Experimental investigations into the performance of water as dielectric in EDM

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***Abstract*: For many years, the spark generator, called the Lazarenko chain, has been used in electricity suppliers for EDM presses and in several applications it has an enhanced shape. EDM methods widely developed have been converted to a computer tool. This move made EDM more open and more enticing in terms of conventional methods. Lazarenko EDM device uses a form of power supply resistance capacitance that was commonly used in the 1950's on the EDM computer and was later used as the basis for the further production of EDM. Further pulse and solid state generator advances in the 1960s also minimized past difficulties with poor electrodes, as well as with orbital structures. In the 1970s there was a decrease in the amount in electrodes in cavities. The explosion of the discharge in the dirty liquid gap was established by the physical study of the discharge mainly through air and vacuum, and the study of the breaking force of the isolating hydrocarbon liquid, when applying EDM. Because it is interpreted as an ionic activity similar to that. Figure demonstrates the basic theory of EDM. 1. In the late 1940s [32], the methodology was established.**

1. Introduction

In the 1980s a digitally operated network (CNC) EDM was developed in the United States. The current development model utilizes novel forms of energy such as vibration, illumination, electronic, biological, electrical, electrons and ions. Thanks to the strong strength to the weight, toughness and heat-resistance properties, industrial and technical development of strong and challenging materials have been demonstrated that are broadly applicable in aerospace, nuclear engineering and other industries. The EDM mechanism does not require mechanical energy; neither stiffness, intensity nor toughness of the working element content can impact the deletion rate [22]. Implementation by many researchers in the Taguchi System on the EDM process Tungsten Carboid 610 analysis of these parameters is not much considered by many of the studies , particularly for processing very tough materials such as Tungsten Carbide, both Engineering Phylosography (DOE) and Mathematical Formulation (ANOVA)[16, 25]. The Taguchi method [11] is thus used to define optimal workmanship parameters for the minimum electric wear rating, the minimum material removal rate and minimum surfacing roughness in EDM operations as a productive instrument for the parametric design of performance characteristics. The specifics of the experiment are identified with Taguchi.

2. Working Standard of EDM

The electrode travels to the workpiece to reduce the spark difference to ionize the dielectric fluid through the applied stress [26]. A dielectric liquid split between the electrode and the workpiece is produced in short-term releases. The substance is extracted by corrosion of the electrical dumping of the instrument and workpiece [37]. Dielectric fluids are used to distribute the power of the discharge in very narrow cross section tubes. It also cools off all the electrodes and cleans from the vacuum machined products. The dielectric's electrical resistance affects the release energy and the time when the spark is triggered [34]. Early discharge leads to low resistance. When the resistance is strong, the condenser hits a higher charge before discharge begins. A servo device that measures the difference voltage to the reference value guarantees that the electrode moves properly to preserve the accurate spark distance, as well as that the electrode is withdrawn where short circuits are present.

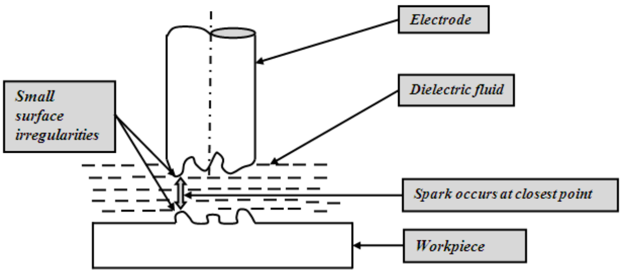

Figure: Working principle of EDM [42]

When the average gap voltage determined by the operator is above that of the reference servo voltage, the feed rate rises. On the contrary, if the average split voltage is higher than the reference voltage, the feed rate will decrease even if the electrode has an electrode withdrawal. This happens when the gap is small, corresponding to a reduced inflammation. The quantity extracted by an individual spark of 106-104 mm3 is minimal, but usually 10'000 times a second this simple process is replicated. The definition for the erosion mechanism is illustrated in Figure 1.2 (A-E) with a single EDM update. The voltage between the electrodes is first added. This inflation voltage is usually 200 V. By pushing the electrode into the work piece, the dielectric disintegration is triggered. This causes the electric field to rise in space before reaching the required breakdown value.

3. Taguchi Technique

A Japanese engineer Dr. Genichi Taguchi was born in 15 Jan 1924. Since the late 1940s he has been instrumental in developing the industry in Japan. Following World War II, the Allied powers noticed that Japan's Telecommunications System efficiency was incredibly weak and entirely inadequate to boost long-haul connectivity, the Allies proposed that in order to establish state-of-the-art communication networks, Japanese development centers could be set up in similar ways as bell laboratories. The Japanese also developed the "Laboratories of Electric Contact" (ECL) with Dr Genichi Taguchi, in charge of improving the efficiency of R&D and improving the quality of goods. Dr. Taguchi began designing modern approaches for refining the computer research process. He has developed techniques often referred to as "Taguchi techniques."

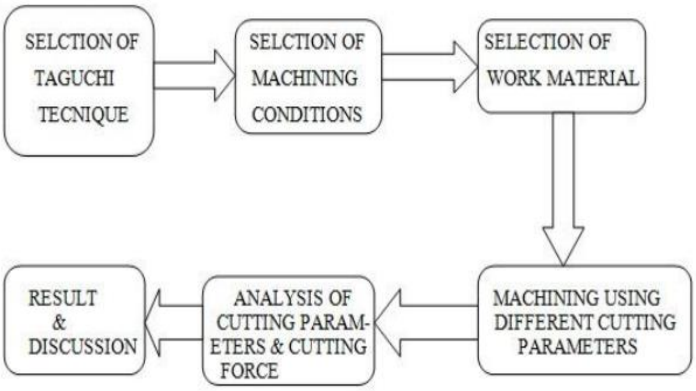

Figure Flow Chart of Taguchi Method

Taguchi Philosophy

Taguchi has a rather strong quality management policy of production. Indeed, his theory creates a completely separate group of engineers who believe in breathing and life-efficiency. His theory has far-reaching implications, but concentrates on three basic principles.

Efficiency cannot be tested into a component. Output is conceived by device design, parameters and tolerance design through a mechanism. The aim of this article is to describe the parameter design by deciding what process parameters the product most affects and then designing them to provide a given target output of the product.
Value is better obtained by growing the gap between goals. The system is engineered to be resistant to environmental conditions that are uncontrollable. The signal (product quality) should also have a large noise ratio (uncontrollable factors).
The service factor can be calculated as a feature of the standard deviation and system-wide estimation of the losses. This is the idea of the failure or the complete damage of low performing goods on the consumer and community.

Concept Design: This is the primary stage of the design in the development of the specific component or process design utilizing the engineering and technological skills. It is an essential step, however we cannot enable all ideas to be explored. Study is thus restricted to a few definitions, which are chosen based on prior knowledge or speculation.
Parameter Design: It is the design stage during which an analysis is performed to evaluate conditions that eliminate differences in efficiency.
Tolerance Design: It is the tertiary architecture in which process tolerances and the uncertainty sources are placed. This is a way to reduce consistency improvements by eliminating their source directly.

4. Experiment And Data Collection

Any of the test conditions of the internal array is checked. -- Examination is essentially replicated or performed according to the particular sequence used in a specific environment. Columns are decided by causes, but rows decide test conditions. When running a test, the interaction state cannot be regulated, since they rely on the key factor levels.

Randomization

Any randomization is used in the order of the measures in the different studies. The randomized training order defends the experimenter from any unforeseen and unpredictable variables which could differ throughout the whole experiment and impact the outcomes.
The three most-used methods are addressed however, the randomization may take several types.
a. Randomization total
b. Simple to replicate
c. Fulfill in boxes

Selection Of Sample Size: From a very realistic point of view, for the conservation of the sample measurements equilibrium (orthogonally) of the experiment a minimum of one test outcome is needed. More than 1 test per survey can be used to measure minor variations in the general population. The experiment's sensitivity improves. There should also be economic concern at this period. If research is quite costly, a test can be used per test.

Observed Variation In An Experiment: If an experiment is performed on a substance or procedure where the phenomenon has a background, at least 75 per cent of the variance traditionally observed can mask the difference in the experimental results. The variance from fair to moderate test outcomes in the latest output data should be at least 75 percent of the variance from decent to weak studies. The explanation is that the right variables and quantities have been used in the experiment.

5. Conclusion

The Wear Intensity (TWR) for Tool Wear was found to be the least in Copper when the method parameter values for the current discharge were set at 7A, 300µs, and 1µs, respectively, pulse on time (Ton) and pulse off time (Toff). For Mild Steel unit, TWR was found to be the least favorable when TWR was 0.0110gm / min in response to process parameter values such as current (Ip), time pulse (Ton) and pulse out time (Toff) were set as 21A, 300µs and 3µs, respectively, for process parameters discharge current (Ip).

References

[1]. Jeswani, M.L(1981), “Effects of the addition of graphite powder to kerosene used as thedielectric fluid in electrical discharge machining”, Wear, 70, 133–139.
[2]. Erden, A.(1983), “Effect of materials on the mechanism of electric discharge machining (EDM)”, J. Eng. Mater. Technol., 105, 132–138.
[3]. S. Tariq Jilani, P.C. Pandey, (1984):Experimental investigations into the performance of water as dielectric in EDM, International Journal of Machine Tool Design and Research, 24, pp.31–43.
[4]. Sato, T., Mizutani, T., Yonemochi, K., Kawata, K., (1986), “The development of an electrodischarge machine for micro-hole boring”, Precision Engineering, 8 (3), 163–168.
[5]. Pandit, S.M., Mueller, T.M.(1987), “Verification of on-line computer control of EDM by data dependent systems”, J. Eng. Ind., 109, 109–121.
[6]. W. Koenig, L. Joerres (1987): A aqueous solutions of organic compounds as dielectric for EDM sinking, CIRP Annals—Manufacturing Technology, 36, pp. 105–109.
[7]. Phadke M.S.(1989), “Quality Engineering Using Robust Design”, Prentice-Hall, Englewood Cliffs, NJ.
[8]. Soni J.S., Chakraverti, G.(1990), “Production of surface finish and accuracies with rotatingelectrode in electro-discharge machining”, Proc. Conf. 14th AIMTDR, IIT Bombay, 297.
[9]. Unal R, Dean E.B. (1991), Taguchi approach to design optimization for quality and cost: an overview, in: Proceedings of the International Society of Parametric Analyst 13th Annual, May 21–24
[10]. Bayramoglu, M., Duffill, A.W.(1992), “Production of three dimensional shapes using computational electrical discharge machining”, In Proc. Int. M.T.D.R. conf., pp 107-112.
[11]. Glen Stuart Peace(1993), “Taguchi Methods”, Addison-Wesley Publishing.
[12]. W. Konig, F.-J.Siebers, (1993): Influence of the working medium on the removal process inEDM sinking, American Society of Mechanical Engineers, Production Engineering Division (Publication) PED 64, pp. 649–658.
[13]. Soni, J.S., Chakraverty, G.(1994), “Machining characteristics of titanium with rotary electro-discharge machining”, Wear, 171, 51–58.
[14]. Bayramoglu, M., Duffill, A.W. (1995), “Manufacturing linear and circular contours using CNC EDM and frame type tools”, Int. J. Mach. Tools Manuf., 35(8), pp.1125–1136.
[15]. Wong, Y.S., Lim, L.C., Lee, L.C.(1995), “Effect of flushing on electro-discharge machined surfaces”, Journal of Materials Processing Technology, 48, 299–305
[16]. RanjitK.Roy(1996), “A Premier On The Taguchi Method”, Van Nostrand Reinhold, New York.
[17]. Xiankui WANG, Baoge YING, Weigang LIU(1996), “EDM Dressing of Fine Grain Super abrasiveGrinding Wheel”, Journal of Materials Processing Technology 62, pp 299-302.
[18]. Y.K. LOK and T. C. LEE(1997), “Processing of Advanced Ceramics Using the Wire-Cut EDM Process”, Journal ofMaterials Processing Teclmology 63 , pp839-843.
[19]. C.K. Chow , G.R. Brady , V.F. Urbanic , C.E. Coleman(1998), “Hydrogen ingress through EDM surfaces of Zr±2.5Nb pressure-tube material”, Journal of Nuclear Materials 257, pp35-43.
[20]. Che Chung Wang , Biing Hwa Yan , Han Ming Chow , Yasuo Suzuki(1999), “Cutting austempered ductile iron using an EDM sinker”, Journal of Materials Processing Technology 88, pp 83–89.
[21]. Lonardo, P.M., Bruzzone, A.(1999), “Effect of flushing and electrode material on die sinking EDM”, CIRP Annals - Manufacturing Technology, 48 (1), 123– 126.
[22]. B.H. Yan, C.C. Wang, W.D. Liu and F.Y. Huang(2000), “Machining Characteristics of Al2O3/6061Al Composite using Rotary EDM with a Disklike Electrode”, The International Journal of Advanced Manufacturing Technology, 16:322-333.
[23]. Wang, C.C., Yan, B.H.(2000), “Blind-hole drilling of Al2O3/6061Al composite using rotaryelectro-discharge machining”, Journal of Materials Processing Technology, 102, 90–102.
[24]. A. Taylan, L. Blaine, Y.C. Yen (2001): Manufacturing of dies and molds, Ann. CIRP 50 No.2, pp. 405–423.
[25]. Guu, Y.H., Hocheng, H.(2001),“Effects of workpiece rotation on machinability duringelectrical discharge machining”, Journal of Material and Manufacturing Processes, 16 (1), 91–101.
[26]. RanjitK.Roy(2001), ”Design of Experiments Using the Taguchi Approach”, John Wiley & Sons,New York.
[27]. Bojorquez, B., Marloth, R.T., Es-Said, O.S.(2002), “Formation of a crater in the workpiece on an electrical discharge machine”, Engineering Failure Analysis, 9, 93–97.

[28]. Lin, C.L., Lin, J.L., Ko, T.C.,(2002), "Optimization of the EDM process based on the orthogonal array with fuzzy logic and grey relational analysis method", International Journal of Advance Manufacturing Technology, 19 (4), 271–277.

[29]. Mohan B., Rajadurai A., Satyanarayan K.G.(2002), "Effect of SiC and rotation of electrodeon electric discharge machining of Al-SiC composite", Journal of Materials ProcessingTechnology, 124, 297–304.

[30]. Bayramoglu, M.; Duffill, A.W. (2004): CNC EDM of linear and circular contours using plate tools, Journal of Materials Processing Technology, 148, pp.196–203.

[31]. Mohan B., Rajadurai A., Satyanarayana K.G.(2004), "Electric discharge machining of Al–SiC metal matrix composites using rotary tube electrode". Journal of MaterialsProcessing Technology, 153–154, 978–985.

[32]. Schumacher, B.M.(2004), "After 60 years of EDM, the discharge process remains still disputed. Journal of Materials Processing Technology", 149, 376–381.

[33]. Singh, S., Maheshwari, S., Pandey, P.C.(2004), "Some investigations into the electric discharge machining of hardened tool steel using different electrode materials", Journal of Materials Processing Technology, 149, 272–277.

[34]. Kansal, H.K., Singh, S., Kumar, P.(2005), "Application of Taguchi method for optimization of powder mixed electric discharge machining", International Journal of Management and Manufacturing Technology, 7, 329–341, Nos. 2/3/4.

[35]. Kuneida, M., Lauwers, B., Rajurkar, K.P., Schumacher, B.M.,(2005), "Advancing EDM through fundamental insight into the process", Annals of CIRP, 54 (2), 599–622.

[36]. Luis, C.J., Puertas, I., Villa, G.,(2005), "Material removal rate and electrode wear study on the EDM of silicon carbide", Journal of Materials Processing Technology, 164–165, 889–896.

[37]. Kansal H.K., Singh H., Kumar P. (2006): Performance parameters optimization (multi characteristics) of powder mixed Electric discharge Machining (PMEDM) Through Taguchi's method utility concept, Indian journal of Engineering & material Science, 13, pp.209-216.

[38]. Marafona, J.; Chousal, A.G., (2006), "A finite element model of EDM based on the Joule effect", Int. J. Mach. Tools Manuf., 46 (6), 595-602.

[39] M. Kiyak , O. C ¸ akır(2007), "Examination of machining parameters on surface roughness in EDM of tool steel", Journal of Materials Processing Technology 191 ,pp 141–144.

[40] Hao Tong , Yong Li , Yang Wang (2008), "Experimental research on vibration assisted EDM of micro-structures with non-circular cross-section", journal of materials processing technology 2 0 8 ,pp 289–298.

[41]. Sohani, M.S., Gaitonde, V.N., Siddeswarappa, B, Deshpande, A.S.,(2009), "Investigationsinto the effect of tool shapes with size factor consideration in sink electrical dischargemachining (EDM) process", International Journal of Advance Manufacturing Technology,45, 1131–1145

[42]. Kuldeep Ojha, R. K. Garg, K. K. Singh(2010), "MRR Improvement in Sinking Electrical Discharge Machining: A Review", ournal of Minerals & Materials Characterization & Engineering, Vol. 9, No.8, pp.709-739.