering 2, 507-512.