Biopolymer and Green Energy from Palm Oil Mill Effluent Using Bioelectrochemical System

ITEX'18
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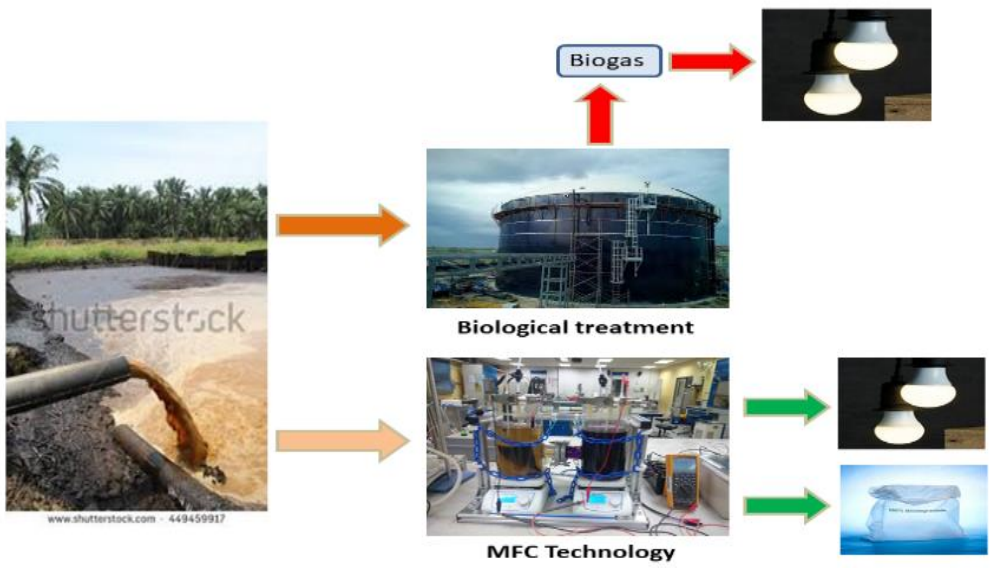
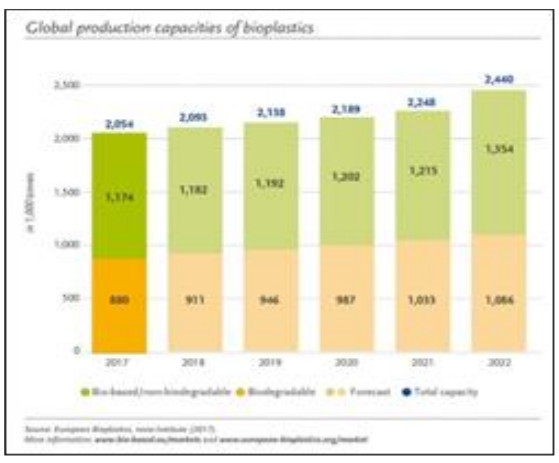
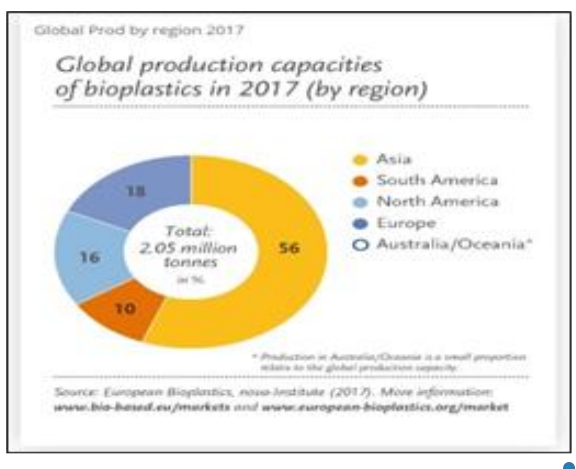
PRODUCT BACKGROUND



- Polyhydroxybutyrates (PHB) are bio-plastics that are produced by selective microbial species utilizing carbon rich substrates.
- Anode of microbial fuel cell (MFC) is considered as bioreactor to produce biopolymer from MFC system
- In Malaysia, palm oil mill effluent (POME) is one of the major wastewater which possesses very high BOD and COD.
- Each ton of crude palm oil produces 5-6 tons of Palm oil mill effluent (POME) and existing POME treatment is highly energy intensive.
- The present invention is focused on the production of PHB in MFC from POME using controlled inoculum





PATENT

PATENT FILLING STATUS: PI2015000405, DATED: 16 FEB 2015

BENEFITS/USEFULLNESS

- Cost effective:
  - ✓ PHB production from bioreactor = 6 RM/kg
  - ✓ PHB production from MFC = 1.5 RM/kg + 150 W/m^3 electricity
- Environmental friendly: Electricity and PHB production from POME wastewater

PUBLICATIONS

1. Islam et al., 2018, ***ACS sustainable Chemistry Engineering***, 6:4130-4137
2. Islam et al., 2017, ***I*, & E Research**, 7:813-821
3. Islam et al., 2017, ***Energy and Fuels***, 31:6132-6139
4. Islam et al., 2017, ***Energy and Fuels***, 31:968-976
5. Islam et al., 2017, ***RSC advances***, 7:4798-4805
6. Fatima et al.,2014, ***Bioprocess and Biosystem Engg.***, 37:943 -951

COLLABORATORS

PUSACO

SUNNY

NOVELTY

- Novel system producing direct electricity and bioplastic.
- High yield of PHB due to the increased cell growth in the bulk as well as on the electrode surface.

ENVIRONMENTAL IMPACT

- COD removal efficiency (78%)
- Green electricity production
- Bio-ploymer production

MARKETABILITY

- Bio-plastic industry
- Bio-medical industry
- Palm oil mill industry

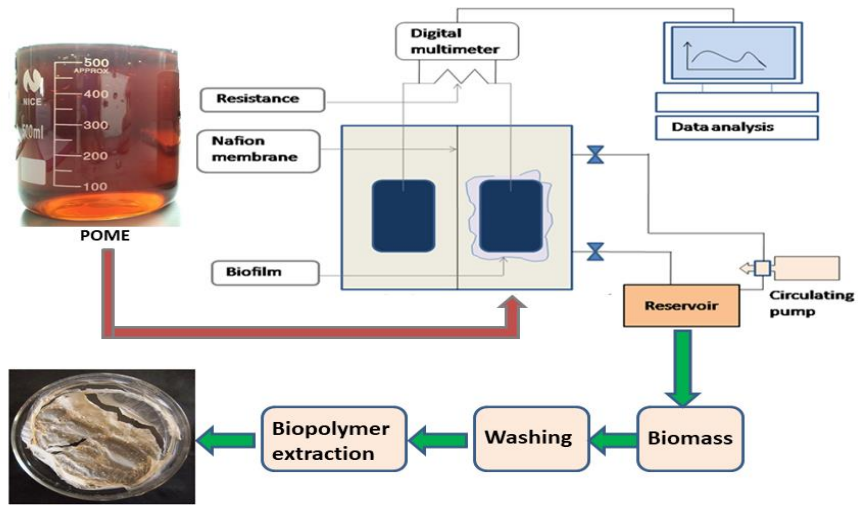
SUSTAINABILITY FACTORS

- Wastewater bioremediation
- Green energy
- Biodegradable polymer

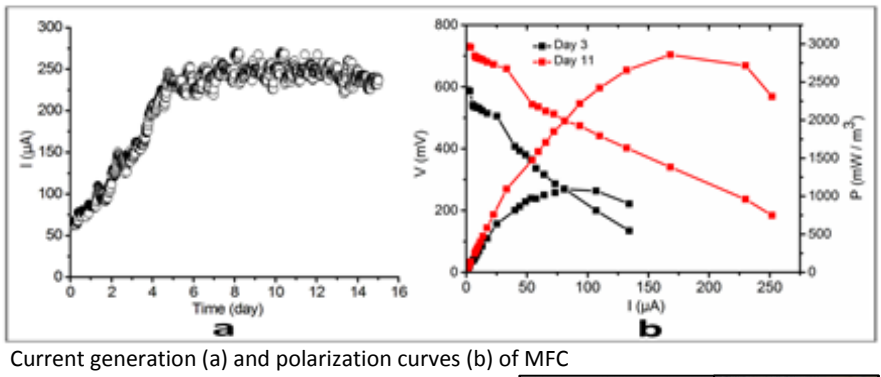
ACHIEVEMENTS

- **GOLD MEDAL**, CITREX 2018, UMP

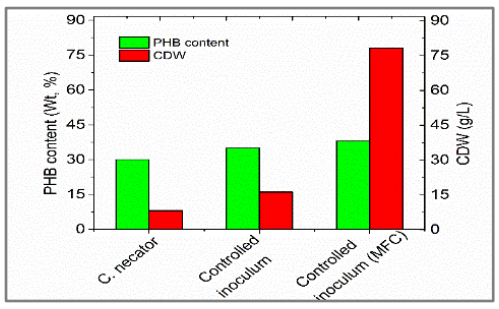
STATE OF THE ART/METHODS



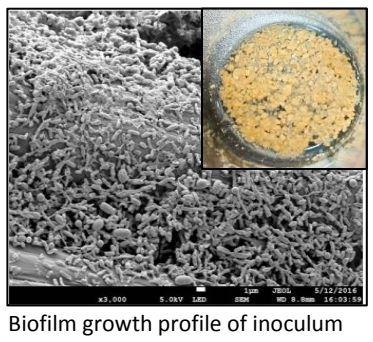
PRODUCT CHARACTERISTICS



Current generation (a) and polarization curves (b) of MFC



CDW and PHB analysis using different inoculums and rectors



Biofilm growth profile of inoculum

Thermal properties of PHB

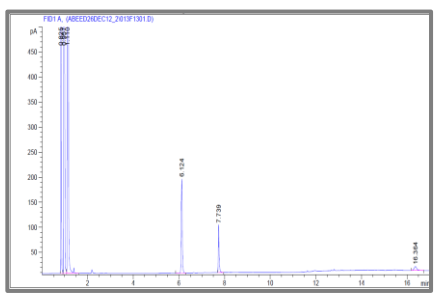
Sample	T_m (°C)	X_c (°C)	T_d (°C)	Reference
PHB_{POME}	168.13	58	266	This study
$PHB_{Glucose}$	124.67	52	270	Mozumder et al. 2014
$PHB_{Glycerol}$	161.14	55	250	Mozumder et al. 2014
PHB_{Biomer}	149.83	60	255	Gonzalez et al. 2014

T_m – Melting temperature, X_c - Degree of crystallinity, T_d – Degradation temperature

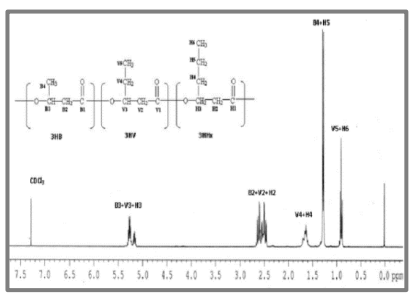
Molar mass distribution of PHB

Sample	M_n (Kda)	M_w (Kda)	PDI	Reference
PHB_{POME}	1188	1352	1.13	This study
$PHB_{Glucose}$	1235	1457	1.18	Mozumder et al. 2014
$PHB_{Glycerol}$	624	992	1.59	Mozumder et al. 2014
PHB_{Biomer}	564	844	1.50	Gonzalez et al. 2014

M_n – Number average molecular weight, M_w – Weight average molecular weight, PDI – Polydispersity index



GC-FID spectrum of PHB



H-NMR spectrum of PHB