

Application News

No.L511

High Performance Liquid Chromatography

Analysis of 1, 2, 3-Benzotriazole in Electrical Insulating Oil with Prominence-i

Electrical insulating oils are used widely in oil-immersed transformers and oil-filled capacitors. When abnormal heating or insulation degradation occurs inside oil-filled equipment, gas produced by decomposition of the insulating oil and products of insulator deterioration will mix with the insulating oil and change its chemical properties. Quantitation of 1, 2, 3-benzotriazole is used as a method for testing the performance of insulating oil. 1, 2, 3-benzotriazole is often added to electrical insulating oil to suppress streaming electrification during cooling, and prevent sulfidation corrosion. It is also known to improve thermal stability and electrical properties. The method used to quantify 1, 2, 3-benzotriazole in electrical insulating oils is described in JIS C 2101 "Testing methods of electrical insulating oils."

An example analysis of 1, 2, 3-benzotriazole in electrical insulating oil is described here using the new Prominence-i integrated high performance liquid chromatograph.

Standard Solution Analysis

Fig. 1 shows the structural formula of 1, 2, 3-benzotriazole.

A standard solution was pretreated based on JIS C 2101, and analyzed with the Prominence-i integrated high performance liquid chromatograph. The analytical conditions used are shown in Table 1. JIS C 2101 states to pretreat a standard solution by obtaining 1 kg of electrical insulating oil containing no 1, 2, 3-benzotriazole (mentioned in JIS C 2320 "Electrical insulating oils") then adding 1, 2, 3-benzotriazole. For the purpose of this experiment, our sample was prepared by obtaining 1/10 the amount of electrical insulating oil (100 g), adding 10 mg of 1, 2, 3-benzotriazole, then performing the pretreatment process shown in Fig. 2. The standard reference solution containing the equivalent of 100 mg/kg 1, 2, 3-benzotriazole, which was obtained by this method was then diluted with a water-ethanol (6:4 [v/v]) mixture, and used for analysis. Fig. 3 shows the chromatogram obtained for the 10 mg/kg 1, 2, 3-benzotriazole standard solution.

JIS C 2101 mentions using an injection volume of 50 μ L. However, an injection volume of 5 μ L was used in this study due to a possible negative effect on peak shape.

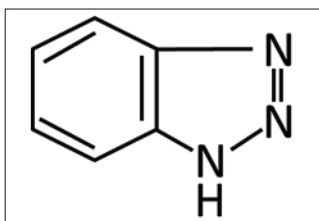


Fig. 1 Structural Formula of 1, 2, 3-Benzotriazole

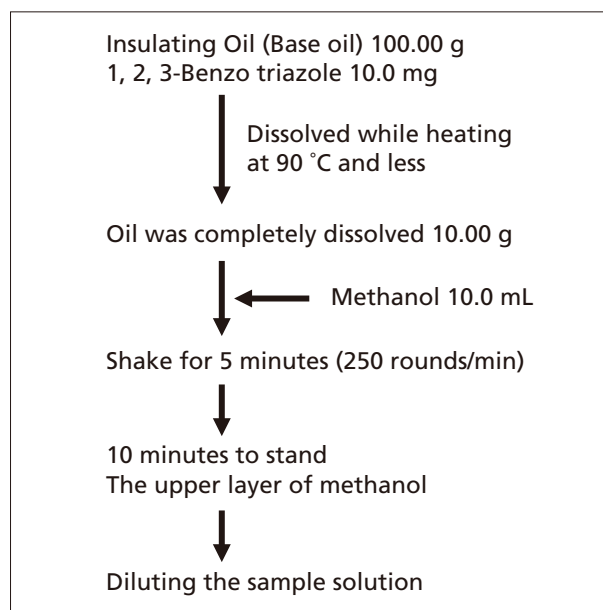


Fig. 2 Pretreatment of Standard 1, 2, 3-Benzotriazole Solution in Insulating Oil

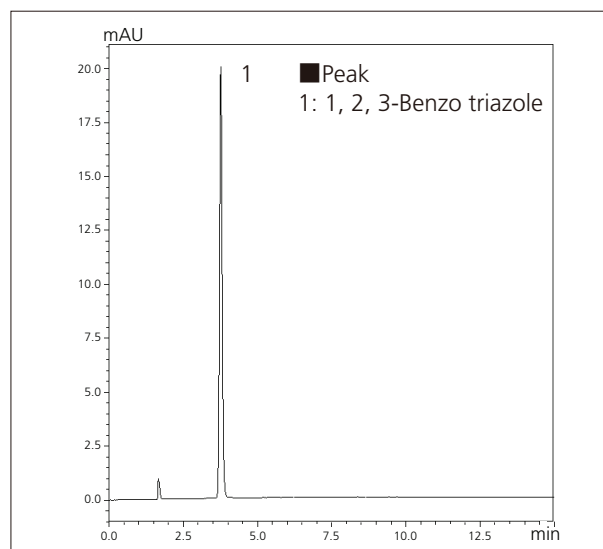


Fig. 3 Chromatogram of Standard Solution (10 mg/kg, 5 μ L injection)

Table 1 Analytical Conditions

Column	: Shim-pack VP-ODS (150 mm L. \times 4.6 mm I.D., 5 μ m)
Mobile Phase	: Water/Methanol = 6/4 (v/v)
Flowrate	: 1.0 mL/min
Column Temp.	: 40 °C
Injection Volume	: 5 μ L
Detection	: UV 270 nm

■ Calibration Curve Linearity

1, 2, 3-benzotriazole standard solutions were prepared in the range of 0.1 to 20 mg/kg and analyzed. The resulting calibration curve is shown in Fig. 4, and shows that good linearity was obtained.

Fig. 5 shows the chromatogram obtained for 0.1 mg/kg 1, 2, 3-benzotriazole standard solution.

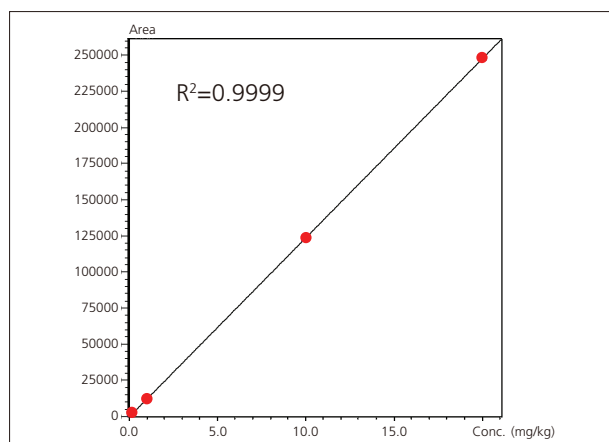


Fig. 4 Calibration Curve Linearity

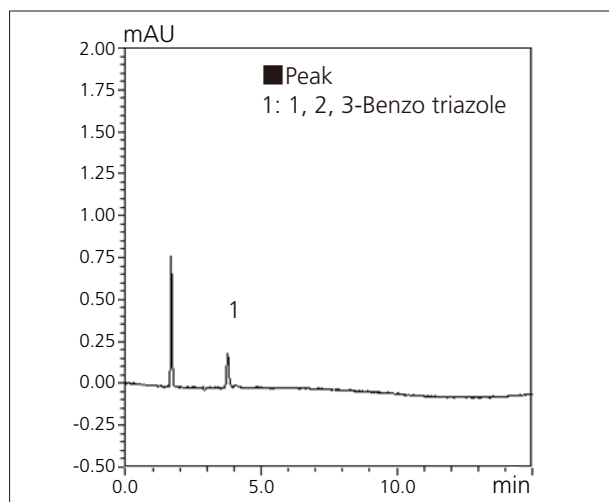


Fig. 5 Chromatogram of Standard Solution (0.1 mg/kg, 5 µL injection)

■ Analysis of 1,2,3-Benzotriazole in Electrical Insulating Oil

Two types of electrical insulating oil were pretreated as shown in Fig. 6. The oils were analyzed after methanol extraction without dilution.

The results of analysis are shown in Fig. 7 and Fig. 8. Electrical insulation oil A contained the equivalent of 0.5 mg/kg 1, 2, 3-benzotriazole, and electrical insulation oil B contained the equivalent of 8.0 mg/kg 1, 2, 3-benzotriazole.

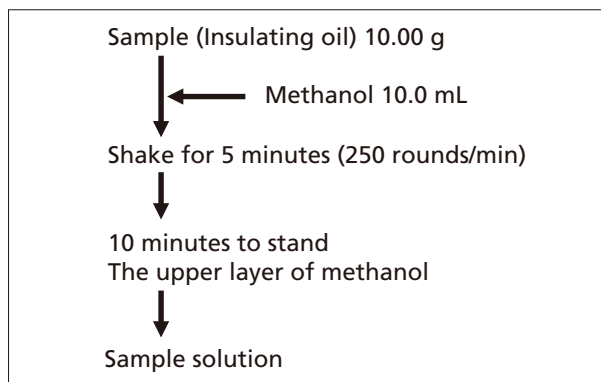


Fig. 6 Sample Oil Pretreatment

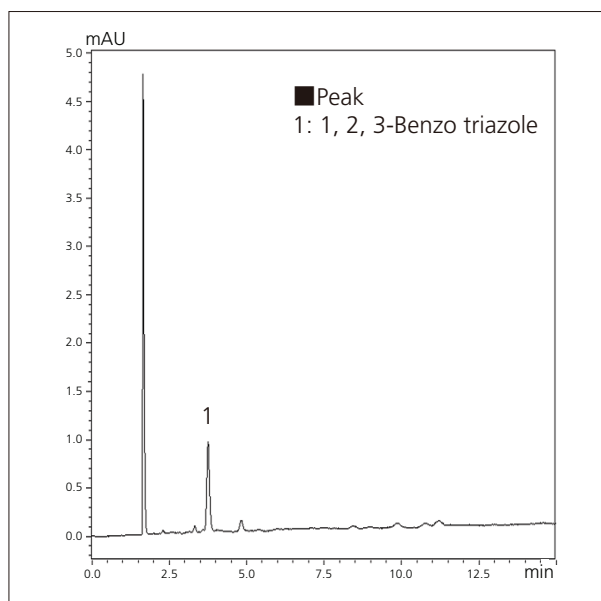


Fig. 7 Electrical Insulating Oil A Chromatogram

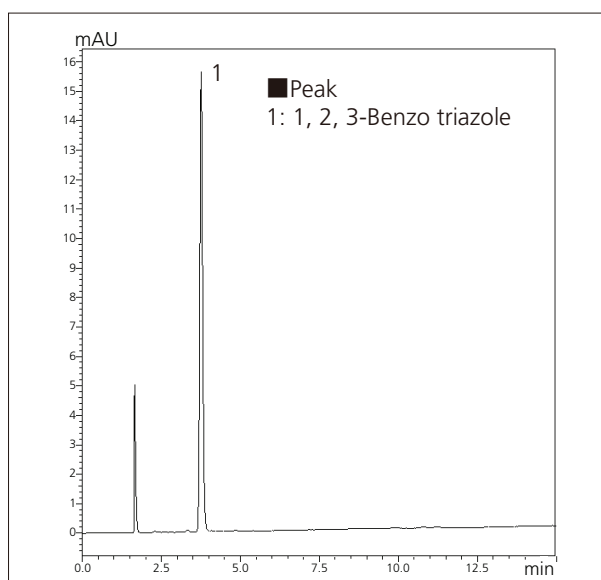


Fig. 8 Electrical Insulating Oil B Chromatogram

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