Studies on Preparation of Methanol-biodiesel & Its Performance

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Abstract: The biodiesel was chemically modified for the first time with the oxydol at 60 ℃ and atmospheric pressure in this paper. Results showed that the modified biodiesel and methanol can be soluble with each other at any proportion. With the methanol-biodiesel (methanol ≤ wt40%), the diesel engine can start and run smoothly without any modification, and its emission can fully meet the Europe III Standard. The obstacle on price for biodiesel competing against petroleum diesel fuel on the market was overcome and another new way was created for the transportation fuel diversification.

Key words: Biodiesel; methanol; chemical modification; methanol-biodiesel
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Biodiesel, a potential substitute for petroleum diesel fuel[1], is more expensive than petroleum diesel fuel. To reduce the cost of biodiesel, many methods[2-3], such as waste oil or fat as feedstocks, preferential policy in USA and EU issued to encourage the consumption, and through gene engineering to seek plant with more oil content, were tried in the world so far.

There is at least one unsaturated bond in biodiesel molecule. We thought that the biodiesel could be modified chemically through oxidation of the unsaturated bond to add polar groups on its molecular chain. According to the principle that the more like in molecular polar the more dissolves in each other, the thermodynamically stable solution of modified biodiesel and methanol would be got and will be superior to the unstable solution of unmodified biodiesel and methanol with the help of surfactant[4].

In this paper, the chemical modification[5] of biodiesel with oxydol as oxidant and its soluble property with methanol were firstly studied. The effect of methanol-biodiesel prepared upon diesel engine was also investigated.

1 Experiments

1.1 Chemical modification of biodiesel

Adding Biodiesel and catalyst into a three-mouth flask and heating them to designated temperature in water bath under stirring firstly. Then, dropping oxydol (H_2O_2, 27.5 wt%) into the flask, settling the product to demix after the reaction finished. After washing and distillation, the resultant oil phase was called the modified biodiesel.

1.2 Solubility test

Twenty gram of methanol was added into 20 grams of modified biodiesel. If the solution will keep soluble with each other completely after 24 hours at room temperature, the modified biodiesel and methanol will be thought soluble with each other completely at any proportion, or they will be thought not to dissolve in each other fully.

1.3 Performance of methanol-biodiesel

No-load diesel engine test was performed with R180-1 diesel engine (rated power, 5.15 kW; rated speed, 2 600 r/min). Load diesel engine test was conducted with ZS195 diesel engine (rated power, 8.8 kW; rated speed, 2 000 r/min). Emission was analyzed with KM9106 Flue Gas Analyser.

2 Results and discussion

2.1 Effect of the reaction temperature

Tab. 1 Effect of the reaction temperature upon the solubility of methanol with modifed biodiesel

Temperature /℃	50	55	60	65	70
Soluble	No	No	Yes	Yes	No

It can be seen from the table 1 that the resultant modified biodiesel and methanol were not soluble with each other completely when the reaction temperature is

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higher than 65 ℃ or lower than 60 ℃. This is because of the reaction rate is slower when the temperature is lower and the reactants can not react completely in the designated time, or the oxydol is decomposed when the temperature is higher and there is not enough oxydol included in the reaction. So the appropriate reaction temperature should be 60 ℃.

2.2 Effect of the quantity of oxydol

According to computation, the mole ratio of oxydol/biodiesel is 1∶1 when weight ratio of oxydol/biodiesel is 60%, it means that the quantity of oxydol must equal or exceed 60 wt% in order to ensure all the biodiesel can be oxidized. Table 2 shows that methanol and modified biodiesel were soluble with each other completely when oxydol added less than 60 wt%. This is because the oxidized part of the biodiesel can act as a solubilizer. So the most economical quantity of oxydol is 28 wt% according to the data in table 2.

Table 2　Effect of quantity of the oxydol upon the solubility of methanol to modified biodiesel

H_2O_2/wt%	60	50	40	30	28	26	24
Soluble	Yes	Yes	Yes	Yes	Yes	No	No

2.3 Performance of methanol-biodiesel

The no-load test results showed that the diesel engine started very hard and was not able to run smoothly when the methanol in methanol-biodiesel exceeded 50 wt% and not to start and run completely when exceeding 60 wt%. There were no difference on starting and running between methanol-biodiesel (methanol ≤ wt40%) and petroleum diesel fuel when they were used on the same diesel engine.

The load test with methanol-biodiesel (methanol 35 wt%) results showed that its dynamic performance was not superior to petroleum diesel fuel. This can be understood because of the heating value of the methanol-biodiesel is only about 70% of petroleum diesel fuel. However, the emission of methanol-biodiesel can easily meet the Europe Ⅲ Standard but the petroleum diesel fuel cant at the same work condition.

3　Conclusions

The resultant biodiesel modified by oxydol at 60℃ and atmospheric pressure was able to form stable solution with methanol at any proportion.

With the methanol-biodiesel (methanol ≤ wt40%), the diesel engine can start and run smoothly without any modification. Its emission was superior though dynamic performance was inferior to petroleum diesel fuel.

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甲醇生物柴油的合成和性能研究

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摘　要：以价格低廉的双氧水为氧化剂，在60 ℃及常压条件下，对生物柴油进行了化学改性。结果表明，改性后的生物柴油和甲醇可以任意比例互溶。所制甲醇生物柴油（甲醇≤40%）可以使未做任何改动的柴油机很好地启动和运行，而且尾气排放可以完全达到欧洲3号标准的要求。较好地解决了生物柴油由于其价格较高而迟迟不能在市场上进行大面积推广的难题，为车用燃料的多元化又开辟了一条新的道路。

关键词：生物柴油；甲醇；化学改性；甲醇生物柴油

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