Optimisation of Laser cutting on CFRP and Investigation of cutting parameters

Ashraf Shahe[1], Jagmeet Saini[2], Kajal Kunwar[3], Ravikant Vishwakarma[4], .Madhukar Sorte[5]

[1]Student, Saraswati College of Engineering, India, asbmw04@gmail.com
[2]Student, Saraswati College of Engineering, India, jssaini942@gmail.com
[3]Student, Saraswati College of Engineering, India, kunwarkajal1995@gmail.com
[4]Student, Saraswati College of Engineering, India, ravikantv6396@gmail.com
Asst.Professor, Saraswati College of Engineering, India, madhukar.sorte@gmail.com

Abstract: This Research paper aims to study the effects of laser cutting/ drilling on a composite fiber reinforced polymer. It is super strong and light weighted material which has multiple applications. It is used in various industries such as aerospace, automobile and curl. CFRP has a very good strength to weight ratio. The conventional methods for CFRP is difficult but laser cutting offers an alternate method in which quality cut can be obtained by controlling different process parameters. Fibers are lightweight, stiff, and strong, which provide most of stiffness and strength of the composite laminates. The polymer matrix binds the fibers together thus transferring load to reinforced fibers, and providing protection from environmental attack to fibers. Thermoset and thermoplastic are two kind of polymer matrix materials used most commonly. Thermoplastic polymers, however, are available which combine better mechanical properties, environmental resistance, temperature performance and processebility.Optimisation is possible on the basis of Taguchi method.

Keywords: - CFRP, Laser cutting, Taguchi method, Optimisation.

Introduction

Carbon fiber reinforced composite are easy to replace metallic components in many industries for past several year. Compared to metal, Carbon fiber reinforced composite have low density, high specific strength and stiffness, high corrosion resistance. The polymer matrix binds fibers together thus transferring load to reinforced fibers and providing protection form environment attach to fiber. During conventional machining damages such as delamination and pull out occur this may reduce strength against fatigue, this degrading long term famous _____ of composite laminats. The delamination effect is a serious issue which may lead to damage in layers. CFRP is proved to be good for environment and energy related applications like wind power blades, tidal power blades , fuel cells tube trailer tank, battery charging flywheel and electric cable core. CFRP had also found its application in automobile parts like car body, frame, hood, roof, and body panel for bus, propeller shaft, compressed natural gas tank, radiator core support, and chassis. They are also used in sporting goods like ski, bicycle, fishing rods, hockey sticks, badminton rackets, and golf shaft. Because of its key properties of high strength to weight ratio it has gained the attention of aerospace and aeronautical industries.

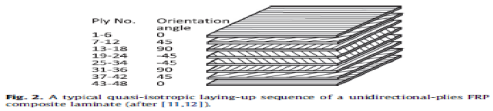

Fig. 2. A typical quasi-isotropic laying-up sequence of a unidirectional-plies FRP composite laminate (after [11,12]).

Literature review

Yue Lui, et al [1] observed that compared to metals fiber reinforced metals have various alpha properties which promises increase and enhancement. he concluded From various experimentation done by research team it is clear nanoclay properties of CFRP are showing promising increase and enhancement.

Saleel Visal, et al [2] derived that CFRP which are modified shows netter mechanical properties which have not been modified. Composite papers which are modified, shows better mechanical properties than unmodified.

B.V.Kavada,A.B.Pandea ,M.V.Tadavia ,H.C.Jakhari [3] says that Composites have been widely used in engineering application such as automotive, aircraft and manufacture of spaceships and sea vehicles' industries due to their significant advantages
he concluded thatIt is an outstanding technology capable of improving productivity and lowering production costs.

Paul Theophilus [4] observed that The principal aim of this work is to present a review of the literature of the past 30 years on drilling of carbon fibre reinforced plastic composites. he also concluded that Hence machining at higher speed, harder tool material and lower feed rate have lesser delamination of the GFRP.

Paulo C. Priarone, et al [5] displayed various mechanical properties of advanced composite material on order to improve the surface quality of machining done. He concluded that Aiming to improve the surface quality/integrity of the machined holes

Kishore Kumar, et al [6] showed us that drilling is the most commonly employed machining operation for polymer composite. An overview of mechanical drilling is also observed for CFRP and other composite laminates as well.

L. Francis Xavier 1 D. Elangovan, et al [7]gave a review of the literature on the conventional deep hole drilling process to produce small deep holes was conducted. He concluded Coolant through the spindle, drill tip geometry, carbide tooling, coatings and cycle selection are important factors when drilling deep holes.

B.V.Kavada,A.B.Pandeya ,M.V.Tadavia , H.C.Jakharia, dec et al, [8] they gave a bore holes having large length to diameter ratio, deep hole drilling process is used in industries. He concluded that Machine tool rigidity has a major impact on deep hole drilling because the less stable the foundation of the machine.

V. Senthilkumar, et al, [9] reviewed that Laser cutting is a thermal based non-contact process capable of cutting complex contour on materials with high degree of precision and accuracy. He concluded that The performance of laser cutting process depends on the input process parameters like laser power, cutting speed, assist gas pressure etc

Chithirai Pon Selvan M, Nethri Rammohan and Sachidananda

HK, et al [10] observed that laser beam machining on the various properties that affect the quality of the process such as heat affected zone formed in the work-piece, laser cut quality and why laser beam machining is more advanced than the other machining processes. he concluded that LBM being a flexible process, the various input parameters can be altered to improve the surface quality, decreased HAZ and other output parameters and is widely used in various industries.

K. Tschirpke, R. Hellmann et al [11] reviewed that optimization study of laser cutting thin layers using a design of experiment approach (DOE). He concluded that we have optimized the laser cutting of thinlayers in a comparative study using both fiber and CO2 lasers

M. T. Shete, et al [12] gives a overview to select best method for Laser cutting. The important characteristics of _____ of laser cutting are surface roughness. He concluded that The importantcharacteristics of interest for laser cutting process study are surface roughness and Better quality cuts can is obtained by using inert assist gases.

Shubham Wadekar1 & Swapnil U. Deokar, et al [13] give a review on To investigate the effect of parameters associated with the laser cutting process and concluded that It has been found that most of the experimental studies on laser cutting are based on the one parameter at a time approach.

S. Ragunath, et al [14] mainly covers on drilling process which causes on drilling process which causes delamination failure on fiber reinforced polymer. The delamination factor is more on exit than on entry at pane of drill but in conventional drilling.

S. Keerthi Vasan, et al [15] deals with issue related to drill point angle, feed ____ which observed in various parts of composites. She concluded that Delamination observed in various parts of the composites, it is found that delamination occurs more in exit part more than the entry part of the drilled hole.

Umashankar M. Rawat*, V.V. Potdar, et al [16] gave a review the literature on optimisation of cutting parameter in machining using taguchi method. RThey concluded that We have observed have taken the input parameter (contolable factors); cuting speed, feed rate and depth of cut.

K. lipin and Dr. P. Govinda, et al, [17], deals with the issue of Taguchi methods are widelyused for design of experiments and analysis of experimental data for optimasation of processing conditions. they concluded that Taguchi methods has been used to determine the main effects, significant factors and optimum machining conditions to obtain better performances

Ng Chin Fei,1 Nik Mizamzul Mehat,2 and Shahrul Kamaruddin1, et al [18], he dealed with In order to further enhance the effectiveness and robustness of the optimization process, other approaches can be incorporated with the Taguchi method and concluded on A systematic methodology exploring the relationship between parameters and identifying the optimal process conditions is proposed in the optimization of processing parameters, that is, the Taguchi method.

3. Conclusion

4.References

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