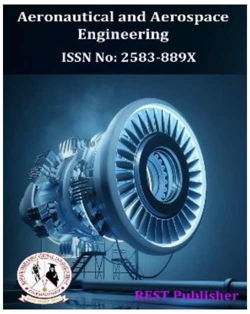
Aeronautical and Aerospace Engineering
Vol: 1(3), September 2023
REST Publisher; ISSN: 2583-889X (Online)
Website: http://restpublisher.com/journals/aae/
DOI: https://doi.org/10.46632/aae/1/3/4



Strength of Processed Aluminium Laminates using the SPSS Method

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Abstract. *Technological advancements in the lamination industry have led to many different ways to laminate paper. Some processing approaches include adhesive gluing, nice and warm lamination, extraction plastic laminate, and flame lamination. Whether you're using thin, shiny metal foil, wrapping food, or covering a protective head, if you're on the US side of the Atlantic you might call it aluminum foil, and you might call it aluminum foil. Europe side (or near another sea entirely). The tensile strength for pure aluminium is approximately 90 MPa, although it can reach over 690 MPa for some heat-treatable alloys. The yield strength of pure aluminium is 7–11 MPa, whereas the yield strength of aluminium alloys ranges from 200–600 MPa. Aluminum can be drawn and extruded readily because it is 50–70% more ductile than steel. For instance, laminated films are used in point-of-purchase (POP) displays, ID badges, flexible packaging, and ham wrapping. To improve product integrity, adhesive foil laminated is applied to a range of substrates, including polyester, polypropylene, and polyethylene. Aluminum alloy 1235, which has a minimum percentage of 99.35%, is now the most popular foil alloys on the market. It is the perfect alloy for a number of industrial including food service businesses due to its extraordinarily high aluminium content.***:** *In order to increase the adhesion between the aluminium alloy sheet and the glass fibre reinforced polypropylene layer, this work deals with plasma chemical treatment of the aluminium alloy AA6061-T6. A surf test and a correspondence goniometry were used to assess the mechanical characteristics and wettability, while SEM combined XPS and EDS were used to analyse the paper presents the experimental and topology of the aluminium alloy sheet. Additionally, Al/GF/PP laminates' static performance and interlaminar characteristics were assessed independently. The outcomes showed that the laminates with the aluminium alloy sheet changed by nitrogen surface modification for 10 minutes had higher mechanical properties. This is caused by a mechanism that combines chemical and mechanical bonding of the carbonyl groups and mechanical bonding of the aluminium alloy sheet to the layer of glass fibre reinforced polypropylene with a rough surface (CeN and C]N). In contrast to phosphoric anodic oxidation, nitrogen surface treatment of aluminium alloy sheets can result in interlaminar shearing. Laminates made of aluminium, gf, and pp have outstanding static and mechanical properties. Ratio studies are statistical analyses of data from appraisals and property valuations. Nearly all states utilise them to produce quantitative measure of the proportion of current market price about which individually estimated taxable property is appraised as well as to offer assessment performance indicators. Evaluation parameters taken as Fiber orientation (°), Fiber content (%), Density (g/cm3), Thickness(mm) and Tensile strength (MPa). The Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .658 which indicates 66% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis. Strength of Processed Aluminium Laminates Characteristics of sisal fiber the Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .658 which indicates 66% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.*
Keywords: *Fiber orientation (°), Fiber content (%), Density (g/ cm3), Thickness (mm) and Tensile strength (MPa).*

1. INTRODUCTION

Extrusion, rolling, and annealing are used to create aluminium laminates having an inner coarse coating and an outward fine layer. Surface morphology attract more attention such as interfaces spacing, misorientation, and texture were generated across the hetero-interface by altering the post-annealing regimes, leading to blatant mechanical discrepancies. Tensile tests revealed that rolling and extrusion were used to create aluminium laminates with only a dense - graded (CG) plate sandwiching two ultrafine-grained (UFG) plates. The microstructural variations between the block layers were then controlled by varying the annealing temperature (150–400 °C) and time (10–60 min). The laminates were able to combine high strength and high ductility in a manner that was better than that predicted more by Rule-of-Mixture (ROM) [1] by adopting an appropriate annealing regime. Processed metal alloy laminates made in the current investigation follow a pattern comparable to laminates made of dissimilar metals that were reported in Refs. This essentially shows that the starting strength and hardening behaviour of the block materials determine how the microstructure evolves for various alloy laminates throughout ARB processing [2]. Carbon-fiber sturdy steel laminates

(CFRMLs) containing aluminium sheets and fibre composite prepreg have had their mechanical property profiles examined. Investigations have been done into the mechanical properties of carbon-fiber-reinforced aluminium hybrid composites (CFRMLs) in profiles of deferraluminum sheets and fibre composite prepreg. Two alternative aluminium surface treatments, one employing a normal P2-Etch process and the other with a modified FPL-Etch technique that included a silane coupling agent, were used to achieve differences in adhesive bonding. Interfacial fracture energy was measured using double-cantilever beam (DCP) experiments, and the latter technique resulted in an up to six-fold increase in interfacial fracture toughness. The failure behaviour and fractured mechanisms of CFRMLs were investigated using laser and scanning electron microscopy. Mechanical characteristics of the laminate, such as strength properties and Young's modulus, showed no discernible variations [3]. The performance of aircraft alloys has long been enhanced by the aluminium industry. Due to this, commercial aeroplanes are now made out of high toughness 7xxx alloys, high radiation tolerance 2xxx alloys, and high strength 6xxx alloys. Although the aluminium industry continues to create high-performance alloys, optimising the usage of materials is becoming an increasingly fascinating technique to improve the effectiveness of airframe structures [4]. composites made of polymers with aluminium or titanium. The two main standardised FMLs that have received a lot of interest in both study and industry over the past few decades are glass-aluminum-reinforced epoxy and aramid-reinforced aluminium laminates. Aluminum sheets that have been fatigue-fractured can be bridged by stiffened carbon fibres, preventing crack propagation (fiber bridging is not an important factor for FMLs with less stiffened glass fibers). Importantly, when iron layers are cleverly broken in FMLs, fibre bridging becomes a crucial duty. In FMLs that incorporate thin glass buttresses between aluminium and carbon fiberglass reinforced thermoplastic (CFRP) layers, fibre bridging can take place in two vertical orientations and bypass the crack path, preventing corrosion rate of hybrid composites brought on by electrostatic interactions between carbon and aluminium. hydrothermal circumstances [5]. laminates that have aluminium layers outside of the CFRP layers. To forecast the CAI responsiveness of these laminates, numerical simulations were run using the LS-Dyna finite element (FE) code, which is commercially available. For the CARALL-A and CARALL-B FMLs, the bending moment strength as well as removal area results exhibited strong agreement between experiment and FEA results at low energy levels (14J-21J), but were inconsistent at good impact energy levels (31J). It was discovered that numerical modelling could accurately depict the beginning and location of compressive cracking in the samples [6]. Plates of processed pure aluminium can benefit from further AR. They discovered that the samples forced to submit to ARB investigated the metallographic evolution and mechanical behavior through continuous reshaping after cold rolling. They also looked into the impact of subsequent cold working mostly on thermal stability of Al-Fe-Mn-Si films that had undergone ARB processing. Pure Al sheets with ARB processing were exposed to CR [7]. Laminated aluminium is superior to materials reinforced with glass or aramid fibres. Adhesion between composite laminates and aluminium foil is a significant problem for total laminate performance, in addition to the significance of matrix reinforcement and matrix especially polymer composites. This subject has been the subject of extensive inquiry. The most popular surface treatment technique currently utilised to enhance the functionality of aluminium alloy surfaces is sulfuric sodium borohydride etching (SCAE). To guarantee a strong mechanical bond here between adhesive and the aluminium surface, the aluminium alloy must first get a suitable amount of surface treatment. The aluminium surface can be treated with SCAE and reaction products anodization (CAA) to make it ready for bonding [8]. The first ARB cycle shows a metal laminate stacking sequence where titanium and aluminium are bound together. The chromium layer subsequently rolled to create the outer layer while the aluminium surfaces being wire brushed and piled in the second cycle. The tungsten layers were added during the subsequent cycles. Up to 4 cycles were covered by the ARB procedure. In combination to titanium-aluminum laminates, titanium grade 1 and mono-material aluminium AA2024 were ARB treated. Alumina is stretched up to four cycles (N4) and titanium up to seven cycles (N7) [9]. Strength can maintain the structural integrity of microelements. In addition, their strength and ductility of films generally decrease with thickness due to size effect. The manufacture of aluminium laminated foil utilising a combination technique of accumulation rolling bonding (ARB) as well as asymmetric rolling is described in this work (AR). It was discovered to increase ductility and strength. The laminate structures created by ARB have perovskite grains and just a randomized microstructure with anomalous coarseness in part of the grains during AR processing, according to TEM data [10]. As the ARB process the aluminum matrix undergoes high cycles, the mechanical properties and binding strength between it metal layers are significantly impacted by the hybrid composite (IMC) layers, which are generated between the members as during grinding machine and thermal annealing. In order to further application, it is crucial to understand how thermal annealing affects the mechanical attributes of metal-metal alloys [11]. Their durability and widespread use in commercial aero planes. On the other hand, during processing, bonding between aluminum layers is encouraged by Al 1050's high ductility. Therefore, the purpose of this study is to examine how the elements of roll-bonded laminates treated using comparable strain routes affect fracture mechanisms and increase impact toughness [12]. resistance to both high and low temperatures, as well as its large specific elastic stiffness. Typical aluminium MMCs supplemented with particles have low room temperature ductilities that are susceptible to particle fracturing and particle-matrix interactions. These low ductilities are generally 2% to 5% of the elasticity of the hard composite material (SiC or A1203), which is typically 20%. deformation contributes to premature fracture from [13]. By using three-point bending and cheap and effective tests, the influence of strength on the morphological behaviours of carbon fiber-reinforced aluminium laminate (CARALL) was examined. To achieve various interfacial bond strengths, AA6061 sheets were treated to surface preprocessing under three situations (surface treatment and A-187 and A-1387 contact modifications). Scanning electron microscopy, raman spectroscopy, and X-ray electron impact spectroscopy were used to examine the attachment interfaces of CARALL. A tension-shear test was used to ascertain the interfacial binding strength between aluminium alloy and epoxy resin. After CARALL's energy absorption capability and failure mode were examined three-point bending under low velocity impact and different aluminum alloy volume contents and surface pretreatment [14]. Reinforced aluminium composites are materials (Aral) and glass fibre reinforced aluminium laminates are two fiber-metal composites that have found use in aeronautical engineering (Clair). For improved impact and fatigue strength, carbon fibre is also used in fibre metal laminates. By analyzing tensile strength, elastic modulus, and fatigue strength, it was determined whether carbon fibre preparation was appropriate for use in fiber-metal laminates. They noticed that when the laminates' thickness increased, their tensile strength, elastic modulus, and residual stress all increased. Additionally, they stated that the rate of crack propagation was two percent lower compared to monolithic aluminium sheet [15]. For one day, mix aluminium titanate powder with a full volume of binder solution. The slurry was then added, along with some dichloromethane to lower the slip stiffness, and ball milled for a further two days. By significantly raising the binder density, lowering the level of dispersion, and cutting the milling period to 6 h, inhomogeneous material was created. The powders were poorly mixed as a result of this technique, and the tape was overly solidified [16]. Especially laminates In the automobile and rail transportation industries, consecutive layers of thin aluminium alloy and glass fibre reinforced thermoplastic (GFRTP) have a lot of potential. These high-performance and inexpensive composite materials are employed to create the crash box in meltdown portions of the front structures of new energy cars and skin systems, as opposed to conventional thermoset-based FMLs like epoxy resin. Autoclaved, thermoplastic (TP)-based FMLs for initial use in the aerospace industry have the advantage of efficient manufacturing, recyclability, and thermos formability [17]. Coated steel and metals alloys both exhibit significantly increased low- and high-cyclic fatigue lives due to the presence of modulus at the material contact. The compressive stress in the inner reinforcing layers lowers the stress inside this outer aluminum layers because of the increased Applied load of the steel/titanium layers. As a result, these composites have stronger suppression of macro-crack start, which increases high-cycle fatigue life. Strongly increased low-cycle fatigue life results from substantial fracture deflection at the delicate layer interface at elevated stress amplitudes [18].

2. MATERIAL AND METHOD

Fiber orientation (°): The performance of the composite in terms of composite mechanical strength is impacted by the fiber orientation in the matrix. Natural fibre reinforced composites' overall look is significantly influenced by the shape, size, and arrangement of the structural components. Composites (FRC) (FRC). The two main parts of the majority of ACMs and FCMs are matrices and reinforcements. In an entire complete muscle, there are five different fibre orientations that could exist: fusiform, unipennate, bipennate, triangular, and strap. The central nervous system's motor programmers are controlled by skeletal muscle (CNS). In (thermo-)mechanical this and for fiber-reinforced composites, fibre orientation tensors are well-established descriptors of fibre orientation states. In this essay, various analysis and parameters of the fourth order orientation tensors and acceptable parameter ranges are presented.

Fiber content (%): The function of the composite both before and after cracking is influenced by the fiber volume fraction (by volume), the ratios of fibre modulus with matrix elastic, and the ratio of fibre strength to matrix strength. From Advanced High-Strength Natural Fiber Composites in Construction Untangle a bunch of threads from another small swatch of fabric. Hold the lump with tweezers (on your flameproof container) and gently move it towards a small flame cluster. Cotton fibers ignite when exposed to flame. Synthetic fibers melt away from heat.

Density (g/ cm3): The ratio of an object's mass to its volume is its density. Grams per cubic centimetre, or g/cm3, are frequently used to measure density. Keep in mind that a cubic centimetre is a volume and a gramme is a measure of mass (same volume as 1 milliliter). A box with some more particles inside it will be denser than a box with fewer. It should be noted that pure water has a density of 1 gramme per cubic centimetre (or g/ml). Water's density is greater as a solution than as a solid, unlike to most other substances. The mass of a substance per unit volume is called its density. d = M/V, where d is thickness, M is matter, and V is volume, is the formula for density. Grams per cubic centimetre are the most common units used to measure density.

Thickness (mm): A millimeter is equal to 1000 micrometers or 1000000 nanometers. Since an inch is officially defined as exactly 25.4 millimeters, one millimeter is exactly 5⁄127 (≈ 0.03937) of an inch. A calliper can be used to gauge the paper's thickness. Between the caliper's jaws is placed a piece of paper or a paper card. Following the clamping of the jaws, their separation is measured. The thicknesses of a sheet can be displayed via digital callipers. A density gauge is a number that represents how thick a specific TML is at a specific moment in time. There are numerous thickness metrics for each TML, including: Measurement at Base the initial TML measurement made. Closest Measurement: The TML measurement that was taken two years ago or less.
Tensile strength (MPa): The force measured in square inch pounds (psi) or complications due (MPa) required to drag a specimen until the material fails is known as tensile strength. A specimen in the shape of a dumbbell is placed in the grips

or mouth of a tensometer to conduct this test. Within English metric units, tensile strengths are typically given in units of grams per square inch, which are sometimes abbreviated as psi.

Method: SPSS Statistics is a statistical control Advanced Analytics, Multivariate Analytics, Business enterprise Intelligence and IBM a statistic created by a software program is a package crook research. A set of generated statistics is Crook Research is for a long time SPSS Inc. Produced by, it was acquired by IBM in 2009. Current versions (after 2015) icon Named: IBM SPSS Statistics. The name of the software program is to start with social Became the Statistical Package for Science (SPSS) Reflects the real marketplace, then information SPSS is converted into product and service solutions Widely used for statistical evaluation within the social sciences is an application used. pasted into a syntax statement. Programs are interactive Directed or unsupervised production Through the workflow facility. SPSS Statistics is an internal log Organization, types of information, information processing and on applicable documents imposes regulations, these jointly programming make it easier. SPSS datasets are two-dimensional Have a tabular structure, in which Queues usually form Events (with individuals or families) and Columns (age, gender or family income with) to form measurements. of records Only categories are described: Miscellaneous and Text content (or "string"). All statistics Processing is also sequential through the statement (dataset) going on Files are one-to-one and one-to-one Many can be matched, although many are not in addition to those case-variables form and By processing, there may be a separate matrix session, There you have matrix and linear algebra on matrices using functions Information may be processed.

3. RESULT AND DISCUSSION

TABLE 1. Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
Fiber orientation (°)	90	4	1	5	282	3.13	.115	1.093	1.196
Fiber content (%)	90	4	1	5	270	3.00	.131	1.245	1.551
Density (g/ cm3)	90	4	1	5	291	3.23	.133	1.264	1.597
Thickness (mm)	90	4	1	5	294	3.27	.119	1.130	1.276
Tensile strength (MPa)	90	4	1	5	297	3.30	.158	1.495	2.235
Valid N (listwise)	90								

Table 1 shows the descriptive statistics values for analysis N, range, minimum, maximum, mean, standard deviation Fiber orientation (°), Fiber content (%), Density (g/ cm3), Thickness (mm) and Tensile strength (MPa) this also using.

TABLE 2. Frequencies Statistics

		Fiber orientation (°)	Fiber content (%)	Density (g/ cm3)	Thickness (mm)	Tensile strength (MPa)
N	Valid	90	90	90	90	90
	Missing	0	0	0	0	0
Mean		3.13	3.00	3.23	3.27	3.30
Std. Error of Mean		.115	.131	.133	.119	.158
Median		3.00	3.00	3.00	3.00	3.00
Mode		3	3	3	3	5
Std. Deviation		1.093	1.245	1.264	1.130	1.495
Variance		1.196	1.551	1.597	1.276	2.235
Skewness		-.429	.321	-.043	-.260	-.098
Std. Error of Skewness		.254	.254	.254	.254	.254
Kurtosis		.047	-.794	-.900	-.198	-1.484
Std. Error of Kurtosis		.503	.503	.503	.503	.503
Range		4	4	4	4	4
Minimum		1	1	1	1	1
Maximum		5	5	5	5	5
Sum		282	270	291	294	297
Percentiles	25	3.00	2.00	2.00	3.00	2.00
	50	3.00	3.00	3.00	3.00	3.00
	75	4.00	4.00	4.00	4.00	5.00

Table 2 Show the Frequency Statistics in Strength of Processed Aluminium Laminates. Fiber orientation (°), Fiber content (%), Density (g/ cm3), Thickness (mm) and Tensile strength (MPa) curve values are given.

TABLE 3. Reliability Statistics

Cronbach's Alpha Based on Standardized Items	N of Items
.658	5

Table 3 shows the Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .658 which indicates 66% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.

TABLE 4. Reliability Statistic individual

	Cronbach's Alpha if Item Deleted
Fiber orientation (°)	.587
Fiber content (%)	.656
Density (g/ cm3)	.536
Thickness (mm)	.591
Tensile strength (MPa)	.614

Table 4 Shows the Reliability Statistic individual parameter Cronbach's Alpha Reliability results. The Cronbach's Alpha value for Fiber orientation (°) .587, Fiber content (%).656, Density (g/ cm3) .536, Thickness (mm) .591 and Tensile strength (MPa) .614 this indicates all the parameter can be considered for analysis.

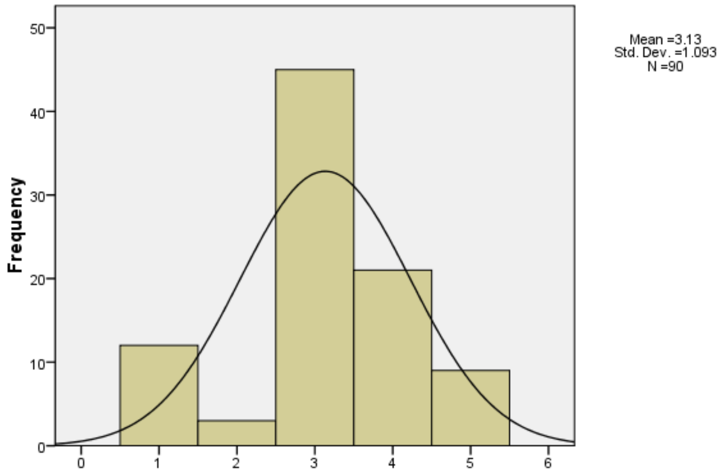

FIGURE 1. Fiber orientation (°)

Figure 1 shows the histogram plot for Fiber orientation (°)from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Fiber orientation (°)except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

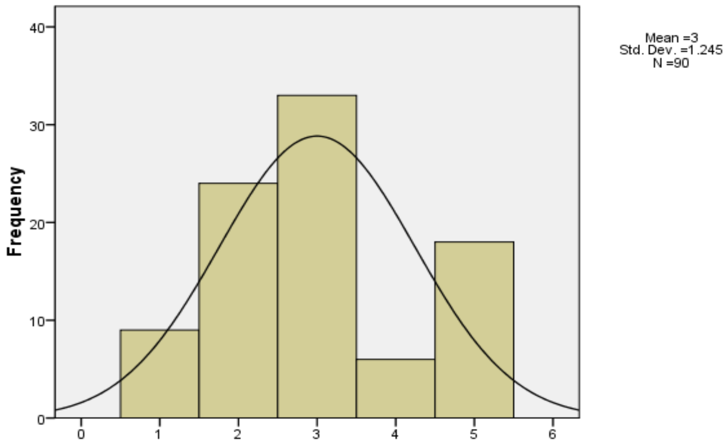

FIGURE 2. Fiber content (%)

Figure 2 shows the histogram plot for Fiber content (%) from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Fiber content (%) except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

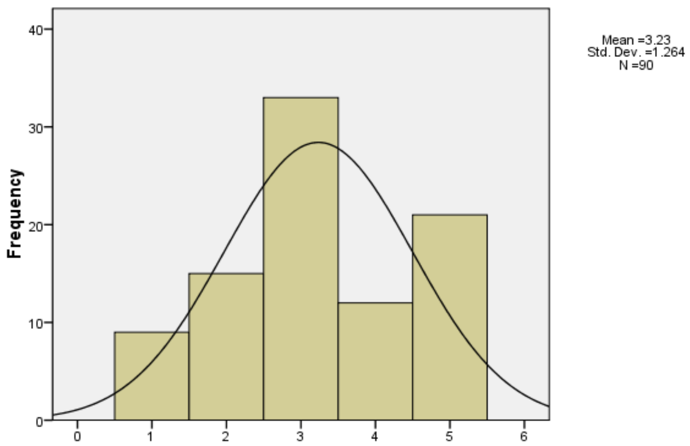

FIGURE 3. Density (g/ cm3)

Figure 3 shows the histogram plot for Density (g/ cm3)from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Density (g/ cm3)except the 3 value all other values are under the normal curve shows model is significantly following normal distribution.

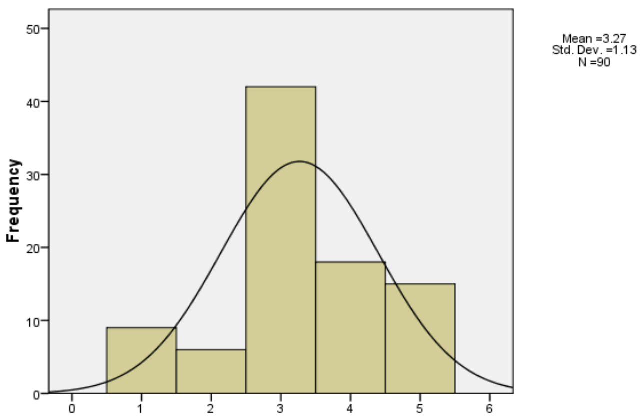

FIGURE 4. Thickness (mm)

Figure 4 shows the histogram plot for Thickness (mm)from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 3 for Thickness (mm)except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

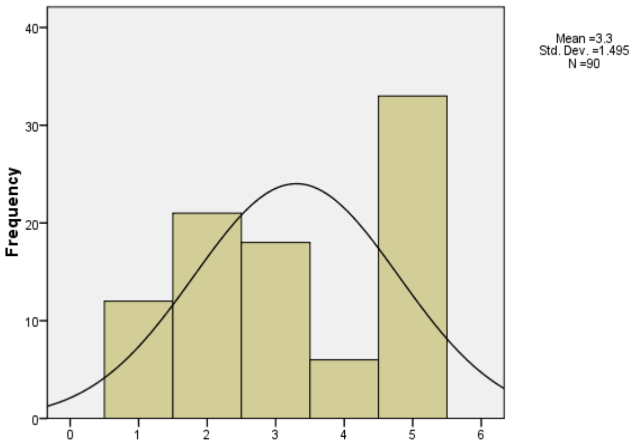

FIGURE 5. Tensile strength (MPa)

Figure 5 shows the histogram plot for Tensile strength (MPa)from the figure it is clearly seen that the data are slightly Right skewed due to more respondent chosen 5 for Tensile strength (MPa)except the 2 value all other values are under the normal curve shows model is significantly following normal distribution.

TABLE 5. Correlations

	Fiber orientation (°)	**Fiber content (%)**	**Density (g/ cm3)**	**Thickness (mm)**	**Tensile strength (MPa)**
Fiber orientation (°)	1	.149	.368**	.407**	.264*
Fiber content (%)	.149	1	.214*	.096	.290**
Density (g/ cm3)	.368**	.214*	1	.499**	.319**
Thickness (mm)	.407**	.096	.499**	1	.172
Tensile strength (MPa)	.264*	.290**	.319**	.172	1
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

Table 5 shows the correlation between motivation parameters for Fiber orientation (°). For Thickness (mm)is having highest correlation with Fiber content (%)and having lowest correlation. Next the correlation between motivation parameters for Fiber content (%). For Tensile strength (MPa)is having highest correlation with Thickness (mm)and having lowest correlation**.** Next the correlation between motivation parameters for Density (g/ cm3). For Thickness (mm)is having highest correlation with Fiber content (%)and having lowest correlation**.** Next the correlation between motivation parameters for Thickness (mm). For Density (g/ cm3) is having highest correlation with Fiber content (%)and having lowest correlation**.** Next the correlation between motivation parameters for Tensile strength (MPa). For Density (g/ cm3) is having highest correlation with Thickness (mm)and having lowest correlation**.**

4. CONCLUSION

Technological advancements in the lamination industry have led to many different ways to laminate paper. Some processing approaches include adhesive gluing, nice and warm lamination, extraction plastic laminate, and flame lamination. Whether you're using thin, shiny metal foil, wrapping food, or covering a protective head, if you're on the US side of the Atlantic you might call it aluminum foil, and you might call it aluminum foil. Europe side (or near another sea entirely). chemical treatment of the aluminium alloy AA6061-T6. A surf test and a correspondence goniometry were used to assess the mechanical characteristics and wettability, while SEM combined XPS and EDS were used to analyse the paper presents the experimental and topology of the aluminium alloy sheet. Additionally, Al/GF/PP laminates' static performance and interlaminar characteristics were assessed independently. The outcomes showed that the laminates with the aluminium alloy sheet changed by nitrogen surface modification for 10 minutes had higher mechanical properties. The performance of the composite in terms of composite mechanical strength is impacted by the fibre orientation in the matrix. Natural fibre reinforced composites' overall look is significantly influenced by the shape, size, and arrangement of the structural components. Composites (FRC) (FRC). The two main parts of the majority of ACMs and FCMs are matrices and reinforcements. The function of the composite both before and after cracking is influenced by the fiber volume fraction (by volume), the ratios of fibre modulus with matrix elastic, and the ratio of fibre strength to matrix strength. From Advanced High-Strength Natural Fiber Composites in Construction Untangle a bunch of threads from another small swatch of fabric. The ratio of an object's mass to its volume is its density. Grams per cubic centimetre, or g/cm3, are frequently used to measure density. Keep in mind that a cubic centimetre is a volume and a gramme is a measure of mass (same volume as 1 milliliter). A box with some more particles inside it will be denser than a box with fewer. A millimeter is equal to 1000 micrometers or 1000000 nanometers. Since an inch is officially defined as exactly 25.4 millimeters, one millimeter is exactly 5⁄127 (≈ 0.03937) of an inch. A calliper can be used to gauge the paper's thickness. Between the caliper's jaws is placed a piece of paper or a paper card. The force measured in square inch pounds (psi) or complications due (MPa) required to drag a specimen until the material fails is known as tensile strength. A specimen in the shape of a dumbbell is placed in the grips or mouth of a tensometer to conduct this test. Ratio studies are statistical analyses of data from appraisals and property valuations. Nearly all states utilise them to produce quantitative measure of the proportion of current market price about which individually estimated taxable property is appraised as well as to offer assessment performance indicators. The Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is .658 which indicates 66% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.

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