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Plastic from Green Plants

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Malaysian Technical University Network

MTUN

UTHM

One of the four technical universities in Malaysia

Est. 2000

Pioneers in "Practice And Application Oriented" teaching and learning methodology for higher technical education in Malaysia.

Situated at the UNESCO heritage site of the Historical CITY OF MELAKA

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T.U.N.A.I CONCEPT

TECHNOLOGY @UNIVERSITY ADVANCING INDUSTRIES

A University that produces highly skilled technologists and enhances inventions, impacting industries and society

ACADEMIC

- 8 Faculties
- 86 Programs (PhD, Master, Bachelor, Diploma)
- 10,930 Students Enrolled
- 677 International Students

RESEARCH

- Niche Area : Advanced Manufacturing & Computing Technology
- 6 Centers of Excellence

STUDENT DEVELOPMENT

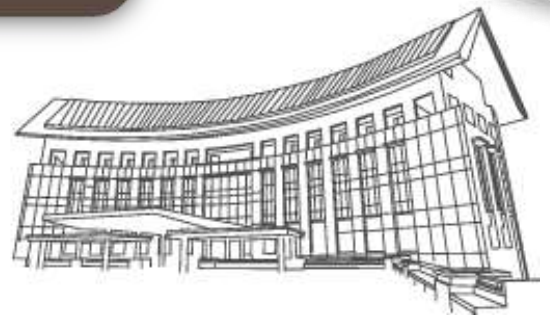
- 86% Graduate Employability 2018
- 26,418 Graduates since 2005
- Professional Certification – Microsoft Data Science, CISCO, Oracle, Lean Six Sigma, etc.

INDUSTRIAL ENGAGEMENT

- More than 100 industry partners
- Industrial Labs – Samsung IoT, ST IoT Academy, CISCO Academy, Microsoft IT Academy, Oracle Academy
- Active alumni and community programs

HUMAN RESOURCE

- 2,065 staff (880 academicians, 1,185 administrative)
- 326 Professional Certified staff – Technologist, Ir., C.Eng, Gs., L.Ar ., etc
- 55.1% staff with PhD
- Academics appointed as experts and consultants – OIC Cert, Blockchain Technology, CTFL Cert, etc.



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PRESENTATION OUTLINE

- Introduction
- Bio-based Polymer
- Starch as Plastic
- Thermoplastic Starch
- Modification of Thermoplastic Starch
- Mechanical Testing
- Environmental Testing
- Conclusion

Introduction

- Nowadays, most materials used in plastic industry are produced from synthetic polymers that obtained from fossil fuels.
- These conventional materials due to their non-degradable and non-renewable nature created serious environmental problems upon disposal (Sahari et al, 2012).
- Every year, around 500 billion plastic bags were used and as much as one million plastic bags are being disposed every minute (Sangita et al., 2011).

Introduction (cont)

- Plastic bags are difficult to dispose to environment like soil, ocean and lake where it takes around 300 years to photodegrade (Sangita, Reena, & Verinder, 2011)
- When degrade in water, it will pollute the water.
- Conveyed difficult issues to the human being, wildlife and environment (Haque, 2017)

A pregnant sperm whale washed up dead on a beach in Sardinia, Italy. Its stomach was full of plastic.

COURTESY OF SEAME SARDINIA

ENVIRONMENT | PLANET OR PLASTIC?

This pregnant whale died with 50 pounds of plastic in her stomach

The Mediterranean Sea is choked with plastic waste, and the sperm whale may be the latest casualty of the pollution problem.

Salt is produced on Madura Island, Indonesia, by evaporating seawater, an ancient technique. A new study found that salt made in this region contains some of the highest microplastics sampled.

PHOTOGRAPH BY ULET IFANSASTI, GETTY IMAGES

ENVIRONMENT | PLANET OR PLASTIC?

Microplastics found in 90 percent of table salt

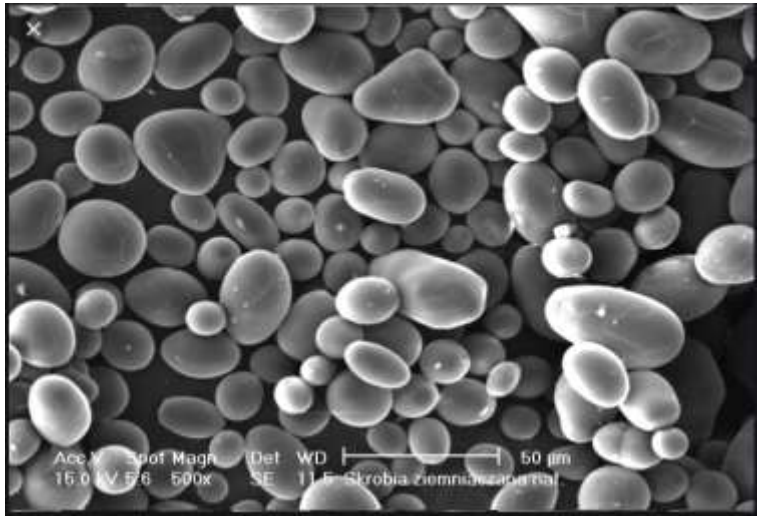
A new study looked at sea, rock, and lake salt sold around the world. Here's what you need to know.

Bio-based Polymer

- Hence, biopolymer made from natural resources seems to be a promising approach for this global issue
- It is readily biodegradable and thus, more environmental friendly than the conventional polymers.
- Among all biodegradable polymers, starch has been reported as one of the most promising one due to its easy availability, biodegradability and renewability (Xu et al., 2005)

Starch as Plastic

- Starch can exhibit thermoplastic behaviour with the addition of plasticizer, heat, and shear.
- To develop plastic from starch, the granular structure of the starch must be either totally or halfway destroyed under high temperature and shear with the presence of plasticizers such as glycerol, sorbitol, water, and others.



Potato Starch Granules, (Joanna Szymonska, 2009)

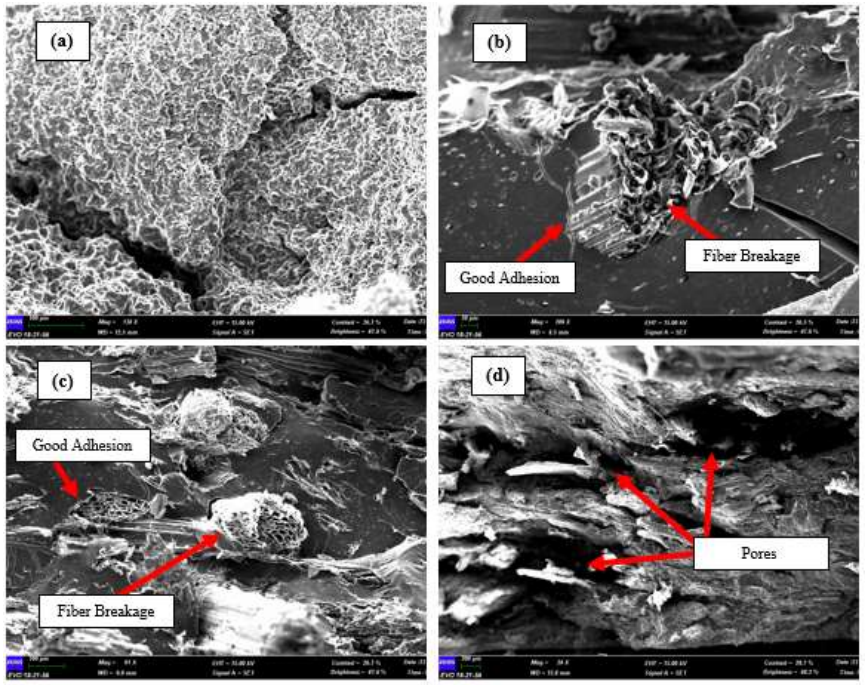
Development of Thermoplastic Starch

Thermoplastic Starch

- Starch will be act as thermoplastic material (Thermoplastic Starch- TPS) in presence of a plasticizer at high condition of temperature.
- However, the strength of native starch are extremely poor, thus, blending of starch with other material is necessary in order to improve the strength and stability.
- Natural fiber has been reported as promising reinforcement agent to improve the properties of TPS.

Modification of Thermoplastic Starch

- Thermoplastic Cassava Starch + Sugarcane Bagasse Fiber

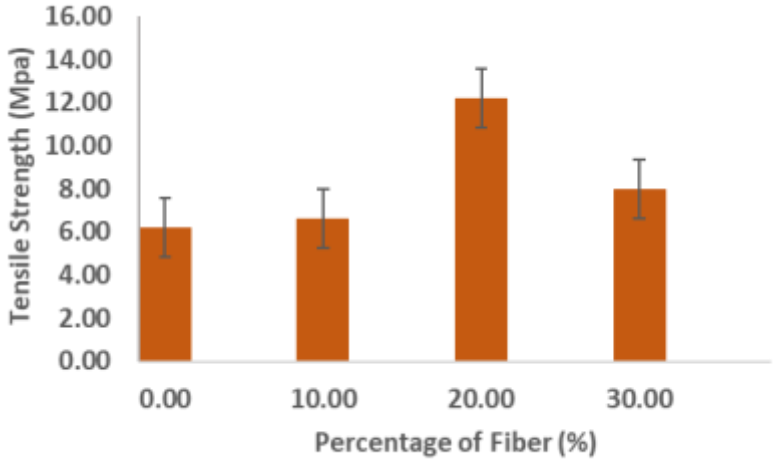


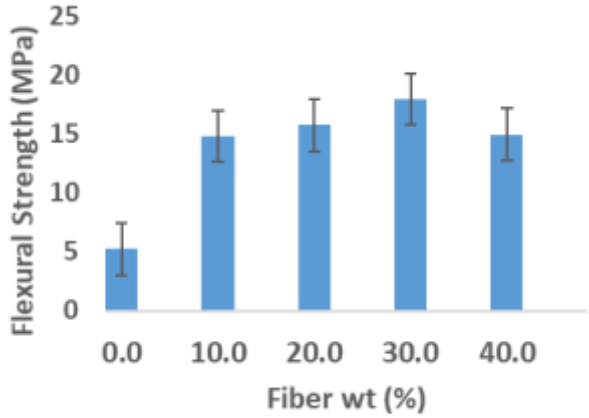
Findings: Sugarcane fiber is compatible with TPS matrix, fiber breakage were spot on the fracture surface

Mechanical Testing (Strength)

Tensile testing

Flexural testing

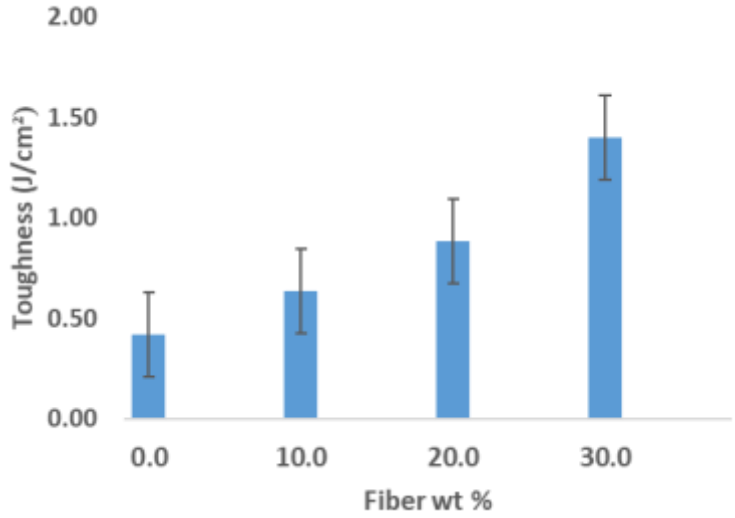




Findings: Improve in tensile and flexural strength

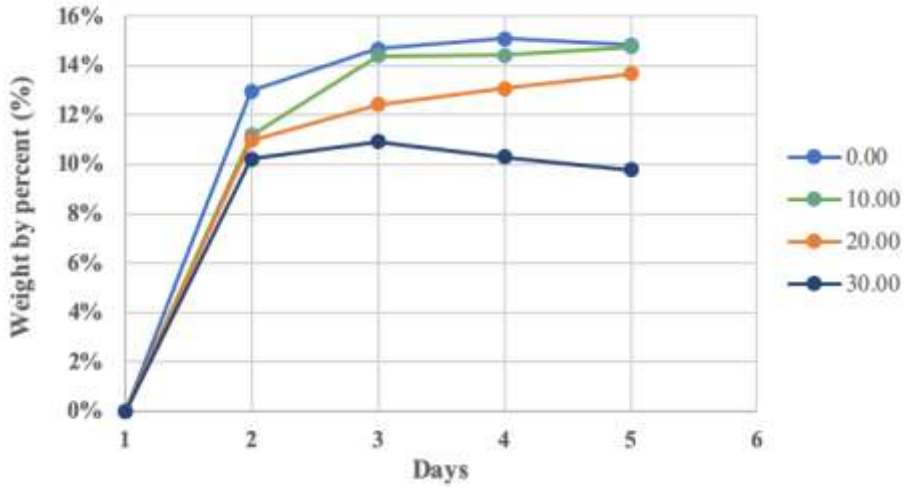
Mechanical Testing (Toughness)

Impact testing



Findings: Improve in impact toughness of TPS after addition of sugarcane fiber

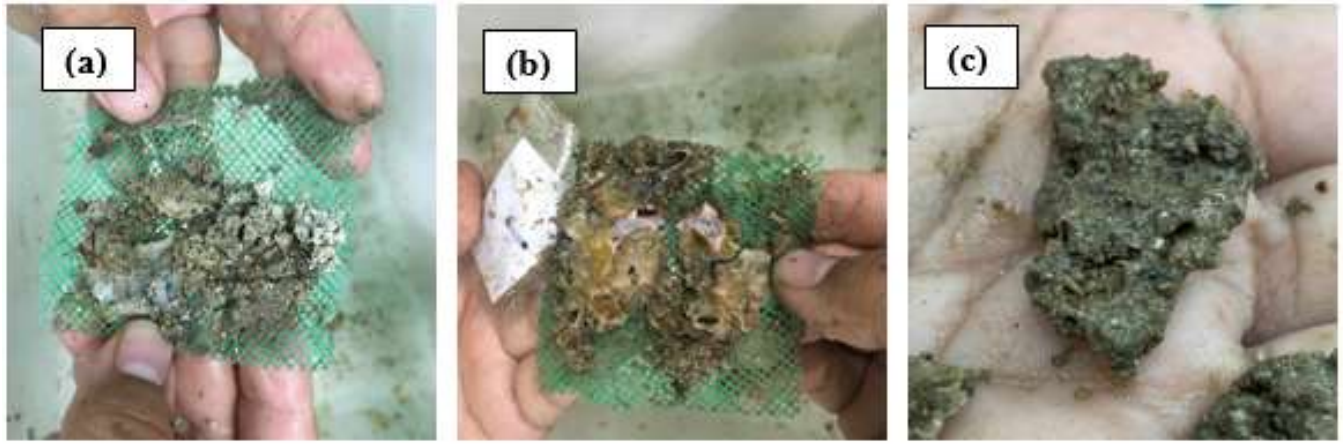
Physical Testing (Moisture absorption)

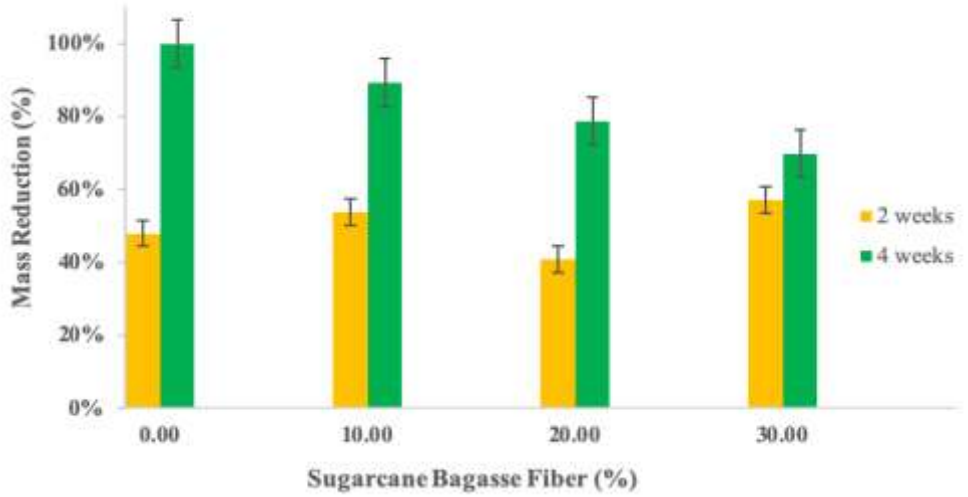


- Findings: Incorporation of Sugarcane fiber reduce the moisture sensitivity of TPS

Environmental Testing

- Biodegradable Testing (Soil Burial) 4 weeks

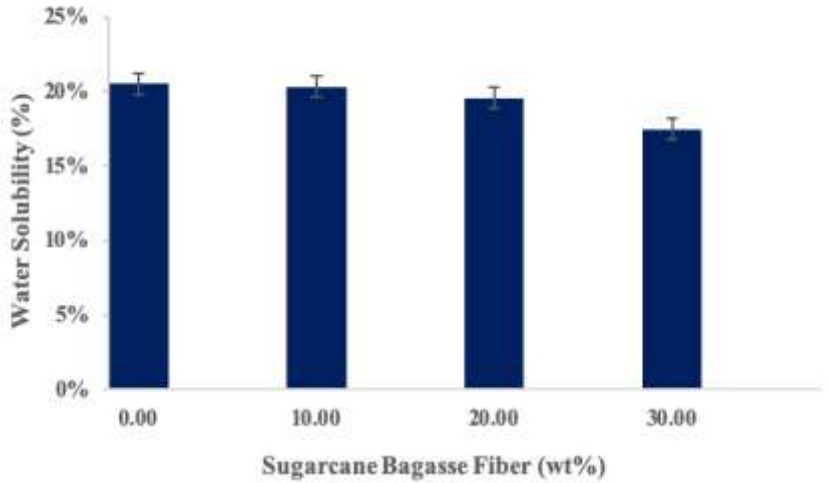




Findings:
- TPS show 100% degradation after 4 weeks of soil burial
- TPS/sugarcane show less degradation than pure TPS (presence of fiber)

Environmental Testing

- Water Solubility Test (24hr)



Findings:
- TPS show 20% degradation after 24hr water solubility test
- TPS/sugarcane show less solubility (presence of fiber)

TPS

TPS/Sugarcane composites

Conclusion

- Thermoplastic starch is an excellent material in terms of the environmentally friendly characteristics.
- The limitation of this biopolymer in the mechanical and physical properties can be improved via modification with other materials
- The modifications carried out in the previous studies using natural fiber/biopolymer, coating has improved the properties of TPS
- Environmental friendly PLASTICS DERIVE FROM GREEN PLANTS is promising candidate to replace the non-biodegradable materials in order to create a more sustainable environment in the near future

Thank You

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