AN EXPERIMENTAL INQUIRY INTO SURFACE ROUGHNESS OF PAINT-FINISHED MILD STEEL BY SOME TOP AUTOBODY SPRAY PAINTERS IN KADUNA METROPOLITAN AREA, NIGERIA

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ABSTRACT

Body finish appeal is one of the first noticeable things about any automobile. Most factory autobody painting is highly automated, so aesthetically appealing body finishes of high quality are efficiently achievable with high production rates. However, autobody painting for maintenance or repair in Nigeria is mostly done using manual skills and minimally automated facilities, with a high chance of ending up with low-quality or unappealing body finishes. The purpose of this paper is to present an experimental comparative study about the average surface roughness of paint-finished auto bodies by three top artisanal autobody spray painters, named MA Motors, Alsarafa Body Painters, and IBK Motors in Kaduna metropolis, Nigeria, relative to factory-painted vehicles at Peugeot Automobile Nigeria (PAN) Plc and relevant engineering standards. A cold-rolled mild steel sheet was procured for the study as the most common but corrosion-susceptible autobody material. The sheet was ascertained through nominal composition analysis and was used to produce four similar-sized sheet samples. The samples were individually taken to each of the spray painters and PAN, where they were surface-cleaned, painted, and cured according to the usual methods and standards used there in paint-finishing auto bodies. The surface roughness of the paint-finished samples was measured at 20 different points on each sample with the CRV-135 surface roughness tester and analyzed statistically in terms of the mean value (Ra), root mean square, depth to peak ranges, skewness, kurtosis, and variance. The obtained results indicated that the paint finishes from IBK Motors, Alsarafa Body Painters, MA Motors, and PAN had Ra values of 1.368µm, 1.4725µm, 1.6495µm, and 1.258µm, respectively. The analysis also indicated that all the paint-finished surfaces had minimal roughness, uncharacterized by excessive variations, peaks, and valleys, about their flat average values. The analysis finally indicated that autobody paint finishes by the spray painters are of similar and high quality by engineering standards and comparable to finishes at PAN. The paper provides useful insight into the surface roughness of paint-finished auto bodies by the spray painters as a fundamental quality control parameter that should be imbibed by all in the auto-body painting business, especially in Nigeria, to meet requirements by standards, customers, and users.

Key Words: Auto-body, Spray painting, Artisanal skills, Finish quality, Primary concern, Surface-roughness, Minimization.

INTRODUCTION

Automobile body spraying is a time-consuming and complicated business that necessitates the use of specialized equipment and abilities. It's a business that's best left to experts in the area (Akafuah et al, 2016., Alsoufi and Bawazeer, 2015). Paint is usually applied in layers on an automobile body, each with a thickness of a few microns (µm). In autobody painting, there are several stages to follow. The first stage is to remove all rust and grime from the body, followed by thorough degreasing and drying. After that, the base coat or primer, top coat, and clear coat are applied, with color matching. The primer is used to even out any underlying surface irregularities on the autobody after the cleaning process, while the base coat provides the main color for the overall paintwork and plays a remarkable role in establishing its final visual impression. The clear coat is the last or atop coat and is used to protect the autobody against abrasion, dirt, and ultra-violet radiation (Akafuah et al ,2016.,Alsoufi and Bawazeer, 2015., Mahajan et al, 2019., Anton Paar, 2021). One of the first noticeable things about any vehicle is its surface quality, as dictated by the overall quality of its paintwork. There are essentially three surface quality parameters that a paint-finished autobody is intended to exhibit, namely (Guma and Ishaya, 2019., CUBII, 2021., Ulbrich et al, 2021):

i. Sufficient hardness and adherence of the paint finish to the substrate to remain intact in service when under mechanical loads, elastic-plastic distortions, thermal stress, and climatic conditions.
ii. High smoothness, gloss, and aesthetic quality of the paint finish attracting buyers and users to the vehicle, while also

increasing the vehicle's value when it comes time to sell it.

iii. Adequate corrosion and wear protection of the car body.

Surface roughness control is, however, fundamental and influential in all stages of autobody painting for achieving all the intended surface qualities (Saseendran and George, 2018). This is because the extent of surface roughness can negatively or positively affect paint film adhesion, aesthetic quality, and corrosion resistance of the paint finishes. Surface roughness is an inevitable phenomenon that can objectionably occur even with the state-of-the-art surface finishing technologies such as super-finishing. It can occur even at micro and lower levels by surface variations of tiny wavelengths, marked by minute rises and falls, or local apexes and unevenness of various interspacing and amplitudes. It is a critical parameter that requires adequate control to achieve the best results in many finishing processes in engineering, including painting. Surface finishes of painted auto bodies need to be flexible, uniformly smooth, and highly resistant to stone-chipping, but lowering surface roughness to an ideal level can be impracticable and will usually raise production costs significantly. It therefore demands a trade-off between costs and performance to obtain a practicable surface roughness in most paint finishing jobs (IBS, 1976., Alsoufi et al, 2016., Saseendran and George, 2018). Assessment of surface roughness of autobody is a critical routine quality control tool that is beneficial for improving the painting process through performance evaluation, maintaining quality standards, reducing complaints or rejections of the paintwork due to inferior surface quality by customers, and reducing the painting costs. The factors that determine the surface roughness and hence the quality of autobody paint finishes are the materials used for autobody, the quality and color of the paint used, the skills or technology used in cleaning and painting, and the control of attendant environmental factors during the painting process (Alsoufi et al, 2016., Saseendran and George, 2018).

A variety of materials are used or exploited for auto-bodies to reduce weight, improve visual quality, increase durability and safety, and improve the strength of vehicles. Currently, low carbon and alloy steels, polymers and their alloys, aluminum alloys, magnesium alloys, and thermosetting resins with fiberglass or carbon are the materials utilized to manufacture auto-bodies (Davies, 2012., Berladir et al, 2017). Steel is the most commonly employed of these material kinds due to its relative affordability, greater availability, superior formability, and innate ability to absorb impact energy in a crash scenario. Advanced high-strength steel and mild steel are both employed in the building of auto-bodies. Because of its malleability, affordability, high strength, and higher availability, mild steel is used extensively. However, due to its greater susceptibility to corrosion than other varieties of steel and consequently less appealing appearance, mild steel has the worst aesthetic attributes. Most modern auto-bodies are made of cold-rolled mild steel sheets of a thickness of up to 2.5mm in some cases (AvtoTachki, 2021., Davies, 2012., Dave et al, 2016., Fentahun and Savas, 2018., Han, 2020., Mishra, 2020., Sivanu et al, 2021). Painted auto-bodies need to be flawless and harmonious, but it is difficult and costly to achieve this. The surface finish of mild steel auto-bodies determines the surface roughness of paint coats on them, particularly when the coats are only 12.7µm thick (Schmael and Purcell, 1988). Therefore, the capability to achieve smooth paint finishes on steel auto-bodies depends on the skill or technology employed and the quality of the steel substrate together with the flow characteristics of the individual layers that form the total paint layers. Typical achievable average roughness (Ra) values in microns on steel auto-bodies are 0.80-1.40 for bare mild steel, 0.70-0.90 for phosphate steel, 0.05-0.15 for polyester surface, and 0.04-0.09 fora clear coat over basecoat enamel (Schmael and Purcell, 1988). The depletion in volume of the coating during the drying process or the attendance of particles at submicron level within the formulation of the coating can also result in the roughness of the paint film layers at the micro or macro levels (micro-roughness) (Jai and Palija, 2015).

i. Flow is induced by surface tension gradients as well as coating application procedures such as spraying, brushing, etc. (macro-roughness).

ii. Imperfect control of application and curing conditions of the paint coatings as well as inherent and environmental impurities or other unfavorable factors during the painting process.

Autobody spraying is a very competitive and lucrative business in Nigeria (Grutech, 2021). The main reason attributed to this is the opportunity of making a lot of money from the business from charges of as much as N30,000 to N50,000 per vehicle in less advanced vehicle painters, subject to the automobile size and type, the quality of equipment to be used in painting, and the professional expertise to do the painting. The costs are even much higher, in the range of about N100,000 to N200,000 per vehicle in advanced painting outlets (Nigerian Informer, 2021). A boost to the business is attributable to the favorable market created for it by the relatively large number of used automobiles, which require painting and have been increasingly imported into Nigeria over the past few decades. In fact, Nigeria has one of the world's highest concentrations of second-hand cars. More than 11 million second-hand cars were in use in the country in 2014, with the bulk of them more than 20 years old from their original manufacturing dates. This enormous importation of used cars in the country includes those without a clean title, such as accident ones, which are less expensive in price, but dealers fix, repaint, and sell them for premiums. Nigeria is also known to have a large number of bad roads and reckless drivers who are inclined to overusing or abusing vehicles, thereby causing physical damage to them amid frequently exposing them to harsh weather conditions that cause them to deteriorate faster, necessitating their higher repair or repainting rates. Road accidents in Nigeria also cause damage to automobiles that require bodywork repairs and or spray painting (Grutech, 2021).

Most factory auto-body painting is done using automated setups such as robotic technology, so the best paintwork quality in terms of solid, uniform, and appealing coats is efficiently achieved with high production rates. However, autobody painting in Nigeria for maintenance or repair is mostly done with artisanal skills using no or minimal automated facilities, so the quality of obtainable paintwork can generally be less than what is obtainable from factory painting (Deaton, 2021., Guma and Akporhuarho, 2021). There are many autobody spraying booths, shops, workshops, and enterprises in Nigeria. These paint-spraying outfits can be found in cities and towns and even on roadsides, but the qualities of facilities they use, professionalism, and services they offer are not the same. It is on record that many Nigerian automobile spray painters don't do the job the right way. The faults that they commit are in terms of using low-quality paint, not giving the vehicle buffing/waxing treatment, improper or non-striping of paint, prepping the car with the old paint fully on the car, improper preparation of the car, and painting it on a rough foundation (NaijAuto.com, 2021). Any of these faults can result in an inferior quality of vehicle paintwork. There is therefore a need to enforce quality standards in the auto-body painting sector to ensure that customers get the best services for the money they pay. This paper aims to present an experimental assessment of the surface roughness of paint-finished mild steel as the most aesthetically unattractive autobody material by three top artisanal autobody spray painters in Kaduna metropolis, namely; MA Motors, Alsarafa Body Painters, and IBK Motors, relative to factory-painting at Peugeot Automobile Nigeria (PAN) Limited and engineering standards in order to understand the quality of auto-body paintworks produced by the three enterprises in terms of surface roughness values.

2. MATERIALS AND METHOD

2.1Materials

A cold-rolled mild steel sheet of 609.6mm by 609.6mm by 2mm-thickness was procured in cold-rolled form from the Nigerian steel market. The as-procured sheet is shown in Plate I.

Plate I: The as-procured cold-rolled mild steel sheet for the study

2.2Method

2.2.1 Ascertainment of the procured mild steel sheet

The Shimadzu PDA 7000 metal analyzer, made in Japan, was used to determine the average nominal composition of the mild steel sheet. The sheet material was determined to be mild steel, with a nominal composition of 99.175 percent, 0.162 percent Al, 0.093 percent C, 0.184 percent Mg, 0.205 percent Si, 0.121 percent Ni, 0.017 percent Cu, and 0.034 percent P on average. A scriber was used to cut four samples from the confirmed sheet, each measuring 304.8 × 304.8 x 2mm. After that, the four components were mechanically sawn apart. The samples were subsequently taken one by one to PAN Ltd, MA Motors, Alsarafa Body Painters, and IBK Motors, where they were surface-cleaned and painted using normal auto-body paint-finishing processes and standards. Plates I, II, III, and IV show the appearances of the painted samples A, B, C, and D at PAN Ltd, MA Motors, Alsarafa Body Painters, and IBK Motors, respectively.

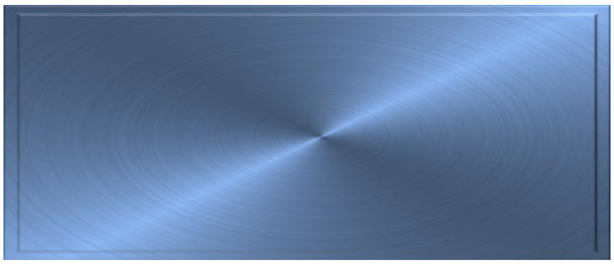

Plate I: The sample that was paint-finished at PAN Ltd (A)

Plate II: The sample that was paint-finished at M.A. Motors (B)

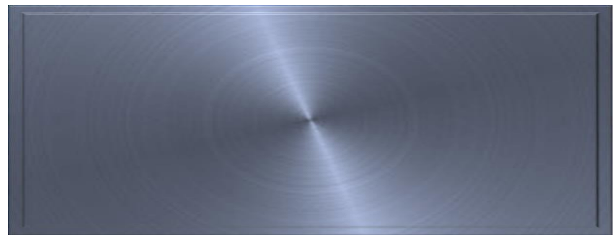

Plate III: The sample that was paint-finished at Alsarafa Body Painters (C)

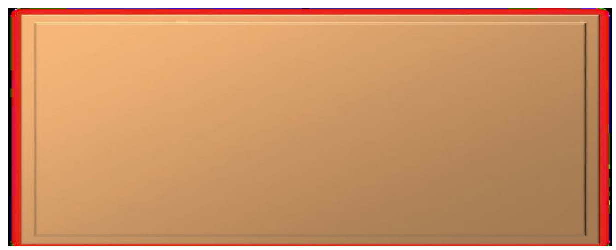

Plate IV: The sample that was paint-finished at IBK Motors (D)

2.2.2 Surface roughness measurement of the paint-finished samples

The surface roughness of the paint-finished samples A to D shown in Plates I, II, III, and IV, respectively, was determined in the production workshop of the Department of Mechanical Engineering's production workshop of Nigerian Defence Academy, Kaduna, using the handheld, portable, battery-powered CRV-135 surface roughness tester. The tester was initially calibrated according to its user manual and accessory calibration specimens to ensure accuracy of its surface roughness measurements on each paint-finished sample. The tester was calibrated by using it to measure and compare the surface roughness of the calibration specimen to what is obtainable within the surface roughness range of the tester in accordance with the ISO 5436-1 2001standard. In all cases, the calibration readings were observed to be consistent and satisfactory within the range. A steel tape and light and marker were used to lightly earmarked 20 test points at similar positions on each sample. The calibrated tester was operated according to its manual and used to measure R_a and Rz values at each earmarked spot of the samples. During the measurement procedure, the tester was placed with its stylus near a given spot where surface roughness was to be measured. The tester was operated and its stylus moved linearly along a line to the desired measurement spot or near it by designed or made capability of the tester. The stylus or probe moved accordingly responding to the surface roughness along the short line to the spot. These movements were converted into electric signals, which were amplified, filtered, and converted into digital signals by an A/D converter of the tester. The digital signals were then refined in the main processor of the tester and the measured Ra values displayed continuously on a digital readout of the tester. The reading at or near the earmarked spot was noted and recorded. This procedure was repeated for every earmarked spot on all the painted samples. The tester had a measuring range of 0.03m to 6.35m for Ra values and 0.2m to 25.3m with a resolution of 0.01m for Rz values, a maximum stylus force of 15.0mN, a piezoelectric probe, a diamond stylus tip radius of 2 microns, a 3-digit LCD, a piezoelectric pick-up stylus for external surfaces, a diamond tip of 2 microns, and a calibrating rectangular piece according to the ISO 5436-1 2001 standard.

With the obtained surface roughness measurements, the average value of each paint-finished sample A, B, C, and D were evaluated following equation 1 (BS EN ISO 4287, 2000; Whitehouse, 2012., Saseendran and George, 2018):

$$R_a = \frac{1}{n}\sum_{i=1}^{i=20}(R_{ai}) \qquad (1)$$

Where n = 20 was the total number of points on each sample and Rai was the ordinate of the individual points of the effective profile taken from the mean line within the sampling length.

The average (R_z) of the measured vertical distances from the highest peak to the lowest valley (R_{zi}) (within the sampling lengths) was determined according to equation 2 given as (BS EN ISO 4287, 2000; Whitehouse, 2012., Saseendran and George, 2018):

$$R_z = \frac{1}{n}\sum_{i=1}^{i=n}(R_{zi}) \qquad (2)$$

Where n = 20 was the number of sampling lengths. The root mean square or the square root of the mean square (R_q) of the measured R_{ai} values for each painted sample A, B, C, and D was determined according to equation 3 given as (BS EN ISO 4287, 2000; Whitehouse, 2012.,Saseendran and George, 2018):

$$R_q = \sqrt{\frac{1}{n}\sum_{i=1}^{i=n=20}{R_{ai}}^2} \qquad (3)$$

The skewness (R_{sk}) (a measure of the asymmetry of the probability distribution of the measured R_{ai}values) of each of the painted samples (A, B, C, and D) was determined according to equation 4 given as (BS EN ISO 4287, 2000.,Saseendran and George, 2018).

$$R_{sk} = \frac{1}{{R_q}^3}\left[\frac{1}{n}\sum_{i=1}^{i=n}{R_{ai}}^3\right] \qquad (4)$$

The kurtosis (R_{ku}) of the measured R_{ai} values for each painted sample (A, B, C, and D) was determined to measure the peakedness of the probability distribution of the R_{ai}values on the samples. This was determined according to equation 5, given as (BS EN ISO 4287, 2000., Saseendran and George, 2018).

$$R_{ku} = \frac{1}{{R_q}^4}\left[\frac{1}{n}\sum_{i=1}^{i=n}{R_{ai}}^4\right] \qquad (5)$$

The measured Rai values on the four samples were used to conduct analysis of variance (ANOVA) using the F statistical distribution at 95 % confidence level that is at the α = 5% significance level using the following two hypotheses;

1. H_0: The Rai values on the painted samples by the spray painters and PANare equalso by comparison their meanvalues are the sameamong the painters and PAN, against the alternative hypothesis.
2. H_1: The Rai valueson the painted samples by the spray painters and PAN are not equal soby comparisontheirmean values are not equal.

The choice between the two hypotheses was then made by comparing the value for the alternative hypothesis, which was derived from equations 7–11 by Microsoft Excel tools for variation in the paint-finish roughness among j = 1-4 with the value obtained from the null hypothesis, determined from equation 6. The choice was to accept the alternative hypothesis and reject the null hypothesis if the latter was shown to be true (Anderson, 2019).

$$F_0 = F(\alpha, k-1, N) \qquad (6)$$

For which k = 4 is the number of painters including PAN and N =20 is the number of data values collated for each painted sample (Anderson, 2019).

$$SSB = \sum_{j=1}^{j=4} n_j\left(\overline{Ra}_{ij} - \overline{Rai}\right)^2 \qquad (7)$$

Where; SSB = the sum squares between treatment, n_j = 20 = the collated surface roughness data valuesfor the sample painted at painter j and PAN, $\overline{Ra_i}$= the mean for all the collated Rai data values from the individual painter j and PAN, and $\overline{Ra}_{ij}$ = mean of the collated Ra_i values in $j = 1-4$ (Anderson, 2019).

$$SSE = \sum_{i=1}^{i=20}\sum_{j=1}^{j=4}\left(Ra_i - \overline{Ra}_{ij}\right)^2 \qquad (8)$$

$$MSB = \frac{SSB}{k-1} \quad \text{(Anderson, 2019)} \qquad (9)$$

For which $k-1$ is the degree of freedom for the number of painters including PAN.

$$MSE = \frac{SSE}{N-k} \quad \text{(Anderson, 2019)} \qquad (10)$$

For which; SSE= sum square of errors, $N-k$ is the degree of freedom for all the measured total Rai values in j =1-4.

$$F_1 = \frac{MSB}{MSE} \qquad \text{(Anderson, 2019)} \quad (11)$$

3.0 RESULTS AND DISCUSSION

3.1 Results

Results of the measured surface roughness in terms of R_a values at 20 different points on samples A, B, C, and D are shown in Fig. 1, while Fig. 2 depicts the R_z values for the corresponding points i = 1 to 20 on the samples. The mean square surface roughness on samples A, B, C, and D is depicted in Fig. 3. The averages of the R_{ai}, R_{zi}, and R_{qi} surface roughness values for the 20 points on each sample are shown in Fig. 4. The evaluated surface roughness skewness and kurtosis values for the four samples are shown in Figs. 5, and 6 respectively, while their average values for the four samples are depicted in Fig. 7. The result for the analysis of variance (ANOVA) using the surface roughness (Rai) values depicted in Fig 1 and equations 6-11 is shown is shown in Table 1.

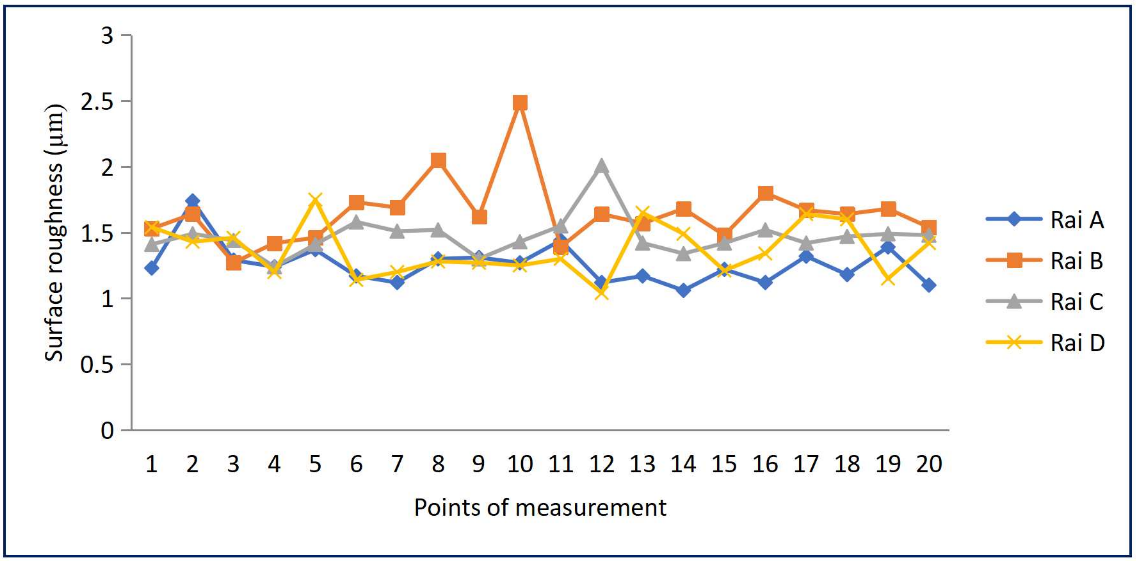

Fig.1: Measured Rai surface roughness values at different points on the paint-finished samples A, B, C, and D

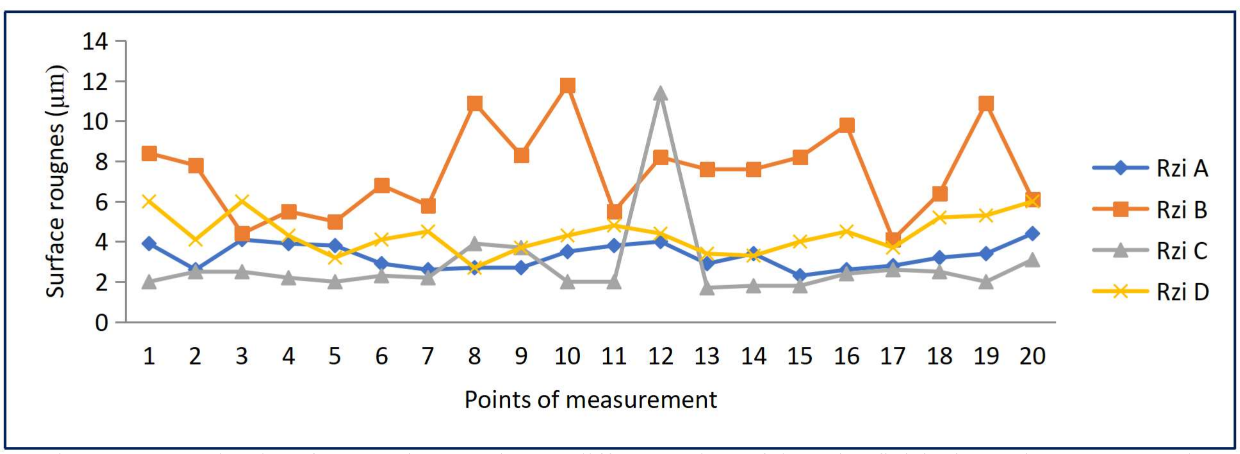

Fig. 2: Measured Rzi surface roughness values at different points of the paint-finished samples A, B, C, and D

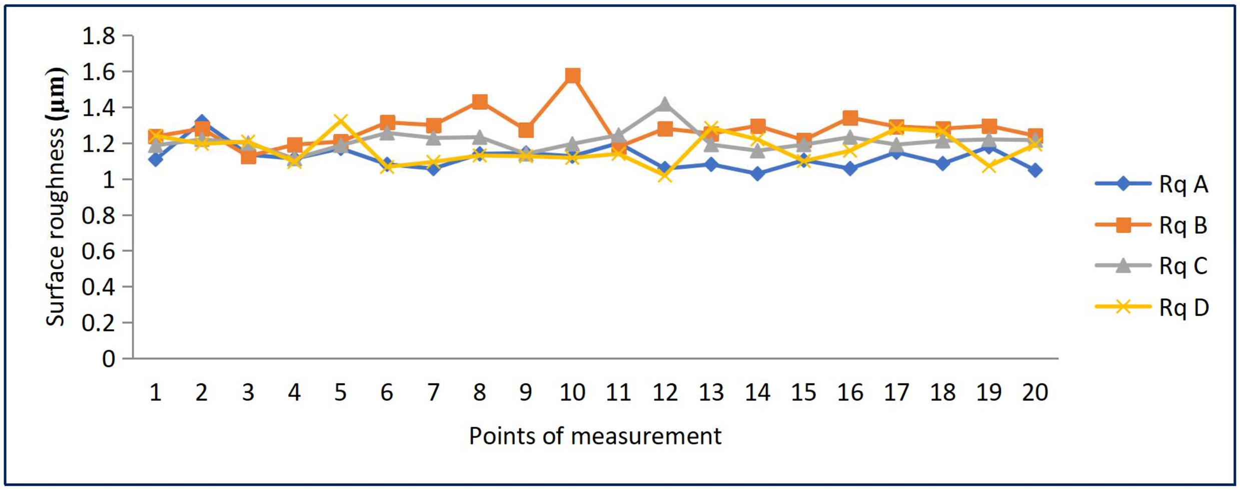

Fig. 3: The mean square surface roughness of samples A, B, C, and D

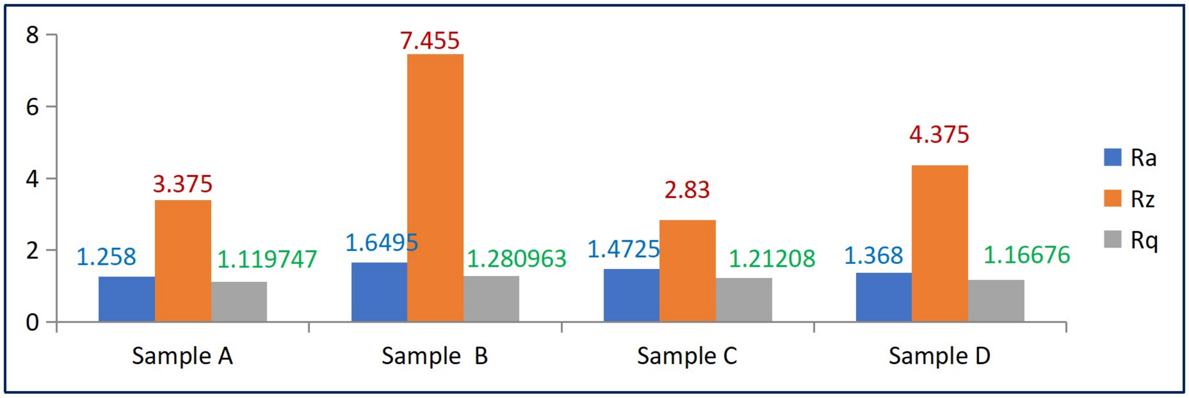

Fig. 4: Computed averages of Rai, Rzi, Rqi surface roughness on samples A, B, C, and D

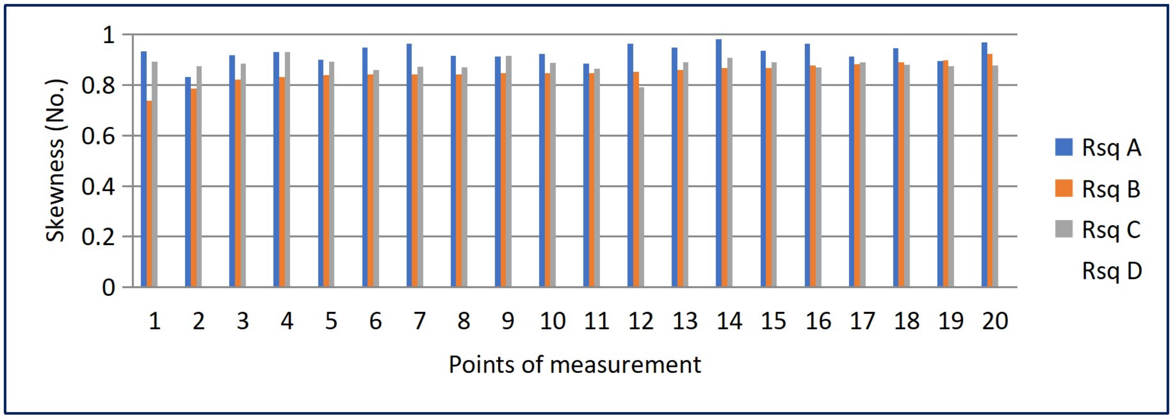

Fig. 5: Degree of skewness of surface roughness measured at the points on samples A, B, C, and D

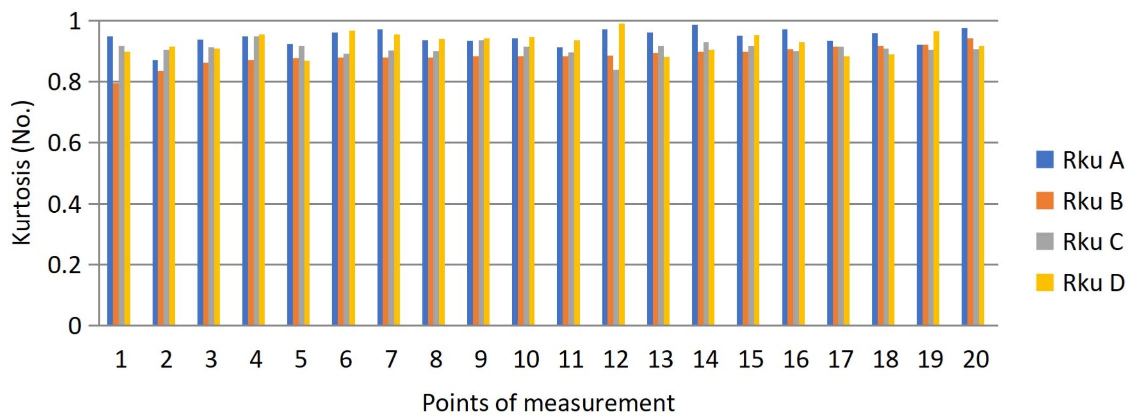

Fig. 6: Kurtosis of the measured surface roughness on samples A. B, C, and D

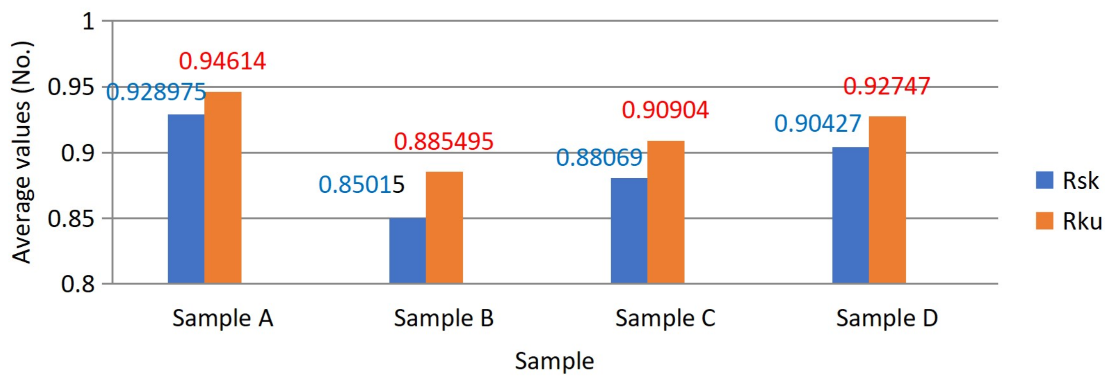

Fig. 7: Average skewness and kurtosis of the measured surface roughness on samples A. B, C, and D

Table 1: Evaluated statistical parameters for ANOVA test by hypothesis

Statistical parameter	Calculated value
F_o	3.2389
SSB	1.20549899
SSE	3.429792
K-1	3
N-K	16
MSB	0.4018330
MSE	0.214382
F1	1.874378

3.2 Discussion

Fig. 1 indicates that the surface roughness of the paint-finished samples A, B, C, and D varied randomly from point to point on each surface. As can be observed from Fig. 1, the surface roughness of sample A (from PAN Ltd) is the least, followed by that of sample D (from IBK Motors) and that of sample B (from M.A. Motors) is the highest, as can be observed from Fig. 1. The measured surface roughness values on sample A ranged from 1.06 to 1.74µm, while the values on sample B ranged from 1.27 to 2.05µm. Intermediate in the surface roughness between samples A and B are samples C (from Alsarafa Body Painters) and sample D (from IBK motors), with measured values that ranged from 1.24 to 2.01µm and 1.15 to 1.65 µm, respectively. It can, however, be observed that the surface roughness values of the samples are in close range with one another and with the results from PAN's experience as a factory auto-body painter. The resulting pattern is more or less similar to the measured surface roughness values of the four samples shown in Fig. 2, in which the values for samples A, D, C, and B ranged from 2.6 to 4.4 µm, 2.7 to 6 µm, 2 to 11.4 µm, and 4.1 to 11.8 µm respectively. The same result trend and comparability are exhibited in Fig. 3 by the square root of the mean square of the values of samples A, B, C, and D with values of 1.02956 to 1.31909 µm, 1.0198 to 1.32288 µm, 1.11325 to 1.4177 5µm, and 1.12694 to 1.57797 µm respectively. The result patterns are also upheld by the average values depicted in Fig. 4, such as averages (Ra) of 1.258 µm, 1.368 µm, 1.4725 µm, and 1.6495 µm for samples A, D, C, and B, respectively, as can be observed from Fig. 4.

According to CAB Incorporated, 2021., IIT Kharagpur, 2021., and the process chart by Engineering Toolbox (2008) shown in Fig. 8, the best-known engineering processes that produce minimal average surface roughness (Ra) with ranges of values include precision turning 1.25 to 12.50 µm, reaming 0.8 to 3.2 µm; precision grinding 0.90 to 1.6 µm; honing 0.13 to 1.25 µm; polishing 0.1 to 0.4 µm; lapping 0.08 to 0.25 µm; and super finishing 0.01 to 0.25 µm.

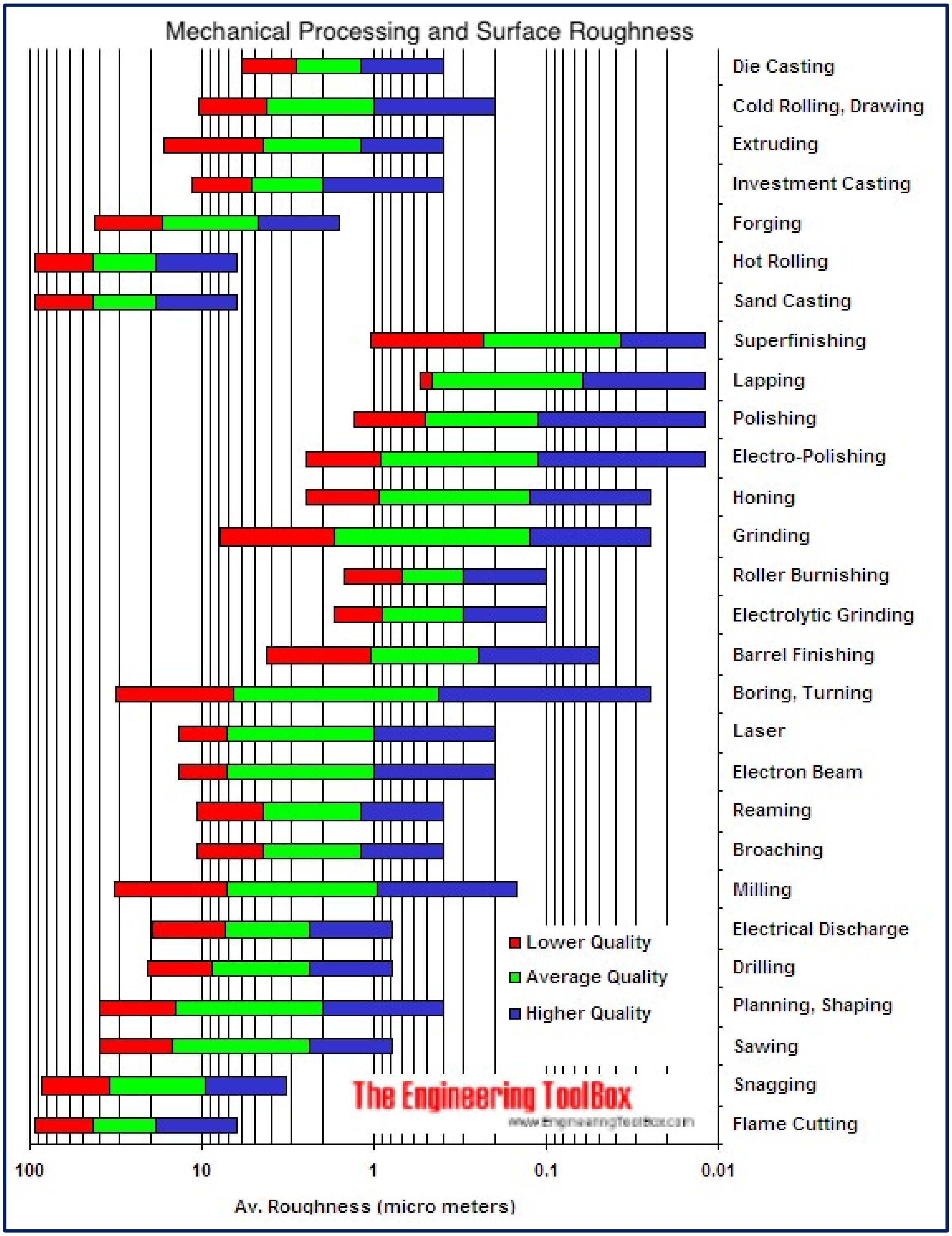

Fig. 8: Chart of the achievable average surface roughness (Ra) range values from the various finishing processes in engineering (Engineering Toolbox, 2008)

From these, it is evident that the average surface roughness (R_a) values of 1.258 µm, 1.368 µm, 1.4725 µm, and 1.6495 µm for samples A, D, C, and B, respectively, are comparable to what is obtainable from precision grinding and honing processes and are within values considered as high surface finishes. This is upheld by the work of Guma and Gana (2020), who show that the paint finishes of the surfaces by the spray painters are of a high gloss standard, falling within the 70–90% gloss level.

Figs. 5 and 6 respectively show the degree of skewness and Kurtosis as measures of the degree of symmetry in the Rai surface roughness profile distributions on samples A, B, C, and D about their midlines or average value. From Fig. 5, it can be observed that there are more or less symmetric distributions or zero skewness of the surface roughness profiles of samples A, B, C, and D about their midlines. This indicates that the distribution of the measured surface roughness values on samples A, B, C, and D is not characterized by excessive peaks and valleys, about a flatter average according to Ba et al, (2021). On the other hand, the kurtosis (Rku) depicted in Fig. 6 describes the likelihood of the profile flattening. According to Ba et al. (2021), a kurtosis value below 3 (platykurtic) represents non-Gaussian surfaces with relatively flat peaks and valleys, whereas a kurtosis value above 3 (leptokurtic) represents abrupt peaks and valleys. It can therefore be seen from Figs. 6 and 7 that the kurtosis values of the measured surface roughness values on samples A, B, C, and D are all less than 1. This indicates that the surfaces of the samples are characterized by relatively flat peaks and valleys (Ba et al, 2021).

It can be seen from Table 1 that F_o is greater than F_1 so the alternative hypothesis that the surface roughness (Rai) values on the painted samples by the spray painters and PAN are not equal so by comparison their mean values are not equal is rejected against the null hypothesis that the Rai values on the painted samples by the spray painters and PAN are equal so by comparison their mean values are the same among the painters and PAN (Anderson, 2019).

4.**CONCLUSION**

The surface roughness of paint-finished cold rolled mild steel sheet as an auto-body material by three top artisanal auto-body spray painting enterprises named MA Motors, Alsarafa Body Painters, and IBK Motors in Kaduna metropolis in Nigeria has systematically been investigated. Measured and analyzed surface roughness values of the paint finishes relative to values obtained from the painted steel sample at Peugeots Automobile Nigeria Plc as a standard factory auto-body painter in Nigeria and engineering standards indicate that the paint finishes by the spray-painting outfits are of a high quality that is comparable to what is obtainable from a precision grinding process. The paper aims to provide insight into the aesthetic quality of auto-body paint finishes by the enterprises and general useful food for thought information on quality control in the auto-body spraying business in Nigeria.

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