

BIO-FUEL PRODUCTION

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What is BIOFUEL?

- ▶ Bio fuel is a type of fuel whose energy is derived from biological Carbon fixation.
- ▶ Bio fuels derived from biomass conversion , liquid fuel & solid biomass.
- ▶ Rudolf diesel was inventor of biodiesel on the year 1890.

Common examples of Bio fuels

- ▶ 1) ETHANOL
- ▶ 2) VEGETATIVE OIL
- ▶ 3) ANIMAL FATS
- ▶ 4) GREEN DIESEL

Classification of Bio Fuel

- ▶ First generation Bio Fuel
- ▶ Second generation Bio Fuel

TYPES OF BIOFULES

First generation biofuels

Second generation biofuels

- Bioalcohol
 - Biodiesel
 - Vegetable oil
 - Biogas
 - Syngas
 - Solid biofuels
- Main two types

First generation Bio Fuel

- ▶ They are also called as conventional Bio Fuel.
- ▶ The first generation Bio Fuels refers to the fuels that have been derived from sources like starch , animal fats & vegetable oil .
- ▶ The oil is obtained using the conventional techniques of production.
- ▶ EX-bio diesel , green diesel , bio ether , bio gas etc.
- ▶ This is mostly used in European countries.
- ▶ It is mineral acid and chemically known as fatty acid methyl.
- ▶ It is very commonly used when it is mixed with mineral oil.

Second generation bio-fuel

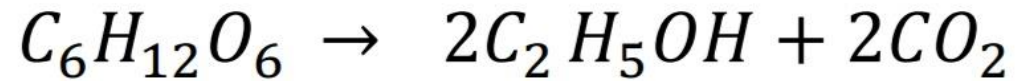
- ▶ These are the produced from sustainable feed stock.
- ▶ Sustainability of a feedstock is defined among others by availability of the feed stock on GHG gas emission and impact on biodiversity and land use.

Microorganisms in biofuel production

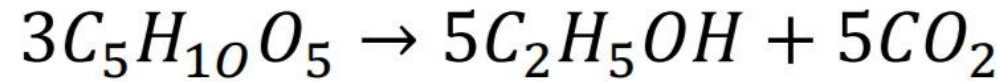
- ▶ Microalgae, bacteria, fungi, yeast etc. are helpful in biofuel production.
- ▶ Biodiesel production using microbial lipids, which is named as single cell oils, has attracted great attention in the whole world.
- ▶ E. coli has the natural ability to synthesize fatty acids and is amenable to genetic manipulation, making it an ideal target for biofuel production.
- ▶ Most researched commercial microorganisms in biofuel production are
- ▶ FUNGI: *Trichoderma sp.*, *Aspergillus sp.*, *Saccharomyces sp.*
- ▶ BACTERIA: *Zymomonas sp.*, *Clostridium sp.*

Ethanol production

Carbohydrates: Cellulose Starch Glucose/sucrose

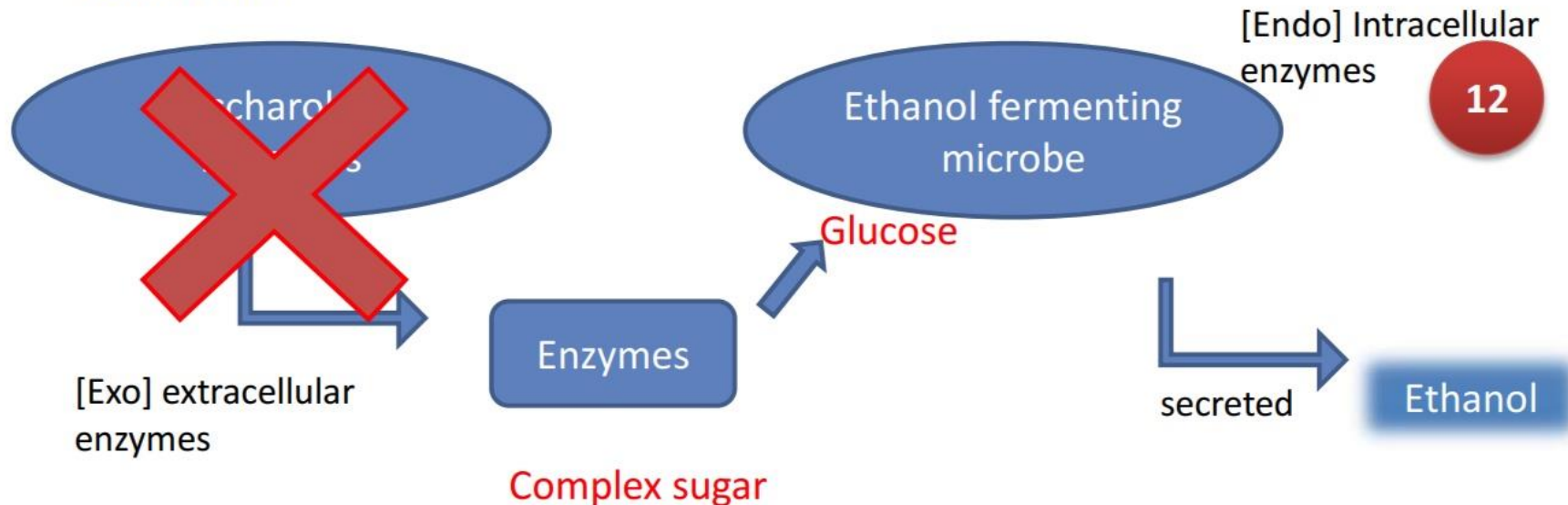


1 mole glucose = 2 moles ethanol + 2 moles carbon-dioxide



3 moles xylose = 5 moles ethanol + 5 moles carbon-dioxide

Commercial



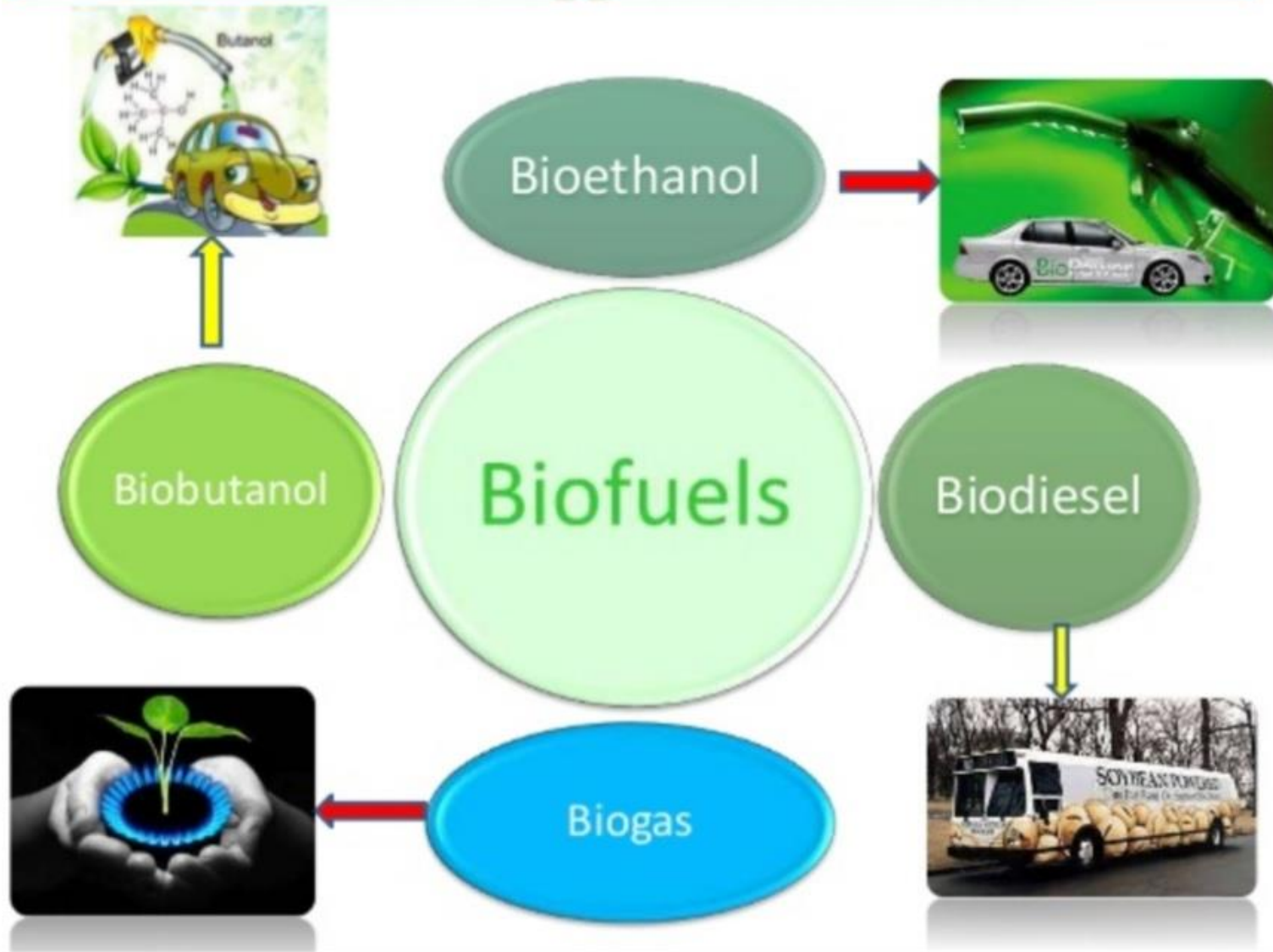
Positives of biofuel

- ▶ The energy content of bio diesel is 90% of the petroleum diesel.
- ▶ The energy content of ethanol is 50% of gasoline.
- ▶ The energy content of butanol is 80% of gasoline.
- ▶ Bio diesel is sulphur free fuel.
- ▶ Bio diesel has fewer polycyclic aromatic hydrocarbons, which has been linked to cancer.

DISADVANTAGES OF BIOFUEL

- ▶ During production of bioethanol, huge amount of CO₂ and other GHGs are released.
- ▶ Energy content of petrol is much higher than bioethanol (it's energy content is 70% of petrol).
- ▶ Used of phosphorous and nitrogen in the production causes negative effect on the environment.
- ▶ Pure ethanol is difficult to vaporise.
- ▶ Can only be transported by auto transport or railroad
- ▶ Due to the high prices of bioethanol some farmers may sacrifice food production for biofuel production which will increase the price of the food around the world.

Common Types of Biofuels



Use of Biofuels

Transportation

Energy generation

Provide heat

Cooking

Lubrication

- ▶ The methanogenic bacteria which utilise CO_2 and H_2 to produce CH_4 the hydrolytic and acetogenic groups of bacteria like Clostridium, bacteroids, bacillus etc.
- ▶ These bacteria are sensitive to pH and the optimum pH for CH_4 production is 6.8-7.2.

USE OF BIOGAS:

- ▶ Biogas containing CH_4 is a valuable product which can be utilised in the production of renewable energy.
- ▶ It can be used for generating electricity and heat.
- ▶ It can also be burned directly for cooking, lighting, heating and process heat.

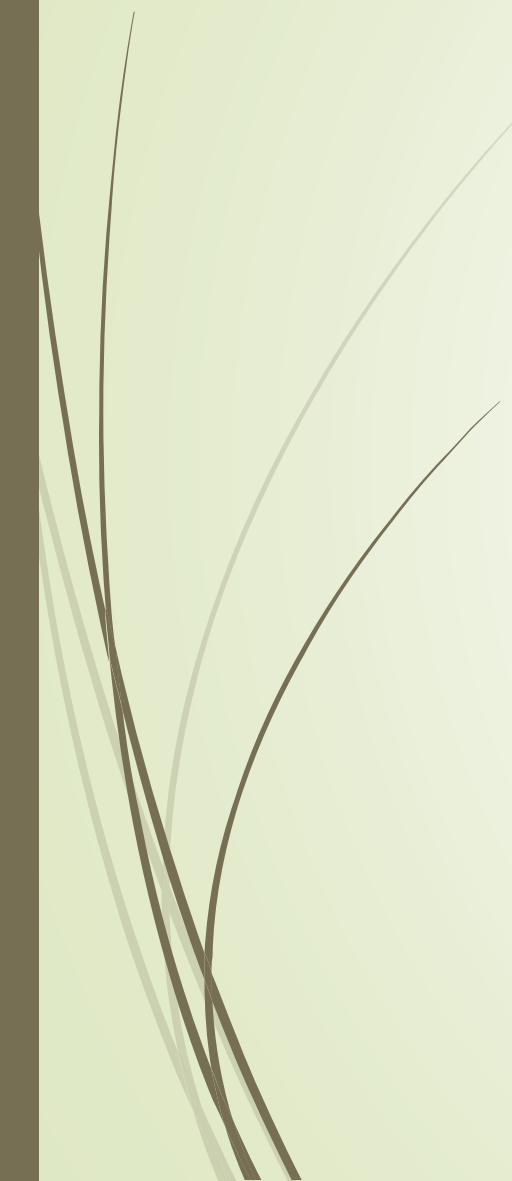
Biogas manures;

- ▶ The material after fermentation and production of biogas are called as biogas manures which are used as manures to different crops.

THANK YOU




SILAGE PRODUCTION

- **Silage** is fermented, high-moisture stored fodder which can be fed to cattle, sheep and other such ruminants (cud-chewing animals) or used as a biofuel feedstock for anaerobic digesters.
 - Silage is made through the fermentation of grass. The process is called **ensilage**.
 - It is usually made from grass crops, including maize, sorghum or other cereals, using the entire green plant (not just the grain). .
- 



Silage Preparation :

- Silage is made by one or more of the following methods:
 - placing cut green vegetation in a silo or pit;
 - piling the vegetation in a large heap and compressing it down so as to purge as much oxygen as possible, then covering it with a plastic sheet; or
 - by wrapping large round bales tightly in plastic film.
- 

PRODUCTION

- The crops most often used for ensilage are the ordinary grasses, clovers, alfalfa, vetches, oats, rye and maize.
- Silage must be made from plant material with a suitable moisture content: about 50% to 60% depending on
 - the means of storage,
 - the degree of compression, and
 - the amount of water that will be lost in storage, but not exceeding 75%.



After harvesting, crops are shredded to pieces about 0.5 in (1.3 cm) long.

The material is spread in uniform layers over the floor of the silo, and closely packed.

Fermentation

- Silage undergoes anaerobic fermentation, which starts about 48 hours after the silo is filled, and converts sugars to acids. Fermentation is essentially complete after about two weeks.
- Silage inoculants contain one or more strains of lactic acid bacteria, and the most common is *Lactobacillus plantarum*. Other bacteria used include *Lactobacillus buchneri*, *Enterococcus faecium* and *Pediococcus* species.



STORING SILAGE

- Silage must be firmly packed to minimize the oxygen content, or it will spoil. Silage goes through four major stages in a silo
 - **Presealing**, which, after the first few days after filling a silo, enables some respiration and some dry matter (DM) loss, but stops
 - **Fermentation**, which occurs over a few weeks; **pH** drops; there is more DM loss, but hemicellulose is broken down; aerobic respiration stops
 - **Infiltration**, which enables some oxygen infiltration, allowing for limited microbial respiration; available carbohydrates (CHOs) are lost as heat and gas
 - **Emptying**, which exposes surface, causing additional loss; rate of loss increases.



Spoilage



- ▶ Spoilage microorganisms e.g. *Clostridium* and *Enterobacillus*, could potentially reduce the quality of the silage, making it unpalatable to livestock.
- ▶ However, the acidic and anaerobic conditions created through the fermentation process inhibit the action of these microbes.



Safety

- ▶ There is a risk of injury by machinery or from falls. When a silo is filled, fine dust particles in the air can become explosive because of their large aggregate surface area. Also, fermentation presents respiratory hazards.
- ▶ The ensiling process produces "silo gas" during the early stages of the fermentation process. Silage gas contains nitric oxide (NO), which will react with oxygen (O₂) in the air to form nitrogen dioxide (NO₂), which is toxic.
- ▶ Lack of oxygen inside the silo can cause asphyxiation.
- ▶ Molds that grow when air reaches cured silage can cause organic dust toxic syndrome. Collapsing silage from large bunker silos has caused deaths.
- ▶ Silage itself poses no special danger.



**THANK
YOU!**