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BIODIESEL

Biodiesel is an alternative fuel that can solve or reduce the impact of air pollution because of various advantageous characteristics. It has been reported that biodiesel can be used in diesel engines without (or with only minor) engine modifications. Diesel engines are widely used in trucks and commercial vehicles because they have the advantages of large power output and fewer exhaust emissions. Although diesel engines produce lower hydrocarbon (HC) and carbon monoxide (CO) emissions than gasoline engines, their higher nitrogen oxides (NO_x) and particulate matter (PM) emissions are a problem. However, the biofuel produced from animals and plants can reduce PM emissions due to its inherent characteristics. Biodiesel is a green renewable fuel that produces only carbon dioxide (CO_2), and can be absorbed by plants as they grow, making biofuels carbon neutral. Thus, using biofuels can significantly reduce global warming and the greenhouse effect.

Biodiesel Production

Biodiesel is a renewable and eco-friendly fuel that is one alternative fuel for vehicles. Biodiesel can be produced from many renewable biological sources such as plants, vegetables, animal fats, used cooking oils, waste oils, and microalgae. The methods of producing biodiesel can be divided into “physical” and “chemical” methods according to processing method and biodiesel characteristics. The physical methods can be subdivided into the “direct mixed method” and the “microemulsion method” while the chemical methods can be subdivided into the “pyrolysis method” and the “transesterification method.”

Transesterification

Oil + alcohol → biodiesel + glycerin

The chemical reaction that converts a vegetable oil or animal fat to biodiesel is called “transesterification.” This is a long name for a simple process of combining a chemical compound called an “ester” and an alcohol to make another ester and another alcohol. Oils and fats are included in the ester family. When they react with methanol or ethanol, they make methyl or ethyl esters and a new alcohol called glycerol or, more commonly, glycerin.

The vegetable oils and animal fats used to make biodiesel can come from virtually any source. All of these products consist of chemicals called triglycerides, so biodiesel can be made from soybean oil, canola oil, beef tallow, and pork lard, and even from such exotic oils as walnut oil or avocado oil.

Even used cooking oil or waste oil can be used to make biodiesel. However, these oils present special challenges for biodiesel production because they contain contaminants such as water, meat scraps, and breading that must be filtered out before the oil is converted to biodiesel.

Methanol is the most common alcohol used for making biodiesel. It is sometimes called methyl alcohol or wood alcohol. It is very toxic and swallowing as little as a spoonful can cause blindness or even death.

The chemical reaction used to make biodiesel requires a catalyst. A catalyst is usually a chemical added to the reaction mixture to speed up the reaction. Since the catalyst is not consumed in the reaction, it will be left over at the end in some form. In biodiesel production, the actual compound that catalyzes the reaction is called methoxide. One common way to make methoxide is to dissolve sodium hydroxide or potassium hydroxide in methanol. Large producers buy a solution of sodium methoxide in methanol that is much safer to work with.

Oilseed Crops for Biodiesel Production

- Soybeans
- Rapeseed
- Canola
- Camelina seeds (left) and canola seeds
- Mustard
- Camelina
- Safflower and Sunflower
- Jatropha
- Castor Bean

Transesterification of rapeseed and Canola oils

Transesterification is the best way to obtain biodiesel because it is well-known and cheap process which gives less problems for the engines than another method. In a standard process of production biodiesel from rapeseed oil there are following process steps i.e. esterification of rapeseed oil, separation of esterification products, methanol distillation and purification of the ester. The main stage of the process is based on the transesterification reaction of rapeseed oil with an alcohol (methanol, ethanol) which results in formation of esters of alcohols and glycerol.

The reaction is reversible due to formation of water, which is responsible for shifting the equilibrium towards the reagents. In order to move the chemical equilibrium towards the ester, an excess of alcohol is used. The transesterification involves three consecutive and reversible reactions. Each molecule of alcohol makes with the residue of fatty acid a distinct monoester molecule. If the triglyceride contains three different fatty acids in its molecule, a mixture of rapeseed oil esters is obtained. There are used various chemical catalysts in the transesterification reaction i.e. acids, alkalis and enzymes. Some of them are the most effective i.e. alkaline catalysts and their methoxides. Only anhydrous reactants should be used, because the water decomposes catalyst and leads the reaction to the side of the reactants. The amount of the catalyst depends on its type, quality of substrates, reaction time and temperature. Its value varies from 0.2% to 2% by mass relative to the weight of oil. Unrefined oil requires more catalyst. Free fatty acids content in oil should not exceed 0.5-1%. The higher the water content in methanol, the greater the consumption of catalyst and higher contents of free fatty acids as well as soaps. Forming of soaps reduces the activity of the catalyst and increases the viscosity, so the separation of the glycerol is more difficult.

In the majority of the biodiesel production processes, methanol is used, mainly due to the cost and its physical and chemical advantages (polar, shortest chain alcohol and the reactivity is easier).

For the basic-catalyzed process, the optimal ratio is 6:1 (alcohol: oil). Applying alkaline catalysts in the reaction allow to carry out the transesterification process at room temperature. The reaction time is very diverse and can vary from several minutes to several hours (typically about 30-60 minutes). Mixing is important because of the lack of mutual solubility of the substrates. Appropriately intensive mixing of reactants increases the contact area. Using the refined oils with a higher purity as well as pure and anhydrous methanol, allows to obtain biodiesel with a high content of methyl ester (96.5-99%).

In the transesterification reaction, the oil is converted to FAME (Fatty Acid Methyl Ester). The flow, which goes out from the reactor, should be purified. First, the methanol is recovered and then residue is carried to separation of glycerin. Next, the obtained biodiesel is purified to commit the standards of quality.

Transesterification of Animal Fat

Transesterification reaction aims in producing fatty acid alkyl ester with lower viscosity and enhanced calorific value, by reacting the triglycerides in fat/oil with alcohol in presence of catalyst. The reaction kinetic involves in conversion of triglyceride into diglyceride followed by monoglycerides which eventually gets converted in fatty acid alkyl ester. Any alcohol with simple carbon chain can be used as solvent for the reaction but the feasibility of reaction is achieved upon using alcohol like methanol and ethanol.

The yield of biodiesel is deeply affected by water content and FFA (free fatty acids) concentration present in the fat. Residual glycerin as reaction byproduct can be used in pharmaceuticals whereas unreacted alcohol can be reused upon recovery. Apart from transesterification, the biodiesel can also be synthesized by employing thermal cracking of fat, micro emulsions and direct blending of fat with diesel. However, these methods are least preferred because of their impact on physiochemical properties of biodiesel.

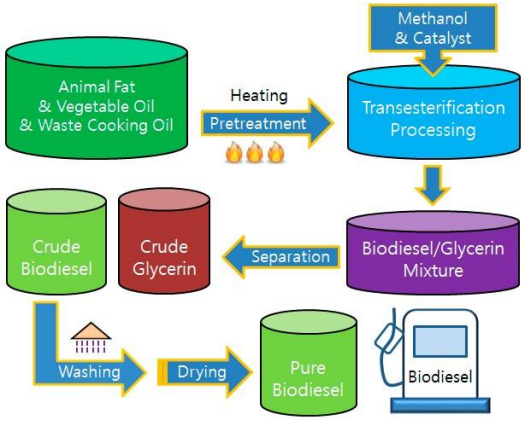

Figure 1. The specific process of transesterification method for biodiesel production.

Greenhouse farming in Nigeria

Greenhouse farming in Nigeria is the business of working on and managing the growing of crops and plants inside a greenhouse. Greenhouse farming technology makes it possible to grow tropical crops (pineapples, tomatoes, peppers) in the cold regions of Russia and France and in the reverse direction, temperate crops (apples, cabbages, blackberries) can also be grown in hot regions of Nigeria, Dubai and Israel using greenhouse farming technology.

In greenhouses, three considerations which are very critical to the growth and development of plants: ventilation, the amount of light that gets through to the plants and retaining the heat generated from the ground. These considerations determine the choice or type of materials used to construct a greenhouse. As a result of these considerations, two materials are majorly used in greenhouse construction: Glass and Plastics (Moldable Polymers).

Glass has a higher light transmission value (97% to 98%) compared to plastics (80% to 96%) so a glass greenhouse allows more light to get to the plants. However, light passing through plastic diffuses therefore making light penetrate more areas of the greenhouse.

Plastics are lighter than glass so they require less construction work and materials when used for greenhouses. Although plastics like twin-wall polycarbonate (TWP) can be more expensive than glass, they are more durable and last longer. Also, plastics have a good thermal insulation value (R) which makes them suitable for retaining the ground-generated heat inside the greenhouse.

To cater for proper ventilation in greenhouse farming, the greenhouses are oriented so that the vents are open towards the direction of prevailing wind flow of the greenhouse site or location.

PREPARATION OF A GREENHOUSE

Components of a greenhouse

A greenhouse has some components, it should be noted that greenhouses vary, some have components the others do not have. The components of a greenhouse are explained as follows:

Iron rods or pipes: Most greenhouses are built with galvanized iron or steep pipes. These pipes are used to construct the frame of the greenhouse. Without the pipes, the greenhouses cannot be constructed. However, some people construct their greenhouses with wood or PVC pipe.

Greenhouse Cover: The greenhouse cover is the plastic or glass used in covering the greenhouse structure. The greenhouse cover protects the greenhouse from the elements of the weather. The plastic or glass used as a cover for a greenhouse should typically has a light penetration rate of between 80%-96%.

Drip Irrigation: Most greenhouses if not all have drip irrigation facilities. Drip irrigation is a type of water efficient irrigation that allows water to drip or trickle to the roots of plants. With drip irrigation, farmers can be able to do fertigation.

Mister: Some greenhouses have misting equipment used for misting when humidity is low. Misting is done to provide humidity for crops during times of low humidity. Low humidity can be harmful to some crops.

Carbon IV Oxide Gas Chamber: All plants need carbon dioxide or carbon IV oxide for photosynthesis. To fast track the growth of plants in greenhouses and to ensure that the crops have a good yield. Some greenhouses have carbon IV oxide gas chamber.

Plastic Mulch: Plastic mulch is used to cover the soil in order to prevent weeds and alter the temperature of the soil. Some greenhouses have plastic mulches which are used to guard against weeds.

Grow Bags: Grow bags are plastic bags that are used for planting crops. Instead of a farmer to plant directly on the soil, he can decide to plant in grow bags. Soilless medium like coco peat can be stuffed in the grow bags to serve as a planting medium.

Planting Media: Soil, coco peat and rock wool etc. can be used as planting media in a greenhouse. Some greenhouses run 100% on water, this type of greenhouse is called hydroponic greenhouses.

Pollinators: Some farmers introduce bees into their greenhouses while some use artificial pollinators to pollinate their crops because the enclosed structure does not allow bees to have access to the crops in their greenhouses.

Climate controlled equipment: Highly sophisticated greenhouses often have the ability to adjust to the best temperature and humidity suitable for the crops grown in them. This climate-controlled equipment is a key component of some types of greenhouses.

Advantages of Greenhouse Farming

There are many advantages of growing crops and plants in a greenhouse. Some of these advantages are:

- Plants are protected from unfavorable weather conditions that affect their growth.

- Plant environment are better managed to reduce the harmful effect of pest and diseases.
- Plants can be grown and made available throughout the year.
- Plants and crop can be grown in commercial quantities in urban areas or in the city.
- Improved harvest and production yields due to better management and control of plant environment