Accepted Manuscript

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PII: S1743-9671(16)30768-1

DOI: 10.1016/j.joei.2017.04.004

Reference: JOEI 322

To appear in: *Journal of the Energy Institute*

Received Date: 28 November 2016

Revised Date: 17 April 2017

Accepted Date: 19 April 2017

Please cite this article as: J. Tian, J. Tan, N. Hu, T. Liu, Y. Wang, H. Zhong, C. Jin, X. Zhang, Characteristics analysis for total volatile organic compounds emissions of methanol-diesel fuel, *Journal of the Energy Institute* (2017), doi: 10.1016/j.joei.2017.04.004.

Characteristics analysis for total volatile organic compounds emissions of methanol-diesel fuel

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Abstract: To study the characteristics of volatile organic compounds(VOCs) emissions from an engine fueled with methanol diesel, an experiment compared with petroleum diesel(0# diesel) and biodiesel was carried out on a Xichai 4CK diesel engine test bench by the solid phase adsorption-thermal desorption-gas chromatography mass spectrometry method. In this experiment, methanol-diesel (20 vol.% methanol), petroleum diesel and biodiesel were analyzed through the sampling system, which consists of Tenax TA adsorption tubes, flow sampling pump, the capillary gas chromatography-mass spectrometry(CGC/MS), etc. The experimental results demonstrate that total volatile organic compounds (TVOC) emissions of methanol diesel are lower than petroleum diesel but higher than biodiesel at maximum power, and that TVOC emissions of methanol diesel reduce with the rise of load but increase when the rotation speed of engine gets faster. And benzene and toluene are two main components of TVOC emissions of methanol diesel, accounting for more than 70% at rated power. Therefore, this study can provide a theoretical basis for popularization and development of methanol-diesel fuel in the future, meanwhile, contributing to make relative regulations and standards to control its emissions.

Keywords: methanol-diesel fuel; total volatile organic compound (TVOC); emission

1. Introduction

With the development of social economy, China has become a great nation in energy consumption, which leads to the fact that the shortage of energy must be solved urgently and that it is essential to discover new energy, especially renewable energy. Study shows that the emissions caused by burning oil fuel have become the main factor in deteriorating air pollution[1,2]. Therefore, the nations of the world have limited the emissions of traditional internal combustion engine by issuing relative regulations and developing clean fuels. Considering the oil shortage and increasing demand in diesel for agricultural machinery in China, it is of great practical significance to carry out researches on alternative fuels of diesel engine[3], such as methanol-diesel fuel.

Although researches on methanol diesel at home and abroad are very active in recent years, the conclusions lack of comparability[4,5]because the applications of methanol in diesel engine and the focuses of studies are varied. Currently, methanol diesel researches mainly pay attention to the its dynamic performance and economy as well as emissions characteristics of engine with different blending ratios of methanol and diesel[6]. The studies on the VOCs emissions characteristics of methanol-diesel fuel are rare and only focus on formaldehyde[7,8]. In the emission regulation, normal gas pollutants (CO, HC, NOx), particulate matter (PM) mass and smoke intensity are limited[9], therefore, there has been an obvious reduction in normal pollutants under effective administration and technical progress in recent years. However, the latest study has found gradually, that some unregulated pollutants such as VOCs are much more harmful to health and environment[10-13]. In addition, particle number and distribution of particle size are gaining more and more attention because small particles especially micro-particles can be inhaled into human body[14], thus, causing damage to health. Unfortunately, there is still not a standard or series of regulations about VOCs and PM in China.

At present, the popularization of methanol diesel as an alternative fuel for diesel engine still has a long way to go as a result of lack of uniformity and standardization for methanol-diesel fuel on the market. Hence, it is necessary to carry out a comprehensive study on methanol-diesel, VOCs emissions characteristics of which are mainly discussed in this paper, to provide a scientific basis for its environmental effect evaluation, popularization as well as regulation in the future.