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LAM MAN KEE

Editor PPT
Biography

• Dr. Lam Man Kee is currently working at the Department of Chemical Engineering, Universiti Teknologi PETRONAS, Malaysia.

• His research interests include biodiesel and bioethanol production technology, microalgae cultivation, catalysis and life cycle assessment.
Recent Publications


Fuel: Current environmental and social issues

Fossil fuel:
- Air pollution
- Water pollution
- Green house gas effect
- Acidification

Renewable fuel:
- Food vs fuel
- High cost
- Deforestation

The Energy Crisis

Counterthink: Fuel vs Food

Will Work for Food

Fossil Fuels

Renewable Fuels
Biodiesel sources

Edible Oil

Non-Edible Oil
Microalgae as the third generation of biofuel

- One of the oldest living microorganism on Earth
- More than 30,000 species
- Freshwater & Marine
- Main constituents in the microalgae cell:

  Lipids → **Biodiesel**

  Carbohydrate → **Bioethanol**
Advantages of microalgae biofuel

- Does not compete with food supply

- Relatively high lipid productivity compared to terrestrial oil plants
  - Microalgae: 54-126 tonne/ha/year
  - Palm oil: 3.62 – 10 tonne/ha/year
  - Jatropha: 0.14 - 4.13 tonne/ha/year

- High photosynthetic efficiency -> Able to utilize CO₂ efficiently

- High growth rate -> 100 times faster than land based plant
Cultivation of microalgae biofuel

- Light
- Water
- Carbon
- Nutrients
An ideal microalgae biofuel production flow

- **Sunlight**
- **CO₂ from flue gases**
- **Free and abundantly available**
- **Wastewater as nutrient source**
- **Alternative carbon source**
- **Biofuel production**
- **CO₂ mitigation**
Biodiesel production from microalgae lipid

Crude microalgae lipid → Microalgae biodiesel

Transesterification
Sequential Baffled Photobioreactor (SBP)

100 liter cultivation – Pilot scale

The flow of bubbles in the baffled system
SBP: Microalgae cultivation under indoor and outdoor environment
Problems with microalgae cultivation for biofuel production

**Availability of nutrients source**: Nitrogen & Phosphorus

- Chemical nutrients – high cost  
  not environmentally friendly

- Wastewater – inconsistent nutrients concentration  
  serious contamination

**Availability of carbon source**: CO₂

- Atmospheric air – low concentration, 0.03 %
- Flue gas – toxic compounds: CO, NOₓ, SOₓ  
  high temperature: 65°C-450°C
Problems with microalgae cultivation for biofuel production

- Life cycle energy balance – not well understood
- Economic potential - not well understood
- Feasibility of outdoor cultivation
Related Journals

Chemical Sciences Journal

Chemical Engineering & Process Technology
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