International Journal of Applied Research 2015; 1(8): 712-714

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(8): 712-714
www.allresearchjournal.com
Received: 23-06-2015
Accepted: 22-07-2015

Bam SA
Department of Mechanical Engineering, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria.

Iortsor A
Department of Mechanical Engineering, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria.

Akaaza JN
Department of Mechanical Engineering, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria.

Correspondence:
Bam S.A
Department of Mechanical Engineering, University of Agriculture, Makurdi, P.M.B. 2373, Makurdi, Nigeria.

Improvement and comparative analysis of River Benue Foundry sand using Guinea-Corn, Cassava Maize as binders in casting

Bam SA, Iortsor A, Akaaza J N

Abstract
River Benue Foundry sand prepared using clay materials were found lacking in certain properties like: dry compression strength, shatter index and permeability. Investigations were conducted using Guinea-corn, Cassava and Maize as binders to improve the properties of this sand. The results showed that Cassava and Guinea-corn were more effective when added in liquid starch form as they improve the foundry properties of the sand.

Keywords: Improvement, Comparative, Foundry sand, Binders, Guinea-corn, Cassava, Maize.

1. Introduction
Foundry sand mixtures for molding purposes should possess certain properties like green strength, permeability, toughness, as well as dry strength (Onyeji, 2010) [8] The required levels of these properties vary depending on the type of moulding, the type of metal cast, as well as the size and shape of casting (Mathew and Aku, 1983) [6]. The properties of clay bonded foundry sand which consists of sand, clay, water and sometimes one or more additives mainly depend on the type and amount of their ingredients (Mathew, 1982) [5]. And (Shehu and Bhatti, 2012) [9]. Moulding/foundry sand mixtures especially those prepared from local sand and clay materials are lacking in some properties like toughness and dry strength. This research deals with an investigation conducted to upgrade the properties of this sand through the use of Guinea-corn, Cassava and Maize (readily available) as binders. Materials other than sand, clay and water added to foundry sand are called additives. These are used to improve sand properties, surface finish of castings, and to reduce expansion defects such as scabs, rat tails, buckles and as well as to make shake-out easier. Foundry sand that are lacking in properties are better economically up graded locally than purchase of the same sand far away. These additives belong to the group of cereals mainly used to improve green and dry properties of moulding sands. The mature grain of the common cereals consist of carbohydrates, nitrogenous, mainly proteins, lipids (fat) mineral matter and water with small quantities of vitamins, enzymes and other substances, some of which are important nutrients in the human dietary (Carey and Winter, 1986) [3].

2. Materials and Methods
2.1 Materials
The silica sand and clay material was obtained from River Benue in Makurdi Local Government Area of Benue State-Nigeria. Guinea-corn, Cassava and Maize flour were purchased in the local market.

2.2 Method
A 3×7×1 factorial experimental design consisting of 3 different additives (Guinea-corn, Cassava and Maize), 7 starch levels (8, 10, 12,14,16,18 and 20%) and 1 moisture (water) content of 14% for the mould, producing the required samples/ specimens for the entire tests was involved. For each starch level 3 samples were produced and tested, and the average result was taken.

Ridsdale Dieter equipments were used, and standard procedure adopted (Oyetunji *et.al*, 2013) [1]. And (Joint committee on sand testing, 1966) [4]. Producing 3 sets of furnace baked sample/ tests. In the first set of tests the sand/clay mixtures were tested without any additive of Guinea-corn, Cassava and Maize. In the second set of tests the sand mixture was tested with the additives of Guinea-corn flour, Cassava flour and Maize flour only. In the third set of tests, the sand mixture were produced and tested with additives in liquid starch form before baking in the furnace for 24 hours. The sand was prepared by thorough mixing with the additives in laboratory mill with rotary rollers. This mixture was packed and casted in a standard metal mold and then air dried for 6 hours before baking in the oven at120 °C for another 24 hours and then testing for the following properties:

(i) Dry compression strength,
(ii) Shatter index,
(iii) Permeability,
(iv) Plasticity,
(v) Expansion, and
(vi) Refractoriness.

3. Results and Discussion

The result of the first set of test of sand clay mixture with water is presented in Figures 1-6. These results show a reliable response to all the properties: of dry compression strength, shatter index, permeability, plasticity, expansion and refractoriness (Ndaliman, 2012) [7].

The result of the second set of tests of sand /flour (additive)/ water mixture was not possible as it was not possible to produce the test samples/ specimen.

The result of the third set of tests of sand /liquid starch (boiled in water) mixture is equally presented in Figures 1-6. Adding sand to this starch was not really convenient but was made to some extent by putting part of the sand into the liquid starch and mixing thoroughly before further adding the remaining sand. The result of these sets of test was more respondent and encouraging than even the first set, indicating that it is better to boil water and dissolve the flour in it as starch before mixing with the sand for production of the samples.

Comparatively, as the additives are introduced to the samples, the dry compression strength, shatter index and plasticity (Figures 1-3) tend to increase with Cassava and Guinea-corn respectively, up to 16% starch content (Bam, 2006) [2]. As the starch content increases above 16%, there is a decrease in these parameters. This shows that 16% starch content will give optimum values of dry compression strength, shatter index and plasticity respectively. On the other hand, on addition of these additive to the sand, the permeability, expansion and refractoriness is reduced significantly (Figures 4-6) (Zirmsek and Vingas, 1963).

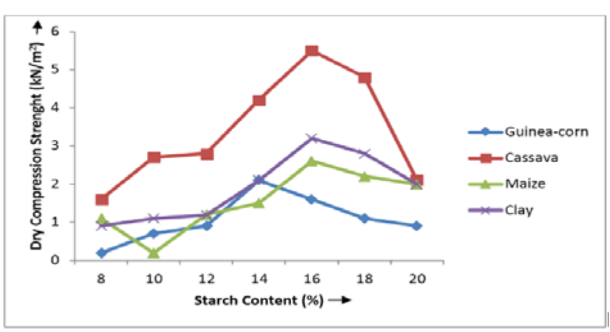

Fig 1: Dry Compression Strength against Starch Content

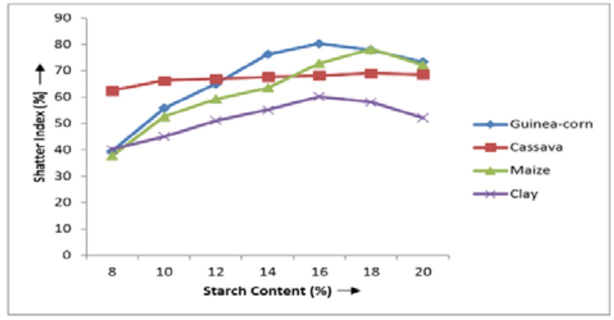

Fig 2: Shatter Index against Starch Content

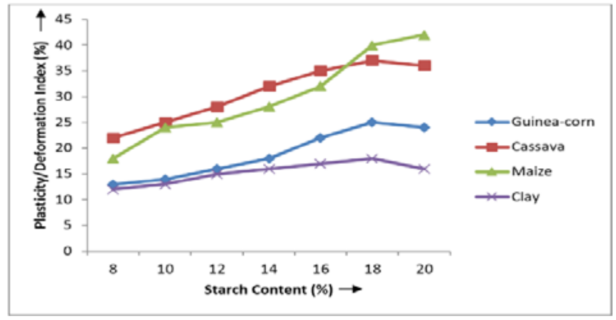

Fig 3: Plasticity/Deformation Index against Starch Content

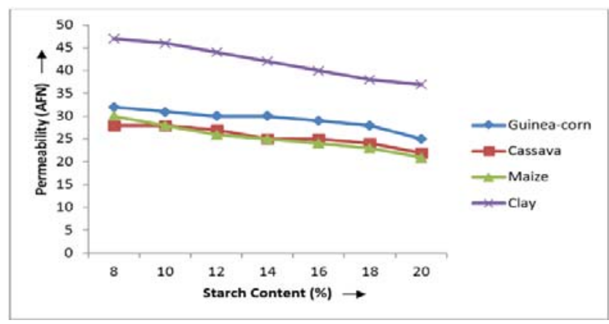

Fig 4: Permeability against Starch Content

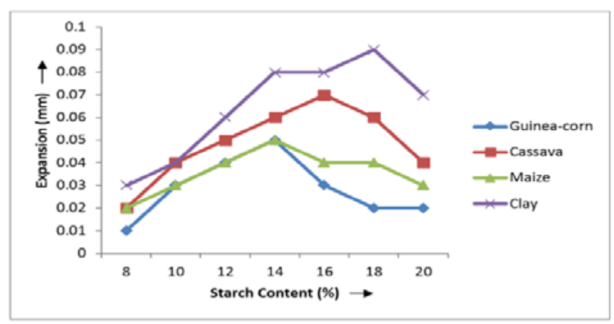

Fig 5: Expansion against Starch Content

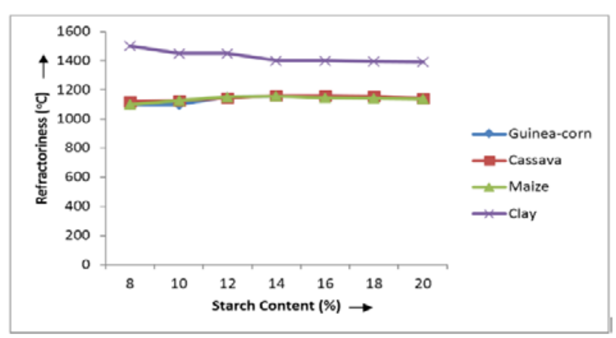

Fig 6 Refractoriness against Starch Content

4. Conclusion
It may be concluded from the foregoing that:

(i) Cassava, Guinea-corn and Maize additives improve the properties of River Benue foundry sand with Cassava and Maize showing more response.
(ii) It is better to use liquid starch (boil in hot water) or gelatinized condition than using the flour directly.
(iii) That these additives increase the dry compressive strength, shatter index and plasticity.
(iv) That these additives decrease the permeability, expansion and refractoriness

5. Acknowledgement
The authors thank the Department of Mechanical Engineering of the University of Agriculture, Makurdi for provision of facilities for this research.

6. References
1. Oyetunji A, Seidu SO, Opaluwa AI. Study on the Shear strength of foundry Sand Cores using Clay and Cassava starch as binder International Journal of Engineering. Tome. 2013; 11:155-160.
2. Bam SA. the effect of cassava, maize and guinea-corn as binders on the foundry properties of Benue river sand. M. Eng. Thesis, University of Agriculture Makurdi, 2006.
3. Carey PR, Winter DL. Updating resin binder processes. Part V, Mcgraw hill, New York 1986, 46-52.
4. Joint committee on sand testing “methods of testing prepared foundry sands”. The institute of British Foundrymen, London, 1966.
5. Mathew P. Local synthetic moulding sand mixtures for foundry applications. Nigerian Journal of Engineering and Technology. 1982; (5)1:57-65.
6. Mathew P, Aku SY. Improvement of some Nigerian foundry sands with locally available additives Nigerian Journal of Engineering and Technology. 1983; (6):1:1-6.
7. Ndaliman NB. Effect of certain Additives on refractory properties of Termite Hill for Furnace lining. Nigerian Journal of Education and Technology. 2012; 2(1, 2):44-46.
8. Onyeji A. Analysis and characterization on Nyikangbe clay, Chanchaga L.G.A of Niger state. Journal of metallurgy and material Engineering. 2010; (5)2:55-62.
9. Shehu T, Bhatti RS. The use of yam flour (Starch) as Binder for Sand mould production in Nigeria. World Applied Science Journal. 2012; 16(6):858-862.
10. Zrimsek AH, Vingas GJ. Steel foundry green facing sand Trans 1963; 71:36.