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Manufacture of Power Hacksaw Blades From Locally Available Medium Carbon Steel

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Abstract

The manufacture of power hacksaw blades using worn out sawmill blades made of medium carbon steel has bean achieved. They were produced through carburization, hardening and tempering processes. The produced power hacksaw blade when compared with the imported one showed the former having a slightly higher wear rate than the latter. The result also showed that the tool life of the produced power hacksaw having a hardness value of 459BHN and the imported one of hardness value 575 BHN was 922.3mins and 1140mins respectively. Although, the imported hacksaw blade has a slightly higher tool life than the produced one, which may due to a higher hardness value, the produced power hacksaw blade compares favourably well with the imported hacksaw blade.

Keywords: Power hacksaw blade, bone charcoal, tooth wear, tooth life, hardness value.

1.0 Introduction

Nigeria has been noted to import a lot goods[1], even some items that could have been produced locally are being imported. One of such items is the power hacksaw blade. The importation of power hacksaw blades is an unhealthy economic situation for the country as scare foreign exchange is continually being expended on this importation**.** Sawing is a cutting operation employing a cutting tool, a blade having a series of small teeth, with each tooth removing a small amount of material. The power hacksaws are used for cutting thick metal sheets, circular bar, metal of other sections [2,3], . The power hacksaw has a rigid bow supporting a horizontal Straight saw blade. It operates in a reciprocating motion. On the cutting stroke the blade teeth are forced into the metal being cut using gravity or hydraulic pressure and on the return stroke the blade is unloaded lifted to reduce wear on the blade. Power saw generally have a chip tray to retain the metal waste and collect the lubricating fluid [3,4]. Oyetunji and Olorimtoba [5] carried out preliminary studies on the manufacture of hand hacksaw blades from locally available mild steel and carburizers. The results showed that the handsaw blades produced through carburization, hardening and tempering processes using pulverized palm kernel shells charcoal, coconut shell and snail shell have average tooth wear of approximately 0%, 8.3%, 13% and 57% respectively after cutting a piece of 10mm diameter mild steel rod. Ibhadode and Ojeah [6] also studied the manufacture of hand hacksaw blades from locally available mild steel. The performance of the hacksaw blades was found to be satisfactory. Adegbuyi, [7] investigated the development of the machining properties of locally fabricated cutting tools. Some other researcher carried out studies on cutting and tool life [8,9,10] . It has been observed that most sawmill blades made of medium carbon steel when worn out are allowed to rust away or put to limited use. Its disposal is difficult because it does not decompose. This paper is therefore aimed at the manufacture of power hacksaw blades from worn out sawmill blades made of medium carbon steel, thereby creating wealth from waste .It is hoped that this will generate interest in establishing small and medium-scale industries for the manufacture of hacksaw blades, thereby creating employment opportunities.

2.0 Materials And Methods

Material: The worn out sawmill blades made of medium carbon steel used were obtained from a wood sawmill factory in Benin City, Nigeria .Imported power hacksaw blade manufactured in Britain was bought from a Tool store in Benin City,Nigeria.

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3.0 Sample Preparation

Cutting of Blade teeth: The blades were cut from 1.75mm thick worn out sawmill blades made of medium carbon steel to a length and width of 400mm and 30mm respectively using Guillotine shearing machine. Ten blade blanks were clamped on the shaping machine at the same time for cutting each tooth on the blank using high-speed steel tool. The number of teeth per 25mm cut was six (6), the tooth pitch was 4.5mm and depth of tooth was 1.75mm, while the rake angle and relief angle are 0° and 64^0 30' respectively.

Carburizing of Blades: Carburizing is a heat treatment process in which iron or steel absorbs carbon liberated when the metal is heated in the presence of a carbon bearing material, such as charcoal or carbon dioxide, with the intent of making the metal harder. Depending on the amount of time and temperature, the affected area can vary in carbon content. Longer carburizing times and higher temperatures lead to greater carbon diffusion into the part as well as increased depth of carbon diffusion. When the iron or steel is cooled rapidly by quenching, the higher carbon content on the outer surface becomes hard via the transformation from austenite to martensite, while the core remains soft and tough as a ferritic and/or pearlite microstructure [11]. Eight pieces of cut medium carbon steel blades were carburized using 60% bone charcoal, 15% palm kernel shell and 25% cast iron powder. The blades were initially polished to remove surface impurities before placing the blades and the carburizing materials inside the heat resistant boxes .The heat resistant boxes were properly covered and fortified with firm heat resistant clay to prevent heat loss by conduction in accordance with Rajan et al [12] . The carburizing box was charged into the laboratory furnace heated to 900^0 C and soaked for 3 hours inside the furnace after which it was switched off.

Off setting of Blade Teeth : Each carburized blade was clamped on a vice and each tooth was displaced away from the general lay of the blade, by tapping gently with a hammer on a blunt center punch at the root of the tooth. A regular alternate tooth set was given to each tooth and the tooth profiles were determined on the tool markers microscope in accordance with Ibhadode and Ojeah [6].

Hardening and Tempering of Blades: Oxy-acetylene flame was used to heat the blade teeth which had been offset to a temperature of 870°C and the quickly quench in water. All the hardened blades were tempered by kerosene stove to 250°C.

4.0 Test Procrdure

Hardness test: The carburized blade was clean properly and placed in the Brincll hardness testing machine. The machine was loaded with a mass of 3000Kg and a ball of diameter 10mm used to indent the blade. The indentation on the blade was then measured with a microscope and recorded. The Brinell hardness number (BHN) is calculated using Eqn. (1).

$$BHN = \frac{P}{\pi\frac{D}{2}(D-\sqrt{D^2-d^2})} \quad (1)$$

where P = Applied load, D= Ball diameter, d = Indentation diameter.
The same procedure was used to obtain the hardness value for uncarburised blade, imported blade and mild steel material of 16mm diameter.

Wear and Tool Life Test: Produced hacksaw blades was fixed in a power hacksaw machine and used to cut 16mm diameter rib rod mild steel material and the tooth wear measured at suitable interval using the tool markers microscope with a magnification of x 15 until the blade failed. The blade tooth wear (W) was determined using Eqn. (2)

$$W = w_1 - w_2 \quad (2)$$

where w_1 = initial blade's tooth depth and $w_{2=}$ final blade tooth depth. The same procedure was used to determine the wear rate and tool life for the hacksaw blade imported from Britain ..

5.0 Results And Discussion

The Brinell hardness test of the materials is shown in Table 1. It was observed that the hardness value of the imported blade (575BHN) was slightly higher than the produced blade (459BHN). From Fig 1, it was observed that blade wear increased with increased time for the produced carburized blade and the imported blade. It was also observed that the produced blade had a slightly higher wear than the imported blade. For instance, after

60mins.the wear for the produced and imported hacksaw blade were 0.03mm and .024mm respectively. It was also shown that the tool life for the produced and imported hacksaw blade were 922.3min and 1140min respectively (Fig 2). The imported blade has a slightly higher tool life than the produced hacksaw blade. This may have been due to the fact that the imported hacksaw blade had a slightly higher hardness value than the produced blade which was 575BHN and 458.85 BHN respectively. We therefore conclude that the produced hacksaw blade compare favourably with the imported blade.

Table 1: Hardness Value of Materials Used

MATERIALS	HARDNESS VALUES(BHN)
Uncarburised blade	**397.35**
Produced carburized blade	**458.85**
Imported blade	**575.00**
16mm rib rod mild steel	**181.27**

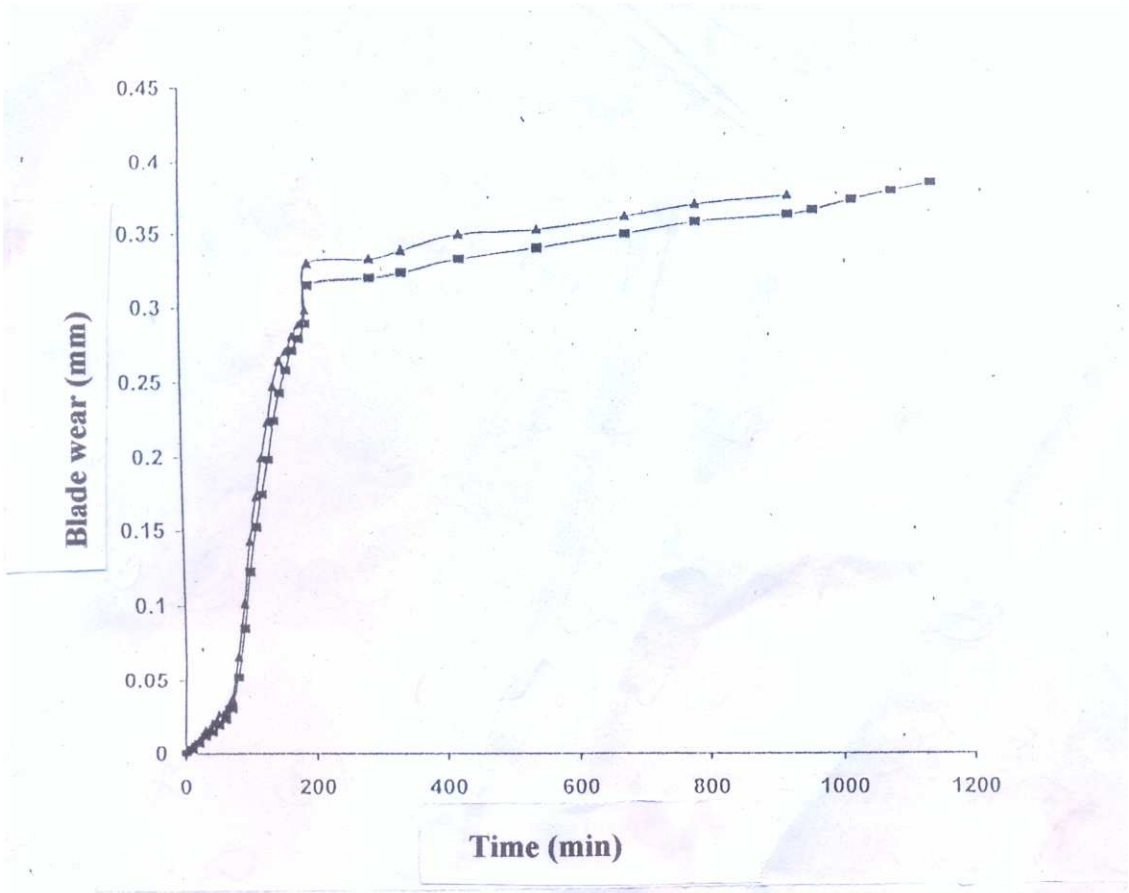

Fig 1: The plot of blade wear against time for produced (▲) and imported (■) hacksaw blade.

Conclusion

The manufacture of power hacksaw blades using worn out sawmill blade made of medium carbon steel has been achieved. The performance of produced hacksaw blade was found to compare reasonably with imported blades. It is hoped that this work will further activate the production of hacksaw blades in Nigeria thereby generating employment and saving the country of huge foreign exchange used for importation. It is recommended that other carburizing agent should be exploited in other to increase the carbon content of blade thereby leading to its improved performance.

References

[1]Ikoku C.V. 1998. Indigenous Technology Development. *The Nigerian Engineer* 36: 13 - 14.
[2] Maklenko N 1987. Cutting of Metals In.*:fitting Practice* 2nd Edition, Mir Publishers, Moscow, Pp 65- 77.
[3] Ibhadode A.O.A., 2001. Metal Machining In:*Introduction lo manufacturing Technology* 2nd Edition, Ambik Press, Benin City, Nigeria Pp 352 - 503.
[4] Osakue E.E 1990. Design and Manufacture of a power hacksaw from local materials. M. Eng Thesis, University of Benin, Benin City, Nigeria.
[5] Oyetunji A. and Olorimtoba D.T 2003. Preliminary Study on Manufacture of Hand Hacksaw blades from locally available mild steel and carburizers *Nigerian Journal of Engineering Research and Development 2:* 3, 48-56..
[6] Ibhadode A.O.A. and Ojeah C.C 1991. Manufacture of Hand Hacksaw blades from locally available mild steel. *The Nigeria Engineer* 26: 4, 51-55.
[7]Adegbuyi P.A.O. 1997 .Developing the machining properties of locally fabricated cutting Tools.*Nigerian journal of Technical Education* 13:1 &2, 48-59.
[8]Kurimolo T and Harrow G.I981. The wear of High Speed Steel cutting Tools under the action of several different cutting fluids. *Proceeding of the Twenty-Second International Machine Tool Design Research Conference .Manchester* -.237-246
[9]Muklar M and Ibhadode A.O.A.I999. Effects of cutting fluids on Tool wear during Turning operation . *NSE Techinical Transaction.* 34:4, 64-75
[10]Osarenmwinda J. O.2004. Cutting tool flank wear under several cutting fluid. *Nigerian journal of Engineering Research and Development* 3:4, 5 1 -57.
[11] Oberg, E., Jones, F., and Ryffel, H. (1989) *Machinery's Handbook 23rd Edition.* New York: Industrial Press Inc.
[12]Rajan T.V., Sarma C.P. and Sharma A. 1988. Heat treatment Principles and Practice, Prentice Mall Eaglewood. Pp 1-49.