NIPAH *(NYPA FRUTICANS)* UTILIZATION FOR BIO-ETHANOL AT DELTA MAHAKAM.

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Abstract
In the year 2007-2012, the Indonesian government target to replace 1.48 billion liters of gasoline with bio-ethanol. Currently a new bio-ethanol can be supplied as much as 137,000 liters per month (0.4%). Nipah (Nypa fruticans) is one of palm species that grows in the mangrove forest. Sugar from the sap of Nipah is high enough so that it is potential as a base for the production of bioethanol. Vegetable-based fuel or bio-ethanol can reduce environment pollution; due to its CO2 emissions are very low, making it more environmentally friendly. Bio-ethanol can be used as a substitute for fossil fuel. Bio-ethanol with levels of 95-99% can be used as material substitution for gasoline.
Keyword : *Nipah, Bio-Ethanol, Delta Mahakam*

BACKGROUND & PURPOSE

Background

The decreasing of fossil energy resources in the world including Indonesia, forcing the energy experts to look for other renewable energy as an alternative to fossil fuels. Nipah *(Nypa fruticans)* is one of the main constituent of mangrove forest with a composition of about 30%.

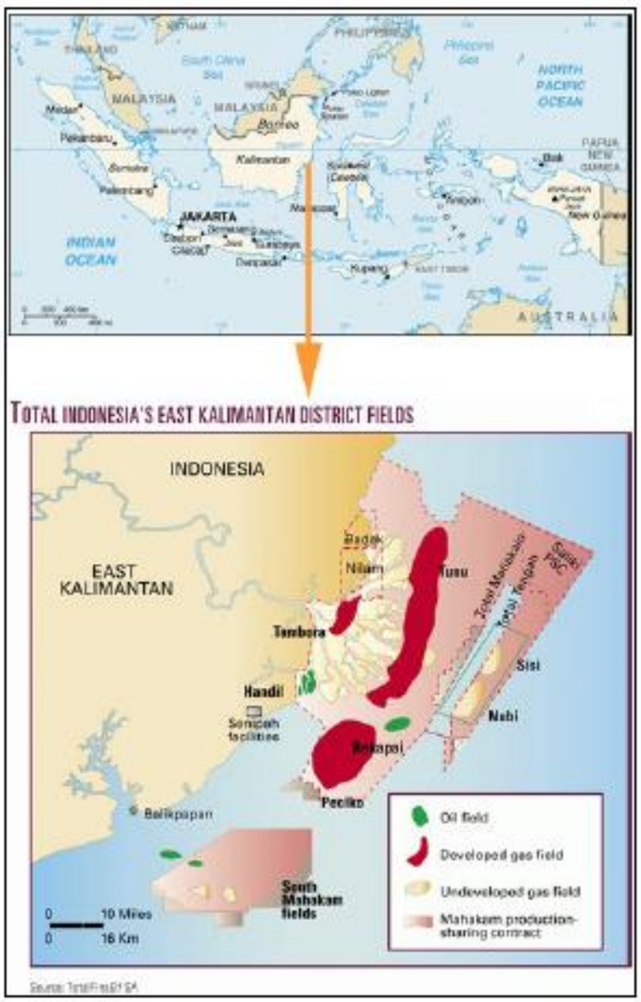
Purpose

The Subscriptions is proposed to produce biofuel energy for other renewable energy as an alternative energy to replace fossil fuels. Nipah potentially be used as raw material for biofuels.

Production of bioethanol from nipah sap can be done through the metabolic activity of microbes that can produce etanol. *Saccharomyces cerevisiae* is widely used in bioethanol fermentation with the conversion of the high sugar and high tolerance to produce ethanol

INTRODUCTION

Mahakam Delta is on the eastern coast of Kalimantan island at the position of 117^{o}15' – 117^{o}40' EL and 0^{o}19' – 0^{o}55' SL and administratively includes the District of Kutai Kartanegara in East Kalimantan Province. Besides its high biodiversity, the Delta had been recognized as the largest production zone for oil and gas in Indonesia. Three multinational companies, i.e. Total E&P Indonesie, Vico Indonesia Co., and Chevron Indonesia Co. are operating in the Delta. Total E&P Indonesie occupies the largest part of the Delta for oil and gas exploration and exploitation with the production of 70,000 barrels of oil/day and 200,000 barrel equivalent gas/day. Total E&P Indonesie at Delta Mahakam area consists Central Processing Area (CPA), Central Processing Unit (CPU), North Processing Unit (NPU) and South Processing Unit (SPU).



Picture 1. Delta Mahakam Area

The decreasing of fossil energy resources in the world including Indonesia, forcing the energy experts to look for other renewable energy as an alternative to fossil fuels. One type of biofuel that has been developed to replace the gasoline fuel is ethanol (ethyl alcohol), which is made from biomass (plants) through biological processes, namely enzymatic and fermentation. Results from research during the last 20 years has found 60 species of plants that can be used as an alternative to fuel energy, one of which is *Nypa Fruticans* as raw material for bioethanol. Nipah (*Nypa fruticans*) is a species of palm trees that grows in mangroves environment near the offshore. *Napa* is potential to produce biofuel energy. Nipah (*Nypa fruticans*) is a kind of palm that grows on mangrove forest environment or tidal area near the waterfront. This plant is intended to protect land or sea shore from abrasion. Like the coconut tree, whole Nipah plant can be used for various purposes. Napa can also be tapped to get sweet liquid from young fruit bunches. So far utilization of *nipah* sap is not optimal.

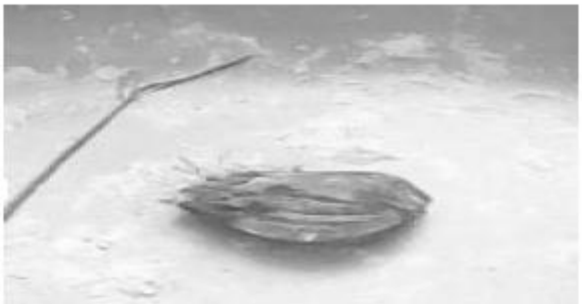
Picture 2. Mangrove Forest at Delta Mahakam

Bio-ethanol Process Production

In general, bi-ethanol production technologies include 4 (four) series of processes, with consisted: preparation of raw materials, fermentation, distillation and purification.

Raw material for bio-ethanol

The raw material of bio-ethanol can be classified into three categories: 1). palm sugar (sucrose), such as sugar cane, nipah sap, sweet sorghum juice, coconut sap, palm sap, cashew-fruit juice; 2). starch materials such as grain sorghum, sago, cassava, sweet potato, canna, arrowroot, dahlia tubers; and 3). Cellulose materials (lignocelluloses) include wood, straw, banana stems, etc.



Picture 3. *Nypa Fruticans*

Fermentation process

The fermentation process is often defined as the cracking process carbohydrates and amino acids in anaerobic, i.e. without the need for oxygen. Compounds that can be broken down in the fermentation process are primarily carbohydrate, whereas the amino acids can be fermented by only a few specific types of bacteria. Carbohydrate is the main substrate that is broken in the process of fermentation. If carbohydrate in the form of polysaccharide compounds, it will first be broken down into simple sugars before fermentation, namely hydrolysis of polysaccharides into glucose. Furthermore, glucose will be split into other compounds depending on the type of fermentation. One example is the fermentation of glucose into alcohol through the Embden-Meyerh of

Parnas (EMP) conducted by the yeast, such as *S. cerevisiae*.

During batch fermentation system, several parameters can cause a decrease in specific growth rate of the microbes that caused both by the concentration of substrate and product of ethanol. Immobilized cells in fermentation processes have been developed to reduce the inhibition caused by high concentrations of substrates and products, thereby increasing productivity and yield of ethanol.

Picture 4. Fermentation Process

Distillation

Alcohol produced from the fermentation process is usually still contain gases such as CO2 (resulting from changes in glucose into ethanol) and aldehyde that need to be cleaned. CO2 gas in the fermentation of such typically reaches 35% by volume; so as to obtain good-quality ethanol must be cleaned by filter-bound ethanol by CO2. In general, the fermentation can produce bio-ethanol or alcohol with a purity of about 80-10% and cannot be categorized as ethanol-based fuel. In order to achieve the purity above 95% so it can be used as fuel, the fermented alcohol must go through the process of distillation to separate the alcohol with water on the basis of differences in boiling points of the two materials which is then condensed back.

Distillation is a separation process based on the components of its boiling point, boiling point of pure ethanol at 78oC, while the water is 100oC, by heating the solution at a temperature range of 78 - 100oC will result in most of the ethanol evaporated, and the condensing units will be produced ethanol with 95% volume concentration.

Purification

Distillation process carried out to obtain bio-ethanol with a high concentration. Results distillation process is not fully pure ethanol, but still contains water even in small quantities. Bio-ethanol is used as a mixture of fuel for vehicles must be completely dry or anhydrous so as not to cause corrosive to the machine. Therefore, purification is necessary to eliminate water contained in ethanol.

Bio-ethanol can be purified by two methods, namely chemistry and physics. Chemical method using crushed limestone to absorb water. This method is properly used for household-scale producers because it is simple and relatively inexpensive cost. Its use is 7 liters of bio-ethanol needed 2-3 kg of limestone. The mixture allowed standing for 24 hours while occasionally stirred, and then the mixture is evaporated and condensed into a liquid again as ethanol 99% or more. This bio-ethanol can be mixed with gasoline or used pure. The weakness of the use of limestone that is the amount of ethanol that is lost is very high.

In the purification method used physics synthetic zeolite. This purification process uses the principle of surface absorption. Bio-ethanol should be used for purification of synthetic zeolite 3A (size 3 Angstroms), which can bind more water. Advantages using synthetic zeolites:

(1) the time required is shorter and

(2) lost only 10% ethanol.

But it is more expensive than limestone. Therefore, the use of synthetic zeolite is more suitable for large scale business.

Microbes Producing Ethanol

Bio-ethanol (C2H5OH) is the liquid from the fermentation of sugar from sources that contain carbohydrates using microorganisms. Bio-ethanol in the fermentation process is formed through several metabolic pathways, depending on the type of microbe involved. For the yeast *S. cerevisiae* and a number of others, ethanol is formed via the Embden-Meyerhof Parnas (EMP). Some of the yeast *Candida tropicalis*, *Pichia wickerhamii* can perform on xylose metabolism through heterolactic (hexoses Mono Phosphate/HMF). Similarly, the fungus *Fusarium* sp., *Rhizopus* sp., and the bacterial genus *Clostridium* was also able to produce ethanol from xylose. The third line is important in fermentation of alcohol is the path Entner-Doudoroff (ED) that are found in bacteria *Zymomonas mobilis*.

In order to obtain the ethanol production process that is really effective, the microbe used should have characteristics, including:

1). Has the capability of rapid fermentation of carbohydrates that are relevant,

2). Have the ability to perform flocculation and sedimentation,

3). Genetically stable,

4) Osmotoleran, especially against a solution of high concentration of carbohydrates,

5). Tolerant to ethanol, and has the ability. to produce high ethanol concentration,

6). Cell has the capability of living is high, so it can be used repeatedly, and

7). Tolerant to temperature.

S. cerevisiae is the yeast in the class *Ascomycetes,* a sub-class *Hemiascomycetidae*, *Endomycetales* orders, families *Saccharomycetaceae*, sub family *Saccharoycoideae*, and genus *Saccharomyces* . *S. cerevisiae* is a unicellular organism that is microscopic creatures, and it uses sugar as a carbon source for metabolism, including sucrose, glucose, fructose, galactose, mannosa, maltose and maltotriosa.

S. cerevisiae is a microorganism of the most widely used in fermentation of alcohol, because it can produce high yield, resistant to high alcohol content, resistance to high sugar levels and remain actively engaged in activities at 4 - 32^{o}C. *S. cereviceae* will metabolize glucose and fructose to form pyruvic acid through the reaction stages on the path to Emden-Meyerhof-Parnas. Then the decarboxylation reaction occurs that converts pyruvic acid into acetaldehyde, and continued dehydrogenation reaction that converts pyruvic acid into ethanol.

CONCLUSIONS AND RECOMMENDATIONS

1. Nipah (*Nypa fruticans*) is a species of palm trees that grows in mangroves environment near the offshore.Nipah potentially be used as raw material for biofuels
2. Nipah in the fermentation process is formed through several metabolic pathways, depending on the type of microbe involved.
3. Bio-ethanol process production technologies includes 4 (four) series of processes, with consisted: preparation of

raw materials, fermentation, distillation and purification

4. Ethanol content produced from the fermentation determine the productivity of the basic materials used for the production of bioethanol.

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