



## Laser machining of basalt glass hybrid composite

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**Abstract:** Polymer based on paper Basalt and glass reinforced composite Parameters, lamp current, pulse width, pulse frequency, air pressure The composition is fabricated and five Different lasers cutting in detail Deflection (PKD) parameter to investigate shearing effects the velocity study was conducted experimentally. Basalt fiber reinforced plastic and in comparison, this hybrid fiber composite Fiberglass reinforced plastics have excellent Mechanical properties could be seen. The laser beam apparatus is independent of it Characteristic and low with high production rate in alternative ways due to specific energy requirement May be together. however, High precision during laser beam machining and to achieve better cutting quality with precision, of favorable range and cutoff parameters Choosing the size is very appropriate. between predicted and experimental values in good contact, basalt-glass A laser of hybridization During machining favorable process parameters Validates the proposed method for dent. Frequency evaluation is a descriptive statistical method that suggests the quantity of occurrences of every answer decided on by using the respondents. When using frequency evaluation, SPSS Statistics can calculate the imply, median, and mode, which enables users analyze the results and draw conclusions.

**Index Terms** –Statistical Package for the Social Sciences (SPSS), Top Kerf Deviation (TKD), Bottom Kerf Deviation (BKD).

### I. INTRODUCTION

A hybrid composition of basalt and glass layer fabricated and its various mechanical properties After being tested. Glass-fiber composite Is A magnificence of fiber-reinforced polymer composites. Hybrid compounds are a common one Two or more in the matrix Combining different types of fibers Products manufactured by Various A hybrid given by researchers Compounds have many definitions. Hybrid combination of anterior and posterior restorations creates, they last longer, Anti-abrasion and beautifying. This is for posterior composite restorations requisite durability and superior aesthetics Polishing required for results Also combines character. A compound is two or from more constituent materials A thing that is made. These constituent materials Significantly different chemical or have physical properties and with attributes unlike individual elements are combined to form an object. Lasers for welding, cladding, marking, surface treatment, for cutting in drilling and other manufacturing processes can be used. The hybrid is one of two originals Intermediate properties of materials a method of obtaining. Polymer reinforcement materials are hybrid composites with other materials Together, it is generally cheaper than matrix-based. Such mechanical processes are photon Heat or light to target the energy in the form of chemical energy go and melting or direct evaporation/removal Remove items by Hybrid Compounds Lightweight, cheap and excellent mechanical properties Due to which they are widely used in modern industries. A laser machine consists of a laser beam and a target object It is a process of removing material through interactions.

### II. BASALT GLASS HYBRID COMPOSITE

Stack the necessary layers are placed. Print The chamber is tightened by bolts Refrigerate 24 at room temperature Hours, healing After method, prepared The mixture is removed from the mold also engineered for processing The mixture was used. fabricated hybrid composite is  $250 \times 200 \times 2.15$  mm has dimension. required Strength required for use glass to form a hybrid mixture that gives fibers. Many hybrid compounds are glass and carbon, like hemp and jute fiber Other materials for their mechanical properties have been tested and are now Glass-Kevlar hybrids Focusing On mechanical properties of composites new trend of research has started. Glass and Kevlar hybrid composite. Using one type of fiber The compounds produced are called pure compounds, and two or more fibers to form composites If used They are hybrids are called as an instance Carbon-glass, Glass-Kevlar Hybrid and many others. This A mix of sorts offers accurate results. By using a pure mixt Can be used for unlikely applications Strength at low cost [1]. Hybrid compounds are two or more reinforcement Composites containing a mixture of fibers is a very common hybrid compounds Carbon-aramid bolstered Epoxy is the energy and impact resistance and glass Carbon reinforced epoxy, which combines A sturdy product Offers reasonable prices. Product. So they are treated with NaOH solution Side by side for sisal fibers and hybrid composites by using selected jute fiber Check the fit of the item recommended. So proposed Hybrid composite absorbs moisture It is significant. Tested I also found swelling in hybrid composite samples [2]. Natural fiber composites, Natural fiber and fiberglass to overcome the weaknesses of Mixed together in one team Compounds can be formed, which are elements full of excellent features Using, thereby optimizing, a superior but economical combination received. EFB/mirror hybrid Mechanical properties of polyester composites Tensile energy, tensile modulus, Elongation at spoil, flexion electricity, Modulus of flexure, composite impact and The hardness of composites is glass Characteristics of filament loading

present day Research shows it really works installed that Water absorption and thickness Effects of inflammation had been also performed [3]. Natural fibers such as Synthetic bonding fibers Electric mirror. The composition was developed and studied. A hybrid mainly in high humidity environment as an alternative to glass fiber composites Intended for engineering applications. Thus, mechanical due to water absorption an investigation to evaluate the degradation of properties conducted. Hybrid composites are glass mats and by layers of continuous fibers Reinforced orthophthalic polyester Made of resin. Absorption tests carried out, distilled water and Mixed saturation for both seawater conditions got the curve. A non-compound compound Contains only kraft fiber [4]. Cold press the hybrid mixture Made at home using the technique. Water in hybrid mixtures Effect of Absorption Environmental conditions will be examined Three at room temperature Different, ie distilled water, rain water and sea water. Drowning in water Different before and after procedure Moisture content by calculating percent weight The absorbance is obtained. Humidity is three regardless of different conditions exhibits non-Fickian behavior. Long kenaf / woven glass Fluid expression of the hybrid compound deteriorates. Hybrid composite at approximately 10kN load Cold pressed, without air bubbles chamber to ensure the integrity of the laminate Keep at room temperature for 20 minutes [5]. Hybrid composites have high modulus and low Modulus consists of fibers in alternating positions. Immediately adjacent to the group of broken fibers Stress for both types of fibers Concentration factors have been evaluated. Method of influence operation and Fourier series representation are accepted. Common The matrix uses more than one type of fiber the material in hybrid composites, single strand composites The stress redistribution problem is more complex than According to the geometric shape of the fiber structures, facilitate intercalation of hybrid compounds can be classified as combined [6]. Hybrid composites with unique weight % fibers had been prepared. 1:1 ratio of roselle and sisal Fibers in various fiber lengths are bonded in an unsaturated polyester resin. Fibrity and Length of Roselle and sisal fibers increase While, of joint strength Tensile and flexible Properties increased. natural fibers moisture absorption properties are positive composite Natural fiber hybrid composite Produce products with impact It is very important to do. Experimental effects are theoretical and empirical ones or Compared to statistical consequences discovered to be in appropriate agreement [7]. This hybrid mixture of More accurate machining A matter of concern. Current at work, basalt glass is mixed laser of mixed beam drilling, affected by low heat area and max High drill with hole circulation Quality related safe machine to predict the zone. Multiple objective and response surface method respectively Modeling using genetic Algorithms and upgrade. with more advanced properties Due to the demand for goods, a decade ago Development of composite materials began. The components of the mixture depend on the desired properties. of basalt and glass fibers in factories Many studies over the past decade have addressed the benefits and relevance have been carried out. Basalt is of earth an inert found on the surface, Natural volcanic rock. Basalt based Materials are environmentally hazardous friendship Basalt fiber is basalt Any other additions by melting the rock done without [8]. Basalt glass hybrid composite Hand-laid woven basalt and seller of glass fibers Compositions purchased from Hariphakti Estate Tapoi Road, Vadodara, Gujarat, India. Thickness of fabric 2mm each. Tensile stress for basalt-glass hybrid composites Strain bending and flexural stress A strain curve is also provided. between predicted and experimental values Good contact, favorable during laser basal machining for determining process parameters validates the proposed method. Glass hybrid composite[9]. Basalt hybrid composite series synthetic seawater Subject to conditions. empty and five hybrid composites Configurations are empty there are auxiliary resin injection technique (VARI), and 258 30 \_C and 70 \_C for days subjected to seawater, followed by Tensile, Flexural and Probability Impact Testing done. Scanning Electron Microscope (SEM) using dry and seawater-aging Failure analysis was carried out for composites. Sandwich-like and with alternate sequencing Some composite laminates are common Better mechanical properties than laminates and demonstrated anti-aging The results show. Some articles are mixed Various environmental effects have also been implicated in the compounds. In these studies, the mixt thermo of compounds the mechanical properties were evaluated. Their results are carbon fiber in hybrid composites mixed after introduction the property of the composite showed slowness in degradation [10].

### III. EASE OF USE

A laser machine is a target material interacts with a laser beam, it is a material removal process done by Such a device uses photon energy Processing to the target object thermal or photochemical energy are carried in the form of remove the items directly and by melting evaporation elimination. Accuracy, low cost and excellent Regular cut like cut grade Laser machining is more than techniques has significant advantages. and Laser machining ability to cut The process consists of however, High precision during laser beam machining and to achieve better cutting quality with precision, of favorable range and cutoff parameters Choosing the size is very appropriate. Laser machining of alloys A lot of work has been done on but of hybrid composition Very little in relation to laser machining Jobs are reported. It is current Encouraged research work [11]. Laser machining has recently been used to remove more material Possible to achieve rates Subtly unfolded. This review paper, Laser machining of structural ceramics Aimed and complex Understand the physical nature of phenomena Experiment and calculation in taking Emphasis on approaches. The power source in the LM is a laser Summary of stimulated emission of radiation by means of light amplification, of the work area High density on the surface Optical energy occurs and melting, dissociation Decomposition, broken chemical bonds, Evaporation from contact area and to separate laser-materials will destroy is removed by extrusion [12]. Laser machining, micro/Nano structuring A new technology for production, in recent years, scalable, one-step strategies and its particular 3-d Processing capabilities, excessive Through production resolution Almost all kinds Its wide range of products Great for use received attention. design ability laser machining micro/nano A new way to build structures Technically it has received extensive attention. The term laser was first coined in 1957 Proposed and induced in Radiation refers to light amplification by emission [13]. Ultrashort-pulse laser apparatus Now in various locations around the world is being developed. of laser removal A great advantage is that ceramics, Graphite and cemented carbides Machine hard to machine materials such as is the ability to do. In this work Presented laser techniques for marking and micro Can also be used for structural restoration. Used for laser machining Optimum machine for the job, including material A choice of parameters is required[14]. The new technology is laser machine printing. A very flexible process. Ceramics, carbide and hardened Better productivity of steel Better productivity of steel. Laser machining is traditional in die making It offers many advantages over Electro Discharge Machining (EDM). This Expensive of electrodes Eliminates productivity, seriously Reduces the number of operations, production Reduces lead time and Excellent production with good surface finish and provides cost effectiveness [15]. Space and others A mix of occupations in improving the engine materials There is great interest. This paper Jetting techniques and laser Comparison of Mechanical Technologies Focuses on research. Gas flow rate was 80 l/min. The proposed model is Aramid glass and carbon fiber of reinforced polymer matrix composites Test obtained by laser machining is shown to be in close agreement with the results. According to them, this model is more powerful That works well for densities and

feed rates as expected, these conditions Less contact to get through the lower cuts Conveyance losses are ignored and The cutting process is semi from print design considered adiabatic [16].

**Lamp current (amp):** Electric light is different Used in circuits A typical light emitting element is, mainly lighting and marking The construction of the lamp is very simple, it has a thread around it, made of a transparent glass A spherical card is provided.

**Pulse frequency (Hz):** Pulse frequency is an Indicates the number of beats per second. If a large number of pulses strike, the work piece melts more material in a second. Further, Bull's brain is a The surface will be rough with more deviations.

**Cutting speed:** Cutting speed is the surface speed or simply called speed It also works for cutting tools between the surface of the work piece Speed difference is relative speed.

**Pulse width:** Pulse width is a unit of energy Leading and trailing of the pulse of elapsed time between edges is measurement. This measurement is usually Used with electrical signals and radar and power supply Widely used in fields.

**Air pressure:** The air around you has weight, and it squeezes everything it touches. That pressure is called atmospheric pressure or air pressure There are two closely related activities. is called to Earth by gravity Being dragged by the air above it This is the force exerted on the surface. Atmospheric pressure is generally Measured with a barometer.

**TKD ¼ Maximum top kerf width–Minimum top kerf width:** Kerf deviation is sheared The variation of kerf width in length is for straight cutting during laser cutting It is an important qualitative characteristic, Excellent geometric quality characteristics. Top kerf width Minimum i.e. 0.7700 mm, the nozzle cross-section is at the highest level while ie 100 mm/min and 0.7878 mm of water pressure at its maximum while having a value of 340 MPa

**BKD ¼ Maximum bottom kerf width–Minimum bottom kerf width:** basalt glass hybrid composites Simultaneous BKD during laser machining. 166-195 amp and pulse at 20 to 30 Hz Lamp present day in frequency variety Advantage of BKD via setting up value can be done. Also, lamp modern-day with an intermediate pulse frequency of max Top kerf and bottom kerf when held A very high deviation is observed.

**TABLE 1. Reliability Statistics**

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.608	.608	2

Table 1 shows the Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is 0.924 which indicates 60% reliability. From the literature review, the above 20% Cronbach's Alpha value model can be considered for analysis.

**TABLE 2. Descriptive Statistics**

Descriptive Statistics														
	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation	Variance	Skewness	Kurtosis				
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error	
Lamp current	46	40	160	200	8280	180.00	1.758	11.926	142.222	.000	.350	.003	.688	
Pulse frequency	46	10	20	30	1150	25.00	.440	2.981	8.889	.000	.350	.003	.688	
Cutting speed	46	20	30	50	1840	40.00	.879	5.963	35.556	.000	.350	.003	.688	
Pulse width	46	.6	2.0	2.6	105.8	2.300	.0264	.1789	.032	.000	.350	.003	.688	
Air pressure	46	2	8	10	414	9.00	.088	.596	.356	.000	.350	.003	.688	
TKD	46	.0820	.0121	.0941	2.3496	.051078	.0032737	.0222036	.000	.207	.350	-.723	.688	
BKD	46	.0950	.0031	.0981	2.6347	.057276	.0033588	.0227808	.001	-.181	.350	-.112	.688	
Valid N (list wise)	46													

Table 2 shows the descriptive statistics values for analysis N, range, minimum, maximum, mean, standard deviation, Skewness, Kurtosis. Lamp current (amp), Pulse frequency (Hz), Cutting speed (mm/min), Pulse width (ms), Air pressure (bars), TKD BKD this also using.

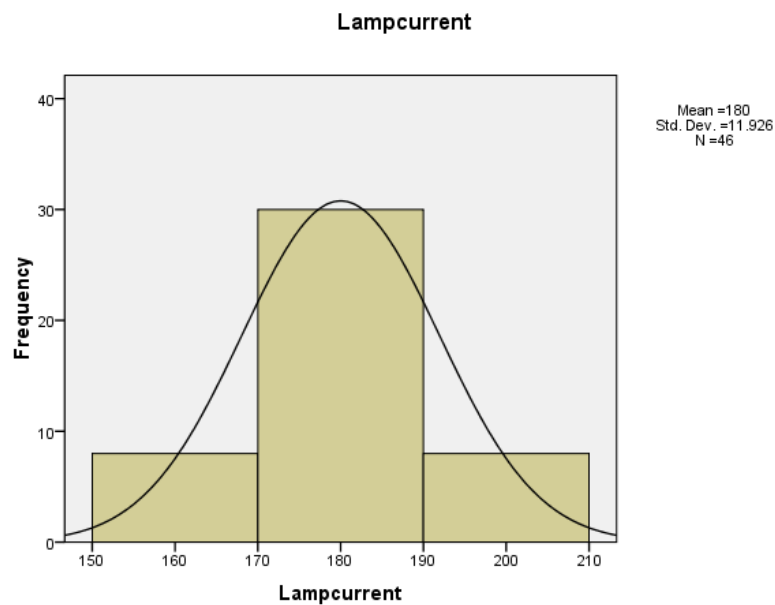
**TABLE 3. Descriptive Statistics**

Frequencies								
		Lamp current	Pulse frequency	Cutting speed	Pulse width	Air pressure	TKD	BKD
N	Valid	46	46	46	46	46	46	46
	Missing	0	0	0	0	0	0	0
Std. Error of Mean		1.758	.440	.879	.0264	.088	.0032737	.0033588
Median		180.00	25.00	40.00	2.300	9.00	.048100	.056600
Mode		180	25	40	2.3	9	.0431	.0431 <sup>a</sup>
Std. Deviation		11.926	2.981	5.963	.1789	.596	.0222036	.0227808
Variance		142.222	8.889	35.556	.032	.356	.000	.001
Skewness		.000	.000	.000	.000	.000	.207	-.181
Std. Error of Skewness		.350	.350	.350	.350	.350	.350	.350

Kurtosis		.003	.003	.003	.003	.003	-.723	-.112
Std. Error of Kurtosis		.688	.688	.688	.688	.688	.688	.688
Range		40	10	20	.6	2	.0820	.0950
Minimum		160	20	30	2.0	8	.0121	.0031
Maximum		200	30	50	2.6	10	.0941	.0981
Percentiles	25	180.00	25.00	40.00	2.300	9.00	.036100	.043850
	50	180.00	25.00	40.00	2.300	9.00	.048100	.056600
	75	180.00	25.00	40.00	2.300	9.00	.067350	.072100
a. Multiple modes exist. The smallest value is shown								

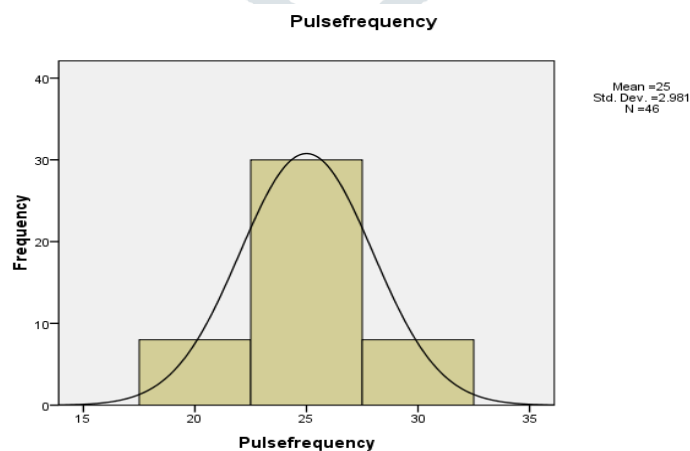
Table 3 show the Frequency Statistics in physics, is the number of waves that pass a fixed point in unit time. Lamp current (amp), Pulse frequency (Hz), Cutting speed (mm/min), Pulse width (ms), Air pressure (bars), TKD , BKD this also using Variance curve values are given.

**IV. HISTOGRAM PLOT**



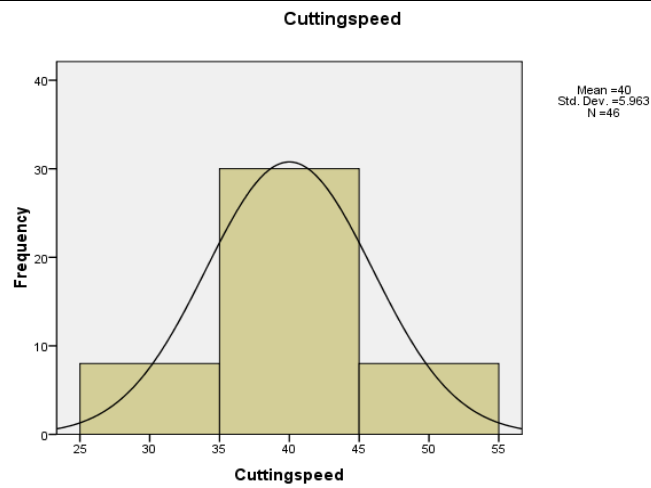
**FIGURE 1. Lamp Current**

Figure 1 shows the histogram plot for Lamp Current process from the figure it is clearly seen that the data are slightly bell karo due to more respondent chosen 1 for I Lamp Current except the 1 value all other values are under the normal curve shows model is significantly following normal distribution.



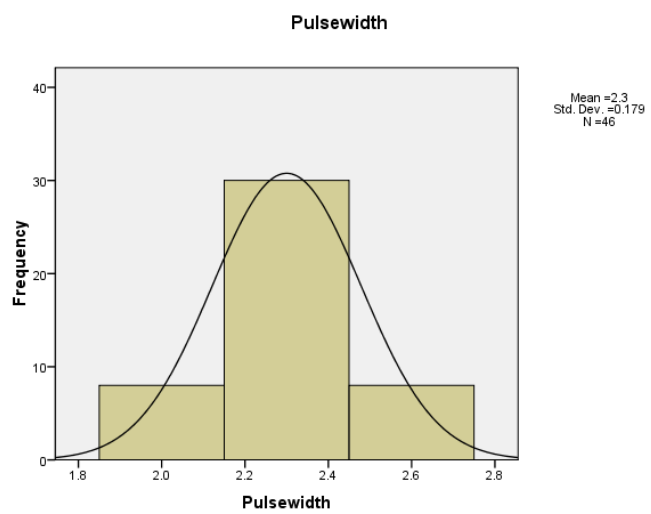
**FIGURE 2. Pulse Frequency**

Figure 2 shows the histogram plot for Pulse Frequency from the figure it is clearly seen that the data are slightly bell karo due to more respondent chosen 1 for Pulse Frequency except the 1 value all other values are under the normal curve shows model is significantly follo wing normal distribution.



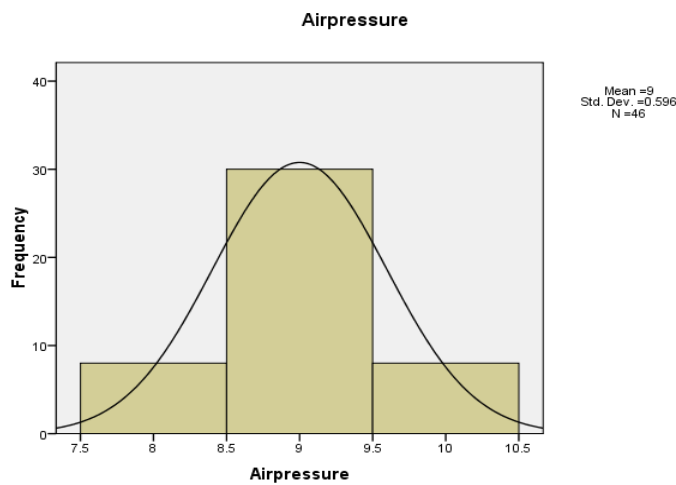
**FIGURE 3.** Cutting Speed

Figure 3 shows the histogram plot for Cutting Speed from the figure it is clearly seen that the data are slightly bell karo due to more respondent chosen 1 for Cutting Speed except the 1 value all other values are under the normal curve shows model is significantly following normal distribution.



**FIGURE 4.** Pulse width

Figure 4 shows the histogram plot for Pulse width from the figure it is clearly seen that the data are slightly bell karo due to more respondent chosen 1 for Pulse width except the 1 value all other values are under the normal curve shows model is significantly following normal distribution.



**FIGURE 5.** Air pressure

Figure 5 shows the histogram plot for Air pressure from the figure it is clearly seen that the data are slightly bell karo due to more respondent chosen 1 for Air pressure except the 1 value all other values are under the normal curve shows model is significantly following normal distribution.

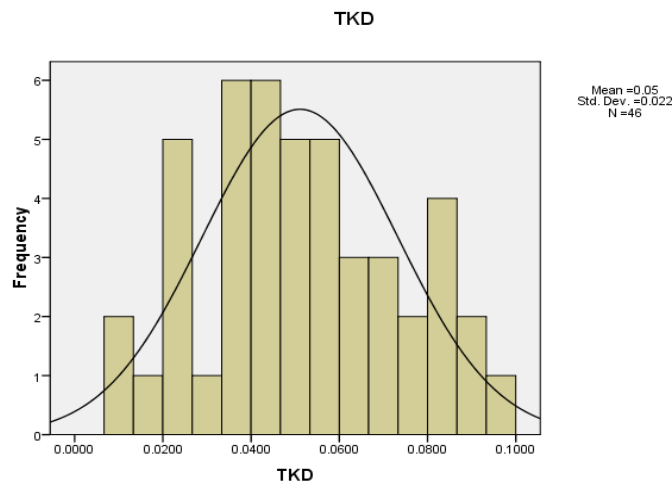


FIGURE 6. TKD

Figure 6 shows the histogram plot for TKD from the figure it is clearly seen that the data are slightly Left skewed due to more respondent chosen 5 for TKD Language except the 5 value all other values are under the normal curve shows model is significantly following normal distribution

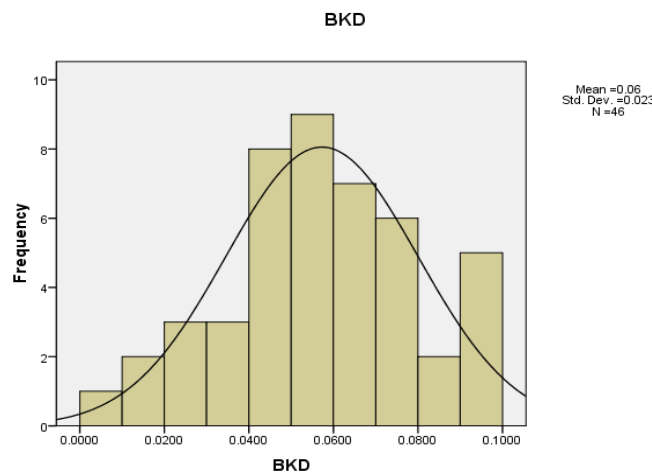


FIGURE 7. BKD

Figure 7 shows the histogram plot for BKD from the figure it is clearly seen that the data are slightly Right skewed due to more respondent chosen 4 for BKD Language except the 4 value all other values are under the normal curve shows model is significantly following normal distribution.

TABLE 4. Correlations

	Lamp current	Pulse frequency	Cutting speed	Pulse width	Air pressure	TKD	BKD
Lamp current	1	0	0	0	0	0.107	0.057
Pulse frequency	0	1	0	0	0	-0.037	-0.106
Cutting speed	0	0	1	0	0	-0.175	-0.167
Pulse width	0	0	0	1	0	-0.097	0.021
Air pressure	0	0	0	0	1	-0.201	-0.001
TKD	0.107	-0.037	-0.175	-0.097	-0.201	1	.437**
BKD	0.057	-0.106	-0.167	0.021	-0.001	.437**	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows the correlation between motivation parameters for Lamp current (amp) For TKD bottom kerf width with and BKD top kerf width having lowest correlation. Next the correlation between motivation parameters for Pulse Frequency for TKD top kerf width with and BKD bottom kerf having lowest correlation. Next the correlation between motivation parameters for Cutting Speed for BKD bottom kerf width with and TKD top kerf width having lowest correlation. Next the correlation between motivation parameters for Pulse width For BKD bottom kerf width with and TKD top kerf width having lowest correlation. Next the correlation between motivation parameters for Air Pressure for TKD top kerf width with and BKD bottom kerf having lowest correlation. Next the correlation between motivation parameters for TKD for Lamp current with and Pulse width bottom kerf having lowest correlation. Next the correlation between motivation parameters for BKD for Lamp current with and Air pressure bottom kerf having lowest correlation.

TABLE 5. Regression (Model Summary)

Dependent Variable	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sum of Squares	df	Mean Square	F	Sig.
TKD	.306 <sup>a</sup>	.093	.020	.0224235	.540	5	.000	.824	.002 <sup>a</sup>
BKD	.207 <sup>a</sup>	.043	.077	.0236393	.874	5	.000	.358	.001 <sup>a</sup>

Table 5 shows the result of R, R squared, adjusted R squared, sum of squares, df, F, significance. The overall R squared value for the model is above 0.4, so this is reliable data. From the literature review, R value above 0.2 can be considered to analyze the model. The sum of squares value for the model is greater than 0.5, so this is reliability data. From the literature review, the value of squares above 5 can be considered to analyze the model. The overall F value for the model is above .358, so this is reliability data. From the literature review, a value above 10 can be considered to analyze the model. The overall identity value for the model is 0.01, so this is reliability data. From the literature review, a value less than 0.5 can be considered to analyze the model.

#### IV. CONCLUSION

A hybrid composition of basalt and glass layer fabricated and its various mechanical properties After being tested. Glass-fiber composite is a class of fiber-reinforced polymer composites. Hybrid compounds are a common one Two or more in the matrix Combining different types of fibers Products manufactured by Various A hybrid given by researchers Compounds have many definitions. A laser machine is a target material interacts with a laser beam It is a material removal process done by Such a device uses photon energy Processing to the target object thermal or photochemical energy are carried in the form of remove the items directly and by melting evaporation elimination.

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