CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

The purpose of literature review is to provide background information on the issues to be considered in this thesis and to emphasize the relevance of the present study in order to predict the MRR and $R_a$ in WEDM process. This review is mainly focused on the selection of optimum process parameters.

2.2 BACKGROUND RESEARCH ON WEDM

The broad review of literature has been carried out on WEDM process and it has been classified into two main categories as given below:

- Research on development of WEDM process and its tools.
- Research on application of optimization tools to optimize process parameters of machining Processes.

2.2.1 Research on Development of WEDM Process and its Tools

Several researchers in the past have made attempts to improve the efficiency of WEDM process.
Mohan et al (2004) have investigated the machining characteristics of SiC/6025 Al composite using rotary electro-discharge machining (EDM) with a tube electrode. Brass was used as the electrode material to EDM SiC/6025 Al composites. Three observed values: MRR, electrode wear rate (EWR) and SR are adopted to evaluate the machinability. Peak current, polarity, volume fraction of SiC reinforced particles, pulse duration, hole diameter of the tube electrode, and speed of electrode rotation were used as the input variables to assess the machinability. The optimum machining parameter for maximum MRR, minimum EWR and better SR were found out using genetic algorithm. Kibria et al (2010) have addressed the issues of micro-EDM utilizing different types of dielectrics such as kerosene, deionized water, boron carbide (B$_4$C) powder suspended kerosene, and deionized water to explore the influence of these dielectrics on the performance criteria such as MRR, tool wear rate (TWR), overcut, diametral variance at entry and exit hole and surface integrity during machining of titanium alloy (Ti-6Al-4V). Pradhan et al (2009) have attempted the optimization micro-EDM process parameters for machining Ti-6Al-4V super alloy. To verify the optimal micro-EDM process parameters settings, metal removal rate (MRR), tool-wear rate (TWR), over cut (OC) and taper were chosen as observed performance criteria. In addition, four independent parameters such as peak current, pulse-on time, flushing pressure, and duty ratio were adopted for evaluation by the Taguchi method. From the ANOVA and S/N ratio graph, the significant process parameters and the optimal combination level of machining parameters were obtained. Yuan-Feng Chen et al (2008) have investigated how machining characteristics and surface modifications affect low-carbon steel (S15C) during EDM processes with semi-sintered electrodes. Nikalje et al (2013) have discussed the influence of process parameters and optimization of electrical discharge machining (EDM)
performance measures on MDN 300 steel. The process performance criteria such as material removal rate (MRR), tool wear rate (TWR), relative wear ratio (RWR), and surface roughness (SR) were evaluated. Discharge current, pulse on time, and pulse off time have been considered the main factors affecting EDM performance. Abhang et al have presented the optimization of machining parameters in steel turning operation by Taguchi method. In their study the experimental work was carried out by turning EN-31 steel alloy by using tungsten carbide inserts. There were three main purposes of their study. The first was to explain and demonstrate a systematic procedure of Taguchi parameter design and applying it to the data on turning. The second was to find out the optimal combination of process parameters based on S/N ratio and to know the significance of each parameter by performing ANOVA analysis. The third important aim was to find out the effect of lubricant temperature in steel tuning process on the response (i.e. surface roughness). Vikas Magdum & Vinayak Nair (2013) have investigated the use of tool materials and process parameters for machining forces for selected parameter range and estimation of optimum performance characteristics and they developed a methodology for optimization of cutting forces and machining parameters.

Senthil Kumar et al (2006) have presented the optimization of machining parameters on machining S.G. iron (ASTM A536 60-40-18) using alumina based ceramic cutting tools. The optimum machining parameters are found out using genetic algorithm. Durairaj et al (2013) have summarized the Grey relational theory and Taguchi optimization technique, in order to optimize the cutting parameters in Wire EDM for SS304. Periyanan et al (2011) have focused on the Taguchi technique for the optimization in micro-wire electro discharge grinding process to achieve maximum MRR considering the feed rate, capacitance and voltage as the cutting parameters. Based on the experimental result and analysis it is concluded that medium
feed rate, high value of capacitance and voltage such combination of optimized parameters gives high value of MRR (0.39mg/min). The experimental result shows that the most influential parameter on the MRR is feed rate, capacitance and voltage. Also from the verification experiment it is concluded that Taguchi technique is suitable to solve the above said problem.

Basavaraj et al (2014) have presented “Micro Structure Analysis of steel 85 and Al-7050 for cold expanded holes” ensures that the plastic deformation regions seen near the holed section are thicker than those away from the hole section. The inlet (mandrel entrance) surfaces are the location for weakest compressive peak stresses. Omole et al (2014) have investigated “Assessment of hardness and tensile properties of stir – cast Aluminium matrix reinforced with tetra carpidium conophorum kernel” deals with the increase in hardness of aluminium reinforced matrix when compared to normal. This will ensure that the greater hardness is achieved in composite material. Keshavamurthy et al (2013) have investigated “Micro Structure and mechanical properties of Al 7075 –TiB\textsubscript{2} in – situ composite” ensures the considerable improvement of hardness and tensile strength of the composite material when compared to un-reinforced alloy and successful fabrication by stir casting technique. Marilena Colt-Stoica et al (2013) have presented “Defects in composite material caused by drilling in manufacturing process” point outs that hole defects are concentrated on their edge, to a distance of 2mm from the edge. The crushing of the fibers (matrix and fibers) are observed in the hole edge. Vignesh et al (2013) have presented “Experimental investigation and analysis of piston by using composite materials” provides us a valuable information such as hardness and wear resistance of the composite material is increased to a notable value. Hemalatha et al (2013) have proposed “Processing and synthesis of metal matrix Aluminum 6063/Al\textsubscript{2}O\textsubscript{3} metal matrix composite by stir casting process”
ensures that composite material clearly superior to base alloy in hardness, tensile strength, wear resistance etc.,

Dinesh Pargunde et al (2013) have demonstrated “Fabrication of metal matrix composite by stir casting method” ensures that optimization of the whole casting process by controlling and filling with optimal plunger movement and also Less scrap and waste production when new design is taken on the use. Botezatu et al (2012) have projected an overview of “SEM study on fracture behaviour for PA 6 composite used on Automotive parts” gives us detailed knowledge about the SEM analysis and various micrographs observation on crack faces. It also provides information about microcracks, matrix cracks, fiber cracks etc., Videnskab et al (2012) have presented the “Marginal adaptation of a low-shrinkage silorane-based composite: A SEM-analysis” point outs that no statistically significant difference between the two materials was shown for gap formation and chipping. The hypothesis that reduced polymerization shrinkage will improve the marginal adaptation is not supported in this study. Danimir et al (2012) have attempted the “Profilometric and SEM analysis of composite surfaces after cement excess removal” gives the detailed information about the surface roughness analysis by Profilometric and SEM analysis. Different ways of excess removal significantly influence the surface characteristics of the used composite cement. Chandramohan et al (2011) have addressed the issue of the “Tensile and hardness tests on Natural fiber reinforced polymer composite material” gives the knowledge about the tensile loading condition, plastic deformation, tensile fracture micrograph and tensile strength. Rabindra Behera et al (2011) have investigated the “Forgeability and Machinability of stir cast Aluminium alloy metal matrix composites” ensures that with increasing the weight percentage of SiCp in cast MMCs, the hardness increased and the value of the hardness at the middle of the casting compared to the both end of casting. It
also gives general information about cutting forces, cutting force will increase with increase in weight percentage of SiC<sub>p</sub>.

Muhammad Hayat Jokhio et al (2011) have proposed the “Manufacturing of Aluminum Composite Material Using Stir Casting Process” ensures that the porosity generally found in stir casting of aluminum composites increases with increase in "Al<sub>2</sub>O<sub>3</sub>" particles contents in aluminum matrix especially containing high percentage of alloy addition. Vivekananthan et al (2010) have investigated the issue of “Experimental evaluation of Aluminium-fly ash composite material to increase the mechanical and wear behavior by stir casting method” ensures that addition of magnesium and silicon improves the wet ability of fly ash with aluminium melt. Veeresh Kumar et al (2010) have offered the “Studies on A16061-SiC and Al7075-Al<sub>2</sub>O<sub>3</sub> metal matrix composites”, micro hardness of the composites increased with increased filler content, micro structural studies revealed the uniform distribution of the particles in the matrix system. Masato Hotta et al (2013) have dealt the “Examination of composite resins with electron microscopy, micro hardness tester and energy dispersive X-ray micro analyzer” ensures that the revolutionary technologies employed to manufacture composite resins have dramatically changed their properties, especially in terms of the size, shape, and distribution of the filler particles. Although recently improved restorative composite resins could offer the properties required of dental restorations.

Rupesh Chalisgaonkar et al (2015) In this research work, development of a multi response optimization technique has been undertaken, using traditional utility method in conjunction with the weight assignment concept (for multiple customer's priorities) in trim cut wire electrical discharge machining (WEDM). Pure titanium has been selected as work material for experimentation. The effect of key process parameters such a
wire type (zinc coated and uncoated brass wire), pulse on time (TON), pulse off time (TOFF), peak current (IP), wire feed (WF), servo voltage (SV) and wire offset (WOFF) were investigated on material removal rate (MRR), surface roughness and wire weight consumption (eroded weight of wire after machining) in finish cut WEDM operation. Two different types of wire electrodes were taken for experimental research (uncoated, zinc coated). Vikram Singh et al (2015) the study investigated that, AISI D2 steel specimen is machined by using brass wire as electrode and the response surface methodology (RSM) is used for modelling a second-order response surface to estimate the optimum machining condition to produce the best possible response within the experimental constraints. The results from this study will be useful for manufacturing engineers to select appropriate set of process parameters to machine AISI D2 steel. Ravindranadh Bobbilli et al (2015) The current work presents a comparative study of wire electrical discharge machining (WEDM) of armour materials such as aluminium alloy 7017 and rolled homogeneous armour (RHA) steel using buckingham pi theorem to model the input variables and thermo-physical characteristics of WEDM on material removal rate (MRR) and surface roughness (Ra) of Al 7017 and RHA steel. The parameters of the model such as pulse-on time, flushing pressure, input power, thermal diffusivity and latent heat of vaporization have been determined through design of experiment methodology. Wear rate of brass wire increases with rise in input energy in machining Al 7017. The dependence of thermo-physical properties and machining variables on mechanism of MRR and Ra has been described by performing scanning electron microscope (SEM) study. Gopalakannan et al (2015) the newly engineered metal matrix composite (MMC) of aluminium 7075 reinforced with 10 wt% of B4C particles were prepared by stir casting method. Experiments were carried out by adopting face centered central composite design of response surface methodology. Analysis of variance was applied to investigate the influence of process parameters and their interactions viz.,
pulse current, gap voltage, pulse on time and pulse off time on material removal rate (MRR), electrode wear ratio (EWR) and surface roughness (SR). Mantra Prasad Sthapathy et al (2015) the control parameters like vibration amplitude, weld pressure and weld time are considered for the welding of dissimilar metals like aluminum (AA1100) and brass (UNS C27000) sheet of 0.3 mm thickness. Experiments are conducted according to the full factorial design with four replications to obtain the responses like tensile shear stress, T-peel stress and weld area. All these data are utilized to develop a non-linear second order regression model between the responses and predictors. As the quality is an important issue in these manufacturing industries, the optimal combinations of these process parameters are found out by using fuzzy logic approach and genetic algorithm (GA) approach. During experiments, the temperature measurement of the weld zone has also been performed to study its effect on different quality characteristics.

Gangadharudu Talla et al (2015) an attempt has been made to fabricate and machine aluminum/alumina MMC using EDM by adding aluminum powder in kerosene dielectric. Results showed an increase in MRR and decrease in surface roughness ($R_a$) compared to those for conventional EDM. Semi empirical models for MRR and $R_a$ based on machining parameters and important thermo physical properties were established using a hybrid approach of dimensional and regression analysis. A multi response optimization was also performed using principal component analysis-based grey technique (Grey-PCA) to determine optimum settings of process parameters for maximum MRR and minimum $R_a$ within the experimental range. Milan Kumar Das et al (2015) the objective of this paper is to find out the combination of process parameters for optimum surface roughness and material removal rate (MRR) in electro discharge machining (EDM) of EN31 tool steel using artificial bee colony (ABC) algorithm. For experimentation, machining parameters viz., pulse on time, pulse off time, discharge current
and voltage are varied based on central composite design (CCD). Second order response equations for MRR and surface roughness are found out using response surface methodology (RSM). For optimization, both single and multi-objective responses (MRR and surface roughness: Ra) are considered. From ABC analysis, the optimum combinations of process parameters are obtained and corresponding values of maximum MRR and minimum Ra are found out. Pujari Srinivasa Rao et al (2015) study the effect of wire EDM parameters on aluminum alloy because of its growing applications in various industries. In the present research, parametric analysis of wire EDM parameters was performed by Taguchi method on surface roughness (SR) and material removal rate (MRR). The above performance measures are simultaneously optimized by hybrid genetic algorithm with the use of developed linear regression models. The obtained results show a good agreement with experimental values. Finally, for a suggested combination of parameters white layer measurements were also made as it adversely affects many other properties. Giovanna Gautier et al (2015) the paper investigates the interactions between common process parameters of WEDM and final quality of the generated surface, through analysis of variance (ANOVA) and regression models based on experimental results. In particular, the paper is focused on the effects of pulse on time, pulse off time, servo-reference voltage, and wire tension on the surface finish during the WEDM of a Ti-48Al-2Cr-2Nb (at. %) γ-TiAl alloy Results. Dastagiri et al (2014) metal removal mechanism in Electrical Discharge Machining (EDM) is mainly a thermal phenomenon where thermal energy is produced in plasma channel, and is dissipated though work piece, tool and dielectric. The process is mostly used in situations where machining of very hard materials, intricate parts, complex shapes. The aim of this work is to pursue the influence of four design factors current (I), voltage (V), pulse on(Ton), and duty factor (η) which are the most connected parameters to be controlled by the EDM process over machining specifications such as material removal rate (MRR)
and tool wear rate (TWR) and characteristics of surface integrity such as average surface roughness (Ra) and the hardness (HR) and also to quantify them. In this paper the experiments have been conducted by using full factorial design 2^3 with three central point in the DOE techniques and developed a mathematical model to predict material removal rate, average surface roughness and hardness using input parameters such as current, voltage, pulse on, and duty factor. Manisha Priyadharshini et al. (2014) die-sinking electric discharge machining (EDM) is one of the essential non-contact machining processes which is often used to produce complex profiles. However, machining of composites is found to be difficult even using WEDM due to the inadequate process parameter sets affected by improper parametric correlation. Therefore, this work demonstrates the parametric optimization of WEDM for desired responses using grey relational Taguchi analysis. Taguchi method was used to design the experiments using L_{9} orthogonal array and the effect of each parameter on the responses while machining Al/SiC_p&Mg/SiC_p composites using a molybdenum wire electrode was studied collectively.

### 2.2.2 Research on Applications of Optimization Tools to Optimize Process Parameters of Machining Processes

Assarzadeh & Ghoreishi (2008) have presented new integrated neural-network-based approach for the prediction and optimal selection of process parameters in die sinking electro-discharge machining (EDM) with a flat electrode. Taguchi method with fuzzy logics is being used for the optimization of the electrical discharge machining process parameters Lin (2000). The use of grey–fuzzy logic have been proposed for optimizing the electrical discharge machining process by considering pulse on time, duty factor and discharge current as machining parameters and electrode wear ratio, material removal rate and surface roughness as responses (Lin & Lin
2005). The grey and fuzzy integrated approach have been projected for the optimization of turning Hadfield steel with Al₂O₃/Tic mixed ceramic tool by considering cutting speed, feed rate, depth of cut and nose radius of tool as cutting parameters. The optimal selection of machining conditions in the electro jet drilling process has been presented using hybrid neural network, desirability function and genetic algorithm approach. Initially a back propagation neural network is being used to formulate a fitness function for predicting the response parameters of the process. From the network output, the desirability method obtains a composite fitness function for further use in the genetic algorithm. The optimized input parametric combinations and the multi response characteristics of the process were predicted finally by genetic algorithm (Mohan Sen & Shan et al 2006).

Rama Rao & Padmanabhan (2012) have presented the effect of process variables on MRR in electrochemical machining of aluminum metal matrix composites. They have considered the percentage of reinforcement, voltage, feed rate and electrolyte concentration as input parameters to study their effects on MRR of ECM. They have also used Response surface methodology for establishing the mathematical relationship between the various input process parameters and the MRR. Honda HosnyAbuzied et al (2012) have proposed artificial neural network approach to predict the better responses such as MRR and SR by varying the machining parameters such as applied voltage, feed rate and electrolyte flow rate on electrochemical broaching process. Chakradhar & Venu Gopal (2011) have proposed multi-objective optimization of electrochemical machining of EN31 steel by grey relational analysis. They have investigated the effect of process parameters such as electrolyte concentration, feed rate and applied voltage on multiple performance characteristics including MRR, overcut, cylindricity error and surface roughness. Norfadzlan Yusup et al (2012) have projected an overview of particle swarm optimization method to optimize process
parameters of both traditional and modern machining processes from 2007 to 2011. (Rao & Pawar 2010) have developed a mathematical model using response surface methodology to correlate the interrelationships of various wire electric discharge machining parameters (WEDM). Muthu Kumar et al (2010) have demonstrated optimization of WEDM process parameters of Inconel800 super alloy based on Grey-Taguchi method. They have chosen gap voltage, Pulse On –time, Pulse Off-time and wire feed as process parameters with multiple performance characteristics such as MRR, SR and kerf.

Saurav Datta & SibaSankar Mahapatra (2010) have presented quadratic models to represent the process behavior of WEDM. They have considered discharge current, pulse duration, pulse frequency, wire speed, wire tension and dielectric flow rate as machining parameters and MRR, roughness value of the worked surface as responses. Ganesan et al (2011) have determined the optimal machining parameters for continuous profile machining by considering minimum production time, subject to a set of practical constraints, cutting force, power, dimensional accuracy and surface finish and by applying genetic algorithm and particle swarm optimization techniques. Dhanabalan et al (2012) have presented optimization of EDM process parameters with considerations of pulse on time and pulse off time as machining parameters and MRR, electrode wear rate and surface roughness as machining performance characteristics based on the orthogonal array with the grey relational analysis. Farhad Kolahan et al (2011) have presented an approach that combines grey relational analysis and regression modeling to convert the multi responses obtained from Taguchi method design of experiments into a multi objective model and then the process parameters are optimized by SAA. They have chosen turning process of St.50.2 steel. Seung-Han Yang et al (2009) have proposed a method of optimizing the process parameters of EDM using counter propagation neural network and simulated
annealing scheme. Hsien–Ching Chen et al (2010) have projected optimization of WEDM parameters by integrating back propagation neural network and SAA. It has been found that the parameter optimization of EDM on machining Ti-6Al-4V with multiple quality characteristics using the Taguchi method and grey relational analysis by choosing discharge current, open voltage, pulse duration and duty factor as process parameters and electrode wear ratio, material removal rate and surface roughness as performance characteristics to evaluate the machining effects Kao et al (2010). They have conducted experiment based on orthogonal array and shown an improved electrode wear ratio of 15%, material removal rate of 12% and surface roughness of 19% when the Taguchi and GRA are used. It has been observed that the optimization of EDM process for multiple performance characteristics using Taguchi method and Grey relational analysis to find the optimal machining conditions under which the micro-hole can be formed to a minimum diameter and a maximum aspect ratio.

Jong Hyuk Jung & Won tae Kwon (2010) have investigated the Taguchi method is used to determine the relations between machining parameters and process characteristics. Electrode wear, the entrance and exit clearances had a significant effect on the diameter of the micro-hole when the diameter of the electrode is identical. Grey relational analysis is used to determine the optimal machining parameters, among which the input voltage and the capacitance are found to be the most significant. The obtained optimal machining conditions are an input voltage of 60V, a capacitance of 680PF, a resistance of 500Ω, the feed rate of 1.5μm/s and a spindle speed of 1500rpm. Under these conditions, a micro-hole of 40μm average diameter and 10 aspect ratio could be machined.

Somashekhar et al (2010) have offered the optimization of MRR in micro – electric discharge machining (μ-EDM) using Artificial Neural
network (ANN) and Genetic Algorithms (GAs). They reported on the development of modeling and optimization \( \mu \)-EDM process. ANN is used for analyzing the material removal of \( \mu \)-EDM to establish the parameter optimization model. A feed forward neural network with back propagation algorithm is trained to optimize the number of neurons and number of hidden layers to predict a better material removal rate. A neural network model is developed using MATLAB programming, and the trained neural network is simulated. When experimental and network model results are compared for the performance considered, it is observed that the developed model is within the limits of the agreeable error. Then, GAs has been employed to determine optimum process parameters for any desired output value of machining characteristics. This well-trained neural network model is shown to be effective in estimating the MRR and is improved using optimized machining parameters. Ling xung Zhang et al (2010) have proposed a hybrid model using supporting vector machine and multi-objective genetic algorithm for processing parameters optimization in micro-EDM. They have considered processing time and electrode wear as objectives. They adopted supporting vector machine and proposed non-dominated sorting genetic algorithm to find an optimized combinations of minimum processing time and electrode wear. Rahman et al (2010) have presented the optimization of machining parameters on tool wear rate of Ti-6Al-4V through EDM using Copper Tungsten Electrode. They have taken peak ampere, pulse on time and pulse off time as machining parameters to investigate the effects on tool wear rate of titanium alloy Ti-6Al-4V in EDM. Chandrasekaran et al (2010) have proposed the application of soft computing techniques in machining performance and optimization. They have applied neural networks, fuzzy sets, genetic algorithms, simulated annealing, ant colony optimization and particle swarm optimization tools to four machining processes –turning, milling, drilling and grinding. Mohammadreza Shabgard et al (2013) have presented mathematical and numerical modeling of the effect of input-parameters on the flushing
efficiency of plasma channel in EDM process. In their study, the temperature
distribution on the surface of work piece and tool during a single discharge in
the electrical discharge machining process has been simulated using
ABAQUS code finite element software. Janardhan et al (2010) have
considered pulse train data analysis to investigate the effect of machining
parameters on the performance of wire electro discharge turning process.
They aimed at giving an insight into the wire electro discharge turning
process, by analyzing the effect of machining parameters on material removal
rate, surface roughness and roundness error using the pulse train data acquired
at the spark gap. Joshi et al (2011) have proposed intelligent process modeling
and optimization of die-sinking electric discharge machining. In their paper,
Physics based process modeling using finite element method (FEM) has been
integrated with the soft computing techniques like ANN and GA to improve
prediction accuracy of the model with less dependency on the experimental
data. A two-dimensional axi-symmetric numerical FEM model of single spark
EDM process has been developed based on more realistic assumptions such
as Gaussian distribution of heat flux, time and energy dependent spark radius,
etc. to predict the shape of crater, material removal rate and tool wear rate.

Abdelouahhab Jabri et al (2013) have presented a multi-
optimization technique based on genetic algorithms to search optimal cuttings
parameters such as cutting depth, feed rate and cutting speed of multi-pass
turning processes. Ramezan Ali & Mahdavi Nejad (2011) have presented the
optimization of SR and MRR of EDM of Sic parameters. Artificial neural
network (ANN) with back propagation algorithm is used to model the
process. A multi-objective optimization method, non-dominating sorting
genetic algorithm-II is used to optimize the process. Affects of three
important input parameters of process viz., discharge current, pulse on time
(Ton), pulse off time (Toff) on electric discharge machining of SiC are
considered. Rajyalakshmi & Venkata Ramaiah (2013) have combined the
orthogonal array design of experiment with grey relational analysis. The main objective of their study is to obtain improved material removal rate, surface roughness, and spark gap. They adopted grey relational theory to determine the best process parameters that optimize the response measures.

Porwal (2013) have used a hybrid method comprising of GRA coupled with principal component analysis for the determination of preferred combination of input parameters of hole drilling micromachining process for maximization of material removal rate and minimization of other three output parameters such as tool wear rate, hole taper and hole overcut simultaneously. Ruben Phipon & Pradhan (2012) have dealt with the single and multi objective optimization of micro EDM process using Genetic Algorithm and they also have used mathematical models using Response Surface Methodology. To the best of the knowledge of the authors most of researchers have proposed the method combining grey relational analysis and fuzzy logic are discussed and compared with reference to the models available in literature. Ugrasen et al (2015) this study outlines the development of model and its application to optimize WEDM machining parameters using the Taguchi’s technique which is based on the robust design. Experimentation was performed as per Taguchi's L’16 orthogonal array. Each experiment has been performed under different cutting conditions of pulse-on, pulse-off, current, and wire speed. Among different process parameters voltage and flush rate were kept constant. Brass wire having diameter of 0.18 mm was used as an electrode. Three responses namely accuracy, surface roughness, volumetric material removal rate have been considered for each experiment.

2.3 IDENTIFIED GAPS IN THE LITERATURE

After a comprehensive study of the existing literature, a number of gaps have been observed in machining and optimization of WEDM.
Extensive research has been carried out in the area of EDM process, but WEDM process has received less attention by the researchers in the past.

The focus of WEDM research in the past has been carried out to improve the process capability and its performance of this system.

In the earlier research work, most of the studies are focused on either tool wear studies or radial overcut studies in WEDM process.

In the earlier research work, the quantitative methods have been developed with considerations of a single objective only in optimization of machining operations.

Optimization of process parameters while machining alloys for WEDM process only are focused by several researchers.

No comprehensive analysis is carried out to access the performance of machining of Al/SiC_p & Mg/SiC_p.

2.4 STATEMENT OF THE PROBLEM

The present work “Optimization of Process Parameters in Wire electric discharge Machining (WEDM) for composites” has been undertaken keeping into consideration for the following problems:

WEDM process is a potential process that offers several improved characteristics over other process.
• It is necessary to develop efficient models to select optimal WEDM process parameters for machining composites. Because composites are increasingly used in aerospace, jet engines, marine engineering, transportation industries, railway equipments, production equipments, food, petroleum, electrical industries and surgical instruments.

• Recently many models have attracted several researchers in their area of research domain.

• This work presents a logical and systematic procedure using GRA, RSM and MINITAB 16 SOFTWARE approach to optimize the operating parameters of WEDM for composites.

2.5 SUMMARY

In this chapter, an effort is made to review the literature on various mathematical models and the effect of process parameters of WEDM process. The available papers have been classified as research on development of WEDM process and its tools and research on application of optimization tools to optimize process parameters of machining processes. This chapter also summarizes the current state of the art in machining, the limitations existing and the approaches made. The limitations reviewed are addressed in the current research work.