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Physio-Chemical and Mechanical Behaviour of(*Pinussylvestris)* as Binders on Foundry Core Strength

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Abstract
The mechanical potential of sand core binders made withPinussylvestris has been examined. Ota silica base sand bonded with 6% of cassava starch in admixed proportion of Pinussylvestris was tested for tensile, compressive strength and permeability to establish the binding efficiency. Tensile strength of the green baked core were oven baked at 50°C, 100°C, 150°C and 200°C.The cylindrically shaped permeability specimens were tested with permeability meter. Study revealed thatPinussylvestris showed an improve properties at 6% cassava starch at 200°C.
Keywords:*PinusSylvestris foundry cores, cassava starch.*

1. Introduction
Suitable molding raw materials for core making have been of great interest recently. Industries have showninterest in the use of locally sourcing binders for productions in order to boost the ailing economy [1-8]. Cores are made of core sand mixtures from sand grains and binders[6-11]. A proper and formulated admixture gives good green compressive strength and adequate baked strength to prevent premature collapse during usage. Binders are introduced into the molding and core mixtures in order to improve their properties especially the strength [5-11]. The usage of *Manihotesculentacrantz* (Cassava Starch) for sand core processes has not been widely study in the literature, and hence the continue need to investigate its prospective with other binding additive such as pine oil in this respect is considered necessary. Cassava starch has therefore been chosen for the study because is easily sort for and cheap with excellent bonding features. Equally, cassava starch and pine oil has no negative health implication; they are environmental friendly for the production of sand cores and most importantly reduce the total addiction on foreign materials to promote the development of indigenous technology.This study aimed at producing sand cores locally using Ota silica sand, cassava starch and pine oil as binder and examining their suitability and behavior during casting process.

2. Experimental procedures
2.1 Materials
Base material used for this work was collected from Ota in Ado-odo Local Government in Ogun state, Nigeria. Binders which are cassava starch, was extracted from cassava tubers obtained from Arobieye in Ota, Ogun State, Nigeria. The pine oil was purchased from South Africa market. Equipment such as universal strength testing machine, weighing balance, mixer, measuring cylinder, specimen rammer, permeability meter, oven, shaker, sets of sieve, crucible furnace, hack saw machine, mould box, core box and wire brush were used.

2.2 Method
2.2.1 Preparation of Manihotesculentacrantz
Peeled and washed cassava tubers were grinded into pulp and water was added for extraction. The admixed particulate was left to stay for 180 minutes before the water above was poured. The starch residue was properly dried to white in line with (Popoola, 2011).
2.2.2 Sand preparation
The silica sand was collected from the Ota river side, washed to remove clay and dirt. The processed silica sand was dried and sieved using shaker of different meshes and aperture. The obtained and dried sand was studied with ED X-ray fluorescence analyzer for mineralogical composition is shown in Table 1.

Table 1: Mineralogical composition of the foundry sand used for the study

Composition	SiO_2	Al_2O_3	K_2O	CaO	$Ti0_2$	Cr_2O_3	MnO	Fe_2O_3	MgO	CuO	Na_2O
Wt%	Balance	0.58	0.08	0.34	1.60	0.02	0.02	0.45	0.16	0.04.	0.04.

2.2.3 Sieve Analysis

Standard sieve test of Bs 410 series to remove all coarse particles according to Popoola, 2011 was used. Weight of sieved sand sample values in Table 2 were used to calculate grain fineness number ($GFN = \frac{TotalProduct}{Total\ \%\ of retained grain}$) and fines (%).

Core mixture and core making

The mixtures constituent and % composition of the mixed oils are shown in Table 2 below.

Table 2: Composition of the mixed oils and starch

S/No	% Mixture
1	3% Starch + 2% pine oil + 3% water
2	3% Starch + 6% pine oil + 3% water
3	6% Starch + 2% pine oil + 3% water
4	6% Starch + 6% pine oil + 3% water

The blended admixed constituent was gradually put into 45 mm diameter by 50 mm height and immediately rammed with a rammer. Subsequent to the ramming, the core specimen was ejected directly from the sleeve by a piston. Thereafter the ejected core was transferred to an electric oven with temperature of about 1200^{o}C capacity.

3. Results and discussion

3.1 Sand mineralogy study

From the ED X-ray fluorescence analyzer for mineralogical composition during sand preparation it shows that the Ota sand contains 0.45%Fe_20_3, 0.58% Al_20_3 and 95.50% $Si0_2$. The silica content value is in line with the acceptable value suggested for moulding and core sands between 85% and 97%. According to Popoola, (2011) higher silica content is essential to resist the heat from molten metal during casting operation.

3.2 Comparative effect of baking temperature on foundry properties at various binders composition.

In Figure 1, the variation in foundry properties; CM, PM and B/SS as a result of the composition admixture are compared along with baking temperatures. From the Figure, it is observed that these properties increased with change in composition at various levels of binder additions. Specifically, composition of 3% starch with 2%pine oil binder in all the baking temperature considered. While an increase in the starch content at 6% significantly improved the foundry properties for various levels of pine oil binders (see Figure 1 and 2). It can however be said that all investigated properties are favored at 150^{o}C for most composition at all temperatures.

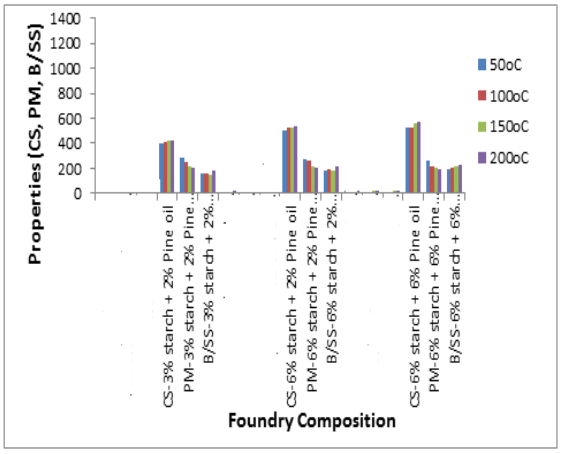

Figure 1: Comparative chart for combined foundry composition with 3%H_2O

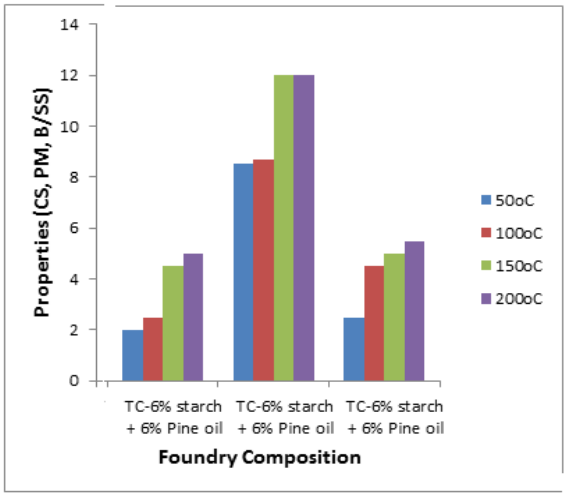

Figure 2: Comparative chart for TCs of different composition and at various temperatures

4. Conclusions

1. The use of pine oil (*Pinussylvestris)*as potential binders on foundry core strength have been established to significantly improve foundry properties at different baking temperatures
2. The higher foundry properties can be obtained at 150^{o}C baking temperature and that TC increases and decreases for some foundry compositions
3. It can be said that higher starch and oil additions favored PM value for pine oil in all admixtures. Higher TCfor pine oil in all compositions is obtainable at 200^{o}C baking temperature.

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