

**Analysis of Biofuel (Part 2)  
Determination of Formic Acid, Acetic Acid, and  
Propionic Acid in Biodiesel - Diesel Fuel Blend**

Recently, biodiesel fuel (BDF) has been receiving attention as one approach to lessening the environmental load associated with automobile fuel by utilizing material originating from biomass (biological resource) as a fuel. There is a movement toward use of BDF mixed with light oil (BDF - diesel fuel blend) in diesel passenger cars and assuring consistent quality of this fuel is necessary.

▪ **Analysis of a Standard Solution**

The Shim-pack IC-SA3 anion column was used for separation of formic acid, acetic acid and propionic acid. Detection was carried out by the suppressor method using a conductivity detector.

Table 1: Analytical conditions

Column:	Shim-pack IC-SA3 (250 mm L. × 4.0 mm I.D.)
Guard Column:	Shim-pack IC-SA3(G) (10 mm L. × 4.6 mm I.D.)
Mobile phase:	1.0 mmol/L Sodium carbonate 1.0 mmol/L Sodium hydrogencarbonate
Flow rate:	0.7 mL/min
Column temperature:	40 °C
Injection volume:	20 µL
Detection:	Conductivity detector CDD-10ASP (Cell temperature : 43 °C)

Some minor constituents of this BDF-light oil blend are formic acid, acetic acid and propionic acid, which have corrosive effects on metals, so their concentrations must therefore be controlled. This Application News introduces an example of the analysis of formic acid, acetic acid and propionic acid in blended BDF-light oil using the Prominence HIC-SP suppressor-type ion chromatograph.

Figure 1 shows the chromatographic results following injection of 20 µL of a standard mixture of the 3 compounds (5.0 mg/L each), and Table 1 shows the analytical conditions.

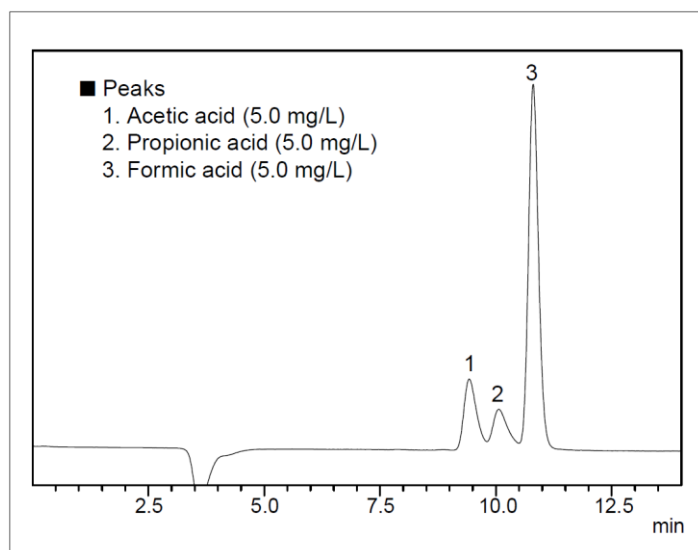


Figure 1: Chromatogram of a Standard Mixture of Formic Acid, Acetic Acid, and Propionic Acid

▪ **Linearity**

Figure 2 shows the calibration curve of the 3 compounds at concentrations from 0.5 to 10 mg/L. Excellent linearity was obtained for each compound, with a correlation coefficient (R<sup>2</sup>) greater than 0.999 for each.

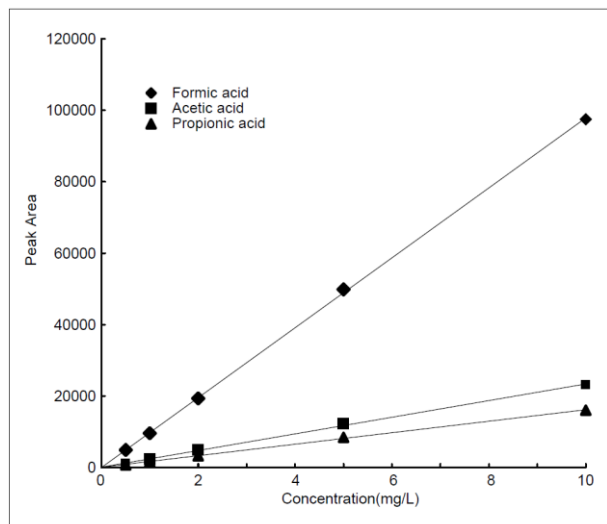


Figure 2: Linearity (0.5 to 10 mg/L)

▪ **Analysis of Diesel Fuel and Biodiesel - Diesel Fuel Blend**

Figure 3 shows the analysis results of commercial diesel fuel and a blend of BDF and diesel fuel.\*<sup>1</sup> When calculating the spike recovery of each of the compounds added to the commercial diesel fuel at

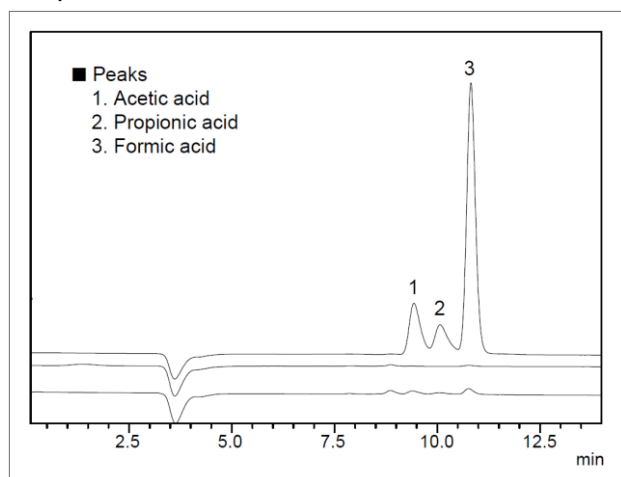


Figure 3: Chromatogram of Diesel Fuel Blend  
(Upper) Diesel Fuel (spiked 20 mg/L each)  
(Middle) Diesel Fuel (not spiked)  
(Lower) Biodiesel-Diesel Fuel Blend

▪ **Repeatability**

Table 2 shows the relative standard deviation for each of the compounds based on 6 repeat analyses (n=6) at 0.5 mg/L. Good results were obtained, with relative standard deviations from 0.7 to 1.7 %.

Table 2: Peak Area Repeatability

	Peak Area		
	Formic Acid	Acetic Acid	Propionic Acid
1 <sup>st</sup>	5066	1262	835
2 <sup>nd</sup>	4982	1207	834
3 <sup>rd</sup>	5028	1240	837
4 <sup>th</sup>	4970	1214	807
5 <sup>th</sup>	5038	1235	827
6 <sup>th</sup>	5008	1217	816
Average	5015	1229	826
%RSD	0.7	1.7	1.5

a concentration of 20 mg/L, a 90 % recovery rate is obtained. Figure 4 shows the diesel fuel sample preparation procedure.\*<sup>2</sup>

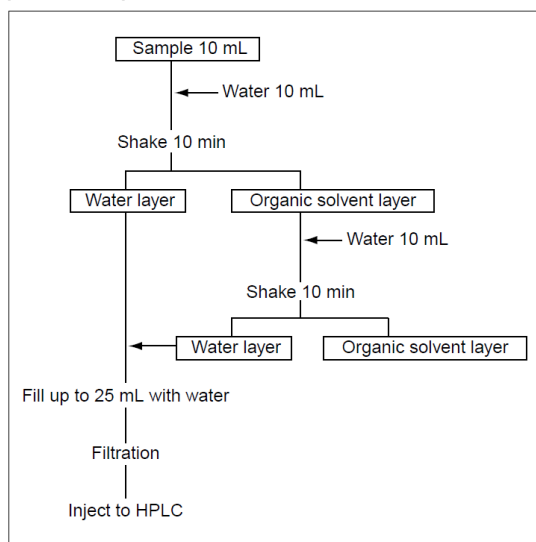


Figure 4: Sample Preparation

\*1 The BDF – diesel fuel blend for this analysis was provided by the National Petroleum Dealers Association of Japan.

\*2 In this experiment, the BDF – diesel fuel blend was prepared at 1/5 the scale shown in Fig. 4 to accommodate a smaller sample

NOTES:

\*This Application News has been produced and edited using information that was available when the data was acquired for each article. This Application News is subject to revision without prior notice.



SHIMADZU CORPORATION. International Marketing Division  
3, Kanda-Nishikicho 1-chome, Chiyoda-ku, Tokyo 101-8448, Japan Phone: 81(3)3219-5641 Fax: 81(3)3219-5710  
Cable Add.: SHIMADZU TOKYO