IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 10, Issue 1, January 2020, ||Series -IV|| PP 29-32

Optimization of Crankshaft Oil Hole Drilling Process- A Review

Mr.Prashant H. Bhole, Dr.Gopal E.Chaudhari
Research Student, Department of Mechanical Engineering, KBC North Maharashtra University, J.T.Mahajan college of Engineering, Nhavi Marg Faizpur Maharashtra, India.425524
Associate Professor, Department of Mechanical Engineering, KBC North Maharashtra University, J.T.Mahajan College of Engineering, Nhavi Marg Faizpur Maharashtra, India.425524
Received 02January 2020; Accepted 16 January 2020

Abstract: Crankshaft oil hole drilling process is one of the important step in crankshaft manufacturing process. Drill bit failure or breakage is one of the sensational issues in crankshaft oil hole drilling process. It can be minimized by controlling some input parameters. With minimization of drill breakage, productivity also should be maintained. Therefore it is necessary to optimized drilling parameters to improve drill bit life and productivity as well. This paper review the research work completed by previous researcher in optimizing drilling parameters. In past, researcher has been used the conventional multi objective optimization methods, but each methods has its limitations. From review of these papers it is observed that MOORA and TOPSIS are effective methods among other multi objective optimization methods.
Keywords: Crankshaft oil hole drilling, MOORA, TOPSIS

I. INTRODUCTION

Crankshaft is a important components for an internal combustion engine which converts reciprocating motion caused by the piston to the rotary motion which is further delivered to the wheels of the vehicle through the transmission system. Crankshaft rotates at very high speed during engine's operation and unbalanced crankshaft can cause the high amount of vibration and decrease the overall efficiency of the engine. There are various bearings and connecting rods that are associated with the crankshaft. Bearings are connected to the smooth rotation of the crankshaft and connecting rods are connected for the transfer of linear (reciprocating) motion from the piston to the crankshaft. For proper functioning and movement of bearing and connecting rod proper amount of lubrication has to be provided. The lubricating oil from the engine swamp is provided to connecting rod and bearing through various holes drilled in the crankshaft. Oil Hole Drilling provides passage to the lubricating oil to flow through the crankshaft to the position where bearings and connecting rods are attached thus providing lubrication for bearing and connecting rods.

These oil holes have very high length to diameter ratio. Drilling length is 20 times of the hole diameters. Therefore this oil hole drilling process may be treated as deep hole drilling process. Optimization of drilling process parameters is necessary to improve the performance of the process. Performance crankshaft oil hole drilling process can be improved by minimizing the problems occur in this drilling process.

Extreme values of design criteria can be solved by optimization. However, there are multiple conflicting criteria that need to be handled. When we satisfying one of these criteria, it may be comes with expense of another criteria. Such conflicting objectives are solved by Multi-objective optimization which provides a mathematical model to obtain optimal solution for the problem which satisfies the various criteria required by the application. Therefore, multi-objective optimization is the process of optimizing to get the collection of objective functions.

The objective of this paper is to summarize the problems occurs in deep hole drilling process, methodology which followed by previous researcher to solve these problems or optimization etc, by reviewing their work.

II. LITERATURE REVIEW

In this paper, previous research work is divided in to three categories.
Category I- research work in crankshaft oil hole drilling
Category II- research work in deep hole drilling process
Category III- research work in multi objective optimization methods in drilling

Category I- research work in crankshaft oil hole drilling

Very less work has been done on optimization crankshaft oil hole drilling process. However researcher found out solution to many problems occur in this process. Wei hang et al [1] identified the problems of heat dissipation and drill tip strengthening when deep-hole drilling on manganese steel. higher cutting resistance and poorer heat conductivity of this material were the reasons for these problems. They investigated the characteristics of manganese steel drilling and noval gundrill point was developed. Authors confirmed that gundrill life was improved by 33% in comparison with conventional drill point. P.L. Rupesh et al [2] studied the drill breakage issue in Volvo crankshaft oil hole drilling process. He found out some reasons for drill breakage such as point angle, honing angle, speed, coolant etc. By eliminating these reasons, drill breakage issue can be reduced by 73 to 75%. Hemank raj [3] studied the minimum quantity lubrication system in crankshaft oil hole drilling process. He concluded from his experiments that MQL is cost effective, requires less space, safe for operators than conventional wet type lubrication systems. Bruce L. Tai [4] summarized the advancements and challenges of MQL system in powertrain machining. He mentioned two major challenges, cooling and chip evacuation ability during MQL machining.

Category II- research work in deep hole drilling process

Deep hole drilling process is the process in which length to diameter ratio is more than 20. As in crankshaft oil hole drilling process, length to diameter ratio is more than 20, it can be treated as deep hole drilling process. For deep hole drilling process researcher used different machineries and technique.

Ultrasonic deep hole drilling was studied by U. Heisel et al [5]. For experimental work, authors took electrolytic copper ECu 57 material. Machining results was improved by optimizing vibration amplitude, cutting speed and chip form. P. Kuppanet al [6] investigated the effect of EDM process parameters in deep hole drilling of Inconel 718 material. Desirability function approach was used to optimize the process parameters for maximize material removal rate with desired surface roughness. Duck Whan Kim et al [7] proposed the peck drilling for improving tool life through the analysis of thrust force. One step feed length, for stable machining, was determined to be about a tenth of the tool diameter. Authors conducted the experiments at various cutting conditions and conclude that monitoring system was the effective way to improve tool life. L. Francis. Xavier [8] reviewed the literature on conventional deep hole drilling process. He found that coolant through spindle, drill tip geometry, tooling coating and cycle selection were effective parameters to improve deep hole drilling process.

Tauseef Aized et al [9] investigated the deep hole drilling process for AISI D2 material by taking different input parameters in account. Authors used response surface based design of experiments to obtained better hole quality. Their work concluded that spindle speed and feed greatly influence the quality of drilled hole. Grey relation analysis method was used by Mustafa Ay et al [10] to optimize micro EDM drilling process of Inconel 718 nickel based supperalloy for improving hole quality. It was observed that pulse current was the most efficient on performance characteristics. Arshad Noor Siddhique et al [11] studied the optimization of deep drilling parameters based on Taguchi method for minimizing surface roughness. They conducted the experiment by using solid carbide cutting tool. Results of ANOVA indicates that speed was the most significantly affecting factor. Surface roughness was reduced by 71.97%. Investigation of optimum EDM drilling process parameters was done by Jagmeet singh et al [12] to obtain maximum machining rate and minimum erosion wear rate. Authors used Taguchi method followed by grey relation analysis. Tungston carbide drill was used for the experiments.

A.D.Lukyanov et al[13] discussed the feature of optimization of deep hole drilling process which performs the extraction of tool from hole on reaching the critical value of torque. A numerical calculation was performed and the dependence of hole drilling time by vertical feed was obtained. R. Heinemann et al [14] studied the effect of MQL on tool life of small twist drill in deep hole drilling. They concluded that discontinuous supply of coolant brings about significant reduction in tool life compared to continuous supply of MQL. MQL with high water content and low viscosity had a beneficial effect in deep hole drilling and had improved penetration capability.

Category III- research work in multi objective optimization methods in drilling

A multiple-objective optimization problem starts when a decision maker has to take some decision. The decision maker may have to consider number of criteria for which different alternatives may be available. But it may satisfies all the criteria or some of them. At this situation, decision maker have to take decision, which alternative would best satisfies the all criteria. For this purpose many methodologies may be used. These all methodologies within multi-objective optimization analysis have similar steps of organization and construction of decision matrix, but each methodology uses given information differently. There are many multi objective optimization methods has been used to improve the performance of machining process. Among that, GRA, TOPSIS are most effective methods.

Previous researchers were used different methods for making drills in different materials. M. Priyadarshini et al [15] studied the drilling using laser technique. They compared hybrid optimization approach for determining the optimal process parameters which minimizes HAZ and hole circularity with maximizing material removal rate in a pulsed Nd YAG laser micro drilling of high carbon steel. Pulse width, number pulses, assist gas flow rate and its pressure were considered as input parameters. The experimental results obtained from design of experiment were used in Fuzzy-TOPSIS methodology to determine the optimized parameters. Optimization of laser micro drilling on nickel alloy C263 with thermal barrier coating TBC was studied by K. Parthiban et al [16]. TOPSIS was used for optimization. The surface roughness and surface crack density were performance characteristics. In their work, authors suggested that for reduced surface roughness and surface crack density, optimal parameters. They found from ANOVA, inclination angle and number of passes were the major influencing factors. Their work exhibited a 19% improvement in surface fin5sh and 12% reduction in surface crack density.

A multi performance characteristics optimization based on Taguichi approach with grey relation analysis for drilling process of Inconel 625 was proposed by N. Manikandan et al [17]. Taguchi method was used to plan the experimental run. Four performance characteristics such as MMR, surface roughness, overcut, form & orientation tolerances were considered. Muliple regression models were developed. To validate the result, a conformation test was conducted which conform that there was considerable improvement in performance characteristics. Milos Madic et al [18] in 2015studied the multi objective optimization methods in laser drilling. In his study, AHP was used to weighting the criteria. For optimization WASPAS and OCRA methods have been applied. Experimental run indicates that CO_2 laser cutting of 3 mm thick aluminums alloy plate is to be performed by using cutting speed of 3 m/min, laser power of 3 kW and assist gas pressure of 6 bar. There exists a perfect correlation between rankings obtained by WASPAS and OCRA methods.

Maheswara Rao [19] had usefully applied Multi objective optimization methods to improve quality of machining process in terms of Material removal rate, Ra and Rz. Experiments were carried out on CNC lathe. Three MOOM methods had been applied i.e WSM. WPM, TOPSIS. All methods gave the same optimum parameters for multi-response. M. Saravanan et al [20] studied the multi objective optimization of drilling parameters using genetic algorithm. They optimized the drilling parameters for reducing delaminaion and eccentricity problem in CFRP. They also maximized material removal rate. Feed rate and torque had been selected as input parameters. Their investigation was compared with numerical methods and soft computing techniques.

III. RECOMMENDATION

In future, research work will involve the investigation of process parameters for improving crankshaft oil drilling process by minimizing the problems occurring during the operations like drill bit breakage and less productivity. In addition, work could be extended by applying multi objective optimization methods to optimize the drilling process parameters and to find most influencing parameter among them which are responsible for problems in crankshaft oil hole drilling process**.**

IV.CONCLUSION

Literature review indicates that many authors show their interest in optimization of deep hole drilling process on EDM or ECM machine but very few works has been done on crankshaft oil hole drilling process. So there is much gap in research on crankshaft oil hole drilling process. Very less work has been done to optimize the process parameters for minimizing the problems occurring during the crankshaft oil hole drilling process. It is observed that MOORA and TOPSIS are effective methods among other multi objective optimization methods but they have their own limitations which can be removed coupling them different criteria weighting methods like PCA, CCSD.

REFERENCES

[1]. Wei Zhang , Fengbao He, Dilin Xiong, "Gundrill life improvement for deep-hole drilling on manganese Steel", International Journal of Machine Tools & Manufacture 44 (2004) 327–331

[2]. Rupesh. P. L, k. Raja, m. Thamaraikannan & k. Logesh, " elimination of drill breaking issue during oil hole drill in volvo crank shaft", International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) ISSN (P): 2249-6890; ISSN (E): 2249-8001, Vol. 8, Issue 4, Aug 2018, 625-634

[3]. Hemank Raj, "A Comprehensive Study of Minimum Quantity Lubrication System in Oil Hole Drilling Machine in Crankshaft Manufacturing Process", International Journal for Scientific Research & Development| Vol. 5, Issue 10, 2017 | ISSN (online): 2321-0613, 727-730

[4]. Bruce L. Tai, David A. Stephenson, Richard J. Furness, Albert J. Shih, "Minimum Quantity Lubrication (MQL) in Automotive Powertrain Machining", 6th CIRP International Conference on High Performance Cutting, HPC2014, 523 – 528

[5]. U. Heisel (1), J. Wallaschek, R. Eisseler, C. Potthast, "Ultrasonic deep hole drilling in electrolytic copper ECu 57",CIRP Annals - Manufacturing Technology 57 (2008) 53–56

[6]. P. Kuppan, A. Rajadurai & S. Narayanan," Influence of EDM process parameters in deep hole drilling of Inconel 718", Int J Adv Manuf Technol (2008) 38:74–84

[7]. Duck Whan Kim, Young Soo Lee, Min Soo Park, Chong Nam Chu, "Tool life improvement by peck drilling and thrust force monitoring during deep-micro-hole drilling of steel", International Journal of Machine Tools & Manufacture 49 (2009) 246–255

[8]. L. Francis Xavier, "Effective Parameters For Improving Deep Hole Drilling Process By Conventional Method - A Review", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 2 Issue 3, March – 2013

[9]. Tauseef Aized & Muhammad Amjad, "Quality improvement of deep-hole drilling process of AISI D2", Int J Adv Manuf Technol (2013) 69:2493–2503

[10]. Mustafa Ay, Ulaş Çaydaş & Ahmet Hasçalık, "Optimization of micro-EDM drilling of inconel 718 superalloy", Int J Adv Manuf Technol (2013) 66:1015–1023

[11]. Arshad Noor Siddiquee, Zahid A. Khan, Pankul Goel, Mukesh Kumar, Gaurav Agarwal, Noor Zaman Khan, "Optimization of Deep Drilling Process Parameters of AISI 321 Steel using Taguchi Method", 3rd International Conference on Materials Processing and Characterisation (ICMPC 2014), Procedia Materials Science 6 (2014) 1217 – 1225

[12]. Jagmeet singh, Arun Kumar, "Optimization of Process Parameters for Deep hole drilling using drill EDM for Maximum machining rate and minimum EWR on Tungsten Carbide", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 p-ISSN: 2395-0072, Volume: 04 Issue: 07, July -2017, pp1783-1785

[13]. A.D. Lukyanov, T.S. Onoyko, T.A. Najafabadi, "Optimization of Processing Conditions when Drilling Deep Holes: Twist Drills", International Conference on Industrial Engineering, ICIE 2017, International Conference on Industrial Engineering, ICIE 2017

[14]. R. Heinemanna,, S. Hinduja, G. Barrow, G. Petuelli, "Effect of MQL on the tool life of small twist drills in deep-hole drilling", International Journal of Machine Tools & Manufacture 46 (2006) pp 1–6

[15]. M. Priyadarshini, P.P. Tripathy, D. Mishra, S. Panda, "Multi characteristics optimization of laser drilling process parameters using Fuzzy-TOPSIS method", Materials Today Proceeding, volume 4 issue 8, 2017, pp 8538-8547.

[16]. K. Parthiban, Muthukannan Duraiselvam, Manivannan Raja, "TOPSIS based parametric optimization of laser micro-drilling of TBC coated nickel based superalloy", Optics & Laser Technology, 102:32-39 · June 2018

[17]. N.Manikandan, S.Kumanan, .Sathiyanarayanan, "Multiple performance optimization of electrochemical drilling of Inconel 625 using Taguchi based Grey Relational Analysis", Engineering Science and Technology, an International Journal, Volume 20, Issue 2, April 2017, Pages 662-671.

[18]. M. Madić, M. Radovanović, D. Petković, B. Nedić, "Multi-Criteria Analysis of Laser Cut Surface Characteristics in CO2 Laser Cutting of Stainless Steel", Tribology in Industry , Vol. 37, No. 2 (2015) pp 236-243.

[19]. Maheswara Rao, K. Jagadeeswara Rao, K. Laxmana Rao, "Multi-objective optimization of MRR, R_a and R_z using TOPSIS", international journal of engineering sciences & research technology, ISSN: 2277-9655, 5(9): September, 2016, pp 376-384.

[20]. M.Saravanan, , G.Manikandanm, R. RinuKaarthikeyen, "Multi Objective Optimization of Drilling Parameters Using Genetic Algorithm", Procedia Engineering, Volume 38, 2012, Pages 197-207.

Mr.Prashant H. Bhole, et.al. "Optimization of Crankshaft Oil Hole Drilling Process- A Review". *IOSR Journal of Engineering (IOSRJEN)*, 10(1), 2020, pp. 29-32.