The 6TH International Conference On Mechanical Engineering

Organized by Dept. of Mechanical Engineering, Institut Teknologi Sepuluh Nopember

ICOME2023

"Innovation in Mechanical Engineering for Smart and Green Technology"

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BOOK OF ABSTRACTS

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The 6th International Conference on Mechanical Engineering

ICOME 2023

The committee would like to welcome you to the 6th International Conference on Mechanical Engineering (ICOME 2023). This event is hosted by Department of Mechanical Engineering, Faculty of Industrial Technology and System Engineering Institut Teknologi Sepuluh Nopember, and Department of Mechanical Engineering, Udayana University, Indonesia. ICOME 2023, which is held hybrid on August 30th - 31st, with a theme of "Innovation in Mechanical Engineering for Smart and Green Technology". It aims to bring together international researchers, industrial professionals, and students from the broad range of disciplines related to mechanical engineering and sciences. The intimate, collegial, and stimulating ambience provided through ICOME is the perfect environment for you to discuss the current trends in mechanical science and engineering related fields.

It is our pleasure to present this Participant Guidebook. This book includes the conference schedule, keynote speaker, invited speaker, detail of parallel sessions and abstracts.

On behalf of the committee, we would like to thank you for your active contributions to share your findings through this conference. We would like to express our gratitude to the reviewers for their dedications, comments, and suggestions hence the accepted papers have met the international journal standard. Eventually, we gratefully acknowledge the committee members, individuals, and sponsors for their support in ICOME 2023.

We sincerely wish for your research and knowledge to be enriched.

Sincereley Yours,

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Prof. Siew Hwa CHAN

Professor Siew Hwa CHAN is a Fellow of Academy of Engineering, Singapore, a Fellow of ASEAN Academy of Engineering and Technology and President's Chair in Energy. He obtained his PhD from Imperial College London and is a Professor in the School of Mechanical & Aerospace Engineering. He leads the hydrogen and fuel cell research in Nanyang Technological University. Dr Chan is one of the founding members and a Co-Director of the Energy Research Institute @ NTU (ERI@N). He is also the Senior Vice President in charge of Research and Innovation at China-Singapore International Joint Research Institute in China-Singapore Guangzhou Knowledge City, China. Prof Chan was a Director of Maz Energy Pte Ltd (Nitroparaffin-based fuel additives company) and a Founder and Director Xin Xiang (Guangzhou) Hydrogen Technologies Co., Ltd. (A fuel cell company manufacturing key components for PEMFC). He was a consultant to Total SA and had served as a member of Advisory Board to NTU President and Provost, Management Board of Energy Studies Institute, Advisory Board of Horizon Fuel Cell Technologies, member of China-Singapore Guangzhou Knowledge City Think Tank, Governing Board member of Centre for Hydrogen Innovation, member of Future Energy Technology Watch Group (Ministry of Trade and Industry, Singapore), Technology and Technical Advisor to Sydrogen Energy, and Chairman of Ammonia Handling Technical Advisory Group (A*Star), etc. He is also the focal point for ASEAN COSTI (Committee on Science, Technology, and Innovation) Sub-Committee on Sustainable Energy Research. ASEAN COSTI is a sectoral body under the ASEAN Economic Community (AEC) led by Minister for Trade & Industry.

Prof. Dr.-Ing. Jean Rom Rabe

Prof. Dr. Ing Rom Rabe is a Professor of Marine Engineering and Operation, Hocshcule Wismar, University of Applied Science. He obtained his PhD degree from Rostock University. He has a lot of experience in the field of Mechanical Engineering, Process Engineering, Thermal Engineering and Ship Technology. After he completed his postgraduate study, he became an Engineer at MAN B & W Diesel AG Augsburg. He was also a scientist at Lehrstuhl für Kolbenmaschinen und Verbrennungsmotoren (LKV), Lehrstuhl für Kolbenmaschinen und Verbrennungsmotoren. He was involved in large engines as the team leader at Forschungszentrum für Verbrennungsmotoren und Thermodynamik Rostock GmbH (FVRT GmbH). He was appointed as a Professor of Ship Technology/Ship Operation at Ship Technology/Ship Operation. Since 2014, he has been a regular guest lecture at Institut Teknologi Sepuluh Nopember.

Prof. Dr. Harus Laksana Guntur, S.T., M.Eng.

Prof. Harus Laksana Guntur is Professor at The Department of Mechanical Engineering, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia. He graduated his Bachelor of Engineering (B.Eng) from the Dept. of Mechanical Engineering, Institut Teknologi Sepuluh Nopember. He graduated his Master of Engineering (M.Eng) & Doctor of Engineering (Dr.Eng) from Precision and Intelligence Dept., Tokyo Institute of Technology (TITECH), Japan. His research interests include vibration energy recovery, vibration absorber, vibration isolation, system dynamics and vehicle dynamics.

Invited Speakers

Dr. M.V. Reddy	Energy Storage Technology at NouveauMonde Graphite, Canada	Energy Storage Technology and Sustainability
Asst. Prof. Ivan Tolj	Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture	Energy System
Mohan Lal Kolhe	Faculty of Engineering and Science, University of Agder, Kristiansand, Norway	Smart Grid and Renewable Energy

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Our core business is the supply of electricity, especially in generation, transmission and distribution. Obtaining the task of electrifying all over the archipelago, PLN has the obligation to increase installed capacity for power supply and the development of electricity infrastructure such as transmission networks, substations, and distribution networks. At all times, we continue to improve ourselves and improve services, considering that electricity is a basic infrastructure need that will create a multiplier effect for the progress of the Indonesian economy.

Our business continues to expand into various business sectors through subsidiaries, associated entities, joint ventures, and special purpose vehicles (SPV) under the auspices of the PLN Group. Through the implementation of SOLID (Securing Business Sustainability, Optimizing Cost Efficiency, Leading Industry Capabilities, Increasing Profit Contribution and Developing New Edge) business portfolios, we will continue to develop services to become a World Class Electricity Company.

6th INTERNATIONAL CONFERENCE ON MECHANICAL ENGINEERING 2023 (ICOME)

30-31 August 2023

Wednesday, August 30, 2023	
Time (Wita)	**Description**
08.30 - 09.00	Participant registration
09.00 – 09.40	Opening Ceremony Entertainment (Dance performance) Speech: General chair of ICOME 2023 Head of Mechanical Eng. Department Rector of ITS
09.40 – 10.00	Break
10.00 – 10.40	Keynote Speech I Prof. Dr. Siew Hwa Chan Moderator: Prof. Prabowo
10.40 – 11.20	Keynote Speech II Prof. Dr-Ing. Jean Rom Rabe Moderator: Dr. Suwarno
11.20 – 12.00	Keynote Speech III Prof. Harus Laksana Guntur Moderator: Moch Solichin, M.T.
12.00 – 13.00	Break
13.00 – 14.30	Parallel Session I
14.30 – 14.45	Break
14.45 – 16.00	Parallel Session II

Thursday, August 31, 2023	
Time	**Description**
08.00 - 08.30	Participant registration
08.30 – 10.00	Parallel Session III
10.00 – 10.15	Break
10.15 – 12.30	Parallel Session IV
12.30 – 13.15	Lunch
13.15 – 15.45	Parallel Session V
15.45 – 16.00	Closing Ceremony

6th International Conference on Mechanical Engineering 2023 (ICOME)

Parallel Session Mapping

Date & Time	Parallel Session	Breakout room Name and Paper Number			
		ROOM A (TABANAN)	ROOM B (AMLAPURA)	ROOM C (BANGLI)	ROOM D (Ballroom)
August, 30th 13.00– 14.30	1	11, 7, 10 19, 21, 25	22, 24, 28 29, 31, 32	83, 45, 46 66, 73, 74	27, 47, 49 50, 64, 67
August, 30th 14.45 – 16.00	2	139, 149, 151 87, 130	13, 20, 5 33, 34	26, 90, 106 131, 137	94, 95, 96 88, 82,
August, 31st 08.30 – 10.15	3	114, 127, 132 150, 2, 39	78, 79, 91	3, 8, 14	84, 18, 23
August, 31st 10.15 – 12.30	4	157, 158, 159 163, 57, 68 72, 103, 99	110, 111, 36 41, 44, 58 60, 63, 65	101, 38, 40 42, 53, 55 69, 89, 97	108, 113, 120 121, 6, 9 12, 15, 16
August, 31st 13.15 – 15.45	5	119, 43, 48 52, 54, 56 59, 62, 70, 71	112, 115, 118 124, 128, 134 135, 147, 75, 100	109, 116, 122 123, 160, 102 148, 162, 4, 81	133, 142, 146 153, 154, 155 156, 161, 125, 86

Wednesday, August 30th, 2023 – Parallel Session 1

TABANAN Room-A		Session-1	Title	OFFLINE
13.00 - 13.15	A1-EF01	11	Effect of pilot injection timing on performance and exhaust emissions of Diesel Dual Fuel engines (biodiesel-hydrogen)	**Atok Setiyawan (Moderator)**
13.15 - 13.30	A1-EF02	7	The role of circular cylinders in improving the performance of the Savonius wind turbine	Gusti Rusydi Furqon Syahrillah
13.30 - 13.45	A1-EF03	10	Design of Electric Vehicle Battery Cooling System with Phase Change Material (PCM)	I Made Arsawan
13.45 - 14.00	A1-EF04	19	Numerical Investigation on Drag and Lift of Hydrofoil Due to Homogenous Roughness	Imaniar Fitri Aisyah
14.00 - 14.15	A1-EF05	21	Energy Management For Hybrid Solar Vehicle	Alfauzan Yendra
14.15 - 14.30	A1-EF06	25	A Novel Method of Adaptive Headlight Technology Through Multi-Source and Multi-Lens Light Array Switching Settings	Ian Hardianto Siahaan

Wednesday, August 30th, 2023 – Parallel Session 2

TABANAN Room-A		Session-2	Title	OFFLINE
14.45 - 15.00	A2-EF01	139	The Economic Analysis of Using E2W for Ride-Hailing Riders as a Main Strategy for Reducing Greenhouse Gas Emissions from transportation sectors in Indonesia	**Yudha Saputra (Moderator)**
15.00 - 15.15	A2-EF02	149	Energy Baseline for Measurement and Verification in Energy Audit on an Oil and Gas Industry	Prapti Mahandari Cokorda
15.15 - 15.30	A2-EF03	151	Optimization of Biodiesel Production from Low-Quality Oil Under Mild Reaction Conditions Assisted by High Shear Mixing	Siti Zullaikah
15.30 - 15.45	A2-EF04	87	Numerical Study of Multi-stage Standing Wave Thermoacoustic Engine	Prastowo Murti
15.45 - 16.00	A2-EF05	130	Analysis of Motion and Energy Potential of the Vertical Axis Pendulum with Sector of Circle Type for the Prime Mover of Ocean Wave Power Generation System	Irfan Arief

Wednesday, August 30th, 2023 – Parallel Session 1

AMLAPURA Room-B		Session-1	Title	ONLINE
13.00 - 13.15	B1-EN01	22	Numerical Study of the Effect of Vortex Generator Located at the Near Wall-Body Junction on the Aerodynamic Characteristics of NASA LS-0417 Airfoil	**Sutardi (Moderator)**

13.15 - 13.30	B1-EN02	24	Reduce GHG's By Utilizing Biogas in Starch Industry	Ahmad Nahwani
13.30 - 13.45	B1-EN03	28	NUMERICAL STUDY OF TWIN ROTOR SAVONIUS HYDROKINETIC TURBINE ARRANGED IN SIDE-BY-SIDE WITH ADJACENT RETURNING BLADES IN A NARROW WATER CHANNEL	Audha Fitrah Aulina and Tri Yogi Yuwono
13.45 - 14.00	B1-EN04	29	BLADE PROFILE DESIGN OPTIMIZATION OF BACH TYPE SAVONIUS VERTICAL AXIS WIND TURBINE USING CUBIC SPLINE INTERPOLATION GRAPHIC METHOD	Vava Muhammad Risdhian and Vivien Suphandani Djanali
14.00 - 14.15	B1-EN05	31	Numerical Study of the Performance of Twin Co-Rotating Savonius Hydrokinetic Turbines Arranged Side by Side in a Narrow Channel	Dhia Fairuz Shabrina and Triyogi Yuwono
14.15 - 14.30	B1-EN06	32	Numerical Study of the Performance of Two Savonius Hydrokinetic Turbines With Unidirectional Rotation in Tandem Configuration	Lailatus Sadiyah Yuniar Arifianti and Tri Yogi Yuwono

Wednesday, August 30th, 2023 – Parallel Session 2

AMLAPURA Room-B	**Session-2**	**Title**	**ONLINE**
14.45 - 15.00	B2-EN01	13	The Performance Comparison Between Modelled and Fully Simulated Porous Media in Turbine Blade Cooling	**Farida Purnadiana (Moderator)**
15.00 - 15.15	B2-EN02	20	Numerical Study of the Performance of Twin Savonius Hydrokinetic Turbines with Adjacent Advancing Blades in a Side-by-Side Configuration Placed in a Narrow Channel	Anisah Nurul Izzah
15.15 - 15.30	B2-EN03	5	Simulation and Modeling of Internal Combustion Engine for Control Algorithms in Chevrolet Tavera Electric Vehicle Traction System Powertrain	Sunardi Sunardi
15.30 - 15.45	B2-EN04	33	Numerical Study Of The Effect of The Upstream Installation of The D-Type Cylinders On The Performance Of The Savonius Wind Turbine	Kunti Dhiwaniati Sudda
15.45 - 16.00	B2-EN05	34	COMBUSTION CHARACTERISTICS IN DIESEL ENGINES DUAL FUEL SYSTEM WITH BIODIESEL FUEL AND HYDROGEN GAS AT THE MEDIUM LOAD	Khoirul Anwar

Wednesday, August 30th, 2023 – Parallel Session 1

BANGLI Room-C		Session-1	Title	OFFLINE
13.00 - 13.15	C1-EF01	83	Studies the effect of Triton X on the textural properties of PVA-based electrospun nanofibers	**Ika Dewi Wijayanti (Moderator)**
13.15 - 13.30	C1-EF02	45	Carbon Capture and Utilization Technology to Upgrading Biogas Using Bubble Column Reactor: Effect of Concentration of Ca(OH)2 Solution on CO2 Removal	Mayongga Heriz Febrada
13.30 - 13.45	C1-EF03	46	Study of Mechanical Properties with Additional Nano Tio2 on Jute Fiber Epoxy Composite	Sugiarti Ni Wayan
13.45 - 14.00	C1-EF04	66	Effect of Plastic Deformation Percentage Variations in SMAW Welding of AISI 1020 Steel on Microstructure and Mechanical Properties	Rais Fathur Rahman
14.00 - 14.15	C1-EF05	73	EXPERIMENTAL STUDY FOR MECHANICAL PROPERTIES OF THE EPOXY HYBRID COMPOSITE RAINFORCED BY FIBERGLASS AND BAMBOO BLADES AS THE ALTERNATIVE 10GT CATAMARAN BOAT	Muhammad Arsy Robi Ferdian and Alief Wikarta
14.15 - 14.30	C1-EF06	74	Rice Bran Protein Extraction with Microwave-Assisted Extraction (MAE) as Wall Material for γ-Oryzanol Encapsulation	Cholisah Cindy Rachmania and Siti Zullaikah

Wednesday, August 30th, 2023 – Parallel Session 2

BANGLI Room-C		Session-2	Title	OFFLINE
14.45 - 15.00	C2-EF01	26	Colloidal ZnO- Prepared Using Ethanol as Solvent in its Future Application to Produce ZnO-SiO2 Nanoparticles Using Electrospray Method	**Nurdiana Ratna Puri (Moderator)**
15.00 - 15.15	C2-EF02	90	The Effect of Temperature and Artificial Aging Time on The Hardness and Crystal Structure of The Shape Memory Alloy Cu0,83 Al0,14 Zn0,03	Budiarto Budiarto
15.15 - 15.30	C2-EF03	106	Steam Erosion Failure on ASTM A210 Grade A1 Waterwall Tube of Subcritical Boiler	Heny Andya
15.30 - 15.45	C2-EF04	131	Abrasion Failure on ASTM A213 T12 Bottom Slope Tube of Supercritical Boiler	Heny Andya
15.45 - 16.00	C2-EF05	137	Failure Behavior of Improved Honeycomb Sandwich Inserts by Replacing Potting Mass with Carbon Fiber Layer	Ismail Maydiyanto and Alief Wikarta

Wednesday, August 30th, 2023 – Parallel Session 1

BALLROOM Room-D		Session-1	Title	OFFLINE
13.00 - 13.15	D1-MF01	27	Optimization Of Electric-Bike'S Frame Using Topology Optimization, Back Propagation Neural Network And Genetic Algorithm	**Mohammad Khoirul Effendi (Moderator)**
13.15 - 13.30	D1-MF02	47	Optimization of PID Control Parameters in Quarter Vehicle Model Active Suspension System using Back Propagation Neural Network and Genetic Algorithm Methods	Mohammad Khoirul Effendi
13.30 - 13.45	D1-MF03	49	Development of a Wireless Vibration Monitoring System and Its Mobile Notification based on Low-Cost Devices	Muhamad Aditya Royandi
13.45 - 14.00	D1-MF04	50	Development of Flank Wear and Surface Roughness Prognosis System in Lathe Machine Based on an Affordable Monitoring System	Muhamad Aditya Royandi
14.00 - 14.15	D1-MF05	64	Remaining Useful Lifetime Prediction of Lithium-Ion NMC 18650 Battery Cells Using Support Vector Machine	Andira Rahman Imani and Alief Wikarta
14.15 - 14.30	D1-MF06	67	Simulation And Strength Analysis Of The Single Attachable Connector For Electric Scooter With Wheelchair Using Finite Element Method	Agam Wiranata Trisnakusuma and Alief Wikarta

Wednesday, August 30th, 2023 – Parallel Session 2

BALLROOM Room-D		Session-2	Title	OFFLINE
14.45 - 15.00	D2-MF01	94	Analysis of Boring Bar Vibration Response Reduction Due to the Effect of Internal Damper Addition with Variation in Diameter of Damper and Cutting Parameters in the Machining Process	**Moch. Solichin (Moderator)**
15.00 - 15.15	D2-MF02	95	Optimization of Stiffness and Damping Coefficient Using Genetic Algorithm In An Electric Bus With Air Suspension System	Cony Nurlita
15.15 - 15.30	D2-MF03	96	Cutting Speed Recommendation Based on Cutting Tool Orthogonal Force in Transverse Cutting of Lathe Machine: Simulation Approach	Muhamad Aditya Royandi
15.30 - 15.45	D2-MF04	88	Numerical Modeling of a Single Panel Slab-Track with Steel Fiber and Polypropylene Fiber Reinforced Concrete	Ardyan Ezardika
15.45 - 16.00	D2-MF05	82	Finite Element Modeling of the Steel Fiber Reinforced Concrete Notched Beam with DRAMIX 3D 65/35	Akbar Kalam Ramzy

Thursday, August 31st, 2023 – Parallel Session 3

TABANAN Room-A	Session-3		Title	ONLINE
08.30 - 08.45			**Invited speaker & moderator: Prof. Mohan Lal Kolhe**	
08.45 - 09.00	A3-MN01	114	The Effect of Concentration of Clove Flower Extract Inhibitor and Fluid Flow Velocity on the Corrosivity of API 5L Grade B Steel in an H2SO4 Environment	Tubagus Noor Rohmannudin
09.00 - 09.15	A3-MN02	127	Failure Analysis of Superheater Drain Tube in Heat Recovery Steam Generator	Helena Carolina Kis Agustin
09.15 - 09.30	A3-MN03	132	Mechanical properties and corrosion rate of friction stir Mg-alloys AZ31B-H24 welded joints produced using a triangle pin at different tool rotation speeds	Muji Prihajatno
09.30 - 09.45	A3-MN04	150	Influence of Additives on Physical and Mechanical Properties of Rapeseed Oil Polyol Based Rigid Polyurethane Foam as Artificial Bone Model	Prandhito Hasri Mirhendy
09.45 - 10.00	A3-MN05	2	THE TENSILE STRESS ENHANCEMENT OF CORNER-LAP JOINT 450 (C-L45) USING FRICTION STIR WELDING	Felixtianus Winarto
10.00 - 10.15	A3-MN06	39	Mold Design of Helmet Shell from Biocomposite Banana Fiber and Polypropylene	M. Jauharul Wafi T. and I Made Londen Batan

Thursday, August 31st, 2023 – Parallel Session 4

TABANAN Room-A	Session-4		Title	ONLINE
10.15 - 10.30	A4-MN01	157	Analysis of the Effect of Anodizing Time on the Anodizing Layer Thickness of Aluminum 5052	**Atria Pradityana Moderator)**
10.30 - 10.45	A4-MN02	158	Analysis of the Effect of Temperature and Anodizing Time on the Coating Thickness in Anodizing Process of Aluminium 6061	Muhammad Lukman Hakim
10.45 - 11.00	A4-MN03	159	Analysis The Effect of Welding Current on Welding Results Using Radiography Test	Atria Pradityana
11.00 - 11.15	A4-MN04	163	FDM 3D Printer Parametric Process Optimization Of Creality Ender 3 3D Printer For Dimensional Accuracy Printing Quality Using PLA+ (Polylactid Acid) Material	Faris Ahmad Mizanus Sabri
11.15 - 11.30	A4-MN05	57	Fabrication Of Superhydrophobic Coating Using Stearic Acid Doped With Zinc Oxide On SS400 Steel Strips Substrate	I Wayan Padma Yogi Asana and Fahmi Mubarok

11.30 - 11.45	A4-MN06	68	The Analysis of CO2 Pressure and Welding Speed Effect on in AISI 1045 MIG welding	Suheni Suheni
11.45 - 12.00	A4-MN07	72	Effect of Welding Time on Microstructure and Mechanical Properties of Rotary Friction Weld Joints of AA6061	Lyoni Fransisca Malau
12.15 - 12.15	A4-MN08	103	Study of Bajakah Tampala (Spatholobus littoralis Hassk) Extract as Green Corrosion Inhibitor for Carbon Steel API 5L Grade B in 3.5% NaCl Solution	Andhika Prasetya Ramadhani
12.15 - 12.30	A4-DN09	99	Prediction of the Cutting Forces of Face Milling Process on JIS SKD 11 Tool Steel Material with Cryogenic Cooling using Fuzzy Inference System	Chezta Ahmad Muzakky

Thursday, August 31st, 2023 – Parallel Session 5

TABANAN Room-A	**Session-5**		**Title**	**OFFLINE**
13.15 - 13.30	A5-EF01	119	Numerical Study of the Effect of Economizer Hopper Shape on the Number of Fly Ash Particles that can be Captured in the Flue Gas System	**Bambang Arip Dwiyantoro (Moderator)**
13.30 - 13.45	A5-EF02	43	Utilization of palm oil empty fruit bunch as co-firing fuel with water and acid washing pretreatment	Hanafi Prida Putra
13.45 - 14.00	A5-EF03	48	Experimental Study on Cow Manure: From Outhouse into House	Victoriano Lendeng
14.00 - 14.15	A5-EF04	52	Thermal Characteristics of Coal Co-Combustion with Empty Fruit Bunch and Fronds Blends by Thermogravimetric Analysis	Moch Zulfikar Eka Prayoga
14.15 - 14.30	A5-EF05	54	Battery Pack Cooling Phenomenon at Varied Air Cooling Temperature using Computational Fluid Dynamics	Suci Madhania
14.30 - 14.45	A5-EF06	56	Wooden Fishing Vessels Performance due to Biofouling Invasion	Ronald Hutauruk
14.45 - 15.00	A5-EF07	59	PV Stand-Alone System with Hybrid Lithium-Ion Battery and Hydrogen Storage in Derawan Island	Sawungsari Nur Farisah and Vita Lystianingrum
15.00 - 15.15	A5-EF08	62	Scale-up of Bubble Column Reactor for Carbon Mineralization with Precipitated Ca(CO)3 Product	Suci Madhania
15.15 - 15.30	A5-EF09	70	Analysis of the Steam Pressure Prediction on Steamflood Process Using NARX Model	Farah Shabira
15.30 - 15.45	A5-EF10	71	The Effectiveness of Using Circular Turbulator in Square Elbow 900 with Reynolds Number Variation	Randi Purnama Putra

Thursday, August 31st, 2023 – Parallel Session 3

AMLAPURA Room-B	Session-3		Title	ONLINE
08.30 - 08.45			**Invited speaker & moderator: Prof. Ivan Tolj**	
08.45 - 09.00	B3-EN01	78	Numerical Investigation Of The Efficacy Of Downward Push-Pull Air Curtain For Protecting Standing Shop-Floor Worker From Virus Transmission Through Coughing Droplets	Burniadi Moballa
09.00 - 09.15	B3-EN02	79	Experimental Study of the Influence of the Upstream Installation of The I-Type Cylinder on the Performance of The Savonius Wind Turbine	Ergo Swasono Kromodiharjo
09.15 - 09.30	B3-EN03	91	Investigation of Heat Exchanger effectiveness using Solar Water Heater	Apurv Yadav
09.30 - 09.45	B3-EN04	93	Convective Heat Transfer Performance on Various Straight Fin Configurations	Muhammad Aulia Rahman
09.45 - 10.00	B3-EN05	105	Hydrothermal Technology Processing of Municipal Solid Waste to Coal Equivalent Solid Fuel for Indonesian Power Generation	Muhammad Kamal Wisyaldin
10.00 - 10.15	B3-EN06	107	Exploring the Impact of Relative Humidity on Cough Droplet Evaporation and Dispersion in Confined Environments: A CFD Analysis	Luthfi Hakim

Thursday, August 31st, 2023 – Parallel Session 4

AMLAPURA Room-B	Session-4		Title	ONLINE
10.15 - 10.30	B4-EN01	110	Numerical Study of Intake Manifold Length Effect on Air and Fluid Flow Pattern on a 125 cc SOHC Engine	**Giri Nugroho (Moderator)**
10.30 - 10.45	B4-EN02	111	Development of a Real-Time Monitoring and Power Prediction System for Solar Power Plants Using Machine Learning	Ridho Hantoro
10.45 - 11.00	B4-EN03	36	Numerical Study of the Performance of Two Savonius Hydrokinetic Turbines with Opposite Rotation in Tandem Configuration	Ryan Effendi
11.00 - 11.15	B4-EN04	41	Numerical Analysis of Cooling Design for Photovoltaic Performance Optimization	Sandi Saputra
11.15 - 11.30	B4-EN05	44	Effect of Installation of an Ellipse Cylinder Beside The Advancing Blade on The Performance of The Savonius Wind Turbine	Intan Rahmahwati
11.30 - 11.45	B4-EN06	58	Enhancement of Energy and Power Model for Electric Hybrid VTOL UAV with Flight Test Data	Willardi Aji Pradana
11.45 - 12.00	B4-EN07	60	Effect of Distance on Multistage Runner Gravitational Vortex Water Turbine (GVWT)	Qori'Atul Khasanah
12.15 - 12.15	B4-EN08	63	Impeller Design and Slurry Pump Selection on Cutter Suction Dredger Project	Muhammad Rozaq

12.15 - 12.30	B4-EN09	65	Numerical Simulation on the Last-Stage Low-Pressure Turbine with and without Lacing Wire	Thearith Yone

Thursday, August 31st, 2023 – Parallel Session 5

AMLAPURA Room-B		**Session-5**		**ONLINE**
13.15 - 13.30	B5-EN01	112	Numerical Study on The Effect of Modification Internally Cooling Passages of NASA C3X Turbine Blade	**Is Bunyamin Suryo (Moderator)**
13.30 - 13.45	B5-EN02	115	Indonesia Carbon Cap and Tax Analysis on 60 MW Class Pulverized Coal Boiler Coal-Fired Power Plant Decarbonization Initiative: Biomass (Sawdust) Cofiring Application	Alfian Muhammad Reza
13.45 - 14.00	B5-EN03	118	Design of Linkage Guide Vane to Control Water Flow in a 6-Blade Kaplan Turbine Runner	Sirojuddin Sirojuddin
14.00 - 14.15	B5-EN04	124	Techno-Economic Analysis for Green Hydrogen Production in Gresik District	Naurah Ranaindy and Suwarno Suwarno
14.15 - 14.30	B5-EN05	128	The Effect of Hydrodynamic Wave Load on 5 MW Semisubmersible Floating Offshore Wind Turbine	Mujadid Aldin Albasyir
14.30 - 14.45	B5-EN06	134	Composite Multi-Criteria Decision Analysis for Optimization of Hybrid Renewable Energy Systems: IKN-Nusantara as a Case Study	Hendro Nurhadi and Angga Panji Kesuma
14.45 - 15.00	B5-EN07	135	Near Endwall Three-Dimensional Flow Control of NASA LS-0417 Airfoil using Co-Rotating Vortex Generator	Sutardi Sutardi and Joshua Clarence Sean
15.00 - 15.15	B5-EN08	147	The Shear Layer of D-65° Type bluff body in Effect of Main Cylinder as passive control flow Modification: A Numerical Analysis	Gunawan Sakti
15.15 - 15.30	B5-EN09	75	Design of Floating Tidal Energy Converter 1	Odie Zainal Makhali
15.30 - 15.45	B5-DN10	100	Surface Roughness Prediction in End Milling with Cooling Liquid Nitrogen on AISI D2 Tool Steel Material using Fuzzy Inference System	Muhammad Fiky Izzulhaq

Thursday, August 31st, 2023 – Parallel Session 3

BANGLI Room-C		**Session-3**	**Title**	**ONLINE**
08.30 - 08.45		**Invited speaker & moderator: Dr. Reddy**		
08.45 - 09.00	C3-DN01	3	Tool Life Simulation on Hot Forging Process for Femoral Stem of Hip Arthroplasty	Dinny Harnany

09.00 - 09.15	C3-DN02	8	Improving Rice Harvesting Efficiency: Design and Evaluation of Ripper Type Rice Harvesters	Arthur Halik Razak
09.15 - 09.30	C3-DN03	14	Isotropic Body-Centered Cubic (BCC) Lattice Structure Design	Ahmad Anas Arifin
09.30 - 09.45	C3-DN04	17	STRENGTH ANALYSIS OF MEVITS (MULTI-PURPOSE ELECTRIC VEHICLE ITS) CHASSIS LADDER FRAME TYPE DUE TO STATIC AND DYNAMIC LOADS ON LIFE FATIGUE	Harys Herawan
09.45 - 10.00	C3-DN05	30	PID Control for Radial Active Magnetic Bearings	Rizqa Ruviana
10.00 - 10.15	C3-DN06	1	Plastic Injection Tool for Cone Chain Production Using Bottle Waste: Design-ing and Manufacturing	Ahmad Zubair Sultan

Thursday, August 31st, 2023 – Parallel Session 4

BANGLI Room-C	**Session-4**		**Title**	**ONLINE**
10.15 - 10.30	C4-DN01	101	The Effect of Adding Cone Rubber-Mass Dynamic Vibration Absorber to Boring Bar on Reduction of Vibration Response in Machinery Process (Lathe Machine)	**Wiwiek Hendrowati (Moderator)**
10.30 - 10.45	C4-DN02	38	Optimization of Tensile and Impact Strength on Injection Molding Process Parameters of Biocomposite Material (Banana Fiber and Polypropylene) Using Taguchi Grey Fuzzy Method	Rahmat Basya Shahrys Tsany
10.45 - 11.00	C4-DN03	40	DESIGN OF A MULTIFUNCTIONAL STATIONARY BIKE FOR STROKE THERAPY AND PUBLIC TRANSPORTATION	Sihmaulana Dwianto
11.00 - 11.15	C4-DN04	42	Model-Based Systems Engineering Applicability Study for Indonesian Technology Industry	Muhammad Fikri Zulkarnain
11.15 - 11.30	C4-DN05	53	Modeling and Analysis of MEvITS Electric Vehicle Spaceframe Chassis	Fairuz Disya
11.30 - 11.45	C4-DN06	55	Improvement of Durability in Leaf Springs through Chamber Clearance Modification for Medium Duty Truck	Primastika Akbar Kharisma
11.45 - 12.00	C4-DN07	69	Numerical Simulation on the Effect of Tip Clearance on the Last Stage Low Pressure Steam Turbine	Vuthy Lim
12.15 - 12.15	C4-DN08	89	RESEARCH ON THE EFFECT OF FORD EVEREST BRASS RESULTS WHEN RUNING ON CLASS C ISO 8608:2016	Le Minh
12.15 - 12.30	C4-DN09	97	ARTIFICIAL NEURAL NETWORK MODELLING FOR AISI 4340 SURFACE ROUGHNESS ANALYSIS	Cindy Hartita

Thursday, August 31st, 2023 – Parallel Session 5

BANGLI Room-C	Session-5		Title	ONLINE/ OFFLINE
13.15 - 13.30	C5-DN01	109	Design and Analysis of PID Control Systems for Motion Control in Unmanned Autonomous Forklift	**Hendro Nurhadi (Moderator)**
13.30 - 13.45	C5-DN02	116	Prediction of the Frictional Coefficient in Surface Grinding of ASSAB 8407 Tool Steels with Dry and Minimum Quantity Lubricant (MQL) Teqniques using Fuzzy Inference System	Heri Febrian
13.45 - 14.00	C5-DN03	122	Study of Modal Frequency in New Tuned Mass Damper System with Plate Spring	Ardi Noerpamoengkas
14.00 - 14.15	C5-DN04	123	Design Optimization of the Proximal Phalanx Thumb Exoskeleton for Patients Post-Stroke Attack	Rika Qoryah
14.15 - 14.30	C5-DN05	160	MODERN CUTTING OF GLASS PLATE USING HOT AIR ABRASIVE JET MACHINING	Srajendra Prasad
14.30 - 14.45	C5-DN06	102	Surface Roughness Prediction of Turning Process on KRUPP-2344 Steel Material Using Fuzzy Inference System	Sabil Sabil
14.45 - 15.00	C5-EF01	148	The Relation Between the Tensile Strength of Ramie (Boehmeria Nivea) Yarn and Its Gauge Length	**Putu Suwarta (Moderator)**
15.00 - 15.15	C5-EF02	162	Electrochemical corrosion study on stainless steel used for low-pressure steam turbine blades	Handi Muhtadi
15.15 - 15.30	C5-EF03	4	Composite Nfrp (Natural Fiber Reinforced Plastic) Cane Dregs Fiber With 5% NaOH Delignification Treatment Using Compression Molding Techniques In Wind Turbine Blades Applications	Muhammad Nurhidayatur Rozikin
15.30 - 15.45	C5-EF04	81	Wedged Gurney Flap for Performance Improvement of Vertical Axis Wind Turbines	Taurista Perdana Syawitri

Thursday, August 31st, 2023 – Parallel Session 3

Ball Room Room-D	Session-3		Title	OFFLINE
08.30 - 08.45	D3-MF01	84	Modeling and Control of Reaction Wheel Pendulum with Feedback Linearization and LQR Control	**Unggul Wasiwitono (Moderator)**
08.45 - 09.00	D3-MF02	18	The Effect of Various Structure Mass to the Dynamic Response and User Convenience in 3D Printed Articulated and Non-Articulated Ankle Foot Orthosis	Novita Nur Wulandari

09.00 - 09.15	D3-MF03	23	Design of Toilet Pressure Control System Based on PLC for Train Carriages Implementation	Manuntun Jaya Mulia Simangunsong
09.15 - 09.30	D3-MF04	76	Numerical Modeling of Polypropylene Fiber Reinforced Concrete Notched Beam	Pannadipa Putera Sukmajaya
09.30 - 09.45	D3-MF05	77	Experimental study of flat-plate collector integrated with Al-Foam+PCM Thermal Storage	Muhammad Basri Katjo
09.45 - 10.00	D3-MF06	80	Dynamic linear analysis of a resilient slab-track structure for high-speed railway system: Evaluation of the dynamic magnification factor	Sinta Nabilah Salma

Thursday, August 31st, 2023 – Parallel Session 4

Ball Room Room-D		**Session-4**	**Title**	**OFFLINE**
10.15 - 10.30	D4-MF01	108	Fuzzy PID Control for Parallel Friction Stir Welding Robot Manipulator	**Arif Wahjudi (Moderator)**
10.30 - 10.45	D4-MF02	113	Chassis Strength Analysis of a City Car with a Capacity of Two Passengers	Randi Purnama Putra
10.45 - 11.00	D4-MF03	120	Strength Analysis of Standing Wheelchair Frame Using Finite Element Method	Rizkhi Nurirawan and Alief Wikarta
11.00 - 11.15	D4-MF04	121	The effect of crossfeed variations on vibration and surface roughness for hardened tool steel SKD11 ground by surface grinding machine	Suhardjono Suhardjono
11.15 - 11.30	D4-MF05	6	STRESS ANALYSIS OF API 5L X80 PIPE WITH DENT DEFECT CAUSED BY INDENTER RIPPER BUCKET TEETH	Ricko Kusuma Putra and Rachmat Sriwijaya
11.30 - 11.45	D4-MF06	9	Green Hydrometallurgy Process of Iron using Organic Solutions (Citric and Glutamate) for Ferronickel's by products: Preliminary	Fathan Bahfie
11.45 - 12.00	D4-MF07	12	Evaluating Machine Learning Algorithm for Real-Time Heat Exchanger Optimization and Automatic Issue Detection Device: Experimental Analysis	Sagar Wankhede
12.15 - 12.15	D4-MF08	15	Preleminary Development the Optimum Dimension Estimator and 3D Engineering Drawing Generator of Archimedes Screw Turbine Shaft	Herman Budi Harja
12.15 - 12.30	D4-MF09	16	Experimental Study of anti friction Bearing Failure Based on characteristic of Machine Frequency Defect	Herman Budi Harja

Ball Room Room-D	Session-5		title	OFFLINE
13.15 - 13.30	D5-MF01	133	Tribological Performance Prediction using Random Forest Machine Learning for Water-Based Lubricants Formulated with Ionic Liquids	**Wahyu Wijanarko (Moderator)**
13.30 - 13.45	D5-MF02	142	Application of the Ulrich-Eppinger Method in Designing Crusher Modules in Hammer Mill Machines to Maximize Fineness of Coconut Shell and Palm Shell Powder Grinding	Mega Diana
13.45 - 14.00	D5-MF03	146	Simulation of Color Based Mixing using Koch-Fractal Passive Micromixer with Variation Types of Channels	Riona Ihsan Media
14.00 - 14.15	D5-MF04	153	Domestic Production of Dialysis Solution for Import Substitution	Siti Zullaikah
14.15 - 14.30	D5-MF05	154	Dynamic linear analysis of resilient slab-track structure for high-speed railway system: Effect of different subgrade condition	Danny Triputra Setiamanah
14.30 - 14.45	D5-MF06	155	The effect of the wing taper ratio and spar thickness to spar strength for a Medium Altitude Long Endurance UAV	Widyawasta and Alief Wikarta
14.45 - 15.00	D5-MF07	156	Static Structural Analysis of Sluice Plate Angle and Transmission System Revamp for Irrigation System in West Nusa Tenggara	Hafiz Gunawan and Alief Wikarta
15.00 - 15.15	D5-MF08	161	The remaining life assessment of the tube boiler after 35 years of operation	Suwarno Suwarno
15.15 - 15.30	D5-MF09	125	Finite Element Modeling of Milling Spindle Thermal Behavior with Variation of Bearing Preload	Tria Mariz Arief
15.30 - 15.45	D5-EF10	86	Quantitative and Qualitative Investigation of Condensate from the Air Handling Unit in a Central Air Conditioning	Kasni Sumeru

KEYNOTE SPEAKER

H2FC Research @ NTU and The Role of Turquoise Hydrogen in Renewable Energy Scarce Countries

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Abstract. This presentation will first briefly introduce Nanyang Technological University (NTU), then a brief history of the hydrogen and fuel cell's research, development and demonstration activities in Singapore, and the alignment of current research activities at NTU towards Singapore's National Hydrogen Strategy. Low-carbon hydrogen will be the focus, in particular the turquoise hydrogen produced from methane, which is a main ingredient of natural gas. Currently, steam methane reforming (SMR) is the most popular and cost-effective hydrogen production technology globally. However, the process emits significant amount of CO_2 that go against the carbon reduction intent. Carbon Capture and Sequestration (CCS) is not always implementable in country such as Singapore due to its geographical constraint. The alternative is to split methane (or natural gas) into turquoise hydrogen and solid carbon, producing no or negligible CO_2. The splitting process is either by direct thermal decomposition of methane or by catalytic decomposition of methane, generally known as methane cracking or methane pyrolysis. The speaker will share the importance of turquoise hydrogen in energy transition period, especially from the cost perspective, then various technologies for producing the turquoise hydrogen, their challenges, and opportunities.

Energy Efficieny and Renewable Energy Sources

Jean Rom Rabe[1]

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Abstract/Research profile. As a Professor of Marine Engineering, Professor Rabe research interest is in the operation of maritime technical systems – basically ships. There is a remarkable need in the transport sector to reduce greenhouse gas emissions (directly related to reducing the consumption of fossil fuels) as well as the necessity to avoid harmful exhaust gas emissions. There is a big potential besides the technical aspects (like alternative fuels, optimization of the combustion process as well as all technical processes aboard a ship), i.e., route-optimization and intelligent planning of transportation and logistics. These topics are the focus of the research in Professor Rabe's department. His idea is to use holistic approaches – based on a deep understanding of basic disciplines like thermodynamics and chemistry – combined with solid knowledge in process engineering and completed by intelligent control using modern automation- and diagnosis technology. His research activities are not limited to ship applications, but also in power plants and many complex systems on- and offshore. Because a ship is a compact model for many complex challenges such as power generation and energy conversion. For this reason, his knowledge – especially regarding alternative fuels, optimization of combustion processes, and the efficiency of complex technical systems - are used for instance to hold lectures also in renewable energy – study courses (as for ITS).

Zero Energy Loss Vehicle: Wasted Vibration Energy Recovery Technology in Vehicle

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Abstract. A research conducted by Zuo reported that only 10-15% of the fuel energy or electricity is used to drive the ve-hicle. The rest 85-90% of the energy is wasted into other form of energy, such as: heat energy, friction and vi- bration. Researchers have developed technologies to recover the wasted energy into electricity. Kinetic energy recovery system (KERS), regenerative brake system (RBS), regenerative shock absorber (RSA) and thermal energy recovery system (TERS) are several technologies which have been developed by researchers and car manufactures. The goal for the research is to improve the fuel efficiency. The concept of zero energy loss vehicle has been developed in the last decades, where all wasted energy are harvested and converted into electricity (usa-ble energy). The vibration energy potential in a vehicle has been researched: city car 100w-400w, bus/public transportation 200w-2kw, truck 1kw-10kw, military vehicle 800w-10kw, and train 5kw-6kw. We have developed several type of regenerative shock absorber, implemented in vehicle and tested its performance. They are: Hy-draulic based regenerative shock absorber, rack pinion type regenerative shock absorber, ball-screw mecha-nism regenerative shock absorber, multi input-single output hydraulic based regenerative shock absorber. When the wasted vibration energy in a vehicle can be converted into electricity (usable energy), the fuel effi-ciency can be improved significantly. The potential energy harvested from vehicle suspension has been investigated, up to 420 Watt with standard driving style. The potential fuel improvement efficiency is 2-3% for typical vehicle passenger, 3-5% for heavy duty vehicle, and more than 6% for military vehicle. The improvement fuel efficiency even higher for electric vehicle, up to 7-10%.

Keywords: *Zero energy loss vehicle, vibration energy recovery, regenerative suspension, vibration energy harvesting.*

INVITED SPEAKER

Water and Heat Management of Proton Exchange Membrane Fuel Cells

Ivan Tolj[1, a)], Željko Penga[1, b)] and Gojmir Radica[1, c)]

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Abstract. This study employs numerical analyses to assess thermal management's influence on a 1 kW edge-cooled proton exchange membrane fuel cell (PEMFC) stack, excluding external humidification. The research introduces a realtime transient computational fluid dynamics (CFD) model, providing rapid insights compared to experiments. The model investigates factors like bipolar plate materials, operating delta pressure, and cooling fin designs, revealing correlations between temperature and material conductivity, stack performance enhancement through pressure manipulation, and the pivotal role of cooling fin configurations. The study also examines heat transfer to a metal hydride tank. These findings contribute to optimizing thermal strategies for PEMFC stacks.

Comprehensive Review of Technical and Economic Considerations Influencing the Planning of Electric Vehicle Charging Stations

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Abstract. The global shift towards electric vehicles (EVs) has brought into focus the need for an efficient and strategically designed charging infrastructure. The optimal planning of electric vehicle charging stations presents a multifaceted challenge, involving intricate considerations such as electric vehicle traffic patterns, energy resource availabilities, and the limitations of distributed network capacities. This extended abstract delves into the technical complexities associated with the design and planning of EV fast charging station locations, aiming to highlight the crucial role of integrated solutions in overcoming these challenges. Electric Vehicle Traffic Patterns: The success of charging station deployment hinges on a profound understanding of EV traffic patterns. This entails analyzing commuting routes, travel behaviors, and usage frequency. By harnessing data-driven insights, planners can identify high-traffic corridors and pinpoint optimal charging station locations. However, the challenge lies in predicting demand variations over time, ensuring that stations cater to both daily commuters and long-distance travelers. Energy Resource Availabilities: Sustainable charging infrastructure necessitates the integration of renewable energy sources. Solar and wind power, for instance, offer clean energy inputs; yet, their intermittency poses a challenge. A comprehensive energy resource assessment is pivotal, aligning station locations with renewable energy potentials. Advanced energy storage solutions and smart microgrid management are crucial to store excess energy during peak production and dispense it during charging hours. Limitation of Distributed Network Capacities: While rapid charging stations are imperative for widespread EV adoption, they present a potential strain on the distributed electrical grid. The collective demand from multiple fast chargers can exceed local grid capacities, leading to voltage fluctuations and grid instability. This calls for collaboration with utility companies to assess grid limitations and devise load management strategies to prevent overloading, ensuring a harmonious coexistence of EV charging with existing infrastructure. Integrated Optimization Strategies: Addressing these challenges requires an integrated approach that combines technical, geographical, and energy-related aspects. Optimization algorithms, informed by real-time traffic data and energy availability forecasts, can assist in determining optimal charging station placements. These algorithms need to consider traffic patterns, energy resource potentials, and grid capacities simultaneously, striving for a balanced distribution of charging facilities. Conclusion: The optimal planning of electric vehicle charging stations is at the nexus of sustainable transportation and energy innovation. By acknowledging the complexities of electric vehicle traffic patterns, energy resource availabilities, and distributed network capacities, planners can chart a course for an integrated charging infrastructure. Collaboration among stakeholders, including policymakers, urban planners, energy providers, and technology experts, is crucial to overcoming these challenges. As the transportation landscape evolves, achieving an interconnected network of strategically positioned charging stations will be pivotal in accelerating the transition to electric mobility, thereby contributing to a cleaner and more sustainable future.

MATERIAL

Composite Nfrp (Natural Fiber Reinforced Plastic) Cane Dregs Fiber With 5% NaOH Delignification Treatment Using Compression MoldingTechniques in Wind Turbine Blades Applications

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Abstract, Indonesia's energy needs are increasing from time to time, this is due to the increasing population growth. The use of conventional energy derived from fossils still dominates as asource of energy used. Wind energy in Indonesia has considerable potential to be exploited.One of the important components in a wind turbine is the blade or blade. The knife serves tocatch the wind which is then forwarded to the generator. In making composites for this studyusing the compression molding method, this method is carried out using hydraulics as a press, the fibers that have been mixed with resin are inserted into the mold cavity, then pressing and heating. Then from the test results, it was found that for the absorption energy,the optimal value of impact strength, tensile strength, and tensile elastic modulus on the composite specimen with delignification treatment for 2 hours, where the absorbed energy was obtained 1.8 J and the impact strength value was 0.040. J / mm2, the value of tensile strength obtained is 7,700 MPa and the modulus of elasticity is 1287.03 MPa.

Keywords: Blade, composite, compression, epoxy, variation.

Carbon Capture and Utilization Technology to UpgradingBiogas Using Bubble Column Reactor: Effect of Concentration of $Ca(OH)_2$ Solution on CO_2 Removal

Mayongga Heriz[1)], Wanda Oktavia [1)], Kusdianto[1)], Suci Mahdania[1)], SitiMachmudah[1)], Mohammad Irwan Fatkhur Rozy[1)], Sugeng Winardi[1,a)]

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Abstract. The CO_2 content in biogas has several effects that need to be considered, such as affecting its calorific value or energy value. The higher the CO_2 content, the lower the heating value of the biogas. One way to absorb CO_2 is by carbonation using a solution of $Ca(OH)_2$ to become $CaCO_3$. Synthesis of $CaCO_3$ by carbonation to obtain high quality products is still being carried out in terms of phase, morphology and particle size. $Ca(OH)_2$ slurry was prepared with various concentrations, namely 0.05 M, 0.07 M, and 0.1 M. Scanning Electron Microscopy/Energy Dispersive Spectroscopy (SEM-EDS) and X-Ray Diffraction (XRD) test carried out to analyze the properties of $CaCO_3$. The Precipitated Calcium Carbonate (PCC) crystalline phase at all concentrations is all calcite with scalenohedral morphology. The difference in the concentration of $Ca(OH)_2$ has significance effect to CO_2 absorption and the morphology of PCC. The higher the concentration of $Ca(OH)_2$ slurry, the higher the percentage of CO_2 absorption in biogas, but with the effect of likely forming scalenohedral morphology that are commonly used in the paper industry to enhance opacity.

Keywords: CO_2 Reduction, Precipitated Calcium Carbonate, $Ca(OH)_2$ Concentration, Bubble Column, Absorption.

Study of Mechanical Properties with Additional Nano Tio2on Jute Fiber Epoxy Composite

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Abstract. This research is conducted to test the tensile strength and impact strength of jute-epoxy composites with the addition of nano TiO_2. Composite materials has manufactured using Vacuum Assisted Resin Transfer Moulding (VARTM) process. The ratio of reinforcement and matric have based on the weight fraction of 60% wt: 40%wt, with a total of 3 layers of jute fibres. The addition of nano TiO_2 content consists of three variations that 0.5 g, 1 g and 3 g. The process of mixing the matrix and nano TiO_2 is carried out using a stirrer which is stirred for 24 hours. Composites without the addition of nano TiO_2, were also produced as controls. Tensile testing was conducted based on ASTM D 638 standard at a head speed of 2 mm/min and a withdrawal load of 5 kN. The test results showed that the composite with the addition of 3 gr of nano TiO_2 was the best composite with tensile strength and elastic modulus of 57.418 MPa and 0.813 GPa. Meanwhile, impact testing was conducted based on ASTM D6110 with a pendulum weight of 13.17 kg, showing the test results of composites with the addition of 3 gr is a composite that is able to absorb the highest energy with an energy value of 0.36 Joule. It can be concluded that the addition of nano TiO2 greatly affects the tensile and impact strength of the composite material.

Effect of Plastic Deformation Percentage Variations in SMAW Welding of AISI 1020 Steel on Microstructure andMechanical Properties

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Abstract. This study aims to determine the effect of SMAW (Shielded Metal Arc Welding) welding on AISI 1020 steel with variations in the proportion of plastic deformation of 0%, 25%, 50% and 75% on the microstructure and mechanical properties of the material. Welding is carried out with a current of 80A and a voltage of 30V. The results of macroscopic observations found that the greater the proportion of plastic deformation, the greater the width of the HAZ (Heat Affected Zone). The results of microstructural observations with an optical microscope show that the greater the proportion of plastic deformation, the finer the shape of the ferrite in the BM (base metal) region. On the other hand, in the FGHAZ (Fine Grain Heat Affected Zone) region, the ferrite shape becomes coarser as the proportion of plastic deformation increases. Meanwhile in the CGHAZ (Coarse Grain Heat Affected Zone) region, a ferrite phase is formed at grain boundaries with coarse pearlite for each variation of plastic deformation. The results of the hardness test show that the greater the proportion of plastic deformation, the greater the hardness value in the BM region. In the HAZ and WM regions, the greater the proportion of plastic deformation the lower the hardness value. The results of the tensile test showthat the greater the proportion of plastic deformation, the greater the UTS (Ultimate Tensile Strength) and YS (Yield Strength) values.

Mechanical Properties of the Polyester Hybrid CompositeReinforced by Fiberglass and Bamboo Blades as The Replacement Materials for 10GT Boat

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Abstract. Traditional fiberglass reinforced plastics (FRP) 10 GT fishing boats with the hand lay-up method generally havelow mechanical properties because they do not comply with Indonesian Classification Bureau (BKI) standards, namely tensile strength 98 MPa with modulus elasticity 6.86 GPa and bending strength 150 MPa with MOE 6.86 GPa. Meanwhile,the large number of ships produced in Indonesia impacts the higher demand for fiberglass. The creation of large fiberglasscan produce carbon gas emissions which can become air pollution which ultimately causes global warming. So in this study, a partial replacement of the fiberglass layer was carried out using a thin layer of bamboo woven twill with a width of 5mm, a more environmentally friendly material than fiberglass itself. Tensile and bending tests on composite specimensof a mixture of fiberglass and bamboo slats were carried out to determine whether the composite complied with BKI standards for sailing. The tensile test standard used in this study is American Standard Testing and Material (ASTM) D638,and the standard for the bending test is ASTM D790. The results of the tensile test on bamboo with an alkalization processand without alkalization and the results obtained were 111.718 MPa for bamboo without alkalization and 221.692MPa forbamboo with alkalization. The alkalized bamboo slats were used as mixed-layer specimens. This experiment conducted hand lay-up FRP testing with and without press to determine the best method. The tensile and bending test results for specimens with press are 221.856 MPa and 229.856 MPa, while without press are 112.227 MPa and 228.476. They then tested four-layer hybrid composite specimens with variations of one of the fiberglass layers replaced by woven bamboo, namely in the Woven Rooving (WR) 800 and Chopped Strand Matt (CSM) 450 parts. For the WR 800 replacement variation of 106.316 MPa, and 166.234 MPa, while for the replacement of CSM 450 of 118.806 MPa and 62.451 MPa. Inthis experiment, a hybrid composite composition that can meet the BKI standard for 10GT vessels is obtained, namely thevariation of woven bamboo, which replaces the fiberglass layer, WR800, in FRP composites with the press.

Microwave-Assisted Extraction (MAE) of Rice Bran Proteinas a Wall Material for γ-Oryzanol Encapsulation

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Abstract. Rice bran is a by-product of the rice milling process and contains various bioactive compounds, including γ- oryzanol, which can reduce hypercholesterolemia. However, the high reactivity of γ-oryzanol in the environment results inthe need for coatings to make maximum use of bioactive compounds. Many encapsulation processes have been developedusing wall material from many sources. Rice bran, which also contains rice bran protein (RBP), has hypoallergenic properties, good foaming stability, and can be used as a wall material. Therefore, this research focused on enhancing proteinextraction from defatted rice bran (DRB) by microwave-assisted extraction (MAE) to produce rice bran protein suitable for encapsulating γ-oryzanol. RBP obtained by alkaline extraction at different temperatures, times, and pH revealed that the highest yield of RBP of 7.88% was obtained at T= 60°C, t= 60 minutes, and pH 11. This operation condition was then used to optimize the extraction of RBP by MAE using power and time variables. The RBP obtained by MAE is as high as14.16%, almost double compared to conventional alkaline extraction at W= 100W, t= 25 minutes, and pH 11. The solubility, foaming, and zeta potential of RBP acquired revealed properties that make it a suitable wall material for γ- oryzanol encapsulation.

Studies the effect of Triton X on the textural properties ofPVA-based electrospun nanofibers

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ABSTRACT

Electrospinning has many advantages in fabricating nanofibers in terms of being relatively inexpensive and quitesimple. Indeed, several important parameters need to be considered when utilizing the machine. In order to produce nanofibers with good textural quality, one way to improve the properties is by varying the surfactant concentration. A composition of 0, 3, 7, and 10 wt. % Triton X was mixed with 8 wt.% Polyvinyl alcohol (PVA) in distilled water as the precursor solution. A flow rate of 12 ml/h, the distance between the needle tip and the collector of 15 cm, the rpm of the collector of 200 rpm, and a voltage of 15 kV were set on the machine. The precursors were then fabricated using an in-house electrospinning machine. Characterization of nanofibers was done using Scanning Electron Microscope (SEM), X-Ray Diffraction (XRD), and Fourier Transform Infra-Red (FTIR).Uniform nanofibers with the smallest crystallite size were successfully produced by a 7 wt.% of Triton X. FTIR spectra showed that the resulting nanofiber was pure and uncontaminated with impurities. A semi-crystalline PVA structure was observed in the XRD pattern. Indeed, the addition of Triton X contributes to reducing the formation of the beads and increasing the homogeneity of precursors.

The Effect of Temperature and Artificial Aging Time onThe Hardness and Crystal Structure of The Shape Memory Alloy Cu0,83 Al0,14 Zn0,03

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Abstract. Shape memory alloys are materials that have the ability to return to their original shape when subjected to deformation and heated above the transformation temperature, known as the effect property of shape remembering alloys. The purpose of this study was to discuss the effect of variations in temperature and artificial aging time which were previously carried out by heating sintering and fast immersion in brine media on those made by powder metallurgy. The preparation of the Cu0.83 Al0.14 Zn0.03 alloy by powder metallurgy method, test sample was started by weighing Cu, Al, and Znpowder using a stoichiometer, the three elements Cu, Al, Zn were mixed in a ball mill for 3 hours. Green density samples with a diameter of 20 mm and a thickness of 5 mm were made by pressing with 10 tons held for 5 minutes. Heating sinteringtemperature of 750^0C for 1 hour in fast immersion in brine media, followed by artificial aging heating at temperatures of 250^0C and 300^0C, a fixed time of 30 minutes and a holding time of 45 and 90 minutes and a constant temperature of 250^0C. The results of this study, in the crystal size test, the effect of temperature increase and artificial aging time had the same tendency to decrease significantly, where the crystal size decreased (from 0.606 nm to 0.533 nm), and the results of this crystal size test resulted in an increase in dislocation density from 4.815 to 6.056 line/mm^2 and the micro lattice strain increased significantly from 0.196 to 0.214. The temperature process conditions, and artificial aging time caused a decreasein the hardness value from 63 to 47 HB and a decrease in tensile strength from 223 to 166 MPa, and the yield strength tendedto decrease.
Keywords: Alloy Cu0.83Al0.14Zn0.03 powder metallurgy XRD Hardness

Steam Erosion Failure on ASTM A210 Grade A1 Waterwall Tube of Subcritical Boiler

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Abstract. Waterwall tube is one of critical parts of boiler component's that main function converts water into superheated steam. Tube failures in the boiler are a common issue that often leads to boiler performance reduction and in the worst condition the unit will shut down. The aim of this failure analysis is to identify the tube leak is primary leak or only secondary damage mechanism of tube failure. In addition, the result hopefully can be as power plant OEM references for safety and prevent future occurrences of tube failure. The visual inspection and data collection comparison was developed and validated for determining the mode of failure. The results of macrography analysis indicated the wall thinning of failure direction and pattern due to steam erosion from outside tube, starting from the external diameter, and leading to a significant reduction in thickness to a critical value of 0.085 mm. In contrast, the minimum wall thickness of waterwall tube is 2.8 mm. Consequently, the tube is unable to withstand the hoop stress and leaks occurred due to overload tearing and propagated. Scanning Electron Microscope (SEM) testing reveals dimple rupture fracture patterns, while metallographic results show no evidence of microstructural degradation. These results are consistent and good agreement with the hardness test results, which indicate hardness values ranging from 164 to 174 HV near and far from the failure site. The chemical composition investigation waterwall tube complies with ASTM A210 Grade A1 material standard. In conclusion, this analysis provides valuable insights into the causes of steam erosion and confirmed as secondary damage failure mechanism in waterwall tubes. The findings can be used to develop mitigation strategies such as immediate actions for shutdown and prevent future tube failures, ensuring the safe and efficient operation of boilers.

The Relation Between the Tensile Strength of Ramie (Boehmeria Nivea) Yarn and Its Gauge Length

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Abstract. This study aims to examine the correlation between the tensile strength of ramie (Boehmeria Nivea) fibres and different gauge lengths under uniaxial static tensile loading. The stress-strain curves for each gauge length were inconsistent due to the non-uniformity of the Ramie yarn bundle. “Strain hardening” and multiple load drops were seen on the stress-strain curves, which is beneficial for structural applications where performance and safety are major concerns. When the gauge length increases, the tensile strength decreases due to more defects, which act as stress concentration on the fibres, and this behavior also confirms that the size effect plays a role in ramie fibres. The large variability in the ramie fibres should be taken as a precaution when designing structural parts made of this material.

Colloidal ZnO- Prepared Using Ethanol as Solvent in itsFuture Application to Produce ZnO-SiO_2 NanoparticlesUsing Electrospray Method

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Abstract. ZnO nanoparticles gathered so much attention from researchers in the past few years due to their advantages inmany fields, such as photocatalytic activity and medicine. However, producing ZnO nanoparticles has still been challengingdue to its natural agglomeration behavior. One of the methods that can be used is electrospray. This method offers a low evaporation temperature and produces a high-yield material. Regarding the process used, electrospray, several parametersmust be considered; one essential thing is the colloidal precursor solution. The high stability of ZnO colloids made from zinc acetate dihydrate dispersed in ethanol as a solvent is rarely discussed. The ZnO-colloid was prepared using distillation equipment and lithium hydroxide as the source of alkali. The effects of operation parameters (sonication time) and alkali concentration added in producing the ZnO colloid were investigated in this study. ZnO Colloid with a good stability agreement comes with 0.1 M zinc acetate dihydrate (ZnAc) concentration and 0.14 M lithium hydroxide ratios, which hasa zeta potential of -14.4 mV and 0.324 mS/cm conductivity.

Failure Analysis of Superheater Drain Tube in HeatRecovery Steam Generator

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Abstract. Superheater drain tube is one of the components of Heat Recovery Steam Generator (HRSG). The tube experienced failure after twenty years of operation. The failure was noticed due to the finding of water drips during regularinspection. After removal of pipe insulation during operation, it was found that there was a steam leakage in the tube. Thepaper analyzes the failure of the superheater drain tube so that similar failure can be avoided. Field observation, visual inspection, XRD, chemical test and metallography were carried out in order to investigate the failure. Results of field observation and visual inspection reveal that the pipe experienced wall thinning originated from external side of the pipe. No anomalies or defects can be found in the internal wall of the pipe. Hence, it is determined that the tube leakage was caused by progressive external or outer wall thinning due to corrosion under insulation. The corrosion occurs due to reaction between tube external surface and water, forming corrosion product in the form of Fe_3O_4 dan Fe_2O_3. The source of the water may originate from water moisture yielded from condensation of tube surface and water contained glass wool insulation. Hanging clamp improper installation may also act as water pathway from external environment into the glass wool.

Abrasion Failure on ASTM A213 T12 Bottom Slope Tube of Supercritical Boiler

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Abstract. The bottom slope is a component of the waterwall system in a supercritical boiler. This component plays a crucial role in the operation by converting the liquid phase to gas. The design of the bottom slope must consider several factors, including material strength, fluid flow rate, temperature, and pressure it faces. The aim of this failure analysis is todetermine the main cause of tube failure and implement measures to prevent such failures in the future. Data collection will involve gathering information about the boiler's design operation and conducting visual inspections to identify how the tube failed. The results of macrography analysis indicate the presence of failure areas and wall thinning, starting from the external diameter, and leading to a significant reduction in thickness 4.3 mm. As a result, the tube is unable to withstandexternal pressure and fails due to excess falling slag. Scanning Electron Microcope (SEM) testing reveals abrasion fracturepatterns, while metallographic results show microstructural degradation. These results are consistent with the hardness testresults, which indicate hardness values ranging from 200 to 210 HV near the failure site. The chemical composition of theinvestigated bottom slope tube complies with ASTM A213 T12 material standards. In conclusion, this analysis provides valuable insights into the causes of abrasion due to falling slag and its primary damage failure mechanism in bottom slope tubes. The results of this study can be utilized to formulate effective strategies for mitigating tube failures in boilers. These strategies may include immediate shutdown procedures and preventive measures to ensure the safe and efficient operationof the boilers in the future.

Experimental Analysis of Failure Behavior in Improved Honeycomb Sandwich Inserts by Replacing Potting Mass with a Carbon Fiber Layer

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Abstract. The pursuit of achieving the lightest possible structures without compromising safety and strength initially emerged in motorsports and has rapidly disseminated into the automotive industry. This advantageous trend has led manyracing vehicles to adopt monocoque chassis constructed from carbon fiber sandwiches with honeycomb cores. A monocoque chassis embodies a singular structural unit wherein the body functions as a load-bearing element. This chassis supports the suspension, steering, drive, and other essential components and showcases exceptional strength. Despite theseadvantages, certain vehicle segments still require metals, as in some racing competitions like the DTM Racing Car in Germany. Considering this, because sandwich structures are weak under localized loads since the honeycomb compresseseasily, reinforcement is introduced used on the connection zone of composite and metal material to spread the load to a larger area. This research will determine Tensile Pull-Out strength with an experimental method that refers to ECSS-E- HB-32-22A Space Engineering: Insert Design Handbook by the European Cooperation for Space Standardization (ECSS). This new reinforcement method will take the pull-out strength advantage of the insert method and the load spread benefit of the chamfer method. According to some studies, the potting mass will fill the space in sandwich structures, making thestructure heavier. The new reinforcement method will remove the potting mass, replace it with carbon fiber layers, and adda metal insert. From this research, the new reinforcement method has an average Tensile Pull-Out strength of 8012.03 N, and the old reinforcement method has an average Tensile Pull-Out strength of 3620.35 N and 4897.54 N. From that result,the new reinforcement method has better Tensile Pull-Out strength than the old one.

Electrochemical corrosion study on stainless steel used for low-pressure steam turbine blades

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Abstract. – Stainless steels, including ferritic-martensitic and precipitation-hardening stainless steel, find extensive utilization in low-pressure steam turbine blades. The failure of these blades often stems from fatigue originating in the pitting region, highlighting the importance of investigating the susceptibility of such incidents. This paper presents an investigation of pitting corrosion in stainless steel using electrochemical methods to probe the pitting behavior and assess the susceptibility of stainless steel to localized corrosion. The experimental setup involved exposing the stainless-steel specimens to artificial sea water comprising three wt.% NaCl and monitoring their electrochemical responses with linear polarization and cyclic voltammetry. The results show that the presence of chloride ions disturb the ability of SS410 to form passive layer and hindering the repassivation of the passive layer.

Mold Design of Helmet Shell from Biocomposite BananaFiber and Polypropylene

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Abstract: In this study, the mold was designed for helmet shell made from biocomposite with a material composition of 10% banana fiber, 10% Maleic Anhydrite Polypropylene (MAPP) and 80% polypropylene. Based onSNI 1811-2007 Mold components are prepared with dimensions according to the SNI standards. Based on the requirements set out in the standards, the helmet shell must meet the impact and penetration tests. The design is intended to determine the thickness of the helmet shell. For this reason, as a first step, an impact simulation is carriedout with the help of Ansys software with thickness variations ranging from 2mm to 6mm. The simulation results showthat the thickness of the shell from 4mm to 6mm meets the requirements, which is indicated by an acceleration drop that does not exceed 300g. Furthermore, to determine the resistance of the helmet shell against the indenter weighing3kg, which is suspended from a height of 1.6m, a penetration simulation was carried out with the help of Ansys software. From verification by experiment, the thickness of the helmet cover that complied was 5mm and 6mm, whichwas shown by the thickness of the shell not being penetrated by the indenter. Next, a helmet shell mold with a thicknessof 5mm was designed, starting from the manual calculation of the required clamping force of 1367.96kN. And with a melting temperature of 163ºC bicomposite material, the required cycle time is calculated as 129.38 seconds. The design is welcome with the Autodesk Moldflow simulation software, the simulation results of the injection process produce the required injection time of 12.43 seconds, with a filling confidence level of 100%, and the injection pressure is 8.789MPa.

The Analysis of CO2 Pressure and Welding Speed Effect onin AISI 1045 MIG welding

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Abstract. Metal Inert Gas Welding (MIG) is an LSW welding method that uses CO2 as a protective gas. The MIG weldingprocess is more widely applied to various welding positions and is more efficient and inexpensive. This welding process issuitable for construction. However, the MIG welding process requires a skilled welder because it requires continuous andstable control to prevent burn-back. The heat-affected zone (HAZ) is the area formed around the groove due to the heat input of the welding material. In the HAZ region, there is a change in the microstructure, which causes changes in materialproperties. The welding process was carried out at speeds of 2.75 mm/s, 3.49 mm/s, 2.67 mm/s and 3.41 mm/s with pressurevariations of 10 and 15 bar. Changes in material properties occur due to welding speed which indicates the amount of HI received. The higher welding speed causes a decrease in the HAZ area, which indicates a more ductile material.

Effect of Welding Time on Microstructure and Mechanical Properties of Rotary Friction Weld Joints of AA6061

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Abstract. This study conducted an experiment to investigate the metallurgical and mechanical properties of joints made through rotary friction welding (RFW) using AA6061 aluminum alloy rods. The examination of the microstructures in theRFW joints was carried out by employing optical microscopy, along with observing the weld macrostructure using a low magnification microscopy to examine the flow behavior during the RFW process. Subsequently, the characterizations of RFW joints were conducted using Vickers microhardness measurements, tensile tests and fatigue tests using a rotating bending machine in combination with fractographic study. It was discovered that the higher welding time led to improvedstrength of the AA6061 weld joints but accompanied by the formation of more flashes and higher burn-off length. In contrast, at a low welding time, typically 5 s, the RFW process was inadequate to produce the friction heat required to makesound weld joint hence resulting in low strength. It appeared that the most satisfactory weld joint was achieved at 10 s welding time as indicated by its high strength, around 223.2 MPa with less flash was produced compared to the weld at thewelding time of 15 s. This particular RFW joint had the fatigue strength lower than that of AA6061 base metal and the fatigue crack origin was located at the HAZ of AA6061 owing to softening during the welding process.
Keywords: Rotary friction welding; AA6061 aluminum alloy; tensile strength; fatigue

Study of Bajakah Tampala (*Spatholobus littoralis Hassk*) Extract as Green Corrosion Inhibitor for Carbon Steel API 5L Grade B in 3.5% NaCl Solution

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Abstract. Failure control of pipeline, due to internal corrosion, can be realized by the addition of chemical inhibitors. Organic-based inhibitors (green-inhibitors) are of interest for further development because of their environmentally friendly. Organic compounds adsorbed on metal surfaces and forming a layer that blocks metal contact with the environment will reducethe corrosion rate. The green-inhibitor used was Bajakah Tampala (*Spatholobus littoralis Hassk*) extract. The purpose of thisstudy was to analyze the effect of Bajakah Tampala extract added in a corrosive solution medium of 3.5% NaCl solution. In this study, the test material used was carbon steel API 5L Grade B in 3.5% NaCl solution media with concentration variationsof inhibitor of 0, 250, 500, and 750 ppm. The extraction method used is the maceration method with 96% alcohol solvent which is then concentrated in a rotary evaporator. Corrosion rate measurement was carried out by potentiodynamic polarizationtest and immersion test. The surface morphology observation was done by stereo microscope and the phase of rust determined by XRD analysis. The results of this study indicated that the efficiency of Bajakah Tampala extract that can be obtained was 68% at a concentration of 750 ppm.

Mechanical properties and corrosion rate of friction stir Mg-alloys AZ31B-H24 welded joints produced using a triangle pin at different tool rotation speeds

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ABSTRACT

Light weight metals such as magnesium alloys, in particular AZ31 alloys have long been used in aircraft and automotive industries due to a good combination of high strength and low density. However, some problems arisewhen the alloys are welded using conventional fusion welding processes hence leading to the use of alternative welding process such as friction stir welding (FSW). In the present work, mechanical properties and corrosion resistance of friction stir AZ31B-H24 magnesium alloy welded joints with variation in tool rotation speeds of 910rpm, 1500 rpm, and 2280 rpm have been investigated. Friction stir welding (FSW) processes were performed usinga tool having a triangular pin which moved along a joining line at a speed of 30 mm/minute. After welding, variousnumber of tests were carried out including macro- and microstructure observation, Vickers microhardness measurements, tensile tests and corrosion measurement in 3.5% solution using Tafel technique. Results showed that high strength of the FSW welded joint, typically 212.2 MPa was obtained at a tool rotation speed of 2280 rpmresulting in a welding efficiency of 86.3%. The strength of the weld joints was associated with grain size according to the Hall-Patch relationship. In addition, the hardness distribution of the weld joints revealed that the lowest value of hardness was observed in the stir zone (SZ), typical between 47 Hv to 54 Hv suggesting that this zone was prone to softening during welding. Similar to the results of tensile tests, it was found that the tool rotation speed of 2280 rpm produced the FSW joint with excellent corrosion resistance as indicated by the lowest value ofcorrosion rate of 0.015 mm/year.

Keywords: *FSW AZ31B-H24, mechanical properties, corrosion rate, triangle pin.*

Influence of Additives On The Physical and Mechanical Properties Of Rapeseed Oil Polyol Based Rigid PolyurethaneFoam As an Artificial Bone Model

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Abstract. In the field of medicine, simulating body networks like polymer muscles and artificial bones is crucial. Orthopedic doctors use artificial bone models extensively for surgical practice, especially bone fracture repairs. Human artificial bones made from polyurethane foam offer a viable alternative, closely mimicking real human bone properties. To create this foam, polyol and isocyanate are combined with additives like a blowing agent (distilled water), catalysts, and surfactants to modify its physical and mechanical properties. Due to environmental concerns, there is growing interest in renewable-based polyol forpolyurethane foam production, but research on additive impacts with renewable-based polyol is limited. This study investigatesthe effects of specific additives (distilled water as a blowing agent, amine catalyst, and silicon glycol surfactant) on rigid polyurethane foam (RPUF) made with renewable-based raapseed oil polyol. Various parameters will be analyzed, including different amounts of water (0.2, 0.6, and 1.0 grams per hundred grams of polyol), catalyst (0.2, 0.4, and 0.6 pphp), and surfactant(2, 4, and 10 pphp). The resulting RPUF samples will undergo rigorous testing following ASTM F-1839 standards, evaluatingmacrography, density, void content, compressive strength, and compressive modulus. Additionally, SEM testing will study theeffect of additives on the foam cell structure. The research shows that higher water content in RPUF reduces its physical and mechanical characteristics due to water acting as a blowing agent, leading to larger cell sizes and thinner foam cell walls. In contrast, higher catalyst concentrations improve RPUF's physical and mechanical properties by expediting the gelling and blowing reactions, forming smaller and thicker foam cell walls. Similarly, higher surfactant content improves RPUF's properties by reducing surface tension, enhancing polyol dissolution and homogeneity, resulting in more foam cells during thereaction and preventing cell growth throughout the process.

Keyword: *Catalyst, Surfactant, Rigid Polyurethane Foam, Water*

Fabrication Of Superhydrophobic Coating Using StearicAcid Doped With Zinc Oxide On SS400 Steel Strips Substrate

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Abstract. This study presents a novel approach to identify the optimal parameter to develop a temporary superhydrophobiccoating on SS400 carbon steel substrates by coating them with stearic acid combined with zinc oxide to generate additionalsurface roughness. The coating was aimed to protect the SS400 carbon steel during storage and handling in the manufacturing industry.

The surface modification process involved chemical etching using hydrochloric acid and chemical bath deposition using stearic acid with varying etching times, stearic acid concentrations, and stearic acid to zinc oxide mole ratios. The optimumvalue of surface modification on the contact angle and water sliding angle was investigated using Taguchi's method combined with the assignment of weight to convert a multi-response problem into a single-response problem.

The Fourier Transform Infrared (FTIR) spectroscopy result indicates the successful deposition of stearic acid on the substrate. The analysis of variance (ANOVA) result showed that the stearic acid to zinc oxide mole ratio significantly enchants the water contact angle. Optimum conditions were investigated using the multi-response performance index (MRPI) of both the water contact angle and water sliding angle resulting in 60 minutes of etching time, 40 millimolar stearic acid concentration, and 0.08 stearic acid to zinc oxide concentration as the optimal parameters. The low surface energy surfaces generated from methyl group (-CH3) provide non-wetting properties on the surface, while the etching timecombined with the addition of zinc oxide provides surface roughness. The stearic acid also provides surface modification on zinc oxide, which generates low surface energy and micro roughness. The higher stearic acid to zinc oxide mole ratio generates better coverage of stearic acid on the zinc oxide surface. The confirmation experiment that was conducted usingoptimum conditions resulted in a 155.6° water contact angle and 34.5° water sliding angle which is considered reproduciblebased on the evaluation conducted using the confidence interval that overlaps between the predicted and the confirmationexperiment.

Keywords: Analysis of variance (ANOVA); multi-response performance index (MRPI); stearic acid; superhydrophobic; Taguchi's method; zinc oxide.

The Effect of Concentration of Clove Flower Extract Inhibitor and Fluid Flow Velocity on the Corrosivity of API5L Grade B Steel in an H_2SO_4 Environment

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Abstract. Organic corrosion inhibitors are an effective method of corrosion protection due to their biodegradability, affordability, and environmentally friendly nature. These inhibitors are derived from natural extracts containing antioxidant compounds. Clove flowers contain antioxidant compounds such as eugenol, eugenol acetate, and caryophyllene as the main compounds, which serve as organic corrosion inhibitors. In this study, API 5L Grade B steel was immersed in a 0.5 M H_2SO_4 solution with varying concentrations of clove flower extract (CLE) of 0 ppm, 2000 ppm, 4000 ppm, 6000 ppm, and 8000 ppm and fluid flow velocities of 0 m/s (static flow), 0.5 m/s (laminar flow), and 1.2 m/s (turbulent flow). The corrosion rate in this research was determined using weight loss and potentiodynamic polarization methods. Complementary data was obtained through OES, GC-MS, EIS, FTIR, and XRD analyses. The results of the study demonstrated that the clove flower extract inhibitor effectively reduced the corrosion rate by adsorbing onto the steel surface through physisorption. In the weight loss tests at flow velocities of 0 m/s and 1.2 m/s, the highest inhibition efficiency was achieved with the inhibitor at 8000 ppm. Ata flow velocity of 0.5 m/s, the highest efficiency was obtained with the inhibitor at 4000 ppm. The corrosion rate was directly proportional to the flow velocity; as the flow velocity increased, the corrosion rate also increased. In conclusion, the findings of this study confirm that CLE inhibitors can effectively decrease the corrosion rate through their adsorption onto the steel surface via physisorption. The efficiency of inhibition was highest with the inhibitor at 8000 ppm for flow velocities of 0 m/s and 1.2 m/s, and at 4000 ppm for a flow velocity of 0.5 m/s. Moreover, the corrosion rate exhibited a direct correlation with flow velocity; as the flow velocity increased, the corrosion rate also increased.

Analysis of the Effect of Anodizing Time on the AnodizingLayer Thickness of Aluminum 5052, 6061, and 7075

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Abstract. Aluminum is often used in everyday life apart from being corrosion resistant, aluminum also has various variations. This aluminum variation is called a series, in which each aluminum series is combined with other different elements. This research focuses on 3 aluminum alloy series, namely 5052, 6061, and 7075. This study aimed to determine the effect of time on the thickness of the anodizing layer. There are 3 types of tests carried out in this study, namely XRF (to determine the elemental and oxide composition), SEM (to determine the thickness of the anodizing layer), and Megger Test (to determine the material's resistance). The results showed that the data with the highest validation according to linear regression was the layer resistance data of aluminum 7075 anodizing, whereas other data showed small significance. Overall, the response of each aluminum series is different when the anodizing process is performed. Aluminum 5052 and 6061 have a saturation point at the anodizing time of 20 min, whereas aluminum 7075 still shows an increase in thickness over time. This is influenced by the elements and oxides in it. Meanwhile, the Meggertest results show that the thicker the oxide layer, the greater the resistance.

Keywords: *Aluminium 5052, Aluminium 6061, Aluminium 7075, Anodizing, SEM, XRF, Megger test*

Analysis of the Effect of Temperature and Anodizing Timeon the Coating Thickness in Anodizing Process of Aluminium 6061

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Abstract. Aluminum 6061 is an Al-Mg-Si alloy that is lightweight, malleable, and corrosion-resistant. Aluminum 6061 iscommonly used for the anodizing process. Anodizing is a coating method by forming an oxide layer on the metal surface which aims to protect and decorate. This research process uses aluminum 6061 as an anode and a Pb platea cathode, with electrolyte solution HH_2SSSS_4 20%. Variations were made on the anodizing temperature (10 ℃, room ± 30 ℃, and 50 ℃) andvariations on anodizing time (10 minutes, 15 minutes, 20 minutes, 25 minutes, and 30 minutes). The tests carried out were the Scanning Electron Microscope (SEM) to determine the thickness of the coating and the Megger test to determine the resistance of the material. The results of the research on the best and optimal coating thickness at the anodizing temperatureof 10℃ were 3,004 µm with the anodizing time of 30 minutes, at room temperature ± 30℃ with the best and optimal coating thickness of 12.2 µm with the anodizing time of 20 minutes, and at 50℃ the best and optimal coating thickness was 14.44 µm with the anodizing time of 20 minutes. So that the higher the anodizing temperature and the longer the anodizing time will form a higher layer thickness value. However, if it has exceeded the optimal point, the layer thicknesswill decrease. This research, it is hoped that it can support SMEs' anodizing service providers in developing optimal anodizing temperature and time variations to improve the quality of anodizing products.

ANALYSIS THE EFFECT OF WELDING CURRENT USING RADIOGRAPHY TEST, PENETRANT TEST, AND MAGNETIC TEST METHODS ON CORROSION RATE OF PRESSURE VESSEL ASTM A 36 MATERIALS

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Abstract. A pressure vessel that functions to store liquid or gas which is often used in the oil and gas industry and has a pressure difference on the inside from the outside. Pressure vessels have several important components. These componentsare interconnected using a welding process. The welding process is carried out by many variables that determine the resultof the welding, one of which is the strong current. The welding results are not spared by the existence of errors in the welding process. These errors are in the form of welding defects which can interfere with the quality or quality of the welding results. To be able to detect a defect and to be able to determine the quality from the welding results, a non- destructive testing process is carried out. The non-destructive test used in my final project is using the magnetic test method,penetrant test, and radiography test. this can find out the type of defects that occur in the pressure vessel and can determine the best type of Non-Destructive Test method for detecting a defect in the welding results carried out in the pressure vesselmanufacturing process. welding defects that occur. In addition, additional tests will be carried out in the form of corrosionrate testing using the weight loss method with variations in welding currents which will later obtain data on the relationshipbetween strong currents and the corrosion rate that occurs.

FDM 3D Printer Parametric Process Optimization Of Creality Ender 3 3D Printer For Dimensional Accuracy Printing Quality Using PLA+ (Polylactid Acid) Material

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Abstract. 3D printing technology is one of the additive manufacturing processes that is starting to be widely used in Indonesia today. This technology's ability to create various forms of design into three-dimensional visuals makes it one ofthe most popular technologies in the world of engineering. The quality produced by 3D printing depends on the type of filament and the careful selection of process variables. In recent years, a lot of research has been carried out to explore various ways to improve the quality of printouts from 3D printer machines with various variations of parameter optimization and experimental design concepts. This research aims to improve the quality of extrusion-type 3D printer prints with FDM (fused deposition modeling) technology for the Creality Ender 3 using PLA+ filaments, which have slightly better strength than standard PLA filaments, which are widely used in general. By designing optimum process parameter settings using the Taguchi method with three process parameter factors, which include print temperature, layer thickness, and print speed, which are also adjusted to the characteristics of PLA+ filaments, optimum settings were obtained with printing temperature of 230°C, layer thickness of 0.20 mm, and print speed of 100 mm/s.

Keywords: 3D Printing, Dimensional Accuracy, PLA+, Optimization

RENEWABLE ENERGY

The role of circular cylinders in improving the performance of the Savonius wind turbine

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Abstract. The important role of circular cylinders in improving the Savonius wind turbine performance was demonstrated experimentally in this study. This was carried out by placing circular cylinders in 3 (three) configurations, namely configuration-A: circular cylinder is placed in front of the returning blade with a constant distance S/D = 1.4; configurationB: a circular cylinder is placed beside the advancing blade at various distances Y/D = 1.27, 1.42, 1.61, 1.82 and 2.00, and configuration-C: is a combination of the two configurations. The Savonius wind turbine used in this study is made of PVC pipe, which is split into two with a diameter of D = 165.2 mm and a height of H = 294.4 mm equipped with a shaft having a diameter (b) = 19 mm. In this experiment, the turbine torque is measured using a rope break dynamometer to obtain the power coefficient (CoP) and moment coefficient (Cm) as a function of the tip speed ratio (TSR). For a wind speed operated at 5 m/s, the results show that for configuration-A, the presence of a circular cylinder effectively improves the turbine performance, where the CoP of the turbine increases by about 19% at a TSR of close to 0.6 relative to a conventional turbine. As for configuration B, not all Y/D distances can improve turbine performance, but only at Y/D = 1.42 and 1.61. The highest increase in CoP was obtained at a distance of Y/D = 1.61, with an increase of more than 25% at TSR = 0.69 compared to a conventional turbine. On configuration-C, the circular cylinder installed at Y/D = 1.61 and 1.82 caused the improvement of the turbine performance, where Y/D = 1.61 gave an increase in CoP of about 27.8% at TSR of about 0.63 relative to the conventional turbine.

Keywords: Savonius wind turbine, Circular cylinder, Returning blade, Advancing blade.

Design of Electric Vehicle Battery Cooling System with Phase Change Material (PCM)

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Abstract. The development of electric vehicles is still constrained by overheating that occurs in electric vehicle batteries. Overheating batteries also has an impact on the electrochemical reactions taking place inside the cells, which can cause extraexothermic reactions and can cause a sudden rise in temperature resulting in an explosion [1]. The battery temperature must be maintained in the range of 15-40◦C to make full use of the maximum effectiveness of the battery [2]–[4]. Battery Thermal Management Systems (BTMS) are required for thermal management that occurs in electric vehicle batteries. BTMS can reduce the negative effects of temperature on batteries by reducing the temperature and temperature differences that occur inside electric vehicle batteries. Various studies have been conducted to overcome the occurrence of overheating in electric vehicle batteries. One way that can be done is to use an electric vehicle battery cooling system. The use of Phase Change Material (PCM) as a cooling medium for electric vehicle batteries is one alternative that can be done. Many things can affect the effectiveness of battery cooling including PCM material, PCM layout position against the battery, PCM shape, PCM dimensions and others. Phase Change Materials (PCM) are materials that change their physical characteristics when absorbing or releasing heat energy. Of the several PCM materials developed, paraffin material is a potential PCM material candidate for development, but this material has low thermal conductivity. The addition of other elements to paraffin such as PCM has also been widely studied, such as the addition of SiO_2, graphite, nickel and others. In this study, we will try to design an electric vehicle battery cooling system by utilizing paraffin and TiO_2 materials as PCM and adjusting the location of the PCM between the batteries, in the hope that it can provide an effective battery cooling effect.

Effect of pilot injection timing on performance and exhaust emissions of Diesel Dual Fuel Engines (biodieselhydrogen)

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Abstract. One of the Indonesian government's programs to achieve Net Zero Emissions by 2060 is the reduction of petroleum oil use in transportation. The government's goal is that by 2025, biofuels will supplant 30% of fuel oil on a national scale. Biodiesel derived from palm oil is used as an alternative to diesel fuel in Indonesia. However, the use of biodiesel with a low calorific value reduces the efficacy of diesel engines, necessitating the addition of additional fuels. Hydrogen gas is one of the fuels which can enhance biodiesel. This research aimed to determine the efficacy and emissions of a dual-fuel diesel engine. B100 and hydrogen gas are utilized as fuel, with biodiesel injection times of 11, 13, 15, 17, and 19 degrees BTDC. By varying the injection time of the B100 pilot fuel in a diesel engine fueled with a mixture of Hydrogen-Biodiesel gas, the most optimal performance improvement was obtained at the injection time variation of 15° BTDC, with increases in Torque, Brake Thermal Efficiency (BTE) of 0.286% and 4.51%, respectively. 4.67 percent reduction in specific fuel consumption. Carbon Monoxide (CO), Hydrocarbon (HC), and Smoke Emissions decreased by 100, 305.8%, and 10.1%, respectively, at the injection time variation of 19° BTDC.

Numerical Investigation on Drag and Lift of Hydrofoil Due to Homogenous Roughness

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Abstract. In regard to energy efficiency and environmental sustainability, adding a foil system to a Hydrofoil Supported Watercraft (Hysuwac) can effectively increase lift force and reduce resistance. However, submerged hulls are prone to biofouling, which increases surface roughness especially in the foil area. Because a rough surface increases the ship's resistance, it is crucial to maintain the hydrofoil's performance from it. In this study, the effect of roughness on the drag and lift of a foil is investigated. Reynold Averaged Navier-Stokes (RANS) simulations together with the k - ω SST turbulence models were performed to study the effects of roughness on the drag and lift of the hydrofoil. The selected ks value represented the common ship-hull roughness, varied from 81.25, 325.00, and 568.75 in µm respectively. To further obtain reliable outcomes on the roughness effect, comparisons with smooth surfaces were also performed. The results indicate that roughness has considerable effects on the flow over the hydrofoil. Surface roughness increases drag coefficient. The presence of surface roughness also has a significant impact on flow separation, as it is found to delay separation. Moreover, roughness is shown to decrease hydrofoil efficiency.

Energy Management for Hybrid Solar Vehicle

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Abstract. This paper presents the results of a research on the energy management of a hybrid solar vehicle. The energy management system of hybrid solar vehicles tries to select the best operating mode according to the driving conditions and the state of charge of the battery. In this study, the suggested energy management system used a particular energy balancing equation as the foundation of the algorithmic decision-making for each mode of operation of the vehicle. In order to investigate the power supplied by each component, the fuel consumption of the vehicle, and the efficiency of each component, the algorithms are then simulated on a model of a series-parallel hybrid solar vehicle system. The results show that the fuel consumption of an internal combustion engine on a hybrid solar vehicle is about 28% less than the conventional vehicle, in which up to 0.7 % contributed by the photovoltaic cells.

Keywords: Energy Management, Hybrid solar vehicle, Fuel comsumtion, Regenerative brake, Photovoltaic.

Utilization Of Palm Oil Empty Fruit Bunch as Co-Firing Fuel with Water and Acid Washing Pretreatment

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Abstract. Empty fruit bunches (EFB) as co-firing fuel are rich in potassium oxide which may hinder its utilization. Water and acid washing has been reported effective in reducing the alkali content of solid fuel. In this study washing is carried out with different acetic acid concentrations and batches of washing. Theoretical indices and SiO_2-CaO-K_2O (SCK) are used to evaluate the effectiveness of washing process utilizing the ash composition of each sample. The results of this study show that acid-acid-acid-water washing with acetate acid concentration of 1 vol.% and temperature of 30°C is the most effective washing to reduce K2O composition in ash while also lowering ash content. Water-water-water washing with temperature of 50°C is worth considering for non-acid washing. From the theoretical indices it is predicted to have medium to high slagging risk and low fouling, while from SCK ternary diagram it is predicted to have low risk slagging tendency.

Experimental Study on Cow Manure: From Outhouse into House

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Abstract. Manure is the second largest source of greenhouse gas (GHG) emissions from agriculture. A sufficient method for handling manure is needed. Meanwhile, the need for construction materials and economic and population growth are rising. This study aims to tackle both problems by utilizing cow manure mixed with clay as bricks using wet torrefaction and solid-liquid separation to reduce the amount of untreated manure and supply construction materials with greener and improved clay bricks. Cow manure was treated using a wet torrefaction process, heating the manure at 100 ℃, 120 ℃, and 140 ℃, and then left to dry. The dried manure was then mixed with clay, molded, dried, and then baked to produce baked red clay bricks. The bricks were then tested for their compression strength and water absorptivity to determine the relationship between wet torrefaction parameters and brick characteristics. After the tests were completed, it was found that mixing cow manure into bricks increased the compression strength by up to 400% compared to pure clay brick and water absorptivity by up to 150%. Even though the strength of these bricks was increased, utilizing them as conventional construction material is not recommended. Instead, breathable façade material is more favored. Alongside solid product, torrefaction also produced liquid product rich in nutrients. Previous research showed that the nutrient content was sufficient to be made as liquid fertilizer. These results showed the possibility of implementing torrefaction of cow manure to reduce waste and upgrade the products' value.

Keywords: Manure, Wet torrefaction, Clay, Brick, Breathable façade material.

Thermal Characteristics of Coal Co-Combustion with Empty Fruit Bunch and Fronds Blends by Thermogravimetric Analysis

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Abstract. Indonesia has an abundance of natural biomass resources, particularly from oil palm agriculture, which is underutilized. Empty fruit bunches (EFB) and fronds (FRD) are two examples of insufficiently utilized biomass, both biomasses are blended in equal proportion and coded as EFFR. Even though co-combustion is frequently examined using a single variety of biomass, barely any article thoroughly investigates the effect of combining multiple types of biomasses. For assessing the co-combustion effect, five blends of EFFR were employed, with combination 5% (EFFR5), 10% (EFFR10), 15% (EFFR15), 20% (EFFR20), and 25% (EFFR25), with sub-bituminous coal. All samples were examined in duplicate for characteristics analysis (proximate, ultimate, and calorific value) then thermogravimetric analysis employed TG-DTA. As the results, the EFFR20 combination exhibited the optimum sample as combustion evaluation result, with highest index value at ignition index (Di), burnout index (Db), combustion index (S), reactivity (R), flammibility index (C), while lowest value at index of intensity (Hf), with 4.78x10-8, 20.88x10-12, 11.44x10-11, 4.77x10- 3, 3.58x10-5, and 2.74, respectively. This result suggests that EFFR20 as most prospective blends for utilizing as co- combustion fuel with bituminous coal by considering combustion characteristics. The insights of this study are beneficial for promoting renewable energy sources in electricity generation.

Battery Pack Cooling Phenomenon at Varied Air Cooling Temperature using Computational Fluid Dynamics

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Abstract. The Ministry of Education, Culture, Research, and Technology, in collaboration with PT Industri Kereta Api (INKA), has carried out the research and development of Bus Listrik Merah Putih (BLiMP). This initiative aims to promote the widespread adoption of electric vehicles as public transport in Indonesia. The BLiMP electric bus relies on Lithium ferro phosphate (LFP) battery packs, each consisting of 34 modules housing 72 battery cells. Throughout the operation of the bus, the battery functions as the power source. Of paramount importance during battery operation is maintaining its temperature at an optimal level. Failure to do so could result in severe damage to both the battery and the bus occupants. The battery's temperature escalates due to heat generation, which could potentially trigger thermal runaway and consequent damage if temperatures experience significant spikes. The core purpose of the study was to emulate the cooling process of the BLiMP battery pack through the utilization of ANSYS FLUENT 2023 V2 software. This simulation was aimed at evaluating how the cooling air temperature influences the cooling system of the battery pack. The findings revealed that the ECM model produced results that closely mirrored actual data, with the incorporation of lower coolant temperatures leading to enhanced performance, as indicated by the contour results. Among the array of tested air-cooling temperatures, 16°C seemed to be the most optimal for sustaining the battery pack's prime temperature.

Keywords: Ansys fluent, Computational fluid dynamics, Cooling system, Electric vehicle.

PV Stand-Alone System with Hybrid Lithium-Ion Battery and Hydrogen Storage in Derawan Island, Indonesia: Techno-Economic-Enviromental Analysis

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Abstract. The achievement of the energy mix for renewable energy share ASEAN Member State (AMS) of 14.2% in 2020 with a target of 23% in 2025. AMS energy mix is dominated by oil (33%) and coal (28%). Indonesia has a renewable energy mix target of 23% by 2025 and reduce Greenhouse Gas (GHG) emissions by 29% by 2030. The dedieselization program in isolated systems is one of the efforts to achieve this target. Derawan Island, one of the favorite tourist destinations in East Kalimantan, Indonesia, is one of the isolated systems targeted at reducing the use of diesel generators (DG). Derawan Island is powered by four DGs and 90 kW PV (renewable energy (RE) fraction 5%). With the objective of reducing reliance on DGs and maximizing RE utilization, this study examines the potential of additional photovoltaic systems (PVs) along with fuel cells (FCs) and lithium-ion batteries (LiBs) into the existing electricity system on Derawan Island. The contribution of this study is to perform a techno-economic-environmental analysis of several specific system scenarios. Furthermore, sensitivity analysis was conducted to assess the impact of load growth and DGs reduction scenarios. The results of this study, the DG/PV/FC/LiB (1 DG) scenario is the optimum scenario where from an economic aspect it has the lowest NPC and LCOE compared to the PV/FC/LiB and PV/LiB scenarios $12,515,510 and $0.3353/kWh. Emissions produced by DG/PV/FC/LiB scenario are carbon monoxide 3,459 kg/yr, unburned hydrocarbon 139 kg/yr, particulate matter 13.7 kg/yr, and nitrogen oxides 275 kg/yr.

Quantitative and Qualitative Investigations of Condensate from the Air Handling Unit in a Central Air Conditioning

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Abstract. Condensate is a by-product produced by air conditioning (A/C) during operation. Central air conditioners are commonly used in buildings that have a large cooling load. To distribute the cooled air into the conditioned room, an air handling unit (AHU) is used. This study was conducted on an AHU with a cooling capacity of approximately 34 kW. Data was collected for 5 hours from 08:40 to 13:40, and recorded for every 20 minutes. Based on the results of data collection, the average condensate production was 6,205 l/20 minutes, while based on calculations was 5,446 l/20 minutes. This difference is due to changes in the air condition entering the cooling coil during measurement. Based on the measurement data, in terms of quantity, the condensate volume has the potential to be used as raw material for drinking water for all building occupants who use central air conditioning, considering that the drinking water requirement for each adult is only about 2 liters/day. Meanwhile, based on the examination of condensate quality in the laboratory, it showed that out of 22 parameters, only 1 parameter has not been fulfilled by the condensate as drinking water, namely its pH. To overcome this, sodium bicarbonate can be added so that the pH of the condensate water meets the requirements for drinking water.

The Economic Analysis of Using E2W for Ride-Hailing Riders as a Main Strategy for Reducing Greenhouse Gas Emissions from transportation sectors in Indonesia

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Abstract. Efforts to reduce greenhouse gases in the transportation sector have been carried out by the Government of Indonesia by accelerating the adoption of ICE-driven vehicles to electric vehicles through an incentives program for both electric two-wheeled (E2W) and four-wheeled (E4W) vehicles. Two hundred fifty thousand incentive packages of IDR 7 million specifically for the transition to electric or convertible 2-wheeled (E2W) vehicles have been allocated in 2023. However, until Q2 2023, this program has not been able to be adequately absorbed. This research shows that the target of adoption needs to be adjusted. Ride-Hailing Riders should be the primary target for transforming into electric vehicles, especially two-wheelers. With a total of > 3 million riders, the target for reducing greenhouse gas emissions will be significantly improved if the subsidy program is directed at two-wheeled Ride-Hailing riders. Referring to previous research, the potential efficiency gained by Ride-Hailing Riders in terms of cost efficiency is also quite large. Obstacles related to battery charging waiting time are the main issues that should be solved by swapping batteries using Battery Swap Station (BSS). The second-generation E2W that is circulating, like the Smoot Tempur, has adopted a battery swap and BSS support. In the latest generation after Smoot Tempur, Volta Virgo improves the market option by offering a mixed concept using dual batteries, consisting of one embedded battery and one swapped battery, providing more flexibility. This research attempts to prove the Total Cost of Ownership of the lowest price of ICE (Honda Beat) vs. three sample products of E2W with different charging technologies, i.e., Viar Q1, Smoot Tempur, and Volta Virgo, for five years of ownership. It has been demonstrated and proven to show the benefits of using electric vehicles in reducing emissions and having a lower cost of ownership for Ride-Hailing drivers when using the right technological concepts, especially those that accommodate battery swap technology. Providing incentives to E2W will provide a wider gap between E2W and ICE.

Keywords: Internal Combustion Engine (ICE), Electric Two-Wheeler (E2W), Total Cost of Ownership (TCO), Battery Swap Station (BSS).

Energy Baseline for Measurement and Verification on Energy Audit for an Oil and Gas Industry

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Abstract. Energy Audit follows ISO 50002 standard had been done on one of oil and gas industry in Kepulauan Seribu Indonesia. As part of the energy audit report, energy performance analysis on the power plant and measurement and verification (M&V) of the energy performance are presented in this paper. Learning curve methods had been employed to investigate both the power plant performance and the energy consumption base line for initiating M&V. Cumulative Sum (CUSUM) graphic was plotted to investigate the trend of energy saving/losses. Base on four years historical data it is discovered that the second-year data was the most suitable data for energy baseline. Statistical test was run on the secondyear data to detect the parameter that influence the total energy consumption. It is revealed there are two factors that affecting total energy consumption of the oil and gas operation. They are gas production and produced water. The multiple coefficients of determination; R2 of the regression test of those variable is about 70%. The energy waste based on the energy equation baseline is about 12,434 GJ or 1.25% which is equivalent to US $ 35,242 assuming the gas prices is US $ 3/MMBtu.

Optimization of Biodiesel Production from Low-Quality Oil Under Mild Reaction Conditions Assisted by High Shear Mixing

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Abstract. Biodiesel is a low-carbon alternative energy source that can be used in place of fossil fuels. The emulsification of oil and alcohol using high-shear mixing is one of the biodiesel production techniques. The reaction time is reduced due to the development of a fine emulsion between oil and alcohol, and the yield of biodiesel produced is higher than that produced using conventional methods [1–2]. Furthermore, the cost of biodiesel production, which is a key barrier to biodiesel commercialization, can be reduced by employing low-quality oils such as crude rice bran oil (CRBO) [3]. Several parameters can influence this process, including acid catalyst concentration, reaction time, dispersion rate, and ethanol:CRBO molar ratio. The biodiesel production increased significantly as dispersion speed increased up to 8000 rpm and reaction time increased up to 8 minutes. At a 1% w/w acid concentration, a ethanol:CRBO molar ratio of 1:12, 10,000 rpm, and a reaction duration of 10 minutes, the greatest biodiesel yield of 74.58% was attained. Optimization of biodiesel production utilizing the Historical Data Design method [4] and the response surface method (RSM), with biodiesel yield as one of the responses RSM was used to study and optimize the combined parameters of catalyst concentration, reaction time, ethanol:CRBO molar ratio, and dispersion rate. The best settings were 3.3% catalyst concentration, 5.6 minutes of reaction time, an ethanol:oil molar ratio of 27.8:1, and a dispersion speed of 4747 rpm.

Keywords: Biodiesel, Rice bran oil, High shear mixer, Optimization, Historical data design.

Analysis of Motion and Energy Potential of the Vertical Axis Pendulum with Sector of Circle Type for the Prime Mover of Ocean Wave Power Generation System

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Abstract. The Vertical Axis Pendulum Sector (VAPS) of the 120-degree circle type for the ocean wave power generation pendulum system has been investigated. This paper shows how to create a model mathematic in MATLAB validated with the experimental result of a full-scale system of VAPS. The method to solve the pendulum movement system problem is to use the vibration equation which consists of the mass, damping and constant variables as a function of acceleration, velocity and displacement. The result of the experiment is the graph of oscillation wave and the challenge is how much the value of the system damping can make the MATLAB mathematical model graph coincide with the experimental results. The magnitude of the angular velocity is determined by the magnitude of the value of k the smaller the value of k, the greater the magnitude of the resulting angular velocity. With the addition of the initial deviation and the decrease in the damping value, the value of the energy produced by the pendulum increases. The torque value increases as the mass and slope of the pendulum frame increase. The greatest power generated in this study was 2577W at a pendulum mass of 220.18kg and a pendulum frame slope of 30°, and the smallest power was 18.3W at a pendulum mass of 220.18kg and a pendulum frame slope of 15°.

Keywords: Attenuation, Ocean Wave Energy, Vertical Axis Pendulum.

Wooden Fishing Vessels Performance due to Biofouling Invasion

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Abstract. As of now, marine biofouling is still a long-standing challenge and become a big never-ending problem faced by the maritime world, especially for ships. Biofouling inflicts many problems such as increases the roughness of the hull that affects the drag and the fuel consumption, increase emissions both of carbon dioxide and sulfur dioxide and causes corrosion of the hull leading to the ship's deterioration. The commonly object used as a review in previous research was ship made of steel. Therefore, in this study a 1 GT wooden fishing vessel with 8.00 m in length, 2.00 m in width, and 0.90 m in height is used to obtain its performance during the invasion of biofouling, include the ship stability, ship resistance, and the growth of the macro fouling. The methods used is experimental methods and numerical simulation using Maxsurf. In the first three, four, and six months, the average adhered macro fouling thickness under the draft is 3, 5 and 7 mm successively. The most growth of biofouling occurred on the planking joint and on the rudder compared to other area of hull. However, in a square of 10 x 10 cm, there were around 52 barnacles in the first three month after the ship was launched. This continued to grow approximately 33 barnacles after a month later. Finally, in the sixth month, total barnacles on the hull reached roughly 110 barnacles. Meanwhile, total resistance of the vessel before the invasion of biofouling was 3.1 kN, then it increased to 3.2 kN after 3 months during the invasion. In the following month, it gradually went up to 3.7 kN, and roughly 6.7 kN in the end of sixth month. The stability criterion of the wooden fishing vessels before and after the invasion meet the requirement provided by the International Intact Stability Code adopted by the IMO.

Keywords: Biofouling, Wooden fishing vessel, Resistance, Stability.

Scale-up of Bubble Column Reactor for Carbon Mineralization with Precipitated CaCO3 Product

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Abstract. Carbon dioxide is the primary anthropogenic greenhouse gas. The rapid economic growth increased energy demand and fuel consumption, especially fossil fuels such as oil, coal, and natural gas. During their combustion, a large amount of CO2 is released into the atmosphere, which harms the environment and causes global warming. In this work, the bubble column reactor (BCR) was used to absorb CO2 with the carbon mineralization process because it is one of the most widely used multiphase reactors in the industry for gas-liquid reaction systems. Even though a bubble column reactor is one of the multiphase reactors that is easy to construct and operate, scaling up a bubble column reactor is difficult. Scalling-up was conducted by a similarity concept which is relatively simple and straightforward with three parameters used to assess the similarity between two columns (i.e., the ratio of liquid height to column diameter (H/D ratio) to obtain geometric similarity and superficial gas velocity (SGV) & superficial fluid velocity (SLV) to obtain both kinematic and dynamic similarity. This work was conducted using two bubble column reactors, having 7 and 11 cm inside diameter, respectively. Therefore, in this work, a simpler method will be developed to carry out the scale-up of a BCR in the presence of a reaction on the column. Thus, a concept widely used in implementing scale-up, namely the concept of similarity, will be used.

Keywords: Bubble column reactor, Scale-up, Similarity, Superficial gas velocity, Superficial liquid velocity.

Analysis of the Steam Pressure Prediction on Steamflood Process Using NARX Model

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Abstract. Enhanced Oil Recovery (EOR) is used to optimize oil production. One of the processes is steamflood, where the steam is injected into the reservoir to increase the mobility of crude oil with high viscosity so it can move to the producing well. Development of the steamflood process is often to increase the effectiveness of oil production; one way is to use machine learning—the NARX model—to improve oil production in Jati Field. We used the data from PT Pertamina Hulu Rokan, Indonesia, to predict the steam pressure. Using Multi-Layer Perceptron (MLP) Regressor as the algorithm, the exogenous and endogenous inputs are used to indicate the steam pressure on the next day (t+1) and the day after (t+2). The evaluation metrics we used are Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and relative accuracy. The model tuning is performed with default hyperparameters, logistic, and identity activation function tuning, and the prediction results are evaluated using 5-fold k-fold cross validation. As a result, the logistic activation function tuning achieves the highest accuracy prediction for the MAE metric, with 96.24% accuracy and a value of 0.036. Conversely, the identity activation function demonstrates superior accuracy for the RMSE metric, with an accuracy of 93.67% and a value of 0.051. Hence, the NARX model can effectively predict the steam pressure on the steamflood process.

The Effectiveness of Using Circular Turbulator in Square Elbow 900 with Reynolds Number Variation

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Abstract. The square duct is the most used type of duct in the industry. In square duct, 90° elbows are also usually paired. The use of 90° elbows serves to deflect the direction of airflow. The use of the elbow 90° causes losses regarding energy use. An elbow 90° has a greater pressure drop than a straight channel. This study aims to identify the effectiveness of using a circular turbulator in a square elbow 90° with various variations of the Reynolds number. In this study, a circular turbulator was placed on the side of the inner elbow at an angle (α) of 15°. The research was carried out by numerical methods. The turbulence model used is standard k-ε. The test model is a square duct and 90° elbows with a curvature ratio R/Dh = 3. The Reynolds number used is 1.6×10^4, 4.8×10^4, and 9.5×10^4. The results of this study indicate that placing a circular turbulator in a 90° elbow is most effective in reducing the overall pressure drop at ReDh of 1.6×10^4 and 4.8×10^4. The opposite is true when using a circular turbulator at ReDh of 9.5×10^4.

Wedged Gurney Flap for Performance Improvement of Vertical Axis Wind Turbines

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Abstract. The study evaluates the wedged Gurney Flap (GF) on a three-straight-bladed Vertical Axis Wind Turbine (VAWT) using Computational Fluid Dynamics (CFD) simulations. The analysis considers the rotating effect of the blades at three different Tip Speed Ratios (TSRs) corresponding to low, medium, and high ranges. A hybrid RANS-LES model, specifically the stress-blended eddy simulation with transition shear-stress transport turbulence model, is employed for the simulations. The results indicate that the wedged GF does not provide significant performance enhancements for the VAWT at most TSR ranges, contrary to the findings in studies focused on stationary airfoils. Specifically, it is observed that the wedged GF, only improves the power coefficient of the VAWT with GF at low TSR ranges by approximately 3.402% compared to the VAWT with the original GF shape. However, at medium and high TSR ranges, the wedged GF does not exhibit the capability to enhance the VAWT's performance compared to the original GF shape.

Numerical Study of Multi-stage Standing Wave Thermoacoustic Engine

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Abstract. The thermoacoustic engine is a green technology that can harness solar and waste energy to produce electricity in combination with a linear alternator and can be used as a heat pump. This type of engine is particularly appealing because it has a simple structure and contains no mechanical moving parts, consisting only of a stack sandwiched between heat exchangers within a resonator. When the temperature gradient on both sides of the stack reaches the critical temperature (onset temperature), the working gas oscillates spontaneously. Due to viscous loss in the system, a high onset temperature is typically required to induce gas oscillation in a thermoacoustic engine. To address this challenge, a method has been developed to reduce the onset temperature by increasing the number of unit stages comprised of stack and heat exchangers, which has enabled the engine to utilize low-grade thermal sources. However, this method has only been applied to traveling wave thermoacoustic engines, and the standing wave one which provided a more compact and straightforward structure has not yet been explored. This study aims to know the influence of the number of unit stages in a standing wave thermoacoustic engine that can impact both the onset temperature and its acoustic field. The onset temperature is predicted by utilizing a fundamental equation of hydrodynamics and then using DeltaEC software to investigate the acoustic field throughout the engine. The result showed that an appropriate number of unit stages in the standing wave thermoacoustic engine need to be considered in order to get the optimum engine.

Numerical Study of the Effect of Economizer Hopper Dimensions on the Number of Fly Ash Particles that can be Captured in the Flue Gas System

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Abstract. Fly ash in flue gas can clog and cause corrosion in the air preheater. Therefore, the flue gas channel at the outlet of the power plant needs to be designed to accommodate fly ash using a hopper. The function of the hopper is to separate the flow of flue gas from fly ash by collecting the fly ash. The purpose of this research is to determine the effect of hopper dimensions on fly ash and flue gas and to find the optimal hopper dimensions for the power plant. In this study, the variations used are without a hopper and hoppers with depths of 3 m, 4 m, and 5 m. Deeper hoppers result in an increase in flue gas velocity at the outlet and heat transfer coefficient values towards the air preheater. However, the changes in flue gas velocity at the outlet without a hopper and with a hopper are very small, so they do not significantly affect the air preheater. Deeper hopper depths result in increased pressure drop of flue gas and Reynolds number. Increasing the hopper depth leads to a decrease in outlet temperature and heat transfer value towards the air preheater. Deeper hoppers also lead to a decrease in the percentage of fly ash and mass of fly ash passing through to the air preheater, while the mass of fly ash trapped in the hopper increases. The 5 m hopper dimension is the best in reducing fly ash escape, with only 18.53% of fly ash parcels escaping, 86.75 kg of fly ash trapped in the hopper, and only 0.9 kg of fly ash mass escaping.

Keywords: Economizer Hopper, Flue Gas, Fly Ash, Particles, Numerical.

Simulation and Modeling of Internal Combustion Engine for Control Algorithms in Chevrolet Tavera Electric Vehicle Traction System

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Abstract. The conversion of a vehicle powertrain from an internal combustion engine (ICE) to an electric machine (EM) needs to be carried out in a manner that aligns with the characteristics of the vehicle in order to ensure uncompromised driving comfort. Therefore, this study focused on the transformation of the ICE Powertrain-driven Chevrolet Tavera into an EM Powertrain system drive. Models using MATLAB® Simulink® were developed to estimate the characteristics of the EM powertrain system. The Chevrolet Tavera Estimator was assembled by embedding several key components, including a generic engine system block, longitudinal vehicle body, transmission system, torque converter, and a set of controller unit blocks. Each component was parameterized based on the specifications of the Chevrolet Tavera vehicle and simulated in the time domain. During the process of estimating the system identification of the vehicle, the generic engine rotation was used as the input data, while the output transmission rotation served as the target data. This approach enabled the determination of the transfer function of the vehicle. By utilizing the transfer function, it became possible to design the EM Powertrain and its associated control system. Based on the findings, the optimal vehicle characterization by identification includes G-Force values, engine speed, transmission output speed, and vehicle speed of 0.1571 gf, 2898.51 rpm, 2514.75 rpm and 97.235 km/hour respectively. The transfer function showed a 72.64% match with these parameters, effectively representing the performance of the vehicle.

Keywords: Vehicle, Powertrain, MATLAB®Simulink®, Internal Combustion Engine, Electric Machine, Transfer Function, System Identification.

The Performance Comparison Between Modelled and Fully Simulated Porous Media in Turbine Blade Cooling

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Abstract. Porous media is utilized in internal blade cooling. This is because of high surface area to volume ratio in the heat transfer process and the intensive flow mixing which is caused by the complicated to tortuous path of the porous structure. In the present study porous media is modelled and fully numerical simulated by using Ansys 19.2 and it is applied in NASA C3X turbine blade. In the simulation, modifications were made to the number of holes from the NASA C3X turbine blades which were originally 10 cooling channel holes to 8 holes. The three holes near the leading edge are merged into one hole while maintaining their total mass flow rate. In the new hole, it is installed porous media, in the form of fixed bed sphere, in mid-span with the length 1/3 from the length of cooling passages. The meshing process was carried out with conformal meshing in order to obtain mesh results with joint between nodes at the solid-fluid boundary. The total number of elements produced from the meshing is 15.6 million elements. From the simulations, qualitative and quantitative data will be obtained. Qualitative data is temperature contour while quantitative data are temperature distribution and heat transfer coefficient.

Keywords: Porous media, Numerical study, NASA C3X, Conjugate heat transfer.

Numerical Study of the Performance of Twin Savonius Hydrokinetic Turbines with Adjacent Advancing Blades in a Side-by-Side Configuration Placed in a Narrow Channel

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Abstract. This research was conducted to determine the effect of placing two Savonius hydrokinetic turbines in the narrow water channel arranged side by side with adjacent advanced blades on the performance turbine. The two turbines rotate in opposite rotations. The study uses Ansys FLUENT 2021 R2 with meshes selected from the grid independence test process. The simulation uses a k-epsilon model. Dynamic torque every 1˚ will be recorded for 10 revolutions to calculate power coefficient and moment coefficient values. This study uses a water channel with a dimension width of 500 mm. The turbine has a blade diameter (D) of 60 mm and a turbine shaft diameter (b) of 10 mm. This research was conducted using the distance ratio between two turbine shafts with a turbine diameter (S/D) of 2.667 and a water speed of 0.25 m/s, equivalent to the Reynolds number (Re) = 3.1 x 104. The results of the simulation show that for a relative distance between the two turbines of S/D = 2.667, the maximum power coefficient for the upper and lower turbine is 0.34 each at a tip speed ratio (λ) = 1.2. This value is 82% higher than the single turbine. In addition, this also causes the turbine's operating range (tip speed ratio) to be wider, namely in the range λ = 0 to 2, compared to a single turbine which is only in the range λ = 0 to 1.5.

Keywords: Hydrokinetic Savonius Turbine, Side-by-side, Narrow channel, Opposite rotations, Power coefficient, Moment coefficient.

Numerical Study of the Effect of Vortex Generator Located at the Near Wall-Body Junction on the Aerodynamic Characteristics of NASA LS-0417 Airfoil

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Abstract. Boundary layer flow separation from the wing surface plays important role for the airfoil drag development, and therefore the flow separation must be controlled properly. Additionally, three-dimensional flow separation at the near- wall contributes significantly to the increase in the drag. One method that can be used to control flow separation is the installation of vortex generator. This study is intended to investigate the effect of the vortex generator on the airfoil to modify the flow separation and thus on the airfoil characteristics, including drag and lift. Additionally, the total pressure loss is also evaluated at this study. This study is performed numerically using Ansys Fluent to evaluate the effect of the vortex generator attached on the NASA LS-0417 airfoil on its aerodynamic characteristics. The vortex generator is having rectangular form with length, height and thickness are, respectively, 5.0, 2.4, and 0.5 mm. The vortex generators are located at streamwise positions x/c = 0.45, 0.50, and 0.55, and at spanwise positions z/c = 0.004 and 0.006. The Reynolds number is 1 x 105 based on the freestream velocity and the airfoil chord length, where the chord length (c) is 100 mm. The airfoil span (s) is 500 mm. Three-dimensional simulation using k-ω SST turbulent model was employed. The results of the present study show that the vortex generator can modify the flow separation significantly, and it can modify airfoil drag and lift. At the present study, the placement of vortex generator at x/c = 0.45 and z/c = 0.004 results in the best improvement compared to the other placements, where at this VG placement, the lift to drag ratio increases by approximately 7.3 percent compared to that of the plain airfoil counterpart. Finally, the reduction of the total pressure loss up to approximately of 28.5 percent can also be reported at the aforementioned vortex generator placement.

Keywords: LS-0417 airfoil, Vortex generator, Three-dimensional flow separation, Total pressure loss.

Reduce GHG's By Utilizing Biogas in Starch Industry

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Abstract. This study presents results from biogas as renewable energy source and a crucial element in sustainable research and climate change mitigation efforts. It is produced through the anaerobic digestion of organic matter, agricultural waste water. The process involves the breakdown of organic material by bacteria in the absence of oxygen, resulting in the production of biogas. Biogas primarily consists of methane (CH4) and carbon dioxide (CO2), with small amounts of other gases such as nitrogen, hydrogen sulphide, and trace elements. By capturing and utilizing biogas, we can prevent the release of methane into the atmosphere, thereby reducing greenhouse gas emissions and mitigating climate change. This paper aims to fully leverage the potential of biogas as an element of sustainable research and climate change mitigation especially in cassava & metroxylon starch industry in Indonesia. Investing in a gas collection system covered lagoon anaerobic and a modular electricity generation plant 1.5 MW, with final result total capacity of 1.2 MW per day then reducing greenhouse gas emission based on Tier 1 IPCC 67.000 tCO2e per year.

Keywords: Renewable energy, Sustainable, Climate change, Biogas, Green house gas.

Numerical Study of Twin Rotor Savonius Hydrokinetic Turbine Arranged in Side-Byside with Adjacent Returning Blades in A Narrow Water Channel

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Abstract. This study investigates the performance of two Savonius hydrokinetic turbines positioned side by side with adjacent return blades in a narrow waterway. The blade diameter of the Savonius turbine used is 60 mm. Additionally, the cross-sectional area of the water channel is 500 mm × 490 mm. The water velocity in this study is 0.25 m/s, equivalent to the Reynolds number (Re) = 3 × 104. The ratio of the distance between the centres of the two turbines' shafts to the diameter of the turbine blades (S/D) is 2. The 2D simulation used the k-epsilon turbulence model and the moving mesh technique in the ANSYS 2021 R2 software. In the configuration studied, a single turbine and a twin turbine were compared in performance in order to investigate the twin turbine's performance. The maximum coefficient of power value produced by the configuration of twin turbines at S/D = 2 increased by 146.3% in the upper turbine and 163.8% in the lower turbine compared to a single Savonius turbine. The gap flow is biased to the lower turbine, causing the performance produced by the lower turbine to be greater than the upper turbine.

Keywords: Savonius hydrokinetic turbine, Side-by-side, Narrow channel, Coefficient of power, Coefficient of moment.

Combustion Characteristics in Diesel Engines Dual Fuel System with Biodiesel Fuel and Hydrogen Gas at The Medium Load

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Abstract. Palm biodiesel is known to have advantages of low emissions, oxygen content and high cetane number, but it has high viscosity properties and low heating value which will affect the performance of diesel engines. Meanwhile, hydrogen gas has a high calorific value and is flammable, as well as low exhaust emissions which can correct the shortcomings of biodiesel. This research was conducted on a dual fuel diesel engine. One of the aims of this study was to know combustion characteristics on a singlecylinder diesel engine, with constant speed 50% load 2500 watts. The first step is to vary the flow of hydrogen by 2.5 ; 5; 7.5 ; and 10 lpm. At medium loads the value of the combustion chamber pressure increases with the addition of hydrogen to the biodiesel. HRR at medium loads increase compared with single fuel biodiesel by 7.74%. Ignition delay dual fuel at the hydrogen mixture with a flow rate of 2.5 liters per minute (lpm) demonstrates the shortest ignition delay at medium engine loads. The duration of combustion dual fuel at all loads is relatively the same as compared to single fuel. At medium loads the addition of hydrogen concentration to biodiesel with h2 2.5 lpm increases the maximum value of knocking pressure.

Keywords: Dual fuel diesel, CPO biodiesel, Hydrogen gas, Combustion characteristics.

Design of Floating Tidal Energy Converter 1,5 MW for Lombok Strait

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Abstract. The increasing global energy demand and the urgency to address climate change have prompted the energy production sector to rapidly decarbonize and explore alternative sources for sustainable environmental preservation and climate change mitigation. As part of Indonesia's National General Energy Plan (RUEN), a target of 23% renewable energy by 2025 has been set, including the utilization of energy from marine source. To meet this goal, this study proposes the implementation of a Floating Tidal Energy Converter (FTEC), a technology that harnesses energy from tidal currents. Based on data from the Marine Geology Research and Development Center (P3GL) of the Ministry of Energy and Mineral Resources in 2017, which targeted the installation of 3 MW tidal energy power plants in Nusa Penida (Lombok Strait), this research presents the design and analysis of the FTEC system. The design process involves turbine modeling and analysis using QBlade software, determining the loads on the converter system and supporting equipment to establish the main dimensions of the platform and mooring system. Stability analysis and motion response in six degrees of freedom using Time Domain Analysis are conducted to evaluate the system's performance under dynamic loads in the surrounding water areas. The research adheres to relevant standards, such as DNVGL-ST-0164 for Tidal Turbines and the Guidelines for Design Basis of Marine Energy Conversion Systems published by the European Marine Energy Centre. The study results in the design of two Darrieus H-Rotor Vertical Axis Turbines, with a swept area of 2 x 332 m^2 and a rated power of 750 kW each, resulting in a combined output of 1.5 MW at a tidal velocity of 2.3 m/s. The floating platform utilizes a catamaran hull moored by a reliable mooring system. Overall, this research paves the way for future advancements in green technology and renewable energy utilization.

Keywords: FTEC, Tidal Energy, Lombok Strait, Darrieus Turbine, Vertical Axis.

Investigation of Heat Exchanger effectiveness using Solar Water Heater

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Abstract. Water heating has many applications in current scenario. However, this process consumes a lot of power. Solar water heaters (SWH) are most promising solution for this. The effective application of SWH systems are dependent upon the heat exchanger systems used between SWH and final load. Heat exchangers can be majorly classified based on direction of flow from hot and cold source; namely, parallel flow or counter flow. In this work the application of SWH is tested with both these type of heat exchangers. The effectiveness value of the counter flow heat exchanging system was found to be 11% higher than the parallel flow system. The amount of heat transfer of counter flow system was also 4.3% higher per second than the parallel flow.

Keywords: Solar, Water heater, Heat exchanger, Heat transfer, Effectiveness.

Hydrothermal Technology Processing of Municipal Solid Waste to Coal Equivalent Solid Fuel for Indonesian Power Generation

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Abstract. The economy's growth affects the energy demand, increasing power plant construction to meet this demand. Hydrothermal Carbonization involves subjecting raw material to high pressure and temperature in water for a specific duration, resulting in uniform, smaller-sized solids from the high-moisture content material. This process can effectively transfer nutrient components in biomass to a liquid product, serving as a helpful fertilizer. The hydrothermally treated solid products share similar characteristics to solid fuel, ranging between lignite and low sub-bituminous coal. This paper suggests that municipal waste can be converted into solid fuel through hydrothermal carbonization, mixed with coal to meet power plant energy needs. Consequently, this study could aid in solving municipal solid waste issues and reducing coal consumption in power plants.

Keywords: Hydrothermal Carbonization, Power Generation, Fuel, Thermochemical, Municipal Solid Waste.

Numerical Study of Intake Manifold Length Effect on Air and Fluid Flow Pattern on a 125 cc SOHC Engine

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Abstract. The intake manifold is a crucial component in the intake system. The main function of the intake manifold is to provide an even mixture of air and fuel and induce turbulent flow. The length of the intake manifold significantly influences the uniformity of the air and fuel mixture. Therefore, modification of the length of the intake manifold can be done to achieve optimal results. This study uses the CFD (Computational Fluid Dynamics) method to obtain quantitative and qualitative data through simulations. Quantitative data includes the size and percentage of the number of fuel particles, pressure, and speed. Qualitative data include fuel distribution, pathline, velocity contours and vectors, and pressure contours. The simulation results show that the longer the intake manifold, the distribution of fuel particles becomes more even and the speed is more uniform. The length of the intake manifold also affects the pressure drop at the outlet, where the longer the intake manifold, the lower the pressure.

Keywords: Intake manifold, CFD, Velocity distribution.

Indonesia Carbon Cap and Tax Analysis on 60 MW Class Pulverized Coal Boiler Coal-Fired Power Plant Decarbonization Initiative: Biomass (Sawdust) Co-firing Application

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Abstract. The release of the Ministerial of Energy and Mineral Resources of Indonesia Decree number 14.K/TL.04/MEM.L/2023 about coal-fired power plant (CFPP) greenhouse gas (GHG) emission cap, PLN as the only Indonesia-owned electricity company try to reconsider optimizing the GHG production of its CFPP's at a particular value through several decarbonization programs which are conducting biomass co-firing on its existing CFPP as the first step action. PLN has various CFPP types and classes, from two megawatts (MW) to 660 MW. In this study, the used CFPP's basis is 60 MW class, PC boiler type derived from Asam-asam CFPP unit 1-2. The CFPP emits 1.428 kgCO2/kWh, which is higher than the GHG cap mentioned by the Ministerial Decree of 1.297 kgCO_2/kWh. The CFPP uses sawdust as the biomass to be co-fired to reduce its carbon intensity. The gap between the actual GHG production and the GHG cap becomes a value that PLN should pay as a carbon tax which another regulation mentioned the value. This program is expected to boost the use of green energy and avoid the CFPP to pay the carbon tax. However, the implementation of biomass co-firing is not always going smoothly. Based on the study, a specific ratio (%) becomes the best choice to be implemented because it produces the least cost. Based on the study, it can be concluded that the effort to avoid carbon tax must not be profitable. In this study, the action that is recommended to the CFPP is to conduct the biomass cofiring in the ratio of 5 – 9% in terms of economics. However, when the carbon cap value becomes a mandatory factor that shall be obeyed, it shall conduct the biomass co-firing with a ratio of about 10.5% at the minimum.

Keywords: Renewable energy, Decarbonization, Biomass, Co-firing, Coal, Indonesia, Carbon cap, Carbon tax.

Techno-Economic Analysis for Green Hydrogen Production in Gresik District

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Abstract. Carbon emissions have increased annually by 5.5%, which in 2022 is estimated to be 83 million tons of carbon emissions. In 2030, Indonesia has a target of reducing emissions by 32%, equivalent to 912 million tons of CO2. To achieve this target, a change towards decarbonization is designed by constructing a Green Hydrogen Plant (GHP) using the electrolysis method in Gresik District. The method used in this research is numerical analysis, which will be selected by comparing the results of the economic analysis carried out. This study aims to determine the right green hydrogen plant series from the variables studied and analyzed techno-economically, which include NPV, IRR, BEP, and LCOH in each series, and be compared.

Blade Profile Design Optimization of Bach-Type Savonius Vertical Axis Wind Turbine Using Cubic Spline Interpolation Graphic Method

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Abstract. Savonius Vertical Axis Wind Turbine (VAWT) is a type of rotating equipment that can convert wind kinetic energy into electrical energy. The advantages of this type of wind turbine are a simpler design than horizontal axis (HAWT) type wind turbines and a good ability to utilize wind from all directions. This research was conducted to obtain the optimal design of the Bach-type Savonius VAWT blade profile, especially in the blade arc angle (θ) and blade shape ratio (p/q) parameters. The method used is a two-dimensional Computational Fluid Dynamics (CFD) numerical simulation using ANSYS Fluent software and k-ε realizable turbulence models. The simulation was carried out with a flow velocity (U) of 4 m/s. The study was conducted by analyzing the aerodynamic performance of twenty-four Savonius VAWT models with variations in blade arc angle (θ) dimensions of 125°, 135°, 145°, 155°, 165° and 180° and blade shape ratio (p/q) variations of 0, 0.2, 0.4 and 0.6. The simulation coefficient of power (CoP) data will then be plotted into graphs on three-dimensional cartesian axes and contour graphs using the cubic spline interpolation method. From the formed graph found the optimal point of the turbine blade profile. The optimal design is compared back to the conventional semi-circular Savonius VAWT design to determine the improved performance of the optimized turbine. The optimal design is a model with blade arc angle (θ) = 139° and blade shape ratio (p/q) = 0.6. The optimal design yields a coefficient of momen (CoM) value of 0.277 and a CoP of 0.1943. The optimal design has an aerodynamic performance (CoP) higher by 8.78% compared to conventional designs.

Numerical Study of the Performance of Twin Co-Rotating Savonius Hydrokinetic Turbines Arranged Side by Side in a Narrow Channel

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Abstract. The Savonius turbine, known for its simplicity, could be used as a hydrokinetic energy conversion machine, albeit with low efficiency. To address this limitation and utilise the space in the water channel, the installation of neighbouring Savonius turbines was proposed. This research was carried out to evaluate the performance of twin corotating Savonius hydrokinetic turbines installed side by side in a narrow channel. Two-dimensional simulations were conducted using ANSYS Fluent, employing the realisable k-epsilon turbulence model. The inlet water velocity (U) was set at 0.25 m/s, corresponding to a Reynolds number of 3×10^4 based on the inlet velocity and the turbine diameter. The narrow channel was designed to have a width of 8.33 times the turbine blade diameter (D). The ratio of the centre distance between the two turbines to the turbine blade diameter (S/D) was set at 2.33. Through analysis of the coefficient of moment and coefficient of power graphs, the installation of twin co-rotating and side-by-side Savonius water turbines within a narrow channel enhanced the performance of both turbines compared to a single Savonius turbine in the same channel. Furthermore, the operating tip speed ratio range of both turbines was wider compared to the single turbine. Notably, one of the turbines consistently exhibited higher performance than the other. The peak coefficient of performance for turbine 1 and turbine 2 was increased by 89% and 178%, respectively, compared to a single turbine.

Keywords: Co-rotating, Hydrokinetic, Narrow channel, Savonius turbine, Side by side.

Numerical Study of the Performance of Two Hydrokinetic Savonius Turbines with Unidirectional Rotation in Tandem Configuration

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Abstract. Hydrokinetic turbine is a potential alternative energy to be developed to reduce carbon emissions that harm the environment. The beneficiary equipment that can be used is the Savonius hydrokinetic turbine. Savonius hydrokinetic turbine is simple in design and construction and can work at low water flow speeds (i.e. low head rivers). The drag force becomes the main driving force in the Savonius turbine to generate rotating torque. The cultivation of energy in a long water canal by utilising several Savonius hydrokinetic turbines is interesting to study, especially determining the minimum distance for placing several turbines arranged in tandem so that the turbines do not affect each other. This research aims to study the interaction of twin Savonius hydrokinetic turbines arranged in tandem and co-rotating at a distance of T/D = 2.667 and 50, where D is the turbine blade diameter of 60 mm. This research was carried out numerically with the help of Computational Fluid Dynamics software, namely Ansys Fluent 2023 R1. The performance of the two Savonius water turbines is shown based on the power coefficient and torque coefficient supported by the velocity flow contour. The simulation results show that at T/D = 50, the two turbines have practically the same power and torque coefficient values. This shows that the two turbines no longer affect each other.

Numerical Study of The Effect of The Upstream Installation of The D-Type Cylinders On The Performance Of The Savonius Wind Turbine

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Abstract. This study aimed to investigate how the performance of the Savonius wind turbine, characterized by blade diameter (D) of 165.2 mm, end plate diameter (Do) of 320 mm, and shaft diameter (b) of 19 mm, is influenced by the introduction of D-type cylinders as disturbances. These cylinders were added with various cutting angles (θs) of 0°, 53°, and 65°. The research was conducted using a 2D simulation using FLUENT 2021 R2, operated at a wind speed of 7 m/s or equivalent to the Reynolds number (Re) = 1.5 x 10^5. A circular cylinder is placed ahead of the turbine at a distance where S/D = 1.25 and y/D = 0. The outcomes indicated that incorporating a cylinder with specific cutting angles can lead to an augmentation in the maximum power coefficient value of the turbine. The maximum power coefficient value of the turbine (Cpmax) with D-53°type disturbance is 0.18737at tip speed ratio (λ) = 0.6. This value is 1.025 times greater than that of a conventional turbine. But unfortunately, the placement of the D-0°type and D-65° type cylinder in front of the turbine makes the maximum power coefficient of the turbine only 0.17363 and 0.16259, which is 5 and 11.06% lower than the conventional turbine one.

Keywords: Savonius turbine, Coefficient of power, Moment coefficient, D-type cylinder, Upstream installation.

Numerical Study of the Performance of Two Savonius Hydrokinetic Turbines with Opposite Rotation in Tandem Configuration

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Abstract. The water turbine suitable for low flow rates is the Savonius hydrokinetic turbine. Efforts to optimise water energy sources are by using multiple turbines. Therefore, this research was conducted with two Savonius hydrokinetic turbines with opposite rotation in tandem configuration at a distance ratio between the front and rear turbine centre to the turbine blade diameter (T/D) of 50 and a water speed of 0.25 m/s. The Reynolds number used is 3.08×10^4. The turbine blade diameter (D) is 60 mm, the characteristic length of the turbine (L) is 110 mm, and the endplate diameter (D_o) is 115 mm. The research was done numerically using 2D geometry modelling through the ANSYS FLUENT 2021 R2 software by applying a realisable k-epsilon model. The CM and CoP of tandem turbines are larger than single turbines at a TSR of 0.8-1.4. The Cp and TI produced by a tandem turbine resemble a single turbine, indicating that the two turbines do not affect each other, and it can be said that the turbine can work independently at a TSR of 0.8-1.4.

Numerical Study of the Impact of Thermal Paste on the Base Plate of a Water-Cooled Photovoltaic (PV) Module for Performance Optimization

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Abstract. PV installations in Indonesia are viable solutions to generate solar that is harmless to the environment. However, in equatorial zone, the average temperature on sunny days ranges between 34˚C to 40˚C, which leads PV panels to overheat, thereby reducing their efficiency and performance. Various methods for cooling have been implemented, but the resulting temperatures have not yet attained optimal levels due to the inefficiency of cold conducting materials. In this study, a redesigned water-cooled panel with thermal paste as a modified encapsulant (EVA layer) to improve heat transfer distribution and cooling performance efficiency. A numerical simulation is performed to model the fluid flow in the base plate and analyze the thermal paste's heat transfer. The PV cell components are cooled easier due to the use of thermal paste as a modified EVA, as indicated by the final cooling temperature of 29.85 degrees Celsius. However, the area closest to the inlet and outflow cools the fastest. As a result of the final cooling temperature, an increase in electricity production of between 8% and 10% was reported.

Keywords: Photovoltaics, Cooling system, Water-cooled PV, CFD, Thermal paste, Heat transfer

Effect of Installation of an Ellipse Cylinder Beside The Advancing Blade on The Performance of The Savonius Wind Turbine

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Abstract. This research was carried out by adding a circular or elliptical cylinder beside the advancing blade to create a nozzle effect on the flow. An ellipse cylinder allows the wind to pass through a slightly longer path so that frictional losses increase which causes a pressure drop behind the advancing blade. The pressure difference between the front and rear sides of the advancing blade will increase, so the pressure drag acting on the advancing blade will also increase. The difference in the drag force of the advancing and returning blades will also increase so that the positive torque of the wind turbine and the turbine power increase. This research used a 2D numerical method using the ANSYS 2021 R2 software with meshes selected from the grid independence test process. The simulation uses a k-ω SST model. In this research, the ratio of vertical cylinder diameter to turbine diameter (Y/D) is 0.5, the distance from the centre of the wind turbine to the centre of the cylinder (T/D) is 1.50, and the flow velocity is 5 m/s. A circular or elliptical cylinder placed beside the advancing blades varies in cylindrical shape, namely the diameter ratio (Y/X) of 1/8, 1/4, 1/2, and 1. The simulation results show that Y/X = 1/2 has the maximum performance compared to turbines with other cylinder shapes. However, this configuration is still less than the performance of the Savonius wind turbine without cylinders. This is because the distance T/D = 1.50 is still considered too close, so blockage tends to occur in the gap between the cylinder and the advancing blade.

Keywords: Savonius wind turbine, Cylinder, Advancing blade.

Enhancement of Energy and Power Model for Electric Hybrid VTOL UAV with Flight Test Data

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Abstract. Hybrid VTOL configuration is an increasingly popular choice for UAV design, combining the cruise efficiency of a conventional fixed wing aircraft while retaining the ability to operate out of limited landing space. The development of Hybrid VTOL UAV, like many complex system, may involve the use of MBSE framework that make use of analytical model to perform evaluation and verification process. Therefore, this paper proposed a power and energy model enhanced with data from test flight log of a real Hybrid VTOL UAV with the purpose of integration with MBSE framework. The results of the enhanced model aligns with mission log data, however further validation is needed to gauge the effectiveness of both the proposed model and the enhancement.

Effect of Distance on Multistage Runner Gravitational Vortex Water Turbine (GVWT)

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Abstract. Gravitational Vortex Water Turbine (GVWT) is one of the water energy generators with the characteristics of the working area at low head under 3 m and high discharge. This study is conducted on a GVWT turbine using multistage configuration and aims to determine the performance of the runner in a multi-stage configuration by CFD numerical analysis and experimental. The parameters used to determine the performance are torque, power, and efficiency. The result shows the best distance variation is 1.5D with a torque 0.477 Nm and an efficiency of 47.3% due to the distance between runners provides space for vortex to reshape its form through a phenomenon called re-origination. Compared with experiment, the difference results in efficiency of 4,7% with the best efficiency of 42.6% at 1.5D.

Impeller Design and Slurry Pump Selection on Cutter Suction Dredger Project

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Abstract. Cutter Suction Dredger (CSD) is a type of dredger which works hydraulically by using a slurry pump to move material to the disposal site. In the selection of slurry pumps, the calculations used are not the same as those of pumps in general. This is due to differences in the characteristics of the working fluid, especially its density. In addition, because pump performance data generally uses water as a working fluid, a performance correction calculation is needed to obtain the appropriate value. In this project the aims are to identify the characteristics of the working fluid, select the slurry pump and design the impeller based on API 610 standard. The stages in this project are divided into three: calculation; selection; and design. The results showed the working slurry fluid has a characteristics, specifically: Density (ρ) of 1269 kg.m-3 ; Specific Gravity (SG) of 1,269; and Dynamic Viscosity (μ) of 0,0016252 kg.m-1 .s -1 . The Head effective installation (Heff) for working fluid of water analytically is 58.215 m and numerically, using Pipe Flow Expert software, is 58,216 m thus resulted error rate of 0,0023% within the allowable limit

Numerical Simulation on the Last-Stage Low-Pressure Turbine with and without Lacing Wire

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Abstract. A last-stage LP turbine is a potential way to increase the efficiency of a steam turbine. The primary objective of this study is to investigate the characteristics of the performance parameters in the last stage of the LP steam turbine, which explores the single-phase flow in steady-state three-dimensional Computational Fluid Dynamics (3D CFD) for the stator-rotor interaction by comparing two models for the rotor blade that rotates with and without lacing wire due to variation three time of target mass flow rate with pressure inlet. ANSYS-Fluent is the best software used for computation using the steady-state flow model. The performance of the steam turbine derives from CFD results in the static pressure, the torque on the rotor blade, and the flow structure around the lacing wire. And the FEA releases the result of equivalent stress, strain, and total deformation of the rotor blade. Comparing the internal flow features of the final stage blade in the two models with and without lacing wire, it is clear that the model with lacing wire suffers from an energy loss larger and that the flow is not very smooth where the lacing wire locate. Finally, the high torque is for the model without a lacing wire, while the model with a lacing wire has a lower torque than the model without a lacing wire. The maximum stress is in the elastic zone and at the leading rotor blade for the model without lacing and at the interaction of the lacing wire with the rotor blade. The maximum strain is consistent with maximum stress. The maximum deformation, both models appear at the tip for all variations.

Keywords: 3D CFD, Last stage LP steam turbine, Lacing wire, Stator-rotor interaction, Steady-state flow.

Numerical Investigation of The Efficacy of Downward Push-Pull Air Curtain for Protecting Standing Shop-Floor Worker from Virus Transmission Through Coughing Droplets

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Abstract. An article usually includes an abstract, a concise summary of the work covered at length in the main body of the article. It is used for secondary publications and for information retrieval purposes.

Experimental Study of the Influence of the Upstream Installation of The I-Type Cylinder on the Performance of The Savonius Wind Turbine

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Abstract. This research was conducted to determine the effect of placing a bluff body having a diameter of d = 88 mm in the form of a circular cylinder, I-65 cylinder and I-53 cylinder in the upstream area of returning Savonius turbine blade. The study is experimentally done in an open lab using an axial fan as the source of the wind blowing in a wind speed of U =7 m/s equivalent to the Reynolds number (Re) = 1.34 x 105 (based on wind speed U and characteristic length, L). The turbine has a blade diameter (D) of 165.2 mm and a height (h) of 295 mm. The bluff bodies, having a diameter of 0.5 times that a blade diameter, is installed upstream of returning turbine blade, with varying the ratio of the bluff body distance in the Y axis relative to the centre of returning turbine blade to the turbine diameter (Y/D) +0.5; +0.25; 0; -0.25; -0.5. The distance between the bluff body cylinder to the centre of the returning turbine blade is set to S/D = 1.4. The experiment result shows that the installation of the bluff body upstream of the returning blade at the position of Y/D of +0.5; +0.25; 0, -0.25 can increase the performance of the turbine, while at Y/D = -0.5, the turbine' performance is reduced. Improvement in wind turbine performance is indicated by the increase of the coefficient power (Cp) of the turbine with the bluff body compared to the conventional Savonius wind turbine. The maximum power coefficient (Cp) observed in the Savonius turbine equipped with an I-65° type cylinder and the Y=0.25 increases to 31.08% compared to the conventional turbine. These excellent results of the experiment are obtained for a Tip Speed Ratio (λ) of 0.61.

Keywords: Savonius wind turbine, Power coefficient, Bluff body cylinder, I-Type Cylinder, Experimental study.

Convective Heat Transfer Performance on Various Straight Fin Configurations

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Abstract. The rapid increase in electric vehicle demand is led by the awareness of sustainable energy transition. In an electric vehicle, the battery holds a prominent role in energy and power storage, directly affecting its performance. One of the most reliable options for batteries is Li-ion due to its high power and energy density. However, Li-ion is sensitive to its temperature. To ensure the working temperature of Li-ion, many attempts have been made to enhance the heat transfer performance of a battery thermal management system, including surface modification. This study discusses the heat transfer of straight fins with various dimensions and shapes. The results show that the Nusselt number has improved (from just above 30 to almost 60) as the Reynolds number rises. Furthermore, the trapezoidal fin provides higher cooling performance, although the effect is diminished at a higher velocity proven by 8% higher Nu at 1 m/s. Finally, enhancement efficiency is also compared and shows that, although provides higher Nu, trapezoidal fin and higher velocity flow have much higher energy consumption due to pressure drop.

Exploring the Impact of Relative Humidity on Cough Droplet Evaporation and Dispersion in Confined Environments: A CFD Analysis

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Abstract. This study employed a numerical approach known as the multi-component Eulerian-Lagrangian method to investigate the evaporation of droplets generated during a person's cough. A three-dimensional turbulence model was utilized to replicate the air movement within the specified area, and a Lagrangian particle trajectory analysis approach was employed to trace the movement of the droplets. The utilization of the RNG k-ε turbulence model has been applied in simulations. The primary focus was to explore the impact of relative humidity on droplet evaporation. The findings revealed that high relative humidity, characterized by super-saturated wet air, delays the attainment of droplet equilibrium even after evaporation into droplet nuclei. Higher RH levels, specifically within the range of 30% to 50%, lead to longer evaporation delays. Smaller particles (10 microns) experience an evaporation delay of approximately 18%, while larger particles (100 microns) encounter a more substantial delay, reaching up to 26%. The droplet diameter undergoes a reduction of up to 20 percent from its initial size. Consequently, both the number of droplet nuclei and the concentration of carried pathogens can experience a significant increase. Such circumstances pose a heightened risk of respiratory infections.

Keywords: Evaporation, Relative humidity, Droplet, Multi-Component, Eulerian-Lagrangian.

Development of a Real-Time Monitoring and Power Prediction System for Solar Power Plants Using Machine Learning

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Abstract. Overcoming most problems in PV, a monitoring system including data acquisition and data display was created in real-time, and a prediction model for PV power in the next few hours was developed. The highest value of efficiency is when the PV module is configured at a tilled angle of 30°. The input predictions are processed by the stored model. The model used variations of k-NN, k-NN-BPNN, and k-NN-D-BPNN. The model has a MAPE yield of 0.52% for k-NN, 0.95% for k-NN-BPNN and 33.47% for k-NN-D-BPNN, and MSE of 59.84 W2 for k-NN, 225.94 W2 for k-NN-BPNN and 17.701 W2 for k-NN-D-BPNN so that the model is a very good and feasible prediction. The resulting accuracy decreases when the prediction time is added. Therefore, predictions need to be limited to the next 3 hours.

Numerical Study on The Effect of Modification Internally Cooling Passages of NASA C3X Turbine Blade

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Abstract. One way to improve the thermal efficiency of gas turbine is increasing the turbine inlet temperature. Various types of cooling technology have been applied in gas turbine blade either external or internal cooling. Based on the manufacturing process, the internal cooling is the easiest one. Modification of the number and size of the internal cooling passage plays important rule in blade design. It affects the amount of heat transfer, the temperature distribution and the gradient inside the blade and also the mass flow rate of the cooling air and thus resulting the overall efficiency of the turbine. Therefore objective of the present study is modifying number and the size of holes cooling channel of NASA C3X Turbine blade by using ANSYS 19.2. The variation of mass flow rate of ṁ -10%, ṁ +10%, and ṁ +20% from the normal design of C3X turbine blade have been applied. The resultsshow that the modified cooling holes has an adverse effect than the normal turbine blade. The modified cooling holes increases the blade surface temperature by 3.29% which is equivalent to 20.85 K, reduces the heat transfer coefficient by 16.43% which is equivalent to 72.85 W/m2K and reduces the total heat transfer rate by 13.51% which is equivalent to 648.14 W. But in another side by increasing the cooling mass flow rate improves the cooling performance. When compared to the normal C3X turbine blade, the variation with the largest mass flow rate ṁ +20% reduces the blade surface temperature by 2.21% which is equivalent to 14.48 K, increases the vane surface heat transfer coefficient by 23.55 % which is equivalent to 87.22 W/m2K and increases the total heat transfer rate by 8.13% which is equivalent to 337.3 W.

Design of Linkage Guide Vane to Control Water Flow in a 6-Blade Kaplan Turbine Runner

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Abstract. The Kaplan turbine has guide vanes to control the water flow to the runner blades in the turbine, regulate the water flow, and stop the water flow. The objective of this research is to obtain an optimal design of the linkage guide vanes for a 6-blade Kaplan turbine and determine the thrust force values generated by the water flow when the guide vanes are opened at 20%, 40%, 60%, 80%, and 100% from the closed position. The research begins with a preliminary design to determine the forces and minimum dimensions, followed by a 2D and a 3D design, then developed with automatic meshing, boundary conditions, loading, and material properties to get stress simulation. In contrast, flow and pressure simulation is performed on the spiral case when the guide vanes are closed and opened at 20%, 40%, 60%, 80%, and 100%. Validation of the simulation results shows that this linkage guide vane mechanism design can open and close the guide vanes. The minimum safety factor obtained is 4.02, and the maximum pressure is 360393.95 Pa when the guide vanes are opened at 20% from the closed position. The minimum pressure obtained is 118084.31 Pa when the guide vanes are opened at 100%. This design is deemed feasible as it does not exceed the minimum safety factor requirement of 4ul.

Keywords: Design, Guide vane, Linkage mechanism, Safety factor.

The Effect of Hydrodynamic Wave Load on 5 MW Semisubmersible Floating Offshore Wind Turbine

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Abstract. A wind Turbine is a technology that can convert wind energy into electrical energy by utilizing the rotation of the rotor to rotate the generator. Wind turbine technology has developed both onshore and offshore to overcome the global energy crisis. The wind speed in the offshore site is more stable than in the onshore site due to less obstacles. The energy potential in offshore can be reached by using a semisubmersible floating offshore wind turbines that can operate in above 60 meters which is concluded as intermediate-to- deep water. However, the hydrodynamic wave load creates a force that can cause motion on the platform. The motion of the platform will affect the control system and the dynamic response of the turbine components and also the generator performance. Response characteristics of offshore wind tubine in some period range of the ocean wave is a crucial parameter to be considered in the analysis. structural dynamic analysis can be completed simultaneously based on hydro-aero-servo-elastic. Moreover, this study compares the dynamic response of a semisubmersible floating offshore wind turbine and an onshore-based wind turbine with the same capacity to identify the effect of wave loads on wind turbine performance.

Composite Multi-Criteria Decision Analysis for Optimization of Hybrid Renewable Energy Systems: IKN-Nusantara as a Case Study

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Abstract. Indonesia has decided to move its capital from Jakarta to IKN in East Kalimantan. In line with the decision, currently, Indonesia has also committed to increasing the use of green energy and reducing carbon emissions, development of renewable energy infrastructure in IKN is the subject of current priority. With the knowledge of the best hybrid system to be applied to IKN, this research is expected to address the intermittent problem that exists on Renewable energy Power Plant. The criteria to be used in decision-making analysis (MCDM) are technical and economical, the overall criteria are used to obtain the best HRES configuration design. IKN Potensial Renewable energy Resources will be simulated and optimized using HOMER software for subsequent analysis using the decision-making algorithm AHP-TOPSIS method, MCDM analysis will be obtained the best HRES configuration rating. The Outcome of this study is to get the Best Hybrid Renewable Energy System (HRES) Configuration that has reliability to support the sustainability of electricity supply on the IKN. This indicates that extensive investment in PV/Natural Gas/Diesel/ Battery system has a reasonable potential to achieve electricity load demand at IKN-Nusantara. this research are expected to be a reference to relevant authorities in decision-making on the use of new renewable energy systems on IKN.

Near Endwall Three-Dimensional Flow Control of NASA LS-0417 Airfoil using Co-Rotating Vortex Generator

Sutardi and Joshua Clarence S.

Abstract. Optimal wing design has a great influence on the performance, safety and efficiency of an aircraft. Maximizing lift and minimizing drag at low speeds and high angles of attack are crucial. One of the methods how to improve the performance of aircraft wings or airfoil is by minimizing the flow separation from the airfoil surface that leads to the increase in lift coefficient and the reduction in drag. This study is intended to evaluate the effect of the attachment of vortex generator at the near end of the airfoil on the characteristics of three-dimensional secondary flow at the near wall-body junction. The study is performed numerically using CFD commercially available software employing k-omega shear stress transport turbulence model. Two-parallel rectangular vortex generator was situated on the top surface of a NASA LS-0417 airfoil and at spanwise distance from the main body of approximately 4%C and 6%C, where C is the airfoil chord length. Next, there are two chordwise locations of the vortex generator that are investigated in this study, i.e. x = 0.45C and x = 0.55C. Figure 1 shows simulation domain of the present study, while Fig. 2 shows over all meshes and detailed meshes. Table 1 shows research parameters that are used in the present study. Figure 3 shows top view of vortex generator at x = 0.45C (C = airfoil chord length = 0.1 m).

The results of this study show that there is an increase in lift to drag ratio (CL/CD) of approximately 27% at angle of attack of 13 degrees compared to that of on the plain airfoil counterpart, when the vortex generator is situated at x = 0.55C. At this configuration of vortex generator, the presence of vortex generator can reduce the intensity of secondary flow at the nearwall body junction. Figure 4 shows three-dimensional velocity pathline around airfoil at α = 0o, with VG at x/c = 0.55, while table 2 shows lift to drag ratio (CL/CD) obtained at the present study.

Keywords: LS-0417 airfoil, Vortex generator, Three-dimensional secondary flow, Wall-body junction, Lift to drag ratio.

The Shear Layer of D-65° Type bluff body in Effect of Main Cylinder as passive control flow Modification: A Numerical Analysis

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Abstract. Numerous engineering disciplines have extensively researched the airflow around a cylindrical object. This flow configuration holds significant engineering applications and remains a prominent topic in aerodynamics research. The circular cylinder experiences substantial dynamic drags due to flow separation. For this study, Ansys Fluent® was employed to analyze the aerodynamic forces on the main cylinder and its interaction within a 2D unsteady flow. The investigation utilized a main cylinder with a 60 mm diameter, accompanied by a disturbance cylinder of the D-65° type. The distance between the central points of the two cylinders was s/D=1.375. The Reynolds number was Re = 5.3 × 104 with a U∞= 14 m/s velocity. The simulation employed the transition k-kl-ω (3 eqn) turbulence model. The study revealed that tandem cylinders exhibit superior aerodynamic performance by comparing various measurement parameters for single and tandem cylinders. One key parameter investigated was the coefficient of pressure (CP), which indicates the extent of separation delay around the central cylinder. The lift coefficient (CL) decreased by 15%, the coefficient of drag (CD) reduced by 46.95%, and the pressure and wind speed contours indicated delayed separation and diminished pressure drag.

Keywords: Coefficient of drag, CFD, Shear layer, Cylinder Circular, Cylinder D-65° type.

MANUFACTURING AND DESIGN

Plastic Injection Tool for Cone Chain Production Using Bottle Waste: Design-ing and Manufacturing

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Abstract. This study aims to design and manufacture a plastic injection tool to process plastic waste into a cone chain. This plastic Injection tool is designed to be vertical/perpendicular with the main components, namely the hopper, barrel, piston, nozzle, body, and transmission lever. The mold uses the core and cavity method. The specifications for the plastic injection device produced are a vol-ume of 64.27 mm3, a heating time of 15 s, an injection pressure of 6.77 kg and an electricity consumption of 450 watts. Based on the results of testing the melting temperature tool, the values obtained are 245°C HDPE, 190°C LDPE, 230°C ABS, and 265°C PC. From the results of the plastic waste processing, a product with an average weight of 5.14 gr is produced. with a product tensile load that varies according to the raw material, namely the HDPE type produces a product with a tensile load of 216.6 N, LDPE of 110 N, ABS of 153.3 N, and PC material with a tensile load of 200 N. Depreciation of HDPE type of product is 0.94 %, LDPE 0.459%, ABS 0.229%, PC 3.116%.

Keywords: Plastic Waste, Plastic Injection, Plastic Molding

Tool Life Simulation on Hot Forging Process for Femoral Stem of Hip Arthroplasty

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Abstract. This study aims to find the maximum number of cycles of die forging for the manufacture of femoral stems. Femoral stem is a part of hip arthroplasty or an artificial joint that is needed by osteoarthritis patients. The mechanical properties of the femoral stem with the forging process are better than the casting process. The forging process using a large load allows plastic deformation to occur on the die. Changes in die geometry cause product results not in accordance with specifications. The maximum number of cycles of dies forging indicates the usage limit of the dies when operated at specified process parameters. Modeling simulations were carried out using the finite element method using SS316L plate material and Ti6Al4V bars. The loading speed is set at 300mm/s. Variations of the workpiece are plates with thicknesses of 12, 13 and 14 mm and bars with neck diameters of 24, 25 and 26 mm. The total deformation and maximum equivalent stress are obtained from this simulation. Then the results are entered into the Archard Wear Equation. From the equation, the depth of wear is obtained and used to determine the number of cycles die. The results showed that the largest number of cycles dies for plate workpieces with a thickness of 12 mm was 5767 cycles and for bar workpieces with a diameter of 24 mm was 3623.

STRESS ANALYSIS OF API 5L X80 PIPE WITH DENT DEFECT CAUSED BY INDENTER RIPPER BUCKET TEETH

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Abstract .Dent defects are a common form of damage to subsea or land pipelines. Damage to pipe construction due to dent defects threaten the pipeline network's safety and reduces the efficiency and effectiveness of fluid transportation. Subsequently, to bolster the security of the pipeline arrangement, the planned pipeline development must comply with the measures set by the Association of Mechanical Engineering (ASME), particularly ASME B31.8. Mark abandons are no particular case.

This study uses the finite element method to analyze the pipeline network's failure due to dent defects in the pipe segment, specifically the API 5L X80 pipe. The API 5L, X80 pipe segment design uses Computer-Aided Design (CAD) software. Then, the design is analyzed using finite element analysis software. Finite element analysis in this study used *Displacement* variations on the indenter and radius variations of the indenter. This study's analysis output is the Von-Mises Stress value: strain, Plastic Strain, and Deflection.

The analysis of dent defects with variations in *Displacement* at the 30 mm depth indenter showed the most significant stress in the impact area between the indenter and the pipe. This stress value can be used as a reference to analyze real cases in the field of pipe failures, especially in predicting the location of the greatest failure in pipeline construction.

Keywords: *Dent defects, ASME B31.8, Finite element method, API 5L X80 pipe, Von-Mises Stress*.

Improving Rice Harvesting Efficiency: Design and Evaluation of Ripper Type Rice Harvesters

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Abstract: This research aims to compare the efficiency of using a ripper-type paddy harvester with the conventional combine harvester in the paddy harvesting process. The main focus of this study is to identify the amount of paddy wasted or not properly screened by the machines as an indicator of efficiency. The research methodology involves testing the machines both in the workshop and in the actual paddy fields using representative samples. The findings of the study indicate that the ripper-type paddy harvester demonstrates superior efficiency compared to the conventional combine harvester. The amount of paddy wasted or not properly screened during the harvesting process is significantly reduced when using the ripper-type paddy harvester. This provides an advantage for farmers in optimizing their harvest yield. Additionally, the use of the ripper-type paddy harvester offers other benefits. The harvested paddy from the machine is clean and free from contamination by debris or other plant parts. This has a positive impact on the quality of the resulting rice, enhancing its marketability and economic value. Furthermore, the use of the ripper-type paddy harvester also has positive implications for the environment. By reducing the amount of wasted paddy, the utilization of natural resources such as water and energy in the harvesting process can be optimized. Additionally, agricultural waste management becomes more effective, reducing negative impacts on the environment and ecosystems. In the context of agricultural technology development, the findings of this research provide valuable insights for the development of more efficient, environmentally friendly, and sustainable paddy harvesters. The recommendation to use the ripper-type paddy harvester can be provided as an alternative that offers greater efficiency in the paddy harvesting process. Further research can be conducted to deepen the understanding of the impact of this technology on productivity, environmental sustainability, and the welfare of farmers.
Keywords: paddy harvester, ripper-type system, efficiency, harvest yield, environment.

Green Hydrometallurgy Process using Organic Solutions (Citric and Glutamate) for Ferronickel's by products: Preliminary

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Abstract. Laterite processing is experiencing very rapid development through pyrometallurgy and hydrometallurgy. This development is also followed by the issue of green processing so that research on green laterite processing is more focused. In connection with related issues, this research is the beginning of the development of mineral processing with organic solutions those are citric acid and monosodium glutamate in hydrometallurgical processes from ferronickel processing by-products. Based on ICP, XRD, and SEM-EDS data, the use of organic solutions is very effective in mineral processing but still needs development for organic acid solutions that dissolve almost all elements. In contrast, organic base solutions still require expansion to increase the recovery value, but this solution is more selective in reduction.

Evaluating Machine Learning Algorithm for Real-Time Heat Exchanger Optimization and Automatic Issue Detection Device: Experimental Analysis

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Abstract. This paper presents a comprehensive study on the experimentation and analysis of a machine learning (ML) algorithm for real-time heat exchanger optimization (RTHEO) and automatic issue detection. The research focuses on dataset preparation, heat exchanger parameter optimization, issue detection, self-training, and the implementation of machine learning algorithms. The proposed methodology utilizes MATLAB Simulink simulations, employing polynomial regression for parameter recommendation and a combination of algorithms for anomaly detection. The program continuously reads real-time data, compares it with historical patterns, and provides feedback to the user in case of anomalies. The algorithm adapts to observations through self-training, ensuring accurate and reliable predictions. The implementation is carried out using MATLAB, with robust error-handling mechanisms for real-world applications. The simulation procedure is discussed, and a future experimental setup is proposed to verify the program's performance.
Keyword: Machine Learning, MATLAB, Heat Exchanger, Optimization, Reliability, Prediction

Isotropic Body-Centered Cubic (BCC) Lattice Structure Design

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Abstract. Additive manufacturing technology has made remarkable advancements, enabling the development of innovative structures by leveraging existing constraints. A notable area of exploration lies in lattice structures, which offer a promising alternative to solid components. Among the various lattice designs, the body-centered cubic (BCC) structure has gained popularity. Typically, BCC structures comprise diagonal struts, with equal diameters. In this study we proposed control anisotropic strategy by combining BCC and Crossing Cylinder (CC) structure. This study aims to investigate the effect of varying the diameters of the center struts of CC and diagonal struts of BCC on two key parameters: the effective Young's modulus and the Zener anisotropic index A. To achieve this, a homogenization technique is employed, allowing the derivation of a stiffness matrix that characterizes the lattice. Subsequently, the Zener anisotropic index A and effective Young's modulus are computed based on the stiffness matrix. To establish a controlled comparison, a specific control strategy is implemented by systematically altering the ratio between the diameters of the center and diagonal struts. This ratio is maintained at values greater than 1 and less than 1 to ensure diverse structural configurations. The results of this research demonstrate that a ratio of 2.5 between the center and diagonal strut diameters yields the most favorable outcome, as evidenced by an obtained Zener anisotropic index A value of 1.08. These findings provide valuable insights into optimizing lattice structures and their mechanical properties, offering potential benefits for future applications in additive manufacturing.

Preliminary Development of the Optimum Dimension Estimator and 3D Engineering Drawing Generator of Archimedes Screw Turbine Shaft

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Abstract. This paper studies the development of the generator application for obtaining the optimum dimension parameter and 3D engineering drawing of an Archimedes Screw Turbine (AST) shaft. The research method uses Rorres equations for estimating the optimum values of AST shaft dimension parameter, utilizing two Solidwork features which are an Excel template to be an estimator and 3D engineering drawing generator, thus it is achieved the optimum values of AST shaft dimension parameter and 3D drawing of AST shaft. Its generator consists of two sub-systems, namely (i) the sub-system as an estimator of the optimum AST dimension parameter values and (ii) the sub-system as a 3D engineering drawing generator of the screw turbine shaft. The dimensional estimator has an algorithm to determine the optimum dimensions of the AST parameters based on the Rorres method, hence the maximum volume bucket of the screw blade is obtained. It is for achieving high power conversion efficiency. The second sub-system is a part that automatically utilizes the information output of the AST dimension parameter values in 3D engineering drawings using the Solidwork feature. Several data inputs for the estimator are (i)river hydraulic power data as the value of head and water flow rate, and (ii)machining facility and material availability as the value of inner radius and blade number parameters. Simulation performance tests have been done with several different inputs of hydraulic power parameters. The Performance result test showed that the dimensional estimator sub-system can determine the optimum value of each AST shaft dimension parameter as the outer radius (Ro), pitch, number of pitches, and other AST dimension parameters. The generator sub-system can generate the 3D engineering drawing of Archimedes' screw turbine. In addition, the raw material requirements for shafts and screw blades were also obtained.

Experimental Study of Anti-Friction Bearing Failure Based on Characteristic of Machine Frequency Defect

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Abstract. Bearings are machine elements that function as support elements in rotating motion in machine construction. Bearing failure will significantly affect machine performance, therefore it is necessary to monitor the failure growth. In this research, an experimental study of bearing failure was conducted, considering four types of experimental variables as factors affecting the natural frequency of bearings, such as bearing type, rotational speed, scratch depth, and scratch location. The scratch shape is deliberately given to the bearing part using a laser cutting machine as the failure representation. Scratches were machined on the inner ring raceway, outer ring raceway, or roller element part of the bearing. The Design of Experiment (DOE) used the Taguchi method, which aims to obtain a smaller number of trials but could achieve optimum results. The experiment was designed with four variables and three levels and was properly tested on a test rig. The frequency spectrum of the machine's defect characteristics was measured using a vibration analyzer. Omnitrend software was used to interpret and map the frequency characteristics of bearing failures for BPFI, BPFO, BSF, and FTF. The resulting research shows that the greater scratch depth causes an increase in the amplitude value of the defect frequency characteristic. The rotation value of the bearing shaft affects the frequency value of the measured bearing defect characteristics

Strength Analysis of MEvITS (Multi-Purpose Electric Vehicle ITS) Ladder Frame Type Due to Static and Dynamic Loads on Life Fatigue

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Abstract. The strength of the vehicle chassis structure is designed to be able to withstand the load that is applied to all sub-components of the vehicle and its cargo. Therefore, there is a need to select the use of the appropriate chassis structure. This study aims to analyze the performance and safety under static and dynamic load parameters that affect the fatigue life of the MEvITS ladder frame chassis structure. The static load analysis is done by applying the load of all vehicle component weights and also the torsional load. Loading of vehicle weight components is carried out to determine areas that experience maximum stress and a small critical point of safety factor. The torsional load is applied to determine the torsional stiffness by applying equal force values to the two front suspension brackets in the reverse direction, the positive and negative vertical axes. The dynamic loads are performed by applying random excitation to the chassis from road roughness according to ISO 8606. Random vibrations are performed to analyze the response of the chassis from random excitation to determine the fatigue factor of the chassis. Modal analysis is also carried out as input in the random vibration of the natural frequency and the shape of the chassis modes. 3D modeling design of the MEvITS chassis is using Solidworks. The static structural analysis, torsional load, modal analysis, and random vibration are performed in Ansys software. The MEvITS chassis has a safe condition under static loads with a safety factor of 1.3038. Besides that, the MEVITS ladder frame chassis also has low torsional rigidity with a value of 985.488 Nm/deg. then dynamic loading, the chassis shows good performance to resist random excitation. The factor of safety from fatigue due to random excitation is 73.

The Effect of Various Structure Mass to the Dynamic Response and User Convenience in 3D Printed Articulated and Non-Articulated Ankle Foot Orthosis

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Abstract. One of the highest components of disability is difficulty in walking which is caused by disorders of the lower limbs due to disease and joint injuries that occur in athletes. Ankle Foot Orthosis is a tool used to overcome this limitation. Therefore, it is very important to design the orthosis with biomechanical aspects and user comfort. This research has been done by giving effect to changes in structural mass on Articulated and Non-Articulated AFO types and this simulation is to determine the dynamic response that occurred. In the simulation using ANSYS Workbench software and using a dynamic load of a walking human with a gait cycle. Finally, the AFO prototype is using the 3D printing method based on the optimum design for user convenience. The results obtained, that Articulated AFO has higher stresses and deformations compared to Non-Articulated, but for each system, the stresses tend to decrease from 2mm to 5mm thick, but it is necessary to pay attention to heavy aspects. The final design for Non-Articulated is 3mm while for Articulated it is 4mm.

Design of Toilet Pressure Control System Based on PLC for Train Carriages Implementation

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Abstract. The implementation of a control system for vacuum toilets in train carriages is essential to address the drawbacks associated with conventional toilets, including high water consumption and complex maintenance requirements. This research focuses on developing a design of PLC-based Control System for Vacuum Toilets, utilizing a pressure transmitter and a Programmable Logic Controller (PLC). The pressure transmitter, with a scale ranging from -1 to 0 Bar, generates a signal between 0.5 and 4.5V. This signal is processed by the PLC, which analyzes the data and generates output signals for the actuator. The actuator, a solenoid valve, controls the flow of water, air, and waste by opening and closing accordingly. The target pressure value of -70 cmHg is maintained to ensure efficient operation of the vacuum toilets. By implementing this PLC-based control system, water conservation is enhanced, and the challenges associated with complex piping systems and excessive water consumption in conventional toilets are overcome. The system aims to improve sustainability, efficiency, and maintenance ease in train carriage sanitation.

Optimization of Electric-Bike's Frame using Topology Optimization, Back Propagation Neural Network and Genetic Algorithm

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Abstract. The use of electric vehicles has recently increased, along with public awareness of the importance of protecting against climate change. Electric vehicles have limited battery capacity, so reducing the frame weight can save energy consumption, allowing the vehicle to operate longer. Topology optimization is one way to reduce the weight of the electric vehicle frame while considering the applied maximum stress to ensure safety during riding. The topology optimization process is performed by varying input parameters (i.e., percent to retain and retained threshold) and calculating weight and minimum maximum-stress as responses using ANSYS 2021 R2. This process takes a long time because it must be repeated by varying the input parameters to find an optimal value. Therefore, the Backpropagation Neural Network (BPNN) and Genetic Algorithm (GA) are used to reduce the time-consuming using MATLAB R2022B. The data is then divided into three parts, namely training, testing, and validation, with a ratio of 70:15:15. The optimum value is obtained by selecting the percent to retain of 45% and the retained threshold of 27%. The selected optimization parameters are then used for validation as input for the topology optimization method. As a result, the mass of the electric bike frame can be reduced to 39.26%, and the maximum stress can be increased to 12.512%.
Keywords. Electric Bike Frame, Topology Optimization, Back Propagation Neural Network, Genetic algorithm

PID Control for Radial Active Magnetic Bearings

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Abstract. The development of Active Magnetic Bearing (AMB) technology for gas turbines has made significant strides. Initiatives like the Versatile Affordable Advanced Turbine Engines (VAATE) program, in collaboration with DARPA and NASA, aim to enhance gas turbine engineering for efficiency, cleanliness, intelligence, versatility, and durability. AMBs have emerged as superior to rolling element and foil bearings due to their temperature, speed, shaft thickness limitations, and shorter lifespan under heavy loads. AMBs are more suitable for large machines operating under high loads and relatively lower speeds than foil bearings. The research introduces a two-degrees-of-freedom model for AMB systems. The modelling involves two identical electromagnets and simplified equations. The model also considers external forces, including sinusoidal forces from motor vibrations, centrifugal forces from shaft unbalanced assumptions and static forces. The system output is represented by eccentricity. The AMB design adheres to SKF standards for conventional bearings. The rotor model is simulated using MATLAB SIMULINKTM, and the Automatic PID Tuner App is used to find control values based on the created transfer function. System stability is analyzed using the Nyquist stability criteria, focusing on the input rotation speed range of 100 RPM - 459 k RPM. Higher motor rotation rates contribute favorably to the rotor's ability to remain centred within the stator. Higher motor rotation rates contribute favorably to the rotor's ability to remain centred within the stator. Specifically, the PID controller exhibits excellent resistance to various external forces. Static tests assessed the system's ability to bear loads, where forces ranging from 100N to 400N were applied to the rotor. However, adding a 400N load to the rotor has exceeded the value of $1{,}5\times10^{-3}$ m as the maximum eccentricity threshold. As a result, the maximum load that can be applied to this design is 388N, with the resulting eccentricity being $1{,}48\times10^{-3}$ m.

Optimization of Tensile and Impact Strength on Injection Molding Process Parameters of Biocomposite Material (Banana Fiber and Polypropylene) Using Taguchi Grey Fuzzy Method

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Abstract. Polymer Matrix Composite is a composite material with synthetic fibers that is widely used in industry. Polymer matrix composites reinforced with natural fibers are called biocomposites. Biocomposites can be used as the best alternative because they are environmentally friendly, biodegradable, corrosion resistant, non-toxic and have high mechanical properties. The biocomposites to be used for this research are banana fiber, melaic anhydride polypropylene (MAPP) with a composition of 10Wt% banana fiber, 5Wt% MAPP and 85Wt% polypropylene. All these materials were mixed and extruded to form pellets. The biocomposite pellets were injected using an injection molding machine. The molded products were subjected to tensile test with ASTM D 638-03 type V standard, and impact test with ASTM D 256-04 standard. This study will optimize the process parameters of the injection molding machine to find the optimum tensile strength and impact strength using the Taguchi grey fuzzy method with an orthogonal matrix L27(34). The process parameters that are varied include barrel temprature, injection pressure, holding pressure, and injection velocity, each of which has three parameter levels. From this research, a combination of injection molding process parameters that can significantly increase tensile and impact strength is obtained, with Barrel temperature 205^{o}C, Injection pressure 50 bar, Holding pressure 40 bar, and Injection velocity 75 mm/sec.

DESIGN OF A MULTIFUNCTIONAL STATIC BIKE FOR STROKE THERAPY AND PUBLIC TRANSPORTATION

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Abstract. In this study a stationary bicycle was designed and manufactured that can be used as a stroke therapy tool, without the patient having to go to a rehabilitation center. The static bicycle design is equipped with a braking mechanism as a pedaling load which can be adjusted in size, both by the patient himself and his companion. Aside from being a stroke therapy tool, a stationary bicycle is also designed to be used by stroke patients who are healthy when going somewhere or exercising by bicycle, by removing the support, so that the bicycle becomes a conventional bicycle. That is, a stationary bicycle is designed to function as a physical rehabilitation tool for stroke patients, especially on the legs independently to improve fitness, and at the same time function as an environmentally friendly means of conventional transportation. The dimensions of the bike are 1550 mm long, 1110 mm high and 50 mm wide. The bicycle frame material is made of 6061-T6 aluminum tubing. Based on ISO 20957-10:2017 static bicycles are tested for function, and the results are strong and stable bicycles withstanding loads of up to 105 kg. In the stability test on a slanted condition, it was found that when a load of 55 kg the bicycle was stable at a slope of 0° to 5º, but at a slope of 10° the bicycle was unstable.

Model-Based Systems Engineering Applicability Study for Indonesian Technology Industry

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Abstract. The ever-increasing of complexity of a product or systems development has given rise to a development framework such as Model-based Systems Engineering (MBSE). To be able to understand the potential of MBSE implementation in Indonesia, several research has been conducted in ITB. An initial literature study has been performed to map the potential of future research on MBSE. Several implementations of MBSE tools for small project is performed with aim to familiarize with MBSE processes and to understand the advantages and disadvantages of those tools. A survey on the development of technological products is performed with the aim to map the existing conditions and the needs for the future.

Optimization of PID Control Parameters for Quarter-Vehicle Model Active Suspension System using Back Propagation Neural Network and Genetic Algorithm Methods

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Abstract. A suspension system is designed to attenuate vibrations and enhance passengers' comfort levels when a vehicle traverses uneven road contours. With additional power to control the actuators' force, the active suspension system produces better ride quality than passive suspension systems.
System modeling will be carried out using a quarter-vehicle model with a disturbance input form of a step input of 0.1 m. In this study, the control system used is the PID controller, with the parameters of the controller being tuned using the Back Propagation Neural Network-Genetic Algorithm (BPNN-GA) metaheuristic method employing MATLAB R2022b software. In this method, BPNN is used to produce a network that represents the correlation between controller parameters (*i.e.*, KP, KI, and KD) and system response (i.e., Integral Times Absolute Error (ITAE)). The ITAE value represents the value of Settling Time (Ts) and Peak Overshoot (PO) in a damping system.
Next, the Genetic Algorithm (GA) is employed to determine the best BPNN's network *(i.e.,* number of hidden layers, number of nodes in each hidden layer, and type of activation function) with a minimum MSE (Mean Squared Error) value. The performance of BPNN-GA is then compared with another controller method (*i.e.*, Ziegler Nichols method).
The best BPNN's network is obtained with five hidden layers, ten nodes in each hidden layer, and the satlin activation function achieving an MSE training value of 1.6477 × 10-8. Subsequently, this best BPNN's network is utilized as a fitness function to obtain optimum controller parameters (*i.e.*, KP, KI, and KD). The most optimum KP, KI, and KD values are identified through the BPNN-GA method, namely 809193, 621978, and 243984, with a settling time (TS) value of 1.33 s and a peak overshoot of -0.00834 m, along with a Root Mean Square (RMS) value of 0.5747 m/s2. Moreover, in accordance with the ISO 2631 standard, the active suspension system model is classified as slightly uncomfortable.
Keyword. Active suspension system, quarter vehicle model, PID, Back Propagation Neural Network, Genetic Algorithm.

Development of a Wireless Vibration Monitoring System and Its Mobile Notification based on Low-Cost Devices

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Abstract. The monitoring system is vital in the manufacturing industry. It can show or detect the possibility of unwanted behavior. However, the monitoring system needs high investment costs. Therefore, an affordable wireless vibration monitoring system built by commonly available devices in the market was developed in this study. The system has two microcontrollers, each connected to a sensor (as the transmitter module) and a personal computer (as the receiver module). From the MEMS sensor used, the vibration data is transmitted to a personal computer using a wireless communication device. Furthermore, the monitoring application shows a time domain graph from the vibration sensor reading. It includes the signal parameter reading, such as amplitude and RMS. If the data value passes the threshold, The application notifies a mobile phone via message through the WhatsApp application. Moreover, the system can collect data at a sample rate of 1500 samples per second, the level of the sensitivity of the sensor ranges between 40 mV/g, and the measurement range is ±50 g. Eventually, the cost of this monitoring system is about 100 USD, which is 5% of the cost of the existing sensor and data acquisition system. This system showed close agreement with the data accessible by the commercialized sensor and monitoring system. Currently, this system was implemented and evaluated in a lathe machine.

Development of Flank Wear and Surface Roughness Prognosis System in Lathe Machine Based on an Affordable Monitoring System

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Abstract. Tool flank wear and surface roughness are considered as the most impactful parameters that influence the quality of the workpiece. However, those parameters must be measured directly after the machining process is complete. Therefore, this study proposes an online monitoring application with flank wear and surface quality prediction system to monitor them in real-time. Unlike other monitoring systems widely available in the market, the designed monitoring system was created using open-source software without needing any subscription. Moreover, the prognosis system was built with the combination of multilayer perceptron (MLP) and k-nearest neighbors (kNN) algorithms. The MLP was established to predict the flank wear value, resulting a model with accuracy of 0.982. Furthermore, the result will be normalized and later used to classify the surface quality into three different classes using kNN, resulting in 100% accuracy. Afterward, those algorithms were explicitly implemented into the monitoring application. The system was evaluated in real-time for different machining parameters and can achieve a 88.2% accuracy. This study is expected to improve the possibility of advanced technology implementation, especially in small and medium-sized manufacturing enterprises.

Modeling and Analysis of MEvITS Electric Vehicle Spaceframe Chassis

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Abstract. The chassis of an electric vehicle is a crucial component that the structure design must ensure both vehicle safety and performance. When the vehicle is in use, it is subjected to a range of loads, which causes fracture development and deformation in chassis members. This study aims to evaluate the chassis performance and safety under static and dynamic loads. Static loads applied are the load from the weight of the vehicle components and torsional load. Loads of vehicle-weight components are carried out to determine the areas of maximum stress generation and the factor of safety. The torsional load was applied to determine the torsional stiffness by conducting equal value of forces on two front wishbones with reverse direction, positive and negative vertical axis. The dynamic load was conducted by applying random excitation to the chassis from the road roughness based on ISO 8606. Random vibration was carried out to analyze the response of the chassis from random excitation to determine the fatigue safety factor. Modal analysis was also conducted as the input in random vibration from its natural frequency and mode shape of the chassis. The chassis is modeled in 3D with SOLIDWORKS and prepared in Space Claim before the static and dynamic loads were performed. The static structural analysis, modal analysis, and random vibration of the chassis are performed using ANSYS. MEvITS chassis is safe under static load with a factor safety of 2.03. On the other hand, this chassis has low torsional stiffness with a value of 1667.51 Nm/deg. It indicates that the chassis needs reinforcement in the front area of the chassis. For dynamic loading, the chassis shows good performance to restrain random excitation. The factor of safety from fatigue due to random excitation is 9.09.

Improvement of Durability in Leaf Springs through Chamber Clearance Modification for Medium Duty Truck

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Abstract. Leaf springs are designed to reduce vibrations and shocks during dy-namic operation of vehicles. However, leaf springs can experience various types of damage, such as breakage or fatigue, which can lead to suboptimal suspension performance and potential damage to other vehicle parts. In this manuscript, we explore the possibility of enhancing chamber clearance in leaf springs as a po-tential design solution to tackle these concerns. We propose a development ap-proach that involves simulation-based design using CAE (Computer Aided De-sign) software and FEA (Finite Element Analysis). The analysis includes struc-tural and dynamic assessments to optimize the design and evaluate its fatigue characteristics. To validate the modified design, a prototype of the leaf spring with the modified chamber height is created, and various tests are conducted, including articulation, static load, dynamic, vibration, and durability tests. The results of these tests are compared with simulations to verify the expected design outcomes. The objective is to enhance the durability and driving comfort of leaf springs in commercial vehicles. This study simulated design improves the leaf spring durability against fatigue, increasing its lifespan from 180,000 cycle to an impressive 1 milions cycles. The study also contributes to durability of leaf spring with potential chamber design with novelty validation vibration measurement on the antisymmetrical roads.
Keywords: Leaf spring, Durability, Finite Element.

Remaining Useful Lifetime Prediction of Lithium-Ion NMC 18650 Battery Cells Using Support Vector Machine

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Abstract. The rise of the energy needs of humans brought forth important innovations such as the lithium-ion battery. However, lithium-ion battery cells would experience a capacity drop in their usage due to imperfections in the chemical reactions. Predicting that capacity degradation behavior would help improve the efficiency of the lithium-ion battery cells' usage, maintenance, and replacement. One of the many ways to predict said behavior is by using data-driven methods such as machine learning. In this research, the prediction of a lithium-ion battery cell's Remaining Useful Lifetime (RUL) with the NMC cathode type and the 18650 form factor using a machine learning algorithm known as Support Vector Machine (SVM) will be conducted to assess the performance of said algorithm. The data used in this research is a secondary dataset from a study conducted at the Sandia National Laboratory, which tests numerous types of lithium-ion battery cells under several conditions to study the general degradation behavior of lithium-ion battery cells. The dataset is limited to conditions such as a charging rate of 0.5C. The dataset will then be used to train and test several models, each with varying kernel functions such as the linear kernel, polynomial kernel, radial-basis function kernel, and sigmoid kernel, before and after their hyperparameters are tuned using the random search grid methods. The acquired performances of predicting the RUL would then be compared with each other to find the best-performing models. The performance indexes used in this experiment are the Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), Coefficient of Determination (R2), Root Mean Squared Logarithmic Error (RMSLE), and Mean Absolute Percentage Error (MAPE). The best performance from the SVM model predicting the RUL of a lithium-ion NMC 18650 battery cell are as follows, MAE score of 1,347.4521, MSE score of 3,729,987.2910, RMSE score of 1,931.3175, R2 score of 0.6944, RMSLE score of 0.8844, and MAPE score of 2.0422. That performance was achieved using an SVM model with hyperparameters as follows, radial-basis function for the kernel function, a C value of 9.596, and an epsilon value of 1.9. For other hyperparameters of the radial-basis function kernel itself uses the gamma constant of 0. 10000000024877526.

Design and Strength Simulation of Single Attachable Connector for Electric Scooter Wheelchairs

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Abstract. There is an extraordinary need for assistive technologies (ATs) to improve the quality of life for people with disabilities in developing countries. The excessive technology integrated into wheelchairs in the present era makes them vulnerable to damage and difficult to maintain and repair. The Attachable Wheelchair Automator (AWA) is a new design concept, and continuous development is being carried out on the Attachable Wheelchair. The design has been deemed incomplete, with a suboptimal selection of components and applying a telescopic frame in the previous design. Therefore, a new design for the connector mechanism system is needed to address these shortcomings with a single attachable connector. Determining plate thickness and shaft diameter must be reviewed to assess the strength and avoid over-design issues. Plate thickness variations of 2, 3, and 4 mm are considered, while shaft diameter ranges from 8, 10, to 12 mm. Therefore, variations in materials, namely AL 6061 T6 and ASTM A36, are performed in this study. The loads that will occur on this single connector attachable are analyzed under three conditions: static loading, acceleration condition, and deceleration condition. From the load analysis results, the deceleration condition is the most extreme, thus used as a reference in the analysis process using finite element software. The analysis results show that selecting AL 6061 T6 material provides better stress, safety factor, and connector mass values, while ASTM A36 material provides better deformation values. Based on the analysis and considerations of mass, safety factor, and production cost, the recommended design for the wheelchair automator connector is a plate thickness of 3 mm, a shaft diameter of 12 mm, and the selection of AL 6061-T6 material. The safety factor is 2.26, with a stress of 121.64 MPa and a total deformation of 0.24315 mm.

Numerical Simulation on the Effect of Tip Clearance on the Last Stage Low Pressure Steam Turbine

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Abstract. To maximize turbine performance, it is crucial to broaden a deeper comprehension of the flow structure at tip region of the rotor blade and its consequence. The purpose of this study is to examine the impact of tip clearance flow in a low-pressure steam turbine. The research focused on the final stage of the low-pressure steam turbine blade of a typical steam power plant operating at 3000 rpm (50 Hz). Steady-state compressible numerical simulation and blade stress analysis was performed to analyze the flow characteristic and blade stress level on the last stage blade under three operating load conditions. Two variations of rotor blades are adopted. The results found that the torque in both models increased with an increase in loads resulting in increasing turbine output. However, the torque generated by tip clearance model is smaller than torque in the model without tip clearance. It can be implied that the turbine performance is reduced as a result of the presence of tip clearance flow corresponding to tip leakage loss. The blade stress analysis shows that the stress level exceeds on rotor blade in model tip clearance is higher compared to model no-tip clearance under 100% and 120% load.
***Keywords*:** Steam turbine, Tip clearance, CFD, FEA, Stator-rotor interaction

Numerical Modeling of Polypropylene Fiber Reinforced Concrete Notched Beam

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Abstract. This paper presents a numerical modeling approach using a 3D nonlinear finite element package to investigate the stress-strain behavior and the impact of polypropylene fibers on a notched beam. Polypropylene fibers have shown promising results in improving the mechanical properties of concrete. In this study, a notched beam with a 2% volume fraction of polypropylene fibers was subjected to three-point bending conditions to evaluate the behavior of polypropylene fiber reinforced concrete. The in-house 3D nonlinear finite element analysis package, 3D-NLFEA, was utilized to simulate the three-point bending conditions using a plasticity-fracture model of concrete. The objective of this research is to demonstrate the effects of adding polypropylene fibers on the mechanical properties of the notched beam, comparing it with plain concrete. Additionally, this analysis provides insights into deformation, peak load, crack pattern, post-peak behavior, and stress-strain characteristics of polypropylene fiber reinforced concrete in comparison to plain concrete.
Keywords: notched beam; plasticity-fracture model, polypropylene fiber reinforced concrete

Experimental study of flat-plate collector integrated with Al-Foam+PCM Thermal Storage

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Abstract. Thermal Energy Storage as an energy storage technology is beneficial in limiting heat loss from solar collectors by absorbing excess heat from the absorber plates during peak hours of solar radiation. The method to improve SWH system performance is to combine PCM material with metal foam. This study investigates the performance of SWH collectors integrated with aluminum foam with PCM energy storage materials. Experimental tests were carried out by testing four models of absorber plates on a solar thermal energy unit with similar conditions. The first model is a standard flat plate (SFP) without thermal energy storage materials. The second model combines a standard flat plate (SFP) and aluminum foam under the SFP. The third model combines standard flat plate (SFP) and PCM (paraffin wax). The four models combined standard flat plate (SFP) using aluminum foam and added PCM (paraffin wax). Temporary experimental testing is carried out. The research results are expected that the use of thermal energy storage materials using aluminum foam added with PCM (paraffin wax) can contribute to increasing the efficiency of the collector plate.

Keywords: *Flat-plate collector, Thermal energy storage, Aluminium Foam, Phase Change Material.*

Dynamic linear analysis of a resilient slab-track structure for high-speed railway system: Evaluation of the dynamic magnification factor

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Abstract. This paper presents a dynamic non-linear analysis of a resilient slab-track structure designed for high-speed railway systems. The slab-track structures comprise sandwich-type configurations with internal self-compacting concrete (SCC) layers, ensuring enhanced resilience. A novel approach utilizing two-dimensional frame elements and two-joint links is employed to connect the layers of the slab-track structure. The study conducts independent evaluations of both the lateral and longitudinal directions of the slab track, subjecting them to a series of time-history load functions that accurately represent the dynamic forces exerted by wheel trains operating at various speeds and ideal subgrade conditions. The time-history load functions consider factors such as the size and pitch spacing of the wheel, directly influencing the intensity of the applied loads. The ideal subgrade condition is set to mimic a rigid pavement with a California Bearing Ratio (CBR) equivalent to eight percent to establish a benchmark. The primary focus of the investigation centers around the Dynamic Magnification Factor (DMF), which is determined by comparing the dynamic and static internal forces, such as bending moment and shear force. The research findings reveal a significant correlation between the DMF and train velocity. As the train speed increases from 50 km/h to 200 km/h, in most cases, the DMF values exhibit an escalating trend. This analysis provides valuable insights into the behavior of the resilient slab-track structure under varying high-speed conditions, offering essential information for the design and optimization of future high-speed railway systems.
Keywords: slab-track, dynamic analysis, dynamic magnification factor

Finite Element Modeling of the Steel Fiber Reinforced Concrete Notched Beam with DRAMIX 3D 65/35

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Abstract. This paper presents an advanced analysis of the fracture behavior in steel fiber reinforced concrete using an in-house 3D nonlinear finite element analysis (3D-NLFEA). The 50 MPa concrete strength specially design fo slab-track structures is strengthened with hooked end DRAMIX 3D 65/35 fibers. The purpose was to gain additional tensile strength, improved post-peak behavio which include enhanced fracture tensile energy and toughness of the steel fiber reinforced concrete (SFRC) compared to the plain concrete. In this study both experimental and numerical simulation of the nothed SFRC beam with 2.0 % fiber content is carried out. The load in the experimental test is applied as static load and is controlled using displacement control. On the other hand, the numerical simulation is carried out using an inhouse 3DNLFEA package which utilize the multi-surface plasticity-fracture model. From the test result, it is obtained that both the tensile strength and the tensile fracture energy increased significantly. The developed numerical model was able to capture acurately capture the peak load and the post peak softening behavior of the notched SFRC beam.
Keywords: steel-fiber reinforced concrete, nonlinear finite element method, 3DNLFEA, plasticity-fracture model

Modeling and Control of Reaction Wheel Pendulum with Feedback Linearization and LQR Control

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Abstract. This paper presents a modeling and control approach using feedback linearization and LQR control for a reaction wheel pendulum system. First, the derivation of equations of motion for the reaction wheel pendulum system is presented. Then,feedback linearization is employed to linearize the nonlinear system dynamics. This technique transforms the original system into a linear system by canceling out the nonlinearities using feedback. The control design utilizes the linearized model obtained through feedback linearization in conjunction with the LQR control strategy. Simulation results demonstrate the effectiveness of the combined feedback linearization and LQR control approach for stabilizing the reaction wheel pendulum system.

Numerical Modeling of a Single Panel Slab-Track with Steel Fiber and Polypropylene Fiber Reinforced Concrete

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Abstract. This paper presents a nonlinear finite element simulation of the slab-track railway structures designed for high-speed train systems. The study investigates the slab-track system with different fiber types. The objective of the study is to get the optimum design configuration that will replace the conventional slab-track made from reinforced concrete (RC). The two fibers are the hooked end steel fiber DRAMIX 3D 65/35 and polypropylene fiber. The volumetric content of both fibers is 2.0 %. The basic concrete strength is 50 MPa. In this paper, only one panel of slab-track is being investigated. The panel has a width of 600 mm, a width of 2500 mm, and thickness of 200 mm. The panel is tested as a simply supported beam with inverted position to mimic the wheel train restraint. The simulation is carried out using an in-house 3DNLFEA package which utilizes a multi-surface plasticity model that is suitable for modeling plain and fiber reinforced concrete. From the simulation, it was found out that the use of fibers can improve the peak load carrying capacity and enhance the post-peak softening behavior of the slab-track structures.
Keywords: slab-track, nonlinear finite element analysis, 3DNLFEA, plasticity-fracture model, steel fiber reinforced concrete

RESEARCH ON THE EFFECT OF FORD EVEREST BRASS RESULTS WHEN RUNING ON CLASS C ISO 8608:2016

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Abstract. This article presents a study on the oscillation of the Ford Everest 2019 vehicle when crossing a rough road surface of Type C according to ISO 8608:2016 standards. The study focuses on evaluating the impact of the damping coefficient on the following factors: oscillation damping time, oscillation acceleration, and oscillation amplitude of the suspended and unsuspended masses.

Analysis of Boring Bar Vibration Response Reduction Due to the Effect of Internal Damper Addition with Variation in Diameter of Damper and Cutting Parameters in the Machining Process

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Abstract. In this study, a boring bar mechanism design simulation was carried out with the addition of a press-fitted damper made of metal using ANSYS software. The boring bar is made of AISI 1045 material with a diameter of 25 mm and a length of 282 mm. The damper has the same material as the boring bar and has the shape of a solid cylinder placed inside the boring bar with a length of 235 mm. The diameter of the damper varies from 3, 4, 5, 6, to 7 mm. This simulation is also carried out by variations in cutting parameters, including spindle speeds of 320, 450, and 720 RPM, feed rate of 0.06, 0.08, and 0.10 mm/rev, and depth of cut of 0.3, 0.4, and 0.5 mm. Based on the simulation results on variations in damper size, the 7mm custom boring bar is the most optimal variation, which can reduce vibration by 62.47% in the x-axis direction and 66.36% in the z direction at cutting parameter 21 (320 RPM, 0.5mm, 0.1mm/rev).
Keywords: Boring bar, Damper, Cutting Parameter, Vibration Response, Vibration Reduction

Optimization of Stiffness and Damping Coefficient Using Genetic Algorithm In An Electric Bus With Air Suspension System

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Abstract. Riding comfort is the minimum vibration transferred by the road surface to a passenger, where it is characterized by maximum sprung mass acceleration. International standards determine riding comfort, specifically ISO 2631. This research utilizes a genetic algorithm to obtain optimal stiffness and damping coefficients for the vehicle suspension system. The system modeling is simulated using MATLAB software. Based on the genetic algorithm optimization performed, the optimal stiffness and damping coefficients obtained for the system are 203800 N/s and 12771 Ns/m for the front suspension stiffness and damping coefficient, respectively. The rear suspension stiffness and damping coefficient are 310750 N/s and 10702 Ns/m, respectively. With the optimized parameters, the dynamic responses of acceleration and displacement in vertical and pitch motions yield more comfortable results. The conclusions are drawn based on the root mean square (RMS) acceleration value for drivers who meet ISO 2631 comfort standards. The driver's system operates comfortably without complaints at low speeds, with only minor complaints at high rates. With the optimized suspension, the driver can sustain over 16 hours of operation, whether subjected to sinusoidal road. The optimized parameters result in an improved transient vehicle response, characterized by reduced impact forces and quicker attainment of settling time.
Keyword: Genetic Algorithm, Optimization, Suspension System, Half Vehicle Modeling

Cutting Speed Recommendation Based on Cutting Tool Performances in Transverse Cutting of Lathe Machine: Simulation Approach

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Abstract. In this article, a novel strategy to recommend the cutting speed in lathe machines is introduced. The recommendation was obtained through a transverse cutting in a CNC lathe machine with the G97 feature. However, as a preliminary study, this study was developed through a simulation approach in Matlab/Simulink to introduce an insight that an unwanted behavior in transverse cutting with the G97 feature can give a novel way to obtain recommended cutting speed value for the machining process. The simulation was built with one degree of freedom of the mechanical system (m, c, and k) mathematical model. In addition, since this study involves the speed change effect in the turning process, thus the velocity-dependent force coefficient was also included in that model. The simulations were processed with three different spindle speed settings and constant feed rate and cutting depth values. Moreover, the simulation also implicated different cutting force coefficients to analyze the recommended cutting speed in different materials to gain deeper insight. The results showed that the cutting speed can be recommended by considering the unwanted behavior of cutting force in CNC lathe machine transverse cutting. This approach's recommended cutting speed of AISI 1045 is 120-565 m/min. However, that range's maximum limit will also depend on the maximum CNC spindle speed ability to rotate.

ARTIFICIAL NEURAL NETWORK MODELLING FOR AISI 4340 SURFACE ROUGHNESS ANALYSIS

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Abstract. This article shown the performance evaluation of AISI 4340 using the hot-turning method. AISI 4340 is a medium carbon steel known for its impact resistance and is commonly used in gear components of airplane systems, crankshafts and connecting rods. This research focuses on developing mathematical models using Artificial Neural Networks (ANN) to analyze the relationship between dependent and independent variables. The ANN is suitable for nonlinear machining operations with high accuracy and without a predetermined model. Modelling techniques, specifically ANN, are suggested to improved machining effectiveness and reduce production time and costs. This article explains the architecture and function of ANN, describing neurons, weights, and activation functions. This research methodology includes data pre-processing, network training using Back Propagation (BP) algorithm, and selecting activation functions. The Levenberg-Marquardt algorithm is used for training, and the hyperbolic tangent sigmoid transfer function is utilized as the activation function. The results show that a 4-17-1 network structure provides the closest prediction to experimental data for surface roughness, with an MSE of 0.004393106, and a prediction error of 3.79522%. The result demonstrates usefulness of ANN in predicting the machining quality.

Surface Roughness Prediction in End Milling with Cooling Liquid Nitrogen on AISI D2 Tool Steel Material using Fuzzy Inference System

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Abstract. AISI D2 steel is a type of tool steel with a high hardness of 30 HRC to 60 HRC, leading to a challenging machining process. One of the uses of AISI D2 steel is for punches and dies in the forming process, so the results of the AISI D2 steel machining process must have low surface roughness and high precision. One of the ways to reduce surface roughness is by using coolant. Liquid nitrogen was used as the coolant. Purpose of this studies to predict the surface roughness (SR) in the end milling process using AISI D2 steel tool material based on orthogonal arrays by the Taguchi and fuzzy logic method tuned with Genetic algorithm. Experimental studies were performed by varying the liquid nitrogen cooling flow rate (Q), cutting speed (Vc), feed rate (Vf), and axial depth of cut (Aa) used as input parameters. Orthogonal array L18 was used as a design experiment to predict modeling output surface roughness using fuzzy inference system (FIS) Mamdani type1 and Sugeno type 1. The best results can be seen from the smallest RMSE value obtained after modeling using a fuzzy inference system. The smallest RMSE value is obtained from the combination of Sugeno type-1 with rule and tuned output. The next step is to validate by comparing the prediction data with the measurement data, obtaining a prediction error of 0.0198 or 1.98%.

The Effect of Adding Cone Rubber-Mass Dynamic Vibration Absorber to Boring Bar on Reduction of Vibration Response in Machinery Process (Lathe Machine)

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Abstract. Boring bars with a large length-to-diameter (L/D) ratio in the machining process can cause excessive vibration or chatter, which reduces product quality. Dynamic vibration absorber (DVA) is a vibration reduction system that can reduce the chatter effect. In this study, DVA has the shape of a cone placed inside a boring bar, which consists of a mass of absorber made of brass covered with rubber. The rubber is varied, namely natural rubber and neoprene rubber. The simulation is carried out with various cutting parameters, including spindle speed, feed rate, and depth of cut. Based on the simulations, the DVA cone's shape allows it to reduce vibrations in all directions and produce the same reduction values on each axis. Customized boring bar L/D 9 with DVA natural rubber and cutting parameter 2 is the variation with the highest vibration response reduction value, namely 88.50% in the x-axis direction, 83.89% in the y-axis, and 88.52% in the z-axis. Customized boring bar L/D 7 is a geometry variation with the best operation because it can reduce vibration in most variations of cutting parameters compared to other variations of boring bars, namely 23 out of 27 cutting parameters.
Keyword: Boring Bar, Cone Rubber Mass, Cutting Parameter, Vibration Response, Vibration Reduction

Surface Roughness Prediction of Turning Process on KRUPP-2344 Steel Material Using Fuzzy Inference System

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Abstract. One of the characteristics of machine performance in the turning process is surface roughness, which is usually made into a response because of its relation to the machine's capability of the material. Using the combination of cutting speed, feed rate, depth of cut and nose radius, this research will predict ideal surface roughness in the turning process of KRUPP-2344 material, which is equivalent to SKD 61 (JIS) material, by using a Fuzzy Inference System (FIS) Mamdani type1 and Sugeno type 1 available in Matlab R2023a. This experiment setup used an orthogonal matrix L9 consisting of three levels. The experiment was conducted three times for replication. The research showed that factor combination or process parameters in the turning process of KRUPP-2344 could result in a prediction with the most optimum response value. The most optimal result can be known from the smallest RMSE value of the combination of type-1 Sugeno with rules and outputs tuned with a prediction error rate of 2.564%.

Fuzzy PID Control for Parallel Friction Stir Welding Robot Manipulator

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Abstract. Friction stir welding (FSW) is currently widely developed because of its advantages which are green welding techniques. To improve the precision of FSW, especially for long welding, a robotic mechanism needs to be developed. Hence, robust control is essential to be designed as part of the robot's needs. In this study, fuzzy PID was proposed to control the tip of the FSW tool to match the required welding trajectory. To demonstrate the performance of fuzzy PID controllers, comparisons with conventional PIDs were made in this study.
Simulations using MATLAB Simulink, as shown in Figure 1, were built to compare the performance of both controllers. The performance compared was percent overshoot (PO), rise time (RT), and settling time (ST).

Design and Analysis of PID Control Systems for Motion Control in Unmanned Autonomous Forklift

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Abstract. Forklifts, widely used in material handling and transport, traditionally require human operation. To mitigate operator accidents and enhance efficiency, this study introduces an unmanned autonomous forklift with a designed motion control system. The focus of this study is the creation and evaluation of this motion control system, using both simulation and hardware. The system employs a Proportional-Integral-Derivative (PID) control method and a rotary encoder for odometry, adjusting the vehicle's driving force based on the target distance using motor pulses. Simulation tests, with PID parameters Kp = 0.853, Ki = 0.257, and Kd = 0.923, delivered a rise time of 7.46 seconds, a settling time of 23.09 seconds, and a trajectory error of 0.28%. For the hardware prototype, adjustments to PID parameters were made to Kp = 0.97, Ki = 0.3, and Kd = 1. Experiments conducted over a range of distances from 50 cm to 200 cm, with 25 cm intervals, resulted in an average absolute error of 1.84 cm, which equates to a 3.67% deviation.
Keywords: autonomous forklift, motion control system, PID control, odometry, rotary encoder.

Chassis Strength Analysis of a City Car with a Capacity of Two Passengers

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Abstract. The chassis is one of the most important parts of a city car and must have strong construction to withstand the weight of the vehicle. The chassis functions to keep the car rigid and stiff and does not experience bending or deformation when used. This study aims to design and test the chassis of a city car with a capacity of two passengers. This study uses a development method using finite element-based software to test the load on the chassis. The analysis used to determine the strength of the chassis is by looking at the results of the von Mises stress. Chassis loading analysis uses two tests with various loads, namely distributed load and concentrated load. The simulation results show that the chassis of the city car can handle the load well. The results of the strength analysis that occurs on the chassis of the city car show that the maximum stress that occurs due to the distributed load acting on the chassis is 108.10 MPa. While the maximum stress that occurs due to the concentrated load on the chassis is 29.97 MPa.

Prediction of the Frictional Coefficient in Surface Grinding of ASSAB 8407 Tool Steels with Dry and Minimum Quantity Lubricant (MQL) Teqniques using Fuzzy Inference System

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Abstract. This research aimed to predict the effect of the cooling method (CM), Speed of Cut (Vc), and Depth of Cut (a) on the Coefficient of Friction (FC) on the surface grinding of ASSAB 8407 Tool Steel. The Cooling Method consists of Minimum Quantity Lubrication (MQL) and Dry Technique using the Sugeno Fuzzy Inference System (FIS) toolbox method available in Matlab R2023a software. Based on the model analysis, the Cooling Method and Depth of Cut significantly affect the of Frictional Coefficient response, while the Speed of Cut does not affect the response optimally.
Keywords: Fuzzy Inference System, Prediction, Frictional Coefficient (FC).

Strength Analysis of Standing Wheelchair Frame Using Finite Element Method

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Abstract. Assistive technology is needed for the independence of persons with disabilities. A wheelchair as an assistive technology is required by people who cannot stand and walk due to lower body disabilities or old age. However, wheelchair users experience obstacles, such as the need to stand, a basic requirement for daily activities. In addition, the need to stand for wheelchair users can prevent physical and psychological health problems due to sitting for too long in a wheelchair. Standing wheelchairs, like wheelchairs in general, must meet specific criteria to function properly. One of these criteria is the strength of the wheelchair to accept the load from its users. In this study, the strength analysis of the frame structure of the standing wheelchair type N1 when receiving loads from wheelchair users was carried out using the finite element method. The loading model given is 100 kg in six standing frame conditions starting from a sitting position to a standing position with an angle of increase of 0, 18, 36, 54, 72 90 degrees. The simulation results show that the maximum stress experienced by the wheelchair frame at each level of angle increase is 51.86, 181.29. 122.47, 49.67, 29.84, and 9.37 MPa. The highest stress value occurs at the 18 degree angle of elevation level and the lowest at the 90 degree angle of elevation level. All stress values in the frame structure are under the allowable stress of the material, so they are still in a safe condition. The simulation results also show the difference in the location of the occurrence of maximum stress due to the increase in the level of the standing frame. That information is important to determine the structural failure possibility and strengthening the structure when using a lightweight material as a standing wheelchair frame.

The effect of crossfeed variations on vibration and surface roughness for hardened tool steel SKD11 ground by surface grinding machine

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Abstract. The surface grinding is a machining process primarily used to achieve a very smooth surface. In addition to the depth of cut, the crossfeed parameter is very influential on the vibration and has a direct impact on its roughness. High crossfeed has an effect on high machining speed so that machining time is shorter, but results in low surface quality and vice versa. In this study studied the effect of crossfeed on vibration and its consequences on surface roughness. Thus, it is expected that only by monitoring vibrations in real time can control the surface roughness produced by this surface grinding process. The experiment shows that the increase in crossfeed from 5.3 mm/stroke to 11.7 mm/stroke, for the A46QV type grinding wheel, gives an increase in vibration amplitude from 6.01 g.rms to 15.2 g.rms and this results in an increase in surface roughness from 0.42 μm to 1.23 μm. Whereas the A80LV type grinding wheel provides an increase in vibration amplitude from 5.27 g.rms to 12.47 g.rms and this results in an increase in surface roughness from 0.33 μm to 0.96 μm.
Keywords: Surface grinding, vibration, surface roughness, crossfeed.

Study of Modal Frequency in New Tuned Mass Damper System with Plate Spring

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Abstract. This research is a preliminary study of a new TMD (Tuned Massa Damper) model that provides multiple resonant frequencies. The previous studies give asymmetric TMD models, such as Stockbridge type of cable damper. These TMD models make one side damper mass-spring bigger than other side that make it asymmetric. New TMD model in this research uses plate as its spring. It is called by TMDPS (Tuned Mass Damper with Plate Spring). This model overcomes asymmetric matter for applying multiple resonant frequencies. This paper investigates the modal frequency of TMDPS. The spring is from circle-shaped plate with clamp at the center and mass at the circumference. The plate was with and without circle sector-shaped cut. The outside diameter of plate and the spoke width between holes were varied and their effect to modal frequency was studied. This modal study used FEM (Finite Element Method) in ANSYS software. The mode shapes were selected only with vibration direction of vertical or perpendicular to plate plane. The plate models used two element types, solid and shell elements. Result differences between solid and shell element types were small. The result showed that the wider the spoke width and the smaller the outside diameter, the higher the natural frequency. TMDPS application can attenuate main structure vibration at its resonance frequency. This knowledge can be used for designing TMDPS with multiple resonant frequencies.
Keywords: modal frequency, mode shape, plate spring, tuned mass damper

Design Optimization of the Proximal Phalanx Thumb Exoskeleton for Patients Post-Stroke Attack

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Abstract. Hand exoskeleton-type precision grip is a form of robotic development that attempts to imitate human finger movement to rehabilitate post-stroke patients. The exoskeletons can manipulate individual fingers through precise movements; nevertheless, their mechanical structure is intricate, resulting in reduced practicality and increased weight during usage. One way to fix this is to make the exoskeleton lighter so the finger can move quickly and have a small load. This research aims to reduce the mass of the hand exoskeleton by optimizing the thumb's structure by applying generative design methods. The generative design optimization process produces 60 outcomes, which are evaluated and ranked according to their design solution status, recommendation values, visual aesthetics, and mechanical performance validation. The best design is the O-1 design, having a software mass reduction of 74% to 76%, a mass reduction after manufacturing of 67%, the highest safety factor of 1,725, a minimum stress of 11.59 MPa, and a displacement of 0.7288 mm. The O-1 design is the best one that the generative design method came up with compared to the other designs.

Finite Element Modeling of Milling Spindle Thermal Behavior with Variation of Bearing Preload

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Abstract. Bearing preload has a major influence on frictional heat generation, whereas cooling fluid substantially influences the spindle system's heat balance. Finite element modeling was utilized to investigate the effect of bearing preload on the thermal behavior of a machine tool spindle. Both bearing heat generation and cooling fluid were applied as boundary conditions of Finite element mod (FEM). The FEM analysis includes steady state and transient thermal analysis at two different spindle speeds 3000 rpm and 15000 rpm. Based on the analysis's findings, it can be seen that the bearing preload changes affect the heat generation and temperature. The difference in heat generation between the minimum and maximum preload values at rotational speeds of 3000 rpm and 15000 rpm is 9.5 Watt and 47.4 Watt, respectively. When increasing the bearing preload from EL to H at low spindle rotation speeds of 3000 rpm, the temperature rise is roughly 0.56 oC. However, at high spindle rotation speeds of 15000 rpm, the temperature rise could reach 2.75 oC.

Tribological Performance Prediction using Random Forest Machine Learning for Water-Based Lubricants Formulated with Ionic Liquids

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Abstract. Research on lubricant formulation nowadays focuses on environmentally acceptable lubricants. Water-based lubricants are attractive lubricants due to their readily environmentally acceptable. Compared to petroleum-based lubricants, water-based lubricants possess lower tribological performance, therefore finding additives that suitable for water-based lubricants is challenging task. One of the candidates is ionic liquids. Ionic liquids are organic salts consisting of positive ions (cations) and negative ions (anions) that are liquid at low temperature. Ionic liquids well known due to their properties, such as low volatility, high temperature stability, non-flammable, and high polarity, which make ionic liquids suitable for lubricant additives. It is predicted over 1 million ionic liquids can be produced due to the high number of their precursor, therefore testing all ionic liquids is not visible to perform. One of the solutions is using machine learning to predict the tribological performance of ionic liquids using smaller experimental dataset. Each lubricant was transformed into machine-readable format while keeping their comprehensive structure information, namely Simplified Molecular Input Line Entry System (SMILES). Molecular descriptors were generated from SMILES input using AlvaDesc software. Phyton together with Jupyter Notebook web-based computing platform were employed for the program language. Scikit-learn free online package tool with Random Forest Regressor model were implemented for the coefficient of friction prediction. In this study, lubricants formulated with 1,3-dimethylimidazolium dimethylphosphate were predicted. The result showed that Random Forest Regressor model could predict the coefficients of friction with high accuracy ranging from 83.26% to 99.47%.

Keywords: coefficients of friction, water-based lubricant, ionic liquid, machine learning, random forest regressor

Designing Crusher Module of Hammer Mill Using the Ulrich-Eppinger Method to Maximize the Fineness of Coconut Shell and Palm Shell Grinding Results

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Abstract: Organic briquette could be made of coconut shell and palm tree shell. In the current case, 30% of the briquette feedstock were not properly milled, resulting defects. The identified defective modes were improper fineness or particle size. To address this issue, a study to modify and develop a crusher machine aiming to improve the grinding process and reduce waste material was initiated. The Ulrich-Eppinger method was selected as development framework to solve the development problem. This framework starts from concept development to product architectural and detailed design. The study utilized Altair EDEM simulation to simulate the grinding process. The results showed that the developed grinding machine successfully achieved the desired fineness for coconut shell particles with an average diameter of 0.384 mm. Similarly, the palm shell powder manufactured by this machine produced powder particles with an average diameter of 0.31 mm. These conditions were within the expected particle size of < 0.40 mm and could be sieved using a 40 mesh screen.

Keywords: organic briquette, hammer mill, Altair EDEM, Ulrich-Eppinger Method

Simulation of Color Based Mixing Using Koch-Fractal Passive Micromixer with Variation Types of Channels

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Abstract. Passive micro-mixers are essential components in microfluidic system. In this study, the influence of crosssectional shapes, inlet angles, obstacles, and 3D printing methods on the mixing efficiency of a Koch fractal micromixer with rounding corners (RCSM) is examined. The design is performed using the Design of Experiment (DoE) method to test several parameters at a time. The experiment was conducted by doing simulations using Computational Fluid Dynamics (CFD) software. The RCSM micromixer with a trapezoid cross-section shape, a 180° inlet angle, without adding obstacles, and the SLA 3D printing method show the best mixing efficiency of 0.976. It was found that the 3D printing method was the most influential parameter on mixing efficiency, followed by the inlet angle, the shape of the cross section, and the obstacle.

Domestic Production of Dialysis Solution for Import Substitution

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Abstract. More than 30 million people have been affected globally by the coronavirus disease 2019 (COVID-19), which has resulted in over 900,000 deaths [1]. Many healthcare systems have faced significant challenges in treating a large number of patients due to inadequate resources. These challenges are shared by Indonesia, where many active medicinal components are still imported. According to Basic Health Research (Riskesdas) data from 2013 to 2018, the prevalence of chronic renal disease in the Indonesian population was 2% in 2013 and climbed to 3.8% in 2018. As a result, after heart illness, treatment of kidney disease is the second-largest source of funding from the Indonesian National Health Insurance [2–3]. Hemodialysis (HD) is one of the therapies used to help kidney failure patients maintain an ideal quality of life, and it accounts for up to 82% of dialysis services performed in health institutions. There are impediments to getting health treatments and a risk of financial difficulty due to nonmedical costs related to the restricted HD services. Chronic diseases, in addition to kidney problems, significantly raise the likelihood of incurring catastrophic health-care costs. As a result, indigenous production of dialysis solutions is required. Acid-concentrated, bicarbonate-concentrated, and high-purity water are combined to make the dialysis solution. Conductivity and pH measurements were performed on the dialysis solution. The results revealed that the dialysis solution products, including acid-concentrated and bicarbonate-concentrated, meet international standards using domestic materials.
Keywords: Hemodialysis; Acid-concentrate; Bicarbonate-concentrate; Dialysis solution

Dynamic linear analysis of resilient slab-track structure for high-speed railway system: Effect of different subgrade condition

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Abstract. The implementation of high-speed railway systems necessitates the development of resilient slab track designs capable of effectively mitigating dynamic loads caused by train operations, ensuring a comfortable and safe riding experience. This system has three layers: a bed plate, Self-Compacting Concrete (SCC), and the slab track. The condition of the underlying subgrade plays a critical role in the performance of resilient slab tracks. Hence, this study uses dynamic linear analysis to investigate the impact of different subgrade conditions on the dynamic behavior of a resilient slab track for high-speed railway systems. Dynamic Linear Analysis (DLA) is a widely utilized method for evaluating the dynamic response of resilient slab tracks in high-speed railways. It considers the interaction between the track system, structure, and soil. This study employed two models: a longitudinal and a transversal slab track model. The ideal subgrade condition was simulated to resemble a rigid pavement with California Bearing Ratio (CBR) values of 2%, 4%, 6%, and 8%, considering a train speed of 200 km/h. The primary focus of this study is to provide a comprehensive database of the Dynamic Modification Factor (DMF), which is determined by comparing dynamic and static internal forces such as bending moment and shear force. The analysis results offer valuable insights into the influence of different subgrade conditions on the dynamic behavior of the resilient slab track. It was observed that variations in subgrade stiffness and damping have a significant impact on the track's response, with softer and less-damped subgrades leading to higher dynamic amplification.

Keywords: Dynamic Linear Analysis, Dynamic Modification Factor, High-Speed Railway System, Slab Track, Subgrade Modulus

The effect of the wing taper ratio to spar strength for a Medium Altitude Long Endurance UAV

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Abstract. The study of structural strength on aircraft wings is important because it involves flight safety. The Spar is the main component of an airplane wing which transmits most of the lift to the fuselage, so this research is focused on the strength of the spar. The research conducted is a study of the wing spar of Medium Altitude Long Endurance Unmanned Aircraft (MALE UAV) with a total mass of 1,300 kg, with a wingspan that is 16 m long and must be able to withstand loads with a load factor of 4G. Alternative uses of material dimensions to make them lighter and stronger so that aircraft performance can be improved. The analysis was carried out by estimating the distribution of wing lifts using the Schrenk Approximation method. Mathematical calculations were carried out to determine the mechanical strength. The effect of the taper ratio not only applies to lift distribution, but also to its strength, and □ ≤ 0.4 is value that meets the strengths in this study.

Static Structural Analysis of Sluice Plate Angle and Transmission System Revamp for Irrigation System in West Nusa Tenggara

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Abstract. A sluice gate is typically located in remote areas, and its manual mechanism complicates its operational system. One solution is to implement an automatic sluice gate system. This device is crucial in regulating water flow in irrigation systems and controlling water discharge to prevent flooding. The sluice plate is a vital component of the rigid sluice gate, which serves as a barrier against hydrostatic pressure and varying water flow velocities. This component needs to be enhanced to withstand water pressure while remaining lightweight to be operated by the system. Therefore, optimizing the sluice plate design is necessary to minimize the material used. The chosen location for this prototype is the BS Gede Bangkok sluice gate in Batukliang, West Nusa Tenggara. The tested part of the sluice gate is the sluice plate, which is responsible for withstanding hydrostatic pressure. The geometry of the sluice plate is varied, considering thickness ranging from 2.5 to 12 mm, angles between 140 to 180 degrees, and the arrangement of ribs. These parameters will be further examined using parameter optimization methods. The desired outcomes include maximum total deformation and maximum equivalent stress. Considering the weight and torque, an electric motor transmission required to lift the sluice plate will also be designed. The design standard followed is the AWWA C501 sluice gate design. FEM results show that a slight reduction in the angle from 180 to 175 degrees decreases the stress experienced by the sluice plate from 296.5 MPa to 96.4 MPa, a decrease of 67.49%. FEM software optimization yields several design candidates that meet the criteria. The design that meets the requirements features a sluice plate with a thickness of 5 mm and an angle of 170 degrees. This design weighs 104.31 kg with maximum equivalent stress of 49.73 MPa, meeting the safety factor requirements.

MODERN CUTTING OF GLASS PLATE USING HOT AIR ABRASIVE JET MACHINING

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Abstract. In recent days, industries are facing difficulty in machining materials like alloys, carbides, stainless steels, heat resisting steels, etc. Many of these materials also find important applications in industries owning to their high strength to weight ratio, hardness and heat resisting qualities. In spite of recent technological advancements, non-traditional machining processes are inadequate to machine these materials in view of economic production, besides machining of these materials into complex shapes is time consuming and sometime impossible. Non-traditional machining techniques have emerged to overcome these difficulties. The basic machining principle of Abrasive Hot Air Jet Machining is that the abrasive particles are accelerated by a compressed high pressure hot air and are forced through a micro nozzle which collides with hard and brittle work pieces at a very high velocity and density. Since the material removal pro-cess of AHAJM is performed by an integration of brittle machining based on micro crack propagation, there is very little chipping and crack generation in the work piece. Thus, this method is very suitable for the cutting of micro shapes of hard and brittle materials (such as glass, ceramics, silicon etc.). To present investigation focuses on determining MRR and surface roughness when hot air temperature is varied from 300C to 500C, SOD (5, 6, 7mm)and pressure of jet (4, 5, 6kgf/cm2).From the results it can be concluded that MRR and Ra are more significant with increase in temperature.

The remnant life assessment of the tube boiler after 35 years of operation

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Abstract. –Assessment condition for boiler tube is necessary for fit for service, especially for an old boiler. Most of the time, the challenge is a limited record of the boiler inspection and design and commissioning data. This tube inspection and condition assessment needs to be conducted as part of the remnant life assessment. In the present work, inspections and remaining life assessments of tubes in the boiler in the petrochemical plant are reported. The tube inspection comprises a thickness survey, in situ metallography, and hardness measurement. The results show that all those data is correlated and can be used to estimate the boiler's remaining life, which can also be used as a maintenance baseline for further operation. The present investigation can be used as a guideline for performing RLA for old boilers for fit-to-service or regulation needs.

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