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Comparative hardness study of locally produced aluminium alloy motorcycle clutch handle with imported handle using sand and die casting

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Abstract
Foundry is a production process in which pattern is used to prepare mould by ramming suitable prepared sand. The pattern when withdrawn leaves a cavity (shape) in which molten metal is poured into it, after solidification it is extracted and fettled to suit the purpose it is made to serve. This work x-rayed into the foundry production process of Motor cycle clutch handle produced by Sand and Die casting processes, tested for hardness comparatively with the imported one. Hardness is the property of a material that enables it to resist plastic deformation, usually by penetration. It is not an intrinsic material property dictated by precise definition in terms of fundamental units of mass, length and time. It is a property value defined in terms of measurement procedure. The test of the casts (Aluminium alloy motorcycle clutch handle) was carried out using Vickers micro-hardness tester and the result obtained compared with the result of the imported clutch handle made from the same aluminium alloy. These result showed that the average hardness value for Sand cast specimen is 127.65 Hv, for Die cast specimen is 124.25 Hv and that of the imported cast handle is 89.05 Hv, indicating clearly that locally produced aluminium alloy motor cycle clutch handle can equally be used in the motorcycle construction.

Keywords: Aluminium alloy, comparative, casting, clutch handle, motorcycle, Sand, Die, hardness.

1. Introduction
Foundry practice is one of the intermediary basics in industries complementing forging and other machining processes through which metallic raw materials like pig iron**,** Steel scrap, ferro-alloy etc could be processed, refined and shaped into new products in form of machine components and spear parts (Agboola, 2008) [1]. The demand for motor cycle spear parts are so high that purchases are made with less regards to quality (hardness). Castings can be produced using Sand casting, Die casting and other special methods (Askeland, 1996) and (Hassan *et al,* 2010) [5]
The rate of parts failure in motorcycle (Bike) especially the imported parts is quite alarming and require the intervention of professionals/ agencies in quality control of the imported parts through local production (Anosike, 1995) [2]. Hardness is a property of a material that enables it to resist plastic deformation /failure or indentation, usually by penetration. It is not an intrinsic material property dictated by precise definition in terms of fundamental units of mass, length and time. It is a property value defined in terms of measurement procedure (Suleiman *et al,* 2011) [7]. Chemical composition plays a very important role in the quality and standard of a product, depending on the variation/ content of chemical element in such product (Backerud and Sigworth, 1989) [3].

2. Materials and Methods
2.1 Materials
Aluminium alloy scraps was purchased from a local scrap market in Makurdi, Benue state-Nigeria. Moulding/Foundry sand was collected from River Benue in Makurdi for the casting.
The Die made of male and female halves were produced of Cast iron designed to accommodate the handle with standard specifications/dimension.

2.2 Methods
Sand casting was used to produce the motorcycle handle using standard procedure with aluminium scraps from melting to pouring, down to solidification and fettling after production of the pattern. Die mould was equally used to produce the same motorcycle handle with the aluminium alloy scrap using standard procedure and steps, from melting to pouring, solidification and finally, extraction.
The chemical analysis of the locally produced handle and the imported one was carried out using Atomic Emission Spectrometer (AES) where the intensity of light emitted from plasma flame sparks at a particular wave length to determine the quantity/quality of elements in a sample, providing information with property related information of the material/sample.

3. Results and Discussion
The result of the chemical analysis of the locally and imported aluminium alloy motor cycle handle are presented in Table 1. These results showed that there is no much difference the major chemical content (Al, Si and Fe) of these samples. It is worthy of note that Silica and Iron content are the hardness determinant elements. Environment equally affects this determinant factor (Nwoye *et al,* 2010) [6]. It is worthy of note also that the cast alloy interacted with the sand mould which is usually rich in Silica and Iron content, thereby bringing about the hardness (Bam et.al, 2015) [4].

The result of the hardness test for the locally and imported aluminium motor cycle handle is presented in Figure 1. These result showed that Sand and Die casting samples produced locally from the aluminium alloy showed higher hardness value of 127.65 and 124.25 Hv respectively, while 89.05 Hv is indicated for the imported cast aluminium alloy. This result can be controlled by reducing or increasing the hardness (Nwoye *et al*, 2010) [6].

Table 1: The chemical composition of the locally and imported aluminium alloy cast handle.

Elements	Al	Si	Fe	Cu	Mn	Mg	Zn	Cr	Ni	Ti	Sr	Zr	V	Ca	Be
%	95.41	3.2	0.8	0.3	0.2	0.04	0.1	1.5	0.06	0.08	-	-	-	-	-

(a) Imported cast

Elements	Al	Si	Fe	Cu	Mn	Mg	Zn	Cr	Ni	Ti	Sr	Zr	V	Ca	Be
%	95.04	2.6	0.7	0.5	0.18	0.002	0.08	0.2	0.06	0.27	-	-	-	-	-

(b) Sand and Die cast

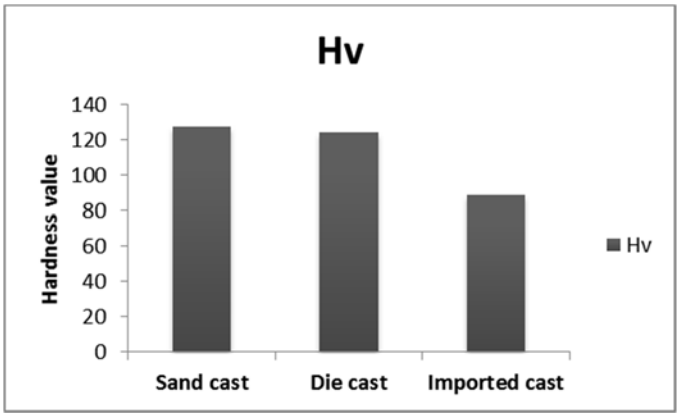

Fig 1: Hardness value for the various casts

4. Conclusion

It can be concluded from the foregoing that:

- That locally produced aluminium alloy from Sand and Die casting can replace the imported cast handle;
- The hardness of the aluminium cast alloys can be reduced or increased by manipulation;
- Metal-mould interaction of samples can affect parts(hardness) casted; and
- Alloy scrap treatment/ addition can bring about parts quality standards.

5. Acknowledgement

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