Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15993
DOI URL: http://dx.doi.org/10.21474/IJAR01/15993

RESEARCH ARTICLE

ANALYSIS OF A DRILLING HYBRID ALUMINUM METAL MATRIX COMPOSITES BY USING SPSS

Nayeemuddin and Umme Salma
Department of Mechanical Engineering, KBN College of Engineering Kalaburagi, Karnataka India.

Manuscript Info

Manuscript History
Received: 05 November 2022
Final Accepted: 09 December 2022
Published: January 2023

Key words:-
AMCs,AlMMCs, MMCs,SPSS

Abstract

Hybrid Metal matrix composites are light weight and high strength Applications include aerospace and automobile industry Advanced materials are used. Mixed Used In preparing metal matrix composites Among various techniques, the stirrup casting technique is the simplest And economical. Aluminum alloy alloys are new The generation is metal matrix composites, which The latest requirements of advanced engineering applications have the ability to fulfill Aluminum matrix composites (AMCs) are light weight high of efficient aluminum core material systems represent a class. Reinforcement in AMCs is Continuous/discontinuous filaments, whiskers or A few percent to 70% is in particulate form. Aluminum Metal matrix composites (AlMMCs) are Light Weight, high stiffness and moderate strength applications Successful in meeting stringent specifications It is a category of proven products. Required Properties. MMCs are metal as a reinforcing material is formed by dispersion in the matrix. Reinforcement To prevent a chemical reaction with the matrix The surface can be coated. For example, in aluminum matrix Carbon fibers with low density and high strength are commonly used. to consolidate composites.

Matrix Materials and Major Compounds: Several metals in groups are used. Aluminum, Titanium, Magnesium and Copper alloys are very important and Super alloys.

Fine particles: Silicon Carbide, Boron Carbide, Titanium Carbide.

Introduction:-

Composite materials are nanometer or molecular Level a combination of two elements. Usually One of the compounds is inorganic and the other is organic It will be natural. Hence, they are traditionally different from compounds, where the elements are Macroscopic (micrometre to the millimetre) scale. Some Specificity between hybrid compounds and conventional compounds Advantages are included. Interestingly, although 7075 aluminium is more than 6061 aluminium Strong, it melts at a slightly lower temperature. 7075 6061 aluminium is hotter than aluminium Good for some applications due to its conductivity is the choice. PMCs are generally straight stress-strain Bends that are prone to failure. Polymer matrix materials with high specific tensile strength Form compounds with strength and stiffness properties contain In Polymer Composites Manufacturing Technology More advanced and fewer raw materials and are production costs. Hybrid composite materials in many engineering applications are lightweight; strength to weight ratio, low cost, and structure Versatility such as ease of development and high strength are used for attributes.

Corresponding Author:- Nayeemuddin
Address**:-** Department of Mechanical Engineering, KBN College of Engineering Kalaburagi, Karnataka India.

Automobile Composites in many indoor and outdoor applications in the industry use hybrid compounds. Magnesium (Mg) 5xxx - magnesium with aluminium Addition strengthens the solid solution by strengthening it increases and strain hardening ability improves. These alloys are of high strength Non-heat-treatable aluminium alloys containing are, therefore, widely used for structural applications are used. Work hardening or "strain hardening" can be used to strengthen aluminium. This process involves forming the metal at a temperature below its recrystallization temperature, which is usually room temperature. The actual process involves forging, bending, drawing, or rolling the aluminium.

Drilling hybrid aluminum metal matrix composites:-

Drilling tests were performed Computer Numerical Control in Vertical Machining Center (VMC 100). (CNC), ARIX CNC Machine Co. Ltd., in Taiwan, China used to conduct experiments. 6 mm diameter drill with size and its helix angle of 30°, point angle 118° was used. SANDVIK (India), TiN coated carbide and polycrystalline and carbides made of diamond (PCD). Were used. The hardness of the drill material HRC is 72, 80 and 90 respectively. [1] The developed models were validated through confirmation experiments. Details of the confirmatory tests The average values were repeated twice were used. Predicted values test the results are very close, so mixed Developed model To predict responses in drilling mixes appropriate. [2] Machining in surface roughness Effect of parameters, metal removal increasing the rate, surface Reduce hardness, particulate metal matrix Response surface method in changing compounds determined using, using coated carbide drills Drilling hybrid metal matrix To predict thrust force in composites and surface roughness have used the response surface method.[3] showed that soft, Extruded and solution-treated materials are hard ageing materials that produce Less wear and lower driving forces than however, alloy investigated parameters Reduce thrust force by up to 25% per range. Self-lubricated aluminium/ Spin speed, feed rate and alumina/graphite He studied the number of hybrid compounds and did an impact on Area. [4] Although Diamond and diamond-coated tools are useful And the machine is very difficult and expensive, which is a major hindrance to instrumentation. However, in the case of drilling, high-speed steel (HSS) Drills are highly cemented carbide The drills and diamond drills used are more expensive. are widespread. unavailable. [7] The Cutting grade of the Surface chip of drilled hole removes the zone It depends. So, Chip surface by studying the manufacturing process More insight into the factors influencing the outcome Researchers can get During the drilling process, chips examine common characteristics collected the chips. of B4C particles and at the B4C-matrix interface Often shorter in tests due to crack propagation Chips were made. Short and intermittent chips make up a chip that is easy to remove from the drilled surface [8]. Drilling is a very important post-processing process that joins individual drilling processes and Reduces the proper selection of tool material. critical to producing good surface-quality holes [10]. Surface finish is affected by feed rate and It was found that cutting speed was not the cause. Mechanical properties of ceramic particle composites Increasingly, however, this Mac incapacitation causes problems. But the Adding small-sized graphite particles is difficult Aluminum matrix composites can be improved by addition to particles, a solid lubricant such as graphite Addition of oil particles rid reinforcement of tribal traits improves compounds.[11] The drilling technique has its advantages and disadvantages And the laser source is mainly of pulse duration Basically, Drilling speed and grade requirements are selected. For example, the helical drilling technique is usually first to second (fs) (ultra short) to nanosecond (nS) is used in the (short) range. with Laser pulse durations. with short or very short pulses of light Helical drilling is relatively slow, but other drilling methods Produce better quality holes compared to [12]. The main objective of this study WJG laser Drilling is to understand process characteristics. Hole drilling and minute heating damage, exiting the hole At the minimum decrease, at the entrance of the hole Minimum spray, hole circle, hole surface profile, minimum bore taper and higher Quality requirements for drilling are important. speed.[14] The demand for customization is increasing From all over the world At the same time competitors Global competition has This trend driving growth from macro to micro markets is largely due to increasing product variety [15]. The attrition rate was 11%. with SiC MMC Compared, 50% of the SiC MMC aluminium matrix SiC is high in friction due to wear. diamond Irregularly shaped composite particles yield due to friction Increases strength and tensile strength, But SiC elongation decreases particle size fraction increases. [16] an Improved surfactant performance in MWCNT-in-oil lubrication It is fundamental There are four primary sub-factors to tribal characteristics- Mechanisms are responsible for the lubrication of the mechanism A deeper investigation reveals. These are viscosities development, formation of micellar structures; Aluminum hydroxide, iron carbide and a three-layer formulation composed of aluminium and iron oxide; MML Formulation and use of doped graphite in contacts; and effortless adhesion of MWCNTs to worn surfaces Peeling off individual graphene sheets of carbon nanotubes due to shear stress and breakage of nanotubes [17] Results from this data were analyzed Excellent machining performance when drilling composites to reach Present study mechanical properties of Al-Al2O3-Gr deals with decisions about for evaluating composites using solid carbide drills.[18] In a study comparing the shear force and torque in drilling materials Consequently, The driving force increases as the point angle increases and

torque is reported to decrease. However, Deviations in drilling materials prone to BUE It is estimated may occur. [19] While quality is the most critical of the various match inability issues when drilling composite materials. Major Diameter variations with whole quality such as problems related to; delamination and matrix resin degradation associated. Cutting parameters and cutting tools for inappropriate combination [20].

Content of mica

Flake mica comes from several sources: schist A metamorphic rock called Feldspar and Kaolin As a byproduct of resource processing, the blazer from deposits and from pegmatites. Micah is physically and chemically similar A mineral name given to a group of minerals. E Mica content and engineering importance of sands To determine relationships between parameters, mica The effects are very noticeable and extraneous are minimally modified by variables. [1] To improve Effect of additives on mechanical and frictional properties Mica content was used to clarify. TMA and sliding friction materials.[2] The increased size 4. Mica is partly The same as achieved by modification with mica The original material of grading is pure material less than mm, Thus The overall particle size distribution remains unchanged. The maximum particle size is 63 mm and four Construction mica a type of granitic base material containing Only the study was limited. contents.[3] The sample with Incorporated muscovite mica throughout the pressure range showed no acute response, while 15 wt% The sample with added mica is very smooth. Strain rate is clearly proportional to stress ratio Affected, and the behavior is similar that of the elastic modulus; The values are lower as the mica content increases.[4]

Spindle speed

Spin speed is the drum in your washing machine indicates the number of revolutions per minute. This Speed is measured in revolutions per minute (rpm). For example, a washing machine at 1400 rpm If set, washing machine drum 1400 per minute The pattern rotates. Sometimes, more washing machine spin speed isn't always the best, as it can wrinkle cotton business shirts, meaning longer ironing times for you. An important factor in the correct detection of spin speed is the implementation of the chattering detection algorithm. The frequency response is normalized to provide information regarding the cycle frequency that is directly related to the impact of the tool during machining Frequency and its modulations. That is why also called cepstral or cepstrum analysis Mathematical analysis to detect failure in machines Techniques is used. [11] Spindle rotation Speed is decisive in reducing the vibration factor. Static (CSS) or Variable (SSV) between machines The main difference in spindle speed is the instantaneous chip thickness calculation is When machining in CSS, a certain rotation Chip thickness of the current calculation in position and previous Depends on the vibrations, which is not true. For the SSV technique, Rotation from speed is continuous variable [12]

Surface roughness

These factors are important in the performance of mechanical components play a role. Therefore, Al2219/15SiCp and Drilled holes in Al2219/15SiCp-3Gr parameters this is significant. Presents the results of the investigation. By tool materials on surface and integrity alloys.[5] SiC integrity and graphite carbide and of the drilled work piece surface in coated Al MMCs using carbide tools Strengthened. Increase in cutting speed and drill feed what decreases is surface roughness they said that it is decreasing. With Al-2219/15%SiCp 5% CCB-1% Curr Compared surface roughness of Al-2219/ alloy it is too much. Conventional coated carbide tool surface coating and Feed rate parameters of surface roughness Outdated multi carbide drill bit for upgrading they also found that [6]

Feed rate

Post-processors are no longer required is part of the program Last minute changes in technical values or Provides more flexibility for revisions. This focuses on adaptive control for the machine. Focuses on adaptive control for the machine. Adaptive implementation of STEP-NC data and feed-rate optimization is realized [15] Applying the perturbations to the Response in manipulated variable and controlled variable Evaluating is Analysis is done. [16]

Thrust force

Tests indicate that There is a thrust force. Hocheng et al Taran used Drilling parameters and composite laminate material important motivation related to delamination with properties linear elastic fracture mechanics to determine force. [17] In terms At A thrust force per air-gap area, HDL is linear Twice the times of PM synchronous motor and six times that of a linear induction motor more [19]. Inclined drill point geometry represents series segments based on One for oblique cutting Analytical model First on the cutting lip of a drill Described to analyze a part. These results of the sections are for various operating conditions to determine thrust and torque are combined. [20]

Tool Wear

Machine type. Chipping is visible to the naked eye Approved chipping or by the instrument maker's microscope, [25] a Some Quantitative Characteristics for Correct Evaluation of Tool Wear required A selection of these characteristics will wear a tool Depends on the specific purpose of the study. Mostly, Dimensional accuracy dictates this choice, meaning that parts must be manufactured [26] replacement strategies are now based on a conservative estimate of tool life. This approach does not allow for tool breakage or chipping of the cutting edge, as these are typically catastrophic processes. Therefore, tools are generally underutilized. [27]

Table 1:- Correlations.

Correlations					
	Spindle speed	Feed rate	Surface roughness	Content of mica	Tool wear
Spindle speed	1	0	-0.077	0	-0.22
Feed rate	0	1	.885**	0	.911**
Surface roughness	-0.077	.885**	1	-0.087	.937**
Content of mica	0	0	-0.087	1	0.045
Tool wear	-0.22	.911**	.937**	0.045	1

Table 1 shows the correlation between the stimulus parameters for Surface roughness has the highest value of -0.077 so it has a high correlation with feet and the lowest value is -0.22 so it has a low correlation with Tool wear.

Next is the correlation between Wear stimulus parameters. Surface roughness maximum value is .911** so it has high correlation with Surface roughness and minimum value is .885** so it has low correlation with one parameters.

Next the correlation between the stimulus parameters for Tool wear plotting has the highest value of .937** so it has a high correlation with Spindle speed and the lowest value is -0.077 so it has a low correlation.

Next the correlation between the stimulus parameters for Surface roughness has the highest value of .937**so it has a high correlation with Spindle speed and the lowest value is -0.22 so it has a low correlation.

Table 2:- Reliability Statistics.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.967	0.967	2

Table 2 shows Cronbach's Alpha Reliability result. The overall Cronbach's Alpha value for the model is 0.967 which indicates 92% reliability. From the literature review, the above 50% Cronbach's Alpha value model can be considered for analysis.

Table 3:- Statistics.

Statistics						
		Spindle speed	Feed rate	Content of mica	Surface roughness	Tool wear
N	Valid	14	14	14	14	14
	Missing	0	0	0	0	0
Mean		1500	200	6	5.323571	5.496429
Std. Error of Mean		148.25	14.825	0.593	0.377807	0.381411
Median		1500.00a	200.00a	6.00a	5.275000a	5.670000E0a
Mode		1000b	150b	4b	2.9500b	2.9500b
Std. Deviation		554.7	55.47	2.219	1.413624	1.43E+00
Variance		307692.3	3.08E+03	4.923	1.998	2.037
Skewness		0	0	0	-0.021	-0.095
Std. Error of Skewness		0.597	0.597	0.597	0.597	0.597

Kurtosis		-0.609	-0.609	-0.609	-1.092	-1.109
Std. Error of Kurtosis		1.154	1.154	1.154	1.154	1.154
Range		2000	200	8	4.56	4.56
Minimum		500	100	2	2.95	2.95
Maximum		2500	300	10	7.51	7.51
Sum		21000	2800	84	74.53	76.95
Percentiles	25	1062.50c	156.25c	4.25c	4.320000c	4.320000E0c
	50	1500	200	6	5.275	5.67
	75	1937.5	243.75	7.75	6.35	6.76

Table 4:- Descriptive Statistics.

Descriptive Statistics												
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Spindle speed	14	2000	500	2500	1500	148.25	554.7	3.08E+05	0	0.597	-0.609	1.154
Feed rate	14	200	100	300	200	14.825	55.47	3.08E+03	0	0.597	-0.609	1.154
Content of mica	14	8	2	10	6	0.593	2.219	4.923	0	0.597	-0.609	1.154
Surface roughness	14	4.56	2.95	7.51	5.32E+00	0.377807	1.413624	1.998	-0.021	0.597	-1.092	1.154
Tool wear	14	4.56	2.95	7.51	5.50E+00	0.381411	1.427109	2.037	-0.095	0.597	-1.109	1.154
Valid N (list wise)	14											

Table 4 shows the descriptive statistics values for analysis N, range, minimum, maximum, mean, standard deviation, Skewness, Kurtosis. Spindle speed/ (r·min1), Feed rate/ (mm·min1), Content of mica/%, Surface roughness/m, Tool wear/ mm, TKD.

Table 5:- Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sum of Squares	F	Sig.
a	.893a	0.797	0.736	0.726923	20.694	13.054	.001a
b	.938a	0.879	0.843	0.565446	23.279	24.269	.000a

Surface roughness is the R value .893a is the R Square value 0.797 is the Adjusted R Square value 0.736 is the Std. Error of the Estimate value 0.726923 is the Sum of Squares value 20.694 is the F value 13.054 signifince values .001a

Tool wear is the R value .938a is the R Square value 0.879is the Adjusted R Square value 0.843is the Std. Error of the Estimate value 0.565446 is the Sum of Squares value 23.279 is the F value 24.269 signifince values .000a

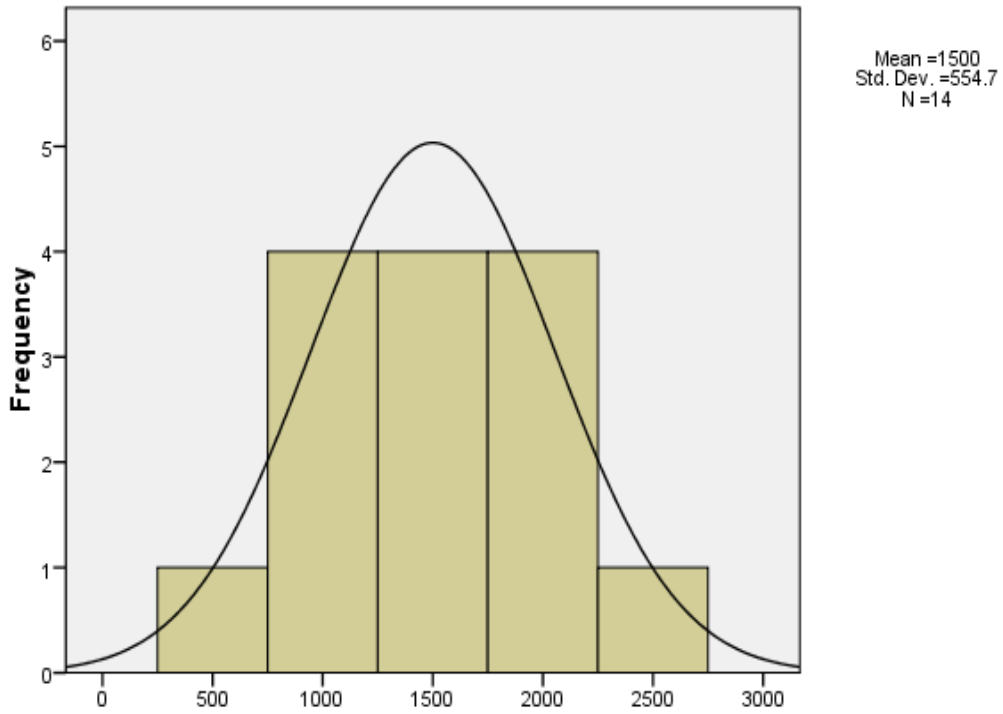

Figure 1:- Spindle speed

Figure 1 shows a histogram plot for feet from the figure where it can be clearly seen that the data is slightly skewed to the left due to high values for 100 to 2500 common values, while all other values are under the normal curve, the sample substantially follows a normal distribution.

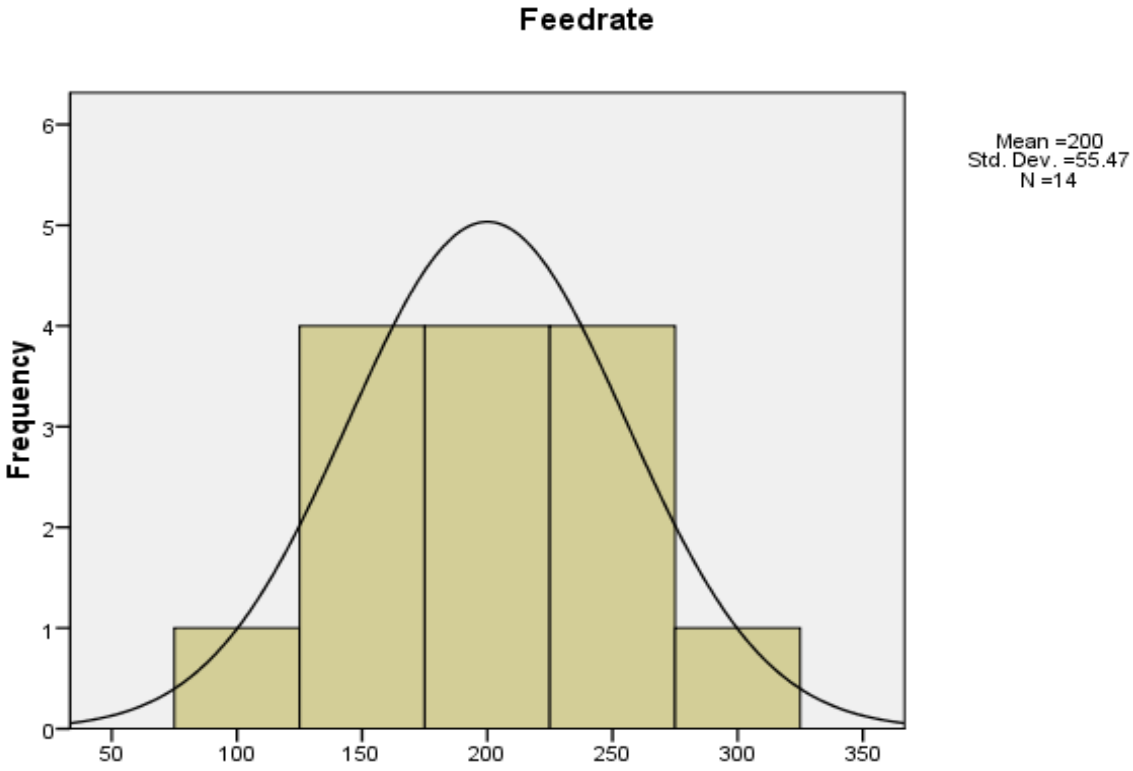

Figure 2:- Feed rate.

Figure 2 shows a histogram plot for legs where it is clear that the data is slightly skewed to the right due to high values for 125-275 common value, while all other values are under the normal curve, the pattern follows substantially.

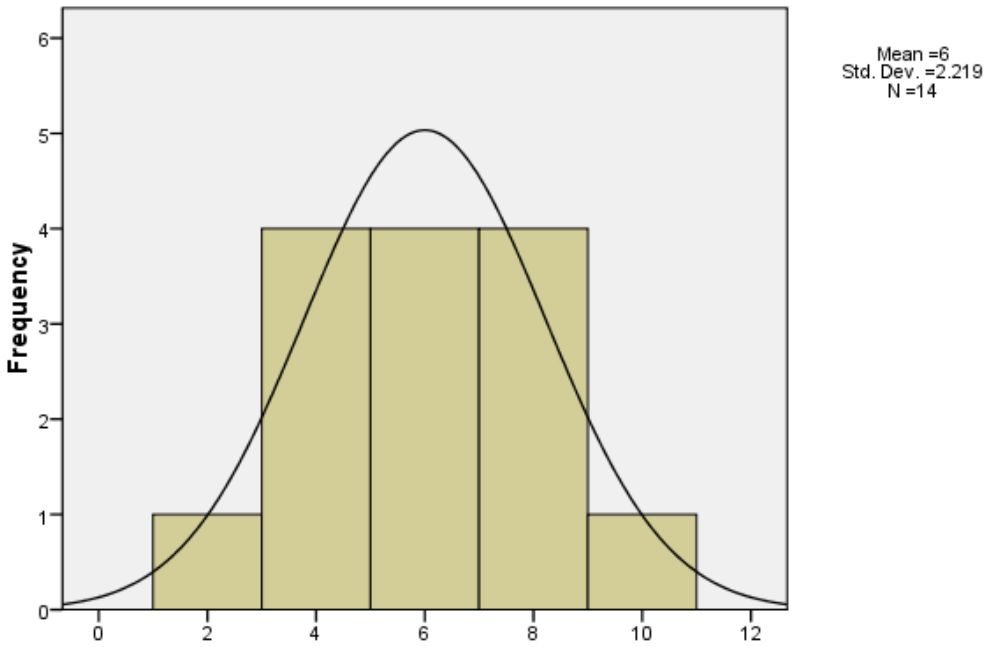

Figure 3:- Content of mica.

Figure 3 shows a histogram plot for legs where it is clear that the data is slightly skewed to the right due to high values for 3to 9 common value, while all other values are under the normal curve, the pattern follows substantially.

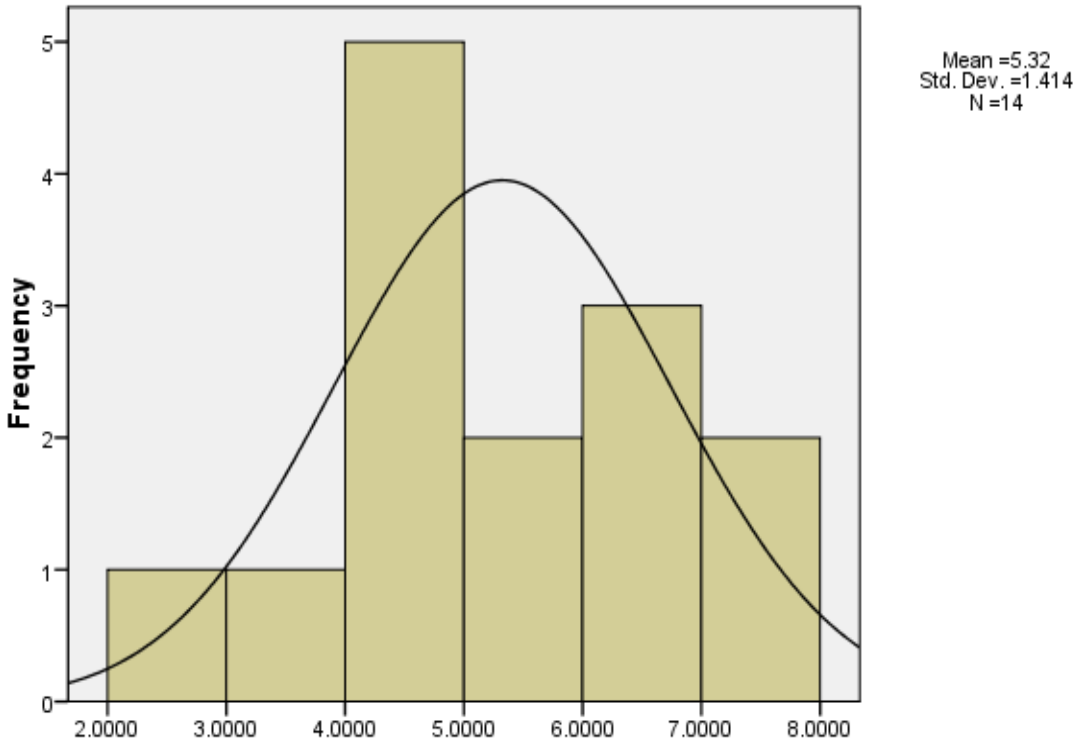

Figure 4:- Surface roughness.

Figure 4 shows the histogram plot for Del. Push as the data is skewed due to values for 2,0000 to 8,0000, while all other values are under the normal curve, the sample is significant. Follows a normal distribution.

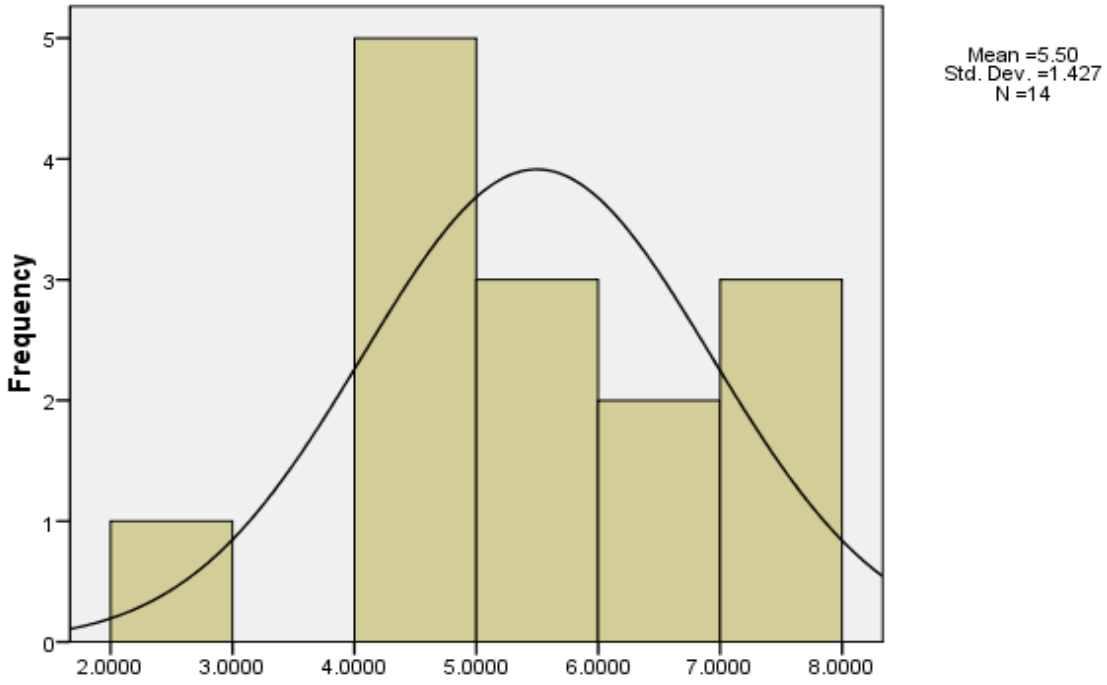

Figure 5:- Tool wear.

Figure 5 shows the histogram plot for Del. Push as the data is skewed due to values for 20000 to 30000, 40000 to 80000 while all other values are under the normal curve, the sample is significant. Follows a normal distribution.

Conclusion:-

The developed models were validated through confirmation experiments. Details of the confirmatory tests The average values were repeated twice were used. Predicted values test the results are very close, so mixed Developed model to predict responses in drilling mixes appropriate. Machining in surface roughness Effect of parameters, metal removal increasing the rate, surface Reduce hardness, particulate metal matrix Response surface method in changing compounds determined using, using coated carbide drills Drilling hybrid metal matrix To predict thrust force in composites and surface roughness have used the response surface method. Spin speed is the drum in your washing machine indicates the number of revolutions per minute. This Speed is measured in revolutions per minute (rpm). For example, a washing machine at 1400 rpm If set, washing machine drum 1400 per minute The pattern rotates. Sometimes, more washing machine spin speed isn't always the best, as it can wrinkle cotton business shirts, meaning longer ironing times for you.

Reference:-

1. Rajmohan, T., K. Palanikumar, and M. Kathirvel. "Optimization of machining parameters in drilling hybrid aluminium metal matrix composites." Transactions of Nonferrous Metals Society of China 22, no. 6 (2012): 1286-1297.
2. Rajmohan, Thiagarajan, and KayaroganamPalanikumar. "Application of the central composite design in optimization of machining parameters in drilling hybrid metal matrix composites." Measurement 46, no. 4 (2013): 1470-1481.
3. Rajmohan, T., and K. Palanikumar. "Modeling and analysis of performances in drilling hybrid metal matrix composites using D-optimal design." The International journal of advanced Manufacturing technology 64, no. 9 (2013): 1249-1261.
4. Rajmohan, T., and K. Palanikumar. "Experimental investigation and analysis of thrust force in drilling hybrid metal matrix composites by coated carbide drills." Materials and Manufacturing Processes 26, no. 8 (2011): 961-968.

5. Basavarajappa, S., G. Chandramohan, M. Prabu, K. Mukund, and M. Ashwin. "Drilling of hybrid metal matrix composites—Workpiece surface integrity." International Journal of Machine Tools and Manufacture 47, no. 1 (2007): 92-96.
6. Lalmuan, S. K., Shubhajit Das, M. Chandrasekaran, and Santosh K. Tamang. "Machining investigation on hybrid metal matrix composites-a review." Materials Today: Proceedings 4, no. 8 (2017): 8167-8175.
7. Ahamed, A. Riaz, ParavasuAsokan, Sivanandam Aravindan, and M. K. Prakash. "Drilling of hybrid Al-5% SiCp-5% B4Cp metal matrix composites." The international journal of advanced manufacturing technology 49, no. 9 (2010): 871-877.
8. Taşkesen, Ahmet, and Kenan Kütükde. "Experimental investigation and multi-objective analysis on drilling of boron carbide reinforced metal matrix composites using grey relational analysis." Measurement 47 (2014): 321-330.
9. Rajmohan, T., and K. Palanikumar. "A mathematical model to predict thrust force in drilling hybrid metal matrix composites." In Frontiers in Automobile and Mechanical Engineering-2010, pp. 1-3. IEEE, 2010.
10. Raja, K., V. S. Chandra Sekar, V. Vignesh Kumar, T. Ramkumar, and P. Ganeshan. "Microstructure characterization and performance evaluation on AA7075 metal matrix composites using RSM technique." Arabian Journal for Science and Engineering 45, no. 11 (2020): 9481-9495.
11. Saravanakumar, A., P. Sasikumar, and S. Sivasankaran. "Effect of graphite particles in drilling of hybrid aluminum matrix composite." Procedia Engineering 97 (2014): 495-504.
12. Pandi, Ganesan, and SaravananMuthusamy. "A review on machining and tribological behaviors of aluminium hybrid composites." Procedia engineering 38 (2012): 1399-1408.
13. Marimuthu, S., J. Dunleavey, Y. Liu, B. Smith, A. Kiely, and M. Antar. "Characteristics of hole formation during laser drilling of SiC reinforced aluminium metal matrix composites." Journal of Materials Processing Technology 271 (2019): 554-567.
14. Marimuthu, S., J. Dunleavey, Y. Liu, B. Smith, A. Kiely, and M. Antar. "Water-jet guided laser drilling of SiC reinforced aluminium metal matrix composites." Journal of Composite Materials 53, no. 26-27 (2019): 3787-3796.
15. Marimuthu, S., J. Dunleavey, and B. Smith. "Laser based machining of aluminum metal matrix composites." Procedia CIRP 85 (2019): 243-248.
16. Rajmohan, T., K. Palanikumar, and S. Ranganathan. "Evaluation of mechanical and wear properties of hybrid aluminium matrix composites." Transactions of nonferrous metals society of China 23, no. 9 (2013): 2509-2517.
17. Singh, Harpreet, and HiralalBhowmick. "Lubrication characteristics and wear mechanism mapping for hybrid aluminium metal matrix composite sliding under surfactant functionalized MWCNT-oil." Tribology International 145 (2020): 106152.
18. Dhiraj V. Astonkar , M. Ramachandran, PrabakaranNanjundan, Malarvizhi Mani, "Analysis of Blind Spot in Heavy Vehicles using TOPSIS MCDM Method", REST Journal on Advances in Mechanical Engineering, 1(2), (2022):19-27.
19. Hayajneh, Mohammed T., Adel Mahmood Hassan, and Ahmad TurkiMayyas. "Artificial neural network modeling of the drilling process of self-lubricated aluminum/alumina/graphite hybrid composites synthesized by powder metallurgy technique." Journal of Alloys and Compounds 478, no. 1-2 (2009): 559-565.
20. Okay, Faik, SerkanIslak, and YakupTurgut. "Investigation of machinability properties of aluminium matrix hybrid composites." Journal of Manufacturing Processes 68 (2021): 85-94.
21. Abbas, ChAsad, Chuanzhen Huang, Jun Wang, Zhen Wang, Hanlian Liu, and Hongtao Zhu. "Machinability investigations on high-speed drilling of aluminum reinforced with silicon carbide metal matrix composites." The International Journal of Advanced Manufacturing Technology 108, no. 5 (2020): 1601-1611.
22. Harris, W. G., J. C. Parker, and L. W. Zelazny. "Effects of mica content on engineering properties of sand." Soil Science Society of America Journal 48, no. 3 (1984): 501-505.
23. Gan, Daoji, Shiqiang Lu, Caisheng Song, and Zhijian Wang. "Physical properties of poly (ether ketone ketone)/mica composites: effect of filler content." Materials Letters 48, no. 5 (2001): 299-302.
24. Frey, M., J. C. Hunziker, E. Jäger, and W. B. Stern. "Regional distribution of white K-mica polymorphs and their phengite content in the Central Alps." Contributions to Mineralogy and Petrology 83, no. 1 (1983): 185-197.
25. SathiyarajChinnasamy, M. Ramachandran, Chinnasami Sivaji, "A Study on Ultraviolet Radiation and Its Effects", REST Journal on Advances in Mechanical Engineering, 1(2), (2022):1-9
26. Ekblad, Jonas, and Ulf Isacsson. "Influence of water and mica content on resilient properties of coarse granular materials." International journal of pavement Engineering 9, no. 3 (2008): 215-227.

27. Lee, Wen-Fu, and Kai-Tai Tsao. "Effect of intercalant content of mica on the various properties for the charged nanocomposite poly (N-isopropyl acrylamide) hydrogels." Journal of applied polymer science 104, no. 4 (2007): 2277-2287.
28. Beste, Ulrik, and Staffan Jacobson. "Friction between a cemented carbide rock drill button and different rock types." Wear 253, no. 11-12 (2002): 1219-1221.
29. Sagheb, Keyvan, Vinay V. Kumar, Adriano Azaripour, Christian Walter, Bilal Al-Nawas, and Peer W. Kämmerer. "Comparison of conventional twist drill protocol and piezosurgery for implant insertion: an ex vivo study on different bone types." Clinical Oral Implants Research 28, no. 2 (2017): 207-213.
30. Agapiou, John S. "Design characteristics of new types of drill and evaluation of their performance drilling cast iron—I. Drill with Four major cutting edges." International Journal of Machine Tools and Manufacture 33, no. 3 (1993): 321-341.
31. T. NareshBabu, M. Ramachandran, SathiyarajChinnasamy, AshwiniMurugan, "The Evaluation of Third-party Logistics Services Using Complex Proportional Assessment", REST Journal on Banking, Accounting and Business, 1(1), (2022):14-22.
32. Chen, W-F., W-Y. Chen, and Y-Y. Tang. "Evaluation of contour quality in sampling inspection of two drill types." The International Journal of Advanced Manufacturing Technology 19, no. 1 (2002): 66-70.
33. Agapiou, John S. "Design characteristics of new types of drill and evaluation of their performance drilling cast Iron—II. Drills with three major cutting edges." International Journal of Machine Tools and Manufacture 33, no. 3 (1993): 343-365.
34. Bediaga, I., J. Munoa, J. Hernández, and LN López De Lacalle. "An automatic spindle speed selection strategy to obtain stability in high-speed milling." International Journal of Machine Tools and Manufacture 49, no. 5 (2009): 384-394.
35. Urbikain, G., D. Olvera, LN López de Lacalle, and A. Elías-Zúñiga. "Spindle speed variation technique in turning operations: Modeling and real implementation." Journal of Sound and Vibration 383 (2016): 384-396.
36. Jayaram, S., S. G. Kapoor, and R. E. DeVor. "Analytical stability analysis of variable spindle speed machining." J. Manuf. Sci. Eng. 122, no. 3 (2000): 391-397.
37. Jemielniak, K., and A. Widota. "Suppression of self-excited vibration by the spindle speed variation method." International Journal of Machine Tool Design and Research 24, no. 3 (1984): 207-214.
38. Ridwan, Firman, and Xun Xu. "Advanced CNC system with in-process feed-rate optimisation." Robotics and Computer-Integrated Manufacturing 29, no. 3 (2013): 12-20.
39. Mears, Lisa, Stuart M. Stocks, Gürkan Sin, and Krist V. Gernaey. "A review of control strategies for manipulating the feed rate in fed-batch fermentation processes." Journal of biotechnology 245 (2017): 34-46.
40. Krishna Kumar TP, M. Ramachandran, SathiyarajChinnasamy, "Investigation of Public Transportation System Using MOORA Method", REST Journal on Emerging trends in Modelling and Manufacturing, 6(4), (2020):124-129.
41. Modak, J. M., H. C. Lim, and Y. J. Tayeb. "General characteristics of optimal feed rate profiles for various fed-batch fermentation processes." Biotechnology and bioengineering 28, no. 9 (1986): 1396-1407.
42. Strenkowski, J. S., C. C. Hsieh, and A. J. Shih. "An analytical finite element technique for predicting thrust force and torque in drilling." International Journal of Machine Tools and Manufacture 44, no. 12-13 (2004): 1413-1421.
43. Dreisbach, Caitlin, Theresa A. Koleck, Philip E. Bourne, and Suzanne Bakken. "A systematic review of natural language processing and text mining of symptoms from electronic patient-authored text data." International journal of medical informatics 125 (2019): 37-46.
44. Meral, Güven, Murat Sarıkaya, Mozammel Mia, HakanDilipak, UlviŞeker, and Munish K. Gupta. "Multi-objective optimization of surface roughness, thrust force, and torque produced by novel drill geometries using Taguchi-based GRA." The International Journal of Advanced Manufacturing Technology 101, no. 5 (2019): 1595-1610.