MAHARAJA AGRASEN INSTITUTE OF TECHNOLOGY

MAIT

उद्यमेन हि सिध्यन्ति
कार्याणि न मनोरथैः

ज्ञानसंग्रह

Driving Innovation Through Research

2022-2023

Volume 2

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Message from the Head of the Department

It gives me immense pleasure to extend my heartfelt congratulations on the release of the second volume of Gyansangreh, a testament to the spirit of knowledge-sharing and academic excellence that defines our department.

This publication book is not just a collection of summary of research articles; it is a reflection of our commitment to continuous learning, innovation, and intellectual growth. I commend Dr. Vipin Kumar Sharma, the editor of Gyansangreh and student member of the team, for thier unwavering dedication and meticulous efforts in bringing together contributions that span diverse domains within and beyond mechanical engineering.

Each volume of Gyansangreh serves as a platform for students, faculty, and researchers to express their insights and creativity. It fosters an environment where ideas flourish and young minds are encouraged to think critically and write with purpose. I am confident that this edition, like the one before, will inspire and enlighten its readers.
I extend my best wishes to the editorial team and all contributors.

Warm regards,

Dr. Vaibhav Jain
Head of Department
Mechanical Engineering Department
Maharaja Agrasen Institute of Technology

Department of Mechanical Engineering

Vision

To be a global leader in Mechanical Engineering education, research & innovation with ethics and values.

Mission

M1: To deliver industry relevant and skill oriented education in Mechanical Engineering, encompassing production, design, thermal, and emerging areas to address diverse global challenges.
M2: To foster ethical values with professional skills for the benefit of industry and society.
M3:To enhance the teaching-learning process through modern pedagogical tools.
M4:To promote research, innovation and entrepreneurship using sustainable technologies and continuous learning.
M5:To strengthen engagement with alumni, industry and other stakeholders for collaborative growth and capacity building.

Program Educational Objectives (PEOs)

The objectives of the Department of Mechanical Engineering are to produce graduates who will have:
PEO1: Employability, entrepreneurship, leadership skills, and the ability to pursue higher education for the enhancement of knowledge.
PEO2: Ability to lead through research and innovation in the field of Mechanical Engineering.
PEO3: Engineering competence with good communication skills, professionalism, moral values as well as foundation for lifelong learning.
PEO4: Technical capabilities pertinent to Mechanical and allied engineering and to provide innovative and sustainable solutions for industrial and societal problems.

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2	Opportunities and Challenges for Renewable Hydrogen Production and Application in India	Sidharth	9th International Symposium on the Fusion of Science & Technologies or ISFT2022 and the 2nd Rajamangala University of Technology Suvarnabhumi International Conference or (RUSiCON)	2022

Effect of Surface Coatings on the Tribological Properties of Sliding Contacts

Vipin Kumar Sharma,

SAE Technica Paperl

The present work discusses the effects of Electrolytically deposited chromium coating on the Tribological behaviour of piston ring material. The frictional behaviours were evaluated using the linear reciprocating Tribometer under varying conditions of load and temperature. Test temperatures of 25, 50, and 100 degrees Celsius and loads of 20, 30, and 40N were applied during the tests to obtain the wear response of the coating under conditions similar to real piston cylinder/ring friction conditions. Tests were carried out with a constant sliding speed of 0.1 m/s. Optical micrographs and scanning electron microscope were used to analyze the nature of wear. It has been found that for lubricated or non-lubricated and coated or uncoated specimens, on increasing load, wear and surface roughness both increased for pins and plates. For dry conditions and a fixed load of 30N, wear of coated pins is found to be increasing with temperature from 25∘C to 100∘C, but plate wear shows a fully opposite variation in wear with increasing temperature thus wear decreased. Therefore, a substantial resistance to wear has been achieved by the hard chromium coating of pins.

Sharma, V., Joshi, S., Mittal, R., Kaushik, I. et al., "Effect of Surface Coatings on the Tribological Properties of Sliding Contacts," SAE Technical Paper 2023-01-0405, 2023, https://doi.org/10.4271/2023-01-0405.

Influence of Process Parameters on KERF Properties of GFRP with Abrasive Water Jet Machining

Anil Kumar Dahiya

International Journal of Materials Engineering Innovation

Abstract: Abrasive water jet machine (AWJM) is used in industries to remove and shape the composite materials and other hard-to-cut engineering materials. In this study, experimental investigation on glass fibre reinforced polymers (GFRP) using AWJ machine for cutting performance is discussed. There are various factors which influence the quality of the surface in AWJM. Water pressure, traverse speed, standoff distance, and abrasive mass flow rate are only several of the variables evaluated in this paper. Minitab 18's Taguchi technique is utilised to design the experiment, and ANOVA is performed to determine the significance and impact of process factors on responses.

Anil Kumar Dahiya; Basanta Kumar Bhuyan; Puneet Kumar; Sachin Salunkhe; Shailendra Kumar, Influence of process parameters on kerf properties of GFRP with abrasive water jet machining International Journal of Materials Engineering Innovation (IJMATEI), Vol. 14, No. 2, 2023

Experimental Modelling and Process Optimization of Abrasive Water Jet Machining of Glass Fibre Reinforced Polymer Composites

Anil Kumar Dahiya

International Journal on Interactive Design and Manufacturing

This paper describes an experimental investigation, modelling and optimization during abrasive water jet machining (AWJM) of glass fibre reinforced polymer composite. Four process parameters namely water pressure, stand-off distance, traverse rate and abrasive mass flow rate are considered to study their influence on maximum delamination length (Max. DLL), surface roughness (Ra) and kerf taper (Kt). The second-order regression models are developed for the maximum delamination length, surface roughness and kerf taper in AWJM of glass fibre reinforced polymer composite using response surface methodology based central composite design approach. From the regression models, it is revealed that delamination decreases with an increase in abrasive mass flow rate, with a decrease in traverse rate. Surface roughness decreases with increase in water pressure and decrease in traverse rate. Kerf taper decreases with increase in water pressure; and decrease in traverse rate and stand-off distance. Further, response surface methodology based desirability function is performed to minimize the Max. DLL, Ra and Kt and the desirability values were found for Ra = 0.936, Kt = 0.942 and Max. DLL = 1 with a combined desirability rating of 0.959 which was reasonably good and acceptable. From the confirmation test of multi-response optimization, it was obvious that the percentage error at optimum level of process parameters for Ra, Kt, and Max. DLL were less than 6.312%, 7.229%, and 4.318%, respectively.

Dahiya, A.K., Bhuyan, B.K. & Kumar, S. Abrasive water jet machining of glass fibre reinforced polymer composite: experimental investigation, modelling and optimization. Int J Interact Des Manuf 17, 1933–1947 (2023). https://doi.org/10.1007/s12008-023-01312-w

Effect of Surface Coatings on the Tribological Properties of Sliding Contacts

Sumit Joshi

SAE Technica Paperl

The present work discusses the effects of Electrolytically deposited chromium coating on the Tribological behaviour of piston ring material. The frictional behaviours were evaluated using the linear reciprocating Tribometer under varying conditions of load and temperature. Test temperatures of 25, 50, and 100 degrees Celsius and loads of 20, 30, and 40N were applied during the tests to obtain the wear response of the coating under conditions similar to real piston cylinder/ring friction conditions. Tests were carried out with a constant sliding speed of 0.1 m/s. Optical micrographs and scanning electron microscope were used to analyze the nature of wear. It has been found that for lubricated or non-lubricated and coated or uncoated specimens, on increasing load, wear and surface roughness both increased for pins and plates. For dry conditions and a fixed load of 30N, wear of coated pins is found to be increasing with temperature from 25∘C to 100∘C, but plate wear shows a fully opposite variation in wear with increasing temperature thus wear decreased. Therefore, a substantial resistance to wear has been achieved by the hard chromium coating of pins.

Sharma, V., Joshi, S., Mittal, R., Kaushik, I. et al., "Effect of Surface Coatings on the Tribological Properties of Sliding Contacts," SAE Technical Paper 2023-01-0405, 2023, https://doi.org/10.4271/2023-01-0405.

Analyzing the Factors for Implementing Make-to-Order Manufacturing System

Surbhi Upadhyay

Make-to-order (MTO) is becoming vital for meeting ever-changing customer requirements. Growing demand for customized items has been linked to a rise in the proportion of MTO businesses. Many sectors and product categories have implemented the MTO concept and achieved a competitive edge in sustainable manufacturing. However, in the case of the automobile sector, little work has been carried out, both in research and practice. In this study, our objective is to identify and prioritize the critical success factors (CSF) which can affect the implementation of make-to-order and rank the different strategies to implement MTO manufacturing systems for passenger cars. This paper proposes an integrated approach where an Analytic Hierarchy Process (AHP) is used for prioritizing factors and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is used for ranking the strategies for implementation. The study shows that a customer-centric strategy would be the best solution to implement MTO in the automobile sector.

Sustainability 2023, 15(13), 10312; https://doi.org/10.3390/su151310312

Unlocking competitive edge and sustainability through Make-to-Order manufacturing: an empirical

Surbhi Upadhyay

In order to minimise the adverse impacts on the environment, manufacturers, policymakers, and society have all been interested in sustainable manufacturing. Several factors related to Configurable Product, Customer Need, Emerging Technology, Information Technology, Market Performance, Organisation Readiness are being studied by the researchers in this process. Make To Order (MTO), as an approach towards management of manufacturing helps to reduce the over production and thus wastage of the items and helps in sustainable manufacturing along with improving the competitiveness of the organisation. The goal of this study is constructing a sustainability model using a MTO manufacturing system. From the responses of structured questionnaires, PLS-SEM (SMART PLS 4), i.e. Partial Least Squares approach to structural equation modelling has been used to develop the model and determine the strength of the relation between items. The empirical findings demonstrate that all the approaches have a significant effect on MTO manufacturing system. Competitive Advantage acts as a mediator for the relationship between MTO and Sustainable manufacturing. The current literature on sustainable manufacturing initiatives has been extended and improved by these findings, and give researchers a fresh angle from which to further explore this idea.

Upadhyay, S., Garg, S.K. & Sharma, R. Unlocking competitive edge and sustainability through Make-to-Order manufacturing: an empirical investigation. Environ Dev Sustain 27, 8811–8834 (2025). https://doi.org/10.1007/s10668-023-04255-0

Innovative Design Approach of Mechanical Skimmer for Restoration of Water-bodies from Aquatic Weeds

Surabhi Lata

IEEE

Emerging technologies and technological innovations define new horizons for the mankind but are adversely affecting the blanket of earth and its creatures. The deteriorating conditions of the natural environment is being taken care of through various schemes of cleanliness, new policies and general awareness among people. The presented investigation provides a solution to an environmental problem faced in the areas where rivers, canals and lakes are present. The trash and debris (human produced or natural) present in these water bodies are source of pollution and also obstruct the natural beauty of the place. The water-bodies have excessive growth of aquatic weeds which flow 1–2 cm below water surface. These aquatic weeds obstruct the flow of water and get hinged and coagulate on any solid surface which appear as floating heap of waste. Till date, these weeds are removed manually with a temporary arrangement of equipment. A solution to this is proposed in the form of design modification of frontal part of mechanical skimmer i.e., the conveyor but with an introduction of third shaft. The shaft was designed with 8 fins equidistant at an angle of 45 degrees with few assumptions made during the design of fins. The design of the shaft was validated through the static structural analysis which was performed for total deformation and Von mises stresses. The solution converged at 10 steps with a total deformation of 2.378%. The entire project aims at scavenging the trash debris and restoring the natural beauty of all water-bodies on the mother earth.

10.1109/ICEPE57949.2023.10201478

Issues and challenges of mass customization Author links open overlay panel

Piu Jain

Materials Today: Proceedings

Mass customization has evolved as an important research area in today's rapidly changing economic landscape. Even though theoretically suitable, practically several critical barriers inhibit its implementation. The purpose of this study is to investigate the issues and challenges associated with mass customization when an organisation transitions from mass manufacturing to mass customization. In businesses striving to implement mass customization, challenges are identified with the help of a literature review. Overcoming these challenges might commence with effective material management.

https://doi.org/10.1016/j.matpr.2023.03.408

Identifying the Enablers for adaptation of FinTech: A Literature Review

Piu Jain

International Journal of Management and Applied Scienc

FinTech, which has become a significant financial sector innovation, has rapidly expanded as a result of new legislation, an expanding economy, and technological advancements. The number of FinTech companies will rise, according to researchers. Thus, it is essential to gain a deeper knowledge of what Enablers fundamentally support FinTech innovation and their objectives. Recognizing and classifying the crucial enablers of FinTech is the aim of this research study. Thirteen enablers are identified and grouped in technology, economic, and customer aspects

https://www.iraj.in/journal/journal_file/journal_pdf/14-920-169337806811-13.pdf

Optimization of process parameters for machining defects of glass fibre reinforced polymer composite machined by AWJM

Anil Kumar Dahiya

Materials Today Proceedings

For the machining of composites like glass fibre reinforced polymers (GFRP), abrasive water jet machining (AWJM) is generally used. AWJM has proven to be a cost-effective and efficient metal removal process of composites, in which a high-speed jet of abrasive and water strikes on workpiece surface to erode the material. In this paper, an experimental investigation is described which is focused on investigating the effect of process parameters on defects like delamination, pulling out of fibres and embedment of abrasive particles of machined samples during AWJM of GFRP composites. For design of experiments response surface methodology (RSM) based on the central composite design (CCD) approach is used. Water pressure (WP), traverse rate (TR), stand-off distance (SOD) and abrasive mass flow rate (AMFR) are considered to study their influence on delamination. The scanning electron microscope (SEM) is used to investigate the microscopic features of machined surfaces. It is revealed that delamination decreases with an increase in AMFR, with a decrease in TR, Further, optimization based on the desirability function is also performed to minimize the delamination. The optimal combination of the cutting parameters (SOD = 2.6 mm, WP = 175-MPa, TR = 104 mm/min and AMFR = 582 g/min) gives the optimized values of Max. DLL is 0.299 mm.

https://doi.org/10.1016/j.matpr.2022.12.138

Influence of process parameters on delamination of GFRP with abrasive water jet machining

Anil Kumar Dahiya

Materials Today Proceedings

Abrasive water jet machining (AWJM) is extensively employed for machining composites such as glass fibre-reinforced polymers (GFRP). AWJM has been demonstrated to be a cost-effective and practical material removal technique for composites, in which a high-speed jet of abrasive and water erodes the material on the workpiece surface. In this paper, an experimental investigation is explained which is focused on investigating the impact of process parameters on the delamination of machined samples during AWJM of GFRP composites. Four main process parameters namely water pressure (WP), traverse rate (TR), standoff distance (SOD), and abrasive mass flow rate (AMFR) are considered to study their influence on delamination. For design of experiments Minitab 18's Taguchi L16 orthogonal array is used, and ANOVA is applied to find out the significance and effect of process parameters on delamination. It is revealed that delamination increases with an increase in traverse rate and water pressure and is prominent at the bottom portion of machined samples. The delamination is measured using a scanning electron microscope (SEM).

https://doi.org/10.1016/j.matpr.2023.03.081

Torsion test for a BAJA chassis using gyroscopic sensor and validation of CAE results

Ramakant Rana

Materials Today: Proceedings

Vehicle dynamics plays an important role in vehicle stability, handling, ride quality and control. The dynamics of vehicle are also dependent on vehicle chassis and hence torsional stiffness of chassis is an important property to consider. High torsional stiffness results in less vibrations and better handling. This paper presents a torsional analysis of the chassis of an All-terrain Vehicle (ATV) used in BAJA SAE competition. Experimental analysis is performed where chassis is put under load and deflections are measured using a gyroscopic sensor. FEM simulations are performed and results are compared to calculate error. The paper concludes with ways to improve torsional stiffness.

https://doi.org/10.1016/j.matpr.2022.01.019

Novel Robotic Platform for Affordable and Customizable Testing and Prototyping

Ramakant Rana

EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy,

The robotic platforms currently available for testing the software stability and functionality are expensive and are not highly customizable in terms of hardware. This makes the platforms out of reach of the grasp of researchers and small-scale start-ups. We have proposed a design of a robotic platform that is easier to manufacture and cheaper to build (totaling under USD 1000). The components used are easily available and are cheaper as compared to the components of currently available robotic solutions. The design features of the platform are explored along with factors and features that make the proposed platform favorable to small-scale researchers and start-ups. The components of the platform are discussed along with their purpose in the design. A model that is highly customizable, easy and cheap to manufacture, and capable of carrying out general tasks of navigation and manipulation was made. Scaling the model physically down to making its smallest gearbox (in wrist actuator) of about 10 cm in diameter, was also made possible using the design principles proposed in the paper. Further scope of improvement and ideas for the next version design were also explored.

https://www.tj.kyushu-u.ac.jp/evergreen/contents/EG2023-10_1_content/pdf/p454-462.pd

Suspension and Steering Setup for a 4-wheel All-terrain Vehicle

Ramakant Rana

EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy

Suspension and steering are subsystems to any automobile which determine how the vehicle dynamically behaves with driver's and terrain's combines input and output as response of the vehicle deciding direction, stability and ride, roll characteristics which were used in this study to obtain optimum lap times. The roll cage acts as a skeleton to the body and the suspension system as the limbs trying to maintain stability and safety in the cockpit. This study is based on BAJA SAE rulebook constraints. An iterative process is adopted to finalize suspension parameters followed by ride and roll calculations and suspension geometry selection. The entire setup is simulated using lotus shark suspension analysis and MSC Adams car multibody dynamics suspension testing in various simulations and loading conditions. The change in suspension parameters such as camber gain, castor, wheelbase and toe change during different conditions were noted as design decision parameters and the geometry was optimized accordingly. The subsystem component design such as control arms and mountings were designed using CAD and simulated using FEA modelling on ANSYS simulation software. The resulting structural deformation and dynamic stability were chosen as design decision parameters. The manufacturing process was aided by use of jigs and fixtures to eliminate error.

https://www.tj.kyushu-u.ac.jp/evergreen/contents/EG2023-10_1_content/pdf/p463-468.pdf

Suspension and Steering Setup for a 4-wheel All-terrain Vehicle

Ramakant Rana

EVERGREEN Joint Journal of Novel Carbon Resource Sciences & Green Asia Strategy

Suspension and steering are subsystems to any automobile which determine how the vehicle dynamically behaves with driver's and terrain's combines input and output as response of the vehicle deciding direction, stability and ride, roll characteristics which were used in this study to obtain optimum lap times. The roll cage acts as a skeleton to the body and the suspension system as the limbs trying to maintain stability and safety in the cockpit. This study is based on BAJA SAE rulebook constraints. An iterative process is adopted to finalize suspension parameters followed by ride and roll calculations and suspension geometry selection. The entire setup is simulated using lotus shark suspension analysis and MSC Adams car multibody dynamics suspension testing in various simulations and loading conditions. The change in suspension parameters such as camber gain, castor, wheelbase and toe change during different conditions were noted as design decision parameters and the geometry was optimized accordingly. The subsystem component design such as control arms and mountings were designed using CAD and simulated using FEA modelling on ANSYS simulation software. The resulting structural deformation and dynamic stability were chosen as design decision parameters. The manufacturing process was aided by use of jigs and fixtures to eliminate error.

https://www.tj.kyushu-u.ac.jp/evergreen/contents/EG2023-10_1_content/pdf/p463-468.pdf

A brief review on various effects of surface texturing using lasers on the tool inserts

Ramakant Rana

Materials Today: Proceedings

This research is extensive work done in attaining knowledge gained by the various researchers in the field of surface texturing on CNC tool inserts. Here in this research, we have reviewed the literature on the effects of the application of Surfaces Laser texturing on the CNC tool inserts. In these times where researchers and scientists are developing new materials, industries are more focused on producing the products at a rapid rate while in the machining process and with less idle time. The laser texturing has been proving the better options when it comes to the better and longer tool life along with the lower tool wear. In this paper, we have tried to gather most of the research related to the effects on the tool life and tool wear affected by the laser texturing on the tool surfaces. We have also discussed the parameters of the laser texturing on the CNC tool inserts.

https://doi.org/10.1016/j.matpr.2022.01.272

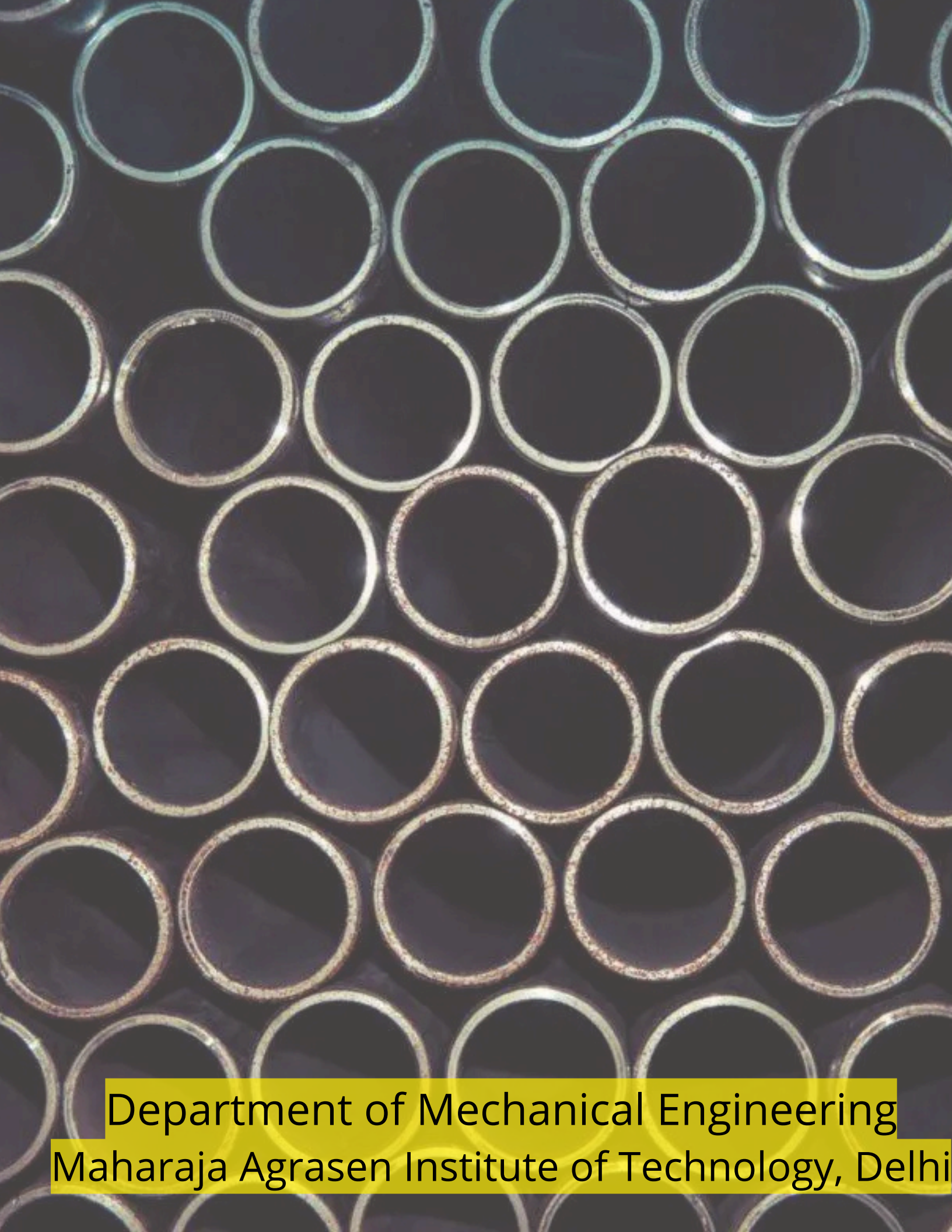
Microstructural assessment of friction stir joined AA6063/10.5%SiC Al-matrix composite

Sachin Gupta

Materials Today: Proceedings

This study analyses the microstructural characteristics of an AA6063/SiC matrix composite that was FS welded through the green welding technology known as FSW. By using the stir casting method, AA6063/10.5 wt% SiC aluminum matrix composite was created. From the constructed composite matrix, specimen plates with a 6 mm thickness were cut and friction stir welded satisfactorily. Using a tool with a transverse velocity of 110 mm/min and a rotational rate of 1100 rpm, FSW was carried out. AISI H13 tool steel was used as tool material and a square pin-shaped tool was manufactured to carry out the FSW. The interfacial test confirmed that FSW generated a considerable drop in the size of reinforced agents and their uniform allocation in the stir region when assessed to the base metal reinforced matrix. The hardening precipitates' development, dissolution, and reprecipitation were all affected by the heat produced during FSW. Enhanced microstructural and mechanical properties were obtained due to the equiaxed well granule configuration and homogenous allocation of SiC constituent parts in the weld zone. The EDAX analysis was carried out to confirm the presence of any silicon oxide segment in the stir zone. The peaks as observed in the EDAX test confirmed that no new chemical constituent part has been formed due to the abrasion heat developed in FSW.

https://doi.org/10.1016/j.matpr.2022.12.083



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