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A Literature Survey on Optimization of Drilling Process for Different Materials

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Abstract - *In this paper, an attempt is made to survey the literatures regarding optimization of drilling process. In this paper various input and output parameters are considered for the study. Also, different tool materials and workpiece materials are incorporated. Further various methods of optimizations like Response Surface Methodology, Taguchi Method, Teaching Learning Based Optimization, Fuzzy Logic Technique, Genetic Algorithm are examined. This paper investigates about the different materials used which for optimization of the drilling process. Also, about the materials that are rarely used but have innumerous applications. The objective of this paper is to provide information regarding the study of drilling process and its optimization.*

Key Words: drilling process, optimization, Taguchi, RSM, TLBO.

1. INTRODUCTION

Optimization is a very essential step in the designing, manufacturing and analysis of any mechanical process. Any of the process is never perfect or fully precise, it always has some shortcomings. To overcome the existing shortcomings, optimization is required. In industries, drilling is practiced on a large scale. Usually, laymen use the drilling machine, in such cases, because of fatigue or continuous monotonous work, there is a possibility that error might occur. Although, the error is very less but it affects the accuracy of the process, sometimes the workpiece is drilled a bit more or less. This affects the quality of final product. This study addresses this issue and proposes a solution. This can be done by standardizing the process for particular pair of workpiece material and tool material. In order to acquire the output parameters, a series of data for input parameters, such as depth of cut, feed rate and cutting speed, must be provided. Surface roughness minimization, material removal rate maximization, and tool wear reduction will all be goals. Response Surface Methodology will be used to accomplish the stated goals.

2. LITERATURE SURVEY

Twenty five articles are taken into consideration in this area to explore the various workpiece & tool materials used in the drilling process as well as the numerous procedures used to optimize the drilling process.

Sumesh A. S. *et. al.,* [1], The goal of this work is to optimize process variables including feed, drill diameter, and cutting speed. For the design of experiments and the examination of empirical observations for the improvement of processing conditions, Taguchi methods are frequently utilized. The approach for inquiry and assessment, input processing circumstances, and response variables are divisions of the research contributions. This research focuses on the Taguchi technique's optimization of drilling settings to achieve the least amount of surface roughness (Ra). The L9 orthogonal array on a radial drilling machine was used in several drilling studies. HSS twist drills were used for the testing on cast iron. The most important control parameters influencing the surface roughness were identified using analysis of variance (ANOVA). The feed rate, drill diameter, and cutting speed were chosen as the control parameters. The drill diameter was discovered to be the most important element for the surface roughness after the nine experimental attempts. The Taguchi technique was especially effective in

optimizing drilling settings for better surface roughness, according to the findings of the confirmation studies. MINITAB17, a piece of commercial software, is utilized to carry out the analysis. Narender Singh *et. al.,* [2], The current work conducts experimental research on reactions such as tool wear rate (TWR) and drilling rate (DR) for electric discharge machining when drilling micro-holes in titanium alloy with brass tools. Response surface methodology based central composite design is used in the tests (CCD). Through experimental, three process variables—current, pulse-on-time, and pulse-off-time—are examined for the two responses, DR and TWR. The impact of each element on replies has been identified through experimentation. The Teaching Learning Based Optimization technique has been used to do single- and multi-objective optimization in order to determine the ideal set of procedure parameters for maximal DR and minimal TWR. To confirm the outcome of multi-objective optimization, the confirmative test has been run. The TLBO algorithm has revealed a 5% gap between experimental and projected values. SEM pictures are used to examine the structure of the micro-drill-machined surface. M. Hari Prasath *et. al.,* [3], One crucial procedure for every construction is drilling, which is frequently employed as the last step before assembly. The goal of this study is to drill SS310 while optimizing drilling parameters including tool geometries, cutting speed and depth of cut parameters such as surface roughness and hole roundness. An L16 orthogonal array is utilized in this study's experiments to examine the effects of various permutations of drilling parameters and tool configurations on hole quality. The Taguchi design of experiments is used to conduct the experiments. The twisted drill and CNC machining center must be used to complete the drilling experiment. This work is beneficial for choosing the best drilling settings and tool geometries that would enhance the quality of the drilled hole by minimizing roughness while also reducing hole roundness error and surface roughness. Ajinkya B. Kashmire *et. al.,* [4], Among the most popular and basic machining techniques is drilling. Carbide twist drills with a 10 mm diameter are used in machining. The majority of automobile components are created using standard machining techniques like planning, milling, shaping, drilling, and turning, among others.

These emphasize timely, high-quality production at a low cost. The quality of a product is thought to be gauged by the product's surface roughness. With the Taguchi Approach, the current work aims to optimize the cutting conditions variables for the lowest Surface Roughness possible when drilling EN-9. The design of experiments (DOE) was used to guide the conduct of the studies, and Analysis of Variance (ANOVA) was used to optimize the minimum surface roughness. Prof M.S Tufail *et. al.,* [5], Among the most popular and basic machining techniques is drilling. Carbide twist drills with a 10 mm diameter are used in machining. The majority of automobile components are created using standard machining techniques like turning, drilling, milling, shaping, and planning, among others. These emphasize timely, highquality production at a low cost. The quality of the product is thought to be gauged by the product's surface roughness. With the Taguchi Approach, the current work aims to optimize the cutting parameters (Cutting speed, feed, and cutting fluid pressure) variables for the lowest Surface Roughness possible when drilling EN-9. The design of experiments (DOE) was used to guide the conduct of the studies, and ANOVA was used to optimize the minimum surface roughness. Mr. Vinayak Samleti *et. al.,* [6], The usage of optimization strategies today is very beneficial for preserving and enhancing both the productivity and quality. Through a survey of the literature, this paper provides an overview of the optimization of several drilling process parameters. The most important control parameters influencing the surface roughness were identified using analysis of variance (ANOVA). In many of the research projects on the drilling process, design of experiments (DOE) and response surface methodology (RSM) methodologies are heavily utilized. During operation, variables including cutting speed, feed rate, drill diameter, depth of cut, and material type all affect drilling process quality. The researchers who conducted the literature review below worked on the drilling process while taking the aforementioned considerations into account. The Taguchi approach has been used in this paper to undertake parametric optimization of the drilling machining operation for Surface roughness (Ra). Mohd Amran Md Ali *et. al.,* [7], This study uses the response surface method to show how drilling parameters affect surface roughness and appearance (RSM). RSM approach was utilized to construct the mathematical model for correlating the effects of drilling factors such spindle speed, feed rate, and drill diameter on surface roughness since it is the most practical and efficient method for creating mathematical models. Additionally, this approach can lesser experiment trial and error. Adem Çiçek *et. al.,* [8], Using Taguchi experimental design, control factor interactions cannot be

predicted. RSM was used to ascertain the ways in which the variables interacted because of this. RSM is a technique for creating mathematical models that depends on the relationship among the independent variables (control variables and factors) and the dependent variable (response). The analysis of the response surface, which is derived from the findings of the design matrix, forms the basis of the model. These are produced based on the parameters that lies in the highest and lowest levels of the influencing factors. Xy stands for the feed rate, the cutting speed, and the heat treatments, respectively. when it was being developed for the experimental design. Himanshu Gupta *et. al.,* [9], Response Surface Methodology (RSM) is a group of statistical and mathematical techniques that can be applied to modelling and analysis of issues where the influence of multiple input variables on the output or response is present. The goal of RSM is to determine the relationship between the responses and the variables under investigation. It is a Design of Experiments (DOE) method for approximating an unknown function for which only a small number of values are computed. The response surface's least square errors fitting is then used to model these relationships. Since it provides a fairly precise estimate of all response variable averages linked to quantities determined during experimentation, a Central Composites Design (CCD) is used. Certain level modifications are permitted and can be used in the twostep chronological RSM, which is a benefit of CCD. With these techniques, it is possible that the tests will end after a limited number of runs and a determination of whether the prediction model is acceptable or not. Mohd Hairizal Bin Osman *et. al.,* [10], a Taguchi method optimization was conducted to identify the test parameters for AISI D2 tool steel accuracy in dry drilling. High accuracy hole diameter production for a range of spindle speed and feed rate values was the paper's stated goal. The drill bits are made of high-speed steel coated in titanium nitride, high-speed steel coated in titanium carbon nitride, and high-speed steel coated in titanium aluminum nitride. CNC Milling machine is used to perform the machining processes, and Coordinate Measuring Machine (CMM) is used for testing the diameter accuracy of holes. Agraharkar Ramakrishna *et. al.,* [11], In this work, the impact of cutting parameters on the drilling of Delrin material is discussed. The study examines the impact of drill diameter, point angle, spindle speed, feed rate, and depth of cut on the rate of material removal when employing twist drills made of (HSS). Different combinations of factors are taken into account in the Taguchi approach to achieve the greatest Material Removal Rate by L12 Orthogonal Array. To analyze the outcomes of the experiment, MINITAB V15 is employed. Signal-to-Noise (S/N) is used to analyze how drilling factors affect the caliber of the drilled holes. Mr. P. N. E. Naveen *et. al.,* [12], The use of lightweight, extremely robust, and reasonably priced composite materials is widespread in the automotive industry. It can be challenging to produce items of great efficiency and good quality using composite materials. The traditional drilling with twisted drilling procedure is a good choice for an economical and successful machining process. This research investigates the various drilling parameters, feed rate, spindle speed and damage factors. The reduction of the damage factor is the paper's primary goal. Mervin A Herbert *et. al.,* [13], In this study, carbon fiber - reinforced polymer composite is used in the operation to create holes for structural assemblies. The effect of the drill diameter, spindle speed, feed rate, and point angle on the thrust force and torque during drilling are the input parameters. The drills are made of solid carbide, and the workpiece is made of high speed steel (HSS). For the experimental layout, Taguchi L27 OA is used, and RSM is used to forecast cutting forces. The experimental results demonstrate that, for both HSS and solid carbide drills, drill diameter, spindle speed, and feed rate have empirical and physical relevance on thrust force and torque. Drills made of solid carbide may be the best option for producing precise holes for structural purposes. RSM may be used to accurately estimate torque and thrust force. Manoj Modi *et. al.,* [14], Optimizing is one of the best methods for raising product quality while lowering costs. This study discusses single response optimization of drilling parameters based on the Taguchi method and specifies an efficient method that can be applied. Spindle speed, tool diameter, and material removal rate are input characteristics that have an impact on the study paper. In experiments, the Taguchi L9 orthogonal array approach is applied. Analysis of Variance was used to determine the drilling parameters that strongly affect the output (ANOVA). N. Baskar *et. al.,* [15], CNC machines are now widely used in the manufacturing sector. Optimal machining parameters, tool shape, and cutting conditions are needed for industrial operations to run well. A very important responsibility is to offer the greatest items possible to the clients at reasonable prices. The workpiece material is EN8 steel, and the central composite process is employed for various combinations of the input parameters. And based on the outcomes of trials carried out throughout various

experimental runs, an empirical equation is developed. The genetic algorithm is employed to calculate empirical equations and to determine the best parameters. Saad Waqar *et. al.,* [16], RSM is an observational statistical tool that can be used to investigate how different factors interact and to optimize operational parameters. When numerous process variables may have an impact on a product's quality attributes, or reaction, response surface design might be helpful. RSM is a useful technique for assessing the process parameters with the fewest number of tests when multiple factors and interactions affect the intended responses for a particular process. We can collect data, estimate the second-order mathematical relationship between the response variables and process parameters, and determine the ideal conditions for the process parameters using a second-order response surface design. An effective three-level design for fitting second-order models is the Box-Behnken design. The structure of this paper is as follows; the second section contains information on the fuzzy approach and the suggested methodology. In the third section, a multiresponse surface methodology achieved by using fuzzy logic in machining is illustrated. At the conclusion, the results are presented and debated. Numan Habib Waqar *et. al.,* [17], The selection of cutting settings is crucial for producing holes of good quality and increasing output. In this study, it is examined how spindle speed and feed rate affect temperature, surface roughness, hole size, circularity, and chip formation when dry drilling grey cast iron ASTM A48. According to Analysis of Variance (ANOVA), the feed rate and spindle speed have the two largest percentage effects on temperature, respectively. All the characteristics are greatly influenced by the spindle speed and feed rate. Yogendra Tyagi *et. al.,* [18], This study focuses on drilling mild steel using CNC drilling machining operations and high-speed steel tools while using the Taguchi method. L9 Orthogonal Array and Analysis of Variance (ANOVA) are used to investigate the performance characteristics of different machining parameters. Multiple regression models are developed to estimate the projected values of surface roughness and material removal rate. R. Dhiliepan Waqar *et. al.,* [19], It was discovered that the Taguchi approach of experimental design centered on orthogonal arrays (OA) was more effective in resolving engineering issues. The use of orthogonal arrays during experiment design could significantly minimize the number of trials. Each column in orthogonal arrays represents the key determinants of the response. The degree of freedom would be determined by the quantity of elements and the quantity of fluctuations in their level. In the current work, L9 orthogonal arrays were used to implement three primary factors with three levels. The number of comparisons done between the design parameter at various levels in order to assess level improvement is known as the degrees of freedom. The standard method for determining degrees of freedom is that they must exceed the number of design parameters. However, it is typically one row less than the number of rows in an orthogonal array. Eight degrees of freedom are taken into consideration for the current investigation. Only the primary components and their interactions were excluded. C. Venkatesha Waqar *et. al.,* [20], Modern optimization techniques for material removal rate include Taguchi method, genetic algorithm, and response surface methodology. An experiment's cutting parameter can be optimized using the response surface methodology, a statistical technique. Response surface methodology is employed in the development of mathematical models. Depending on the number of parameters chosen, the generated model may be a first order or second order model. It is further classified into factorial, complete factorial, central composite, and box-Behnken designs. The experiment specifies that the aforementioned design be used. Nayan. G. Kaneriya, *et. al.,* [21], The tests in this paper were done on a VMC computer. The Response Surface Methodology fits established relationships between input and output parameters the best. To attain the highest Material Removal Rate and Lowest Temperature, mathematical model and parametric optimization were performed using MINITAB 16,14 software. Feed rate, spindle speed, and load are the parameters for the input. In dry drilling of AISI 304 austenitic stainless steel material for Cobalt coated HSS and K20 Solid Carbide drill as a tool material, relationship demonstrates that feed rate has a stronger influence on a twist drill bit temperature. Dong Pham van *et. al.,* [22], The author of this study used coated electrodes to investigate multitargeting choices in microEDM. A Ti-6Al-4V workpiece and an AlCrN-coated tungsten carbide (WC) micro tool electrodes were used in the experiments. To determine the optimal level of Output in micro-EDM, Deng's approach was applied. In order to obtain an appropriate optimal set of technical parameters, Taguchi and Deng's technique are integrated, which results in lower empirical research expenses. Voltage, capacitance, spindle rotation, and quality attributes under ideal conditions are among the optimal technological criteria, along with depth of machining and overcut. The

examination and comparison of the two ranking systems' efficacy as well as the S/N coefficient analysis should serve as the foundation for choosing the best set of technological parameters. M Parthiban Waqar *et. al.,* [23], This essay discusses micro-electric discharge machining (micro-EDM), a process that is frequently employed in the die and tool manufacturing industries. Copper 400-micron micro-Electrodes were employed with titanium alloy (Ti6AI-4v) as the performance material. This study examines the effects of three distinct input machining parameters on the performances of diametrical precision and tool wear, including pulse on time, pulse off time, and servo voltages of micro-EDM. Response Surface Methodology's BoxBehnken design is used to carry out the trials. The optimization process makes use of the neural network. According to the study, the parameters that have the greatest influence on TW and DA are pulse on time and servo voltage, with respective dominance rates of 40.56% and 50.69%. When compared to experimental results, the estimation of TW and DA was shown to have a maximal inaccuracy of 12.72% and 8.78%, respectively. Sara A. ElBahloul *et. al.,* [24], This paper's primary goal is to investigate the best operating conditions for thermal frictional drilling on AISI 304 stainless steel. The tests were carried out using the Taguchi experimental design method, and the fuzzy logic technique was used to evaluate the input parameters of the output axial force, radial force, diameter of the hole, dimensional inaccuracy, roundness error, and bushing length. You can use this study on a variety of bendable materials. Because the bushing length generated is greater than five times the workpiece thickness, experimental results demonstrate that this approach is simple, effective, and efficient for concurrent optimization of numerous quality criteria in the thermal friction drilling process. Sushant Sunil Patil *et. al.,* [25], This study compares the performance of tungsten carbide-tooled friction drill holes on aluminum alloy AISI 1008 and mild steel AISI 1005. The two key factors affecting the procedure are spindle speed and the tool diameter ratio of frictional drilled holes. In experiments, an L18 orthogonal array has been used. The Taguchi study revealed that M1S3F1, M2S3F1, and M1S2F1 are the ideal parameter settings for temperature, bush length, and hardness, respectively. Based on the input parameters of speed, feed, and material type, the regression equation for friction drilling operations is constructed and represented as coded values. The equation is quite helpful for choosing a specific type of input parameter.

Sr. No.	Paper Title	Author	Publication	Tool Material	Workpiece Material	Optimization Method
1.	Optimization Of Drilling Parameters for Minimum Surface Roughness Using Taguchi Method	Sumesh A S , Melvin Eldho Shibu	IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 12-20 (2016)	M35 HSS twist drills	Cast Iron using HSS twist drills, AISI 316 stainless steel, mild steel	Taguchi Method
2.	Multi-Objective parametric optimization during micro-EDM drilling of Ti-6Al-4 V using teaching learning Based optimization algorithm	Narendra singh, Pushpendra Bharti	The international journal of mechanical engineering and Science (JMES) (2022)	Brass tool	Titanium Alloy	Response Surface Methodology, Teaching Learning Based Optimization
3.	Drilling parameter optimization of AISI 310 Austenitic Stainless Steel using Taguchi Method	M. Hari Prasath , K.Ramesh , C.Ahilan	Pramana Research Journal (2019)	High Speed Steel	AISI 310	Taguchi Method
4.	A Study of Surface Roughness in Drilling of EN-9 Steel using Taguchi Approach	Ajinkya B. Kashmire, H. V. Shete, N. D. Jadhav	International Journal of Engineering and Advanced Technology (2017)	Tungsten Carbide	EN 9	Taguchi Method
5.	A Review on Optimization of Drilling Process Parameters of AISI 304 Austenite Stainless Steel by using Response Surface Methodology	Mr. N.S Kurzekar, Prof M.S Tufail	International Journal of Engineering Development and Research (2016)	M35 HSS twist drill	EN 31 Material, HSS tin coated drills	Response Surface Methodology
6.	A Study of Optimization of Drilling Process Parameters using Taguchi Method	Mr. Vinayak Samleti, Prof. V. V Potdar	Novateur Publications (IJIERT)(2016-17)	carbide tool	Grey cast iron	Taguchi Method
7.	Surface Roughness Optimization in Drilling Process Using Response Surface Method (RSM)	Mohd Amran Md Ali, Noraiham Mohamad, Mohd Asyadi Azam, Zulkeflee Abdullah	Jurnal Teknologi (Sciences & Engineering) 66:3 (2014)	twist drill HSS	drill bit	Response Surface Methodology

8.	Optimization of drilling parameters using Taguchi technique and response surface methodology (RSM) in drilling of AISI 304 steel with cryogenically treated HSS drills	Adem Çiçek, Turgay Kıvak, Ergün Ekici	Journal of Intelligent Manufacturing (Research Gate) (2016)	AISI 304 austenitic SS, M35 HSS Twist drills	AISI 304 Cryogenically treated HSS	Response Surface Methodology, Taguchi Method
9.	Optimization of Influencing Drilling Parameters in HSS T1 Using Response Surface Methodology	Himanshu Gupta, Umesh Kumar Vates, Shubham Sharma, Gyanendra Kumar Singh and Vivek Kumar	Middle -East Journal of Scientific Research (IDOSI PUBLICATIONS) (2016)	HSS T1 Grade with tungsten carbide drill bit	HSS T1	Response Surface Methodology
10.	Optimization of Drilling Parameters on Diameter Accuracy in Dry Drilling Process of AISI D2 Tool Steel	Mohd Hairizal Bin Osman , Mohd Hidayat Bin ab Rahman , Mohd Nazri Bin Ahmad , Mohammad Khalid Bin Wahid , Nurul Ain Binti Maidin	International Journal of Applied Engineering Research (2017)	High Speed Steel	AISI D2	Taguchi Method
11.	Experimental Investigation to Optimize process Parameters in Drilling Operation for Composite Material	Agraharkar Ramakrishna , Dr. N. A Rawabawale , S. M. Nagure	International Research Journal of Engineering and Technology (2020)	High Speed Steel	Delrin (acetal homopolymer) Composite	Taguchi Method
12.	Experimental Investigation of Drilling Parameters on Composite Materials	Mr. P. N. E. Naveen , Mr. M. Yasaswi , Prof. R. V. Prasad	IOSR Journal of Mechanical and Civil Engineering (2012)	Carbide Drills	Fibre Reinforced Plastics (FRP) Laminates	Response Surface Methodology
13.	Experimental Investigation in Drilling of Carbon Fibre Reinforced Polymer Composite using HSS and Solid Carbide Drills	Mervin A Herbert , Divakara Shetty , Vijay G S , Raviraj Shetty , B Shivamurthy	International Journal of Current Engineering and Technology (2015)	HSS and Solid Carbide Drills	Carbon Fibre Reinforced Polymer Composite	Response Surface Methodology, Taguchi Method

14.	Parametric Optimization in Drilling of Al–SiC Composite Using Taguchi Method	Manoj Modi , Gopal Agarwal , V.Patil , Umesh Bhatia , Rishabh Pancholi	International Journal of Scientific & Technology Research (2019)	High Speed Steel	Al-SiC	Taguchi Method
15.	Optimization of Machining Parameters on EN8 Material Using Genetic Algorithm	N. Baskar, R. Prabhu, R. Vaiysnavan, R. Prakash, T. Naveen Kumar	International Journal of Engineering Research & Technology (IJERT) (2015)	HSS	EN8	Taguchi Method
16.	Effect of Drilling Parameters on Hole Quality of Ti-6Al-4V Titanium Alloy in Dry Drilling	Saad Waqar, Saad Asad, Shamraiz Ahmad, Ch Asad Abbas, Hassan Elahi	Materials Science Forum (2016)	Tungsten Carbide (C3/C11/C12)	Ti-6Al-4V	Response Surface Methodology
17.	Assessment of Hole Quality, Thermal Analysis, and Chip Formation during Dry Drilling Process of Gray Cast Iron ASTM A48	Numan Habib, Aamer Sharif, Aqib Hussain, Muhammad Aamir, Khaled Giasin, Danil Yurievich Pimenov	Multidisciplinary Digital Publishing Institute	HSS	ASTM A48 Grey Cast Iron	Teaching Learning Based Algorithm
18.	Parametric optimization of CNC Drilling machine for mild steel using Taguchi design and Single to Noise ratio Analysis	Yogendra Tyagi, Vedansh Chaturvedi, Jyoti Vimal	International Journal of Engineering Science and Technology (IJEST) (2012)	HSS	Mild Steel	Taguchi Method
19.	Optimization of drilling parameter for improving MRR on Teflon using Taguchi Design	R. Dhiliepan, A. Abdul Hakeem, R. S. Balasubramaniam, M. Ganesan, S. Kartikeyan, N. Baskar	IJARMATE (2016)	HSS	Teflon	Taguchi Method
20.	Optimization of micro drilling parameters of B4C DRMM Al 6063 composite	C. Venkatesha, N. M. Arunb, R. Venkatesanc	Elsevier (2014)	Boron carbide, Aluminium 6063	Composite material boron carbide	Taguchi Method, Fuzzy Logic Technique

	in μECM using Taguchi coupled Fuzzy Logic					
21.	Optimization of drilling parameters using response surface methodology	Nayan. G. Kaneriya	IJSRD (2018)	HSS, Cobalt coated HSS and K20 Solid carbide drill tool material	AISI 304 Austenitic stainless steel plate	Response Surface Methodology
22.	Multi-objects optimization in μEDM using AlCrN coated tungsten carbide electrode by tungsten method	Dong Pham van, Shailesh Shirguppikar, Phan Nguyen Huu, Minh Nguyen Duc, Tai Bui Tien	EDP Science (2022)	ALCrN coated Tungsten Carbide	Ti-6A1-4v Titanium alloy	Taguchi Method
23.	Optimization of micro-EDM drilling on titanium alloy using RSM and Neutral Network	M Parthiban, M harinath	ICAPSM Journal of Physics: conference series (2021)	Copper Material	Ti-6A1-6v grade 5 titanium alloy	Response Surface Methodology
24.	Optimization of Thermal Friction Drilling Process Based on Taguchi Method and Fuzzy Logic Technique	Sara A. El-Bahloul, Hazem E. El-Shourbagy, Tawfik T. El-Midany	International Journal of Science and Engineering Applications (2015)	uncoated tungsten carbide	AISI 304 Stainless steel	Taguchi Method, Fuzzy Logic Technique
25.	Optimization and thermal analysis of Friction Drilling on Aluminium and Mild Steel by using Tungsten Carbide Tool	Sushant Sunil Patil , Vinayak Bembrekar	IRJET (2016)	Tungsten carbide tool	AISI 1008 Aluminium, AISI 1015 Mild steel	Taguchi Method

3. SUMMARY

After studying the above literature, it is found that; very less work is done on workpiece material Titanium Alloy and this material have more application. Very less work is done on tool material Tungsten Carbide (C3/C11/C12) and Cobalt (M35/M42) and it is also suitable for the given workpiece material. Researchers have used various methods for the optimization of drilling process, but very less work is done using Response Surface Methodology as optimization technique. One can use this paper for improvising the existing ways used for drilling and also to improvise the method of optimization used and can make it better and standard for effective use.

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