KASETSART UNIVERSITY

ABSTRACT BOOK

PMIS2025

THE 10TH PACKAGING AND MATERIALS INNOVATION SYMPOSIUM 2025
13 MARCH 2025

FACULTY OF AGRO-INDUSTRY
DEPARTMENT OF PACKAGING AND MATERIALS TECHNOLOGY
KASETSART UNIVERSITY

Preface

Welcome to the 10th Packaging and Materials Innovation Symposium 2025 (PMIS2025), held under the theme of "Innovative Materials and Smart Packaging for a Sustainable Tomorrow." This symposium is co-organized by the Department of Materials Engineering, Faculty of Engineering, and the Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University. Scheduled for March 13, 2025, PMIS2025 continues to serve as a dynamic platform for knowledge exchange and academic growth.

PMIS fosters an environment where students can share their technical expertise, refine their presentation skills, and gain valuable industry perspectives. Held annually with hosting responsibilities alternating between the Department of Materials Engineering and the Department of Packaging and Materials Technology, the symposium strengthens collaborative networks in Materials Science, Engineering, and Packaging, enhancing both teaching and research efforts.

This year's event features a distinguished keynote speaker, along with 55 oral presentations by undergraduate students from the Department of Materials Engineering, Faculty of Engineering, and the Department of Packaging and Materials Technology, as well as the Department of Textile Science, Faculty of Agro-Industry, Kasetsart University. We extend our deepest gratitude to all speakers for their invaluable time, expertise, and significant contributions to the success of this symposium.

The students' research projects, compiled in the E-Book of Abstracts, have been categorized into four key sessions:

- **Materials for Sustainability (MAS)**
- **Advanced Functional & Smart Materials (ASM)**
- **Materials Processing, Characterization & Testing (MPCT)**
- **Modeling and Prototyping, Emerging Technology & Applications (MPEA)**

We aspire for the 10th PMIS 2025 to spark collaboration, inspire innovation, and drive ongoing knowledge growth. This symposium not only enhances students' career prospects but also aligns with the university's dedication to sustainable development and societal advancement, rooted in the "Knowledge of the Land" philosophy.

The success of this symposium is made possible through the support of various parties. A heartfelt appreciation to the organizing committee, supporting staff, and faculty mentors for their dedication and guidance, which have played a crucial role in developing our students' intellectual and research skills.

I appreciate your vital contribution to this important event!

Apirat Laobuthee
The Chairperson of the 10th PMIS 2025

Welcome to the 2025 Packaging and Materials Innovation Symposium

The 10th PMIS 2025

We are delighted to host this milestone event, jointly organized by the Department of Packaging and Materials Technology (PKMT) and the Department of Materials Engineering (Mat-E) at Kasetsart University.

This year's theme, "Innovative Materials and Smart Packaging for a Sustainable Tomorrow," reflects our commitment to advancing materials and packaging technologies that align with global sustainability goals. We are honored to have two esteemed experts in sustainability, Assoc. Prof. Thumrongrut Mungcharoen and Asst. Prof. Dr. Viganda Varabuntoonvit, who will share their insights on the role of Life Cycle Assessment (LCA) in the development of sustainable materials and packaging.

Beyond expert panels, PMIS 2025 is also a platform for our undergraduate students to showcase their research and innovations in materials and packaging technology. This year, we are proud to feature 54 student projects: 29 from Mat-E, 24 from PKMT, and 1 from the Department of Textile Science. These students have worked tirelessly over the past months, and this symposium marks an exciting step in their journey toward making meaningful contributions to sustainability. The experience they gain here will prepare them well for the fast-evolving world of materials and packaging technology.

A heartfelt thank you to our keynote speakers, presenters, and all attendees. I also extend my deep appreciation to Assoc. Prof. Apirat Laobuthee, our symposium chair, and the dedicated organizing committee from both departments for making this symposium a success. For over a decade, PMIS has been a tradition that brings PKMT and Mat-E together to inspire the next generation of innovators—and we look forward to continuing this journey toward a more sustainable future.

Enjoy the symposium!

Associate Professor Dr. Ratchatee Techapiesancharoenkij

Head of the Department of Materials Engineering

Faculty of Engineering, Kasetsart University

Welcome to the 2025 Packaging and Materials Innovation Symposium

The 10th PMIS 2025

On behalf of the Department of Packaging and Materials Technology, I'm delighted to be part of this event. We're especially pleased to continue our strong collaboration with the Department of Material Engineering.

For a decade, PMIS has provided a vital platform for our students to present their research, exchange ideas, and cultivate innovation. Today, we uphold that tradition, showcasing the culmination of their senior projects.

This year's theme, "Innovative Materials and Smart Packaging for a Sustainable Tomorrow," is profoundly relevant. We face urgent environmental challenges that demand creative and forward-thinking solutions. Our students are at the forefront of this innovation, exploring cutting-edge materials and intelligent packaging to minimize environmental impact.

PMIS is more than just a presentation; it's an opportunity for students to refine their presentation skills, network, and prepare for their professional careers. It's a space for meaningful discussions and peer learning.

My sincere gratitude to the Department of Material Engineering for their continued partnership, and to our faculty for their dedicated mentorship.

To all participating students, I wish you the very best. May this symposium inspire, challenge, and propel you towards impactful careers.

Let's embrace collaboration and innovation to build a sustainable future!

Associate Professor Dr. Lerpong Jarupan

Head of Department of Packaging and Materials Technology

Faculty of Agro-Industry, Kasetsart University

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The Packaging & Materials Innovation Symposium 2025 (PMIS 2025)

"Innovative materials and smart packaging for a sustainable tomorrow"

Department of Packaging and Materials Technology, Kasetsart University

13 MARCH 2025

8:30-9:00	**Registration** Room 0410 Chuchart Kampoo Building, Faculty of Engineering, Kasetsart University						
09:00-09:30	**Welcome and Introduce to PMIS 2024** **Assoc. Prof. Dr. Warapa Mahakamchanakul** Director of Kasetsart University Research and Development Institute (KURDI) **Assoc. Prof. Dr. Anuvat Jangchud** Dean of The Faculty of Agro-Industry, Kasetsart University **Prof. Dr. Wanchai Yodsudjai** Dean of The Faculty of Engineering, Kasetsart University **Assoc. Prof. Dr. Ratchatee Techapiesancharoenkij** Head of Department of Materials Engineering, Kasetsart University Room 0410 Chuchart Kampoo Building, Faculty of Engineering, Kasetsart Universit						
09:30-09:55	**Break**						
10:00-10:30	***"Life Cycle Assessment for Sustainable Materials and Packaging"*** **Keynote Speaker I: Thumrongrut Mungcharoen** President, Asia Pacific Roundtable for Sustainable Consumption and Production Foundation (APRSCP Foundation)						
10:30-11:00	***"Methodology and Application of Life Cycle Assessment (LCA)"*** **Keynote Speaker II: Viganda Varabuntoonvit** Chemical Engineering, Kasetsart University						
	Room 0403	**Room 0405**	**Room 0406**	**Room 0407**	**Room 0410**	**Room 0313**	**Room 0205**
11:15-11:40	MAS01-P01	MAS08-M06	MAS16-M10	MAS23-M14	ASM09-M07	ASM01-M01	MPCT10-P09
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12:05-13:00	**Lunch**						
13:00-13:25	MAS03-M02	MAS10-P03	MAS18-P06	MAS25-M15	MPCT01-P01	ASM03-M03	PMEA01-M01
13:25-13:50	MAS04-M03	MAS12-P04	MAS19-P07	MAS26-M16	MPCT02-P02	ASM04-M04	PMEA02-P01
13:50-14:15	MAS05-M04	MAS11-M08	MAS20-M12	MAS27-M17	MPCT03-P03	ASM05-M05	PMEA03-P02
14:15-14:40	MAS06-M05	MAS13-M09	MAS21-P08	MAS28-M18	MPCT04-M01	ASM06-P01	PMEA04-P03
14:40-15:05	MAS07-P02	MAS14-P05	MAS22-M13	MPCT08-P07	MPCT05-P04	ASM07-P02	PMEA05-P04
15:05-15:30		MAS15-P10	MPCT07-P06	MPCT09-P08	MPCT06-P05	ASM08-M06	PMEA06-M02
15:30-16:00	**Break**						
16:00-17:00	**Awarding and Closing Remark**						

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2025

KEYNOTE
SPEAKER

Innovative materials and smart packaging
for a sustainable tomorrow

Assoc. Prof. Dr. Thumrongrut Mungcharoen

E-Mail: thumrongrut.m@ku.ac.th , thumrongrut.m@gmail.com

PRESENT POSITION

1. President, Asia Pacific Roundtable for Sustainable Consumption and Production Foundation (APRSCP Foundation)
2. Executive Board Member, Thailand Environment Institute (TEI)
3. Advisor, Thai Sustainable Consumption and Production Network/Association (Thai SCP Network/Association)
   (and Retired Lecturer, Chemical Engineering Department, Faculty of Engineering, Kasetsart University, since 2015)

EDUCATIONAL BACKGROUND

- B.Eng. (with Honors) in Chemical Engineering, Chulalongkorn University, Bangkok, Thailand.
- M.Sc. and Ph.D. in Chemical Engineering, University of Texas at Austin, USA. *(Royal Thai Government Scholarship)*

EXPERTISE

Cleaner Technology/ Pollution Prevention, Life Cycle Assessment, Sustainable Consumption and Production, Circular Economy, Eco-Efficiency, Risk Assessment, S&T for Sustainable Development, S&T Research Management

CURRENT TECHNICAL ADVISOR/ EXPERT COMMITTEE (Selected)

2024-Present Advisor/ Expert, Technological and Informatic Institute for Sustainability (TIIS) under MTEC/ NSTDA
2023-Present Chairperson of Circular Mark and EPD Product Label Committee, Thailand Environment Institute (TEI)
2022-Present National Statistics Sub-Committee on Natural Resources and Environment, National Statistics Office (NSO)
2022-Present Leadership Council Member, Sustainable Development Solution Network: SDSN Thailand
2020-Present Expert (Subcommittee/Chair), Circular Economy, Program Management Unit for Competitiveness (PMUC)
2020-Present Executive Committee, Eco-Industrial Park Certification, Industrial Estate Authority of Thailand (IEAT)
2019-Present Committee Member on Eco-Efficiency Evaluation, State Enterprise, State Enterprise Policy Office (SEPO)
2018-Present Advisor/Committee on Academic, Thai Institute of Chemical Engineering and Applied Chemistry (TIChE)
2016-Present Expert in Committee on Eco-Industrial Town Development, Ministry of Industry (MOI)
2014-Present Committee Member, Eco-Factory Certification/ Water Footprint Certification (Vice Chair, since 2018), FTI
2011-Present Expert in the Sub-committee on Promotion of Govt Green Procurement Policy, Pollution Control Department
2000-Present Advisory Committee, Water & Environment Institute for Sustainability, Federation of Thai Industries (FTI)

AWARDS (Selected)

1. Exceptional Contributions to the Field of Chemical Engineering Award (for Lifetime Contributions), Thai
2. Institute of Chemical Engineering and Applied Chemistry (TIChE), 2022
3. Distinguished Alumni Award, Wat Naunnoradit School, 2018
4. Excellent Research Award on Alternative Energy, Ministry of Energy, 2015
5. Outstanding Academic Service Award, Kasetsart University, 2010
6. Outstanding Academic Award, Kasetsart University, 2000
7. PTIT Fellow Award, Petroleum Institute of Thailand, 1999-2000 (now, Petroleum and Energy Institute of Thailand: PEIT)

SELECTED TECHNICAL EXPERIENCE (INTERNATIONAL)

Technical Expert on Cleaner Technology/ LCA/ SCP for several International Organizations such as UNIDO, *DANCED, APO, APEC, ERIA, GIZ,* UNEP/SETAC Life Cycle Initiative, EU Switch-Asia, World Bank Group-Thailand

Country Representative/ Expert in several workshops/ meetings (under ASEAN/UNDP-Energy, BASEL Convention-E-Wastes, APEC-LCA, EU-LCA, etc.)

Keynote/ Plenary Speaker for several International Conferences on Cleaner Technology, Recycle Technology, Life Cycle Assessment, Carbon-Water Footprint, Sustainable Consumption & Production, Circular Economy, STI for SDGs, etc.

SELECTED PUBLICATIONS:

More than 220 technical publications in the form of journals, proceedings, and books such as

- Springer Nature. 2021. *Life Cycle Greenhouse Gas Emissions for Circular Economy*, Chapter 24 of "Introduction of Circular Economy", Editor Lerwen Liu and Seeram Ramakrishna (eBook ISBN 978-981-15-8510-4)
- Springer. 2016. *Carbon Footprint of Products*, Chapter 2 of "LCA Compendium- The Complete World of Life Cycle Assessment: Special Types of Life Cycle Assessment". (eBook ISBN: 978-94-017-7610-3).
- United Nations Environment Programme (UNEP). 2011. *Global Guidance Principles for Life Cycle Assessment Databases:* A Basis for Greener Processes and Products, 156p., ISBN: 978-92-807-3174-3(one of the authors of Chapter 2).

Asst. Prof. Dr. Viganda Varabuntoonvit

E-Mail: viganda.v@ku.th

Academic Committee Position

- **Carbon Footprint Technical Committee for Products and Services**, Greenhouse Gas Management Organization (Public Organization) (2010 - 2022)
- **Carbon Footprint Verification System Development Committee for Organizations**, Greenhouse Gas Management Organization (Public Organization) (2012 - 2013)
- **Expert Advisor on Climate Change Coordination**, Ministry of Energy (2017 - 2018)
- **Subcommittee on the Development of Management Systems for Creating Economic Value (EVM)**, State Railway of Thailand (2017 - 2023)
- **Subcommittee on the Development of Management Systems for Creating Economic Value (EVM)**, Transport Company Limited (2021 - 2023)
- **Subcommittee on Supporting the Evaluation of Ecological and Economic Efficiency of State Enterprises**, State Enterprise Policy Office (2019 - Present)
- **Academic Subcommittee No. 5 on Environmental Labeling Standards, Life Cycle Assessment, Greenhouse Gas, and Related Activities**, National Standards Committee, Industrial Standards Institute (2021 - Present)

EDUCATION BACKGROUND

- B. Eng. (2543) in Chemical Engineering, Kasetsart University, Bangkok, Thailand
- M. Eng. (2546) in Chemical Engineering, Kasetsart University, Bangkok, Thailand
  - AIEJ (Association of International Education, Japan) Short-term Student Exchange Promotion Program (inbound) Scholarship (1 year)
  - Life Cycle Assessment for Power Generation Systems in Thailand Using NETS Method (Master Thesis)
- Ph.D. (2551) in Chemical Engineering, Kasetsart University, Bangkok, Thailand
  - Development of Life Cycle Assessment Tool with Environmental Cost Accounting Based on NETS Method (Doctoral Thesis)

EXPERTISE

Cleaner Technology, Pollution Prevention, Life Cycle Analysis, Eco-Design in Process Industry, Carbon and Water Footprint, Carbon Intensity, Energy Efficiency, Environmental Footprint

RESEARCH PROJECT (Selected)

- **Project "DfE for Electrical and Electronic Equipment Case Study: Room Air Conditioner"** in collaboration with the Institute of Electrical and Electronics Engineers and the National Metal and Materials Technology Center, research funding from the Department of Foreign Trade.
- **Project "Education tool for training on technologies for efficient water use using Virtual application sites (EDWAVE)"** with universities in Asia (India and Sri Lanka) and Europe (Finland, Spain, and Greece), research funding from the European Union EU-Asia Link Program.
- **Project Leader "Development of Life Cycle Database Management System"** at the National Metal and Materials Technology Center.
- **Project Leader "Development of Environmental and Basic Materials and Energy Database for the Petrochemical Industry"** at the Petroleum Institute of Thailand.
- **Project Leader "Development of Life Cycle Database Management System (Thai Life Cycle Database System; TLCD)"** at the National Metal and Materials Technology Center.

SELECTED PUBLICATIONS

- Viganda Varabuntoonvit, Seizo Kato, Thumrongrut Mungcharoen, Anugerah Widiyanto, "LCA Evaluation for Grid Electricity Power Plants in Thailand Using LCA-NETS Method", Proceedings, JSME Environmental Engineering Conference, Kawasaki, Japan, July 2002.
- Varabuntoonvit V., Thumrongrut Mungcharoen, "Life Cycle Assessment Model for Process Design with ProII and SimaPro", Proceedings, the International Conference on Technology of Plasticity, Yokohama, Japan, Oct 27-Nov 2, 2002.
- Varabuntoonvit, V., S. Papong, C. Yuvaniyama and T. Mungcharoen*, "DfE for Electrical and Electronic Equipment Case Study: Room Air Conditioner", Proceedings of the 10th Tri-University International Joint Seminar & Symposium 2003, Mie Univ., Japan, Oct 18-21, 2003.
- Varabuntoonvit, V., T. Mungcharoen*, S. Kato, and A. Widiyanto, "LCA Evaluation for Grid Electricity Power Plants in Thailand Using NETS Method", AIChE Annual Meeting Conference, San Francisco, USA, Nov 2003.
- Varabuntoonvit, V., Mungcharoen, T., Sadamichi, Y., and Kato, S., "Life Cycle Impact Assessment of Fuel and Electricity Using LCA-NETS Method", International workshop: Capacity Building on Life Cycle Assessment in APEC Economies, Bangkok, Thailand, 15-16 December 2005

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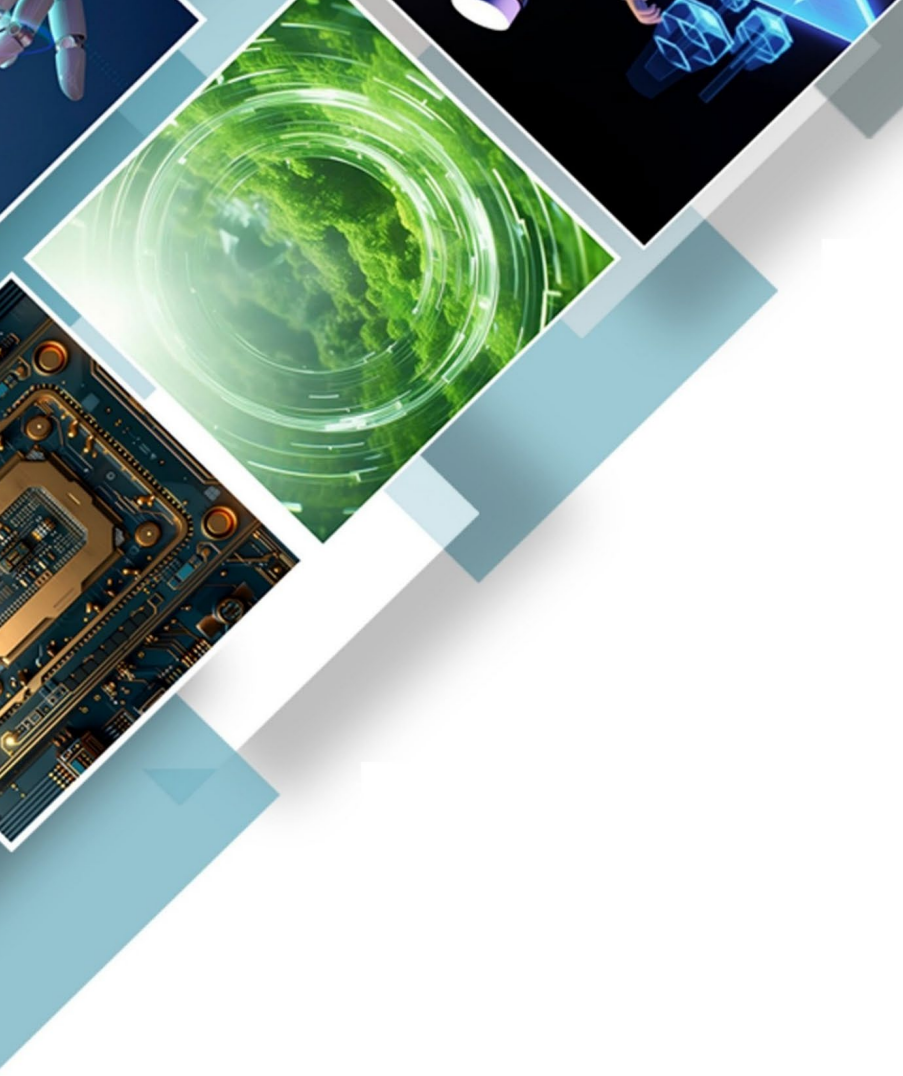


MAS

Materials for Sustainability

Innovative materials and smart packaging
for a sustainable tomorrow

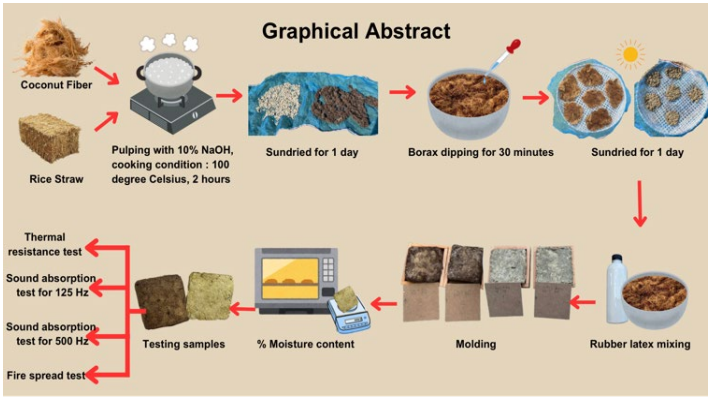
MAS01-P01

Development of acoustic and insulating materials from natural fibers

Nattida Muansin[1], Phonsini Noipachar[1], and Lerpong Jarupan[1,*]

[1]Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University, Bangkok 10900, Thailand
[*]corresponding author: Lerpong.j@ku.ac.th

Currently, most insulation materials used for sound and heat protection are made from synthetic materials, which may pose environmental and health concerns. This study aims to explore the use of natural materials, specifically coconut fiber and rice straw fiber, in producing insulation and acoustic absorbing sheets. The study examined their sound absorption, thermal resistance, and fire retardancy. The sound absorption test at 125 Hz revealed that coconut fiber sheets Type 1 (50:10:40) and Type 2 (40:20:40) demonstrated the highest performance, reducing noise levels to 69.00 dB and 65.33 dB, respectively. At 500 Hz, coconut fiber sheet Type 3 (30:30:40) exhibited the best absorption at 87.00 dB. In terms of thermal resistance, coconut fiber sheet Type 1 and the control rice straw fiber sheet showed the best performance, with temperatures at position B recorded at 37.83°C and 40.33°C, respectively. Sheets with higher borax content tended to have increased thermal conductivity. Fire retardancy tests indicated that adding borax reduced the rate of fire spread. The coconut fiber sheets had an average fire spread rate of 5.00 - 5.17 cm, while the rice straw fiber sheets showed slightly lower values at 4.17 - 4.50 cm, suggesting that rice straw fiber naturally exhibits better fire resistance. This study concludes that coconut fiber sheets are suitable for applications requiring high sound absorption and thermal resistance, while rice straw fiber sheets offer better fire retardancy. These findings support the development of environmentally friendly insulation materials.



Keywords: Acoustic materials, insulating materials, natural fibers, sustainable, sodium hydroxide

MAS02-M01

Study of the influence of powder characteristics and powder mixture ratios on the stereolithographic 3D printing process for TiO_2-based photocatalyst

Siraphop Sutipanwihan[1], Phoom Khunsuk[1], and Ampika Bansiddhi[1,*]

[1]Department of Materials Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[*]corresponding author: fengakb@ku.ac.th

Titanium dioxide (TiO_2) is a widely used photocatalyst due to its efficiency in degrading pollutants under ultraviolet (UV) irradiation. Its performance improves when TiO_2 particles are deposited on surfaces and structured into well-defined geometries, making Stereolithography (SLA) 3D printing a suitable fabrication method. However, incorporating TiO_2 powder into resin presents challenges, as the particles block UV light during curing, hindering printability.

This study investigates the printing process of TiO_2-based photocatalyst structures by examining powder-related parameters and powder-to-resin ratios in SLA 3D printing. Factors such as TiO_2 powder properties, dispersion techniques, and SLA printer settings were analyzed to enhance printability. An LCD-based SLA printer was used. TiO_2 content ranging from 5% to 15% by weight was prepared and characterized using SEM and EDS to evaluate its impact on resin curing and structural integrity.

Results showed that dispersion significantly affected print quality, with an ultrasonicator device ensuring uniform particle distribution, as observed through visual inspection. Higher TiO_2 concentrations hindered UV curing, leading to poor structural formation. Optimizing SLA settings, particularly exposure time and layer thickness, was crucial for balancing light penetration and curing efficiency.

Future research should explore the potential of increasing the amount of TiO_2 on the surface through coating or incorporating chemical additives to improve resin flow and prevent phase separation, as these approaches may effectively enhance the photocatalytic performance of TiO_2.

Keywords: Stereolithography Three-Dimensional Printing, Titanium Dioxide Photocatalyst, Powder-Resin Mixing Method, Printability

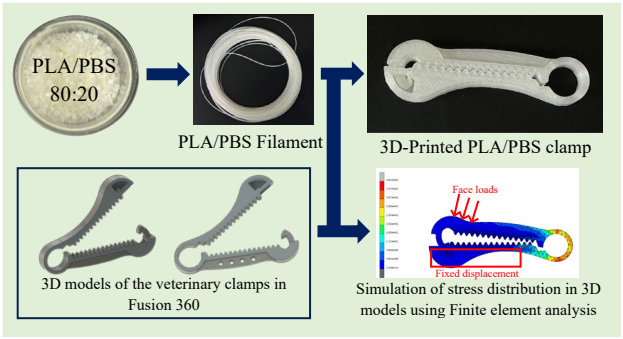
PMIS 2025

Innovative Eco-Friendly PLA/PBS Filament For Veterinary Prototyping Using 3D Printing

Rakhathai Kunaprom[1], Thanatchaporn Phumphuang[1], Chaiyakorn Thitiyanaporn[2], Attaporn Wisessint[3], Ratchatee Techapiesancharoenkij[1], and Amornrat Lertworasirikul[1,*]

[1]Department of Materials Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2]Department of Companion Animal Clinical Science, Faculty of Veterinary Medicine, Kasetsart University, Bangkok, 10900, Thailand
[3]Department of Mechanical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[*]corresponding author: fengarl@ku.ac.th

This project aims to develop veterinary-aid clamp prototypes using a biodegradable blend of polylactic acid (PLA) and polybutylene succinate (PBS) in an 80:20 weight ratio. A three-dimensional clamp model for spaying and kidney dialysis was designed using Fusion 360. The PLA/PBS blend was processed into filaments and the clamps were fabricated via fused deposition modeling (FDM) 3D printing. Finite element analysis was conducted to evaluate stress distribution upon clamp application. Initially, the 3D-printed spay and omentum clamps failed to close completely, necessitating a redesign. Although the revised 3D-printed clamps functioned as intended, simulation results suggested a potential issue with the clamp mechanism's locking capability. This discrepancy was likely due to uneven shrinkage of the PLA/PBS blend during printing. These findings highlight the need for further research to optimize 3D printing parameters for PLA/PBS, ensuring accurate replication of digital models. Simulation of the revised digital model, comprising a spaying clamp and an omentum clamp, which differed only by the presence of four holes on the omentum clamp's arm, showed that the spaying clamp could tolerate forces below 8 N, whereas the omentum clamp's limit was less than 6 N. This suggests that the holes affected how stress was distributed. Experimental testing of the actual 3D-printed PLA/PBS clamps after immersion in a phosphate buffer solution at 40°C for four weeks, showed no detectable chemical or thermal properties changes based on FTIR and DSC analyses. However, elongation at break was reduced by 50%, indicating increased brittleness after accelerated aging.



Keywords: Biodegradable polymer, Finite element analysis, Polylactic acid, Polybutylene succinate, 3D printing, Spay clamp, Omentum clamp

MAS04-M03

Development of Prosthetic Liners for Amputees

Thatchapon Monkonsiri[1], Amornrat Lertworasirikul [1,*]

Department of Materials Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
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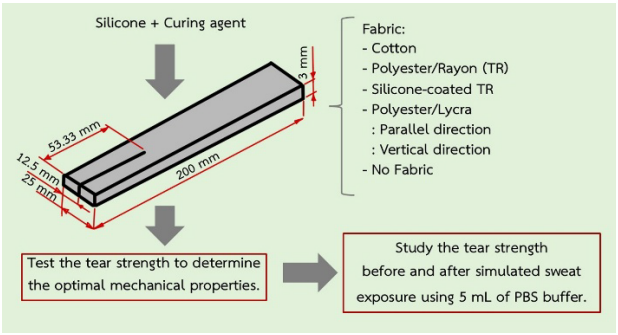
This project aims to develop prosthetic liners using silicone-based materials. Fabric reinforcement was introduced to enhance the tear resistance of silicone. The study examined various fabric types, including cotton, polyester/rayon (T/R), silicone-coated T/R, and polyester/LYCRA blends, as well as two different attachment techniques, such as direct bonding and adhesion through an adhesive layer. The tested adhesive included epoxy (EP), cyanoacrylate (CA), and nano tape acrylic (NT).



However, these adhesives could not attach the fabric to the silicone. Instead, direct bonding during the casting process proved to be effective. The fabric-silicone composite improved the tear resistance of silicone, although it resulted in a reduction in elongation at break. Among the materials tested, silicone reinforced with polyester blended with LYCRA in a parallel orientation retained elongation properties similar to unmodified silicone. To simulate sweat exposure, the samples were tested in a PBS buffer solution, which led to only slight changes in tear resistance and elongation at break. These results suggest that polyester blended with LYCRA is a promising reinforcement material for soft silicone prosthetic liners, maintaining both tear resistance and flexibility after use.

Keywords: Silicone composite, Prosthetic liner, Fabric reinforcement, Tear resistance, Elongation properties

MAS05-M04

Green Recovery of Aluminum from Solar cell

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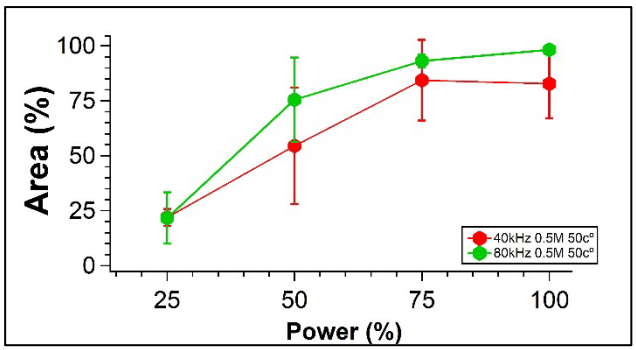
Currently, solar cells are widely used for electricity generation. As a result, when they reach the end of their lifespan, they become electronic waste that poses environmental hazards. This has led to interest in developing methods to recycle solar cells in an environmentally friendly manner. This research focuses on extracting aluminum from solar cells using a sonicator with a potassium bicarbonate solution. The study used solar cell samples measuring 1 × 1.2 cm³. A sonicator was set at a temperature of 50°C for 30 minutes, with variations in solution concentration, frequency, and vibration power as experimental conditions. After sonication, the solution was filtered and dried. The extracted powder and treated solar cell sheets were then analyzed for their composition and chemical bonding using SEM-EDS and Raman spectroscopy. The extraction area was also evaluated using image analysis of the extracted solar cell sheets. The results showed that the three main factors had an impact on aluminum extraction with efficiency between 96-99%. At a frequency of 80 kHz, a solution concentration of 0.5 M, and 100% vibration power, the extracted area was approximately 99%, indicating the highest extraction efficiency. The extracted aluminum was found to be a compound of $Al(OH)_3$. This method presents a promising environmentally friendly approach for recycling solar cells.



Keywords: Solar cells, Sonicator, Potassium bicarbonate, Environmentally friendly

MAS06-M05

Development of environmentally friendly nano-coating sprays

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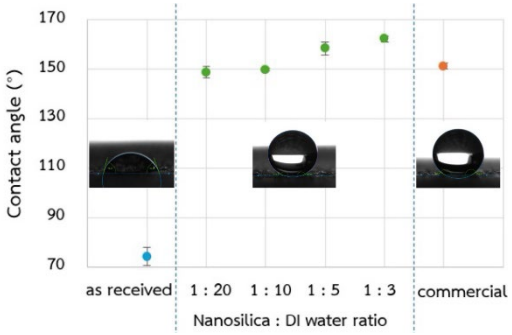
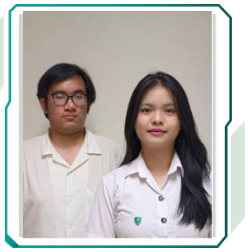
Hydrophobic coatings protect surfaces from water and contamination, but commercial solvent-based solutions pose environmental and health risks. Growing environmental awareness is driving the development of eco-friendly alternatives. This study focuses on eco-friendly nanosilica coatings to enhance water repellency, comparing their performance with a commercial coating spray. Nanosilica particles (30–50 nm) were synthesized and stored in DI water at 3% vol. Coating solutions were prepared with nanosilica stock: DI water ratios of 1:3, 1:5, 1:10, and 1:20, using 2- and 4-ml volumes. They were sprayed onto 10 × 10 cm² areas of cotton, nylon, and polyester fabrics. Water-repellent performance was assessed by measuring water contact angles, while coated surface structures and elemental compositions were examined via SEM and EDX. The results showed that nanosilica coatings significantly enhanced hydrophobicity, increasing the contact angle from 73.35° to 161.04°. Higher concentration and coating volume slightly improved the performance. SEM images revealed nanoparticles uniformly distributed on fibers, with silicon identified as a major element in the coating. Additionally, delivering performance comparable to that of the commercial spray, nanosilica coatings reduces reliance on toxic chemicals, offering greater user safety and minimal environmental impact. These findings highlight nanosilica's potential as a sustainable and effective alternative for water-repellent material development.



Keywords: Nanosilica particle, Surface coating, Hydrophobicity, Contact angle, Eco-friendly

MAS07-P02



The usage of granulated sugars as an anti-wrinkle agents on cotton fabric

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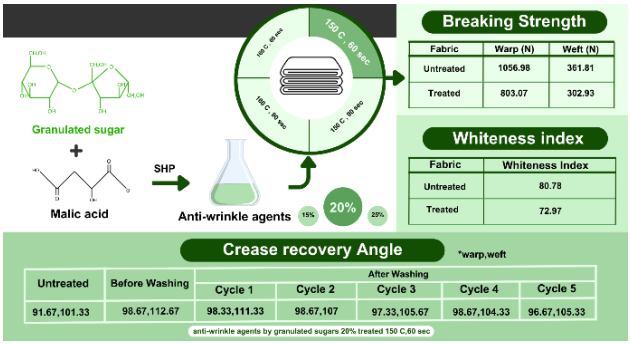

Cotton fabric is widely used in the production of various textile products due to its breathability, comfort, and versatility. However, its susceptibility to wrinkling remains a significant drawback, requiring the use of anti-wrinkle finishing processes to enhance crease recovery ability. This research focuses on applying an eco-friendly anti-wrinkle agent derived from commercially available granulated sugar with malic acid and sodium hypophosphite on cotton fabric. The optimal curing condition was studied. The wrinkle recovery angle, color change, breaking strength, and durability of the treated fabric was also evaluated. The optimal curing condition was found to be 150°C for 1 minute. Under these conditions, the wrinkle recovery of the treated fabric increased by 13.8% in the weft yarn and 9.1% in the warp yarn. However, the fabric's breaking strength and color stability tended to decrease. Furthermore, the durability test revealed that with each wash, the wrinkle recovery efficiency of the treated fabric decreased by approximately 1-4%. Overall, the results suggest that the anti-wrinkle agents derived from granulated sugar could enhance the wrinkle recovery ability and serve as an eco-friendly alternative for use in the finishing process of cotton fabric.

Keywords: Eco-friendly, Anti-wrinkle agents, Granulated sugars, Cotton Fabric

Impact of Macadamia Nutshell Biochar on Humectant and Emulsifier in Skincare Product Formulation Development

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The beauty industry continuously advances skincare product development, increasing consumer demand for natural ingredients. Macadamia nutshell biochar from the Doi Tung project is a promising option, as it is derived from agricultural waste and possesses oil-absorbing properties. Additionally, the rising interest in environmentally friendly products enhances its potential.

This study examines the effects of 45 µm macadamia nutshell biochar combined with two humectants (propylene glycol or butylene glycol) and two emulsifiers (polysorbate 20 or polysorbate 60) as base ingredients for skincare formulations. The 2:1:1 ratio of biochar to humectant to emulsifier was used to create four formulations. Their mechanical and chemical properties were analyzed for potential skincare applications.

Viscosity analysis using a viscometer at 4 rpm for 2 minutes showed that the butylene glycol + polysorbate 20 formulation had the lowest viscosity (16,040 mPa.s) but the highest pH (9.31). Conversely, the butylene glycol + polysorbate 60 formulation had the highest viscosity (27,270 mPa.s) but the lowest pH (8.41). FTIR analysis of the four formulations revealed overlapping peaks of functional groups and chemical bonds among biochar, humectant, and emulsifier, with no new functional groups or bonds formed. This suggests that these components interact effectively without chemical alteration, making them suitable for further skincare formulation development.

Keywords: Biochar, Skincare, Macadamia Nutshell, Humectant, Emulsifier

MAS10-P03

Transformation of fructose into 2,5-furandicarboxylic acid for novel biopolymer production

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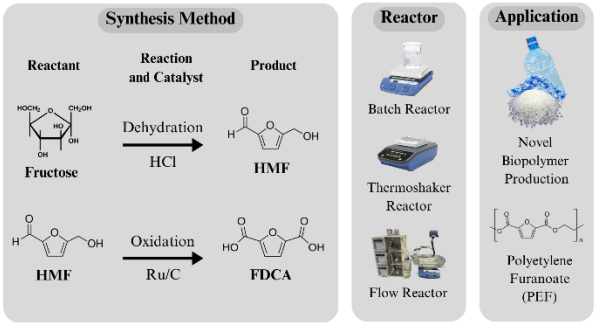

Although PET plastic is recycled into rPET to reduce the consumption of virgin PET, plastic waste generation and the use of petroleum-based resources for PET production continue to increase. However, in recent years, a new biobased plastic, polyethylene furanoate (PEF), has been developed as a sustainable alternative. It is derived entirely from renewable resources, such as fructose, and has a lower greenhouse gas footprint than petroleum-based PET. Additionally, PEF offers better gas barrier properties than PET. The development of an efficient synthesis process for 2,5-furandicarboxylic acid (FDCA), the key monomer for PEF production, remains a challenge due to the limitations of conventional process, including long reaction times, high temperatures, significant byproduct formation, and low product yields. The objective of this research is to improve synthesis process for FDCA from fructose using thermoshaker and continuous-flow reactors. The effects of various reaction parameters on product yield are investigated. The product is monitored over time and analyzed using high-performance liquid chromatography (HPLC). The experimental results showed that both the thermoshaker and flow reactor provided a higher product yield than conventional batch reactor due to increased mass and heat transfers efficiency. These findings provide valuable insights for further optimization and industrial-scale development of FDCA synthesis from fructose, enabling its application in sustainable PEF production.

Keywords: 2,5-Furandicarboxylic acid (FDCA), Polyethylene Furanoate (PEF), Fructose transformation, Flow reactor, Biopolymer

MAS11-M08

Utilization of geopolymers by Thai pozzolans enhancing zeolite for adsorption and encapsulation of heavy metals

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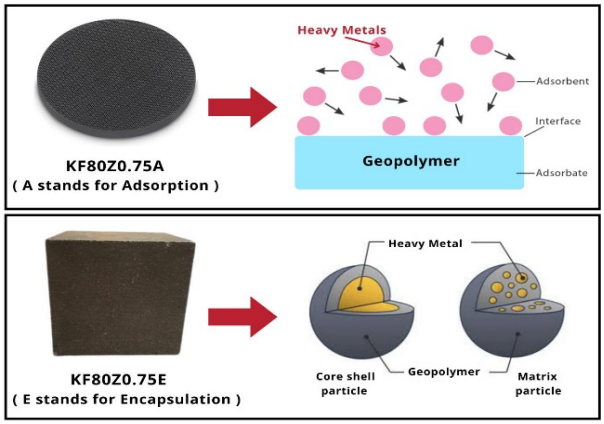
Currently, many industrial factories in Thailand discharge wastewater contaminated with heavy metals such as Cadmium (Cd) and arsenic (As) into natural water sources, leading to environmental contamination. This study investigates using geopolymer paste made from fine pozzolanic materials, such as kaolin and fly ash, which can absorb and encapsulate heavy metals. The geopolymer paste is syn-thesized by mixing pozzolanic materials with alkali solutions. For adsorption, a foaming agent like hydrogen peroxide is used creating a porous structure, while for encapsulation, no foaming agents are added resulting in a dense structure. Experimental results revealed that the optimal kaolin: fly ash ratio was 20:80, and the incorporation of zeolite at concentrations of 0, 0.25, 0.5, 0.75, and 1 wt% significantly influenced the compressive strength of the material. The geopolymer paste formulation KF80Z0.75A (K: F: Z 20: 80: 0.75 for adsorption) demonstrated a maximum compressive strength of 25.73 MPa, whereas the KF80Z0.75E (K: F: Z 20: 80: 0.75 for encapsulation) exhibited a maximum compressive strength of 31.41 MPa after curing 28 days from testing with a Universal Test Machine (UTM). Chemical analysis using a Fourier Transform Infrared Spectrophotometer (FTIR) confirmed that the geopolymer paste consists of sodium aluminosilicate, with complete geopolymerization, as evidenced by the Si-O-(Si/Al) functional group. Additionally, by treatment performance industrial estate of wastewater using geopolymer for heavy metal adsorption, both Atomic Absorption Spectroscopy (AAS) testing indicated that the geopolymer paste has significant adsorption and encapsulation capabilities for heavy metals.



Keywords: Geopolymer; Zeolite; Hydrogen Peroxide; Heavy Metal Adsorption; Heavy Metal encapsulationflexural, ISO 6872:2015

MAS12-P04

Enhancement active bioplastic packaging with silver nanoparticles and lamination to increase shelf life of chilled beef

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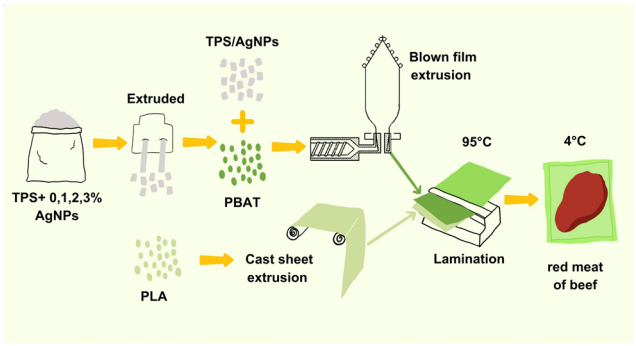

Active packaging materials made from bio-based materials and silver nanoparticles (AgNPs) represent an innovative trend in food packaging. This study aims to enhance antimicrobials efficacy and barrier property of thermoplastic cassava starch (TPS) blended with poly(butylene adipate-co-terephthalate) (PBAT) films for increasing shelf life of chilled beef. TPS/PBAT (60/40) incorporated AgNPs (0, 1, 2, 3% wt.) produced via blown film extrusion. Polylactic acid (PLA) was produced via cast sheet extrusion and then laminated with TPS/PBAT/AgNPs film at 95°C in two directions (forward and backward). UV-vis spectrophotometry revealed that the light transmission of the TPS/PBAT/AgNPs film decreased with increasing AgNPs concentration. Adding AgNPs to TPS/PBAT film enhances toughness properties by increasing tensile strength and elongation at break. Lamination with PLA enhances the mechanical strength and barrier property of the TPS/PBAT/AgNPs film. However, the concentrations of AgNPs did not affect the water vapor permeability of the TPS/PBAT film. At 3%, AgNPs exhibited antimicrobial properties against Staphylococcus aureus growth in nutrient broth by reducing optical density until 5 days of incubation. TPS/PBAT/AgNPs film cannot maintain the moisture content in beef, resulting in moisture loss, dry meat, and an unacceptable appearance. Laminated film with AgNPs 3% can extend the shelf life of chilled beef more than 5 days compared to AgNPs 0% during storage under refrigeration. Therefore, PLA laminated with TPS/PBAT/AgNPs film has efficiency for active food packaging to enhance microbial control in refrigerated meat.

Keywords: Poly (lactic acid), Polybutyrate adipate terephthalate, silver nanoparticles, chilled beef

MAS13-M09

Sensitization of stainless steel after prolonged Exposure to high temperatures

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This research investigates the influence of prolonged exposure to high temperatures on the microstructure, and corrosion resistance of AISI 304 stainless steel. Samples of AISI 304 stainless steel were homogenized and then heated to 800 °C and held for 0, 8, 24, 72, 168, and 336 hours respectively. Corrosion resistance was quantitatively analyzed using the Double Loop Electrochemical Potentiokinetic Reactivation (DL-EPR) technique. Afterward, microstructural analysis was conducted the samples. This study found that prolonged exposure at 800°C to high temperatures affected the corrosion resistance of AISI 304 stainless steel, although no clear trend could be established.

Keywords: stainless steel, corrosion, DL-EPR

The study on single-used packaging usage behavior of consumers in Thailand

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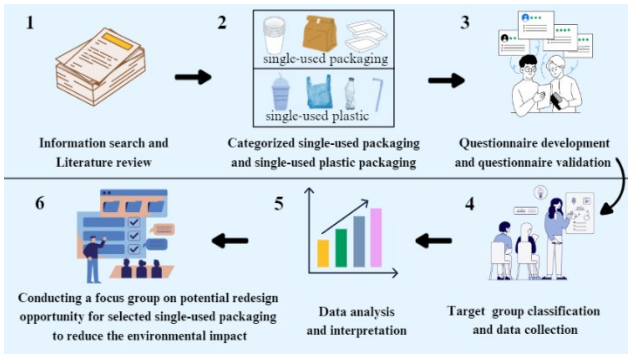
Single-used packaging refers to those packaging items that are used to hold the products only once in a short time. The materials for single-used packaging can be plastic, paper, metal or glass. However, single-use plastic both for packaging and other items such wrap films, bottles, bags, cigarette butts and straws post more severe environmental impact than other materials. This was due to the difficulty of collecting and recycling. Its disintegration can also cause microplastic pollution. As a result, The Single-Use Plastic Directive (SUPD) of the EU member state came into force since July 3, 2021. For Asian countries, information regarding usage behavior of single-used packaging was very limited. This research aims to understand the single-used packaging usage behavior of consumers in Thailand especially on the usage amount and their environmental impact perception on various single-used packaging items. Targets groups are Thai consumers in Bangkok and vicinity utilizing questionnaire as a main research instrument. Online questionnaire development and questionnaire validation were conducted. The questionnaire was designed into 4 sections including personal information, usage rate of single packaging, perception on the level of environmental impact, and suggestions on the environmental impact reduction. Data collection was during December 2024- February 2025. According to the results, 400 respondents participated. Plastic bags were among the main frequent packaging items. After that, the focus group was additionally conducted to identify the potential redesign protocols. This research can be used to support policy measurement and business operators for alterative substitution ideas of packaging items.



Keywords: Single-used, Packaging, Behavior, Consumer, Thailand

PMIS 2025

The development of wrapping paper by natural waxes coating

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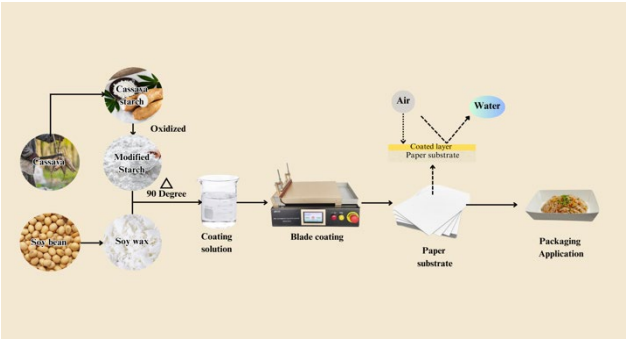
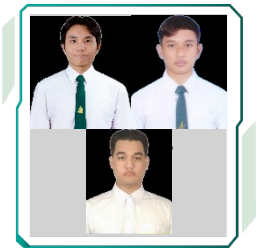
Plastic coated papers for packaging cause recycling difficulty. Moreover, microplastic pollution from the plastic layer during the landfill can also harm the ecosystem. As a result, the shift toward using paper coated with natural substances has gained attention as a viable alternative. This research studied the properties of paper coated with 25% modified starch combined with natural soy wax at concentrations of 10%, 15%, and 20% (w/v). The paper coating was applied using a Mini Automatic Film Applicator(BEVS1818), and the physical properties, water and oil resistance, and mechanical properties were tested. The results showed that as the concentration of soy wax increased, the weight and thickness of the coated paper also increased accordingly. Furthermore, the water resistance test indicated that water resistance improved with an increase in soy wax concentration, with a water resistance enhancement of 71.90% at the 20% soy wax concentration. The contact angle of water also increased in line with the wax concentration. However, in the oil resistance test using the Oil Kit Test method, the soy wax-coated paper at concentrations of 10%, 15%, and 20% demonstrated little improvement for the oil resistance, with Kit No. of 2, 3, and 3, respectively. Based on current experimental results, it was found that the paper coated with 25% modified starch blended with 20% soy wax exhibited the best properties in all aspects and is suitable for development into packaging for food in the future. Suggested applications were food wrapping papers, food trays or other single-used packaging applications.



Keywords: Natural wax, Water resistant, Paper packaging, Coating, Soy wax

MAS16-M10



The effect of heat treatment on the properties of CoCrFeNiTi HEA

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This study aims to enhance the properties of the CoCrFeNiTi high entropy alloys (HEAs) through heat treatment and investigate the changes in their mechanical and chemical properties. The materials used in this research were arc melted CoCrFeNiTi HEAs. This research was focused on the improvement of HEAs properties by applying heat treatment at different temperatures of 700°C and 1100°C for 4 hours. The microstructure, chemical composition, phase composition, and corrosion resistance of HEAs were characterized. Based upon the results, it was found that cobalt, chromium, iron, nickel, and titanium were observed in equiatomic ratio for CoCrFeNiTi HEAs. The results were confirmed by X-ray diffraction (XRD) and chemical composition analysis. Furthermore, the changes of microstructure and hardness were observed in heat-treated specimens. In conclusion, these findings suggested that heat treatment is an effective approach to improving the properties of HEAs.

Keywords: High-entropy alloy; Heat treatment; Mechanical properties; Chemical properties

MAS17-M11

Electroplating for Industrial Applications In the Petroleum Industry

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This research aims to apply the technique for embedding titanium dioxide (TiO_2) particles into a nickel-chromium (Ni-Cr) coated layers on low-carbon steel (SS400) surfaces using a sonicator at varying time on (T_{on})/ time off (T_{off}) ratios (10-50, 20-40, 30-30, 40-20, and 50-10 seconds). The Ni-Cr alloys were electrodeposited through 10 mA of direct current (DC) and pulsed current (PC) with 33 pulse duty cycles. The microstructure, particle distribution, chemical composition, hardness, and thickness of the electrodeposited layers were investigated. The electrolyte solution used in this study consisted of nickel sulfate ($NiSO_4 \cdot 6H_2O$), chromium chloride ($CrCl_3 \cdot 6H_2O$), titanium dioxide (TiO_2), sodium lauryl sulfate (SDS), deionized water, and ethanol. Based upon the results, it was observed that pulsed current electrodeposition with 33 pulse duty cycles, specifically at a T_{on}/ T_{off} ratio of 30-30 seconds, achieved the highest particle distribution and concentration of titanium dioxide particles within the Ni-Cr coating layers compared to other electrodeposition conditions.

Keywords: Electrodeposition, Sonicator, Ni-Cr-TiO_2 film, Microstructure

MAS18-P06

Development of bio-cushioning materials derived from rice straw for fruit packaging

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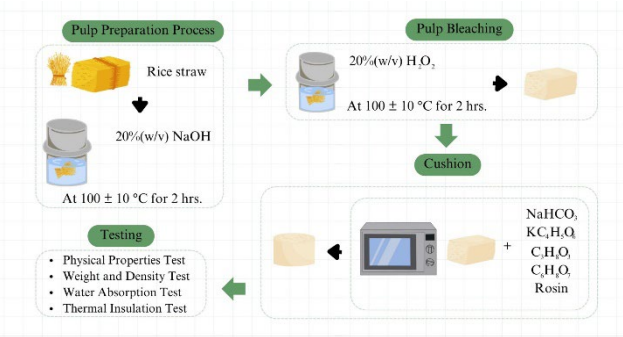
This research examined the feasibility of transforming rice straw, an agricultural waste, into a bio-cushioning material as a sustainable alternative to petroleum-based foam cushions. Rice straw was processed into pulp and -molded using microwave molding process. The physical characteristics of the molded material, including density, weight, water absorption capacity, and heat insulation properties were analyzed. The results showed that the bio-cushioning material had a rough surface, a porous structure, and relatively high density as compared to expanded polystyrene (EPS) foam. Additionally, it exhibited a higher water absorption capacity than EPS foam while retaining good heat insulation properties. The findings suggest that rice straw-based cushioning material has strong potential as an eco-friendly alternative for the packaging industry, promoting sustainable packaging solutions and supporting global sustainability efforts.



Keywords: Rice straw, Bio-cushioning materials, Foaming material, Agricultural waste, Fruits packaging

MAS19-P07

The Effect of Banana Peel on the Properties of Bioplastic Film Using Glycerol as a Plasticizer

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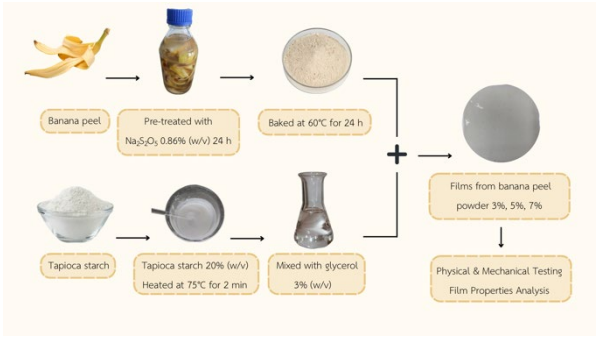
The disposal of food processing waste is a significant environmental challenge, with banana peels being a major byproduct often discarded without further utilization. This study explored the potential use of banana peel powder as an additive in biodegradable plastic films, with tapioca starch as the primary raw material and glycerol as a plasticizer to enhance flexibility. The banana peels were pre-treated with sodium metabisulfite for 24 hours to reduce browning and prevent spoilage, then dried at 60°C for another 24 hours before being finely ground for incorporation into the bioplastic formulation. The effect of banana peel powder at concentrations of 3%, 5%, and 7% was examined in comparison to a control formulation without banana peel. Additionally, the films were subjected to different drying temperatures (50–70°C) and durations (4–8 hours) to evaluate their impact on the film's physical properties. By identifying the optimal banana peel concentration and drying conditions, this study aimed to enhance the functional properties of bioplastic films while addressing organic waste reduction and resource efficiency. The findings provide insights into the feasibility of incorporating banana peel powder in biodegradable plastics, promoting the development of environmentally friendly alternatives to conventional plastics.



Keywords: Banana peel, Biodegradable plastic, Glycerol, Tapioca starch

Synthesis and characterization of tungsten carbide/activated carbon composites as electrode materials for supercapacitors

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Supercapacitors are promising energy storage devices that stabilize the energy supply by delivering high energy within a short time. The electrode materials play a vital role in determining their performance. Activated carbons (ACs) are widely used due to their large surface area, high porosity, and low cost; however, developing novel AC-based materials remains a challenge. In this study, ACs were synthesized from marigold flowers via hydrothermal carbonization at 180 °C for 12 h, followed by KOH activation at 800 °C. WC-loaded mesoporous carbon composites (WC@MC) were synthesized using a solution plasma process with benzene and tungsten electrodes, followed by heat treatment at 1,000 °C for 1 h under an argon atmosphere. The resulting AC and WC@MC were blended at 90:10, 70:30, and 50:50 ratios, forming the composites. Structural analysis revealed that ACs exhibited an amorphous phase, whereas WC@MC showed a high-crystalline WC phase with an amorphous MC. Morphological analysis indicated a 3D sponge-like structure for AC, while WC@MC contained WC nanospheres in the MC matrix. The specific surface area of AC was 1,739 $m^2\ g^{-1}$, which decreased with increasing WC@MC content (from 1,491 to 533 $m^2\ g^{-1}$). Electrochemical tests in 6 M KOH showed that the 90:10 ratio composite exhibited the highest specific capacitance (115 F g^{-1} at 1 A g^{-1}), surpassing ACs (101 F g^{-1}). The enhancement is attributed to WC@MC in the composites, enabling faster charge transport and higher conductivity. However, excess WC@MC reduced specific capacitance. These findings highlight the importance of an optimal WC@MC-to-AC ratio in improving supercapacitor performance.

Keywords: Supercapacitors, Energy storage, Activated carbons, Tungsten carbide, Composites

Development of Biodegradable Film Based on Starch Combined with Duckweed Biomass for Agricultural Applications

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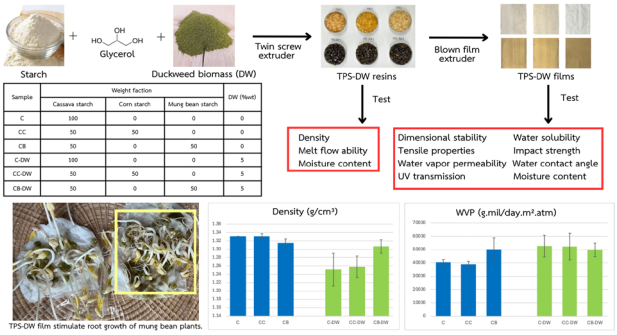
Duckweed is a fast-growing aquatic plant. It is abundantly floating on the water surface, blocking sunlight from penetrating below the water surface; as a result, some underwater plants die due to the inability to photosynthesize. Duckweed biomass (DW) consists of starch and protein, which can be used as raw materials for bio-based film production. Therefore, this research technique aims to develop thermoplastic starch (TPS) films from cassava starch, corn starch and mung bean starch mixed with DW for agricultural applications. The films were prepared by melt mixing of starch, glycerol and DW (5% by weight) in a twin-screw extruder and then forming into films with a film blowing machine. Three types of starch were used for film preparation: cassava starch, cassava starch mixed with corn starch (50:50 w/w), and cassava starch mixed with mung bean starch (50:50 w/w). The addition of DW resulted in decreased density, melt flow ability, tensile strength, and Young's modulus of TPS films, but increased water vapor permeability, dimensional stability and water solubility. From the preliminary results, TPS-DW based films tended to stimulate root growth of mung bean plants, as confirmed by increased number and length of mung bean roots. This research shows that TPS films supplemented with DW are potential environmentally friendly bio-based materials for agricultural applications.



Sample	Weight faction			DW (%wt)
	Cassava starch	Corn starch	Mung bean starch	
C	100	0	0	0
CC	50	50	0	0
CB	50	0	50	0
C-DW	100	0	0	5
CC-DW	50	50	0	5
CB-DW	50	0	50	5

Keywords: Thermoplastic Starch, Duckweed Biomass, Biodegradable Film, Agricultural Applications, Extrusion

MAS22-M13

PMIS 2025

Electroplating for applications in the alternative energy industry

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This research aims to enhance the efficiency of the hydrogen evolution reaction (HER) in electrode charge storage and improve corrosion resistance by using electrodeposited Ni-Sn alloy coating on SS400 steel substrates. The electrodeposition process is conducted via direct current (DC) and pulse current with duty cycles of 33, 50, and 67, applying a current of -3.7 mA. The Ni-Sn electrolyte solution used in this study consisted of nickel sulfate hexahydrate ($NiSO_4 \bullet 6H_2O$), tin (II) chloride ($SnCl_2$), 0.1 M hydrochloric acid (HCl), acetonitrile, and deionized water. The coated layers were analyzed using a scanning electron microscope (SEM) and X-ray diffraction (XRD) to investigate the microstructure and phase composition, respectively, to determine the optimal electrodeposition conditions. Subsequently, the Ni-Sn alloy coatings were electrodeposited to a glassy carbon electrode (GCE) with the optimal electrodeposition conditions. The properties of coated layers were then characterized.

Keywords: Thin-film coating, Electrodeposition, Glassy carbon electrode, Ni-Sn thin film, Hydrogen evolution reaction (HER)

MAS23-M14

PMIS 2025

The Influence of Heat Treatment Process on the Microstructure and Limit of Iron-Nickel Superalloys

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This research investigates the improvement of the microstructure and properties of iron-nickel-based superalloys through heat treatment with varying times and temperatures. The study compares solution treatment at 982°C for 1 hour and 900°C for 2 hours, followed by oil quenching and precipitation hardening at 720°C and 760°C for 16 hours, both air-cooled to room temperature. Additionally, the effects of a second precipitation hardening process conducted at 650°C for 12 hours are also examined. The morphology, size, and average area fraction of the gamma prime (γ') phase were analyzed using a scanning electron microscope. The results indicate that variations in solution treatment temperature and time did not significantly affect the size and average area fraction of the gamma prime phase. Therefore, the solution treatment temperature can be adjusted to optimize processing time. The primary precipitation hardening process, despite being performed at different temperatures, resulted in a similar increase in the average area fraction of gamma prime particles. This suggests that a lower precipitation temperature can be used while maintaining a constant duration. The secondary precipitation hardening process led to an increase in the average area fraction of gamma prime particles, comparable to as-received specimens, confirming its enhancement effect. After all heat treatment processes, the gamma prime particles exhibited an irregular spherical shape, a reduction in size, and an increased average area fraction, demonstrating a more uniform dispersion.

Keywords: Iron-Nickel based superalloys, gamma prime particles, precipitation hardening, average area fraction

Development of Red Seaweed-Based Coating for Paper Packaging

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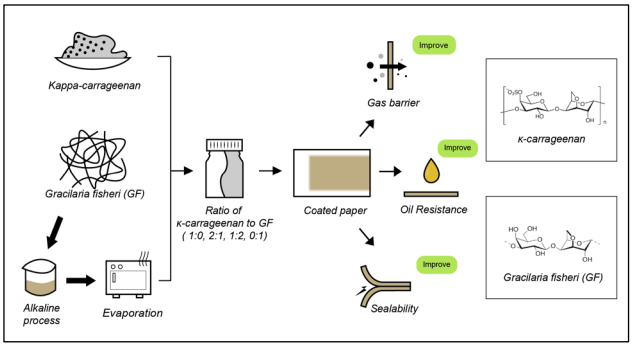

Bio-based coatings have gained increasing global attention due to their environmental advantages over petroleum-based materials. Among potential natural resources, *Gracilaria fisheri* (GF), a red seaweed, has become an ecological concern due to its excessive growth in aquatic ecosystems. However, this abundant seaweed can be used as a rich source of carrageenan, which exhibits gelling, thickening, and film forming properties. This study aims to develop a bio-based coating from GF for paper packaging applications and compare its performance with standard kappa-carrageenan coatings at different mixing ratios. In this study, fresh GF was extracted using alkaline extraction and processed into a coating material through bleaching and homogenization. The extracted coating was then applied to brown kraft papers, with starch used as a base layer to cover paper pores, ensuring uniform coating and optimal performance. The FTIR results showed that extracted GF had a molecular structure similar to that of kappa-carrageenan but lacked sulphate molecules. Interestingly, GF-based coatings exhibited oil absorption comparable to kappa-carrageenan, but they reduced oil uptake by up to 6 times compared to uncoated paper. Additionally, they significantly reduced oxygen permeability by 28 times and improved water vapor barrier properties by 28%, outperforming uncoated paper. Notably, GF-based coatings exhibited heat-sealing capability with a maximum seal strength of 1.3 MPa, which the standard kappa-carrageenan could not achieve. Furthermore, SEM observations confirmed that the coatings effectively concealed the rough and porous structure of the paper. These findings highlight GF-based coatings as a cost-effective and high-performance alternative for food paper packaging.

Keywords: Coating, Paper packaging, Carrageenan, Red Seaweed, Gracilaria fisheri

Effects of sodium sulfite solutions on photocathodic corrosion protection of zinc oxide films on stainless steel.

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Currently, metals used in industries face significant issues with corrosion, as solution factors can intensify the severity of corrosion. One effective method for corrosion prevention is photocathodic protection, which involves using light energy to protect metals from corrosion. This study, zinc sulfide/zinc oxide were synthesized onto fluorine-doped tin oxide-coated glass. The structural results were analyzed by scanning electron microscopy, X-ray diffraction, elemental distribution and composition. Electrochemical measurements revealed that zinc sulfide/zinc oxide films allow light energy to be absorbed, triggering electron excitation and enabling charge transfer to the metal. This enhances corrosion protection efficiency. The study was conducted in solutions with varying concentrations and the protection efficiency increases in the following order: 3.5% sodium chloride by weight, Na_2S + NaOH solutions at 0.01 M and 0.02 M concentrations, and higher concentrations of 0.05 M and 0.1 M. Under light conditions, stainless steel 304 connected with zinc sulfide/zinc oxide thin film is protected against corrosion.

Keywords: Corrosion, Photocathodic, Solution

Development of Bi-Sn alloy for Well Plug and Abandonment

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Currently, cement-sealed gas wells face shrinkage, reducing sealing efficiency. Bismuth-Tin (Bi-Sn) alloy have gained significant interest for sealing applications due to their unique ability to expand upon solidification, which helps improve sealing efficiency. These characteristics make them a promising material for environments where sealing performance and long-term stability are critical. This study investigates the mechanical properties, microstructure, expansion, melting point, and corrosion resistance of five Bi-Sn compositions (60Bi-40Sn, 70Bi-30Sn, 80Bi-20Sn, 90Bi-10Sn, and 100Bi) to provide critical data for selecting appropriate chemical mixtures for different operating conditions. Masterbatch alloy were prepared, and test samples were cast using silicone molds. Composition verification was conducted using X-ray fluorescence (XRF). Mechanical testing included tensile (room temperature), compression (room temperature and 130°C), hardness, and Izod impact tests. Metallographic analysis was performed to study the microstructure, while corrosion resistance was evaluated using a potentiostat. Differential scanning calorimetry (DSC) was used to determine melting points, and solidification expansion was measured to assess sealing potential. The results indicate that 80Bi-20Sn exhibits the best mechanical properties, with the highest elastic modulus, compressive strength at elevated temperatures, and excellent tensile strength, toughness, and hardness. Expansion and melting point increase with Bi content, with 100Bi showing the highest values but the lowest mechanical strength. Corrosion resistance also improves with higher Bi content, with 100Bi demonstrating the best performance. These findings provide a comprehensive understanding of Bi-Sn alloy, facilitating the selection of optimal compositions for high-performance sealing applications, where balancing mechanical properties and corrosion resistance is crucial for specific well conditions.

Keywords: Bismuth-Tin alloy, Bismuth alloy plugs, Plug and abandonment, Mechanical properties, Solidification expansion

Preparation of Doped Hydroxyapatite As Constituent in Sunscreen Product

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This study aims to prepare doped hydroxyapatite (HA) as an additive to enhance the UV protection efficiency of sunscreen. HA was synthesized from catfish bone through grinding and calcination at 700, 800, 900, and 1000°C. The calcined materials were analyzed to determine the optimal temperature for sunscreen application. The samples were then ground and characterized using FTIR for chemical composition analysis and BET for surface area measurement. SEM was employed to examine the microstructure, while UV protection efficiency was evaluated. The results indicated that HA calcined at 1000°C exhibited the most suitable properties. After sterilization, the HA was incorporated into sunscreen formulations and processed into final products. The findings demonstrate that doped HA enhances UV light scattering and improves sunscreen performance. This study highlights the potential of catfish bone-derived HA for developing high-efficiency and eco-friendly sunscreens.

Keywords: Hydroxyapatite, Doping, Sunscreen Products, Bioceramics

Formulation of Vegan Leather from Rice Husk

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This study focuses on the development of vegan leather from rice husks, incorporating zinc oxide (ZnO) nanoparticles to enhance antimicrobial properties. Rice husk, a sustainable agricultural by-product, was processed and combined with polymer binders to create a flexible and durable material resembling leather. The ZnO nanoparticles were added at concentrations of 1-5% by weight. The characteristics of the resulting synthetic leather were analyzed using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR), which confirmed the uniform dispersion and crystallinity of ZnO within the vegan leather structure. Additionally, the mechanical properties of the leather were tested through tensile testing and basic scratching tests. Antimicrobial efficacy against Escherichia coli and Staphylococcus aureus showed significant bacterial inhibition. The mechanical testing indicated that the addition of ZnO improved tensile strength and slightly enhanced flexibility without affecting the aesthetic quality of the material. Furthermore, the vegan leather demonstrated durability, making it suitable for use in the fashion industry, automotive interiors, healthcare settings, and more. This research highlights a sustainable approach to adding value to agricultural waste and introduces an eco-friendly material with outstanding functional properties to the market.

Keywords: Vegan leather, Antimicrobial properties, Zinc oxide nanoparticles (ZnO), Rice husk, Bacteria inhibition

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ASM01-M01

Concrete and Cullet Composite for Increasing Mechanical and Thermal Properties

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Concrete is a widely used construction material; however, its mechanical and thermal properties can be further improved to enhance performance and sustainability. This study aims to determine the optimal concrete mix by partially replacing sand with amber cullet powder to enhance mechanical strength and thermal insulation. The experiment involved testing compressive strength, thermal expansion, water absorption, and density of concrete incorporating amber cullet powder at replacement levels of 0%, 10%, 20%, and 30% by sand weight. The curing periods were set at 7, 14, and 28 days. The results indicate that the concrete mix containing 20% amber cullet powder, cured for 28 days, yielded the best performance, exhibiting the highest compressive strength and the lowest water absorption at 5.45%. This composition demonstrated superior mechanical strength and lower water absorption compared to concrete without cullet replacement. This study highlights the potential of utilizing recycled cullet in concrete composites to enhance material properties while promoting sustainable construction practices.

Keywords: Cullet, Concrete Composite, Mechanical Strength, Thermal Insulation, Sustainable Materials

ASM02-M02

Development of Piezoelectric Sheets from Thermoplastic Elastomer and Barium titanate

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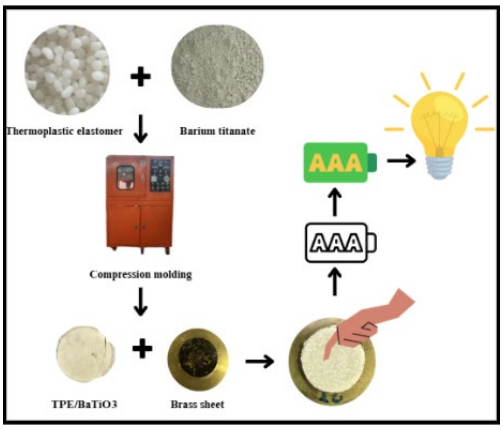
This research investigates the effect of barium titanate ($BaTiO_3$) on thermoplastic elastomers (TPE) to enhance their electrical and mechanical properties. TPE/$BaTiO_3$ composites were fabricated using compression molding at varying amounts of barium titanate (0, 10, 20, 30, 40 and 50 phr). The voltage generation from composite sheets was studied by various techniques such as Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), and thermogravimetric analysis (TGA). The Shore D hardness test, following ASTM D2240 standards, was also conducted.



The results showed a direct correlation between amounts of barium titanate and voltage generation, with the voltage increasing from 0 mV for the undoped material (0 phr) to 1.1 mV at 10 phr, 1.27 mV at 20 phr, 1.31 mV at 30 phr, 1.61 mV at 40 phr and reaching a maximum of 1.75 mV at 50 phr. These materials show the potential for applications in fabricating voltage-sensitive devices in the future.

Keywords: Barium titanate, Thermoplastic elastomer, Piezoelectric Materials, Polymer Composites, Voltage Generation

ASM03-M03

Synthesis and Characterization of Furfurylamine-based Benzoxazines for the Application in Luminescent Printing Inks

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This research focuses on the development of synthesizing benzoxazine for application as a luminescent ink. The main starting materials used include 4-Thymol, 4-Methylphenol, 4-Ethylphenol, and 4-Methoxyphenol, in combination with paraformaldehyde and furfurylamine, dissolved in dioxane. The synthesized products were divided into four compounds: 4-Ethylphenol-furfurylamine (E-fm), 4-Methylphenol-furfurylamine (M-fm), 4-Methoxyphenol-furfurylamine (OMe-fm), and Thymol-furfurylamine (T-fm). Infrared (IR) analysis revealed absorption bands corresponding to the vibrations of C–N and C–O bonds, providing evidence for the formation of the benzoxazine structure. Additionally, ^{1}H-NMR and ^{13}C-NMR were used to confirm the molecular structure of the synthesized compounds. Furthermore, the thermal properties and stability of the obtained benzoxazine were studied using TGA and DSC techniques, along with photoluminescence (PL) analysis. The results from all the analyses showed consistency in the data and highlighted the potential of benzoxazine compounds for developing luminescent inks for industrial applications with high efficiency.

Keywords: Benzoxazine, Furfurylamine, Phenol, Luminescent Printing Ink, Synthesis

ASM04-M04

Development of Doped Hydroxyapatite as Functional Ingredient for Sunscreen Puff Powder

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This research investigates the synthesis and development of doped hydroxyapatite (doped HAp) extracted from the calcination of fish bones in clay pots and crucibles at temperatures of 700, 800, 900, and 1000 °C. The objective is to determine the optimal calcination temperature and container for producing an active ingredient in sunscreen face powder and enhancing ultraviolet (UV) radiation protection. The structure and properties of the samples were analyzed using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), X-ray fluorescence (XRF), Brunauer–Emmett–Teller (BET) surface area analysis, and scanning electron microscopy (SEM). The UV protection efficiency was evaluated by measuring diffuse reflectance ultraviolet-visible spectroscopy (UV-DRS). The results indicate that doped HAp synthesized at 1000 °C in a clay pot exhibits the highest UV protection efficiency. Additionally, the presence of Fe, formed during the calcination process, further enhances UV protection. These findings highlight the potential of this material as an additive in cosmetic sunscreens, suggesting its feasibility for developing high-performance and safe sunscreen face powders in the future.

Keywords: Hydroxyapatite, Nanomaterials, Sunscreen, Puff Powder, Ultraviolet Radiation

ASM05-M05

Synthesis of g-C_3N_4 under different temperatures for photocathodic protection of titanium dioxide/g-C_3N_4 thin films

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Photocathodic protection uses semiconductors that can generate electrons upon exposure to light to transfer electrons to enhance the cathodicity of the metal. This research synthesized graphitic carbon nitride (g-C_3N_4) at temperatures between 520°C, 530°C, 540°C and 550°C and combined with titanium dioxide (TiO_2) to form heterojunction thin films.

The experimental results showed that g-C_3N_4 at 520°C had the best effect in increasing the cathodicity of the metal upon light irradiation, which led to its efficient corrosion protection. However, the g-C_3N_4/TiO_2 synthesis contained a low amount of TiO_2 in the structure, which may affect the performance of the heterojunction. The conclusion from this research shows that the synthesis temperature affects the material properties, including photocathodic protection performance. The results of this study are important for the development of more efficient corrosion protection.

Keywords: Corrosion, Photocathodic Protection, g-C_3N_4, TiO_2, Heterojunction

ASM06-P01

Development of biodegradable coatings and modified atmosphere packaging for extending the shelf life of bananas

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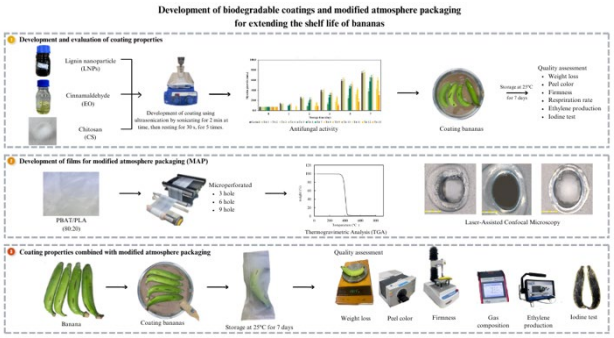
Hom Thong bananas are among the most widely traded fruits worldwide. However, postharvest spoilage remains a significant challenge due to continuous respiration and fungal infections. This study focused on the development of biodegradable coatings and modified atmosphere packaging (MAP) to extend the shelf life of bananas. A bio-based coating was formulated using chitosan (CS), lignin nanoparticles (LNPs), and cinnamaldehyde (CN) at different concentrations.



The results indicated that the T3 formulation ((LNPs_0.6/CN_2.0)/CS_1.0) effectively inhibited fungal growth while maintaining the weight loss, firmness, and appearance of bananas compared to T2 ((LNPs_0.2/CN_2.0)/CS_1.0), T1 (LNPs_0.2/CS_1.0) and control (without coating). Additionally, a biodegradable packaging film was developed using polybutylene adipate-co-terephthalate (PBAT) and polylactic acid (PLA) at an 80:20 ratio based on their mechanical properties. The film was perforated to regulate gas transmission using carbon dioxide (CO_2) laser technology with three different perforation densities: 3/200, 6/200 and 9/200. The results demonstrated that the film effectively absorbed laser energy to form perforations and as the number of perforations increased, the oxygen transmission rate and carbon dioxide transmission rate also increased. The combined application of the biodegradable coatings and MAP was evaluated for its effect on banana shelf life. Bananas coated with T3 and packed in a film with 3/200 perforations, stored at 25 °C, exhibited superior preservation quality. The packaging maintained an optimal gas composition inside the package (4.40% CO_2, 15.96% O_2) compared to 6/200, 9/200 and the control (no perforation) while reducing weight loss, maintaining firmness and delaying fungal growth for up to 7 days

Keywords: Banana, Biodegradable Coating, Lignin nanoparticle, Modified Atmosphere Packaging (MAP), Biodegradable Packaging

ASM07-P02

Development of Ready-to-Serve Indicator Solution based Roselle Powder-Incorporated Chitosan for Nham Product

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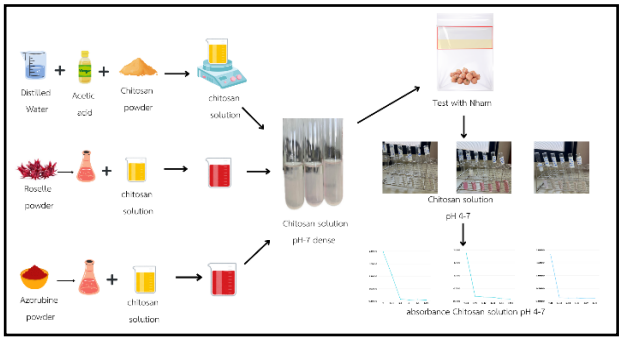

Consumers are increasingly prioritizing products that align with their individual preferences. This study investigates innovative smart packaging solutions designed to facilitate the selection of fermented Nham products based on their sourness levels. The primary objective of this research is to develop a ready-to-serve indicators for Thai-styled fermented sausage packaging by utilizing a Chitosan solution, roselle powder, and food coloring. The chitosan solution was formulated by dissolving 3 grams of chitosan in 1 liter of distilled water and 1M acetic acid, followed by stirring for 2 hours to achieve a 0.3% concentration. Likewise, the roselle solution was prepared by combining 3 grams of roselle powder with acetic acid, ethanol, and distilled water, yielding a 0.3% roselle solution with a neutral pH and a cloudy appearance. The study examined three types of solutions: pure chitosan, chitosan combined with food coloring, and chitosan mixed with roselle powder. Upon the addition of acid to replicate fermentation, all solutions transition from a cloudy to a clear state, visually indicating the degree of sourness. Light absorbance analysis within a pH range of 4 to 7 revealed a decline in absorbance for pure chitosan as pH increases, a pattern similarly observed in chitosan solutions containing food coloring and roselle powder. These findings suggest that as the level of sourness in the fermented sausage intensifies, the indicator solution becomes progressively more transparent, thereby providing consumers with a ready-to-serve indicator as a visual cue for their preference.

Keywords: Smart Packaging, Ready-to-Serve Indicator, Nham Product, Chitosan, Carbon dioxide

ASM08-M06

Fe-Doped Mn_2O_3 Electrochemical Sensors: Promising Approach for Detecting Waterborne Atrazine

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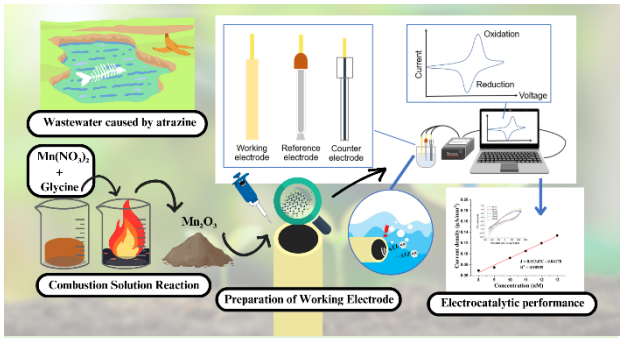

The contamination of water sources by industrial, agricultural, and environmental activities highlights the urgent need for efficient methods to detect toxic substances. Atrazine, Atrazine, a widely used herbicide and persistent waterborne contaminant, poses significant health risks, including endocrine disruption and carcinogenicity. Fe-doped Mn_2O_3 electrochemical sensors have emerged as a promising solution for detecting such pollutants. In this study, undoped and 2- and 4-mol% Fe-doped manganese oxides were synthesized via a solution combustion technique. The 4-mol% Fe-doped manganese oxide exhibited the highest specific surface area (13.4612 m^2/g) and the lowest charge transfer resistance. The incorporation of iron into the manganese dioxide enhanced electron transfer efficiency, improving detection accuracy. When tested with aqueous atrazine solutions, the 4-mol% Fe-doped manganese dioxide electrode showed distinct oxidation and reduction peaks, indicating effective electrochemical activity. Its sensitivity was 0.00698 $\mu A/(nM \cdot mm^2)$ for the 2-7 nM range and 0.01343 $\mu A/(nM \cdot mm^2)$ for the 8-13 nM range. The limit of detection (LOD) was 0.07 nM, well within the acceptable range for atrazine detection.

Keywords: Fe doped Mn_2O_3, Atrazine, Electrochemical Sensor, Herbicide detection, Solution combustion, Water quality monitoring

Comparing the effects of acid etching and anodizing on the development of hydrophobic metal surfaces of Aluminium 1100, Stainless steel 304, and Grade 2 Titanium

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The development of self-cleaning and hydrophobic surfaces has garnered significant attention in both scientific and industrial fields due to their unique ability to repel water and dirt effectively. These properties include preventing liquid adhesion, reducing stain formation, and enhancing material performance in various processes. This research focuses on studying and comparing the effects of the sequence of acid etching (E) with 0.44 M myristic acid and anodizing (A) with 2.55 M sulfuric acid on three metals: Aluminum 1100, Stainless Steel 304, and Titanium Grade 2. The evaluation was conducted using water contact angle (WCA) measurements and Scanning Electron Microscope (SEM) analysis.

The experimental results revealed that the sequence of etching and anodizing processes significantly affects the properties of each material. For Aluminum 1100 and Titanium Grade 2, performing etching before anodizing (E→A) increased the water contact angle to 124° and 112°, respectively. Conversely, for Stainless Steel 304, anodizing before etching (A→E) resulted in a greater increase in the water contact angle, up to 113°. SEM analysis showed that anodizing before etching (A→E) led to a thicker oxide film layer, confirming that anodizing enhances surface roughness and improves air trapping according to the Cassie-Baxter Model. This results in increased hydrophobicity of the surface.

Keywords: Aluminum 1100, Stainless Steel 304, Titanium Grade 2, Hydrophobic, Anodization

ASM10-M08

Utilization of machinable glass-ceramics as fixed partial denture

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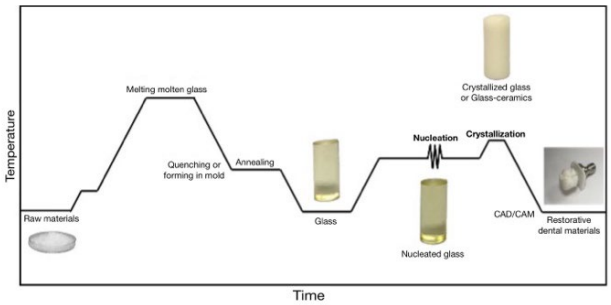

The glass-ceramic is the interesting material in dentistry due to their outstanding properties such as strength, fracture toughness, wear resistance, aesthetics, and biocompatibility. Compared to other ceramic materials such as porcelain, glass-ceramics have higher strength and fracture toughness which are essential for their machinability as restorative dental materials. The microstructure of glass-ceramics consists of both amorphous glass and small crystals that are evenly dispersed. The size and amount of these crystals affect all properties of the material. This research focuses on developing the glass-ceramics for better mechanical, physical, and chemical properties by adding 5 wt% yttria-stabilized zirconia and 1 wt% ceria as additives and improving heat treatment techniques. The heat treatment process consists of nucleation, length of time 72 hours, resulting in large number of nuclei and crystallization, the crystal growth time 5 minutes, resulting in the formation of glass-ceramics. The crystals of the glass-ceramics were controlled in size by adjusting the nucleation and crystallization times as well as temperatures. The resultant glass-ceramics presented biaxial flexural strength at 310.41 MPa, Vickers hardness at 5.77 GPa, and chemical solubility at 88.43 μg/cm^2 which were delivered the successful goal according to ISO 6872:2015 Class 3a.

Keywords: Machinable glass-ceramics, Heat treatment, Yttria-stabilized zirconia, Biaxial flexural strength, ISO 6872:2015

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Investigation of Formaldehyde Migration from Melamine Bowls

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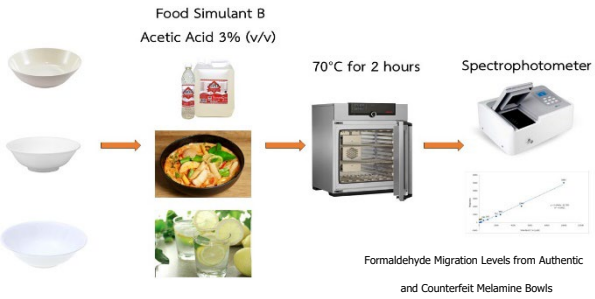

The migration of formaldehyde from melamine tableware into food during use is a significant concern for consumer health, as formaldehyde exposure has been associated with long-term health risks, including potential carcinogenic effects. Regulation (EU) No 10/2011 sets a Specific Migration Limit (SML) for formaldehyde in food-contact materials at 15 mg/kg to ensure consumer safety. This study aims to investigate the release of formaldehyde from authentic and counterfeit melamine bowls available in the market by comparing the migration levels under controlled conditions. The experimental procedure involved exposing melamine bowls to an acidic food simulant (food simulant B, 3% acetic acid) at 70°C for two hours to simulate real-life usage scenarios. Formaldehyde concentrations were measured using a spectrophotometer to ensure accuracy and reliability. The experimental results indicate that the measured values from authentic melamine bowls range approximately from 0.003 to 0.3 mg/kg which are below the Specific Migration Limit (SML) set by EU regulations. As a result, authentic melamine bowls can be considered safe for use without the risk of releasing formaldehyde in amounts exceeding the established standards. The results of this study highlight the levels of formaldehyde migration from authentic and counterfeit melamine bowls available in the market. If formaldehyde is released in high amounts, and consumers repeatedly use the bowls, continuous exposure may pose a health risk. The study emphasizes the need for regulatory oversight and quality control of melamine products in the market to ensure consumer safety.

Keywords: Food Contact Materials, Formaldehyde, Melamine, Food safety, Chemical contamination, Spectrophotometer

Analysis of Microplastics Released from Tea Bags

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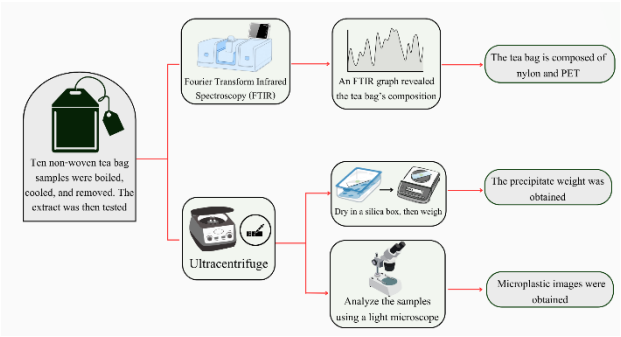
The accumulation of microplastics in the environment is a pressing issue, as they can contaminate soil, water, and air, impacting ecosystems and human consumption. This research focuses on studying the release of microplastics from tea bags, particularly non-woven tea bags, which are widely used today.



This study was conducted by selecting tea bags from three brands. Sample preparation was done by separating the tea leaves from the tea bags, and the empty tea bag samples were analyzed for material composition using Fourier Transform Infrared Spectroscopy (FTIR).
Next, ten empty tea bag samples were placed in 100 milliliters of water and were subjected to a boiling process of hot water. at 95°C for 1 minute. The Aliquot were then left to cool for 30 minutes. After that, The Aliquot were subjected to sedimentation using a centrifuge at a speed of 750 rpm for 25 minutes. The precipitate was collected and analyzed for released microplastics by measuring the weight using a balance with 5-digit precision. Further material identification was performed using FTIR, and the physical characteristics of the released particles were using a light microscope. The FTIR analysis showed that the materials used for the tea bags in all three samples were made of nylon and PET (polyethylene terephthalate). Additionally, The released microplastics were quantified by weighing the collected particles.

Keywords: Microplastic analysis, Tea Bags, Fourier Transform Infrared Spectroscopy (FTIR), Light Microscope, Non-woven Tea Bags

PMIS 2025

Evaluating the Influence of Biodegradable Packaging on the Organoleptic Properties of Dried Fruit Products

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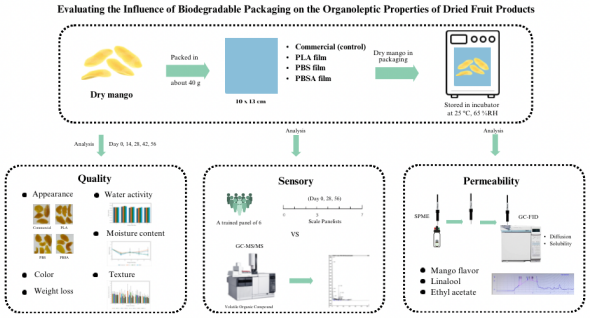
Dried fruits are valued for their high nutritional content and long shelf life, but maintaining quality during storage and distribution is challenging. Packaging plays a critical role in protecting dried fruits from moisture, oxygen, light, and microbial contamination. This study evaluated the effectiveness of three biodegradable films—polylactic acid (PLA), polybutylene succinate (PBS), and polybutylene succinate adipate (PBSA)—compared to a commercial control in preserving dried mango quality at 25°C. The study focused on determining the barrier properties of biodegradable packaging, particularly odor retention, using Gas Chromatography. The permeability of volatile organic compounds through the packaging films was measured using a quasi-isostatic system. The impact on dried mango quality was monitored over 84 days, with evaluations at 0, 14, 28, 42, 56, 70 and 84 days. Quality attributes included appearance, weight loss, moisture content, water activity, color, and texture. Sensory evaluation by a trained panel assessed odor intensity. Among the biodegradable films, PLA demonstrated the best performance in quality preservation. It exhibited the lowest water vapor permeability (WVP), indicating a strong moisture barrier. Gas Chromatography analysis showed that PLA effectively retained key mango volatile compounds, such as linalool and ethyl acetate, outperforming PBS and PBSA, and it also had the lowest permeability coefficient. Sensory evaluation results aligned with these findings, confirming that PLA had the highest aroma retention over time. These results highlight the potential of biodegradable packaging, particularly PLA, as a sustainable alternative for dried fruit products, offering both environmental benefits and enhanced product quality.



Keywords: Biodegradable film, Permeability, Dried fruit, Organoleptic quality, Volatile organic compounds

MPCT04-M01

Study of perovskite crystal structure of thin film solar cells from $MaPbI_3$ solution

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Perovskite solar cells (PSCs) have gained significant attention due to their high power conversion efficiency and low production costs. However, the crystallization process of perovskite thin films directly impacts the performance of solar cells.

This study investigates the effects of post-deposition annealing temperature and spin coating speed on the crystal structure and optical properties of perovskite thin films. The films were synthesized using methylammonium iodide (MAI) and lead iodide (PbI_2) dissolved in gamma-butyrolactone (GBL) and deposited onto a substrate via spin coating at 3000, 4000, and 5000 rpm. Subsequently, the films were annealed at temperatures of 100°C, 125°C, and 150°C. The structural and surface morphology of the films were analyzed using scanning electron microscopy (SEM), while their optical properties were examined through ultraviolet-visible (UV-Vis) spectroscopy.

The results indicate that annealing temperature and spin coating speed significantly affect crystallization and film uniformity. The optimal conditions for producing high-quality perovskite thin films with uniform crystal distribution, low porosity, and excellent light absorption were found to be a spin coating speed of 4000 rpm and an annealing temperature of 125°C. This study provides valuable insights for developing high-performance perovskite thin films for solar cell applications.

Keywords: Perovskite, Solar Cells, Crystal Structure, Thin Films

MPCT05-P04

Development of Edible Sachet from Based Film for Instant Coffee Packaging

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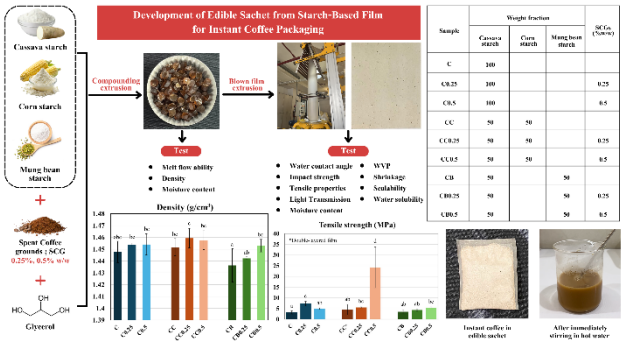

The number of coffee businesses coffee consumption, resulting in increased quantity of spent coffee grounds (SCG), which are waste materials. Good SCG management not only prevents contamination but also makes SCG useful in the food packaging industry. Starches from various economic Thai plants, such as cassava starch, corn starch, and mung bean starch, are raw materials that are abundant, available, and cheap. Therefore, this research technique aims to increase the value of starches and SCG, reduce the waste amount from coffee-related businesses, and reduce the amount of plastic waste in the environment, by developing edible and water-soluble film for instant coffee packaging sachet. Thermoplastic starch (TPS)/SCG pellets are first prepared by mixing starch with glycerol (35% w/w) and SCG using a twin-screw extruder, then converted into films using a blown film extrusion machine and finally three-sided sealed to form sachets. The types of starch (i.e., cassava starch, cassava starch mixed with corn starch (50:50 w/w), and cassava starch mixed with mung bean starch (50:50 w/w), and the amount of SCG (i.e., 0.25% and 0.5%) are varied. The addition of SCG caused the film with increased surface roughness, water solubility, stiffness, tensile strength, but decreased shrinkage, elongation, impact strength, clarity, and water vapor barrier properties. Cassava starch film containing 0.25% SCG is recommended in this work and has potential to be used as a water-soluble, edible, and biodegradable packaging sachets for food products such as instant coffee, seasoning powder, etc.

Keywords: Edible film, Water-soluble film, Spent coffee ground, Cassava starch, Thermoplastic starch

MPCT06-P05

Effect of recycling process on properties and migration of Irganox 1010 from polyethylene film

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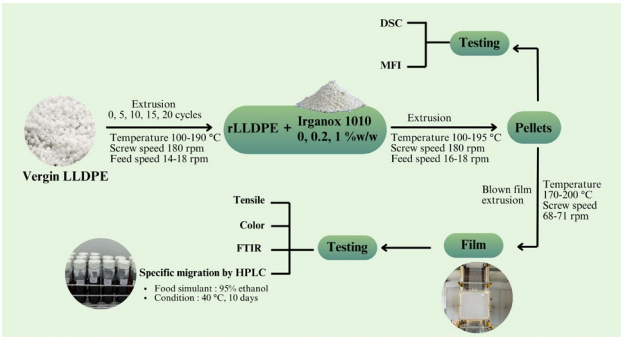
ABSTRACT- Recycling polyethylene (PE) has gained significant attention as a strategy to reduce natural resource consumption and mitigate plastic waste accumulation in the environment. However, the recycling process, which involves thermal and shear stress, can alter the chemical structure, mechanical properties, and thermal stability of PE, leading to inferior material performance compared to virgin PE. To address this issue, antioxidants such as Irganox 1010 are incorporated to enhance the stability of recycled PE. Nevertheless, concerns remain regarding the migration of Irganox 1010 from PE films into food products, potentially posing risks to consumer safety. This study investigates the effects of multiple recycling cycles on the properties of recycled PE pellets and films containing Irganox 1010. The study evaluates changes in mechanical properties, melting temperature, melt flow index, color, and chemical composition. Additionally, the migration of Irganox 1010 into food simulants is analyzed using high-performance liquid chromatography (HPLC). The findings are expected to provide insights into optimizing the recycling process to minimize material degradation and ensure the safety of recycled PE, particularly for food packaging applications. This research contributes to the development of sustainable plastic recycling practices, promoting the safe and effective use of polyethylene for flexible packaging applications.



Keywords: Linear Low-Density Polyethylene, Irganox 1010, Migration, Recycling, Food contact materials

Antimicrobial activity of Zinc oxide in bioplastic laminate film for meat product preservation

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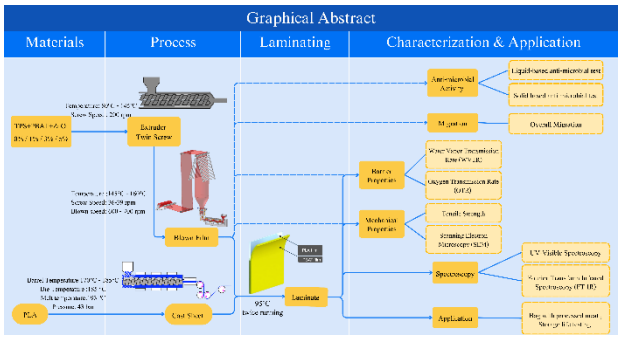

Zinc oxide (ZnO) is widely used as antimicrobial agent in active and antimicrobial packaging. Biopolymer packaging such as thermoplastic starch (TPS), polybutylene adipate terephthalate (PBAT), and polylactic acid (PLA) has potential for utilization in food packaging applications. This study aims to develop antimicrobial TPS/PBAT films incorporating ZnO laminated with PLA for extended shelf life of processed meat. TPS/PBAT blends (60/40) compounded with ZnO (0, 1, 3, 5%) and produce flexible film via blown extrusion. Subsequently, PLA sheets were used for laminated with the TPS/PBAT/ZnO films at 95°C in both forward and reverse directions. The addition of ZnO improved the UV-blocking capacity of TPS/PBAT films and also increased when laminated with PLA. Water vapor permeability (WVP) of TPS/PBAT films increased from 4.54 ± 0.07 g×mm× KPa^{-1}×day^{-1}×m^{-2} to 4.81 ± 0.08 g×mm× KPa^{-1}×day^{-1}×m^{-2} for TPS/PBAT/ZnO 5% films. Moreover, PLA improves the water vapor barrier by decreasing WVP by 1.07 ± 0.03 g×mm. KPa^{-1}.day^{-1}.m^{-2} (~4 times) for TPS/PBAT/ZnO films. Tensile strength and elongation at break of TPS/PBAT films increased for machine direction but decreased for cross direction with increasing ZnO concentrations. PLA-laminated TPS/PBAT/ZnO films exhibited semi-rigid material. At least 3% of ZnO improved antimicrobial activity of TPS/PBAT films inhibited Staphylococcus aureus growth in nutrient broth. PLA-laminated TPS/PBAT/ZnO films extended the shelf life of the processed meat product over 10 days under refrigeration. This study explores the PLA-laminated TPS/PBAT/ZnO films that have potential for use as a high barrier flexible packaging for preserving the shelf-life of meat products.

Keywords: Active packaging, Antimicrobial film, Biodegradable film, Zinc oxide

MPCT08-P07

Process improvement for sugars and their derivative conversion into 2,5-Furandicarboxylic acid (FDCA) for polyethylene furanoate (PEF) bioplastic production in sustainable packaging materials

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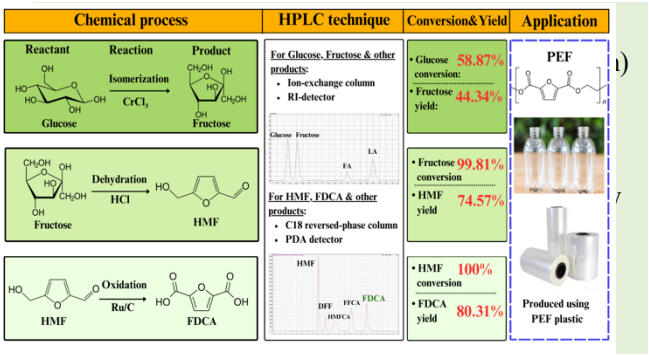
The conversion of sugar into biochemicals as 5-hydroxymethylfurfural (5-HMF) and 2,5-furan dicarboxylic acid (FDCA) has received significan attention due to its potential applications in sustainable packaging, especially the synthesis of polyethylene furanoate (PEF), a substitute for polyethylene terephthalate (PET). However, the production of 5-HMF and FDCA from sugar remains limited by the complexity of the chemical reaction the presence of impurities in the precursors, and the constraints of conventional batch reactors, all of which affect process efficiency. This research aims to improve the conversion of glucose and fructose to 5-HMF and FDCA. The effect of the operating conditions on the product yield is also investigated. The HPLC technique is used to analyze all related products. As the temperature increases, fructose yield—obtained through isomerization of glucose—rises due to the higher kinetic rate constant, as described by the Arrhenius equation. A maximum fructose yield of 44.34% is achieved at 90 °C for 120 minutes of reaction time. Pure fructose yields up to 74.57% HMF, whereas crude fructose produced via glucose isomerization provides HMF yield of 61.02% due to the interference of impurities in the reaction. HMF is then converted to FDCA via an oxidation reaction in both thermo-shaker and flow packed-bed reactors. The flow reactor enhances FDCA yield compared to the thermo-shaker, due to improved mass and heat transfer. This research is used as a guideline for enhancing efficiency of FDCA monomer from glucose and fructose for PEF production in sustainable packaging materials.



Keywords: 2,5-Furandicarboxylic Acid (FDCA), Polyethylene Furanoate (PEF), Sustainable Packaging, Sugar conversion, 5-Hydroxymethylfurfural (5-HMF)

PMIS 2025

Effect of Red Seaweed Extract on the Properties of Carrageenan-Based Films for Food Packaging

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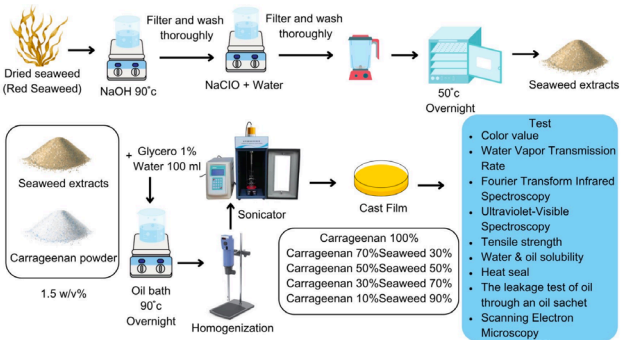

Plastic waste is a major environmental issue due to its non-biodegradability, causing pollution and harming ecosystems. Carrageenan, a biodegradable polysaccharide from red seaweed, shows potential for sustainable packaging with good gel strength and flexibility. However, its commercial production is costly. Semi-purified carrageenan from Gracilaria fisher offers a lower-cost alternative, despite containing impurities, making it a promising option for packaging applications. This study aims to investigate and compare the basic properties of carrageenan films made from a blend of Gracilaria fisher-derived carrageenan and commercial carrageenan. The results showed that films containing Gracilaria fisher-derived carrageenan exhibited noticeable color differences compared to pure commercial carrageenan films. Tensile strength, Young's modulus, and elongation at break of the films varied with the ratio of carrageenan to red seaweed. As the proportion of red seaweed increased, the films exhibited greater stiffness, indicated by higher Young's modulus, while elongation decreased, suggesting reduced flexibility. Additionally, the blended films demonstrated heat-sealing capability, whereas the commercial carrageenan films did not. The film composition with 10% commercial carrageenan and 90% Gracilaria fisher-derived carrageenan exhibited the lowest water vapor permeability. Fourier Transform Infrared (FTIR) spectroscopy revealed that the key functional groups presenting in the carrageenan-red seaweed films included -OH, -CH, S=O, and C-O-C. UV-Vis spectrophotometry also showed that the light transmission of the carrageenan-seaweed blend films decreased as the seaweed content increased compared to the pure carrageenan film.

Keywords: Gracilaria fisher, Carrageenan, Bio plastic, Natural agent

MPCT10-P09

The influence of recycling process on properties and migration of Irganox 1076 from polyethylene

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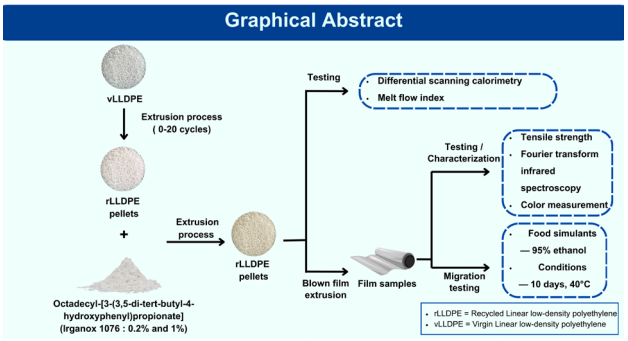
Linear low- density polyethylene (LLDPE) is a popular plastic for flexible packaging due to its clarity and high strength. However, the widespread use of this type of plastic has led to significant plastic waste. Therefore, recycling is necessary to promote sustainability and maximize resource utilization. However, the recycling process of LLDPE involves multiple passes through the extrusion process, resulting in oxidation reactions that reduce the properties of LLDPE. To improve the properties of recycled LLDPE (rLLDPE), Irganox 1076, an antioxidant, is added. This research aims to study the effect of Irganox 1076 content, as well as the extrusion cycles on the properties of rLLDPE. Additionally, the migration of Irganox 1076 from rLLDPE films was measured. The properties of rLLDPE pellets are evaluated using melt flow index (MFI) testing and differential scanning calorimetry (DSC) analysis, while the properties of rLLDPE films are assessed using Fourier-transform infrared (FTIR) spectroscopy, color stability assessment, tensile strength testing, and high-performance liquid chromatography (HPLC) analysis. The results of this study provide important insights into the effects of recycling process on the stability of rLLDPE, which in turn affects its structure, mechanical properties, and migration behavior. These findings are crucial for assessing the material's suitability for food packaging and other applications. The obtained data can be used to improve the recycling process and enhance the safety of rLLDPE for food packaging applications.



Keywords: Linear low-density polyethylene, Irganox 1076, Recycling, Migration, Food contact materials

Improving the Thermal Properties and Stability of PLA for Microwave Applications

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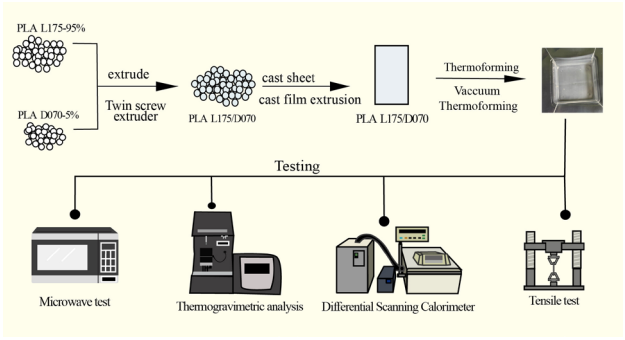

In the current era, consumer behavior has shifted towards emphasizing speed and convenience, such as the consumption of ready-to-eat meals from convenience stores that are heated in microwaves. The packaging of these foods, once used, is discarded as waste, leading to environmental pollution. Biodegradable plastics such as poly(lactic acid) (PLA), derived from renewable resources like starch and sugar, offer a promising solution. However, PLA's brittleness and low heat resistance due to its low crystallinity limit its use in microwave applications. This study aimed to enhance the thermal properties and stability of PLA for microwave applications by incorporating PLA Luminy® D070 as a nucleating agent into high heat-resistant PLA Luminy® L175, making it more suitable for microwaveable packaging. Both unmodified and modified PLA were cast as plastic sheets using an extruder, ensuring consistency in processing and material form for testing. Tensile tests showed an increase in tensile strength from 2286.34 MPa for the unmodified PLA to 2459.83 MPa for the modified PLA, demonstrating improved mechanical performance. The modified PLA sheets also exhibited increased opacity, indicating higher crystallinity. Differential scanning calorimetry, thermogravimetric analysis, and thermal stability under microwave heating were used for confirming the enhanced thermal properties and stability of the materials. The results highlight the potential of using PLA as a possible candidate for sustainable microwaveable food packaging solutions.

Keywords: Poly(lactic acid), microwave applications, High heat resistance

PMIS 2025

MPEA

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Study of the 3D printability of complex Titanium dioxide based photocatalytic structures

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Water pollution is a major environmental issue and titanium dioxide (TiO_2) is an effective photocatalyst for degrading pollutants under light. This study focuses on designing TiO_2 photocatalyst-resin structures and evaluating their printability in the Stereolithography (SLA) 3D printing process. Key stages include gathering user requirements, design evaluation, printing, and incorporating TiO_2 via resin mixing and dip coating. User requirements emphasized high surface area for photocatalytic reactions and efficient water flow. Three designs gear, flower and propeller were evaluated using Fusion 360 and Chitubox software, with honeycomb and propeller structures selected. The honeycomb offers high surface area and mechanical strength, while the propeller enhances water flow and reduces sediment buildup. SLA printing challenges included support structures to prevent warping and optimizing wall thickness for strength and photocatalytic efficiency. Additionally, adjusting print speed and layer thickness was essential for maintaining print accuracy. Incorporating TiO_2 into the resin posed challenges in the SLA printing process, particularly in achieving uniform TiO_2 distribution and successfully printing complex geometries. Direct TiO_2-resin printing resulted in uneven TiO_2 distribution, which was not ideal for achieving optimal photocatalytic performance. To overcome this issue a TiO_2 dip-coating process was applied after printing, improving TiO_2 surface coverage and enhancing photocatalytic efficiency without compromising structural integrity. For future research, testing these structures in real wastewater treatment scenarios is recommended to evaluate their performance and optimize the manufacturing process for industrial applications.

Keywords: Design for 3D printing, Stereolithography, Titanium dioxide, Photocatalytic materials, wastewater treatment

PMIS 2025

Design and Development of Lubricant Oil Packaging in Bag-in-Box

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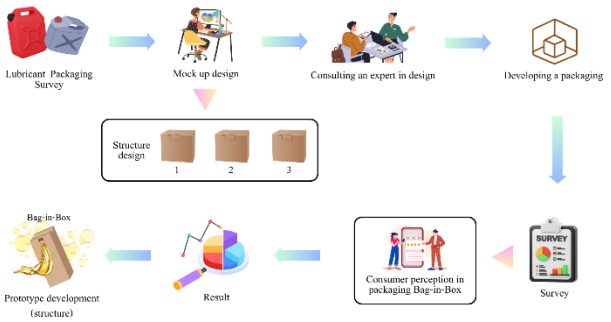
This study aims to design and develop a Bag-in-Box packaging system for lubricating oil to address the issues associated with conventional heavy packaging, which has negative environmental impacts. The research is conducted through a literature review and a market analysis of existing lubricating oil packaging to guide the development of an eco-friendly packaging design, sustainable materials, user convenience, and ease of waste separation. A prototype is then developed and evaluated through expert consultations and an initial user survey. The findings indicate that the Bag-in-Box packaging can reduce plastic consumption while improving transportation efficiency and usability, as well as enhancing the brand's sustainable image. Therefore, this study presents an innovative approach to packaging design that aligns with current environmental conservation trends and consumer preferences.



Keywords: Packaging Design, Bag-in-Box, Lubricant, Consumer response

PMIS 2025

Development of an Augmented Reality Filter Integrating Universal Design Principles for Cosmetic Packaging

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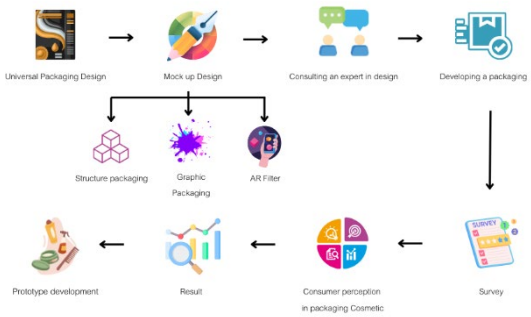
This research project aims to develop cosmetic packaging for hair color-changing products by integrating augmented reality (AR) technology with Universal Design principles. The goal is to create packaging that is accessible and easy to use for all consumer groups, including the elderly and individuals with special needs, while ensuring clear communication of information and offering a modern user experience. The study begins with a literature review on cosmetic packaging design, AR technology, and Universal Design concepts, as well as an analysis of issues in current hair color-changing product packaging, such as lack of convenience and incomplete information. An onsite survey will then be conducted to gather consumer opinions, needs, and suggestions for accessible packaging design.



The newly developed packaging will focus on delivering clear and complete information through AR, allowing users to virtually test hair colors before making a purchase. The design will emphasize ease of use, aesthetic appeal, and user-friendliness, which are essential for enhancing consumer confidence and improving brand image in a competitive market. The expected outcome is to create packaging that addresses the needs of digital-age consumers and serves as an example of accessible design for everyone. The findings will provide a valuable foundation for future improvements in cosmetic product design and marketing strategies.

Keywords: Packaging Design, Cosmetic Packaging, Universal Design, AR Filter

MPEA04-P03

Zanthoxylum limonella-Derived Carbon Quantum dot for Fresh Produce Preservation

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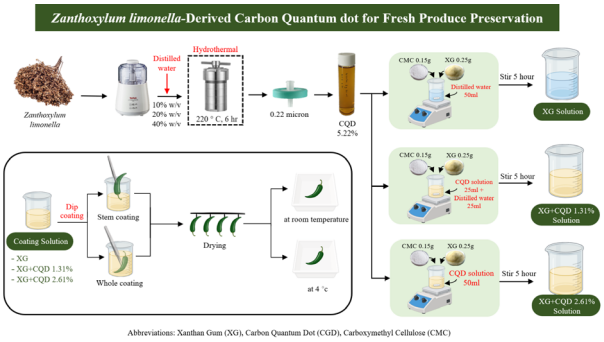
Post-harvest fungal contamination significantly accelerates the deterioration of fresh chili, leading to substantial losses during transportation and storage. This study aims to develop a washable functional coating incorporating carbon quantum dots (CQDs) with antifungal properties to extend the shelf life of fresh green chili. CQDs were synthesized from *Zanthoxylum limonella* using a hydrothermal process at varied concentration ratio. The extensive characterizations were performed by Fourier-transform infrared spectroscopy, photoluminescence, ultraviolet-visible spectroscopy, transmission electron microscopy, and X-ray photoelectron spectroscopy. The bioactivity of CQDs was evaluated based on their antioxidant capacity (2,2-diphenyl-1-picrylhydrazyl assay), antimicrobial activity (against *Escherichia coli* and *Staphylococcus aureus*), and antifungal efficacy (against *Colletotrichum capsici*). Xanthan gum was selected as the coating matrix, with carboxymethyl cellulose added as a disintegrant to enhance dissolution efficiency. Solubility tests confirmed that xanthan gum-based films dissolve in room-temperature water within 40 seconds, ensuring washability. The CQDs were then incorporated into the coating formulation and applied to fresh green chili via a dipping technique. The coated samples were stored under room temperature and at 4 °C, with periodic assessments of quality parameters, including color, weight loss, firmness, water activity, and microbial growth.



Keywords: Carbon Quantum Dots, Zanthoxylum limonella, Coating, Anti-fungal, Fresh green chili

PMIS 2025

Innovative rice straw-based active packaging pads for premium fruit

Artittaya Rodpol[1], Walaiphan Dotsadeewiriyakun[1], Preeyanuch Srichola[2], and Vanee Chonhenchob[1,*]

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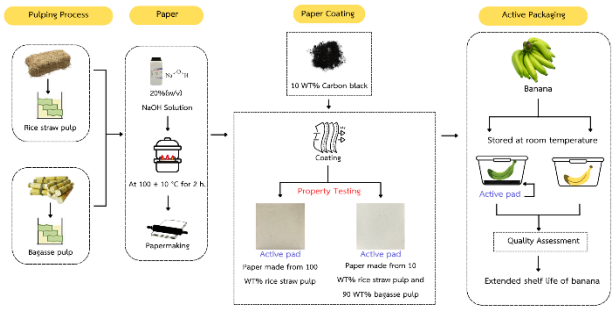
This research investigated the potential of using rice straw, an agricultural waste material, for fruit packaging. Two pulping formulations were compared: 100 wt% rice straw and 10 wt% rice straw combined with 90 wt% bagasse. The physical and mechanical properties of the paper were tested. The results showed that using 20 % (w/v) sodium hydroxide (NaOH) yielded favorable physical and mechanical properties for the 100 wt% rice straw paper. This formulation achieved the highest tensile strength of 0.38 N.m/g, a folding endurance of 51.33 times, and a bursting strength of 6.09 kPa.m²/g. Subsequently, the rice straw paper was coated with a mixture of 10 wt% carbon black powder combined with starch and water in a ratio of 10:90. This coated paper was used as a liner for fruit packaging to extend the shelf life of bananas. It was found that packaging lined with the coated rice straw paper preserved better quality and extended the shelf life of bananas as compared to that without the coated paper.



Keywords: Active packaging, Biomaterials, Ethylene adsorption, Rice straw, Agricultural waste

Chicken Point Cabin Door Design and Structural Analysis

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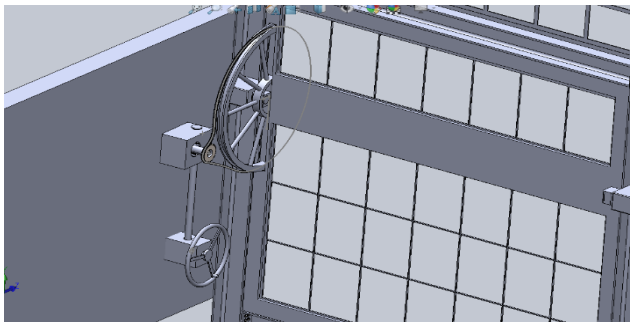
This research stems from an interest in the door design of the Chicken Point Cabin and the desire to explore 3D modeling using a program. The study involved designing a garage door based on the Chicken Point Cabin style using Solidworks to calculate forces and select appropriate materials. It also included calculating the cost of materials used in each component of the door, such as gears, columns, shafts, door axles, and the locking system. The force required to rotate the shaft was calculated at 50 Newton-meters, with a gear ratio of 160:1, which is sufficient for the door to rotate as desired, along with an automatic locking system when it reaches the end. The material selection was based on engineering properties such as strength, weight, and cost to ensure efficiency and durability. Additionally, cost comparisons were assessed with respect to other door designs. Price inquiries were made by various companies, and a survey was conducted to analyze different types of garage doors. The results indicated that solid and translucent doors are the most popular choices, whereas the Chicken Point Cabin style remains less common.



Keywords: SolidWorks; Gear; Torque; Chicken point cabin

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