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Production of Bioethanol from Spent Tea and Potential used in Petroleum Region

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Abstract

Global demand for energy needs has increased due to the rapid development of the human population, raising the industrial prosperity in developing countries. Primary energy demand is still supplied from fossil fuels, such as oil, coal and natural gas. The utilization of fossil fuels will continuously enhance the effect of greenhouse gases in the atmosphere. On the other hand, the extent of the tea plantation area in Indonesia reached 53,009 Ha, so that it will reproduce a waste too. Therefore, spent tes is used for bioethanol production, thereby reducing waste. In addition, it contains cellulose fibres are quite high, environmentally friendly and economical. Bioethanol as motor vehicle fuels can reduce the addition of CO_2 at atmosphere because the use of biomass for the production and usage of bioethanol can be considered as a closed cycle. As a result of this whole process is not accounted for emissions of CO_2 liquid gas a greenhouse gas into the atmosphere. Bioethanol-cellulose can reduce greenhouse gas emissions amounted to 80%. In addition, bioethanol can be used as a solvent to overcome the problem of waxy crude oil. The process into products bioethanol via hydrolysis, fermentation, distillation and characterization using Gas Chromatography-Mass Spectrometry (GC-MS). There is the optimal bioethanol levels produced from fermented inoculant 1% amounting to 8.2% and optimal levels of bioethanol produced from hydrolysis of 8% H_2SO_4 results amounted to 8.2%, thus optimums it as the ethanol produced from 8% acid and 1% inoculant apply to have levels of ethanol amounted to 8.2%. The product program could be developed into bioethanol solvent to dissolve the oil that is waxy crude oil.

Keywords: bioethanol, spent tea, cellulose, process, solvent

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INTRODUCTION

Global demand for energy needs has increased due to the rapid development of the human population, raising the industrial prosperity in developing countries. Primary energy demand is still supplied from fossil fuels, such as oil, coal and natural gas. The utilization of fossil fuels will continuously enhance the effect of greenhouse gases in the atmosphere (Ballesteros et al., 2006). In addition, the negative impact of the exploitation and use of fossil fuels have had direct impact on the depletion of fossil fuel reserves. In this case, the development of an environmentally friendly alternative energy and renewables can serve as a solution (Sarkar, Ghosh, Bannerjee, & Aikat, 2012). One of the renewable energy and environmentally friendly use of butanol, because its use can reduce global warming and environmental pollution (Braide, 2018). That's where the production and usage of bioethanol as motor vehicle fuels can reduce the addition of CO_2 at atmosphere because the use of biomass for the production and usage of bioethanol can be considered as a closed cycle. According to this principle of CO_2 from fuel combustion bioethanol originating from the CO_2-based biomass will be reabsorbed by plants through photosynthesis reactions. As a result of this whole process is not accounted for emissions of CO_2 is a greenhouse gas into the atmosphere. Bioethanol-cellulose can reduce greenhouse gas emissions of 80% (Millati et al., 2011).

Table 1. The Content Of The Nutritional Value Of The Spent Of Tea (*Camellia Sinensis)*

Chemical Composition of Tea Leaves	Dry Weight (%)
Protein	17
Cellulose and crude fiber	34
chlorophyll and pigment	1.5
Starch	8.5
Tannin	25
Caffeine	4
Amino acids	8
Mineral	4
Ash	5.5

The use of waste has been widely carried out such as coffee grounds(Yuliusman, Nasruddin, Afdhol, Haris, et al., 2017) and palm shells(Yuliusman, Afdhol, & Sanal, 2018; Yuliusman, Nasruddin, Afdhol, Amiliana, et al., 2017) and inorganic waste such as plastic waste(Yuliusman, Afdhol, Sanal, & Nasruddin, 2018). Development of bioethanol spent tea from raw materials is done as a fuel substitute premium with consideration of fuel oil as the main source of fuel for transport in Indonesia increasingly thinning and high world petroleum prices, so the development of sources of energy spent tea have greater opportunities to be developed into biofuels, including petrol bioethanol to substitute. The spent of tea is also environmentally friendly and inexpensive if made into a staple production of ethanol (Mahmood & Hussain, 2010). According to Statistics Indonesia Plantation (2017), tea farms in Indonesia is quite extensive i.e. 53,009 Ha, as well as the resulting waste. The dregs of tea as one of the types of solid waste that is still largely untapped by either.

Bioethanol production of spent tea through some method, i.e. the method of hydrolysis, purification products, fermentation, distillation and characterization of bioethanol. for characterization is able to use i.e. GC-MS (Gas Chromatography-Mass Spectrometry) (Tsukatani et al., 2009). Research of the making of the previous conclusion bioethanol i.e. the concentration of sulfuric acid is proportional against the resulting glucose levels before achieved optimum operating conditions i.e. at the concentration of sulfuric acid 8%, and the rate of bioethanol will increase along with increasing levels of glucose at optimum conditions on hydrolysis. Inoculant concentration affects the production of bioethanol on a fermentation process, the greater the concentration of inoculant the smaller the butanol is generated after achieved the optimum operating conditions i.e. at the concentration of inoculant 1%.

METHODOLOGY

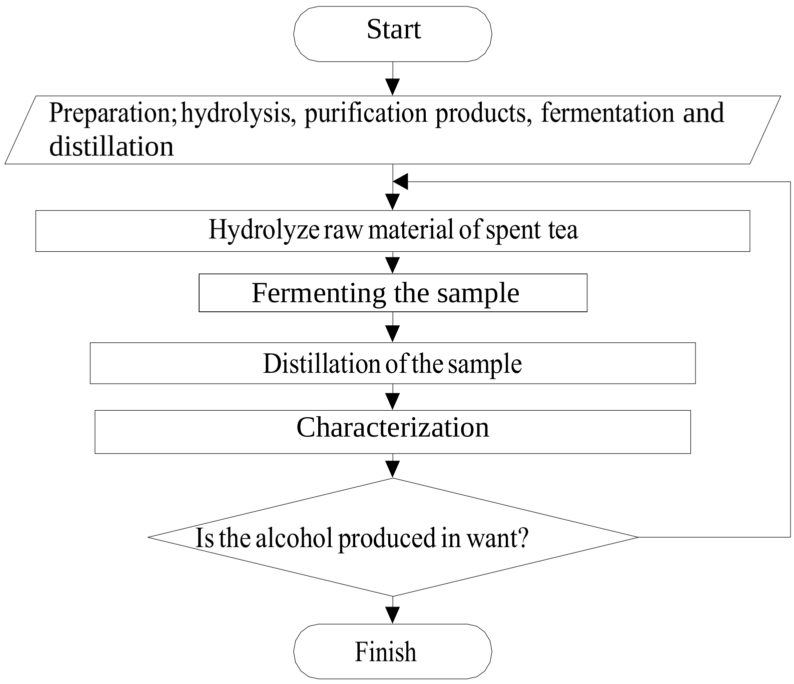

Fig. 1. Research flowchart

The hydrolysis Procedure

Dried spent tea sample hydrolyzed with 1000 ml of H_2SO_4 2% during hydrolysis done warming up above hot plate up to 150°C temperature for 1 hour. To stop the process of hydrolyzed, in the sample of NaOH is added so that the pH becomes neutral (pH 7). Then filtered with filter paper, hydrolyzed the results of the screening will be used for the next process. If it is not directly used hydrolize stored in a sealed container in the refrigerator 4°C.

The fermentation procedure.

As many as 250 ml sample is then bottled (fermentation reactors), *saccharomyces* cerevisiae enzyme added and stirred, then closed by giving out a hose inserted into the water as a source of oxygen for the enzyme and left on for 4 days. After 4 days the samples then determined the levels of ethanol. The fermentation process is done against the sample with different variations of the concentration of the enzyme that is 0.5%, 1%, 1.5%, 2% and 2.5%. It is this procedure on sucrose amended in enzymes to ethanol (Gray, Zhao, & Emptage, 2012).

Distillation

The solution results as much as 150 ml in distilled at a temperature of 80°C and the distillate fit inside the container that is surrounded by ice.

RESULTS

Table 2. Physical Properties of the Data with the Difference Inoculant (%) Bioethanol

No	Inoculant (%)	H2SO4 (%)	Alcohol content (%)	ρ alcohol (gr/ml)	μ alcohol (cP)
1	0.5	8	7.1	0.9680	0.9893
2	1.0	8	8.2	0.9644	1.0404
3	1.5	8	7.0	0.9720	0.9474
4	2.0	8	6.8	0.9800	0.9367
5	2.5	8	6.5	0.9840	0.9312

Table 3. Data Analysis of the Results of the Physical Properties of Bioethanol with Difference % H2SO4

No	H2SO4 (%)	Inoculant (%)	Reducing Sugar (%)	Reducing Sugar Content (M)	Alcohol Content (%)	ρ alcohol (gr/ml)	μ alcohol (cP)
1	2	1.0	11.1260	0.5983	6.8	0.9684	0.9531
2	4	1.0	11.5000	0.6161	7.1	0.9676	0.9981
3	6	1.0	12.0856	0.6526	7.4	0.9524	1.0545
4	8	1.0	12.9813	0.7068	8.2	0.9504	1.0613
5	10	1.0	11.6359	0.6361	7.1	0.9644	1.0404

DISCUSSION

Influence of Acid Concentrations against the reduction of sugar levels

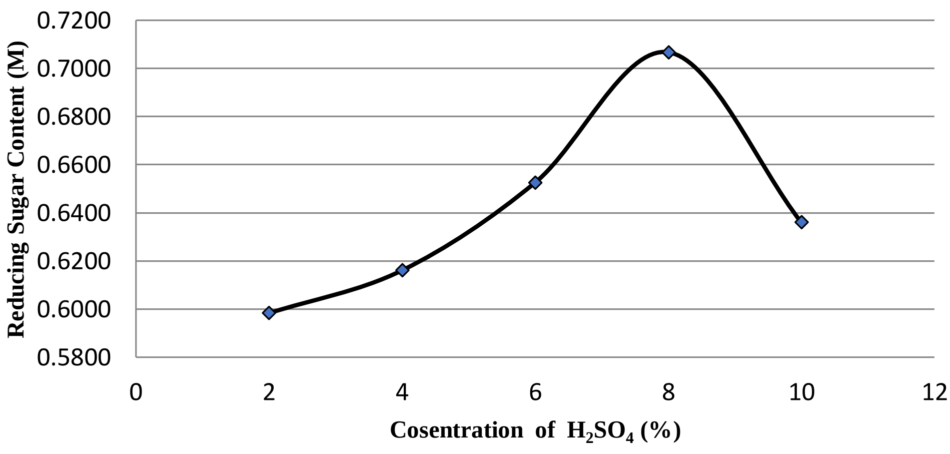

Fig. 2. The Effect of Acid Consentration on Reducing Sugar Content

From the above chart for the manufacture of H_2SO_4 concentration difference based bioethanol seen that in general the reduction of sugar levels increased along with rising concentrations of H_2SO_4. By the time the hydrolysis of 1 hour. However, at a concentration of 10% H_2SO_4 sugar levels decreased reduction. This is caused by cellulose in hydrolyzed spent tea produces Monosaccharides glucose addition namely fructose.

$$\text{Cellulosa} \xrightarrow[T = 150^oC]{H_2SO_4} \text{Glucose}$$

$$\text{Cellulosa} \xrightarrow[T > 150^oC]{H_2SO_4} \text{Glucose + Fructose}$$

Influence of the Concentrations Inoculant bioethanol Levels against.

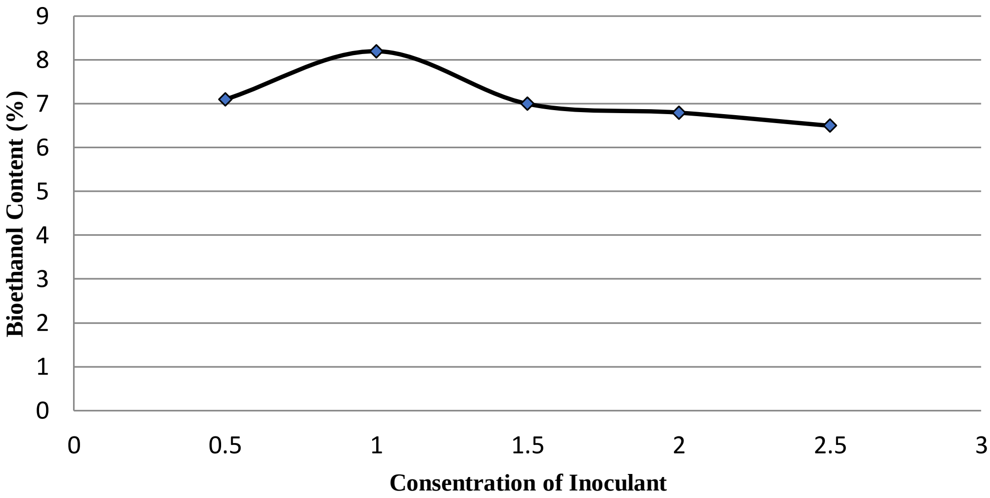

Fig. 3. The Effect of Consentration of Inoculant on Bioethanol Content

From the above chart for the making of different inoculant concentrations based bioethanol seem that levels of bioethanol decreases with rising concentrations of inoculant after reaching the point of optimum. Inoculant of 0.5-1% rate increase from bioethanol 7.1% to 8.2% and of inoculant 1 – 2.5% has decreased from 8.2% to 6.5%. This is due to the greater concentration of the enzyme then the smaller the ethanol in fermented in the produce because consumption of sugar content in the solution is used to grow and breed, and part will be converted into ethanol. In addition, the high total biomass of microbes will lead to occurrence of nutrient competition so that microbes (*s. Ceresiviae*) may not be well developed and leads to enzyme activity decreased.

Influence of the Concentrations of H_2SO_4 against Bioethanol Levels.

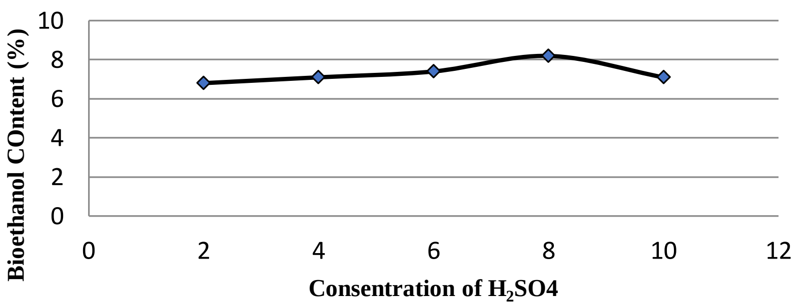

Fig. 4. The Effect of Concentration of H_2SO_4 on Bioethanol Content

For the manufacture of H_2SO_4 concentration difference based bioethanol seem that levels of bioethanol increase over soaring concentration of H_2SO_4 before reaching its optimum point. From 2 to 8% H_2SO_4 bioethanol levels increase from 6.8% to 8.2% and 8-10% H_2SO_4 of bioethanol levels has decreased from 8.2% to 7.1%. This is due to the reduction of sugar there is only a small part of the overhauled into bioethanol but most already make up the fructose. The optimum fermentation in sugar levels ranged from 10 to 14%. If the sugarlevels exceed 14% the most sugar will no longer be overhauled bioethanol, it can also inhibit the activity of microbes that are used during fermentation.

The influence of Density against Bioethanol Content.

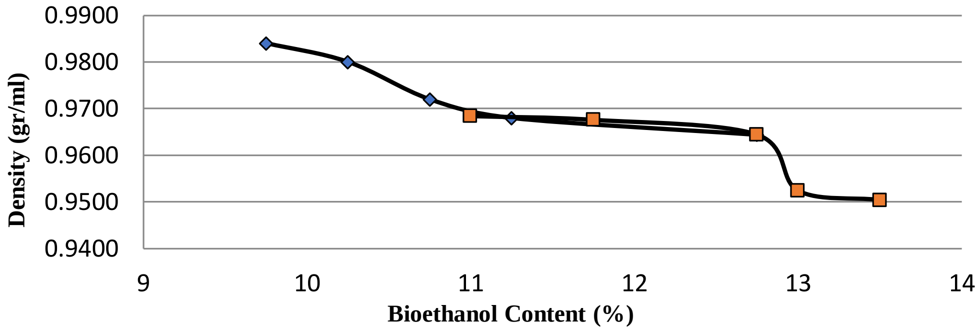

Fig. 5. Bioethanol Content on Bioethanol Density

The density of the resulting density approaching bioethanol according to SNI 11.1-7390-2008 amounted to 0.9448 gr/ml. it is in accordance with the theory that the rate is inversely proportional to the density of bioethanol where the higher levels lower than the bioethanol the density is obtained. This is due to the water mixed with the still bioethanol so the density bioethanol still approaching the density of water, but the higher levels of bioethanol then density will approach bioethanol SNI. The density of the most optimum bioethanol approached bioethanol density based on SNI in 8.2% of bioethanol levels 0.9504 gr/ml.

The influence of Viscosity against Bioethanol Content.

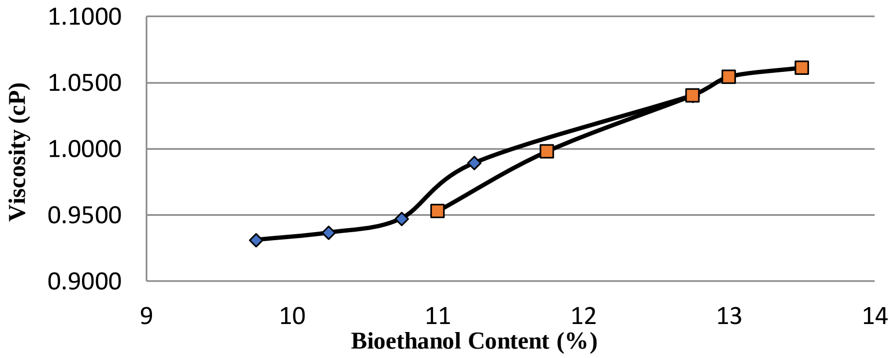

Fig. 6. Bioethanol Content on Viscosity of Bioethanol

The viscosity of the resulting viscosity approaching bioethanol bioethanol according to SNI 11.1-7390-2008 amounted to 1.17 cP. This is in accordance with the theory that levels of bioethanol is directly proportional to viscosity where the higher levels the bioethanol the viscosity in getting. This is due to the water mixes with the bioethanol so that viscosity water approached mass bioethanol, but the higher the viscosity then bioethanol content will approach the viscosity bioethanol SNI. The most optimum bioethanol viscosity approaching bioethanol viscosity based on SNI was 13.50% bioethanol levels of cP 1.0613.

And for this, in the world of bioethanol petroleum can be used as an alternative solvent (Johnson & Lusas, 1983). Because it has a density of bioethanol and low viscosity, resulting in a high oil flux if it is used as a solvent (Koris & Vatai, 2002). So that the solvent can be used to address the problem of the oil well that is waxy crude oil, because the chemical reaction between the solvent and the component of the oil can shorten the hydrocarbon chains (Xiu & Shahbazi, 2012).

CONCLUSION

1. The optimum bioethanol content produced from 1% inoculant fermentation is 8.2%
2. The optimum concentration of H_2SO_4 to produce the highest reducing sugar content is at 8% at 0.7068 M or about 12.98%
3. The optimum bioethanol level is produced from the results of 8% H_2SO_4 hydrolysis of 8.2%.
4. Research shows the optimum ethanol produced from 8% acid and 1% inoculant which has an ethanol content of 8.2%
5. Ethanol can be used as a solvent used to treat waxy crude oil in oil wells

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