The Application of Hydroponic in Biomass Growth

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Abstract: With the continuous growth of the population, the human demand for energy is getting higher and higher. However, the limited fossil fuels are not enough to meet the needs of human. Therefore, as the fourth largest energy source after coal, oil and natural gas, biomass is bound to play a key role in the future development. Biomass can be used in the field of biofuels. Biofuels are a new type of environmentally friendly energy source that is processed from crops such as straw, rice husks, peanut shells, corn cobs, and cottonseed hulls. Water content, ash content, sulfur content and chlorine content are low. Its main advantages are its renewability, low pollution, wide distribution, resource richness and carbon neutrality. The traditional soil cultivation method covers a large area and has low efficiency, so it is not a long-term solution in the case of shortage of land resources. Therefore, it is extremely necessary to explore the feasibility of hydroponics in biomass cultivation.

1. Growing Crops Using Hydroponic

1.1. Principle

Hydroponics means growing plants without soil. It is possible to achieve because it is not the soil that plants grow from, but the minerals it contains. Hydroponics is the use of water to provide plants with the minerals they need. The equipment required for hydroponics is not very complicated and can be used in a large-scale production mode.

1.2. Planting Mode

Hydroponics does not require soil, and the solution for transporting nutrients can be transported by pipeline, so that a large field is not required and a multi-layer structure can be used. Use greenhouse culture to control temperature and humidity, and greatly increase crop yield and quality. In hydroponic systems, PVC pipes are ideal liquid transport devices. They are low in price and low in density. They can use a stacked structure to maximize the utilization of land. At the same time, the structure of the pipeline can effectively increase the light transmittance and reduce the additional light source that needs to be provided to reduce energy consumption. The following figure shows the possible structure of the pipeline structure.

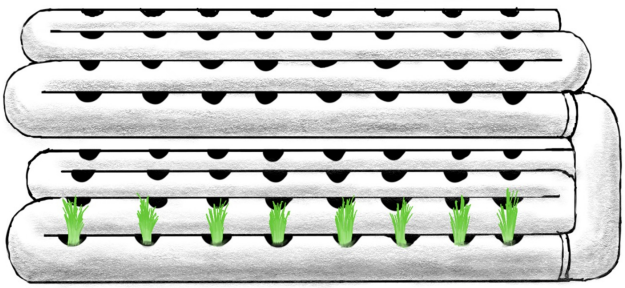

Figure 1. Structure of the Pipeline

1.3. Pipe Structure

The PVC pipe can be about 5 cm in diameter, and a hole is made every 5 cm. The hole is

filled with floating rock to fix the root of the crop. In order to prevent uneven distribution of nutrients, the hydroponic solution passes through the pipeline and continues to provide nutrients to the crops. The waste liquid absorbed by the crops is recovered at the bottom and reused as a solvent for the new solution.

1.4. Hydroponic Solution

The content of per liter standard hydroponic nutrient solution is:

- potassium nitrate 0.7 g/L
- boric acid 0.0006 g/L
- calcium nitrate 0.7 g/L
- manganese sulfate 0.0006 g/L
- superphosphate 0.8 g/L
- zinc sulfate 0.0006 g/L
- Magnesium sulfate 0.28 g / L
- copper sulfate 0.0006 g / L
- iron sulfate 0.12 g / L
- ammonium molybdate 0.0006 g / L.

1.5. Crops

To utilize this technique in biomass, we must decide what kind of plant to cultivate. The most ideal hydroponic crop that can be used in biomass cultivation is oilseed rape and wheal. In this essay, we will use oilseed rape as an example. Rapeseed can make oil while the stems and leaves of oilseed rape can be food for people to eat.

1.6. Yield

The seedling stage, the bud stage, the flowering stage and the fruit stage of rapeseed are about 120 days in total, because it is in the greenhouse, hydroponic rape can be harvested 3 times a year. Take a 6-layer PVC pipe as an example. One hole per 25 cm, one PVC pipe per 20 cm, and an average of 500 square centimeters in one layer can be planted with one rapeseed.

Therefore, in general, 120 rapes can be planted per square meter.

The yield of rapeseed is generally 230-240kg per acre, and the distribution density of the oilseed rape is about the same as that of hydroponic culture. Therefore, the yield of hydroponic rape is about 21150kg/km2, because it is harvested three times a year. The annual harvest is approximately 63450 kg/km2 [1].

2. Preparation of Biodiesel

2.1. Ingredients of Raw Material

(Rapeseed) The content of rapeseed is:

- 3.9%-5.2% of nitrogen
- 24.6%-32.4% of protein
- 5.7%-9.6% of cellulose
- 4.1%-5.3% of ash
- 37.5%-46.3% of oil

2.2. Rapeseed Oil

The oil yield of rapeseed is about 41.7%, so from the rapeseed harvested from 1 square kilometer of hydroponic greenhouse, about 26522kg of rapeseed oil can be obtained after extraction [2].

2.3. Biodisel

One ton of rapeseed oil after degumming can produce 960 kg of biodiesel, using base catalyzed transesterification, and after preparation, 25461 kg of biodiesel can be obtained. At the

same time, it will produce 10% (2652kg) by-product glycerol production [3].

3. Use of Biodiesel

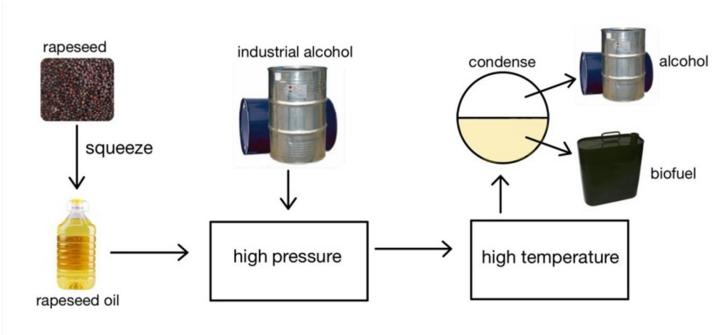

Figure 2 Process of Biodisel

3.1. Combustion of Biodiesel

Energy can be obtained by burning biodiesel, which is one of the most widely used applications for biodiesel. The calorific value of diesel is 42.6MJ/kg. Because biodiesel contains more water and aromatic hydrocarbons, the calorific value of biodiesel will fluctuate between 33~41MJ/KG [4].

3.2. Fuel

As a fuel for burning biodiesel from automobile fuel, it can be seen from the previous paragraph that the efficiency of biodiesel as a fuel is almost the same as that of ordinary diesel. Biodiesel has good environmental performance, good engine start-up performance, good fuel performance, wide range of raw materials, and renewable characteristics. In recent years, many studies have confirmed that whether it is a small, light diesel engine or a large, heavy-duty diesel engine or a tractor, the hydrocarbons after combustion of biodiesel are reduced by 55% to 60%, the particulate matter is reduced by 20% to 50%, and the CO is reduced by more than 45%.

Polycyclic aromatic hydrocarbons are reduced by 75% to 85%.

4. Price Calculation and Comparison

4.1. Price

Including civil engineering part, main frame (steel frame), surrounding covering material, top covering material, external shading system, internal shading system (or internal insulation system), fan water curtain forced cooling ventilation system, top window natural ventilation system, water curtain The overall electric eversion window system, power distribution system, engineering installation fee, transportation cost, tax, a set of standard glass greenhouse cost from: 323~400 yuan / square meter. Therefore, the cost of a square kilometer glass greenhouse is about 40 million yuan.

As a smart greenhouse, almost no additional labor resources are needed, and all the equipment facilities need to be powered by photovoltaic panels in the shading system, so other costs are negligible. Therefore, with an investment of RMB 40 million, it can produce 25,461 kg of biodiesel per year (biodiesel density is about 0.88 kg/L, so it is about 28,933 liters of biodiesel), and there is almost no additional cost involved in the later stage.

4.2. Comparison

Ordinary diesel oil needs to be extracted from crude oil. Crude oil is fossil fuel and it is a non-renewable resource. It is estimated that the existing crude oil resources can only support human demand for 70 years, so ordinary diesel is less sustainable than biodiesel.

5. Conclusion

Biomass cultivation using hydroponic methods is completely feasible, using a glass greenhouse and using a pipe structure to provide nutrients to crops (such as canola) at an affordable price, and this is a renewable resource. Some of the products can be made into biodiesel or other types of biofuels, and other products can also be used as food for humans or livestock. Biofuels (biodiesel) have the advantage of being renewable and releasing less pollutants when burned, making them environmentally friendly. Therefore, in the case of mature technology, hydroponic biomass cultivation can be carried out on a large scale.

References

[1] Chittaranjan K. (2007) Genome Mapping and Molecular Breeding in Plants. Oilseeds. 1, 1-9.

[2] Zhong W., Yinnan Y., Junfeng Y., Zongying G. (2015) Experimental Study on Preparation of Diesel Oil from Rapeseed Oil, 201-204.

[3] Tingting L. (1988) New Fuels - Making Biodiesel from Rapeseed. China Science and Technology Information. 2, 17-17.

[4] Groxiang Z., Runia L., Youfeng L. (2013) Energy Microbiology.