

FINISHING AND AESTHETIC CAPABILITIES OF NIGERIAN METAL FABRICATION COMPANIES: CASE STUDY OF IBADAN, SOUTH-WEST NIGERIA

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ABSTRACT

Poor finishing and aesthetics capabilities of metal fabrication companies in Nigeria have been identified as a major cause of the poor acceptance of locally fabricated metal products. This study was aimed at assessing some finishing and aesthetic capabilities of Nigerian companies. Five companies were identified for study. Five commonly fabricated products of each company were selected for analysis. Their equivalent imported substitutes were identified for comparison. Ten basic operations (painting, electroplating, metal spraying, lapping, super finishing, abrasive belt grinding, buffing, parkerizing, polishing and chemical conversion coating) for accomplishing the three finishing processes (surface cleaning, surface smoothing and surface coating) on a given metal product were identified. Standard equipment types required for the operations were identified from the literature. The fabrication methods, practices and equipment types used by the companies to carry out the operations were compared with industry standards. The physical structures and aesthetics of the product were compared to the imported substitutes. The manpower level of each company based on the age, educational status, years of experience, familiarity with finishing operation of workers was also evaluated. On the average the companies make use of only 40% of the standard finishing operation identified from literature. 50% of the workers have post secondary school qualification and 50% have over 5yrs experience on the job. Investment in equipment and technology is generally poor. It is concluded that comparatively, local metal fabricators lack the required finishing and aesthetics capabilities in area of equipment and manpower skill.

Keywords: Metal Fabrication, Finishing, Aesthetics, Assessment.

INTRODUCTION

Aesthetics has become a major determinant of consumer behaviour such that the twenty-first century has become the age of aesthetics. Finishing consciousness and attention to sensory experiences are merged with consumer decisions (Janet, 2005). Modern consumers are increasingly demanding attention to both functional and aesthetic dimensions in the products they buy. There has been an increasing attention being lavished on the beautification of products such that this might be the age of aesthetics (Postrel, 2003). Therefore, fabricators constantly strive to design products that are functional and appeal to consumers more precisely than ever. Martand (2002) considered

aesthetics to be the "external look good" of the product and it is concerned with moulding the final shape around the basic skeleton. Aesthetics is a dominant factor in creating the demand for a product. Aesthetics has been recognized as an integral part of design and is influenced by the finishing function of the manufacturing process. Generally, the form of a product can be appreciated to a large extent by sight and touch.

Finishing and external appearances of products is the principal medium through which the senses can work (Niebel and Droper, 1974). Most often materials are not adequately resistant to the environments in which they will be used, making them subject to corrosion and deterioration. The

most commonly used materials, such as iron and steel do not possess inherently attractive colours and thus are lacking in sales appeal. As a consequence of these conditions, most manufactured products, after achieving the desired shape, require one or more additional operation (finishing) to clean, smooth, protect or colour them, (Degarmo, 1974). A good design often includes consideration of a finishing or coating operation because a product is often judged for appearance as well as on the basis of function and operation, (Amstead, 1979).

Unfortunately it has been observed that most Nigerian made products, especially fabricated metal products, cannot compete favourably in the market with their counterpart products from developed nations in terms of finishing and aesthetics features.

Generally aesthetics in engineering products poses some peculiar challenges to designers because there is an obvious lack of systematic, scientific, and engineering methods to help them make aesthetic design decisions and conduct aesthetic evaluations (Liu, 2003).

Surface Finishing

Ibhadode (2001) observed that surface treatment is used generally to impact attractive appearance. Other functions of surface treatment are to provide corrosion resistance for materials liable to environmental attack, impact some mechanical properties to the surface and improve safety conditions. Surface finish influences not only the dimensional accuracy of machined parts, but also their properties. Properties such as fatigue life and corrosion resistance are influenced strongly by the type of surface produced (Sule, 1988).

Surface finishing methods may conveniently be divided into (i) mechanical processes (ii) Chemical processes and (iii) ultrasonic cleaning. Mechanical cleaning processes use simple mechanical means based on the application of force to clean a component's surface. These forces may be applied by rubbing and/or impact. Chemical processes involve the use of chemicals to clean a surface in which some form of chemical reaction may occur. While ultrasonic cleaning involves placing the components to be cleaned in a bath of fluid which is subjected to a high-frequency (25-40 kHz) ultrasonic wave energy, or ultra sound, and causes cavitation to occur within the fluid, thereby cleaning the component of contaminants (both external and internal surfaces) by the great forces so generated.

Similarly, surface smoothing processes like polishing, abrasive belt grinding, electroplating, lapping, super finishing, metal spraying and parkerizing are processes are used to produce a smooth surface, great accuracy, aesthetic appearance or a protective coating. On the other hand surface protection processes are principally employed for providing a protective surface to a component from the attack of the immediate environment. In some processes, other additional properties may be imparted to the component surfaces, for example increased wear resistance (Ibhadode, 2001). Such processes include hot-dipped coatings, chemical conversion coatings, cladding, electroplating, and painting.

The aesthetic and finishing characteristics of fabricated products depend on the application of any or combination of the above processes. Their correct and effective application however, requires certain capabilities in terms of equipment, software and skilled personnel.

This study is aimed at analysing the level of these capabilities within the Nigerian local fabrication sector. It will assess the finishing and aesthetic capabilities of Nigerian metal fabrication companies using Ibadan, South-West Nigeria as case study. Specifically the following specific objectives will be considered: (i) Identify some fabrication companies in Ibadan and their products (ii) Identify and characterize the finishing operations currently adopted by these companies for their products and compare these with the standard finishing operation system ideal for such products.

AESTHETICS EVALUATION CRITERIA

A major problem in aesthetic evaluations stems from absence of systematic, scientific, and engineering methods to adopt (Liu, 2003; Noblet 1993). In fact one of the two main issues that form the trust of the emerging field of Aesthetics Engineering has to do with how to incorporate engineering and scientific methods in aesthetic evaluation process (beyond the analyser's 'hunches'). The other issue being how to use engineering and scientific methods to study aesthetic concepts in system and product design. Unfortunately there is yet to be a standardised quantitative method of aesthetic evaluation. Hence aesthetics evaluation is, generally, a subjective process. This fact is captured by the popular saying 'beauty is in the eyes of the beholder'.

However, in this work we recognise that there are certain factor / properties which have some direct bearing on aesthetic qualities of a fabricated metal product. These properties include Form, Symmetry of Shape, Polishing and Gloss Texture, Absence of Visible Surface Cracks and Particles, Continuity of Welding Beads Deposit. We attempt to use these factors as surrogate evaluating criteria of aesthetics in this study.

METHODOLOGY

Study Location: Ibadan, Southwest Nigeria.

Most of the fabrication companies serving the needs of Nigeria and West African coast are located in Ibadan and Lagos, Nigeria. Ibadan was therefore selected because it is representative of the major fabrication clusters in Nigeria.

Data gathering:

The following steps were taken for data gathering. Five (5) major Metal Fabrication companies with their products were identified (Table 1). The companies were visited for onsite assessment, interviews and questionnaires administration.

DATA ANALYSIS AND DISCUSSION

The finishing operations required in a metal fabricated product are determined by their shape, size, and material constituent and intending consumer of such products. The finishing practices of the companies were observed on "As It Is" basis. The product / operations analysis shown Table 2 reflects the current practices of the selected companies. For each of the processes identified in Table 2, the Ideal required operations were identified accordingly from literature.

Table 1: Selected Companies and Their Respective Products

Company	Product
Company 1, Lagos Road, Podo Ibadan.	Maize Sheller, Grinding machine
Company 2, Akinyele LGA Ibadan.	Hammer mill, industrial machine.
Company 3, Iwo road Ibadan	Skip bin
Company 4, Agbowo U.I, Ibadan.	Surface and underground Water, fuel Tank
Company 5, Apata, Ibadan.	Fuel storage tank, truck tanks

Table 3 shows the operations as identified from literatures which have been adapted for producing desired finish.

A comparison between the ideal (expected) and the observed finishing operation currently adopted were carried out and summarized and shown in Table 4.

Human Resources / Skills Analysis

Generally, good surface finishing and aesthetic capabilities are functions of human resources, machineries, techniques and information availability in the finishing unit of any manufacturing organization.

The level of expertise of the personnel was evaluated based on the following; Level and relevance of their Education, Familiarity with standard finishing procedures and equipment, Years of experience. Thirty 36 workers were administered with questionnaire. The following gives the summary of the analysis.

Products Comparison

Typical fabricated metal products from these local companies were compared with equivalent imported ones in terms of aesthetic appeal. Generally, the imported products were aesthetically appealing and give more even grounding and easier to detach for repair and maintenance. The coatings for the local products lack a feeling of freshness, coolness and stability. A typical visual comparison is shown in Fig. 5.

Table 2: The Observed Finishing Practice

Products	Processes	Operation	Methods of application
Maize Sheller	Surface cleaning Surface smoothing Surface coating	- Detergent cleaning - Filing - Grinding - Painting	Using hand and rinse with water Using hand file Using power-driven hand grinder Using hand brush Using spray gun
Hammer mill	Surface cleaning Surface smoothing Surface coating	- Detergent cleaning - Filing - Grinding - Painting	Using hand and rinse with water Using hand file Using power-driven hand grinder Using hand brush Using spray gun
Skip-Bin	Surface cleaning Surface smoothing Surface coating	- Wire brushing - Detergent cleaning - Grinding - Painting	using hand brush Using hand and rinse with water Using power-driven hand grinder Using hand brush Using spray gun
Water Tank	Surface cleaning Surface smoothing Surface coating	- Alkaline cleaning - Grinding - Painting	Using soaking method Using power-driven hand grinder Using hand brush Using spray gun
Petrol Tank	Surface cleaning Surface smoothing Surface coating	- Alkaline cleaning - Grinding - Painting	Using soaking method Using power-driven hand grinder Using hand brush Using spray gun

Table 3: Ideal (Standard) Finishing / Aesthetics Practices

Product	Processes	Operation	Method of application
Maize Sheller	Surface Cleaning	- Wire brushing - Organic solvent cleaning - Alkaline cleaning	- Power-driven rotary brushes - Spraying with the solvent - Spray cleaners
Hammer mill	Surface smoothing Surface coating	- Grinding - Polishing - Buffing - Painting	- Power driven hand grinder - Cloth polishing wheel - Very fine abrasive - Spray gun
Skip bin Water tank	Surface Cleaning Surface smoothing Surface coating	- Wire brushing - Organic solvent cleaning - Alkaline cleaning - Pickling - Grinding - Polishing - Buffing - Chemical conversion coating - Painting	- Power-driven rotary brushes - Spraying with the solvent - Spray cleaners - Spraying with an acid solution - Power driven hand grinder - Cloth polishing wheel - Very fine abrasive - Spray gun - Spray gun

Fuel tank	Surface Cleaning	- Wire brushing - Organic solvent cleaning - Pickling	- Power-driven rotary brushes - Spraying it with the solvent - Spray with an acid solution
	Surface smoothing	- Grinding - Polishing - Buffing	- Power driven hand grinder - Cloth polishing wheel - Very fine abrasive
	Surface coating	- Metallizing	- Flame Spraying

Table 4: Comparison Between Ideal and Observed Finishing / Aesthetics Practice

Processes	Operation		Application Mechanism	
	Ideal	Observed	Ideal	Observed
Surface cleaning	Wire brushing	Wire brushing	Power-driven rotary brushes	Hand brushing
	Alkaline cleaning	Alkaline cleaning	Spray cleaners	
	Pickling		Spraying with an acid solution	Soaking method
Surface smoothing	Grinding	Grinding	Power-driven hand grinder	Power-driven hand grinder
	Polishing	Filing	Cloth polishing wheel	Hand file
	Buffing			
Surface coating	Painting	Painting	Spray gun	Spray gun
	Parkerizing	Parkerizing	Dipping	Spray gun
	Metal	-	Spray gun	-
	Spraying	-	Spray gun	-
	Chemical conversion coating			



Fig. 1: Age Distribution of Workers

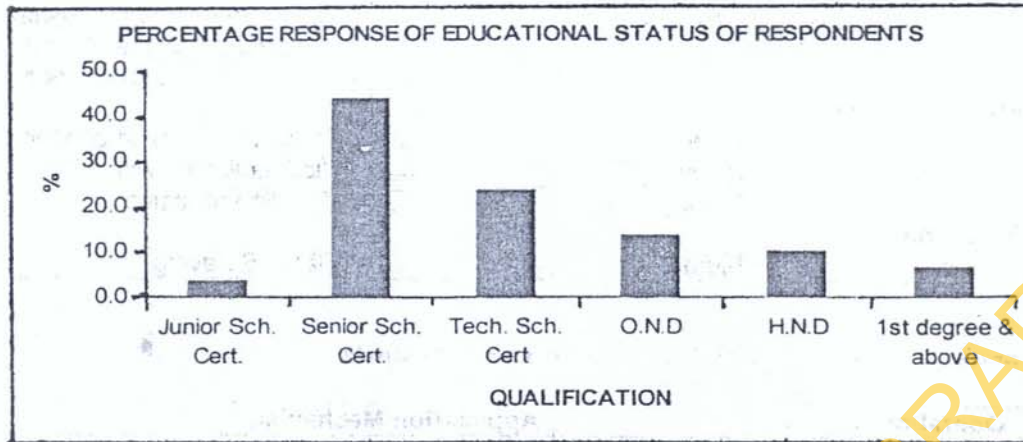


Fig. 2: Educational Status of Workers

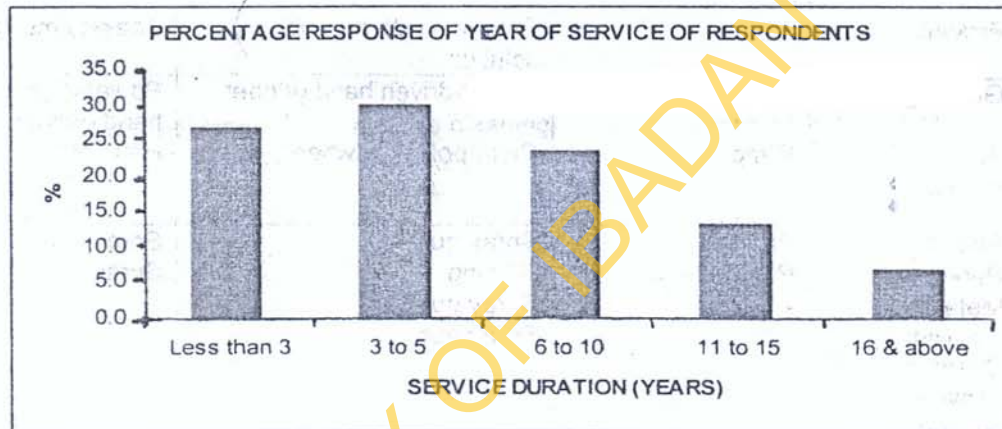


Fig. 3: Distribution Years of Service of Experience of Workers

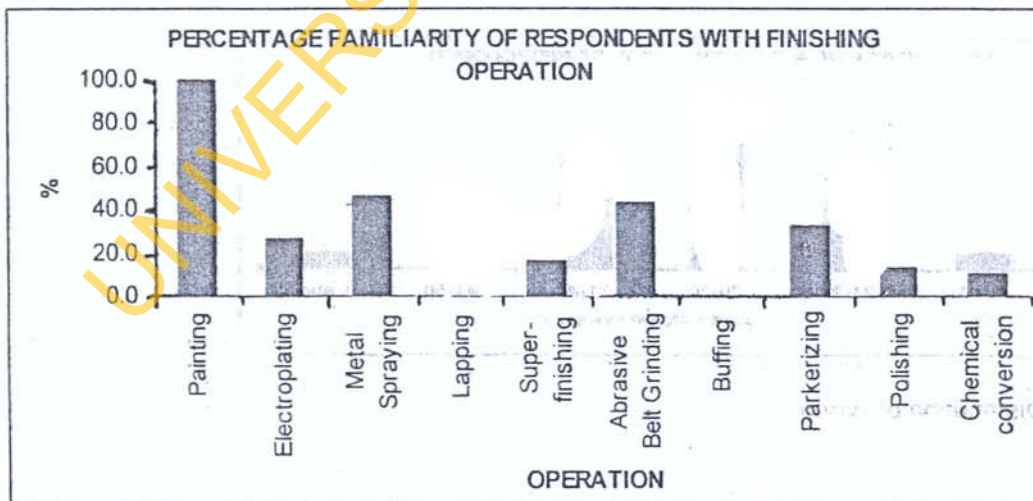


Fig. 4: Percentage of Staff Familiar with Finishing Operation

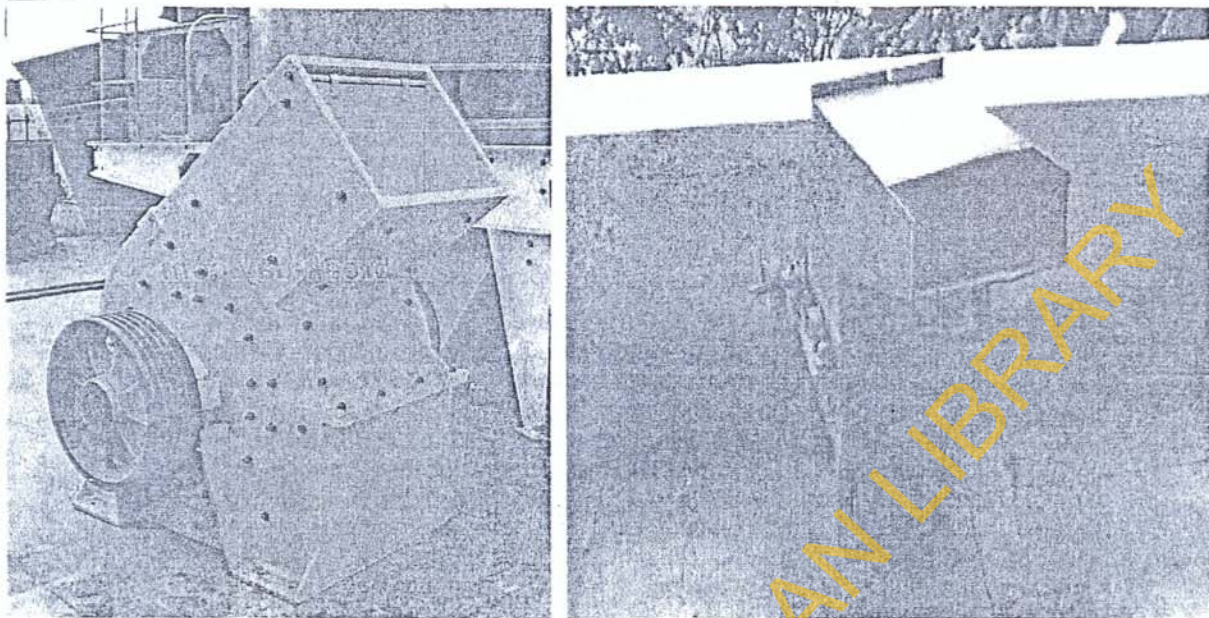


Fig. 5: Imported vs locally Fabricated Hammer Mill: a Visual Comparison

CONCLUSIONS AND RECOMMENDATIONS

Poor finishing and aesthetics capabilities of metal fabrication companies are major causes of the low quality of locally fabricated metal products in Nigeria. Most of these companies lack the appropriate hardware and knowledge base required for high quality finishing operations. It is concluded that comparatively, local metal fabricators lack the required finishing and aesthetics capabilities in the areas of equipment and manpower skill. Investment in these critical areas should therefore be encouraged by the government.

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