CHAPTER 2

LITERATURE SURVEY

2.1 REVIEW OF LITERATURE

Subramanian Gopalakannan et. al. (2012) investigated about the effect of electrode material on electrical discharge machining of 316 L and 17-4 PH Stainless Steel. According to this the result reveals that high material removal rate have been obtained with copper electrode whereas copper-tungsten yielded lower electrode wear, good surface finish and dimensional accuracy. Also it has been observed that output parameter such as electrode wear of EDM increases with increase in pulsed current.

Roger kern (2008) suggested in tech tips that it is a source of important ideas, techniques, and procedure designed to advanced EDM knowledge. It is very important to select the proper electrode material for appropriate die-sinking EDM. This article will search the properties of metallic and graphite electrode materials as well make applications recommendations.

Steve Slate (2002) suggested in the article that if the job has a large cavity without critical dimensions and fast machining is the goal, then electrode wear or tool wear will not be as higher as it would be to a workpiece with complicated feature or thin and deep ribs. However, it is still more important to understand that how and why wear in electrode performs in order to get maximum efficiency.

Gao et al (2008) used an optimization model in electrical erosion machining process, which are ANN model(artificial neural network) and GA(genetic algorithm). It has been reported that ANN helps to represent the relationship between metal removal rate and input parameters whereas GA helps to optimize the parameters, so that optimization results are obtained.
J. Prohaszka et. al. (1997) reported that electrode material will effect on machinability in wire electrical discharge machining. It is suggested that use of proper electrode material will improve the performance of wire EDM. In this paper all effects of the properties of electrode material have been presented by experimental results.

Jatinder et al. (2011) brought out and magnified the developments of EDM wire from copper to brass followed by brass to other coated wires which in turn helped the wire EDM machining providing high speed production, improved contour accuracy and also improving surface finishes. Moreover, high performance wire electrodes along with the increasing electrical discharge machining productivity have been presented as well.

Elman C. Jameson (2001) cleared the basic fundamental of Electrical Discharge Machining. This Book has given the knowledge of die-sinker and wire EDM. Book has explained difference between die-sinker and wire EDM also. Book has covered knowledge of behind spark, how it is controlled, what causes overcut, and the importance of die-electric fluid. It clearly explains the basic element of EDM. All process and description communicate better about EDM to non-engineers on the shop floor.

Kuldeep Ojha et. al. (2010) developed metal removal rate in sinking EDM. He has investigated that Metal Removal Rate (MRR) is an imperative factor in EDM operation. It has explored that if MRR is improved than efficient work will be more by EDM with a lessening wear in tool and enhanced surface value. The research paper is originated on the only advance in MRR by changing difference input factor.

Danial Ghodsiyeh et. al. (2013) reviewed the research trends in wire EDM on relation between different parameters, include wire speed, dielectric flow rate, peak current, servo voltage, pulse off-time, pulse on-time on different process responses include MRR, Surface Roughness, (WWR) Wire Wear Ration, and Surface integrity factors. Research paper highlights the different modeling and optimization methods and their advantage and disadvantage.
Jujhar Singh et. al. (2012) investigated that the effects are studied with high chromium steel as workpiece and copper as tool electrode. For this work L-18 array of orthogonal based on Taguchi design of the experiment is used to perform a sequence of experiments and the experimental facts are scientifically analyzed by ANVOA. The result indicates that discontinuous ultrasonic assisted EDM has higher MRR, higher TWR with the extra number of micro cracks as compared to ultrasonic pulsations.

H. S. Liu et al. (1997) explored the monitoring of Spark Erosion Machining process by means of an abductive network. The voltage and current across the gap between electrode and workpiece are fed into the developed network for the recognition of various pulse types in EDM. The result shows that EDM pulse can be cleared classified even with different machining conditions.

Khalid Hussain Syed et. al. (2012) showed the experimental investigation on the addition of powder of the aluminum metal to dielectric liquid in EDM. In the experiment, the author has used W300 die-steel as a workpiece and copper as an electrode. The experimental result shows that the performance of working is affected significantly by polarity. To get maximum machining rate and minimum EWR, single-to-noise ratio and the analysis of variance is used to achieve the optimal levels for the process parameter as well.

Saeed Daneshmand et. al. (2013) used Ni-Ti alloy as a work piece material. This alloy has important characteristics such as high electrical resistance, high corrosion resistance, long fatigue life, vibration absorption as well. All the process responses have been investigated on different process parameters. In results the surface roughness indicates that pulse on and pulse off have the highest impact on the roughness of surface of Ni-Ti alloys.

Kumar Sandeep (2013) reviewed on current research developments in electrical discharge machining. This paper reviewed the vast array of research work carried out within past decades for the improvement of EDM. Experimental study is mainly concentrated on aspects related to surface quality and MRR which are the most important factor for selecting the optimum condition of processes as well as economical aspects. It explored the research trends in EDM.
Manish Vishwakarma (2012) studied the impact of working input factors of a copper tool on MRR of EN-19 monitored by optimization. The value of EDM operation with tungsten copper tool is valued in terms of the MRR. In the current study the process factors such as peak current, voltage space, pulse on-time, duty cycle and flushing force have been selected. The research is passed out by employing the response surface methodology and ANOVA consideration.

D.V.Ghewade et. al. (2011) brought out the influence of several parameters on the machining characteristics. In which the cutting of INCONEL 718 material using a copper electrode on EDM by Taguchi methodology has been reported. Also, it revealed the effects of peak current on MRR and also pulse on-time affecting the EWR significantly.

Amandeep Singh et. al. (2012) reviewed the recent Advancements in Electrical Discharge Machining bringing out and highlighting several advancements and changes in its machining process so far.

K.S. Banker et. al. (2013) depicted the performance capabilities of different electrodes on EDM where the objective was the removal of metal in a more efficient manner, improved surface quality and reduced tool wear. Various different electrode materials were used for experimentation.

H.S. Payal et. al. (2008) determined the several dissimilar restrictions affecting surface roughness and structural analysis and was conducted on EN-31 tool set with different materials and the detailed analysis of structural feature of machined surface was done by using Scanning Electrode Microscope.

Bhola Jha et. al. (2011) depicted and overviewed the research design and manufacturing of an electrode in Die-Sinking Spark Erosion Machining. The optimization is done for improvement for its electrode design and manufacturing.
S.H. Tomadi et. al. (2009) analyzed the impact of several EDM factors such as machining rate, surface quality and wears in electrode of Tungsten carbide and monitored by the optimizing machining conditions for the purposes of confirmation test.

Ajeet Bergaley et. al. (2013) adopted Taguchi Technique for optimization of electrical and non-electrical parameters in EDM for machining die steel using copper electrode.

Rajesh Purohit et. al. (2012) brought out the effect of input parameters like rotating speed of electrode, hole diameter and grain size of silicon carbide on the output parameters TWR, Metal removal rate and radial over cut obtained during Electrode Discharge Machining improving mechanical properties and surface finish.

Pravin R. Kubade et. al. (2012) investigated the influence of several parameters of EDM on MRR, ROC and EWR while material removing of AISI D3. With applying Taguchi method the experiment was taken out and numerous factors like pulse on-time, peak current, duty factor and space voltage were considered.

Reza Teimouri et. al. (2012) studied of tool wear and overcuts in EDM system in revolving tool with magnetic area are examined. Also, the results indicated that electrode wear rate and over cut are increased by the machining gap with the rotation of tool having a negative effect on overcut.

Reza Atefi et. al. (2012) analyzed the impact of EDM limitations in finishing conditions on machining rate of warm work of steel applying non-natural neural network where the proper machining parameters were chosen by statistical analysis and artificial neural network.

Rakesh Choudhary et. al. (2010) observed that heat affected zone is much deeper in the work piece machined by graphite tool as compared to other tool. This paper indicates that copper as a tool/electrode shows a good response towards the metal removal rate, whereas brass electrode gives best surface finish as compared to other. This experiment has been done on EN-31 die steel as a work piece material.
Hitesh B. Prajapati et. al. (2013) has studied the functioning of dissimilar electrode material on the EN-9 workpiece in EDM system. In this study graphite, copper, and brass, as tool electrodes have been taken. Out of these three electrodes, copper shows better surface finish whereas graphite gives higher MRR than other two.

O. Blatnik et. al. showed the comparison of optimal factors of machining in die sinking EDM and processes of Micro-EDM. Tauguchi and ANOVA methods have been used and result shows a significant difference in the optimal process parameters when the machining surface is drastically decreased.

Edward G. Adamski et. al. (1997) brought out an Electrode to be used in rotary EDM for producing one curved hole and one curved tooth with the perpendicular line of the plane which is parallel to the axis of rotation with at least one curved cooling hole machined in the article used.

Webb Robert S. (1967) described the apparatus for Electrical Discharge Machining and an improved machining power supply followed by various other methods.

Bell Jr. Oliver A. (1975) focused on the Function control circuit of Electrical Discharge Machining power supply with the system rendered to various electrical gap parameters such as gap current or gap voltage level including light emissive devices and photo diode connected in a circuit with the gap and conversion of light signals into electrical signals in which the output signal is utilized as a function control for electrical discharge apparatus.

Webb Robert S.(1961) described that basically various suitable coolants are used such as Water, Light oils, kerosene etc., which act as a dielectric medium and voltage produced by these coolants is calculated and certain machining conditions in presence of these coolants are evolved.

Beat Kilcher (1981) includes the forcing of a flushing medium through a work zone in the work piece in single direction and providing flushing chamber to the work piece to one side and hence the work piece is being machined.
Alfred M. A. Mailllet (1969) has done to obtain the non-oscillating discharge of the capacitor, for which there is employed a capacitor periodically discharged including the gap between electrode and work piece with circuit inductance, capacitance and resistance are provided and matched together and time period is also noted.

Borje Ramsbro (1988) has done in order to provide an accurate geometry reference system in the working zone for the reproducible positioning in which the reference piece is provided with a planar bottom surface and a fastening device by accurately fixing the piece and further the dovetail cross section serves as a reference surface in X- direction.

Oezer John J. (1957) relates to the new and improved methods for automatically controlling and EDM apparatus for removal of metal by heating and disintegrating the same.

Raghuraman s et al. (2013) explored about optimization of EDM limitations using Taguchi technique and grey relation study for mild steel-2026. These methods are being the effective technique to optimize the machining limitations for EDM process.

P. Janmanee et. al. (2010) performed experiments and investigated of different work piece materials on tungsten carbide electrode. According to this research surface roughness of copper–tungsten gives the best when current peak intensity is not over 20 amperes as well.

D T Pham et. al. (2007) showed the study of electrode wear in micro- electrical discharge machining. Its objective is to investigate the suitability of micro-EDM electrode wear compensation methods. According to this study EDM drilling and milling are regarded as separate processes as they require approaches in researching and implementing the results of the study.

Fred L. Amorim et al (2007) Investigation has been done under finishing machining of AISI P20 tool steel by the graphite and copper electrode in die-sinking EDM. In this paper result
shows the behavior of electrodes on tool steel. Best surface finish was obtained for copper electrode under negative polarity.

Anand Panday et. al. (2010) has done on current research trends in modifications of EDM. This paper reviewed the state of the art of technology of better performance machining of advanced workpiece materials with the help of die-sinking EDM, WEDM, Micro-EDM and Dry EDM. K. H.

HO et al (2003) showed that the research work taken out from the innovation to the improvement of the die-sinking EDM within the past years. It reports on the EDM research relating to improving the performance measures, process parameters, control and monitoring the sparking process, shortening the tool design and manufacture. A high range of solicitations is emphasized jointly with the development of hybrid machining processes.

Shukry H. Agheab et. al. (2014) examined the result of different EDM factors (peak current and machining time) in the final stage on the load of electrode wear as a result of solicitation unlike electrode material(copper, brass, and steel) to a workpiece (SS-304) has been studied.

Mohd Amri et. al. (2009) described the material removing of Tungsten carbide ceramic applying spark erosion machining using graphite electrode by utilizing Taguchi design approach. The Taguchi approach is applied to prepare the empirical design, to examine the impact of every factor on output of the machining, and to find the best settings for every EDM factor such as peak current, gap of the voltage, pulse-period and pause-time.

Shahul Backer et. al. (2014) determined the optimization of MRR and TWR in EDM by the aid of Taguchi system and ANOVA. In this experimental study, researchers have been taken OHNS EN-31 material as a workpiece and copper like cylindrical electrode.
Peryakgounder Suresh et. al. (2014) have been investigated the optimization of occurring variables in Micro EDM of stainless steel -316L with the help of genetic system and response surface approach. 400 micro-meter brass electrodes have been used for experimental research.

Priyaranjan Sharma et. al. (2014) investigated response parameters of EDM process to achieve the feasibility in drilling of AISI-329 SS which is extensively used in several industrial applications. This experimental work exhibits the optimum selection of process parameters (i.e., current, time-on, time-off and dielectric pressure) to maximize the MRR and minimize the EWR and taper angle of the hole simultaneously with the help of hybrid optimization technique. Copper and Brass electrode have been used for this experimental study. It has been observed that brass electrode wears rapidly due to low liquid point, great electrical resistivity and near to the ground thermal conductivity equate to copper electrode. Original Taguchi method and ANOVA is used for this experimental study.

Fred Lacerda Amorinet. al. (2010) is a technical paper in manufacturing process. In this work, a sequence of experiments were performed to make available helpful guide lines to optimize the die-sinking spark erosion machining of WC-CO with the help of Cu-W electrode under rough and finish regimes. Important EDM performance parameters were investigated with reference to the MRR, the volumetric relative abrasion, and the normal surface irregularity.

Teepu Sultan et. al. (2014) has done where optimization was performed in two steps using single factor at a time for preliminary evaluation and a Box-Behnken design methodology involving three factors with three levels for determination of the critical experimental condition. A copper electrode having tubular cross section was used to machine through holes on EN353 steel alloy work piece ANOVA technique is utilized for analysis the result of experimental study. Surface topography is revealed using scanning electron microscope micrographs.

Amit Kumar et. al. (2014) has been done on mild steel using brass electrode in EDM. Study has been carried out with the help of Taguchi method. Experiments have been conducted on basis of L9 orthogonal array. In this investigation machining factors for EDM were improved for finding the goal of more metal removal rate, lower wear rate on the tool.
A. A. Khan (2008) found wear and machining rate of various electrodes in EDM. Investigator utilized mild steel and aluminum as a workpiece and copper and brass as an electrode. In this investigation, the highest MRR was observed in cutting of aluminum applying brass electrodes. It has been also investigated that in cutting of steel applying copper electrodes, moderately lesser quantity of heat is absorbed by the work material.

S. Dhanabalan et. al.(2015) has been done on EDM for machining of titanium using copper, brass and aluminum electrodes. It is observed that MRR is high while machining of titanium alloy with brass electrode. Smaller quantity of heat is absorbed during machining of Ti alloy using copper electrodes due to low thermal conductivity. MRR and EWR are average value using aluminum electrodes while machining of Ti alloy.

Harpuneet Singh (2012) reported that experimental research carried out on electrical discharge machining to analysis, the effects of activity limitations like pulsed current on MRR, depth of cut, over cut, weight loss and hardness on EN-31 steel using positive polarity.

Parjeet Hooda et. al.(2015) investigated the optimization of EDM characteristics for dimensional accuracy using Taguchi method. It has been found that process parameters (highest current, voltage, pulse period and pulse pause) have a significant effect on machining parameters (MRR, TWR, and SR). The Taguchi system exposes that the highest current pointedly affects the EWR and surface irregularity, while the metal removal rate chiefly affected by the pulse period. Empirical outcomes are provided to verify this system.

Dr. M. Indira Rani et. al.(2014) has been done for optimization of various machining characteristics of EDM process on AISI D2 steel with the help of hybrid optimization method. The results shows that GRG (grey rational grade) was significantly affected by the machining parameters (t-on, duty cycle and discharge voltage) and thereby responses (MRR and TWR) and confirm high output and correctness of the EDM activity.

P. Abinesh et. al.(2014) studied on wire cut EDM. In WEDM experiments have been conducted for optimization of process parameters influencing metal removal rate, surface
roughness and EW using titanium alloy. Before conducting experiments L-16 orthogonal array is used to optimize the best suited values for machining for titanium alloy on WEDM.

Dhirendra Nath Mishra et. al. (2014) has done on Electrical Discharge Machining by researcher. As per researcher it is an electro-thermal process which is based on the eroding effect of electric arc on workpiece and electrode. After study, investigator concluded that EDM can be used effectively for machining of complex shapes. EDM machining process is an independent of mechanical properties of materials. Higher accuracy results can be achieved by use EDM.

S. N. Joshi et. al. (2011) reported an intelligent activity modeling and optimization of Spark Erosion Machining. Easy computing techniques i.e. non-natural neural network and genetic system have been used to improve the prediction accuracy of the model with less dependency on experimental data.

M.A. Ali et. al. (2013) has worked on Beryllium Copper material for finding metal removal rate using full factorial method. Two level approaches for complete factorial plan of experiment were applied to design the experimental and observation was analyzed by using ANOVA and the best arrangements of the process parameters were predicted.

Mandeep Dhillon et. al. (2015) has done experimental study for evaluation and optimization of EDM parameters on aluminum alloy 7075 using brass electrode. The purpose of present experimental research is to identify the most significant input factors affecting the output response characteristics and obtain the optimum levels of characteristics for chief material removal rate, minimum EWR and surface irregularity.

Arvind Kumar Tiwari et. al. (2014) determined the optimal cutting condition of different w/p materials using different composition of tool (Cu-W) electrodes in EDM process.

Harmanpreet et. al.(2015) for optimization of EDM process characteristics in which Taguchi method has been used. This journal paper indicates that maximum investigator has used Taguchi method of DOE for obtain optimal conditions of process parameters.
M. M. Rahman et. al.(2011) developed mathematical model for finding EWR using methodology of response surface and Design of Experiments. It is statistical approach for optimization of machining characteristics on TWR of Ti-6Al-4V on EDM using Cu-W electrode.

Harpreet Singh et. al.(2012) found that MRR decreased with increase in pulse on-time from 50-100µs while using copper and brass electrode on machining of AISI D3 die steel.

F. Klocke et. al.(2013) investigated Performance by researcher in sinking EDM. Results were found using D-Optimal design of experiments. It shows that discharge current is the main influence on MRR and the discharge duration is main influence on tool wear.

Vikram Singh et. al.(2014) reviewed for optimization of EDM activity restrictions. This paper shows that which methods or techniques have been used for finding optimal conditions of EDM process parameters by various researchers.

S. G. Badekar et. al. (2015) reviewed the demonstrating and optimization of EDM system features on the basis of previous and recent research. This journal evaluates various modeling and optimization techniques used in machining of the workpiece on EDM.

Viral B. Prajapati et. al.(2014) showed the study of literature survey for a review on optimization of process characteristics in EDM for improving performance. On the basis of the reviewing of the process parameters It has been found that pulse-on, pulse-off and discharge current are easily controlled by the operator.

Vijay Kumar Meena et. al.(2006) focused to optimize the EDM process parameters and find the feasibility of using (DMLS) direct metal laser sintering parts as electrodes.

E. Uhlmann et. al.(2013) showed the purpose of research work was the reduction of machining time for producing cavities having a depth of 11mm in the alloy MAR-M247, with respect to the need for surface roughness and subsurface damage. Experiment was conducted
using graphite electrodes of three different dimensions. DOE were applied in the planning and execution of experiments.

Abhijeetsinh V Makwana et al. (2014) reviewed on Electrical Discharge Machining for optimize the activity restrictions applying Taguchi system and Minitab software. After reviewing the previous investigations it was found that copper has higher MRR concerning additional material such as aluminum, gun metal and brass, etc.

Nikhil Kumar et al. (2012) studied for comparing the MRR on Die-sinking EDM applying copper and graphite electrode. Investigation indicates that graphite electrode is better than copper electrode for machining of steel material for solid removal rate and tool wear rate.

Huang et al. (2003) expressed the microstructure study for martensitic stainless steel quenched and then tempered at 600°C. Samples of the work material were finished with 4/5 cutting passes. Negatively polarized wire electrode was used in the first four cutting passes, apart from the past cutting pass, in which the positively polarized wire electrode was used. In the results of scanning electron microscopy examination, craters and martensitic particles were exposed in the graph of the complete surface machined next the ahead cutting pass. In the results of transmission electron microscopes TEM-examination, a heat affected zone of 1.5µm thick was discovered in the surface layer finished with negatively polarized wire electrode.

Klocke et al. (2003) investigated different electrical parameters in a runs of experiments. The measuring device was located at the place where the discharges happened and was electrically separated in order to prevent measuring interference. Cutting speed was found to be lower for material containing more number of electrically non-conductive particles. The voltage, pulse on time, and the ejection current had little influence on the crater dimensions. At lower idle voltages the craters became more elliptical. The discharge forces depended strongly on the electrical factors and the removal of materials. The forces were linearly proportional to the discharge current and the idle voltage.
Ho and Newman (2003) reviewed the study work passed out from the initiation to the improvement of die sinking EDM within the past years. It reported on the EDM investigation relating to improving performing actions, optimizing the activity parameters, observing and governor the sparking activity, make simpler the electrode shape and manufacture. A kind of EDM uses were emphasized together with the improvement of hybrid machining methods.

Puri and Bhattacharyya (2003) employed Taguchi design method involving thirteen control parameters with three levels for an orthogonal array L27 (3^13 ) to find out the main parameters that influence the various machining criteria, such as average surface roughness values, cutting speed and the geometrical imprecision caused due to wire lag.

Tzeng and Chiu (2003) conducted experiments on castek-03 for medium carbon steel solid having exceptional wear resistance. The most important factors affecting the EDM process strength were pulse on time, utilized electric current in low voltage and generating current in high voltage. The most important factors affecting the cutting speed, pulsation on time, and applied electric current in near to the ground voltage. The gain of 13.17 dB was able to decrease the variation range to 21.84%, which improved process robustness by 4.6 times.

Sarkar et. al. (2005) performed experiments using γ-titanium aluminide alloy as work material and then expressed calculated models to predict the surface finish, cutting speed and dimensional deviation as the function of different control factors. They investigated the optimal process factors by using constrained optimization technique in which one performance parameter was optimized allowing for others as constraints.

Manna and Bhattacharyya (2006) developed mathematical models relating to the responses measures such as MRR, SR, spark gap and gap current by means of the Gauss elimination technique for actual machining of Al/SiC-MMC.

Lee and Li (2001) investigated the effecting factors of machining on several machining parameters in spark erosion machining of Tungsten carbide. The effectiveness of the EDM process is assessed in terms of relative wear ratio, rate of machining and the surface finish of the workpiece produced. The electrode material, the polarity of an electrode, voltage of open circuit,
current, duration of pulse, interval of pulse and dielectric flushing were the machining factors. Result depicted that for all electrode materials, the MRR increases with increasing current. Graphite electrode gives the maximum MRR. MRR decreases with the increasing OC (Open Circuit) voltage, whereas the relative wear ratio and surface roughness increases with increasing open-circuit voltage. MRR increases with the increasing of the current in the limit of a low current situation, and turn into constant when machining at the maximum value of highest current. Rise in pulse period results in the increase in material removal rate, whereas material removal rate decreases with increasing of flushing pressure of the dielectric fluid and becomes stable at the maximum values of flushing force of fluid.

Lee and Li (2003) presented a research on the veracity of surface of Tungsten carbide machined on sinking EDM. It was investigated that the unevenness of surface is a task of two core factors namely current and pulse period. An uneven surface is produced due to high current and/or long pulse period. An abundance of micro-cracks was studied at high current and pulse time.

Puertas et. al. (2004) investigated the effect of EDM characteristics such as current, pulse on-time and duty cycle on the machining parameters of tungsten carbide. Machining parameters were surface roughness, volumetric electrode wear and MRR.

Mahdavinejad et. al. (2005) found some instability in EDM process while machining the WC-Co composite material. Investigator studied that the rise in pulse lengths increases instability and therefore, quality of the work surface became irregular. It is due to high temperature of melting and material recasting.

Gandhi and Agrawal (1994) applied the graph theoretic approach to evaluate and analyze the wear in a mechanical system. Contributing wear factors and degree of influence among these factors were identified.

B Sidda Reddy et. al. (2010) explored the effects of design four factors like current, job cycle, source of servo-control, and voltage of OC over the productions on wear in an electrode,
machining rate, roughness of surface and hardness on the machining of AISI 304 SS by using die-sinking EDM. DOE method had been used with various levels of designs and assess for carrying out a less number of experiments. Researcher explained that for more MRR, work cycle and peak current should be stable at the highest levels and confidence interval of ninety five percent with reducing the number of experiments in case of tool wear rate with same considerations.

Rahman M. M. et. al. (2011) discovered material removal property of austenitic 304 SS with the help of electrical discharge machining. This experimental study reveals that with increasing current, the rate of material removal and unevenness of surface increases also. The rate of tool wear increases with increasing peak current until it reaches 150 microseconds of pulses on-time. From the outcomes, no tool wears are produced with reverse polarity in long pulse on-time. It was investigated for the copper electrode.

S K Dewangan (2010) studied the effect of situations of machining factor such as T-on, peak current and dia. of an electrode of P-20 steel by means of a U-shaped electrode of copper with inside wash out the system. Practical were performed using L-18 matrix based on the system of Taguchi. The ratios of S/N were related with the values of practical in the tests was found out by which maximum factor is influenced by the reasons of overcutting, MRR and EWR.

S H Tomadi et. al. (2009) explained the condition of material removal effect of W-C on the productions like rate of tool wear, the rate of material removal and quality of the surface. Validation tests were performed to evaluate the fault between predicted and experimental values in terms of material removal features. Investigators claimed that the W-Cu electrode is a good option for better finishing of the workpiece. The full factorial DOE for optimization tool wear has been utilized by investigators and claimed that more T-off smaller tool wear of W-C and with more Ip, voltage and T-on tool wear increased.

Asif Iqbal et. al.(2011) improved the operation factors for the Electrical Discharge Machining milling function of a workpiece of SS applying copper electrode. Input characteristics
for milling functions are revolutions per minute of an electrode, feed rate, and voltage while the output functions are Rate of Material Removal, Rate of Electrode Wear and Ra. To find the higher rate of machining, the rate of wear in electrode and Ra, a design of central composite is employed for optimization. Optimal settings are arranged for machining at the voltage of 120, rpm of 1200 and feed rate of 4µm per second as per the output results.

N M Abbas et. al. (2007) explained the developments of different investigation in ultrasonic pulsation facilitated EDM such as dry, powder mixed, water based and systems of many EDM modeling to correct and perfectly EDM concert. The researcher found that for micro cutting, ultrasonic vibration facilitated EDM is the best suitable option, for cost effectual dry EDM is used, safe and conductive working position has been achieved by water based EDM, a good surface feature is provided by powder mixed EDM.

Singh et. al. (2004) explored the parameters of settings of material removals such as current on the rate of material removal, overcut, rate of wear in electrode and Ra in EDM using E-31 steel with a dissimilar electrode such as Cu, brass, Al and W-C. Results indicate that higher removal rate of material provides by electrode of Al and Cu, diameter of OC is less with various tools.

Kumar Sanjeev et. al. (2009) experimented with extra applications of spark erosion material removal method with definite status for the surface variation. At the time of machining away from the removal of material, the process effects are the important nature in wear of an electrode. Developments of the plasma envelop having of vapors eroding particles from the workpiece and an electrode, the dielectric liquid affect the surface configuration after material removal and hence, its belongings. Under the definite machining settings measured material removal may be passed out with either combined electrodes or metallic powders mixed in the dielectric. Researcher reviewed the spark erosion machining and upcoming leanings of its applications on the wonder of surface reformation.

Bhattacharyya et. al. (2007) tested on EDM by means of the progress of a calculated RSM model for comparing the interactive and greater sequence results on material removal
factors such as Ip and T-on of machining of M2 D-steel is done by the analysis of EDM factors on unevenness of the surface, thickness of white film and density of surface crack. Optimal combination assessed for reducing the surface integrity with the help of an advanced model.

Dhar et. al. (2007) established a calculated model of 2\textsuperscript{nd}order nonlinear to set up the relationship between machining situations. ANOVA is accomplished to confirm the fitting and suitability of the calculated model. Operation factors in EDM are current, T-on and voltage gap over the outcomes of the rate of material removal, a rate of wear in electrode and ROC of a combined solid with a cylindrical electrode of a brass material having a 30mm diameter.

Puertas et. al. (2004) examined the EDM with a satisfactory choice of removal of material specification which is one of very chief roles of the machine. Researcher claimed the effect of the features of current, T-on and work cycle over the cemented-carbide or solid material. Investigators have determined responses such as rate of tool wear, a rate of material removal and Ra. Calculated models have been achieved with the help of D.O.E. system. Multiple regressions have been effectively employed to modeling for optimal settings of machining. When the intensity of current was increased, the unevenness value of surface also increased. For both power and pulse time, lesser values should be manipulated with applying tungsten carbide.

J Simao et. al. (2003) examined the surface of dissimilar workpiece on material removal process over the EDM. In the present experiment, electrodes are made by powder metallurgy and use of powders put off in a medium of dielectric. In this investigation, the use of primary sintered electrodes is made from W-C resulting in the creation of an identical improved the film of the surface obtained with more or less cracks and thickness of up to 30\(\mu\)m.

Chenthil Jegan et. al. (2012) concludes the group of material removal sets such as current, T-on and T-off is planned for the removal of material of AISI-202 SS metal in EDM. They used gray relational analysis system to optimizing the resulting factors such as rate of material removal and roughness of the surface is presented. The uppermost small affect in addition to the order of worth of the governable effects to the execution of different real features
on EDM machining practice remained defined. It has been seen that the rate of material removal was the main disturbing factor.

S Jai Hindus et. al (2013) has done an experimental study by applying the Box-Behnken plan. The plan displays that the pulse on-time and current (A) affect the rate of electrode wear and rate of material removal. Cylindrical designed copper electrode confirming a diameter of 13mm is castoff to machining of SS 316 L. In EDM, a removal rate of the material is the extreme heavy cause was found to be T-on lagged by Ip and the voltage gap is the smallest important factor. With the increasing in current the rate of material removal increased linearly. For the electrode wear, one of the most important factors was current chased by T-on and crosswise increasing in voltage.

Rajmohan et. al. (2012) tested by applying D.O.E. method under L9 design of matrix and investigated the result of material removal factors of EDM such as T-on, T-off, Ip and voltage on the rate of material removal of AISI-304 SS. S/N ratio and ANOVA are applied to optimization the factors of process and also examined the effect of process factors on removal rate of material.

M Kiyak et. al. (2007) examined the impacts of EDM conditions on the unevenness of surface in the machining of AISI P-20 steel. The selected parameters were such as spark current, T-on, and T-off. They were researched that the surface unevenness of the workpiece and an electrode was changed by spark current and T-on with increasing values, the roughness of a surface is increased and a good surface is achieved with a lower value of pulse on-time and higher T-off.

Reza et. al. (2010) optimized the process factors of EDM by injection wash out type of material removal on different response appearances by means of GRA system. Factors are optimized on dissimilar responses such as removal rate of material, a rate of electrode wear and roughness of the surface. In this experiment, copper electrode and AISI 304 SS workpiece are utilized and the L-18 orthogonal array of Taguchi design has been planned for this experiment. Kumar Ashok et. al. experimented the material removal of EN19 steel by means of a U-designed tubular copper electrode is used with internal wash out system in EDM. The L-18 orthogonal array of Taguchi design system is utilized for conducting all experiments. They were found that
rate of material removal increases with increasing current with a reduction on pulse on-time, a rate of electrode wear increased with increasing T-on and also OC is increased with increasing current.

Rao Srinivasa et. al. (2010) has established the calculated model for forecasting the response factors. With the help of regression study, an experimental and predicted outcome was measured to examine the mathematical model. The relationship of Fuzzy rule was established by research to lessen the no. of experiments.

S Abdurrehman Celik (2007) employed different factors on a workpiece of powder mixed material. The investigator claimed that irregularity of lower surface value measured on the powder material. The surface irregularity is not much influenced by using various shaped of electrode.

Margaret (2004) showed the analysis of various efforts into the EDM and bring about the effects into the atmosphere. A simplified model is used to analyze the process; the main kinds of flow in the model are material and energy flow. It was concluded that the materials which were machined by EDM have no effect on the environment.

Wang and Tsai (2001) showed semi-empirical models of MRR for various workpiece such as EK2, D2 and H13 and tool electrode combinations such as copper, graphite and silver-tungsten alloy. To obtain higher MRR in EDM, a constant method of material removal is necessary, which is partly affected by the pollution of a gap between the workpiece and an electrode, and rate of material removal also affected by the size of the machining surface at the given system (Valentincic and Junkar (2004).

Jaharah et. al. (2008) studied MRR, TWR on AISI H-13 tool steel. Peak current was found to be the major cause which effects MRR. Higher MRR was achieved with high Ip, medium Ton, and low Toff. However, smaller TWR was obtained at high Ip, high Ton, and lower value of Toff.
Kanagarajan et al. (2008) used electrode rotation, Ton, Ip, and FP to study MRR proceeding Tungsten carbide/cobalt cemented carbide and shown experimentally that Ip and Ton are the most significant factors.

Kuppan et al. (2007) derived a calculated model for MRR for drilling endless hole of Inconel 718. The tests were designed by means of (CCD) Central Composite Design and Response Surface Methodology (RSM). It publicized that the rate of material removal is further affected by peak current and duty factor. By employing the approach of desirability function, the factors were optimized for extreme MRR with the preferred Ra value.

Puertas et. al. (2004) studied the effects on cobalt bonded tungsten carbide workpiece of EDM factors for MRR and tool wear in. For each of the outcomes, a model was established. The researcher described that the issue of current was the most effective factor for MRR.

Khan et al. (2009) discussed the performance (MRR and TWR) of EDM on mild steel due to the shape formation of the electrode. The peak rate of material removal was originated for circular electrodes. Machining rate is also higher in wedge-shaped, right-angled and diamond formed electrodes. However, the maximum rate of electrode wear was established for the diamond electrodes. It is also measured by an off-line process planning method as the replication set of rules is mainly based on the rate of material removal, a rate of tool wear and spark gap. However, the modeling of spark setting and spark gap, which are reliant on the circulation of the wastes, was stated to create a more accurate image of occurrence of sparking.

Subsequently, Khan (2008) reported overall performance contrast of copper and brass tool and scrutinized that more rate of material removal was observed in the machining of Al by applying brass electrodes. Relatively low thermal conductivity of brass as a tool material does not allow the absorption of much heat energy, and most of the heat is applied in the cutting of material from aluminum workpiece at a low liquefying temperature.

Dhar et al. (2007) assessed the effect of Ip, Ton, and the voltage on the rate of material removal and rate of tool wear in EDM of Al, Cu and Si alloy with SiCP mixtures. With the help
of three factors, three level full factorial designs, a 2nd order non-linear calculated model has been advanced for creating the liaison amongst material removal elements. It was revealed that the MRR and TWR are increases with increasing in Ip and Ton.

Salonitis et. al. (2009) developed a simple thermal based prototype to determine the MRR and proclaims that the increase of Ip, V or Ton results in maximum MRR. Besides, reducing Toff MRR increases. They reported that model forecasts and practically results are in good agreement.

Taweel (2008) explored the relationship of performance factors in EDM of CK45 steel with Al-Cu-Si-TiC applying the technique of powder metallurgy and assessed the rate of material removal and a rate of tool wear. It was found that these types of electrodes are more complex to Ip and Ton than conventional electrodes. To achieve the higher rate of material removal and minimum TWR, the process factors are enhanced and on experimental verification the results are found to be in good agreement.

Chiang (2008) had described the effects of peak current, T-on, T-off and voltage on the responses such as rate of material removal and rate of electrodes wear. The experiments were scheduled as per the Central Composite Design on Al2O3+TiC workpiece and the impact of factors and their relations were scrutinized applying ANOVA. A calculated model was established and maintained to fit and forecast the rate of material removal exactly with CI of 95%.

Dwivedi et. al. (2008) described the response factors like rate of material removal and TWR by attaining an optimal setting of process factors (Ton, Toff, Ip, and FP) during EDM of Al 6063 SiCp metal matrix composite. It was revealed that peak current is predominant on MRR than other significant aspects. MRR increases with increasing Ip and Ton up to an optimal set and then dropped.

Karthikeyan et al. (1999) develop mathematical models for improving EDM characteristics like rate of material removal, rate of tool wear and roughness of the surface on
aluminium Si carbide particulate composites, by means of full factorial design. The process factors taken into consideration were Ip, Ton, and the percent volume fraction of SiC (V) existing in an LM25 aluminium matrix.

Wang (2009) investigated the possibility and optimization of EDM for inspecting the machinability of W-Cu syntheses applying the Taguchi system utilizing L18 orthogonal table to attain the polarity, Ip, Ton, Tau, turning speed of circular electrode, and V in order to study the MRR and TWR. The tool wear is moderately equivalent to the MRM in EDM.

Mohri et al. (1995) determined that during sparking the wear of electrode is influenced by the snow of turbostratic carbon from the hydro-carbon oil on the surface of tool. Also, the constant wear was produced on the electrode edge due to unpredicted omission of carbon to abrupt at hard to reach areas of the electrode. From this easy thoughtful of electrode wear, about worthwhile uses exploiting both the profits and loss of electrode wear, have been settled.

Marafona et. al. (2000) used energy dispersive X-ray analysis of tool surfaces measuring their compositions and established a wear protection carbon film on the electrode outside by altering the sets of the machining considerations prior to common EDM conditions. The thickness of the wear protection film of carbon made an important progress on the EWR; it has a slight impact on the rate of material removal. Conversely, for applications requiring higher MRR, a large pulse current is forced to increase the electrode wear inserting electrode material onto the workpiece (Mohri et. al., 2000).

Bleys et. al. (2002) developed an online tool wear compensation method based on the pulse analysis and controlled the tool feed movement in real time.

Kunieda and Kobayashi (2004) are clarified the system of resolving ratio of electrode wear in EDM by spectroscopic testing of the vapor density of the electrode solid. Longer Ton is known to result in lower TWR and deposition of a thicker carbon layer on the tool electrode surface. The density of copper vapor from the electrode surface was founded lower when the
carbon layer was thicker, showing that electrode wear is minimized by the protective effects of the carbon layer.

The well-known machining strategy of recompense the tool wear is the circling of the electrode virtual to the workpiece, where a planetary motion creating an effective flushing action, get better part accuracy and process efficiency (Snoeys et al., 1986). This technique also trims down the more than one electrode essential for preliminary roughing and final finishing tasks (Staelens and Kruth, 1989).

Yu et al. (1998) established a constant electrode wears machining system to compensate the length wise tool wear by employing partly cover backward and forward machining action.

Dauw et. al. (1986) determined the amount of electrode wear after the analysis of pulse features founded on release voltage drop time. The analogous tool wears reparation tactics have also been operated to µEDM, which is usually implemented in thin films utilizing cylindrical or tube-shaped electrodes.

On the other hand, Kunieda and Yoshida (1997) compact the tool wear ratio by carrying out µEDM with the help of high-velocity gas as the dielectric medium. The dissimilar approaches of replicating the method of EDM also offer a tremendous prospect of considerate and compensate the electrode wear.

Dauw et. al. (1988) settled a geometrical recreation of EDM representing the growth of electrode wear and fragment geometry.

Caydas and Hascalik (2007) made an attempt to analyze the electrode wear in EDM of Ti alloy using statistical analysis technique. ANOVA and regression analysis were done, the suggested mathematical models can satisfactorily define the outputs inside the limits of issues being experimented. The actual and projected values were in a good conformity. The hollow cavities created by EDM are every time bigger than the electrode, this difference between an electrode and the cavity is referred as Overcut. It turn into valuable when adjacent easiness
works are needed to be manufactured for planetary uses and also in outfits, dies and molds for press work. The dimensional accuracy of EDM is greatly influenced by the OC resulting from the discharge gap and electrode wear. The process factors like Ip, Ton, voltage and the workpiece material are significantly affecting the OC (Overcut). It increases with the increasing of Ip but up to a certain limit besides it depends upon the spark gap voltage and chip form, which differ with the amperage used (Singh et. al., 2004). When low diametral OC is the requirement En-31 may be preferred over copper and aluminium electrodes. CNC EDM commonly makes use of 3D profile electrodes that are expensive and time consuming to manufacture for EDM process. Further for producing complex 3D shaped parts, the capacity of CNC in providing multi-axis movements for simple electrodes in EDM.

Wong and Noble (1986) experiment and investigated the machining with cylindrical electrodes with microcomputer controllers. In recent times MRR improvement technique has been developed by modifying the basic principle of EDM, which supplies single discharge for individually electrical pulse.

Kunieda and Masuzawa (1988) investigated a multi-electrode discharging technique delivering extra discharge at the same time from a corresponding electrode connected serially. An oxygen supported EDM system, which greatly improves the MRR was tested by supplying oxygen into the discharge gap (Kunieda et. al., 1999) besides MRR can be substantially improved with reduced TWR using a multi-electrode discharging system using without any improvement in surface roughness. Surface integrity of EDM surface the term surface integrity is used to define the quality and condition of the surface area of a machine component. It includes the mechanical, topological, metallurgical and chemical settings of the surface area with subsurface build up. It is well established that EDM surfaces ordinarily involvements a transformed having dissimilar features from those of the close relative metallic.

A comprehensive description of surface integrity of EDM components necessitates the measures of Surface Roughness (SR), White Layer Thickness (WLT), Heat-Affected Zones (HAZ), micro-cracks, and Residual Stresses (RS), diffusion of tool material and carbon, and endurance limit (Rajurkar and Pandit 1988).
It has been ascertained that the surface integrity is significantly distorted by EDM and thus efforts are being made to negate the transformations in the surface integrity of machined components. EDM planes are fairly intricate and investigation on the outcomes of EDM machining on plane (surface) reliability have been reported by researchers. The thermal fluctuations may source of cracks in the upper layer and outstanding stresses in the original base layers (Cogun and Savsar 1990).

Although EDM has many profits but, the re-formed layer with cracks, make happen by rapid cooling results in bad surface quality (Kruth et. al., 1995; Schumacher, 2004).

Surface texture, surface topography or surface finish are the terms, which are applied to definite the machined plane relates to the geometric irregularities and to quality the surface. Ideal surface roughnesses are commonly specified by the peak to valley height or the center line average, Ra (µm). The EDM surfaces consist of plenty of craters formed by the discharge energy. If the energy substance is high, bottomless craters will be reached, leading to the bad surface. The surface irregularity has also been found to be in reverse relative to the occurrence of discharge (Pandey and Shan 1980).

A spark-eroded surface is a surface with a matt appearance and random distribution of overlapping craters and is often covered with a network of micro-cracks (Pandey and Jilani 1986). The molten metal was expelled randomly throughout the discharge and later solidified on the electrode surfaces. The crack formation is related to the development of maximum thermal stresses of the material, as well as with plastic deformation. Several efforts made for representing of EDM process and research of the measures of responses to develop the surface value. For the estimate of surface unevenness experimental patterns, as well as multi-regression analysis are usually applied. It has been noticed that there are many process variables that affect the surface finish such as Ip, Ton, open circuit voltage, electrode polarity, thermal properties of the tool, work, and dielectric liquid and debris concentration.
Kiyak and Cakir (2007) investigated the effects of EDM parameters on Ra for machining of AISI P20 tool steel and emphasized that the choice of the machining parameters to achieve a good surface quality of EDM component should be smaller pulsed current and shorter pulse time. This is because, small particle size and crater depths created by discharge and consequently, the smooth surface will be produced.

Keskin et. al. (2006) obtained a regression equation and stated that the results will help to manufacture steel parts with definite surface roughness requirements instead of trial and error. In addition, it is revealed that Ra has an expanding trend with rising in the Ton, which is probably due to more discharge energy freed during this time and increasing the discharge channel.

Khan et. al. (2009) argued the SR performance of EDM mild steel for different design pattern of the electrode. The lowest surface roughness was founded for the cylindrical (circular) electrodes go along with four-sided, three-sided and diamond-shaped electrodes.

Tsai and Wang (2001c) reported several surface finish models by compelling the results of electrode polarity into credit. They successively reported a model reliant on different properties (physical, thermal and electrical) of the workpiece and an electrode with relevant operation factors such as Ton, Ip, polarity, density, conductivity, specific heat capacity, melting and boiling temperature. The later model was found to be a more trustworthy surface finish prediction for various workpiece materials (EK2 and H13) under various process conditions.

The surface qualities of the machined surface were explored extensively by Kanagarajan et. al. (2008). They had selected peak current, Time on, electrode rotary motion, and pressure of flushing as project aspect to examine the EDM responses measures such as roughness of the surface on W-C or CO cemented-carbide. The most effective aspects of reducing the SR have been recognized by applying the methodology of the surface roughness and practically confirmed by conducting tests.

Chiang (2008) recommended a mathematical model and researched the result of peak current, T-on, Tau, voltage and their interactions on SR. The experiments are conducted on
Al2O3+TiC workpiece and found that peak current and Time-on have arithmetical importance on SR. It is demanded to suitable and forecast SR closely with a 95percentassurance interval. In the EDM component, a single structure on the whole surface of the machined parts has been observed. The microscopic observations showed that unusual phase changes occur due to high local temperature attained during the machining. The top layer is a recast layer formed by re-solidification of the molten metal and this film (layer) is found to be deeply alloyed with the pyrolysis products of the cracked dielectric. The material surface is found to be fairly resistant to impression by conventional metallographic reagents. Therefore, the recast film (layer) on ferrous mixtures is often referred to as ‘white’ layer. Micro hardness capacities have shown that for ferrous mixtures, the recast layer generally has a hardness value higher than that of the underlying matrix and may go beyond that possible by normal quenching techniques.

Marafona and Chousal (2006) developed a thermal-electrical model using copper and iron as anode and cathode sparks produced by electrical discharge in a dielectric liquid and the obtained FEM results were compared with the empirical data of the table used by other investigators. The TWR and MRR, as well as surface roughness results, agree reasonably well with them.

Allen and Chen (2007) reported a thermo-numerical model for material removal on molybdenum by a single spark, the effects of EDM parameters on the crater dimension and the tool wear percentage are studied. FEM results are also presented to show how the thermal proceedings of the micro-EDM process affected the surface integrity of machined workpiece.

A FEM base model was reported by Das et al. (2003) using process parameters such as power input; pulse period, etc., to predict the temperature distribution, liquid and solid state material transformation, and residual stresses induced in L6 steel. An attractive characteristic of the model is its ability to predict. The shape of the crater formed during the material removal is also predicted and validated experimentally EDM on AISI D2 steel. The modern study signified now, is associated to EDM of AISI D2 steel, which has an extensively rising kind of uses in dies and mold preparing factories.
Lee et al. (1988) studied the surface conversion and damage in EDM AISI D2 tool and other tool steels and reported that the recast layer is composed of two layers and the depth of surface cracks is found to correlate well with the WLT. They attempted were prepared to measure the depth of white film with respect to the operation limits and surface inequality after EDM. It was found that with a static dielectric and flushing situation, for a kind of Ip levels fluctuating from 5 to 25 A, the bad layer compares well with the pulse energy in spite of the tool steel solid, however the magnitude of the white film be contingent only on the area or size of the current pulse-form but not its shape.

Guu and Hocheng (2001a) considered the results of machining limitations of a rotary EDM like Ip, Ton, and workpiece turning on MRR and surface irregularity, and found to be growth with the increasing of turning speed. Also, the results were matched with the conventional EDM and found to higher MRR, improved SR and reduced recast layer.

Guu et. al. (2003) studied experimentally the surface features and machining reparation make happen by EDM on AISI D2 steel. The recast layer were gauged applying SEM, residual stresses utilizing XRD machine and surface irregularity were gauged by surface profile meter and the empirical contacts were offered. It described that a HAZ is formed just beneath the recast layer and introduces tensile residual stress on the surface due to the non-homogeneity of heat flow (heated and cooled at a high rate) and metallurgical changes or to localize in homogeneous plastic deformation. This stretchable emphasize is the chief source of surface poverty. Subsequently, with experimental analysis

Guu (2005) investigated the surface structure, surface inequality and small rupture of EDM AISI D2-steel applying Atomic Force Microscope and asserts that the emission energy is the issues which find out the surface texture. The range of Ip was taken in the range of 0.5 A to 1.5 A and Ton of 3.2 and 6.4 µs. To avoid excessive machined damage and to get the worthy machined surface with small crack diffusion can be attained by the set of short pulse energy.

Marafona and Araujo (2009) have reported their research on effect of the workpiece hardness but, they did not provide conclusive result that hardness significantly effect MRR. They
suggested that the interaction of workpiece hardness with various factors may be responsible for variation in MRR. Whereas, the surface roughness obtained is marginally influenced by workpiece hardness. The workpiece hardness does effects MMR and Ra of AISI D2 material, but the effect is negligible in comparison to other factors.

Pradhan et al. (2009a) have presented a radial basis function and a back propagation neural system of network for the forecast of surface unevenness. The input parameters used for this investigation were Ip, Ton and duty fraction and both the models could predict surface roughness with reasonable accuracy. However, radial basis function was faster and the back propagation is reasonably more accurate model.

Further, Pradhan et al. (2009b) presented a second order regression model and ANOVA is utilized to test the capability of the model and compared with the radial basis function and a back propagation models. The model forecasts were matched with empirical information and guess mistakes have been determined for a dissimilar set of testing value and were found to be successful, for reliable prediction of Ra and it is found that the ANN patterns are moderately more perfect.

Pradhan and Biswas (2009) developed a neuro-fuzzy and a regression pattern to predict MRR. In this research, experiments were performed with numerous stages of Ip, Ton and duty cycle. The model’s predictions were compared and they were found that the neuro-fuzzy model has well predictive capability than the regression model.

Lee et. al. (2004) revealed experimentally that the outcome of the EDM factors on the outside integrity of AISI 1045 carbon steel and furnished that average WLT and induced residual stress tend to increase at higher values of Ip and Ton. However, for an extended Ton, it is noted that the surface crack density decrease. Besides, obvious cracks are always apparent in thicker white layers. A smaller Ip (i.e. 1 A) tends to increase the surface crack density, while a prolonged Ton amplifies the opening degree of the surface crack, thereby reducing the surface crack density.
Lee et. al. (2003) have shown that crack formation and white layer thickness is correlated to the machining parameters. High Ton will increase both the WLT and the induced stress and both of them tend to support the formation crack.

Bhattacharyya et al. (2007) established mathematical models based on RSM for correlating Ip and Ton different aspects of surface roughness of M2 die-steel machined through EDM at the transverse section of the EDM M2 die-steel and experimentally validated using the SEM micrographs and the graphs plotted and reveal the correctness of the developed models. Optimal combination of parameters has been estimated, which can be used to minimize surface integrity.

Rebelo et. al. (1998) have reported quantitatively and qualitatively that the creation of plasma network between electrode and workpiece, bring about in metallurgical changes, outstanding tensile emphases and surface rupturing. The dimension of random overlying surface craters increase with increasing machining pulse heat (energy). The deficiencies emit from, and evade (avoid) the low spot. The depth of the fissures in the recast film increases with the machining pulse energy.

Ramasawmy et. al. (2005) examined the outcome of the EDM operation considerations Ip and Ton on the thickness of the white layer. Stainless martensitic chromium tool steel was used for the EDM test. Relation of WLT with three dimension surface roughness amplitude, spatial and volume factors are discussed and shown that the Ip has comparatively more significant effect on the dimension of the crater as compared to Ton. It is said that the dimension characteristics of the liquid metal pool define the magnitude of the surface tension, and finally the thickness of the white layer.

Mamalis et. al. (1987) in their experimental study revealed that the physico-chemical changes occur during EDM of steel and a correlation among surface morphology and overall process parameters have been investigated. White layer and crack development are related with the development of high thermal stresses over and above the fracture strength of the material in
addition to plastic deformation and are determined quantitatively by the use of regression equations; it is clearly shown that their dimensional dependence on pulse energy.

Lim et al. (1991) provided a review on the metallurgy of EDM surface, which is reliant on the solidification behavior of the molten metal after the discharge ending and subsequent phase transformation. Solidification of the molten metal takes place at the same time from the top interface with the dielectric fluid and the bottom interface with the underlying metal into the melt and from within the melt towards both interfaces. These clues to the formation of three distinctive sub layers within each recast layer re-solidified from a given pool of molten metal.

Vishnu D. Asal et al. (2013) conduct the experiment on Process constraints of EDM by applying the ANOVA methodology. In this study, the level of current, types of an electrode and spark gap are kept as the main variable. Researchers used the material of SS304 as a workpiece while copper and brass metal as an electrode. They also use up DEF-92 as a dielectric liquid. The design of the experiment is employed to plan the EDM investigates. The dissimilar tools of DOE are employed to examine the final outcome of investigating with the help of charts/graphs in research. The examination is being finished with the help of mini tab- 15 programs. ANOVA is employed to identify the statistical implication of parameters. They were obtained that MRR (Material Removal Rate) process accounting for above 88.31 percent main effects of the aggregate changeability. The rate of machining and rate of electrode wear is the best effective factor when an electrode material is Copper, higher current supply (17 amperes), and spark gap voltage is kept as low (5 volts). Surface unevenness is minimum at the level of low current (9A) and spark gap voltage at the low level (5V).

Chandramouli S et al. (2014) performed experiments on EDM activity parameters with the help of Taguchi methodology and select the best outcome from experiments. The effect of dissimilar activity parameter on machining responses is tested by the Taguchi method. Investigators make use of the data factors as current, time on, and time off and the response factors like rate of material removal, rate of electrode wear, and roughness of the Surface. The Taguchi design approach is employed to define the empirical design and ANOVA system is applied to investigation the impact of information factors on machining responses and find the
ideal process limitations. The Electrode Wear Rate is decreased with increasing in pulse time on and it increases with increasing of pulse time off.

Ahsan Ali Khan et al. (2011) improved the machining factors for the EDM procedure of a SS workpiece with Cu tool electrode. Process limitations are the rotation of electrode, feed rate, and voltage while the response limitations are rate of material removal, rate of electrical wear and roughness of the surface. For receiving higher MRR, EWR, and Ra, they make use of Central Composite Configuration method. The result shows the machining sets for a good condition are settled at the voltage of 120V, 1200RPM and material removal rate four micrometer per second.

M. Kiyak et. al. (2007) studied the effects of EDM process parameters on the surface irregularity for machining of AISI P-20 steel. Ip, T-on and T-off are the designated factors. The researcher investigated the surface rigidity of the workpiece and an electrode was changed by Ip and T-on.

Puertas et. al. (2004) studied on the die-sinking EDM with satisfactory purpose of removal of material settings is the significant parts of the machine. It has been observed that the effect of the factors of power, T-on and work cycle on a hard material such as 94WC-6Co. They select performance measures such as rate of tool wear, rate of material removal, and roughness of the surface using scientific models will be completed by approach of design of experiments combined with several regressions effectively employed to modeling for absolute settings of machining. Each and every time power or pulse times were increased with increasing of the roughness value. As per investigators, low values of W-C had better be worked for both power and pulse time.

Paras et. al. (2014) explained the constraint improvement of Spark Erosion Machining of AISI 304 material by applying Taguchi System. In this research job, Taguchi design methodology is applied to a configuration of experimental research with 3 process constraints and 3 stages utilizing L9 arrays. Cu is employed as an electrode and AISI 304S is utilized as a workpiece. Streamlining is completed applying Taguchi methodology and MINITAB
programming. The machining factors like current, T-on, T-off, depth of cut and performance factors were Material Removal Rate. Researchers have been investigated that Ton factor has the most operational factor for material removal rate. The best consideration setting for the machining rate is Current -14ampere, Ton -7µsec, Toff -8µsec.

Chaudhary et al. (2014) carried out an examination of rate of material removal on H13 D-steel as workpiece material in EDM by applying of Taguchi system. Different operational issues like Ip, Ton, and rate of feed were considered to analysis about the influence of such issues on MRR. Advancement procedure was done by means of Taguchi technique. As per results, investigators concluded, as Ton increased with increasing of the MRR and it is also raised with increasing in the value of current and Material Removal Rate reduces with increasing in the value of feed rate.

Vishal J Nadpara et al. (2014) implemented on AISI D3 steel as a workpiece employing graphite tool of 10 mm diameter. The procedure factors are taken on the source of Taguchi Design Methodology. The chief objective of this investigation is to enhance the procedure factors of the material removing in high, medium and low wear factors with duty cycle. Investigators used the input process factors such as current, duty cycle and pulse time on and the other side the response procedure factors such as rate of material removal and rate of electrode wear. They also employed as Taguchi design approach for obtaining the optimum outcomes of preferring the best procedure factors.

B.S. Reddy et al. (2010) have taken out a survey on the effect EDM factors over MRR, TWR, surface irregularity and hardness. To achieve the desired results different factorial design of experiments and various regression analysis techniques has been employed. The factors in the decreasing order of importance for; Material Removal Rate: servo, duty cycle, current and voltage; Electrode Wear Rate: Peak current, servo and duty cycle; SR: current.

Nilesh M. Vohra (2013) has optimized many factors which are affected by various kinds of machining constraints of EDM. The main goal of this research is to investigate the best cutting factors for a workpiece of SS 304 & electrode material such as copper, aluminum and brass.
grouping on fuzzy logic control based EDM. Experimentation has been done with the help of Taguchi System Design. Researcher has used process factors such as current, spark gap voltage, Ton, and T off. For output they used Material Removal Rate, EWR, and surface irregularity. In this paper investigator concluded that the space voltage has maximum effect on material removal rate.

S.P. Nipanikar et al. (2012) optimizing of process factors of EDM by the Taguchi technique. In this research they used workpiece material as AISI D3 steel. The Taguchi system is applied to develop the empirical design, investigate the outcome of operation factors on the material removing parameters, and forecast the optimal solution for all EDM factors such as Ip, V, work cycle and T-on. They used the factor of performance measures such as rate of material removal and rate of electrode wear and overcut. The MRR (Material Removal Rate) is chiefly changed by peak current, and least affected by duty cycle. The rate of electrode wear is chiefly changed with Ip and gap voltage. The peak current has more effect on radial over cut, and least influenced by gap voltage.

M. S. Sohani et al. (2009) studied into the result of electrode forms by size feature reflection in die-sinking electrical discharge machining practice. This paper with the application of RSM (Response Surface Methodology) for investigating the effect of electrode shapes such as square, rectangular, triangular and circular with size factor consideration with other process factors like current, Ton, T off, and electrode design. Also The Response Surface Methodology based calculated patterns of rate of material removal and EWR have been advanced utilizing the data acquired by way of CCD. Investigator concluded that the excellent electrode profile for advanced Material Removal Rate and less rate of too wear is cylindrical, followed by Three-sided, quadrilateral and right-angled parts. In this experimental study, it is more analyzed that the contact result of ejection current and Ton is greatly important on MRR and TWR, although the important parameters like T off and electrode region are mathematically weighty on MRR and TWR.

S.Nizam Sadiq (2014) conducted the experiments for optimization of milling factors of OHNS steel using Ti-Al-N coated cutter utilizing DOE method. The experiment is about
research of face milling process of OHNS steel plates with various process factors such as feed rate, depth of cut and spindle speed and to investigate the optimal machining settings for minimum Ra (surface roughness). The experiments are designed and conducted with the help of Taguchi design methodology of experiments utilizing L9 orthogonal array and analyzed by ANOVA. Feed rate is selected as an effective parameter and optimum milling process factors for getting lower surface unevenness (roughness) are thousand rpm of spindle speed, 0.08mm of feed rate and 0.8mm depth of cut. The OHNS steel plates are likely for manufacturing tools and having good machinability property by using Ti-Al-N coated milling cutter with optimum cutting factors.

Velusamy Senthilkumar (2011) evaluates the result of Ti-C particles which are mixed in the aluminum complex on EDM procedure factors. The Machining of solid materials such as metal matrix composites (Al/Ti-C) to a high degree of correctness and surface quality is difficult. EDM is one of the best processes for material removal from a solid part which is tough to remove the material on traditional machining methods such as metal matrix composites (Al/Ti-C). EDM is an important unconventional machining method in shaping such difficult to machine materials. The goal of the empirical study is to examine the outcome of current, T-on and flushing force on MRR, and TWR in Electrical Discharge Machining. A copper electrode of dia.7mm was used to drill the workpiece. With using Taguchi approach an L18 orthogonal array, for the 3 machining factors at 3stages of factors, was selected to perform the experiments. ANOVA has been used to find the validity of the experimental plan in the research work.

Rajmohan T. (2012) evaluates the optimization of the material removing issues in Spark Erosion Machining of 304S. In this experimental study, the effect of electrical discharge machining factors such as T-on, T-off, voltage and current on rate of material removal in 304 Stainless Steel were studied. The practices are conducted as per design of experiment method by means of the L9 orthogonal array. The results are investigated utilizing ANOVA and performance graphs. In this experimental study, it is found that different groupings of EDM process factors are required to reach higher MRR for 304 Stainless Steel. ANOVA and S/N ratio are used to evaluate the effect of factors on MRR and also to find the optimum solution for cutting factors. The involvement of each cutting factors towards the material removal rate is also
identified. This research study is useful for manufacturing engineers to select suitable EDM process factors to machine 304 Stainless Steel.

M. Durairaj et al. (2013) studied of machining constraints in Electrical Discharge Machining with stainless steel utilizing single objective Taguchi Design Methodology and Multi-Objective Grey Relational Grade. Research paper reviews the theory of Gray Relational and method of Taguchi design, in this sequence to enhance the material removal factors in EDM for 304SS. The goal of optimization is to get the lowest kerf width and the good quality of the surface concurrently and separately. In this research work stainless steel 304 is employed as the workpiece, wire of brass of 0.25mm diameter utilized as an electrode and purified water is utilized as a dielectric medium. L16, an orthogonal array has been used for experimentation. They used process parameters for optimization such as gap voltage, wire feed, Ton, and T off. Pressure of flushing, speed of wire electrode, tension in wire electrode, resistance and length of material removal are selected as constant factors. Surface roughness and kerf width were found out for each experiment by utilizing the contact type surf coder as well as video measuring system. With the help of multi- objective optimization system of concept of gray relational, value of the most favorable is found for surface roughness and kerf width and by utilizing Taguchi optimization method, enhanced (optimized) value is obtained individually. As per present research paper, the ANOVA is also useful to discover the most major factor.

M.A. Ali et al. (2013) researched the outcome of Die-sinking EDM factors on MRR (Material Removal Rate) of Beryllium Copper was studied. The suitable factors were selected to findings the result of operating considerations on MRR. It has been discovered that peak current was the most significant and effective factor influencing the MRR (Material Removal Rate). As per investigators pulse on and pulse off should be together with other factors in order to influence the machining factors.

S. Raghuram et al. (2013) has studied the optimization of Spark Erosion Machining constraints applying Taguchi Design Methodology for Steel IS 2026. Journal paper’s goal is to examine the optimal set of process factors like peak current, Ton and T off in EDM (Electrical Discharge Machining) process to identify the variations in three response characteristics like
machining Rate, electrode (tool) wear rate, and surface in equality value on the workpiece for machining Mild steel utilizing copper electrode. Experiments conducted based on L9 orthogonal array, analysis has been carried out using Taguchi method.

Sanjay Kumar Majhi et al. (2013) described that a hybrid optimization method is used for find out the optimal process factors which minimize surface roughness & the rate of tool wear and maximize the rate of material removal. The process factors of electrical discharge machining selected for this experimental study are current, pulse period and pulse interval. The effects of these factors have been optimized by multi-response analysis. The designed experimental outcomes are applied in the gray relational and the value of the quality features are found out by the entropy measurement technique. The influences of the process factors on the responses were analyzed by RSM (Response Surface Methodology), which is based on the optimized outcomes.

Anjali V. Kulkarni et al. (2007) revealed that the discharge temperature increase due to the bombardment of the electrons produced during the discharge process. The temperature rise at the discharge affected area is of the order of the high temperature of workpiece material. Design of the discharge striking area, and hence, the machining can be made in the micron area by means of this process. The sizes can be further decreased by decreasing the geometry of the cathode tip, and using careful design of the process and its parameters. Experiments are conducted with graphite anode, 2mm thick copper wire as cathode, and copper work piece in 2.5cm x 2.5cm dimensions with 0.6mm thickness. The working voltage is 155V. Hydrochloric acid with 5% concentration is utilized as electrolyte. Work piece and cathode separation is of the order of 600m.

P.Asokan et al. (2010) described the optimization of working constraints for EDM procedure established on the Taguchi Design Methodology and Simulated Neutral System. In this research paper, the problem of Spark Erosion Machining method which is very tough to findings the optimum material removal issues for refining cutting functioning has been investigated. Optimization of working factors is the main phase in cutting, chiefly for working newer machining method like Electrical Discharge Machining. A method to find out the factors situation is suggested. Founded on the system of Taguchi and the ANOVA, the major issues
influencing the cutting measures like whole time of material removal, OC and taper in a hole is machined by EDM system, are found out.

Ashok Kumar et al. (2007) Studied experimentally the machining factors for EDM utilizing U shaped electrode using Taguchi design methodology where diameter of U-shaped tool (electrode), peak current and time on are taken as process input factors and MRR, rate of electrode wear, and OC (overcut) on the surface of the workpiece are taken as response parameters. Taguchi design methodology of 18 run orders (experiments) were conducted on electronic make smart CNC EDM (Electric Discharge Machine) and relationships were investigated between process and responses parameters. The study indicates that Material Removal Rate improved with increasing current. As the pulse period increased, the Material Removal Rate decreases also. In the case of EWR, the best parameter is ejection current, time on and width of the electrode. In OC, discharge current is one of the most significant parameter, a diameter of the electrode and T-on.

Narendra Sharma et al. (2013) reported the optimization of Electrical and Non Electrical parameters in EDM for machining Die steel utilizing copper tool (electrode) with the help of Taguchi Method. Research paper explores a work on the performance factor optimization for MRR, and electrode wear rate. There are electrical and non-electrical parameters which effects MRR and EWR such as voltage, current, time on, time off, dielectric fluid medium, flushing pressure, tool rotation etc. in this research paper both the electrical and non-electrical factors have been focused which governs MRR, EWR and there optimization. Investigation was based on Design of Experiments (D.O.E) and optimization of EDM process factors. The technique used is Taguchi method which is a statistical tools help in minimizing the number of run orders experiments and the inaccuracy (error) associated with it.

Lalit Kumar et al. (2012) reported the virtual investigation for MRR on Die-sinking EDM utilizing copper and graphite as electrodes. In their research Die-sinker EDM using copper and graphite electrode experiment has been done for optimizing Performance factors and decreasing the cost of manufacturing, finally it is found that a silver electrode give better results in certain characteristics but the cost become high for machining so keeping in mind cost and
other some factors a graphite electrode is more effective than copper electrode in case of both MRR and TWR.

Production Technology of Agril Machinery, Lesson 7 described that there are different types of dielectric fluid used in EDM operations. The most common dielectric fluids are hydrocarbon oil (kerosene). The other dielectric fluids are Paraffin oil, De-ionized water, or Si (Silicon) based oil and transformer oil. The selection of an appropriate dielectric liquid depends upon its various chemical and fluid properties like flash point, dielectric strength, viscosity, specific gravity and color.

Jameson et. al. (2001) described the development of EDM. It was only in 1980’s with the reappearance of (CNC) computer numerically controlled in EDM that took about marvelous progresses to refining the adeptness of machining procedure.

Ho et. al. (2004) described that fresh materials of increasing strengths and capabilities are being developed continuously and performance characteristics are not only dependent on the machining parameters but also on materials of the work part.

Singh et. al. (2012) described that end wear in electrode is the common term of wear and it is defined as the decreasing in electrode length throughout the machining. End wear is also kinds of a wear which can be reduced by optimal set of factors. Side electrode wear and corner electrode wear are supervised with ability of material to resist wear.

G Pardeep Kumar et. al. (2015) described that tool/electrode solid must not undergo much electrode wear when it impinges by +ve ions. Hence increasing in limited hotness has to be reducing by properly electing its belongings or when hotness increases, there would be reduction in melting. The electrode should be simply workable as complicated designed orderly topographies are machined in Die-Sinking EDM.

HO et. al. (2003) explored the unique performance of applying energy of warm air to machining of electrically conductive components unrelatedly of strength and solidity. It has been
A unique benefit in the manufacturing of metals, metallic alloys and as molds die to have complex cavities which are very tough to make by traditional machining methods.

Anil S. Kapse (2013) discussed that particles removal chiefly take place due to vaporization and melting. As warm air treating is needed to be passed out without the appearance of O2 so that the operation can be well-ordered and oxidation escaped. Oxidation followed by a poor surface finish and electrical conductivity of the workpiece obstructing an additional removal of material. Therefore, the dielectric liquid should make available an O2 free machining situation. There must be adequate durable dielectric medium so that it cannot breakdown too easily but simultaneously ionize when the electron collides with its molecule during discharging, dielectric fluid should be resistance to thermal energy.

James A Brown (1991) defined that the clearance should be in each side of an electrode and the workpiece after the machining procedure is known as over cut.

Livshit et. al. (1960) developed a model for electro erosion machining of metals. Poco EDM Technical Manual defined that the work cycle is a fraction of the T-on with respect to the whole working cycle. This factor is calculated by dividing the T-on by the T-on pulse T-off.

S K Dewangan (2010) reported the period of time in microsecond among the arcs (that is to say Ton). Spark off time permits the liquid particles to go hard and to be flushed away of the spark space. Spark off time affects the momentum and the constancy of the cut. Thus, if the interval is extremely small, it will origin spark to be wobbly.

Tarng et. al. (1994) described the peak current is represented by Ip and it is the maximum value of the power (current) supply through the electrodes for the given pulse. The Ip setting current range available on the present Die-Sinking EDM machine is 25 ampere. Increasing in the Ip value will increase the pulse release (discharge) energy which in turn can improve the cutting rate. For higher value of Ip, gap conditions may unstable with improper combination of Pulse-on and Pulse-off, settings. As and when the discharge become conditions become unstable one must reduce the Ip value.
B. M. Schumacher (2004) explored the procedure of material loss worked in EDM as quiet debatable. This is due to explosion of erosion of spark in a unclean dielectric liquid space, while using EDM, is taken as ion act identical as originate by bodily investigation of electrically sparks in vacuum in addition to with do research on the advance potency of safeguarding hydrocarbon solutions.

Dhirendra Nath Mishra et. al.( 2014) suggested that the current is quantified in ampere, permissible per cycle. Supply of current is openly related to the machining rate.

Ghewade et. al. (2011) explored that Die-Sinking EDM is a type of machining of varying the shape of tool/electrode to the workpiece and the shape of the electrode is replaced by arcs. Die-Sinking sparking occurs from the corners of the electrode and across the end surface. Spark length is adjusted by the machine control switches. Sparks produce from the electrode crooks, fabricating a clearance between the electrode crooks and the side-walls of the workpiece. The clearance between the electrode corner and workpiece side-wall is the spark over cut. The electrode end sparking surface, plus the side-wall over cut distance is the sparking area.

Kuneida et al. (2005) have reported that the current opposition of the dielectric impacts the absolution (discharge) energy at the time of arc ignition. If opposition (resistance) is bulky, the capacitor will reach at the charge of higher value before beginning of discharge.

Bojorquez et. al. (2002) explored that short length of discharges is made in a fluid dielectric space, which divides the workpiece and electrode. The solid is machined by an electrode and the workpiece with the erosive outcome of the sparks erosions. The purpose of dielectric liquid is to focus the spark energy into a passage of small area of cross-sectional. It makes cold the electrode also, and blooms away the product of material removal from the space.

P Kuppan (2015) reported that CNC has enabled entire EDM, i.e. a programmed and unattended solid removing after inserting the electrode in the tool holder to obtain the complete refined cavity.
K.H. HO et. al. (2003) described the growing merit of EDM have subsequently at that time been forcefully pursued by engineering industry soft economic profits and making keen research awareness.

Soni, (2007) investigated that the rate of material removal from the workpiece with the way of a chain of recurring electrical arc which is made by electrical pulse generator at the short interval between an electrode and the workpiece in the existence of the dielectric liquid. Dielectric medium makes it potential to wash away the removal of material from the space and it is important to maintain the flushing in the gap.

Yeo et al. (2008) exposed that the disk heat (energy) source models can be developed by refining the estimate of the heat flux and energy fraction, however, a simple cathode erosion model by means of a point heat-source model was presented by Dibitono et al., (1989). The unique energy equilibrium for gas absolutions was reformed and the model utilized the photoelectric effect which is a major group of energy delivered to the cathode face.

Patel et al. (1989) established the anode wearing (erosion) model which receives power as a boundary condition at anode boundary and the power provided is expected to create the flux of energy on the face of the anode solid.

Eubank et al. (1989) investigated an adjustable mass, cylinder-shaped plasma pattern was established for arcs which contain3differential calculations, single individually from the dynamics of fluid, balance of heat, and the calculation of rays joined with the state of plasma calculation. Soft computing modeling the use of the ANN (Artificial Neural Network, Fuzzy logic and hybrid intelligent method in modeling by means of performances obtained from conducted experiments connecting with various materials and machining settings are gaining popularity. There are several ANN uses in EDM, as it is an effective technique to solve a non-linear problem.

Mandal et al. (2007) tried to model the EDM operation applying Artificial Neural Network with back generation as the learning algorithm. Investigators modeled surface
unevenness, Machining Rate (MR) and electrode (tool) wear rate, with dissimilar process factors and they were established properly for forecasting the responses.

Panda and Bhoi (2005) established simulated feed-forward Neural Network which is built on the Levenberg-Marquardt back propagation method of logistic sigmoid activation work to expect MRR of AISI D2 steel. This pattern makes well under the stochastic (having random variables) environment of definite machining conditions in EDM and makes available sooner and extra accurate outcomes. Investigators establish the 3-4-3-1 neural architecture has the full association constant and applied it for the investigation.

Wang et. al. (2003) claimed and combined the practices of ANN and genetic system to find combined result to the present problem of modeling and optimization of EDM activities.

Pradhan (2009) developed an RSM and ANN predictive modeling utilizing peak current (Ip), Ton, and FP (Flushing Force) to predict OC, MRR, and TWR. In the present scenario, an innovative development has been presented to hybridize the characteristics of more than two procedures to take advantage of the possible of each procedure and shrink their drawbacks. Such method with pooled characteristics is called the method of hybrid modeling.

Neuro-fuzzy (NF) methods are grouping of fuzzy logic and neural networks, from now it can acquire from information and hold the inherent interpretability of fuzzy logic. Adaptive Network Based Fuzzy System (ANFIS) was first founded by Jyh-Shing and Jang (1993).

Bud G.E (1997) described that oils have been utilized as dielectric fluid as long as the procedure has existed, but only in the past years have any appreciable studies or scientific methodologies been made as to their constituents and compatibility through people and the environment. There are several types of fluid available. In general, fluids with paraffinic, naphthenic and aromatic bases are used.

Engineers Edge (2000-2016) explained that in electrical discharge machining, discharge energy is make available with the help of generator of power. Electrical discharge machining can be categorized into RC, LC and RLC kinds to producing power. The transistorized type of
energy source of an EDM techniques make available right-angled waveform pulses with the T-on. Pulses are generally varies between one microsecond and 2000 microsecond, peak voltage varies between 40V and 400V, and Ip vary between 0.5A and 500A. By means of RC, LC and RLC type source of power, the spark energy produce with the help of capacitor which is linked in corresponding with the cutting distance. The spark period is very small (< 5msec) due to less impedance of plasma envelop, and the Ip is more up to thousand amperes. The Vp is in the equal limit of power source arrangements. The power source arrangements are generally utilized in electrical discharge machining operations. Minimum tool wear will be produced due to this. Source of power is utilized for make a hole, material removal and micro-electrical discharge machining is used for more rate material removal and good procedure constancy. The power generator of wire electrical discharge machining is generally a capacitive power source which is controlled by transistor that decreases the risk of wire break. In this source of power, the spark frequency can be restricted by fitting the T-on and T-off of the transistors.

Adnan, (2001) explained that in the electrical discharge machining method, the average Ip is the mean of the amperage in the arc distance calculated across a whole phase. One can see this reading on the ammeter throughout the process. The theoretical average discharge current can be finding out by multiplying the duty cycle and the peak current (highest current obtainable for separate pulse from the source of power or generator). The middling discharge Ip is a signal of the material removal (machining) operation efficiency with respect to MRR (Material Removal Rate). The idea of highest peak amperage that can be applied to the electrode is an important parameter. Investigator has also described that very high currents are not utilized as they frequently lead to heat loss of the workpiece surface, the depth of the recast film (layer) might not fully clean up, the intense heat produced can sink deeply into the nearby areas of the work piece which might undergo an uncontrolled heat treating or annealing process. The OC (Over Cut) will find out by the amount of current and the on time, but generally when elevated temperatures are functional, it is an undersized electrode which will leave enough material to be removed advanced in subsequent finishing modes using less power and orbiting, or by changing to larger, finishing electrodes.
McGeough and Regius, (1998) reported that in the electrical discharge machining operation, kerosene is the popular dielectric fluid utilized by means of definite additives that avoid the gas bubble and deodorant. Silicon dielectric fluids and mixture of these fluids with hydrocarbon oils have excellent outcomes. More dielectric fluids such as an aqueous mixture of ethylene glycol, water in a mixture and purified water. Entirely dielectric oil will change in darken color after utilizing, but it appears only logical to start with fluid that is as clear as possible to allow the showing of the submerged part.

Heuvelman C.J. et. al. (1974) reported that under the same machining settings, suction flushing during finishing would be more advantageous. Experiment with vibrating electrodes has also been performed by few researchers. This would mostly help space (gap) cleaning. In such circumstances, for most favorable MMR, the frequency of vibration should be high or on the other hand, the vibration amplitude should be minor or small.

Willey P.C.T (1976) has described that by selecting a proper flow velocity of the dielectric fluid, it is possible in few situations to have required electrode wear and surface roughness values. On the other side, large static dielectric flushing pressure can lead to an increase in material removal rate especially by means of long pulse periods. The method of dielectric flushing also affects the electrical discharge machining performance.

Greene J.E. et. al. (1974) has described few experimental outcomes of the effect of uninterrupted, different, and mixed flushing methods on workpiece and electrode shape and size and investigated that different flushing outcome in a small improvement.

Shankar Singh et. al. (2004) have researched the influences of injection or suction flushing on the degree of edge circling, as well as the angle of slope of the machined surface and informed that larger edge wear and taper happens at the dielectric outlet side.

2.2 IDENTIFIED GAPS IN THE LITERATURE/ BRIEF CONNECTED WORK

After the study of so many kinds of literature, it has been observed that there is a number of gaps in machining of Die-sinking EDM.
1. Most of the research work has been reported on WEDM but limited research work on Die-sinking electrical discharge machining process.

2. Most of the researchers have been used Taguchi approach to parameter design but very limited work carried out on D-Optimal approach of d.o.e for parametric study.

3. Very limited investigation has been observed for optimization of electrode wear for different electrode materials.

4. Very limited research work has been observed in the study of electrode wear with different electrode materials using single workpiece material only.