Determination of Fatty Acid Methyl Ester and Triglyceride in Mixture of Biodiesel Fuel and Diesel Fuel

Introduction

Diesel oil is made of petroleum which is one of the underground resources. The combustion of diesel oil produces carbon dioxide which is considered to be one of the causes of global warming.

Oil in plant is produced by photosynthesis in which atmospheric carbon dioxide is consumed. Biodiesel fuel is made of vegetable oil, which is made from various plant materials, by trans-esterification of triglycerides contained in the vegetable oil into fatty acid methyl esters. Therefore, carbon dioxide exhausted from the combustion of biodiesel in a diesel engine is reabsorbed by plants through photosynthesis, offsetting the amount of carbon dioxide consumed by the plant material: this is called carbon neutrality. As a result, determination of fatty acid methyl esters and triglycerides in fuel is now becoming very important.

In Japan, the measurement method for determination of fatty acid methyl esters and triglycerides was promulgated in Official Gazette No.78 of Ministry of Economy, Trade and Industry, issued on the 22nd of March 2007.

JASCO has determined fatty acid methyl esters and triglycerides in diesel fuel mixed with biodiesel in accordance with this method.

Experimental

JASCO HPLC 2000 series modular components were used for the measurement. The system consisted of a PU-2080 pump, a DG-2080-53 degasser, a CO-2060 column oven, an AS-2057 autosampler, a RI-2031 refractive index detector, and ChromNAV chromatography data station.

The stock solution was prepared by dissolving 5.0 g of methyl stearate and 0.05 g of trilinolein in diesel oil to make the volume up to 50 mL. The standard solutions were then prepared by diluting the stock solution twice, three times, five times, ten times, and hundred times using diesel fuel.

Results and Discussion

Figure 1 shows the chromatogram obtained by injecting 5 µL of the 10 times diluted stock solution. Resolution between methyl stearate (peak 2) and trilinolein (peak 3) was calculated to be 5.7, whereas the Official Gazette's requirement for the resolution is 3.0, well exceeding the criteria.

In order to examine the quantitative precision, 5 µL of the stock solution and the standard solutions with various concentrations were injected and obtained peak areas were plotted against the concentrations of the standard solutions. Results showed that the coefficients of correlation for methyl stearate was r^2=1.0000 in the range of 1-100 mg/mL and for trilinolein was r^2=0.9999 in the range of 0.01-1 mg/mL, respectively.

Figure 2 shows the chromatogram obtained by injecting 5 µL of mixture of biodiesel fuel and diesel fuel (5/95). Peak 2 corresponding to fatty acid methyl esters was quantified to be 48.99 mg/mL in terms of methyl stearate. No peak corresponding to triglycerides was observed. These results meet the Official Gazette's requirements for the contents of fatty acid methyl esters and triglycerides: less than 5.0% (w/v) and less than 0.01% (w/v), respectively.

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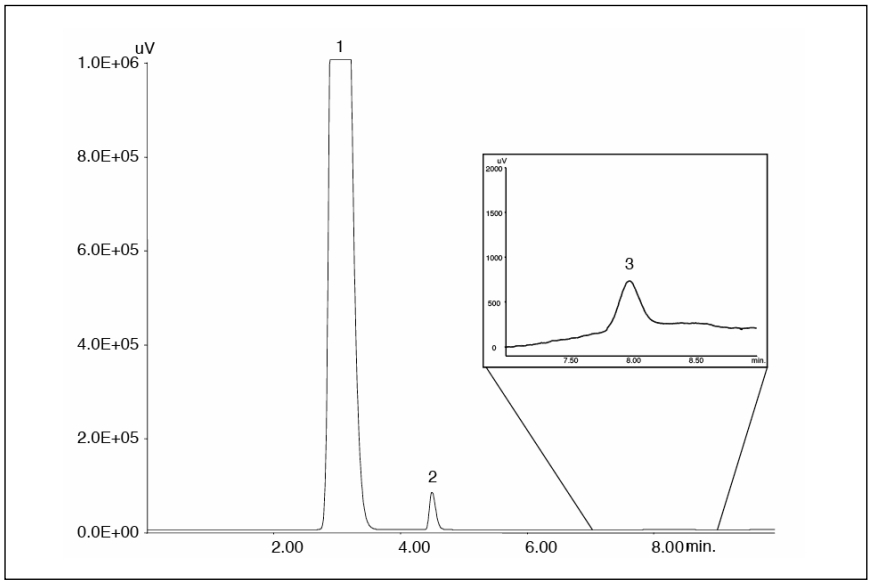

Figure 1 Chromatogram of standard mixture
Peaks: 1=peak derived from diesel oil; 2=methyl stearate(10 mg/mL) ; 3=trilinolein(0.1 mg/mL) Conditions: column=Finepak SIL-5 (4.6 mm x 250 mm); mobile phase=2-propanol/n-hexane(0.4/99.6); flow rate=1.0 mL/min; column temperature=40° C; injection volume=5 µL

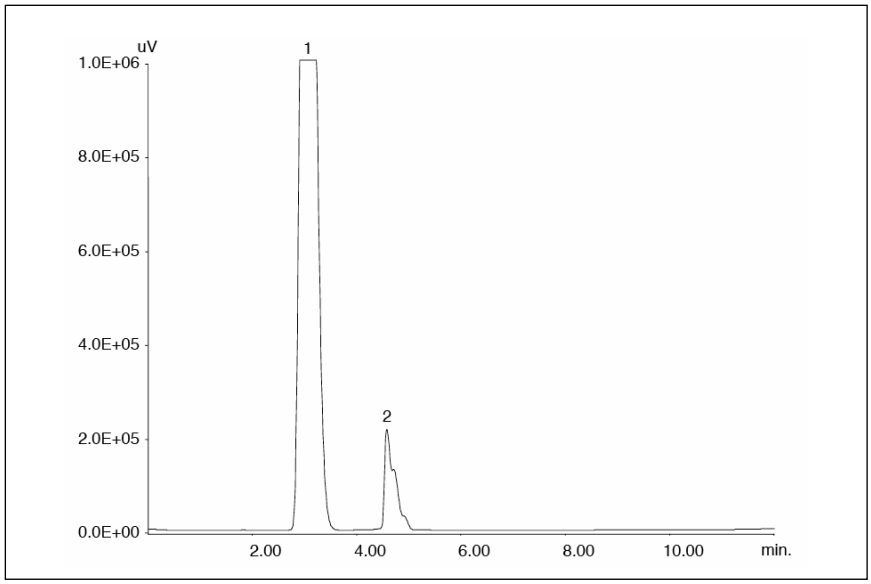

Figure 2 Chromatogram of a mixture of biodiesel fuel and diesel fuel (5/95)
Peaks: 1=peak derived from diesel fuel; 2=fatty acid methyl esters.
The other conditions are the same as in Figure 1.

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