Available online at www.sciencedirect.com

ScienceDirect

Materials Today: Proceedings 4 (2017) 2048–2057

www.materialstoday.com/proceedings

5th International Conference of Materials Processing and Characterization (ICMPC 2016)

Review on modelling and optimization of electrical discharge machining process using modern Techniques

Manish Gangil, M. K. Pradhan, Rajesh Purohit

Department of Mechanical Engineering, Maulana Azad National Institute of Technology, Bhopal (M.P.), India
gangilmanish@gmail.com, mohanrkl@gmail.com, r_purohit73@hotmail.com

Abstract

In recent years, the industrial product not only requires high precision and quality, but also should be produced in minimum time to sustain in the highly competitive market. Thus, it is required to achieve the desired output by regulating the process parameter as per the requirement. The input parameters plays important role in determining the surface quality and also the Material removal rate. Amongst the various machining processes Electrical Discharge Machining (EDM) is one of the most attractive alternatives for the industry due to its attractive attribute of not non-contact of tool and workpiece that leads to very little or no force exert in the tool and work piece. In the current study the thorough literature review of various modern machining processes is presented. The main focus is kept on the optimization aspects of various parameters of the EDM processes and hence only such research works are included in this work in which the use of advanced optimization techniques was involved. The review period considered is from the year 2006 to 2015. This review study has been classified according to different process as Die Sinking EDM, WEDM, PMEDM, Micro-Machining, and various hybrids and modified versions. The review work on such a large scale was not attempted earlier by considering many processes at a time, and hence, this review work may become the ready information at one place and it may be very useful for the subsequent researchers to decide their direction of research.

Selection and peer-review under responsibility of Conference Committee Members of 5th International Conference of Materials Processing and Characterization (ICMPC 2016).

*Keywords:-*Electric Discharge Machining, Process Parameters, Grey Relational Analysis, Neural Network, Genetic Algorithm, Simulated annealing, Artificial bee colony, Finite Element Method, Fuzzy set theory, Optimization.

1. Introduction

Electrical discharge machining is a nontraditional machining process for metals, removing based upon the fundamental fact that negligible tool force is generated during the machining process. The metal removal is carried out a series of electrical sparks generated between tool and work materials with constant electric field in thedielectric environment. The EDM process is generally used for machining of cutting tools, punch dies, and other

2214-7853©2017 Elsevier Ltd. All rights reserved.
Selection and peer-review under responsibility of Conference Committee Members of 5th International Conference of Materials Processing and Characterization (ICMPC 2016).

difficult-to-machine materials. Despite the fact that the process has been well-known as the standard machining procedure with the tools, dies, and molds industry, the process is yet treated as the so called “know-how” process today. That means, the tuning of EDM system variables for obtaining process performance and component accuracy has been empirical.. Even though the up-to-date computer technology has been applied on the machine controller, the EDM process is still one of the expertise-demanding processes in the industry. From the literatures, the comprehensive mechanism of metal erosion during sparking is still debatable, although the basic physical laws have been laid for many years. Alternatively, complex thermal conduction behaviors have been broadly ordinary because the main mechanism of steel erosion based upon ad-hoc engineering technique. This explains why the models for correlating the procedure variables and surface finish are hard to be set up accurately. The modern machining processes are now replacing the conventional machining processes rapidly for many applications due to their significant advantages which are proving beneficial to a greater extent to the present industrial scenario. The Requirements of industrial Introduction products have started increasing and new materials are getting introduced which are very hard in nature and difficult to cut by conventional machining processes. Successful machining of such materials by the modern machining processes has added significant lifeline to the industrial growth and given new dimensions to the quality of components. These processes work on a particular principle by making use of certain properties of materials which makes them more suitable for some applications and at the same time put some limitations on their use. These processes involve large numbers of respective process variables and selection of exact parameters setting is very crucial for these highly advanced machining processes which may affect the performance of any process considerably. Due to involvement of a large number of process parameters, random selection of these process parameters within the range will not serve the purpose. The situation becomes more severe in case if more number of objectives are involved in the process. Such situations can be tackled conveniently by making use of optimization techniques for the parameter optimization of these processes. During the past two decades, few researchers had developed some good quality, advanced optimization techniques such as genetic algorithm (GA), simulated annealing (SA), artificial bee colony (ABC) etc. In the past, similar efforts were carried out by several researchers and the same is presented in Table 1 in the chronological order from 2006 onwards and only that research is highlighted in this work, in which the use of suitable optimization technique was adopted in the EDM process and its versions. The use of some advanced optimization techniques such as Grey relation Analysis (GRA), GA, SA, ABC, Fuzzy logic, Finite Element Method (FEM) etc. Research on various versions of EDM process such as WEDM, micro-EDM, powder-mixed EDM, etc. was also reported in the past.

Nomenclature

MMR	:	Material Removal Rate,	TWR	:	Tool Wear Rate,	WR :	wear Ratio,
SR	:	Surface Roughness,	EWR	:	Electrode wear ratio,	ROC:	Radial over cut,
WLT	:	White layer thickness,	RL	:	Recast layer,	K_w	kerf width

1.1 Major Parameters of EDM

EDM Parameters mainly classified into two categories.1.Process parameter 2. Performance parameter

1.1.1 Process parameter:-The major process parameter as given below on the chart.