A New Oxygenating Additive EGM and Its Effects on the Performances and Emissions of Diesel Engine

LIU Yong-qi, WANG Yan-xia
(College of Traffic and Vehicle Engineering, Shandong University of Technology, Zibo 255049, China)

Abstract: A kind of oxygenate additive, EGM, has been proposed and tested for use with diesel fuel as a means of reducing exhaust emissions. The effects of EGM on the power, fuel economy and emission characteristics are studied on a DI diesel engine 4JB1. An ultrasonic mixer is used to blend various EGM and diesel fuels in real time as they flow to the engine. The results show that smoke and CO emissions decrease significantly with increase in the fraction of EGM in the blends at high loads. The blends have little effects on the NOx emissions. HC emissions are higher than that of diesel fuel at pads.

Key words: ethylene glycol monoacetate (EGM); oxygenating additive; diesel engine; emission
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Diesel engines have the disadvantage of producing soot particles and higher nitrogen oxides emissions and are now subjected to increasingly strict emission standards. It has been shown that many oxygenates are effective in reducing particulate emissions from diesel engines[1]. Ethylene glycol monoacetate (EGM) is regarded as one of the promising alternative fuels or oxygen additives for diesel engines, with high oxygen content[2]. The objectives of this study are to investigate the characteristics of performance and emissions in a diesel engine fuelled with the different proportions of EGM-diesel blends.

1 Experimental setups

A commercial light-duty direct injection diesel engine 4JB1 is used in this study, which is a 4-stroke, 4-cylinder, naturally aspirated, 57 kW diesel engine with displacement of 2.77 L, bore of 93 mm, stroke of 102 mm, Compression ratio of 18.2. An ultrasonic mixer is used to blend various EGM and diesel fuels in real-time as they flow to the engine.

Pure diesel and the blends of diesel with 2% EGM (EGM2), 5% EGM (EGM5), 10% EGM (EGM10) by volume are prepared and tested in these experiments. Smoke is measured by a partial flow smoke opacimeter (AVL DiSmoke 4000). NO, CO, HC are measured by exhaust gas analyzer (AVL DiGas 4000).

2 Results and discussion

2.1 Engine performance

Because the heating values of the blends containing EGM decrease and the engine operating parameters are not adjusted, the engine power outputs are reduced correspondingly when EGM-diesel blends are used. At low engine speed, the engine power outputs of the EGM-diesel blends are nearly the same to that of diesel under full load operating condition. But at high engine speed, they slightly decrease with increase in the fraction of EGM in the blends under full load.

Fig. 1 shows the brake specific fuel consumption (BSFC) versus power output for different EGM-diesel blends and pure diesel fuel at speed of 3 600 r/min. At low loads, the BSFC slightly increases with the EGM addition to diesel. At medium and high loads, the BSFC for three EGM-diesel blends is about the same to that for diesel. But the diesel equivalent BSFC decreases when engine fueled with EGM-diesel blends, it becomes clear with the increase in engine speed.

2.2 Emission characteristics

Fig. 2 illustrates the smoke emission under various loads at the speed of 3 600 r/min. It is obviously that the smoke emission can be remarkably reduced with the EGM addition to diesel. The maximal smoke reduction reached up to 57% compared to diesel fuel, and it occurs at high pad fuelled with EGM10. The improvement of smoke emissions can be explained by the enrichment of oxygen owning to EGM.

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作者简介: 刘永启 (1965年生), 男, 博士, 教授; E-mail: Liuyq65@163.com

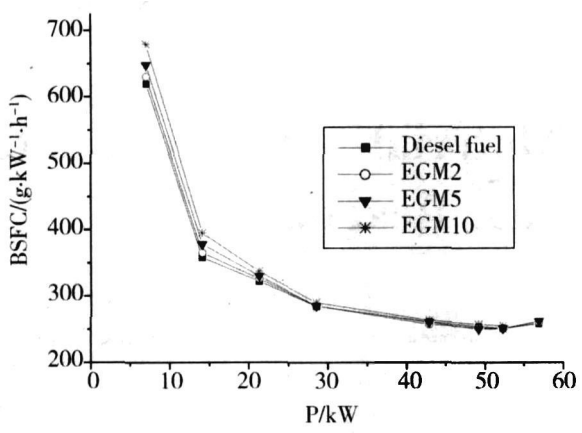

Fig. 1　Comparison of BSFC between various fuels

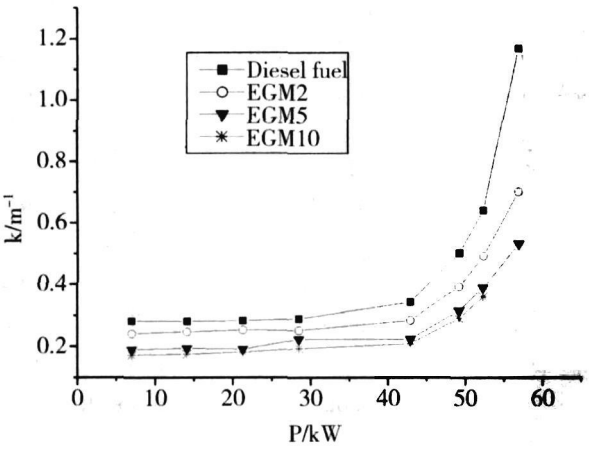

Fig. 2　Smoke emission characteristics

In general, the addition of EGM in diesel has little effects on the NO_x emission. At low and high loads, NO_x emissions of EGM-diesel blends slightly increase. While they decrease somewhat at medium loads in comparison with the engine fuelled with pure diesel. The cetane number value and latent heat of vaporization of EGM are both higher than that of diesel. The higher cetane number value would short the ignition delay, while the higher latent heat of vaporization would extend the ignition delay, resulting that EGM has little effect on the NO_x emission.

HC emissions of the EGM-diesel blends increase with increase in the fraction of EGM in the blends at low load, and this trend becomes smaller with increase in load.

In case of CO emission shown in Fig. 3, the CO emissions of the EGM-diesel blends slightly increase at low load, while they decrease obviously at high load with increase in the fraction of EGM in the blends. The EGM-diesel blends emit more CO emissions compared to pure diesel at all operating conditions, in particular at low loads.

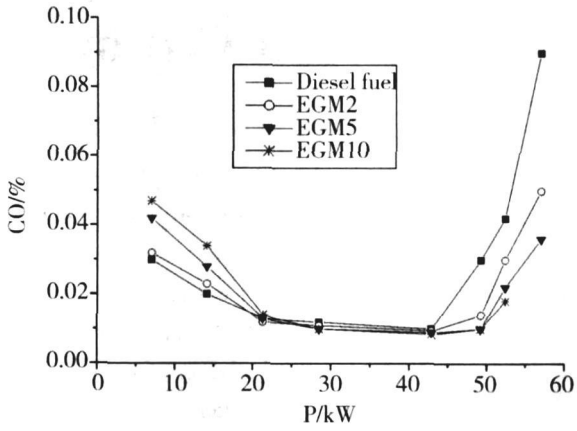

Fig. 3　CO emission characteristics

3　Conclusions

The addition of EGM to diesel fuel changes the physicochemical properties of blends. The energy density of blends decreases with the increase in EGM. While the oxygen content of the blends increases, which has some favorable effects on the combustion of blends. The engine power outputs decrease, the BSFC increase, but the diesel equivalent BSFC decrease when diesel engine fueled with blends. Smoke emissions decrease significantly with increase in the fraction of EGM in the blends at high loads. The blends have little effects on the NO_x emissions. CO emissions slightly increase at low loads, but obviously decrease at high loads. HC emissions are higher than that of diesel fuel at loads. All these results indicate the potential of EGM-diesel blend for clean combustion in diesel engine.

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固体氧化物燃料电池阳极材料 $La_{1-x}Sr_xCr_{1-y}Mn_yO_{3-\delta}$的合成及性能研究

马学菊, 马文会, 戴永年, 杨 斌, 刘荣辉

(昆明理工大学 材料与冶金工程学院//真空冶金国家工程实验室, 云南 昆明 650093)

摘 要: 采用固相法制备 $La_{1-x}Sr_xCr_{1-y}Mn_yO_{3-\delta}$ (LSCM) 固体氧化物燃料电池 (SOFC) 阳极材料, 用 TG-DTA和 X射线衍射分析仪分析了 LSCM材料中钙钛矿相的形成过程, 用 SEM, 直流四探针、交流阻抗等方法对合成材料的结构与性能进行研究。研究结果表明: 用固相法制备所得到的非晶产物分别在 1 250 ℃和 1 350 ℃下烧结 15 h都能得到单一的钙钛矿相, 对 LSCM样品电性能研究表明, 其电子电导率随温度的升高而增加, 在 850 ℃时空气状态下的电子电导率可达 29.2 S/cm; LSCM交流阻抗图是有由两个半圆组成的, 显示出良好的离子电导率.

关键词: 固体氧化物燃料电池; $La_{1-x}Sr_xCr_{1-y}Mn_yO_{3-\delta}$; 阳极材料; 固相法; 电导率

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新型氧化添加剂 EGM影响柴油机性能和排放特性的研究

刘永启, 王延遐

(山东 理工大学 交通与车辆工程学院, 山东 淄博 255049)

摘 要: 提出了用含氧柴油添加剂 EGM降低柴油机碳烟排放的方法, 建立了超声波 EGM柴油在线混合装置, 在 4 JB1直喷柴油机上试验研究了含氧添加剂对发动机性能和排放特性的影响。结果表明, 在大负荷时随着混合燃料中的 EGM增加, 碳烟和 CO的排放显著降低; 对 NO_x的排放影响很小; 在小负荷时 HC的排放增加。

关键词: 乙二醇一乙酸酯; 含氧添加剂; 柴油机; 排放

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