BABA FARID COLLEGE OF ENGG. & TECHNOLOGY

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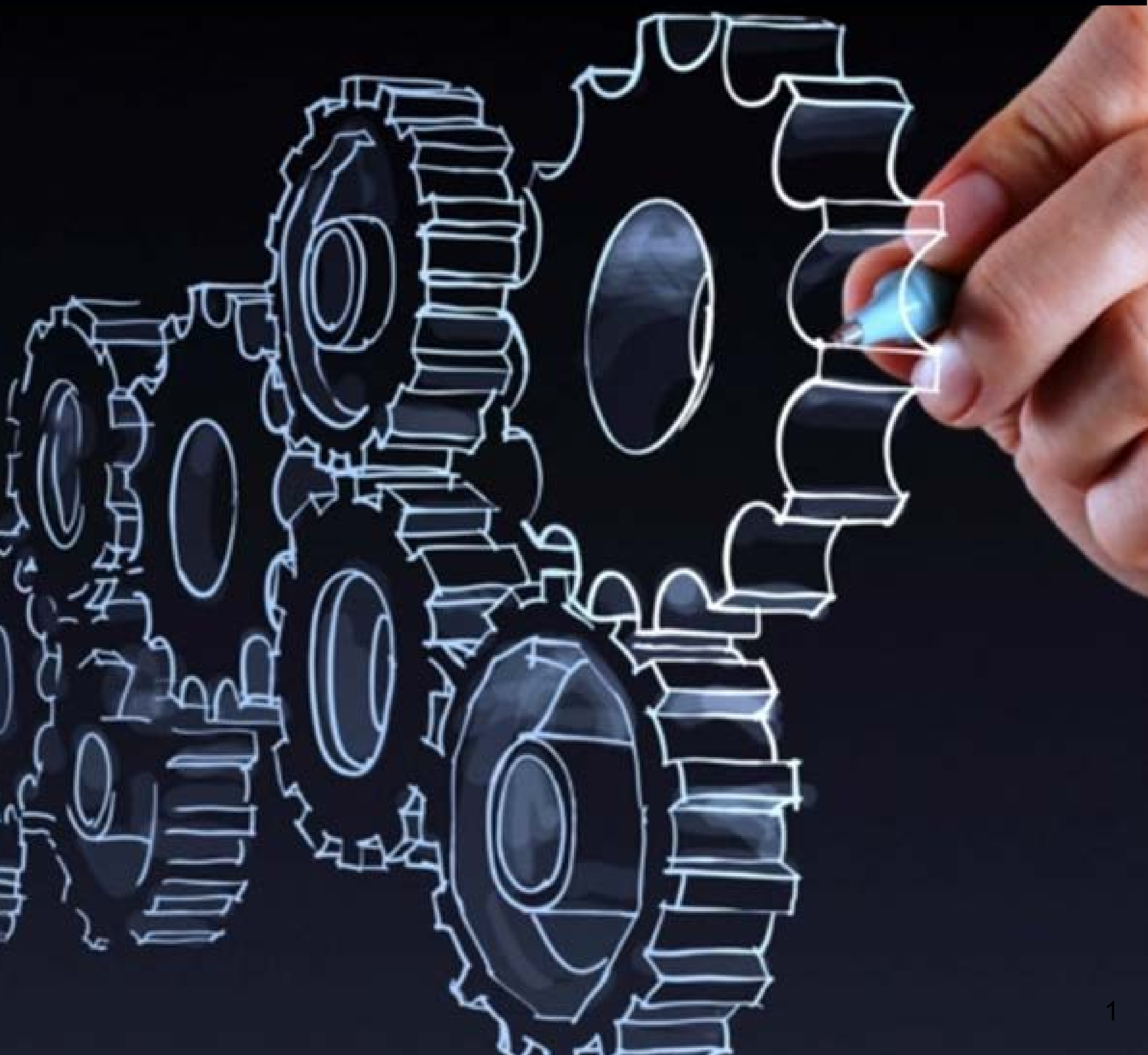
Dr. Manpreet Singh
Dr. Tejinder Pal Singh Sarao



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DESIGN AND DEVELOPMENT OF FLEXIBLE MAGNETORHEOLOGICAL JET SETUP FOR MACHINING OF DIFFERENT INDUSTRIAL APPLICATIONS

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ABSTRACT

The magnetorheological (MR) finishing processes are well-known for their precision and nanofinishing capabilities in a variety of industrial applications. These processes demonstrate thepotential to perform nano level finishing on various industrial applications. The MR fluid is also used in the MR jet finishing process, which involves using a jet of MR fluid to finish industrial applications. The MR fluid is used in the proposed research project to machine complicated shapeswith flexible heads. Abrasive waterjet machining influenced the idea of MR jet machining. The use of magnetorheological (MR) fluid will avoid the instability and dispersal of the stream flow beyond the concentrating channel, that is a problem in abrasive waterjet machining. A paralleled magnetorheological stream in the existence of magnetic field (axial direction) has the ability to have a stronger erosion impact. A magnetic generator will be designed and mounted on flexible head of MR jet machining setup to perform MR jet erosion tests on workpieces. The numerical analysis of the effects of the process parameters on material removal rate will be conducted. The flow characteristics and erosion efficiency of a magnetorheological stream wouldstudy using numerical models in this research project.

Keywords: Magnetorheological Fluid, Micromachining, Concentration, Optimization, Roundness, Surface Roughness

1. INTRODUCTION

The market for higher machining efficiency and quality is growing in many fields, including electronics, precision instruments, optical components, and medical apparatus, owing to the rapidadvancement of science and technology [1-3]. The manufacturing sector is becoming more mindful of the global economy. In today's markets, the demand for fast prototyping and limited output batches is growing. These developments have emphasized the use of modern and advanced technology for easily converting raw materials into useful products, with no tooling time involved.The most commonly used methods for converting raw material into the final form have been machining processes. Their simplicity, individuality, and capacity to build complex geometries arethe reasons for this [4]. The introduction of new technologies, on the other hand, has always been a driving force behind the advancement of more modern machining methods. Metal cutting's main goal is to achieve high efficiency while maintaining high product consistency and low machiningcosts. The type of material and the geometry of a specimen have the greatest impact on process selection.

The magnetorheological (MR) finishing processes are well-known for their precision and nanofinishing capabilities in a variety of industrial applications. These processes demonstrate thepotential to perform nano level finishing on various industrial applications. The MR fluid is also used in the MR jet finishing process, which involves using a jet of MR fluid to finish industrial applications. The MR fluid is used in the proposed research project to machine complicated shapeswith flexible heads. Abrasive waterjet machining influenced the idea of MR jet machining. The use of magnetorheological (MR) fluid will avoid the instability and dispersal

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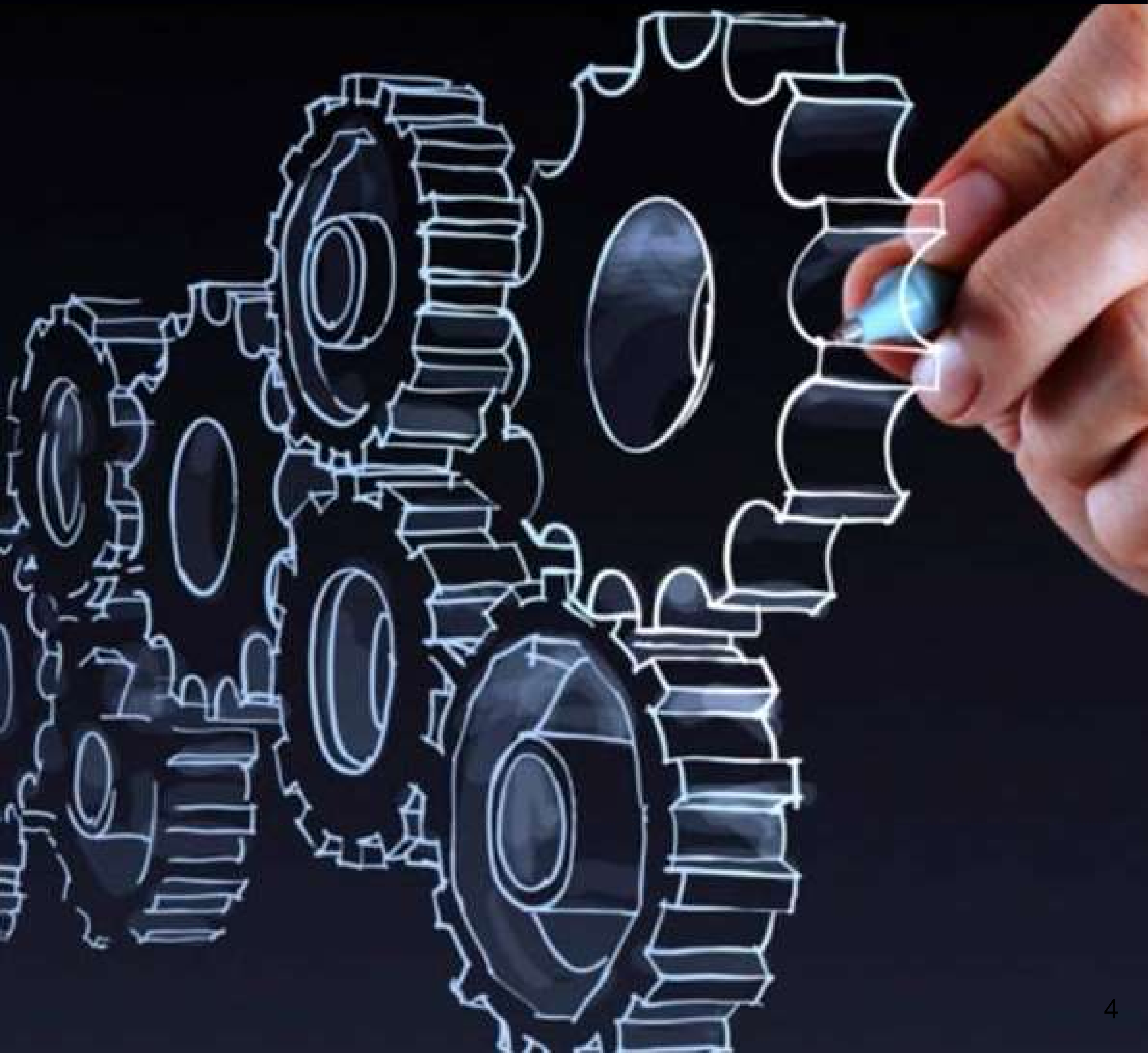

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DEVELOPMENT OF REAL TIME MENTIONED AIR PURIFYING BICYCLE

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ABSTRACT

The real-time monitored air purifying bicycle was created by Mechanical Engineering students at Baba Farid College of Engineering and Technology. This bicycle has a self-driven, controlled air purifier that provides clean air with real-time monitoring. The power unit with controller is used to run the air purifier. The power unit is also charged using the dynamo controller method. This invention initially evaluates the quality of the air with the use of a portable air filters. Depending on the quality of the surrounding air, the ducted fan's speed is adjusted and the air inlet's aperture is kept an eye on. The goal of this technology is to give clean air to cyclists while also benefiting the environment. This breakthrough provides purified air (removes dust, smoke, pollen, bacteria etc.) to the cyclist and environment.

Keywords: Air pollution, air purification, real-time monitoring system, HEPA, carbon activated filter.

1. INTRODUCTION

The pressure within the mask will drop while you breathe in [1], and if your inhalation rate is higher than your supply capacity, a negative pressure will build up around your face, leading to mask leakage and less effective respirator protection. Additionally, it may be uncomfortable for the user to have increased negative pressure on their face [2-4]. The gas source used by PAPR combines electricity with gas filtration to give customers access to clean air. Cycling has gained popularity as a means of transportation since it is eco-friendly, healthy, low-carbon, and good for the environment. For instance, 2.35 million shared bicycles are used on the streets of Beijing, China, every day. The most alarming and straightforward issue for many consumers is getting lost. While smart phones have many useful features, they also have a number of disadvantages when used in a riding environment. These disadvantages include "waterproof, dustproof, shockproof" capability, endurance, poor screen visibility outdoors, the need for a special bracket to mount on a bicycle, and the possibility of missing incoming calls or brief messages while cycling. The smart hardware for bicycle navigation has been launched by several businesses, but the majority of it is unreasonably expensive. Therefore, the market need an easy-to-use, reliable, and functioning electronic device to satisfy user expectations.

Despite the fact that several distinct natural occurrences (volcanoes, fires, etc.) have the potential to discharge a variety of pollutants into the environment, anthropogenic activities are the main contributor to environmental air pollution. However, certain air pollutants that may be harmful to both human health and the environment can be produced by industrial facilities and other operations. Accidental seepage of dangerous substances into the environment is possible. According to the definition, a pollutant is any substance that has the potential to harm humans, animals, plants, or other things. In terms of people, an air pollution may raise the risk of death or serious disease, represent a risk to their health now or in the future, or all of these things. Clinical, epidemiological, and/or animal studies that show that exposure to a chemical is linked

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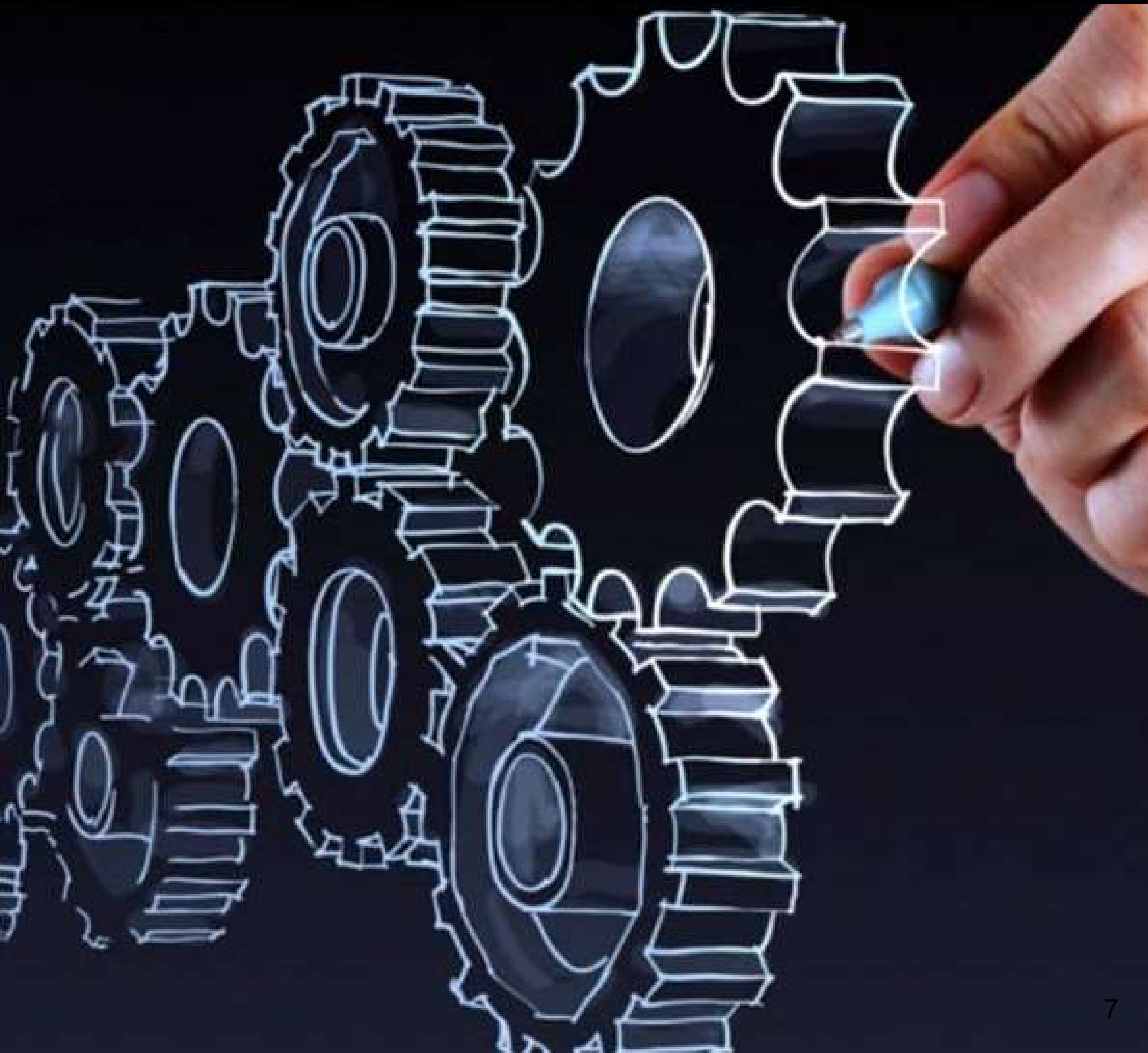

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ELECTROCHEMICAL MACHINING PROCESSES FOR MICRO-MACHINING- A REVIEW

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ABSTRACT

In a number of industrial applications, like aircraft industry, electrical, computer, and micro-mechanics, electrochemical machining processes are a feasible choice to drill the macro- and micro-holes with a smooth surface and an acceptable taper. One of the latest hole-drilling methods such as jet-electro-chemical drilling has gained status for generating huge numbers of good-quality holes in hard-to-machine metals. Recent breakthroughs, new trends, and the impact of critical components on the hole quality produced by these methods are the focus of this study. A comparison of electro-jet drilling with another non-conventional hole-drilling technique demonstrates the potential and adaptability of electro-chemical hole drilling technologies.

1. INTRODUCTION

Classification of Micro drilling process investigated into electrochemical micromachining (ECMM) process, with a suitable ECMM arrangement primarily comprises of micro-tooling scheme, electric powered system, mechanical machining rig, regulating system and governed electrolytic flow structure to regulate electro-chemical machining. As per the analysis, the most effective process parameters such as machining voltage and electrolyte concentration cause a higher material removal rate (MRR) with reduced overcut. The ECMM testing results and analysis will expand its application possibilities.

2. ELECTROCHEMICAL DRILLING (ECD)

ECD is a regulated rapid electrolytic dissolution mechanism in which the work piece functions as an anode. A thin distance separates the cathode instrument from the anode, through which an electrolyte flow [1-3]. The anodic substance dissolves locally when the current of electricity passes via electrolytic-cell [4]. The electromagnetic electrolyte is commonly a distilled solution containing salt that is pushed at increased pressure across the interelectrode gap to facilitate reaction materials, heat dissipation, and metal dissolution. The tubing instrument has a tubular look, consisting of brass, bronze or stainless-steel. The entire surface outside is normally isolated, except for the tip. NaCl, $NaNO_3$, $NaClO_3$ and their mixtures are four of the most often encountered electrolytes. There are mainly two key shortcomings of ECD that are absence of tool encapsulation and stray elimination. The use of salt electrolytes causes clogging of the pores, which leads to insulation loss in ECD. The stray elimination that happens on the hole's internal side walls has a direct impact on process efficiency. It has been attempted to minimize stray exclusion by using high-quality insulation [5]. It was recently attempted with a dual pole tool. To decrease streaming on the hole surface, the two-pin tool uses a metal bush outside the protected layer of a cathode tool. It was found that using a dual pole device reduces hole taper instead of an insulated method. This also increases the precision and consistency of the

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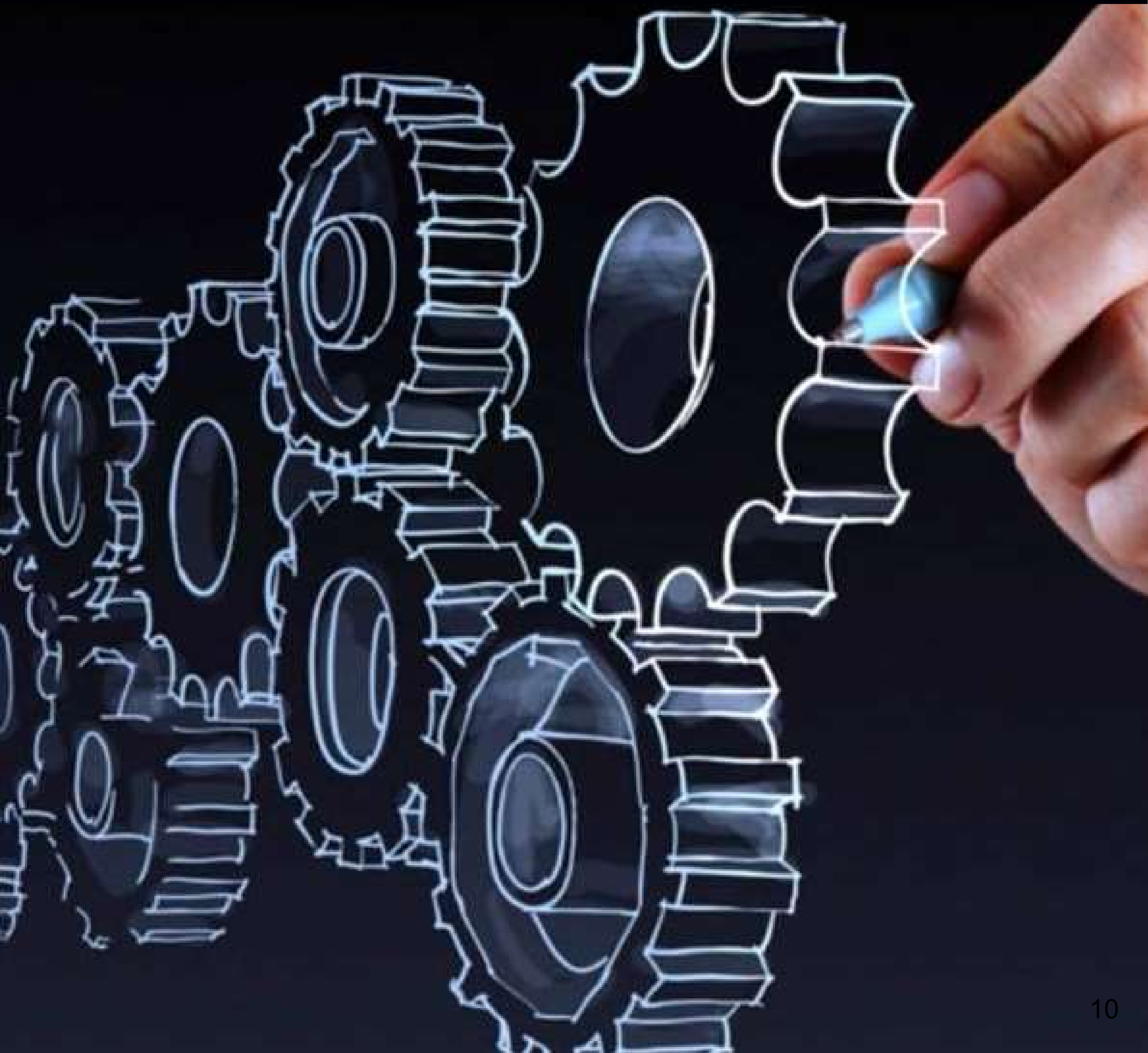

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A NOVEL ROTATING WHEEL MAGNETORHEOLOGICAL FINISHING PROCESS FOR EXTERNAL CYLINDRICAL WORKPIECES

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ABSTRACT

The recent rise in the demand for high precision, close tolerances, and super surface finish quality of components and part assembly modules in the competitive manufacturing industrial environment for the enhanced working life and functional requirements of machines at a global level. A new rotating wheel based magnetorheological process is designed and developed to fine finish the external cylindrical surfaces of soft as well as hard materials. This method is based on the operating concept of the cylindrical grinding system, except that the hard bounded abrasive wheel is replaced with the electromagnet wheel which is capable of generating the regulated magnetic field in the developed process. Due to the generated magnetic field effect, the CIP's particles in the magnetorheological fluid stick-on the wheel and tightly hold the abrasive particles. The fine finishing operation is performed with the help of flexible brushes created by the magnetorheological fluid. A significant range of high precision external cylindrical surface applications can be found in automotive, manufacturing, aerospace, valve & die industries. In the present study, mild steel cylindrical workpiece is used for experimentation purposes. The surface roughness values Ra, Rq, Rz are reduced to 41.17%, 44.62%, 46.45% in 75 minutes of finishing time with rotating wheel based magnetorheological finishing process. The overall results indicate that the new rotating wheel based magnetorheological process is feasible and capable enough to provide fine finishing operation to the external cylindrical surfaces of soft materials as well as hard materials.

Keywords: Magnetorheological Finishing; Surface Roughness; MR Fluid; external Cylindrical Surfaces.

1. INTRODUCTION

Nowadays, industries focused on accuracy and precision in manufacturing for a better quality product. The surface quality of the product is achieved by reducing the surface roughness of the product. Surface roughness directly affects the fit, functioning, and life cycle of the high strength applications [1]. To achieving surface finish at the nano level is the biggest challenge to the industries because it is a time consuming and costly task [2]. A significant portion, about 15-20% of the cost product is spent on the finishing of the product. The overall production of the product is directly affected by the finishing time [3]. Various cylindrical parts are used i.e. shafts, spindles, automotive parts, punches, pins, plungers, valve and die industry, etc. in various machines and equipment, which requires a high finish surface.

There are many finishing processes are in industries to finish the external cylindrical surfaces. The mainly cylindrical grinding process is used to finish the external and internal cylindrical surfaces [4]. In the conventional grinding process, there is no control over the machining forces. The workpiece and grinding wheel directly contact and rubbing with each other due to this a large amount of heat is generated. Due to these reasons several defects i.e. micro-cracks, sub-surface defects, heat affected zone, thermal stresses, etc. are produced on the surface [5-6].

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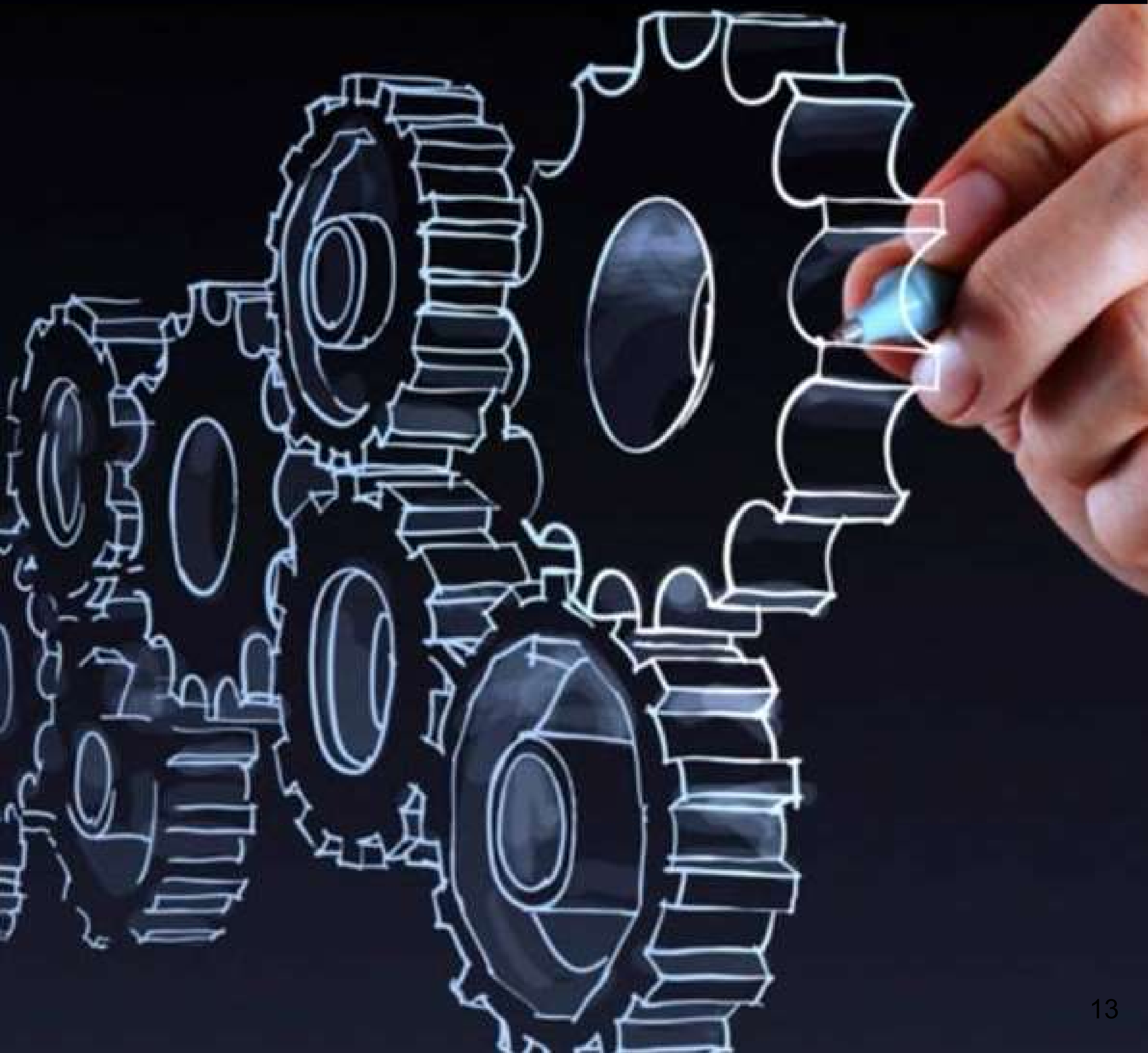

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SELECTION OF REVERSE LOGISTICS SERVICE PROVIDER USING AHP-IMPROVED PROMETHEE BASED HYBRID APPROACH: A CASE STUDY

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ABSTRACT

Reverse supply chain logistics, means mobility of goods from end consumers towards core manufacturer in the channel of product distribution. Due to intricacies, considerable risks are involved in product recovery operations, therefore core competency and experience are prerequisite for successful implementation of reverse logistics process to Third-Party Logistics Providers (3PLPs). The selection of third-party logistics providers is an intriguing practical and research question. Thus, most important strategic issue for top management is the evaluation and selection of third-party logistics service provider who can effectively provide reverse logistics operation services to the firms. The objective of this work is to develop decision support system to assist the decision-makers in selection and evaluation of different third-party reverse logistics providers by Analytical hierarchical process (AHP) and improved Preference Ranking Organization Method for Enrichment Evaluations (improved PROMETHEE) methods. A real-life case of a mobile manufacturing company is illustrated to demonstrate the steps of the decision support system. Present approach also enables the logistics managers to better understand the complex relationships of the relevant attributes in the decision-making environment and subsequently improve the reliability of the decision-making process.

Keywords: Improved Preference Ranking Organization Method for Enrichment Evaluations (improved PROMETHEE); Mobile industry; Analytical hierarchical process; reverse logistics operation.

1. INTRODUCTION

Supply chains Management systems have seen a dynamic change in operational style since the last two decades. In earlier business practices, supply chain flow happens in the forward direction only. In current business environment industries are facing the problem of return flow of the products in the supply chain for a variety of reasons like product recalls, warranty failure, service failure, commercial returns, manufacturing returns, end-of-life (EOL) and end-of-use returns. The evolution of reverse logistics for manufactured products is developing in direct proportion to the rapid advancements in technology and the subsequent price erosion of products as new and improved products enter the supply chain at a faster pace. With such thin margins and so much competition, mismanagement of the supply chain can be devastating. Those organizations with the infrastructure to capture and compare the composite value of components with real time intelligent analysis and disposition based on changes in refurbishment cost, resale value, spare parts, repair and overall demand will not only become more profitable, but such flexibility and scalability will allow them to outmaneuver and eliminate the competition. Reverse logistics is the process of return product handling mechanism in forward supply chain. The industries may have earned more benefits during the process of reuse recycle and remanufacturing of the used products. In general, the producer collects their used products from consumers and then again sells to new customers as new ones

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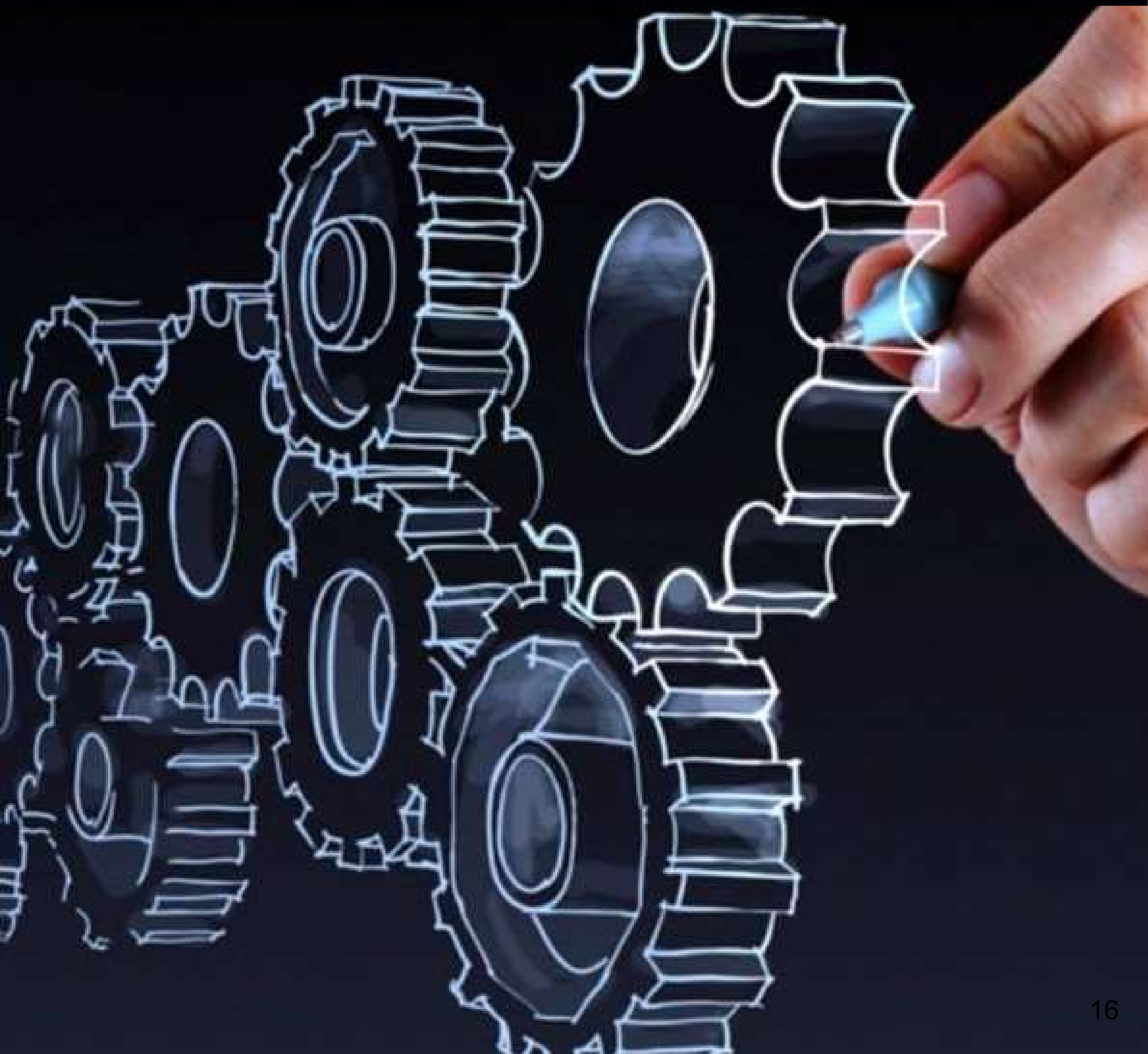

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ADVANCED SURFACE FINISHING PROCESSES: A COMPREHENSIVE REVIEW & FUTURE RESEARCH DIRECTIONS

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ABSTRACT

Better surface quality of every component is essential to perform proper functioning and to reduce the losses of wear and tear in the moving machine parts. Traditional processes do not use for finishing of soft or brittle material, due to high abrading force it produces poorer surface. In a competitive business environment, manufacturing industries are facing challenges in the machining of ceramics, super alloys and composites which requires a high precision level and superior surface quality with optimum machining cost. Advanced finishing processes are capable enough for precise finishing of soft or hard materials without damaging its surface or subsurface. This paper presents a comprehensive literature review the state-of-the-art technology of high-performance surface finishing processes used in manufacturing industries. The processes are divided into three main categories: traditional, advanced and hybrid finishing processes. Limited research has been reported on advanced processes in which finishing force can be easily controlled externally by magnetic field or any other means. A finishing medium is used in all these processes called magnetorheological fluid, which is a mixture of abrasive particles, CIPs, binder and additives. Rheological properties of magnetorheological fluid can be controlled externally by varying magnetic field. Due to control of force acting on an abrasive particles and material removal rate also controlled. Finally, the drawbacks and missing aspects of the related literature are highlighted and a list of potential issues for future research directions is recommended.

Significance: The objective of this study is to encourage and provide researchers with future research directions in the field of advance finishing operations. In addition, the research directions suggested in the paper address several opportunities and challenges that currently face by industry managers & academicians operating in the field of advance finishing processes.

Keywords: Magnetorheological finishing processes, Abrasive flow finishing, Ball end magnetorheological finishing, Hybrid finishing process, Magnetorhelogical abrasive honing, advance finishing process.

1. INTRODUCTION

Defect free surface of each and every part or component is main and last process of production system. It is very time consuming, expensive and highly labor demanding [1]. Traditional processes, grinding, lapping and honing is used to finish the surfaces, but it cannot produce defect free surface due to lack of control on the cutting or abrading forces[2,3]. In all these processes the abrasive or abrasive tools, rub over the work surface. Due to rubbing action large amount of heat generated which cause surface defects, i.e. thermal residual stresses, micro crack, etc. [4,5]. Finishing process also helps to achieve the better closeness to dimensions and remove irregularities i.e. concentricity, taper, straightness or parallelity etc. [6-8] which directly affect the working performance and fatigue life of the part or component [9]. To overcome the disadvantages of traditional processes various types of advanced processes have been developed

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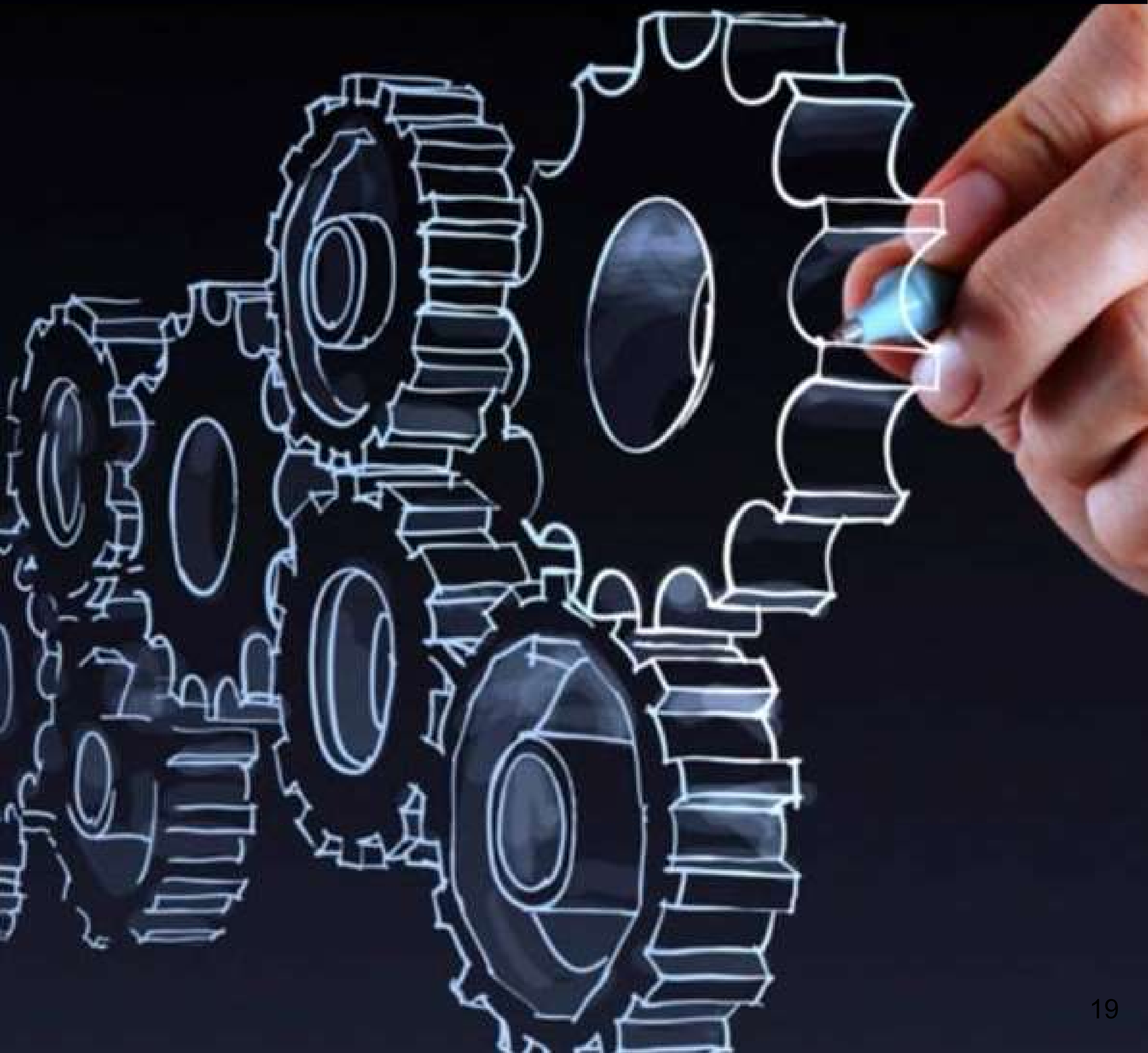

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INVESTIGATION ON PROCESS PARAMETERS OF SUBMERGED ARC WELDING

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ABSTRACT

The present study has been done to study the effect of different input parameters on the desired responses in the submerged arc welding process. Partial factorial technique has been used for the design of experiments. The effects of flux, current, travel speed and voltage have been evaluated on the bead height, bead width, depth of penetration, micro hardness and microstructure of the heat affected zone. The effect of all the input parameters on the output responses have been analyzed using the analysis of variance (ANOVA) and empirical modeling. The effect of variation in input parameters has been studied on the microstructure of the heat affected zone. Plots of significant factors, S/N ratio and empirical modeling have been used to determine the best-fit relationship between the response and the model parameters.

1. INTRODUCTION

Submerged arc welding (SAW) is a common arc welding process. It requires a continuously fed consumable solid or tubular (flux cored) electrode. The molten weld andthe arc zone are protected from atmospheric contamination by being "submerged" under a blanket of granular fusible flux consisting of lime, silica, manganese oxide, calcium fluoride, and other compounds. When molten, the flux becomes conductive and provides a current path between the electrode and the work. This thick layer of flux completely covers the molten metal thus preventing spatter and sparks as well as suppressing the intense ultraviolet radiation and fumes that are a part of the SMAW (shielded metal arc welding) process. DC or AC power can be utilized, and combinations of DC and AC are common on multiple electrode systems. The objective of this research is to study the effect of input factors on the various weld bead properties. The input factors which couldbe varied in the submerged arc welding are current, voltage, travel speed, flux, electrodestick out, electrode diameter polarity etc. whole of the study has been done on the submerged arc welding machine. FD1X-200TZ welding tractor with TORNADO SAW M-800 transformer was used for the study. The welding set up has a maximum current and voltage range of 800 amp and 110 volts respectively.

1.1Pilot Experimentation

In order to study the contributing factors that affect the response parameters, pilot experimentation was carried out on the machine. For the pilot experiment current, voltage, travel speed, flux and electrode stick out were varied at two levels each. For this purposean L_8 Taguchi design was used to study the effect of contributing factors shown in Table 1.

Table 1: Table for Pilot Experiment Factors

Exp.no.	Flux	Current	Travel speed	Voltage	Electrode Stick out
1.	I	350	27	28	15

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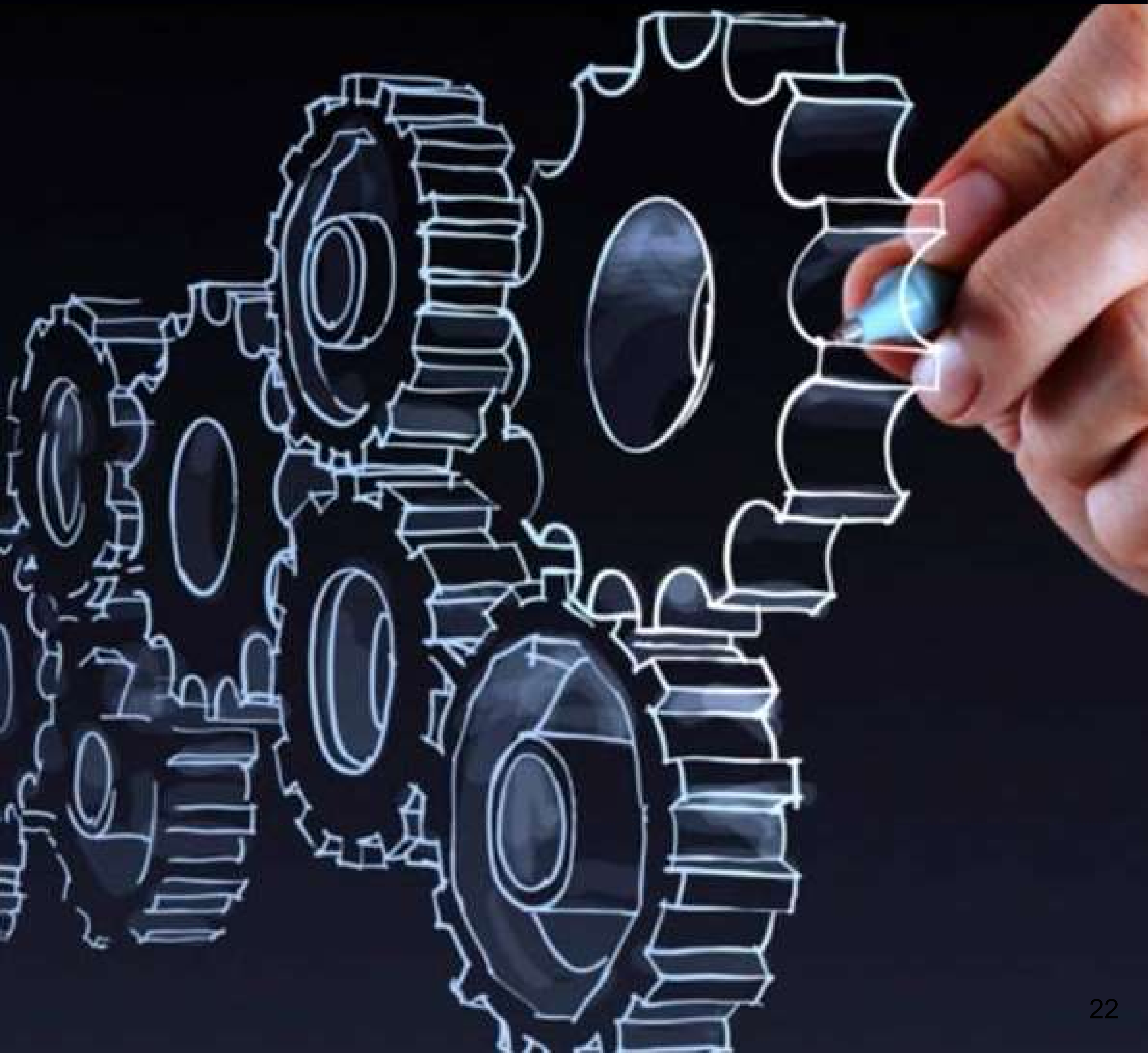

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MACHINING OF Al/SIC-MMC USING FABRICATED ELECTRO JET DRILLING SETUP

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ABSTRACT

This paper presents the experimentally findings on the effects of important process parameters such as applied voltage, nozzle diameter, feed rate, electrolyte concentration, pump pressure etc. on material removal rate during micro drilling of Al/SiC-MMC on developed electro jet drilling set-up. The material removal rate is considered as important response characteristics for evaluating the process productivity. Experimentally acquired results are utilized and constructed the analysis of variance (ANOVA) to identify the significant process parameters. From ANOVA, it is formed that the applied voltage and nozzle diameter are the most significantly and significant parameters respectively which affect the response e.g. MRR. The S/N ratio graph was drawn to identify the optimal process parameter for higher MRR. A mathematical model is developed for MRR. Validity tests results prove that the developed mathematical model is appropriate to conduct the experiment in advance through selection of process parameter setting value.

Keywords: Electrochemical machining, Electro jet drilling setup, Al/SiC-MMC, ANOVA, Additivity test.

1. INTRODUCTION

The modern trend towards miniaturization has given a new impetus to the development of nontraditional small holes drilling techniques. Electro jet drilling (EJD) is one such promising technique, which is finding ever-increasing applications in several industries including aerospace, medical, automobile and micro fabrication (electronic and computers). Electro jet drilling is an efficient non-traditional drilling process for making macro- and micro-holes. Here a negatively charged stream of acid electrolyte is impinged on the work-piece from a finely drawn brass nozzle. The acid electrolyte (10–25% concentration) is passed under pressure (3–10 bar) through the brass nozzle. The electrolyte jet acts as a cathode. Brass nozzle (cathode) connected to the negative terminal of DC power supply. The work-piece acts as anode. A suitable electric potential is applied across the two electrodes. The material removal takes place through electrolytic dissolution when the electrolyte stream strikes the work-piece. The metal ions thus removed are carried away by the flow of the electrolyte. A much longer and thinner flow path required high supply voltage (150–850 V). The use of high potential increased stray voltage. Surface imperfections found frequently during EJD are a result of material in homogeneity rather than process variability.

Bhattacharyya et al.(2001, 2002) highlights the design and development of electro chemical micro machining (ECMM) set up which includes various components like mechanical machining components, electrical system and an electrolyte flow system. Authors claimed that the ECMM system set-up will be capable of performing fundamental research in the area of

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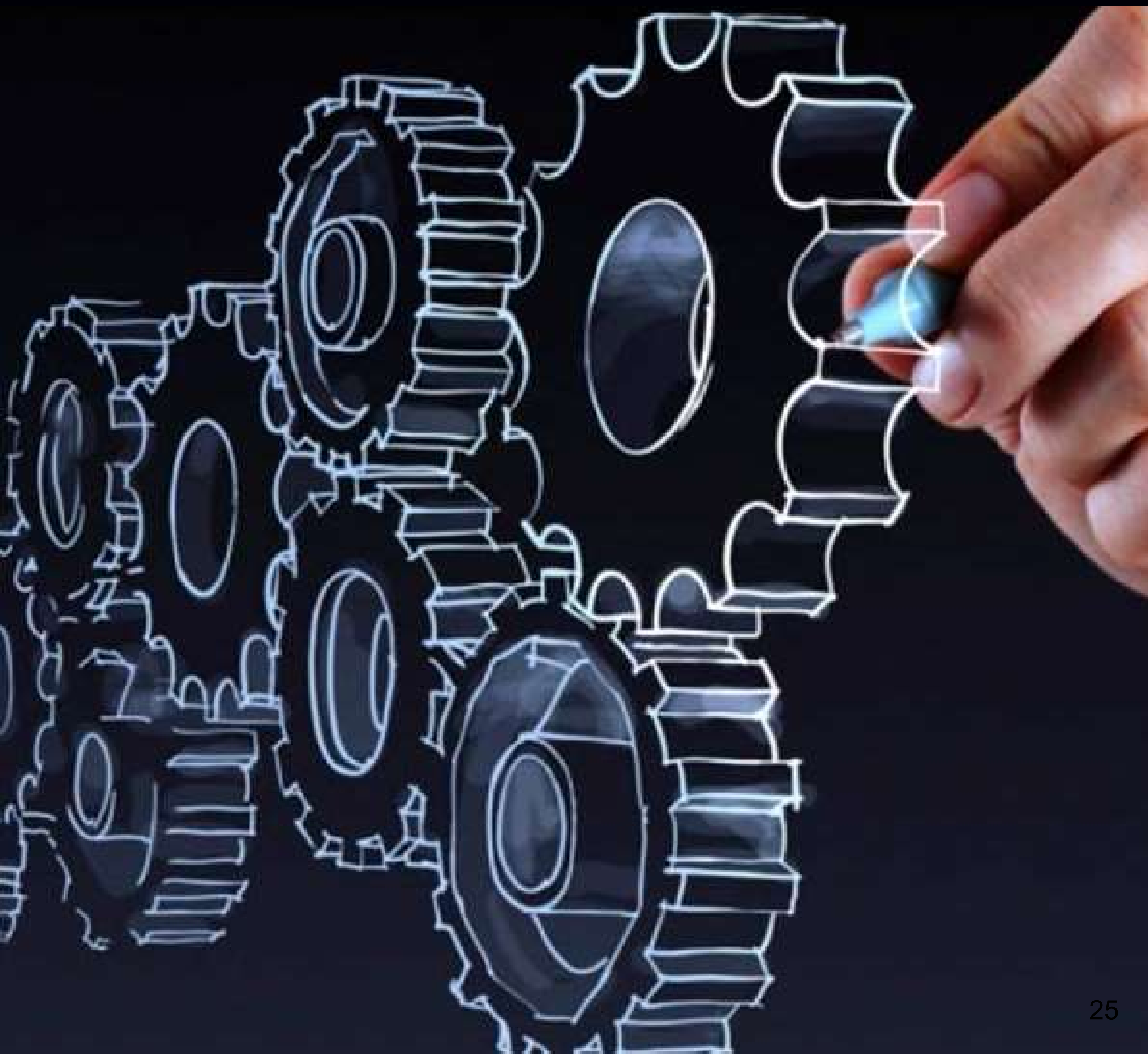

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MAGNETORHEOLOGICAL FINISHING OF COPPER CYLINDRICAL ROLLER FOR ITS IMPROVED PERFORMANCE IN PRINTING MACHINE

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ABSTRACT

The copper cylindrical roller plays an important role in the printing operation. The copper roller requires fine and uniform finishing to uniformly distribute the colours and ingot material. Fine and uniform finishing of copper cylindrical rollers is difficult due to its ductility and low hardness during the traditional finishing. To achieve this requirement, the rotary rectangular magnetorheological (MR) finishing process is employed. To obtain fine finishing, initially, the magnetorheological polishing composition (%age concentration of electrolyte iron particles and aluminium oxide abrasives with base fluid) is analysed for better performance. Furthermore, the centre composite design is used to optimize the finishing parameters. To check the surface texture as well as the roughness value of the cylindrical copper roller, the scanning electron microscopy test, reflection test, and surface roughness profile test are performed on the initial ground and MR finished surface of the copper roller. The present finishing process enhanced the surface texture of the copper roller as it is confirmed by the different test results. The geometrical dimensions in terms of circularity and straightness are checked through the coordinate measuring machine and waviness test. The surface roughness value gets reduced from 190 nm to 25 nm after 60 minutes of MR finishing on 30 mm length and 25 mm diameter of the copper cylindrical roller with optimum parametric conditions. The tests result of surface texture and geometrical dimensions correctness of the cylindrical copper roller is found to be beneficial for improving the functional performance in the printing process.

Keywords: Magnetorheological finishing; copper cylindrical roller; centre composite design; geometrical dimensions; surface roughness.

INTRODUCTION

Copper and its alloy are the most versatile engineering materials which are used for various industrial applications [1-3]. These materials have good mechanical and physical properties such as strength, conductivity, corrosion resistance, machinability, and ductility which make these materials suitable for a wide range of applications [4]. Therefore, these are widely used in energy, electrical power, electronics, transportation, petrochemicals, metallurgy, machinery, light, and other new industries. Copper material also used in the automotive industry for various applications like in brake linings, hydraulic equipment, bearings, gears, power distribution, and power systems, braking systems, gaskets, fittings and all kinds of joints, and accessories, etc [4]. The copper alloy material is used as a copper roller in printing operation. Poly Vinyl Chloride (PVC) sheets are printed with the fine finished external surface of the copper rollers to obtain the good quality printed sheets. The precise finishing of the external surface of the copper roller is essential to provide the proper uniform colour distribution in the

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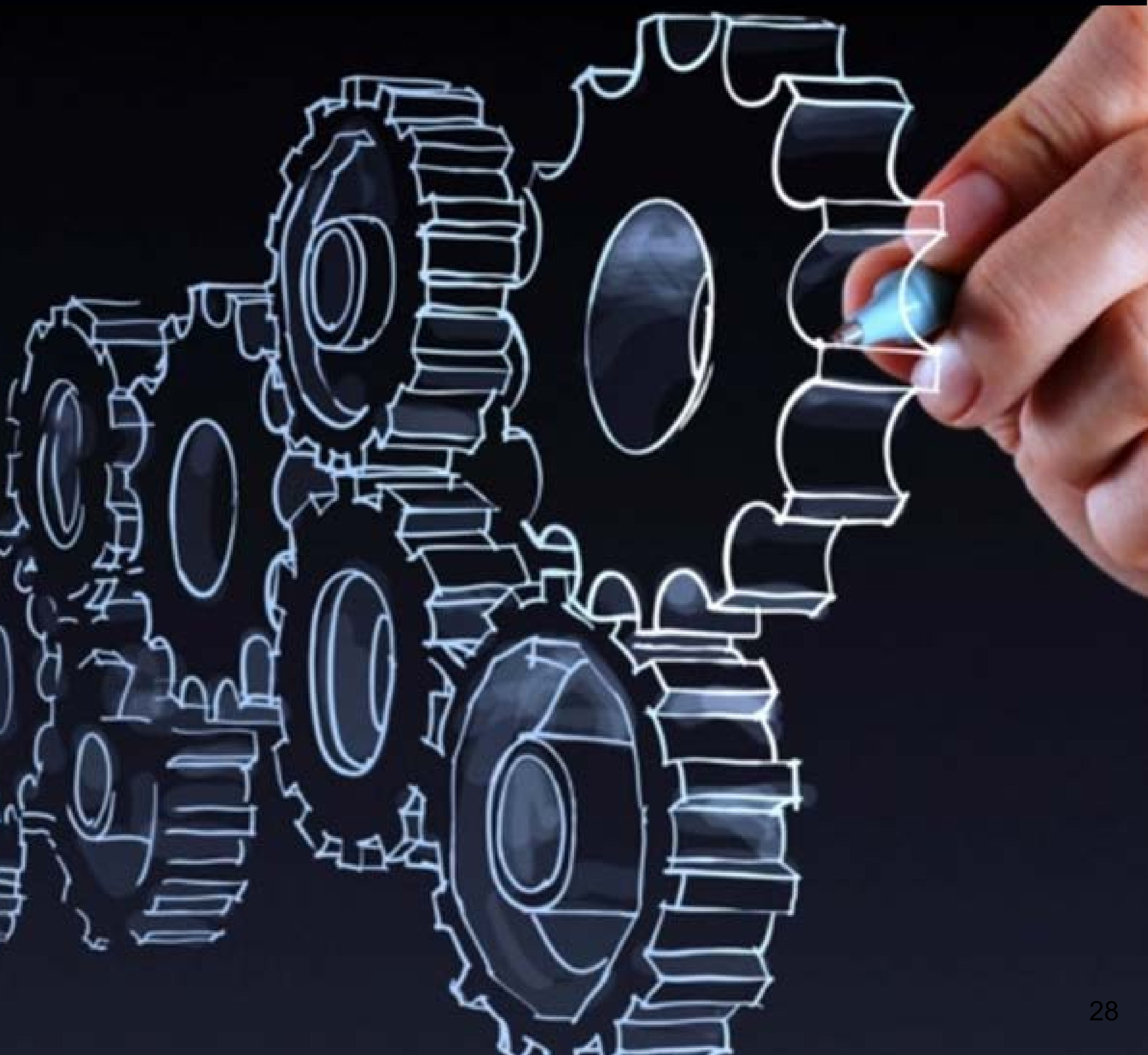

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ABSTRACT

The magnetic field aided finishing method was used to finish a ferromagnetic cylindrical workpiece in this study. The forces in magnetic field aided processes are regulated by the intensity of magnetic flux. In the operating distance with in the tip face of core and the cylindrical work-part, magnetorheological (MR) polishing fluid was used to finish the workpiece. The mechanism was studied parametrically in this research work using response surface methodology. Optimal process parameters were determined using response surface methodology to accurately execute the finishing procedure. Each parameter's percentage contribution to the process's finishing output was also estimated. The finishing of an industrial extrusion punch was carried out using the optimum parameters obtained from the parametric analysis. The batch gradient descent algorithm is used to validate the RSM optimization of process parameters. Batch gradient descent gives the mathematical model which validates the RSM mathematical model.

Keywords: Magnetorheological finishing, H13 Steel, RSM, ANOVA, Additivity test.

A. INTRODUCTION

The finishing operation is the last step in the production of any component made by casting, welding, shaping, or machining. The cost of finishing operations will rise by up to 10% to 15% of the total cost of production [1]. The finishing process is also a value-added operation that raises the cost and lengthens the lead time [2]. As a result, a better finishing process is needed in order to save time and money [3]. Because of the practical requirements of parts, protection, and aesthetics, surface quality enhancement before use in sub-assembly has become a very necessary method in many manufacturing systems [4]. Surface roughness has a significant impact on friction-related issues such as wear resistance and power loss [5]. Finishing methods must be able to not only solve these issues, but also maintain precision and minimal surface defects [6-8]. In comparison to conventional grinding, lapping, or honing processes with fixed tools, MAF does not apply such a rigid tool with significant advantage in subjecting the workpiece to significantly lower stresses and surface defects [9]. Furthermore, chatter disruptions from the surface will not affect the quality of the finished surface. One significant advantage is that in comparison to similar techniques such as electro-polishing, MAF processing produces no chemical emissions [10,11]. The magnetorheological fluid, also known as smart fluid, is used in this operation. A colloidal solution of iron and abrasive particles makes up the Smart fluid [12]. The problem of directional texture and groove angles in MRF is eliminated to improve the surface quality. An experiment was performed in which rotating wheel is used as a tool on which MR polishing fluid is supplied and it is attached to the wheel under the influence

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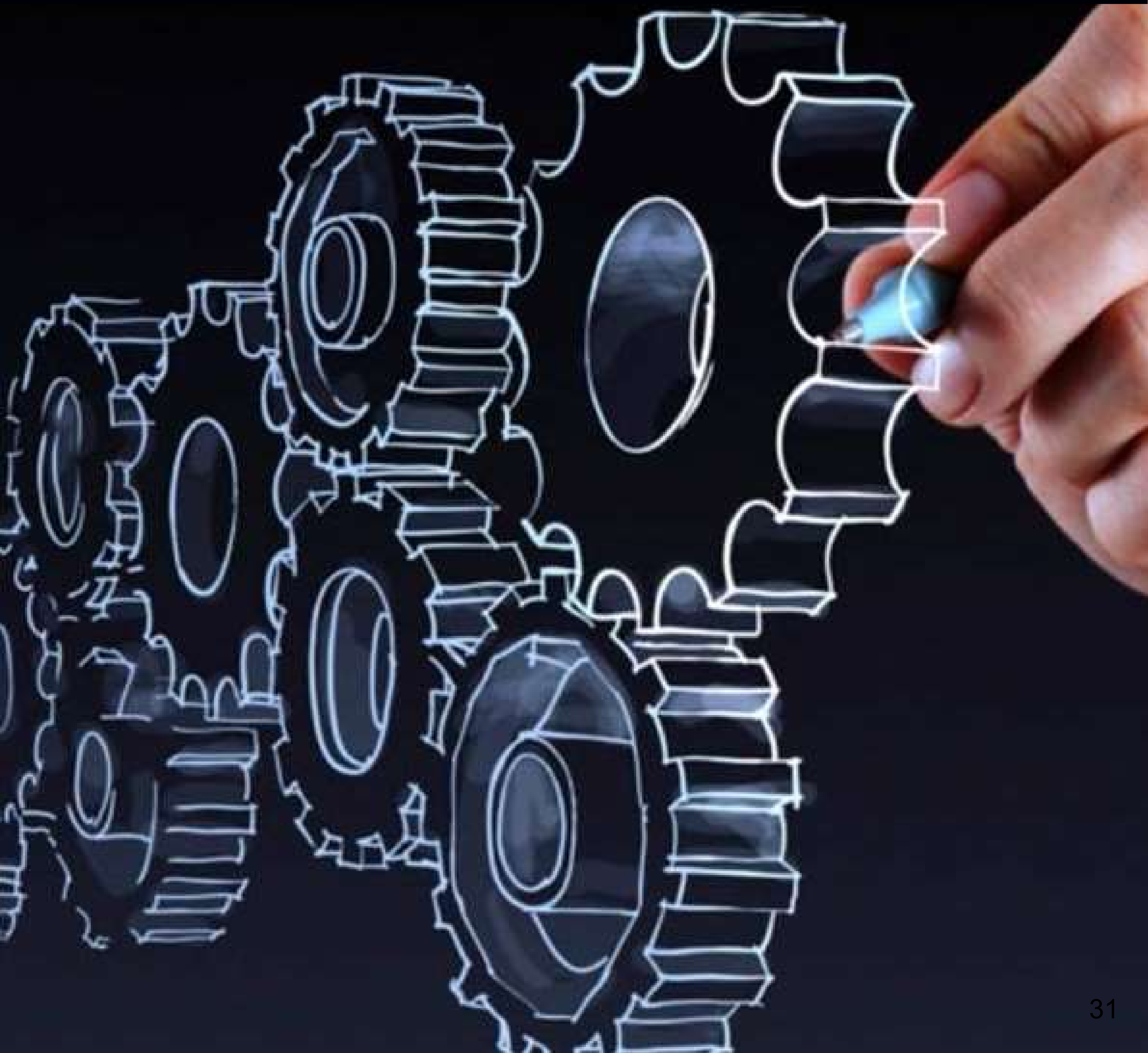

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Manpreet Singh[1]*, Tejinder Pal Singh Sarao[1], Gaurav Garg[1], Gaurav Kumar[1], Arshdeep Singh Kalsi[1], Jashanpreet Singh[2], Ankit Aggrawal[3] and Amrinder Singh Uppal[4]

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ABSTRACT

A rotating core based magnetorheological finishing process has been developed for nano-finishing of external cylindrical surfaces. Shaft made of steel of grade C60 is taken as workpiece which finds its application in manufacturing of various automotive products such as crankshafts, rocker arm shafts, and steering tie rods. The present work involved the parametric studying the developed magnetorheological finishing process. To plan and examine the effect of process parameters namely current, tool core's rotation, workpiece rotation and abrasives concentration on the percentage in surface roughness, the response surface methodology has been employed. Examination of the experimental data depicted that the large contribution to the response variable is made by the current and tool speed which is followed by the rotational speed of cylindrical workpiece and abrasives concentration. The initial surface roughness value of 320 nm reduced to final value of 52 nm in finishing time of 90 minutes with optimized parameters.

Keywords: Cylindrical external surfaces, magnetorheological finishing, response surface methodology, surface roughness.

1. INTRODUCTION

Surface finish is one of the vital characteristics in research areas and requirement in industries especially medical, aerospace and automobile sectors [1]. High strength applications such as in automobile sector, the improved quality of the product is desired to enhance the wear characteristics and service life of the product [2].The higher quality of the surface is essential to attain the desired performance of functions such as fatigue life. Higher fatigue life is required for the various power transmitting shafts such as crankshaft etc [3]. Traditional methods of finishing result in the involvement of large magnitude of cutting forces which is a cause for not attaining better surface finish. To get over these restrictions, several advanced fine finishing methods have been developed [4]. Out of the available fine finishing processes, magnetorheological polishing (MRP) fluid utilized in magnetic field assisted processes. These processes not only provide low magnitude cutting forces but also permit to regulate them. Moreover, the MRP fluid has got rheological properties, which is attracting the various field of finishing applications including complex intricate surfaces [5]. Singh et al. developed an improved ball end magnetorheological finishing (BEMRF) process with a central rotating core and a cooling jacket in which stationary electromagnetic coil wrapped with copper coils is provided which is supplied with cooling medium from a low temperature bath [6]. A passage had been made in the core for continuous supply of MRP fluid. The detailed mechanism have already been demonstrated and reported. Singh et al. studied the finishing performance for

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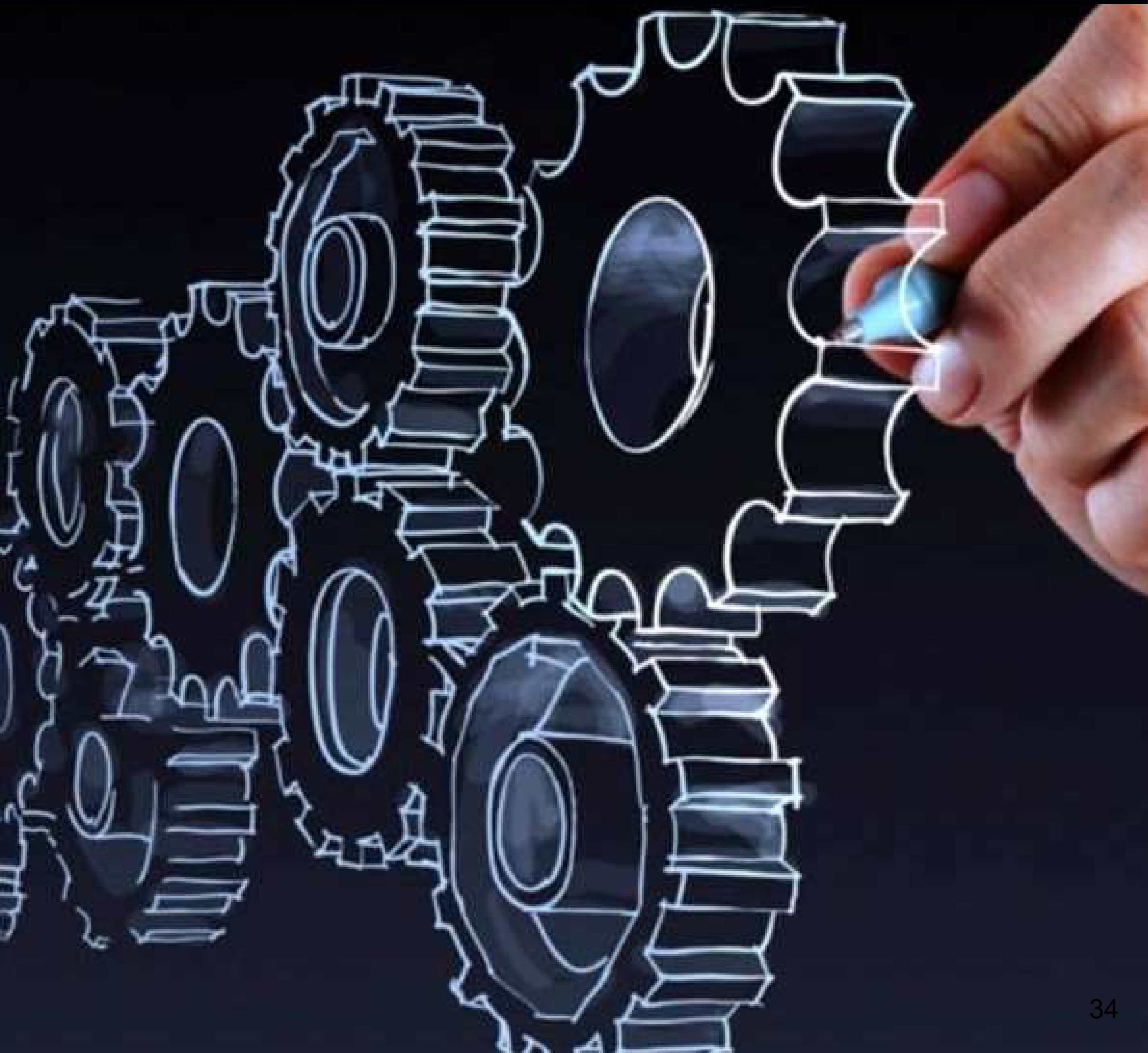

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ABSTRACT

The magnetic field aided finishing method was used to finish a non-ferromagnetic cylindrical workpiece. The forces in magnetic field aided processes are regulated by the magnetic field. In the working distance between the tool tip and the cylindrical workpiece, MR polishing fluid was used to finish the industrial applications. Various process parameters, such as workpiece rotation, tool feed, tool rotation, current intensity by electromagnet, and MR polishing fluid composition, affect the performance of the finishing process. The mechanism was studied parametrically in this work, using response surface methodology. Optimal process parameters were determined using response surface methodology to accurately execute the finishing procedure. Each parameter's percentage contribution to the process's finishing output was also estimated. The finishing of a copper cylindrical roller was carried out using the optimum parameters obtained from the parametric analysis. The batch gradient descent algorithm is used to validate the RSM optimization of process parameters. Batch gradient descent gives the mathematical model which validates the RSM mathematical model.

Keywords: Magnetorheological finishing, Copper roller, RSM, ANOVA, Additivity test.

INTRODUCTION

The finishing operation is the last step in the production of any component made by casting, welding, shaping, or machining. The cost of finishing operations will rise by up to 10% to 15% of the total cost of production [1-5]. The finishing process is also a value-added operation that raises the cost and lengthens the lead time [6,7]. As a result, a better finishing process is needed in order to save time and money [8]. Because of the practical requirements of parts, protection, and aesthetics, surface quality enhancement before use in sub-assembly has become a very necessary method in many manufacturing systems [9-12]. Surface roughness has a significant impact on friction-related issues such as wear resistance and power loss [13]. Finishing methods must be able to not only solve these issues, but also maintain precision and minimal surface defects [14-16]. To overcome this problem magnetorheological finishing (MRF) process was developed in 1996 at centre of optics manufacturing at Rochester [17]. This process uses the magnetorheological fluid which is known as smart fluid. The Smart fluid is a colloidal suspension of iron particles and abrasive particles. Smart fluid under the influence of magnetic field changes its properties. The MR polishing fluid ribbon is created between the workpiece and the wheel. Under the influence of magnetic field, properties of ribbon changes which results in finishing of workpiece. The experiment was performed on a pin-on-disk apparatus for material removal and surface roughness. The material used as a workpiece was steel (SM45C), brass, Aluminium (AL606I). It was found that steel samples achieve a better surface finish as

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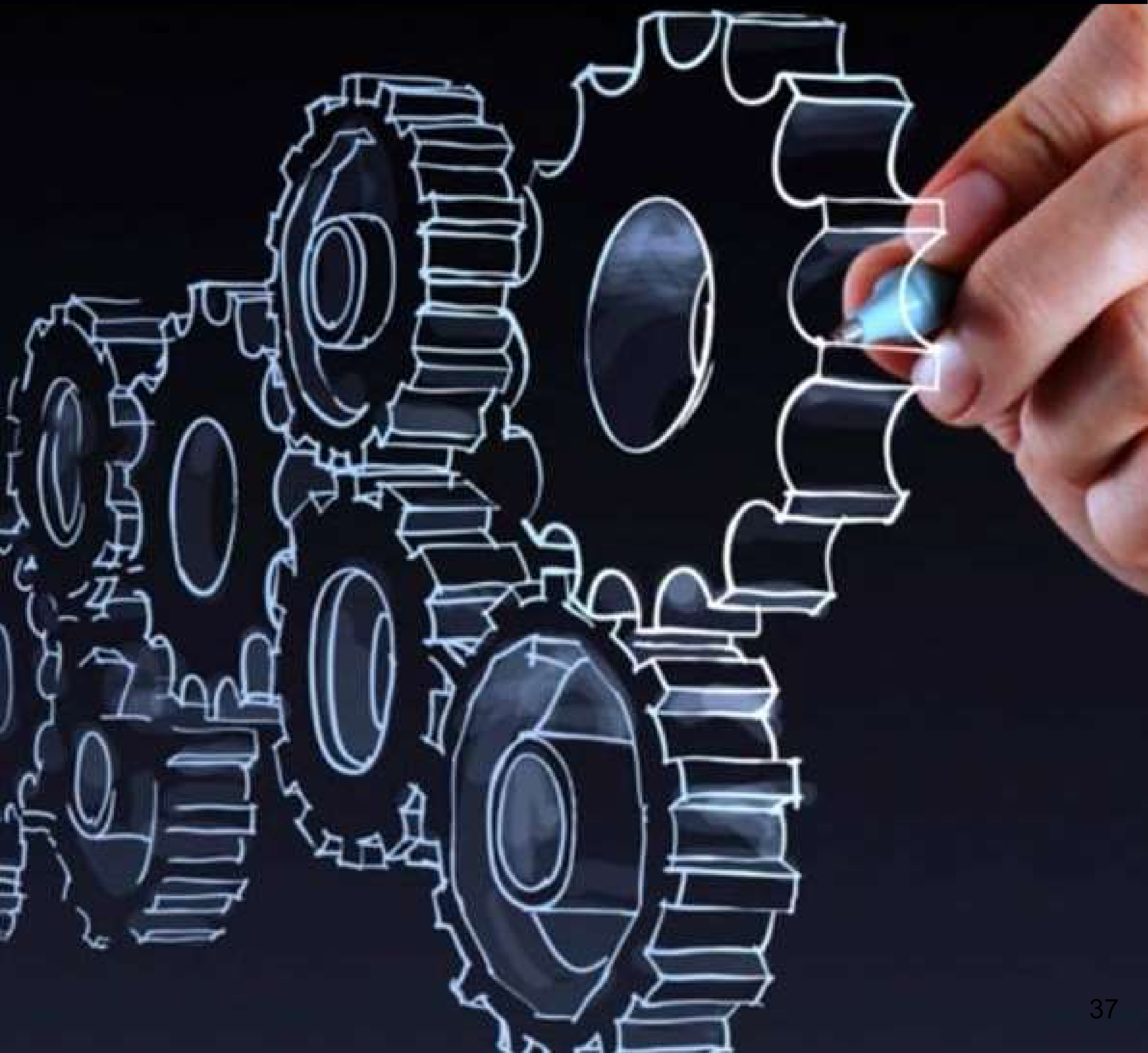

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ABSTRACT

A rotating core magnetorheological finishing process has been developed to finish the external cylindrical surfaces at nano-level as the conventional finishing processes like grinding cannot meet the extreme precise requirement. The quality of finished cylindrical components estimated through its geometrical accuracy, material assets, and mechanical features. The macaroni making machine driving shaft is made up of mild steel where high quality of surface finish is required. In plastic toy industries, the mild steel punches are used where a high level of surface finish is required to increase the appearance of the products and to improve its geometrical accuracy. The MR finishing process can improve the external surface quality of the cylindrical components very precisely. This result in the improvement of prolongs functional performance of the components. In the present work, the optimum process parameters are experimentally investigated for nano-finishing of the mild steel cylindrical external surfaces using the rotating core magnetorheological (MR) finishing process. The rotation of tool core, the rotation of the cylindrical workpiece, the current, and the working gap are the control process parameters which affect the finishing performance i.e. percentage change in surface roughness value. So, the effects of these process parameters on the process response such as percentage change in surface roughness value have been analyzed using signal-to-noise ratios and mean response data. The current and the rotational speed of the tool core have been found as a considerable role for increasing the percentage change in roughness value. Further, the optimum magnitude of the process parameters are predicted as the current 3A, the rotational speed of tool 500 rpm, the rotational speed of the cylindrical workpiece 80 rpm and the working gap of 0.6 mm. With the finishing of these optimum process parameters on the present developed process, the average roughness R_a value of the external surface of the mild steel cylindrical is reduced to 60 nm from the initial R_a value of 600 nm in 90 minutes of finishing. The results of scanning electron microscopy test, mirror images and roughness graphs of the finished surface have confirmed that the present finishing process can fulfil the extreme precise requirement of surface quality which is not possible by the conventional finishing processes. The extreme precise requirement of the surface quality of the external cylindrical workpieces are dealing with mild steel punches in plastic toy industries, dies, and molds, macaroni making driving shafts, armature shaft, and shafts used in gear etc.

Keywords: Magnetorheological finishing, Process, Magnetic flux density, Cylindrical, External surface, Roughness, Optimization

INTRODUCTION

To ensure consistent performance and prolonged service life of contemporary machine components, it requires to be manufactured not only with better dimensional and geometrical accuracy but also with the better surface finish. The surface finish has an important role in

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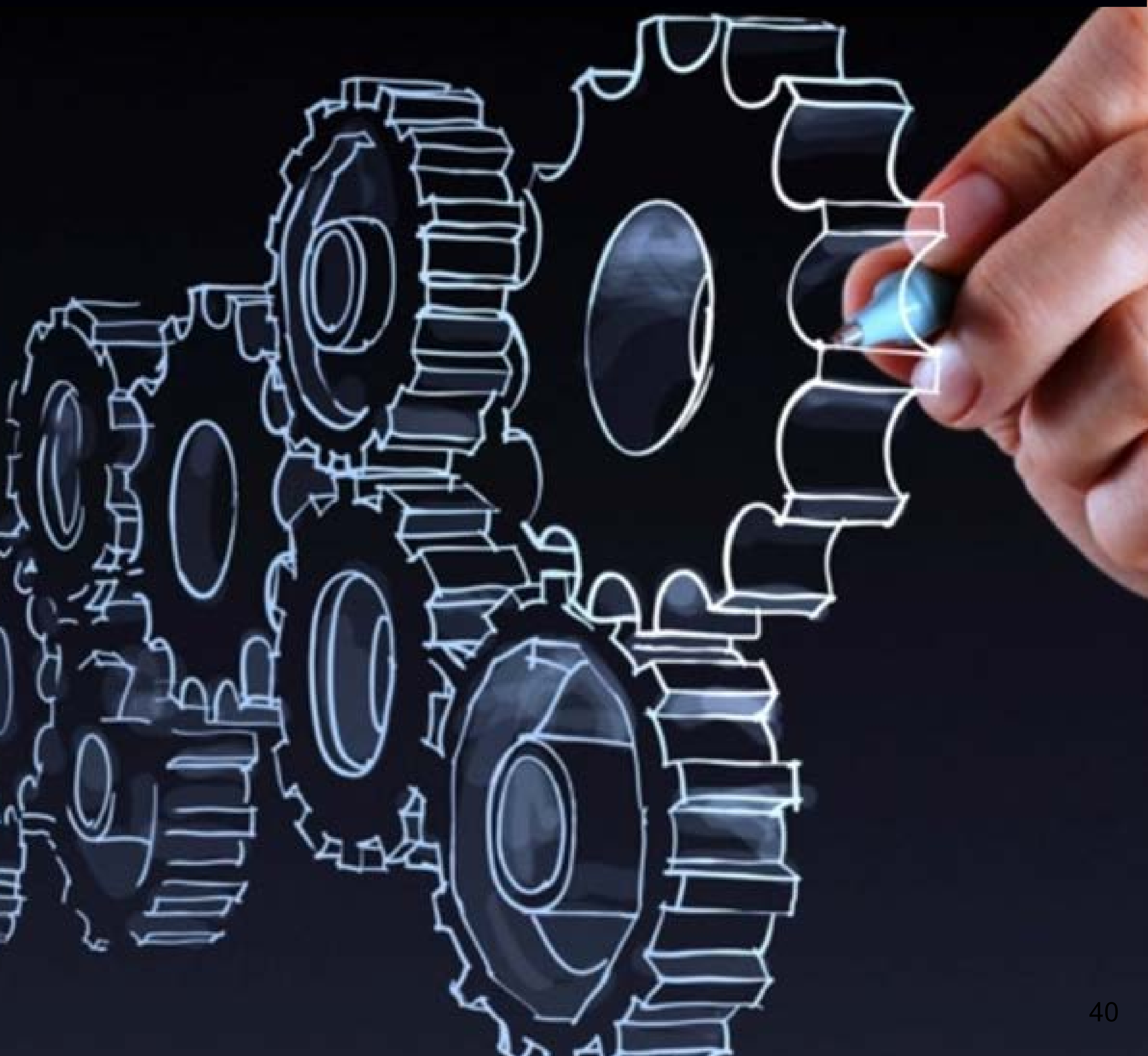

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ABSTRACT

The modern trend towards miniaturization has provided an innovative push towards the creation of unconventional minute holes drilling practices. Electro stream drilling (ESD) is one such emerging process. It finds its various industrial applications such as medical, automobile, aerospace and micro fabrication which further finds its use in electronic and computer components. Keeping these applications in mind, an electro stream drilling setup has been fabricated. Electro stream drilling setup is utilized for experimental investigation during drilling of aluminium silicon carbide metal matrix composite (Al/SiC-MMC) workpieces. In the present work, the effects of significant process constraints like applied voltage (volts), nozzle diameter (mm), feed rate (mm/min), electrolyte concentration (%), pump pressure (bar) on material removal rate are analysed. Using the experimental results, the analysis of variance (ANOVA) table is constructed in order to recognize the major process parameters. It can be inferred from the ANOVA table that the input applied voltage and nozzle diameter significantly affect the material removal rate (MRR). A mathematical model has been developed in this regard to observe MRR. The batch gradient descent algorithm is also used to validate the Taguchi method optimization of process parameters. Batch gradient descent gives the mathematical model which validates the ANOVA model.

Keywords: Electrochemical machining, Electro stream drilling setup, Al/SiC-MMC, ANOVA, Additivity test.

INTRODUCTION

Various advanced manufacturing processes are developed to improves the functional performance of the machines and processes [1-4]. In micro-manufacturing, the electrochemical machining processes are playing an important role in the industries [5,6]. These processes are capable to manufacture the complex shapes at micro-level with a fine finished surface. The surface roughness and other characteristics of the manufactured components depend upon the electrolytic concentration, pressure of the electrolyte and DC power supply [7]. In almost every electrochemical machining process, these parameters play a crucial role to maintain the quality of the manufactured components. The micro machining process is very important in many manufacturing industries, viz. aerospace, bio-medical, electrical, and electronics, auto mobile, thermal power plants, nuclear power plants, etc. because of the use of miniature product in such industries. Scientists and metallurgist have developed different advanced materials whose detailed properties and applications are available but processing of these materials to make miniature part are very difficult because of their high strength, high wear resistant and electrical conductivity [8]. Aerospace and turbine industries requires a large range number of ceramics and composite materials because of their high strength and low density. However, these materials have poor machinability which is one of the barriers to resist their application in

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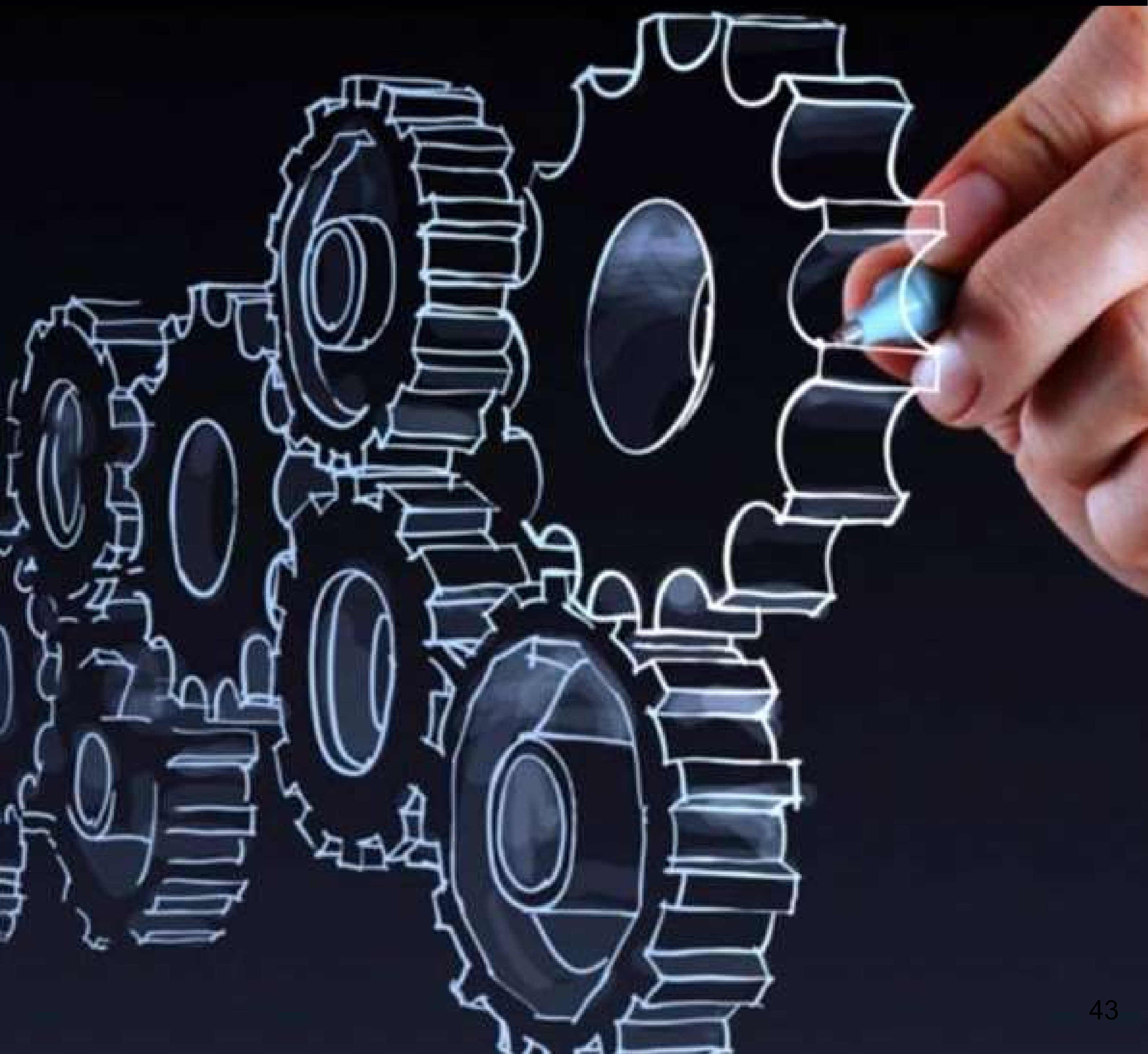

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ABSTRACT

In the manufacturing environments, the deviation in circularity features might happen because of unsatisfactory rotation, variable cutting forces, insufficient cooling, tool wear and tear, faulty device components, chatter, out of alignment in chucks jaws, etc. Due to this variation the variable working gap is obtained which produces the non-uniform finishing. The real-time monitoring through virtual instrumentation is required to detect the harmful faults and provide the solution to overcome these faults to enhances the process performance. These faults basically disturb the finishing performance of the magnetorheological (MR) finishing process. The temperature, vibration, displacement, and current sensing sensors help to monitor the real-time condition and monitor the faults that decrease the efficiency of the process through virtual Instrumentation. The study aims to sensor-based real-time monitoring of the magnetorheological finishing process and tracking the unhealthy components like the vibration of components, current drop, working gap variation, and temperature rise which affects the performance of the MR finishing process.

Keywords:Magnetorheological finishing, Sensors, Real-time monitoring, Virtual instrumentation, efficiency.

1. INTRODUCTION

Nowadays, the surface finishing of components is required in industries for their precise operative functionality. This is because fine finished surface of industrial components tends to decrease power losses, friction losses, and also enhances the machine working performance. Finishing is also a value-added operation which results in an increase in cost as well as processing time. Due to this reason, there is a need for continuous improvement in the performance of the finishing processes to reduce time and cost. The problems related to friction such as wear-resistance and power loss are greatly influenced by the surface roughness. Finishing processes not only need to overcome these problems but also be able to achieve an accuracy as well as minimize the surface defects. The fine finished external cylindrical components are the soul of the industrial machines. The magnetorheological (MR) finishing process is capable to achieve the fine and uniform finishing requirements.

In the manufacturing environments, the deviation in circularity features might happen because of unsatisfactory rotation, variable cutting forces, insufficient cooling, tool wear and tear, faulty device components, chatter, out of alignment in chucks jaws, etc. Due to this variation the variable working gap is obtained which produces the non-uniform finishing. The real-time monitoring through virtual instrumentation is required to detect the harmful faults and provide the solution to overcome these faults to enhances the process performance. The virtual instrumentation (VI) concept requires the use of personal computers fitted with a high-level

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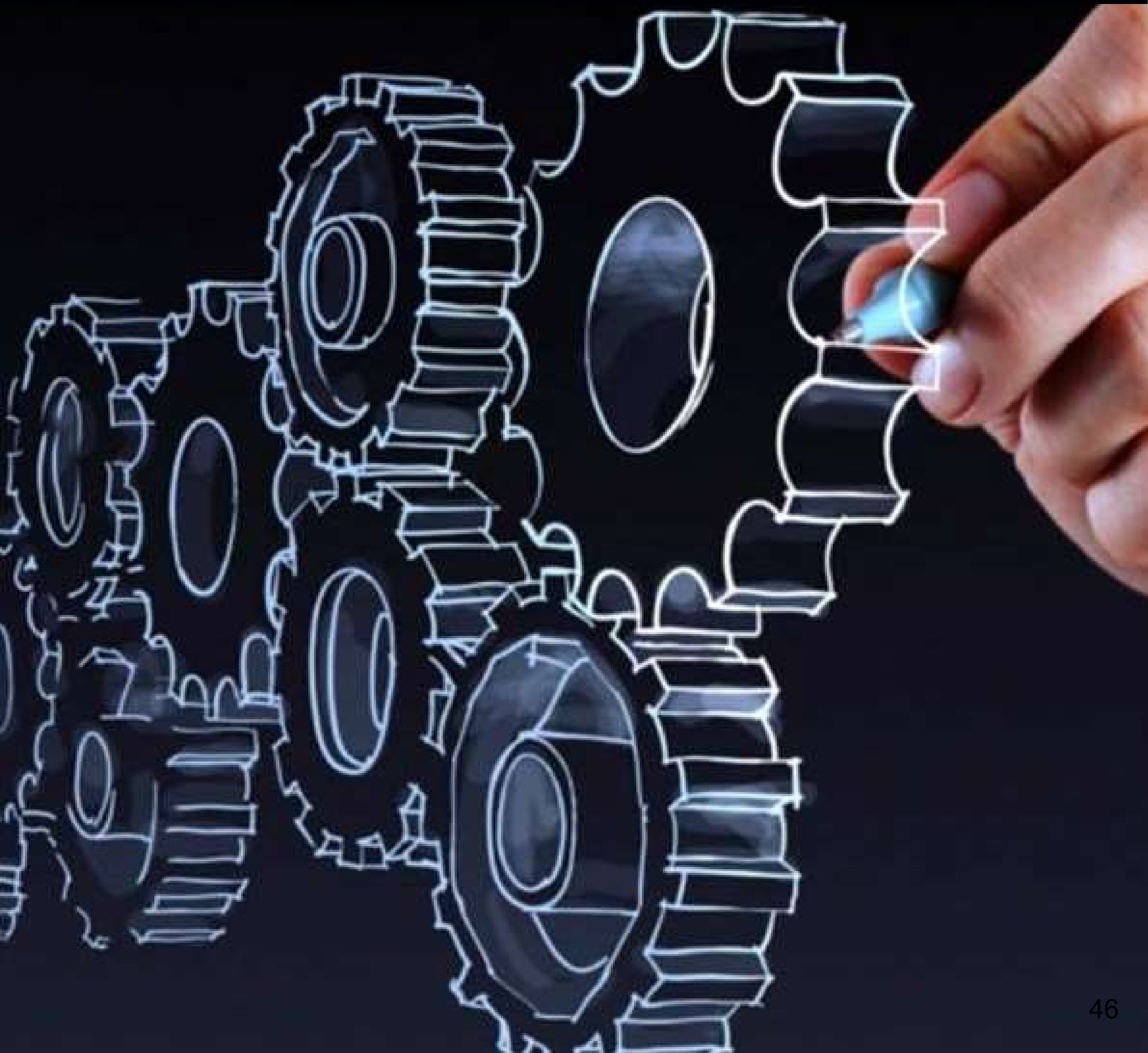

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ABSTRACT
Robotics is the sciences of robots' studies robots are machines that performance tasks some robotneeds for human instructions while some other robots can work independently. Robotics is branchof engineering that intersect with the concept of electronics, computer science, artificial intelligentand mechanical engineering where it deals with design manufacturing and operating robots. Computer vision is one of the fields of computer sciences it concerns on teaching the machine howto process and understand the concept of images of real environment and extract information fromwhich decision are made according to prescribe programming. Construction and building instruction is one of the important industries in the world and has high costs construction and building is one of the industries that involves a big number of working forces. The working force is faced by many difficulties and risks which restrict their performance such as working under weather conditions and carrying heavy weights.

1. INTRODUCTION
Construction automation focuses on applying computer-control on the building and other construction processes [3]. In spite of the fact that construction is one of the very early crafts carried out by human, this discipline didn't sufficiently go into automation. Automation of processes which are related to construction can be divided into two classes; the automation of prefabrication of construction components and the automation of the processes done on the construction site. The prefabrication of components has been fairly automated as well as the other manufacturing and production processes. However, the situation is not the same for the onsiteautomation of construction processes.

Although it is highly needed according to the high cost and very laborious building work, on-site construction automation confronts difficulties which mainly arise from the unstructured, cluttered environment in the construction sites. According to the movement of workers and the progress of building process, thus the environment is dynamic and not easy to be mapped.

2. Historical Perspective
Research in the domain of construction automation started in the 80s of the last century [3]. Sincethat time many automated machines and robotic platforms has been introduced. Shown in Figure

2.1 is the Tiger Stone machine, invented by H. Van Kuijk. This machine was developed for roadspaving in a zigzag form and the borders are filled with concrete [4].

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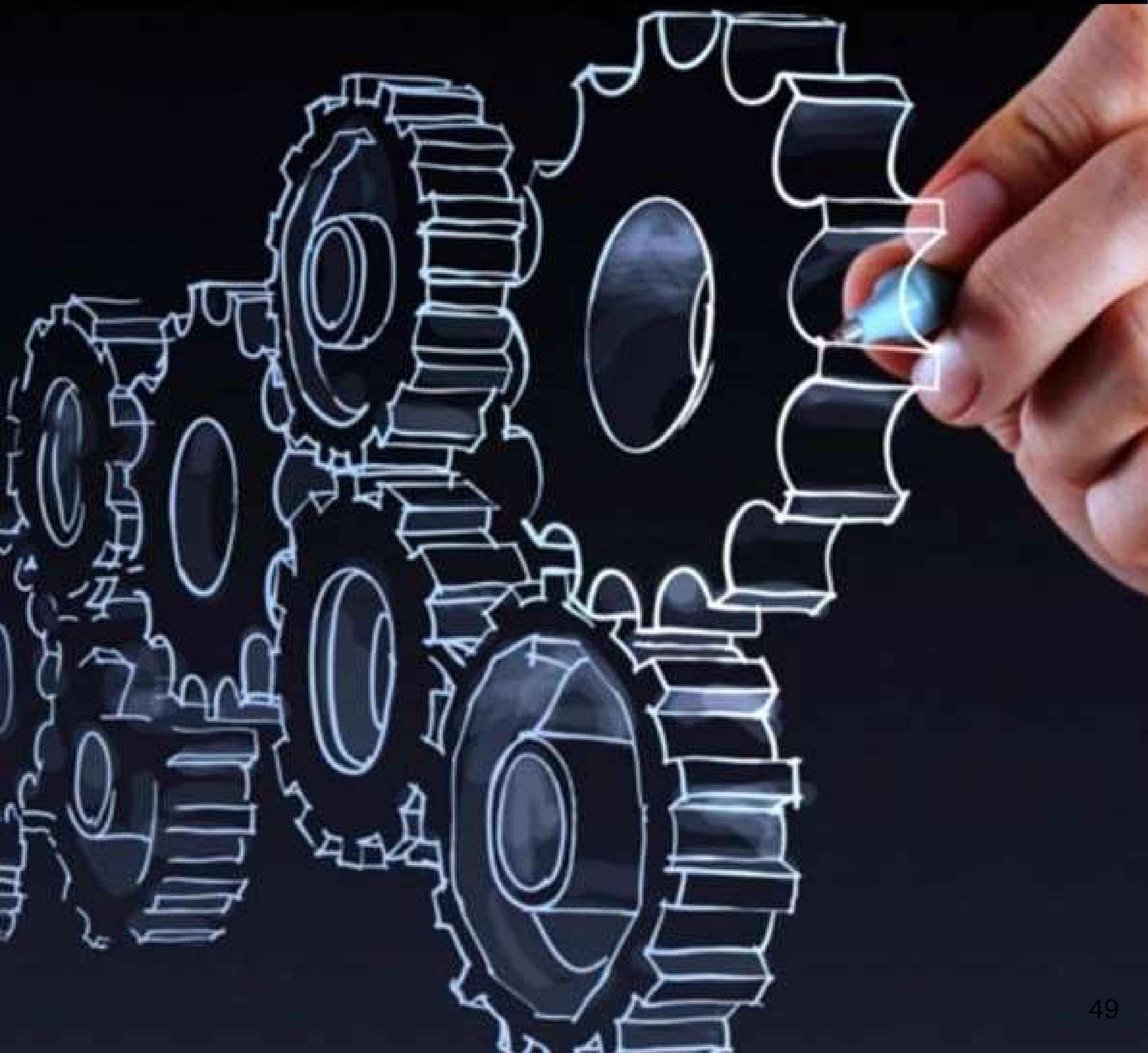

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ABSTRACT
A major problem related to use of tillage equipment is ploughshare wear due to abrasion by soil hard particles, as it seriously affects tillage quality and agricultural production economy. The objective of present study was to increase the wear resistance of ploughshare by hardfacing the ploughshare produced from EN42 high carbon steel with different types of hardfacing electrodes. These hardfacing electrodes, which are designated as HF-5M (Chromium-carbide based), HF-3 (Iron-carbide based) and HF-7 (Manganese-carbide based) and Terrahard-85 are used for hardfacing deposits and applied through shield metal arc welding (SMAW) method. Wear tests on the regular and hardfaced shares are conducted in the actual field environment. The dimension change and weight loss was lower for the hardfaced ploughshares and shown better wear resistance in comparison to regular ploughshares. It was observed that along with hardness, chemical composition and the microstructure played an important role in wear resistance.

Keywords: abrasive wear, ploughshare, hardfacing, wear resistance, tillage equipment.

1. INTRODUCTION
Surface engineering is one of the most relevant current fields of research. The events that occur on the surface, such as wear, corrosion or stress concentration create regions prone to crack nucleation, which under static or dynamic loading will eventually lead to most components and structures failures (Gandra et al, 2013). Wear is known to be as the degradation of material under plethora of service conditions and is considered as one of the major issue of the material used in engineering, having an estimated direct cost of 1-4% of gross national product (Goode, 1989). Whereas the soil tillage is one of the fundamental phases of agricultural production and may be defined as modification of soil structure due to mechanical work of tillage tools (Formato et al, 2005). Operational reliability of agricultural machines designed for work in soil depends mainly on wear and life of their soil engaging implements (Owsaik, 1999). The character and wear intensity of the metallic tool depends upon mechanical properties, size, shape, strength and density of soil particles. Basic geometry of the tillage tool also affects the wear rate while cultivation (Yu and Bhole, 1990).Wear due to highly abrasive soils have surface damage characterized by scoring, cutting, deep grooving and gauging, caused by soil constituents moving on a metal surface (Ferguson et al, 1998). Tillage tools subjected to low stress abrasive wear are usually made of carbon or low alloy steels (Yu and Bhole, 1990). Wear protection methods have essential assumption that higher material hardness increases abrasion wear resistance, but the influence of material characteristics on wear is very complex and often depends on multiple impacts (Ivosic and Jakovljevic, 1992). The quality of the components prone to wear and tear depends on their surface characteristics, which include surface roughness, microstructure and hardness (Muro, 1985).All the influential factors associated with field working conditions seems to suggest that wear must be more than a simple process that can be explained with such mechanical properties of material as hardness (Foley et al, 1984). The

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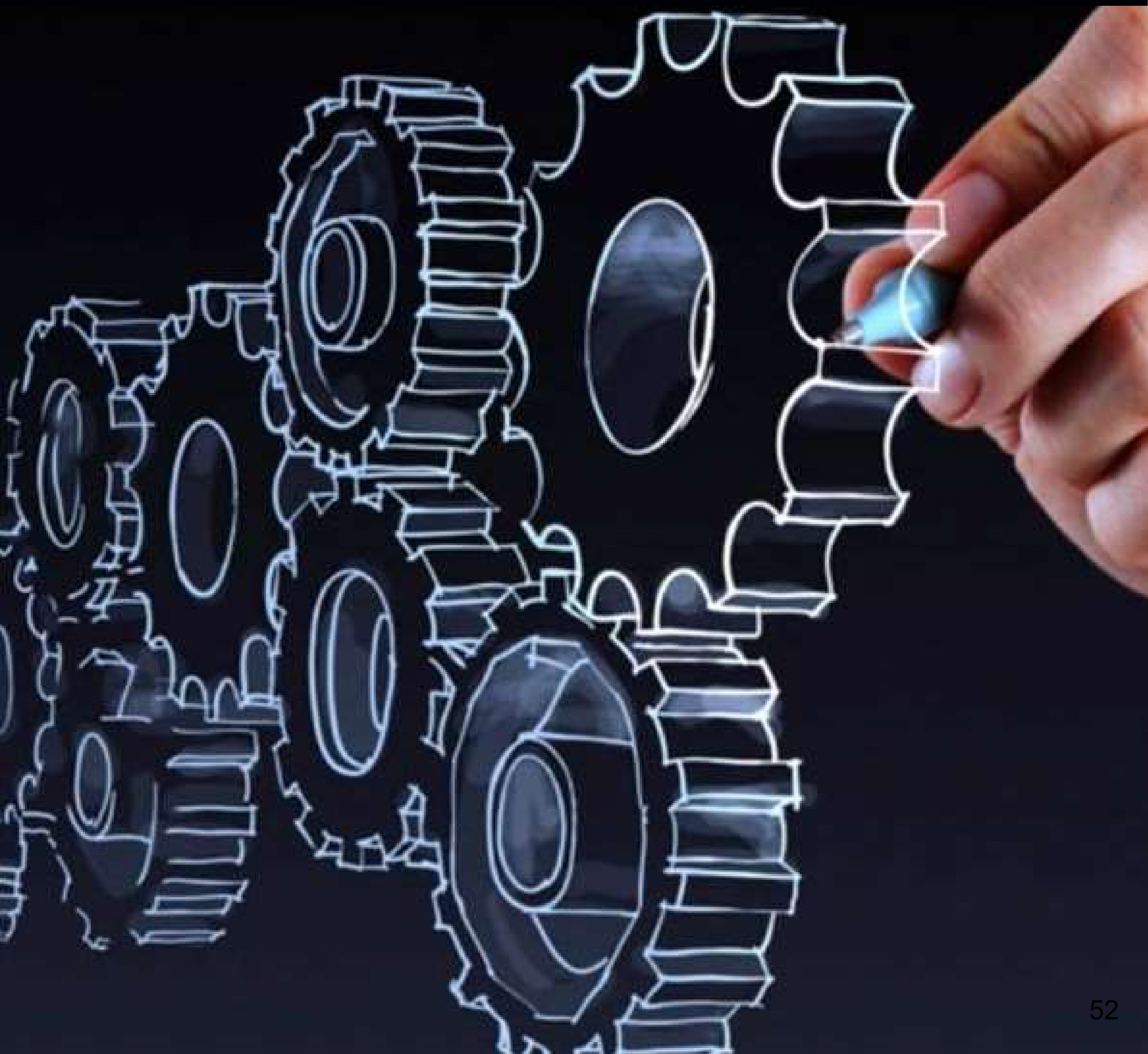

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ABSTRACT

The development in new technologies and the demand for machineries have introduced sensors and signal processing methods for fault detection in machineries. Some of the techniques used are vibration-based fault detection, acoustic based fault detection and temperature-based fault detection. Bearings usually generate vibration and noise while rotating. Due to the continuous rotation of bearing, temperature may increase in the bearing. Based on the noise, vibration and temperature, faults can be identified easily in bearings. This project is intent of developing a vibration-based condition monitoring system for bearing. It includes identification of correct location for sensor positioning, acquisition of vibration data, processing of signal for enhancing defect signature, and application of artificial intelligence in identification/detection of defects.

Keywords: Fault Identification, Optimization, Vibration Signal, Artificial Intelligence (AI), Bearing, Sensors, Signal Conditioning.

1. INTRODUCTION

Nowadays, machinery play a vital role in the day-to-day lives of human beings by providing services through design, manufacturing, and so on. The most widely classified types of machinery are the rotating machinery and the reciprocating machinery. Rotating machinery have an advantage of balancing and, hence they are used mostly in high speed machinery which play a vital role in many industries like oil refineries, power plants, manufacturing units, and so on. Almost in all the rotating machinery, bearing plays a vital role. Bearing not only provides the relative motion between the rotating part and supporting bodies but also transmits load during the course of its operations, so that it may get damaged.

Damages in bearing may be caused due to various reasons like improper lubrication, improper mounting, contamination, misalignment, corrosion, electrical damage, fatigue and so on. Sudden damage of bearing in rotating machineries may cause damage to human life and properties. So, it is necessary to detect the fault to save human life, to improve productivity to increase availability and so on. There are several fault detection techniques to identify the fault in bearings. In the early days, perception-based analysis was the main tool used to diagnose the state of machines. The development in new technologies and the demand for machineries have introduced sensors and signal processing methods for fault detection in machineries. Some of the techniques used are vibration-based fault detection, acoustic based fault detection and temperature-based fault detection. Bearings usually generate vibration and noise while rotating. Due to the continuous rotation of bearing, temperature may increase in the bearing. Based on the noise, vibration and temperature, faults can be identified easily in bearings. This project is intent of developing a vibration-based condition monitoring system for bearing. It includes

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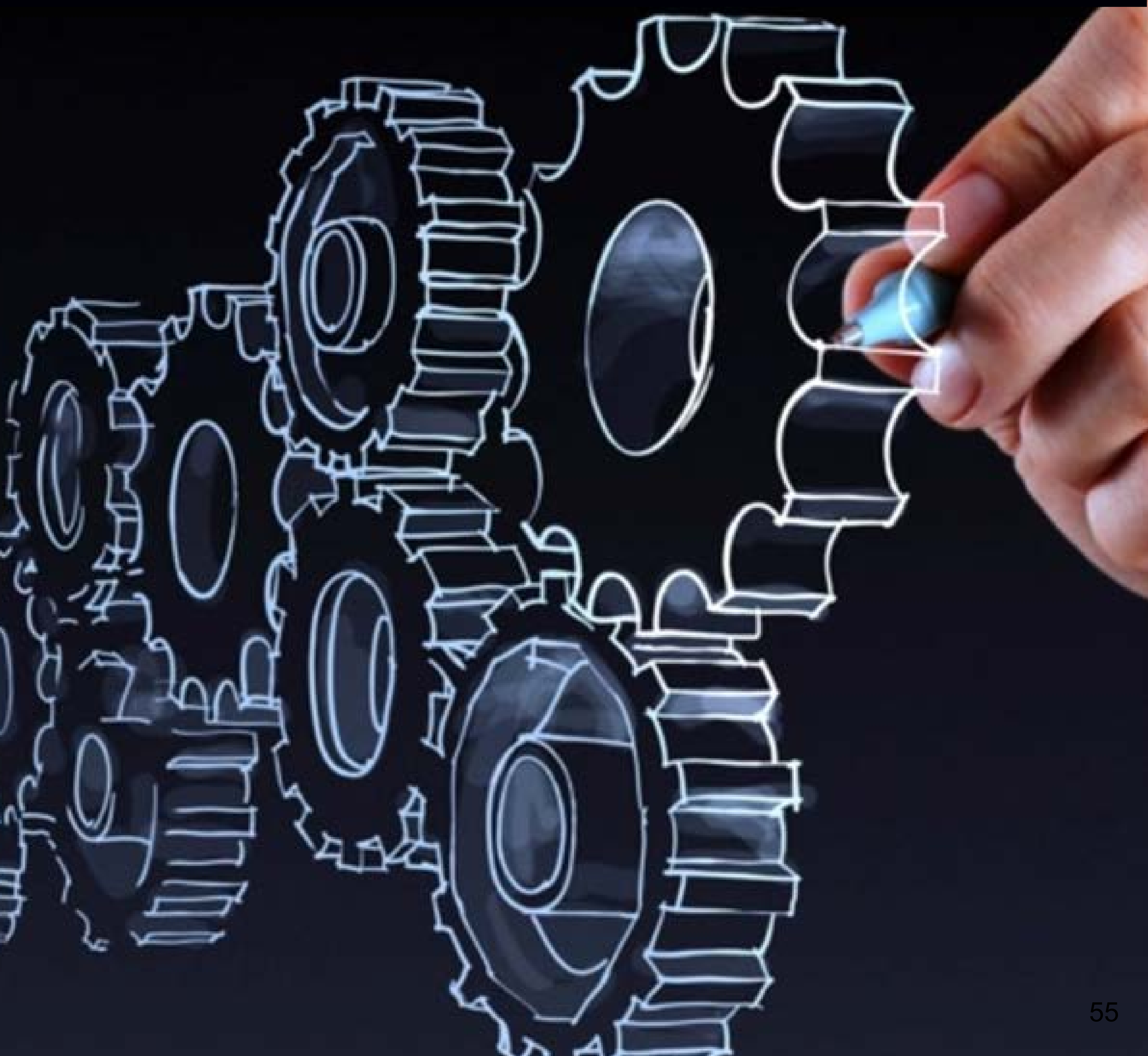

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ABSTRACT

The solid particle erosion is a multifarious phenomenon and includes the degradation of material as a result of continual impingement of high-speed erodent particles. Solid particle erosion can cause severe damage to system components in hydropower systems, boiler tubes, pulverized coal burner nozzles etc. Erosion mechanism is primarily influenced by velocity and impact angle of erodent particles. The size and shape of erodent particles also have significant impact on erosion. Severe plastic deformation technique is widely utilized for creating nanometric sized or ultrafine grain and improving surface region properties on the surface of materials. In this keynote paper, the studies reviewed and reveal that friction stir processing with pinless tool can be utilized to prevent damage on the surface of thermal sprayed coatings.

Keywords: Erosive Wear, Erosion Mechanism, Thermal Spray Technique, Severe Plastic Deformation, Friction Sir Processing.

1. INTRODUCTION

Material issues regarding surface modifications are of paramount importance for the cost effective and reliable operation of industrial components. Mainly flow handling components are widely encountered with effects of corrosion and erosion. The stress concentration is the prime reason in failure or wear of metals [1]. The metal degradation impact on the dependability of manufacturing metals is acknowledged extensively and high wear cost usually has a great impact on wear [2]. In the early 1960s, the industrial or some developed countries started research on wear with systematic efforts. The material degradation results wear part replacements, decreasing production with loss of energy and ultimately increasing time and work [3].

Solid particle erosion (SPE) is the degradation of metals due to repeated impacts of the erodent particles on surface of metals or alloys and is main reason for damage of industrial components [4]. The solid particle erosion is a multifarious phenomenon, as it involves various processes. Many secondary processes are taking place during erosion in the form of chemical, thermal and physical reactions [5]. The kinetic energy of particle in SPE, is partially dissipated by plastic deformation and/or brittle fracture. The phenomenon takes place when a liquid or gas medium containing hard particles striking on a solid surface at particular high velocity [6]. Erosion is a main problem in petrochemical industries, hydro-turbines, pipelines, agriculture sector, control valves, and many more [7]. High temperature SPE is considered as the key material issue and is responsible mainly for failure in energy generation systems [8].

Surface modifications methods are extensively utilized for restricting material degradation related to erosion. Austenitic stainless steels are always preferable material because of higher thermal conductivities and lower coefficient of thermal expansion. The applications of erosion resistant hard coatings can effectively reduce the damaging effects of erosion and erosion–corrosion [9]. Cermet coatings consisting of hard WC particles with metallic binders such as Ni

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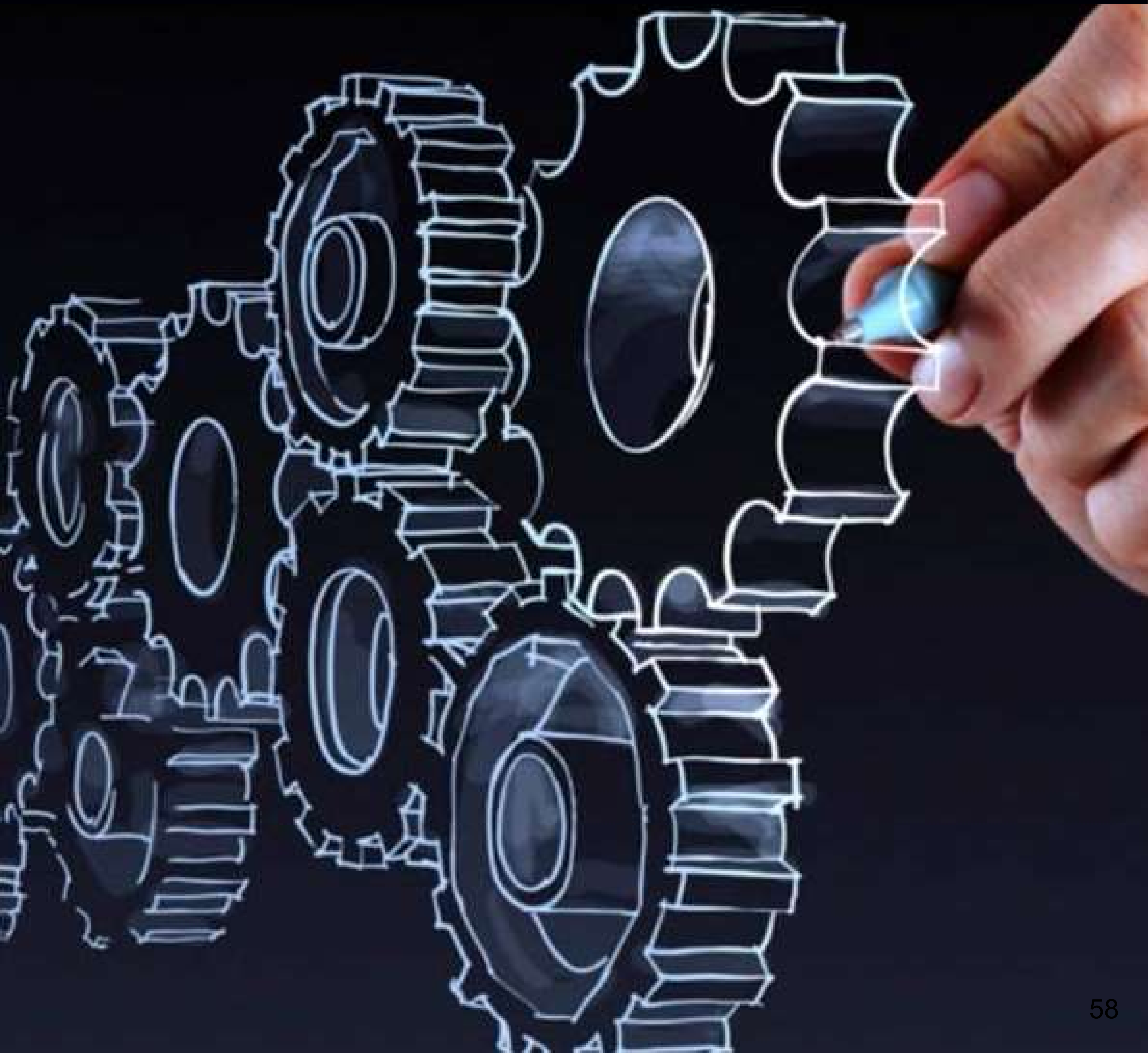

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ABSTRACT

As the industry 4.0 is unfolding machines are connected and communicating to make automatic decisions without human intervention. All this is made possible by the emerging technologies like IoT, Cloud computing and Block chain. This paper introduces block chain, its impact on industry and the challenges in adopting this technology for real world industrial applications.

A. INTRODUCTION

As Industry 4.0 is unfolding, computers are communicating with one another. Intelligent self-aware machines and decentralized decision making are the key components of this industrial revolution. This is leading to automatic decisions making without human participation. A key part of Industry 4.0 is the Internet of Things (IoT). Connected machines help to improve the manufacturing process, scheduling, supply chain and end product. The improvements is in terms of resource utilization, quality of produced goods and reduce lead times [1-4]. Another technology set to help IoT succeed is cloud computing. The cloud platform allows users to perform normal computing tasks using services delivered entirely over the internet.

The cyber-physical systems are shown in Fig 1 using IoT based infrastructure. This system generates great amounts of data, for processing and analyses. The big data is handled through cloud computing. The combination of cloud computing and IoT has given birth to many new real-time applications in critical areas like finance, healthcare and industry. The cloud effectively serves as the processing unit that helps to improve in decision making using the sensory data [5, 6].

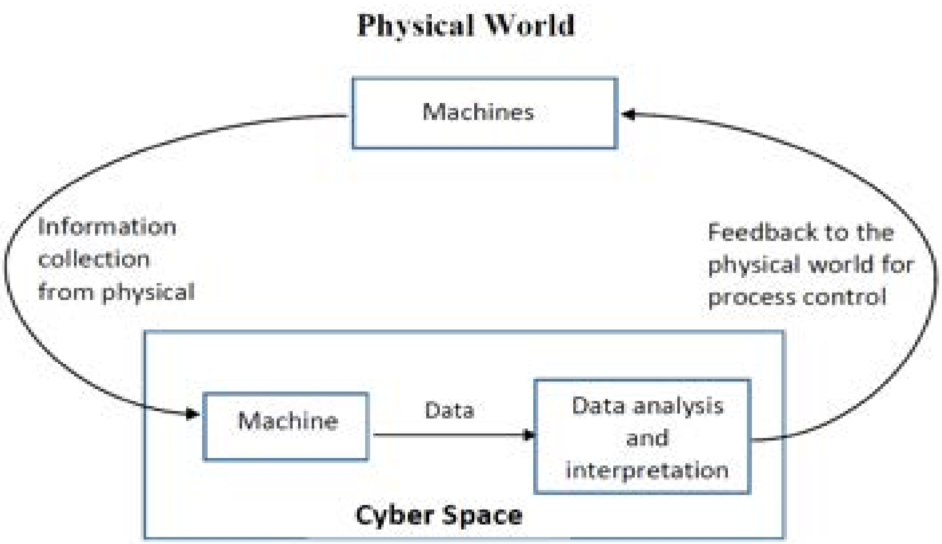

Fig. 1: Cyber-Physical System

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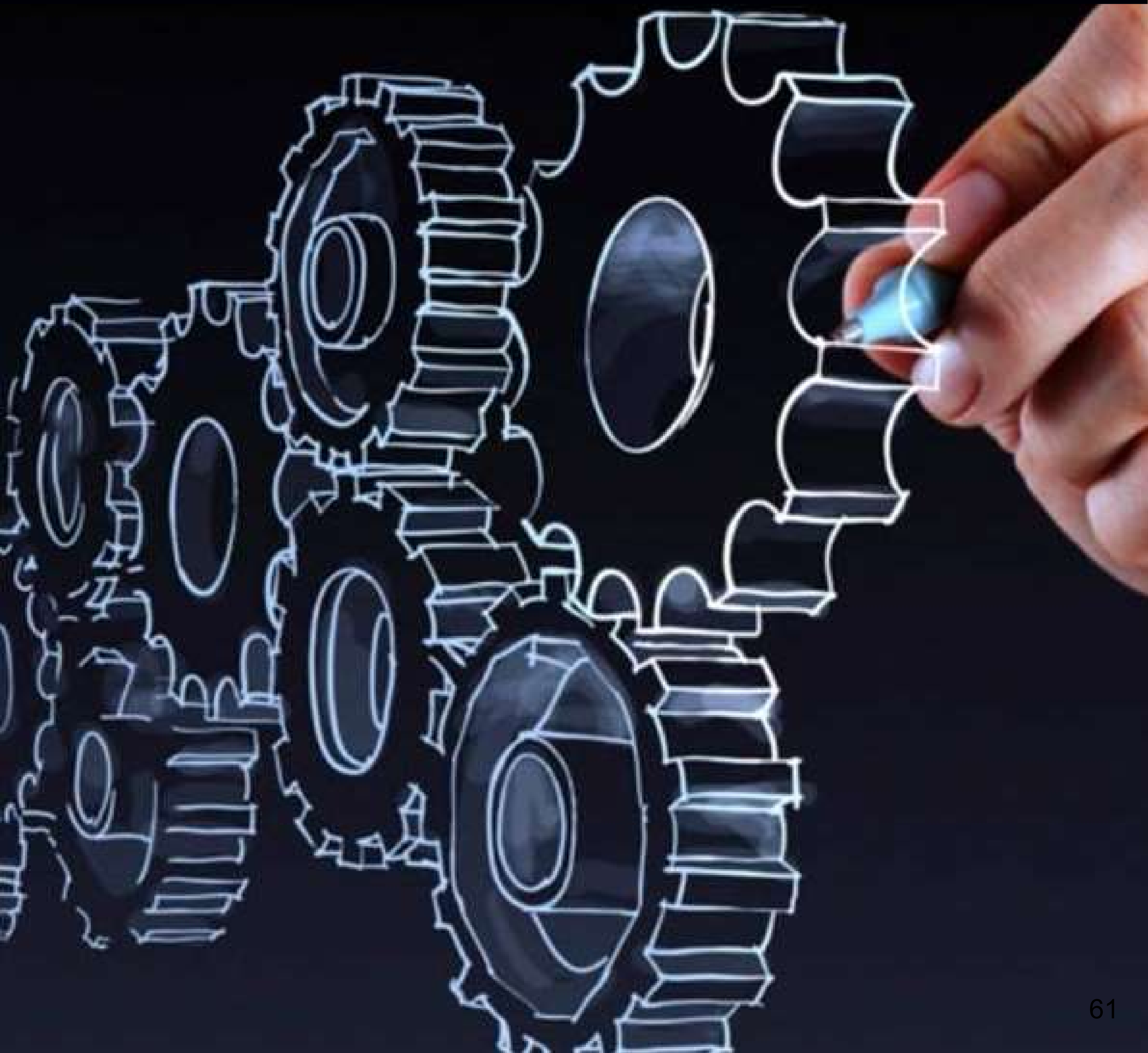

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MAGNETORHEOLOGICAL FLUID-A REVIEW

Manpreet Singh[1*], Tejinder Pal Singh Sarao[1], Gaurav Garg[1], Gaurav Kumar[1], Arshdeep Singh Kalsi[1] and Jashanpreet Singh[2]

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ABSTRACT

Magnetorheological fluids are a smart fluid, this fluid is combination of the suspension of fine, non-colloidal, low-coercivity ferromagnetic particles in a base or carrier fluid. These fluids are controllable fluid which control by the viscosity of the fluid, which have control by application of magnetic field. Application of magnetic field converts the liquid phase of the fluid into the semi solid, which generates the yield stress of the fluid. MR fluid fulfil the important performance criteria such as low initial viscosity, high shear upon the application of the magnetic field, low hysteresis, low power consumption, temperature stability, and fast response. The unique nature of MR fluids has made them suitable for semi-active energy-dissipating applications in particular. In this paper highlight the general principles of MR fluids, their rheology, and critical parameters are discussed and also the mechanisms governing the MR effect are characterized. For a more in-depth review of modelling efforts, compositions and the influence of critical parameters are also discussed in this work.

Keywords: MR fluid, Materials, Rheological properties, Structure

1. INTRODUCTION

Particular magnetization model (de Vincente et al . [1-4]) is the most acceptable model for the magnetization of MR fluid. According to this model, the magnetization effect is produced due to the non-permeability of the two phases, two phases are liquid phase (carrier fluid) and solid phase (CI particles and abrasive particles) respectively. The particles assumed, when in off sate, that the particles act as multi-domain magnets (Agrawal et al.)[6]. Basically, when applying the magnetic field, the MR fluid reacts to the polarization in the suspension particles (Jolly and Nakano[7], Jolly et al.[8]), this polarization creates the dipole moment in the particles, which helps to generate the chain structure of the particles in the direction of the magnetic field lines (Felt et al.)[9]. It defines that the off-state particles are multi domains; each domain has a randomly aligned fluid dipole moment. When the magnetic field is supplied all the particle sub-domains are aligned in one direction. The magnetic field sets the forces together between the two adjacent particles. The forces are attractive and repelling forces between the particles.

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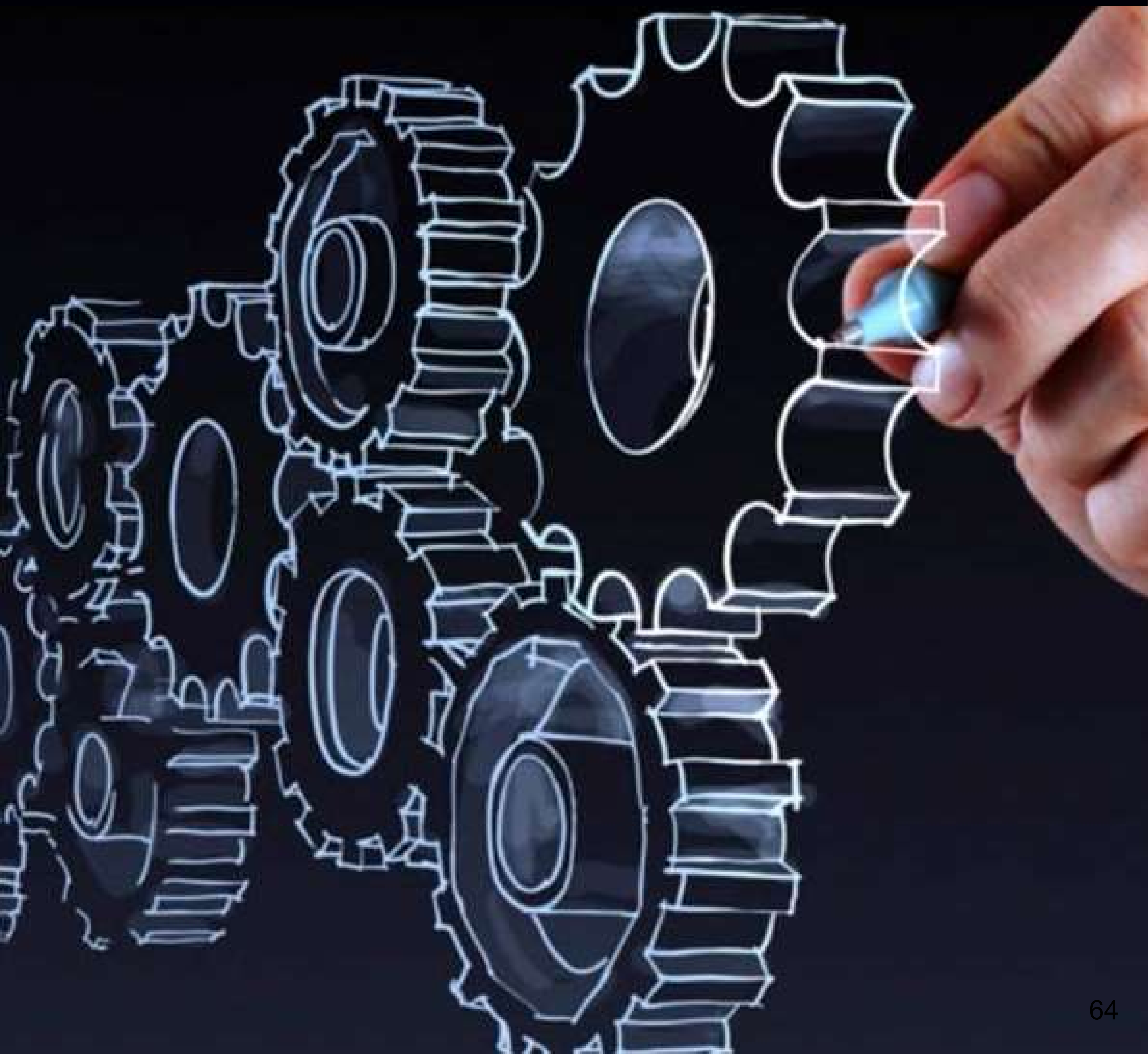

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ABSTRACT

The present study has been done to study the effect of different input parameters on the desired responses in the submerged arc welding process. Partial factorial technique has been used for the design of experiments. The effects of flux, current, travel speed and voltage have been evaluated on the bead height, bead width, depth of penetration, micro hardness and microstructure of the heat affected zone. The effect of all the input parameters on the output responses have been analyzed using the analysis of variance (ANOVA) and empirical modeling.

1. INTRODUCTION

During the earlier times several attempts were made to mechanize the arc welding process. Developing a continuous coated electrode as an extension of the manual metal-arc welding electrode was ruled out for some reasons. Since the coating is non-conducting, arranging electrical contact with the electrode is not practicable. The coating is likely to peel off when the electrode is coiled, and the coating is also likely to get crushed when fed through the feed rolls. In one of the methods attempted, the work piece was painted with a thin slag flux, while feeding of the bare wire and arc travel were mechanized. Many methods were tried out to provide flux coating in mechanized welding, but all efforts led to failure. The idea of placing a thick layer of dry granular flux on the joint ahead of the carbon electrode was conceived and successfully developed in the *U.S.A.* and later applied to the welding of penstocks and water conduits in California. Submerged-arc welding was the next logical step and the process became a commercial success both in the *U.S.A.* and the *U.S.S.R.* by the middle and late *1930's*.

1.1 The Submerged Arc Welding Process

The modern submerged arc welding *(SAW)* is an arc welding process, in which one or more arcs formed between one or more bare wire electrodes and the work piece provides the heat for coalescence. The flux is supplied through a funnel located ahead of the filler wire which is fed continuously. The flux exercises a shielding function. During welding, part of it is converted into a readily removable slag. In fully-automatic welding, the flux is fed mechanically to the joint ahead of the arc, the wire is fed automatically to the welding head, the arc length is automatically controlled and the traverse of the arc or the workpiece is also mechanized. Flux feed may be by gravity flow, through a nozzle concentric with the electrode from a small hopper a top the gun, or it may be through a concentric nozzle connected to an air-pressurized flux tank. Flux may also be applied in advance of the welding operation or ahead of the arc from a hopper run along the joint. **(S.V. Nadkarni [1])**

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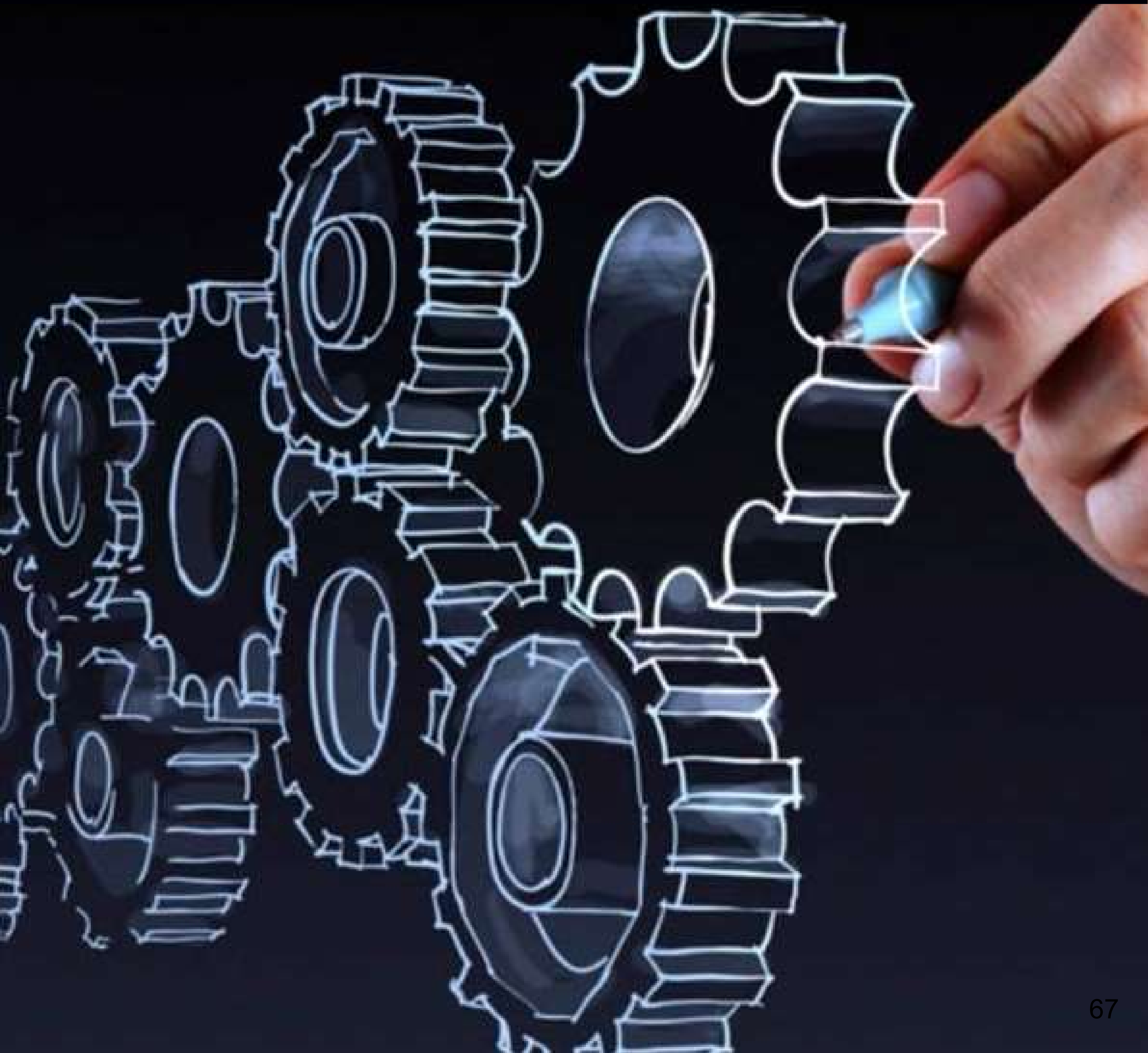

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ABSTRACT

Solid particle erosion is the primary cause behind the emergency shutdowns in the pulverized coal boilers power plants, which led to huge economy & efficiency losses. The Pulverized coal burner nozzles (PCBNs) are subjected to the detrimental conditions due to degradation by solid fragments (fine-grained pulverized coal) in the air passing with high velocity through the tip of Buner nozzle degraded due to the high temperatures inside the combustion chamber. In this review paper, consolidated results of all case studies in the field of erosion resistance in various steam thermal power plants are investigated. To enhance the PCBNs material degradation resistance against high-temperature, the feasibility of improvement and use of new advance materials with single or multilayer coatings can be utilized.

Keywords: Material degradation in PCBNs, Coal firing system, Erosion resistance, thermal spray technique

1. INTRODUCTION

Material degradation is a worldwide problem which marks it a key domain of research from over the years. Erosion is a progressive loss of original material from a solid surface due to continued severe environmental conditions. This phenomenon is also known as solid particle erosion which plays a crucial role in material degradation. In several fields of technology, erosion is a serious problem, mostly in the power generation sector & engineering industries. Erosion is the principal source of eroded material failure and it can be habitually discovered in turbine impellers, machines, nozzles, aircraft turbines, power plants, refineries, high-temperature furnaces and petrochemical industries, etc. The material wastage by the erosion mechanism has become a big problem in FBC, Pulverized coal boilers, the surface of economizers, super-heaters, air feeding and ash removal systems **[1-4].** Over the years many design and methods were purposed to appraise the rate of material removal under different eroded conditions. The outer surface of the nozzle and supporting structure still find fractured or destroyed due to continued exposer of high temperature and pressure **[5].** Poor fuel distribution finds by the nozzle tip results in unequal flame in the chamber. Found that the variation of unequal flame ranges from fuel biasing state to excessive oxygen state, which both states responsible for the slagging and water wall erosion and emission of oxides of nitrogen **[6].**

Erosion in power plant drastically shortens the lifespan of the components and reduces the efficiency and erosion costing approx. US$ 100 million, repair and maintenances cost a year. The cause behind the coal-fired boiler erosion in power generation plants is the high temperature inside the combustion chamber, known as high-temperature erosion or oxidation. This makes a thin film of merging the slat deposit of the PCBNs nozzle material. Present sulphur content produces sulphur dioxide due to the combustion and oxidized to SO3. This problem occurs due to low-quality coal, a high proportion of sulphur and ash present in coal used in the plants. Oxidized SO3 further reacts with the NaCl and moister present in pulverized

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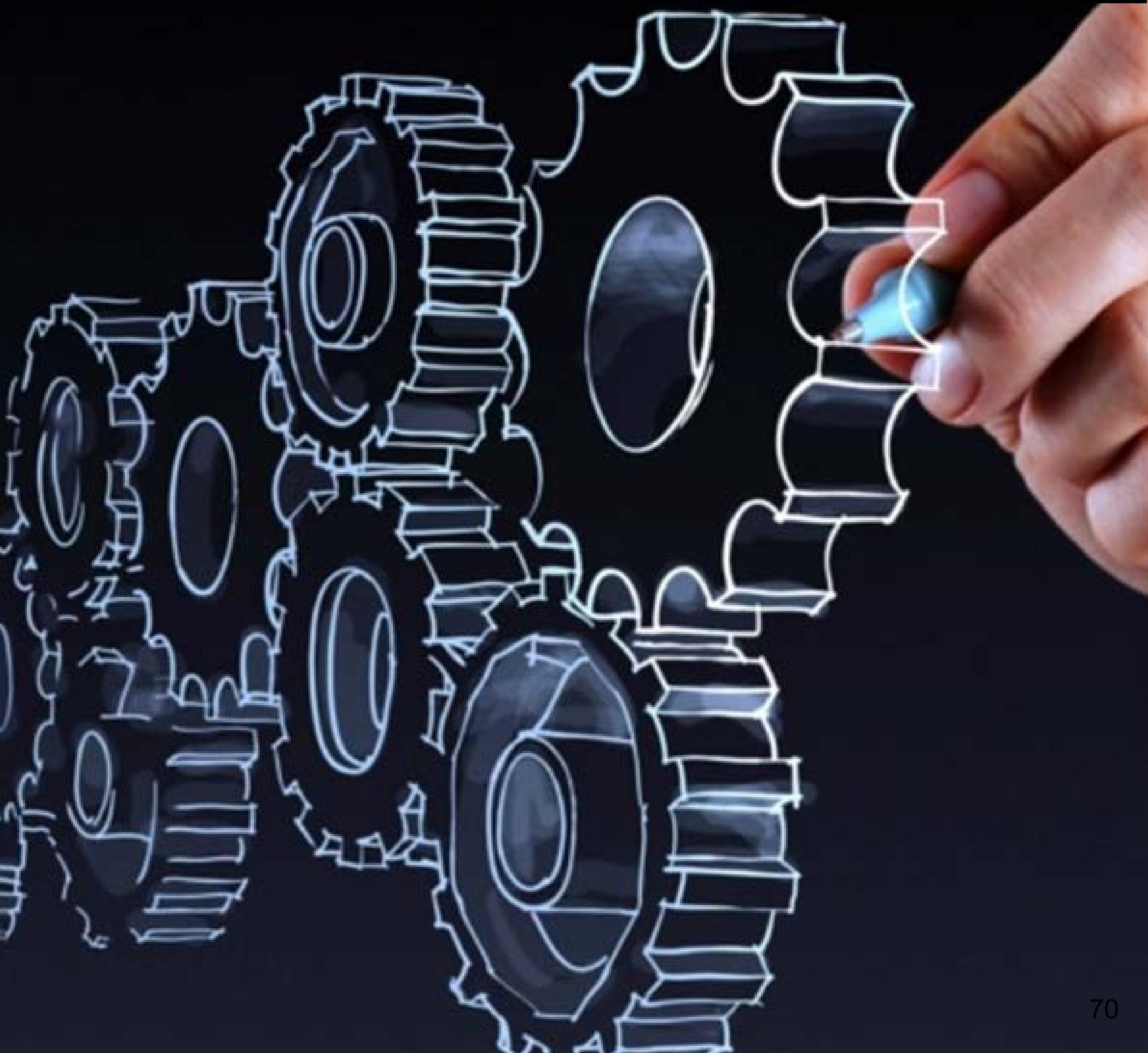

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ABSTRACT

In a number of industrial applications, like the aircraft industry, electrical, computer, and micromechanics, electrochemical machining processes are a feasible choice for drilling the macro- and microholes with a smooth surface and an acceptable taper. One of the latest hole-drilling methods, i.e. jet-electrochemical drilling, has gained status for generating huge numbers of good-quality holes in hard-to-machine metals. Recent breakthroughs, new trends, and the impact of critical components on hole quality produced by these methods are the focus of this chapter. A comparison of electro-jet drilling with another nonconventional hole-drilling technique demonstrates the potential and adaptability of electrochemical hole drilling technologies.

INTRODUCTION

Electrochemical Machining (ECM) is a non-traditional machining (NTM) process belonging to electrochemical category. ECM is opposite of electrochemical or galvanic coating or deposition process. Thus, ECM can be thought of a controlled anodic dissolution at atomic level of the work piece that is electrically conductive by a shaped tool due to flow of high current at relatively low potential difference through an electrolyte which is quite often water based neutral salt solution. The new concept of manufacturing uses non-conventional energy sources like sound, light, mechanical, chemical, electrical, electrons and ions. With the industrial and technological growth, development of harder and difficult to machine materials, which find wide application in aerospace, nuclear engineering and other industries owing to their high strength to weight ratio, hardness and heat resistance qualities has been witnessed. New developments in the field of material science have led to new engineering metallic materials, composite materials and high-tech ceramics having good mechanical properties and thermal characteristics as well as sufficient electrical conductivity so that they can readily be machined by spark erosion. Non-traditional machining has grown out of the need to machine these exotic materials. The machining processes are non-traditional in the sense that they do not employ traditional tools for metal removal and instead they directly use other forms of energy. The problems of high complexity in shape, size and higher demand for product accuracy and surface finish can be solved through non-traditional methods. Currently, non-traditional processes possess virtually unlimited 2 capabilities except for volumetric material removal rates, for which great advances have been made in the past few years to increase the material removal rates. As removal rate increases, the cost effectiveness of operations also increase, stimulating ever greater uses of non-traditional processes.

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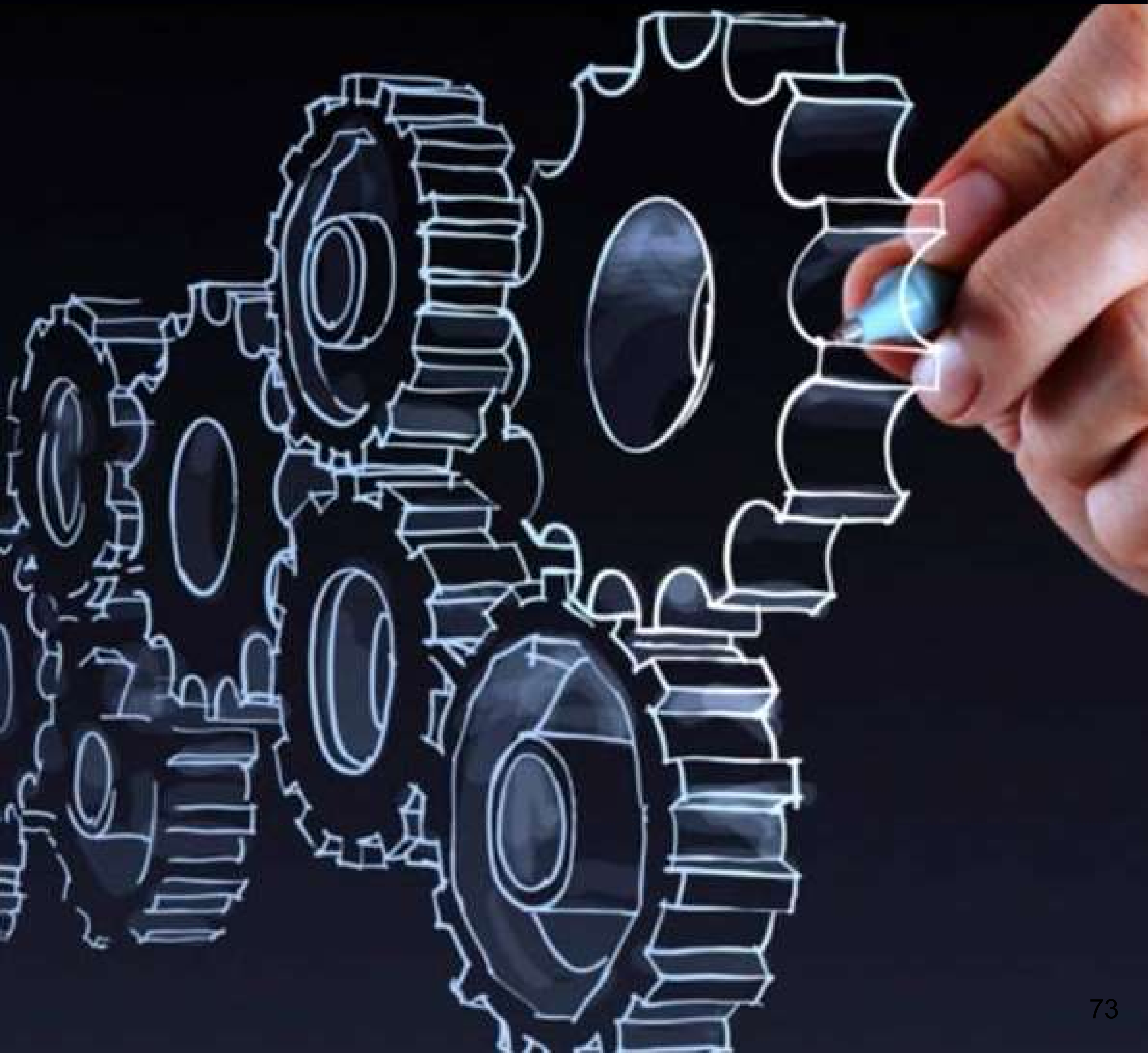

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ABSTRACT

In industrial applications, surface of different equipments is damaged by solid particles entrained in a fluid stream. This type of wear is generally characterized as erosion. Probably the most considerable erosion problems which found in industry are those connected with the equipment used such as in coal-fired power plants, hydraulic turbines, fluid-bed system and coal purification plants etc. Erosion may come into play, when the moving particles strike-out the material from the surface of the equipment which reduces the life and efficiency of the plant equipments. The various factors named as particle shape, particle velocity, angle of impingement and properties of target material, affect the erosion rate. Hardfacing is one of simple and most effective technique to increase the erosion resistance by different welding processes. The soft surface of the component is deposited by suitable alloys or composites which enhance the surface properties. Hardfacing is a useful technique for either repair of failed components or manufacturing of new components.

Keywords: Erosion, Particles, Hardfacing, Surface Properties

I.INTRODUCTION

In few applications solid particle erosion (SPE) is beneficial as in sand blasting, abrasive deburring and water jet cutting, but in industrial applications and power generation, SPE decreases the life of the component surface. This is a critical phenomenon which has been affecting the plant outputs by failure of the components from a long. In coal-based power generation plants, hydraulic turbines, fluid-bed systems and petroleum purification, the components are found in the under of particle attack of slurry transportation [1]. Metal components may be failed not by breaking but due to erosion by changing dimensions mostly changing in volume of upper surface of components. Erosion is a dynamic process in which material is eroded from outer surface interaction between particles and surface [2]. When the particle flows at high velocities, a notorious attack has been observed. The groove may be seen on the target place which is the removal of material. The pure behavior of wear is erosion which comes out from the impact of high-speed solids or slurry [3]. This mechanism involved of material removal from surface by magnitude force impingement during contact of flowing particles and part surface. The striking particles remove the upper layer of material from component surface [4]. The erosive action of high velocity particles makes severe damage in industry. For example, in gas turbine the moving particles eroded the blade surface which reduces the life of the turbine parts [5].

The components degradation due to erosion causes reduce the efficiency of power plants and engines [6]. In hydropower plants, the mixing of solid rock particles in water produces significant erosion of important parts in the rainy season [7]. The mechanism of material degradation by particles is complex. Velocity of particles, hardness, impingement angle and shape of erodent etc. are some of the factors which affect the erosion rate. The erosion resistance of heat-treated steel increase with the hardness and ductility at ambient temperature but in some cases, there are no correlations between the hardness and ductility with erosion rate [8]. Researchers have stated the dependence of erosion rate on the mechanical properties of the component material. In brittle materials, the cracking and chipping are the mechanisms for

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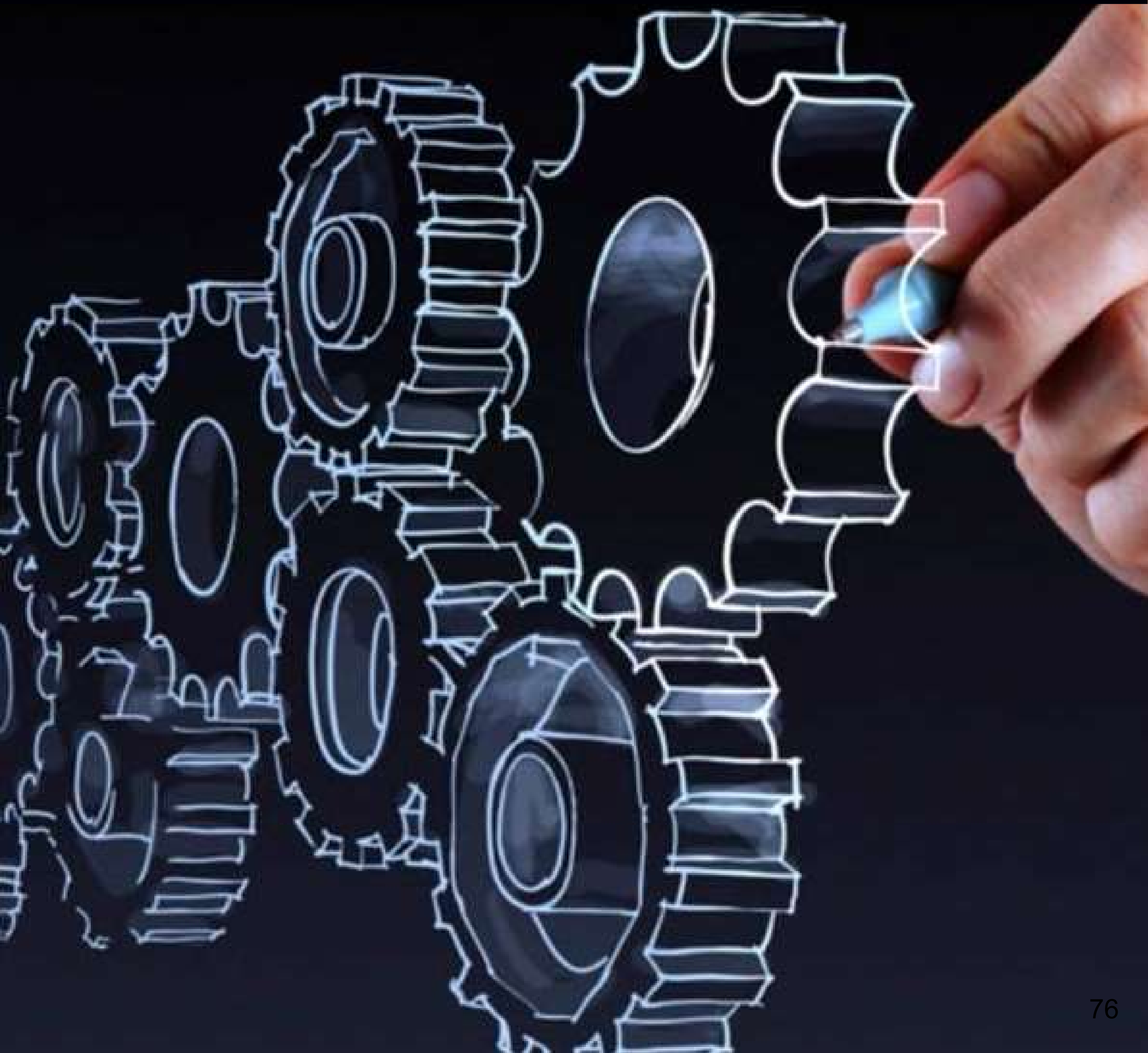

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PERFORMANCE INVESTIGATION OF MAGNETORHEOLOGICAL FINISHING OF ROLLS SURFACE IN COLD ROLLING PROCESS

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ABSTRACT

Cold rolling is one of the most vital manufacturing operations in sheet metal industrials. It produces controlled sizes and accurate thinner gauge components with a smooth surface. In cold rolling operation, the rolls are the most important component. Greater the rolls surface finish, smoother the surface finish of the final products and improves their functional conditions. To accomplish this requirement, the magnetorheological (MR) finishing process using rectangular-rotating core has been used to finish the external surface of the rolls. The process parameters such as roll workpiece rotation, tool feed, tool rotation, working gap and current intensity of the electromagnet and composition of MR polishing fluid are considered to investigate the performance of cold rolling rolls using the rectangular-rotating core-based MR finishing process. To effectively perform the MR finishing operation, the optimum process parameters are predicted using the response surface methodology. The optimum parameters obtained from the parametric study is used to perform the MR finishing on the industrial cold rolling rolls. The reduction in surface roughness is found as 18 nm from the initial ground value of 200 nm. After the MR finishing operation, the cold rolling rolls are sent to the industry for testing its functional performance. In the industry, the performance investigation is performed and compared. Experimentally and theoretically analyse the roll force, roll torque, and power consumption on before and after MR finished rolls surface in cold rolling operation. Almost all the performance parameters with MR finished rolls surface are found in favour of improvement in functional operation during its application in cold rolling process.

Keywords: Magnetorheological nano-finishing; cold rolling rolls; surface roughness.

1. INTRODUCTION

In the modern world, the metal rolling process is one of the most vital manufacturing processes. Most of the sheet metal products are produced by the metal rolling process [1]. Metal rolling is of two types hot and cold rolling [2]. The hot rolling is mainly used for rolling the ingot into the bloom or a slab form at a temperature above the recrystallization temperature of the ingot [3]. The bloom or a slab form is the basic structure for producing a wide range of manufactured forms [4]. Cold rolling is used to deform various metals into the sheets and foils at a temperature below the recrystallization temperature of the material. Cold rolling is a highly accurate process [5]. This process also strengthens the final product and improves its mechanical properties [6]. The main component of the rolling process is a roll. Rolls are made of gray iron, alloy iron, cast steel, and forged steel. The steel rolls are stronger and tougher than the iron rolls [7]. During the metal rolling, the rolls are subjected to wear, thermal stresses, bending stresses and frictional forces [8]. In every metal surface after machining, some quantity of surface roughness is produced. This surface roughness has higher peaks and lower valleys [9]. These higher peaks are the surface asperities. During operation, when two cylindrical metal

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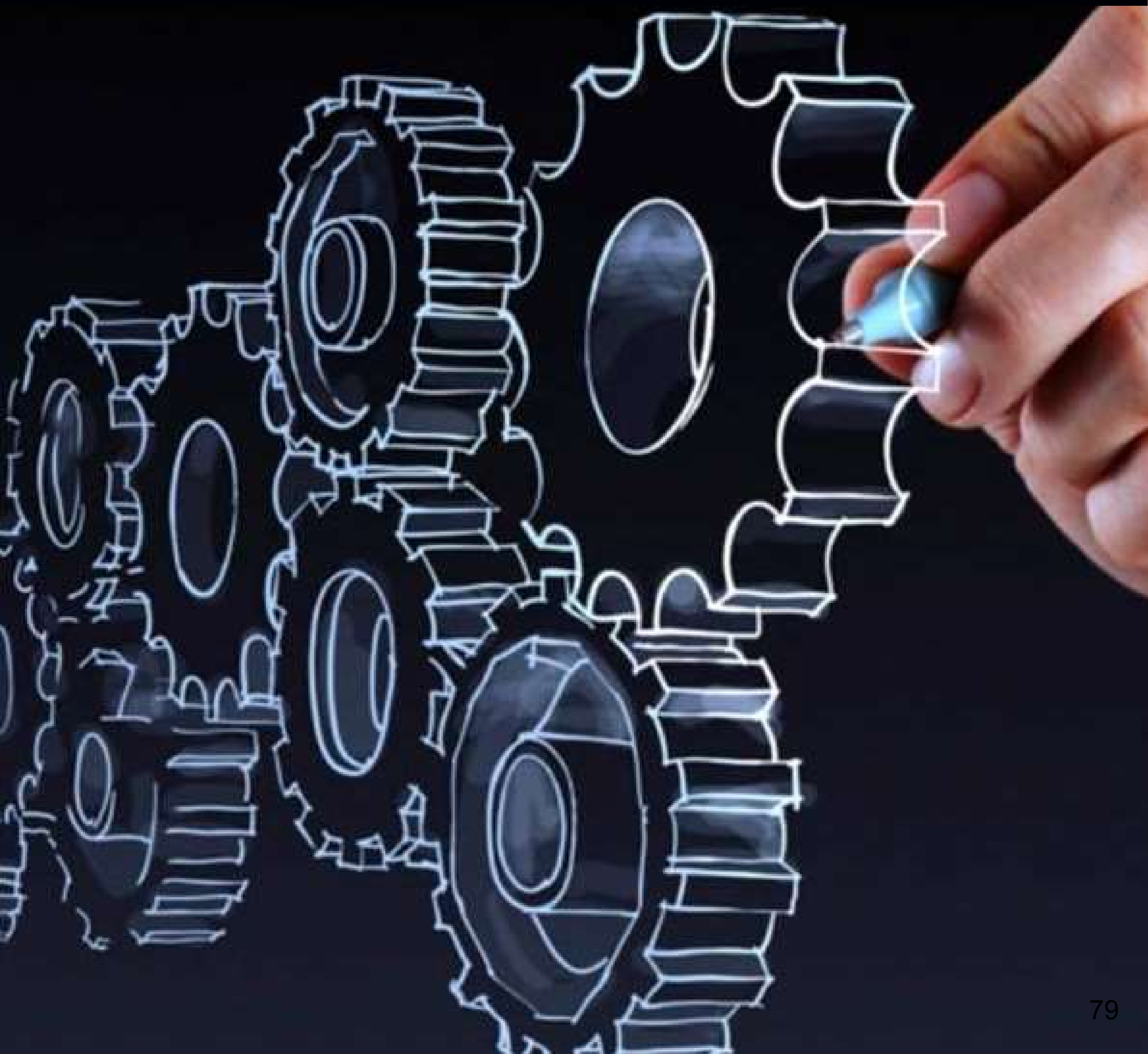

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ABSTRACT

Magnetorheological suspensions are smart and complex fluids which show their behavior from liquid to solid is dependent the on off state of the current to the MR fluid. The basic mechanism of transformation is the attractive dipolar forces between the particles which have been created by magnetic field. The formation of particles chains throughout the fluid is the occurrence of the strength of the magnetorheological fluid. This paper represents the overview of the MR fluid and also examines the forces (hydrostatic, hydrodynamic, dipolar, magnetization) which play important role in the solid form of the fluid. These forces help to understand the rheology of the MR fluid. This article explains the working modes of the MR fluid and latest applications of the magnetorheological fluid.

Keywords: Smart fluid, Rheology, Carbonyl iron particles, Abrasive particles.

1. INTRODUCTION

MR fluid is controllable fluid which respond on the magnetic current with considerable change in the rheology of the MR fluid [1]. MR fluid is in liquid state at the off state (H=0) of the magnetic field like a Newtonian fluid. Noroozi et al, (2013) [2] on state of the magnetic current the dramatic transformation shows in the viscosity of the magnetorheological fluid. Mainly significant advantage of MR fluid over traditional processes of finishing is their changing capacity of the viscosity in a fraction of milliseconds. The strength of the fluid is described by yield stress. Premalatha et al (2012) [3] in MR fluid basically three important forces are working like hydrodynamic, magnetization and dipolar repulsive forces [4]. Hydrodynamic forces play an important role in yielding behavior of the fluid. Bica et al (2013)[5] dipolar repulsive force exactly balances the magneto static forces of attraction between the particles which are control and aligned with the help of magnetic field [6].

2. MR FLUID COMPONENTS

2.1Magnetically Active Phase (CI particles)

The MR fluids are contained is an idealistic combination of many components. However, the major components in many of the MR fluids today have probably remained the same. Highly purified carbonyl iron (CI) powder plays the main role in the MR fluid compositions [7]. Iron particles made by chemical vapour deposition (CVD) decomposition process [8]. The spray atomisation process is not preferred, main reason is that the CI particles are magnetically soft, chemically pure, and spherical in nature, which can be produced by the CVD process [9]. Meso scale particles are produced the more magnetic domains in the CI particles. The upper level of chemical cleanliness (about >99%) decreases the domain pinning defects and also the spherical shape of particles is help to decreases the magnetic shape anisotropy [10]. Due to high saturation magnetization (2.1 Tesla), the carbonyl iron particles are used. Choi et al (2006) [11] the MR fluid also used the alloy of the iron and cobalt which has improved the saturation magnetization (up to 2.4 Tesla). Volume fractions are varies from the ranges of 0.1 to 0.5.

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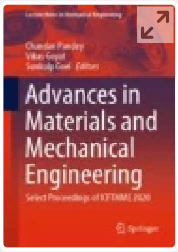
About this book

This book presents the select proceedings of 1st International Conference on Future Trends in Materials and Mechanical Engineering (ICFTMME-2020), organised by Mechanical Engineering Department, SRM Institute of Science and Technology (Formerly known as SRM University), Delhi-NCR Campus, Ghaziabad, Uttar Pradesh, India. The book provides a deep insight of future trends in the advancement of materials and mechanical engineering. A broad range of topics and issues in material development and modern mechanical engineering are covered including polymers, nanomaterials, magnetic materials, fiber composites, stress analysis, design of mechanical components,



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Advanced Finishing Processes for External Cylindrical Surfaces—A Review

Manpreet Singh, Gagandeep Singh & Maninder Singh

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Abstract

External cylindrical surface components are the core of machinery and automotive industry. The sliding and rotational motions are the main working motions provided to the cylindrical components. During these motions, the surface contact with fine finish defines the process performance of the machine or process. This fine finish is obtained through advanced finishing processes like magnetic abrasive finishing (MAF), vibration MAF, and magnetorheological finishing. In this work,