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Application News

Gas Chromatography No.G270

Analysis of Vinyl Chloride in Polyvinyl Chloride Plastics by GC

Residual organic solvents in food packaging materials are receiving attention due to the heightened concern for food safety and public health. Specific standards and specifications as well as testing methods are established for each type of material used in food packaging materials in Japan's "Food Sanitation Act – Section 3: Implements, Containers, and Packaging in the Standards and Criteria for Food and Food Additives, etc."
Polyvinyl chloride, a transparent plastic, can be easily mixed with plasticizers to obtain a desired degree of flexibility depending on the compounding ratio. For that reason, it is used in a variety of applications, including food containers, wrapping films, and gloves.
Vinyl chloride is the monomer of polyvinyl chloride, and is generated when polyvinyl chloride is subjected to thermal decomposition. Due to its widely-reported carcinogenicity, the concentration of vinyl chloride in materials is restricted in conjunction with material testing.
This Application News introduces an example of analysis of vinyl chloride in plastic with polyvinyl chloride as its principal ingredient.

■ Analytical Method

The vinyl chloride test method is for measuring vinyl chloride monomer present in polyvinyl chloride by GC/FID using the headspace method.
Sample pretreatment is conducted according to that specified in the "Food Sanitation Act – Section 3: Implements, Containers, and Packaging in the Standards and Criteria for Food and Food Additives, etc." A commercially-available polyvinyl chloride glove was used as the sample, and the vinyl chloride in the sample was analyzed.
A porous polymer PLOT (porous layer open tubular) CP-PoraBOND Q column was used. The carrier gas flowrate was set so that the vinyl chloride would elute at about 5 minutes. The analytical conditions are shown in Table 1.
Following is an overview of the analytical procedure.

(1) Test Solution Preparation
Cut and weigh out a 0.5 g fragment of sample, and transfer it to a headspace vial. Next, add 2.5 mL *N,N*-dimethylacetamide, seal the vial, and use this as the test solution. (If it is difficult to dissolve the sample, shake the sealed vial occasionally at ambient temperature, and allow it to stand overnight.)

(2) Standard Solution Preparation
Transfer 50 µL vinyl chloride standard solution (10 µg/mL) (cooled using methanol and dry ice) to a vial containing 2.5 mL *N,N*-dimethylacetamide, and immediately seal the vial. Use this as the standard solution.

(3) Measurement
Heat the sealed vials of test solution and standard solution for 1 hour at 90 °C, and introduce 0.5 mL of the respective gas phases into the gas chromatograph. For the gas chromatograph column, use a 3 µm styrene-divinylbenzene porous polymer-coated column, and conduct analysis by GC/FID.

(4) Determination
Compare the detection times of test solution peak and the vinyl chloride standard solution peak. If the retention times correspond, compare their respective peak areas. Verify that the test solution vinyl chloride peak area is not greater than that of the vinyl chloride standard solution peak area (1 µg/g or less in the material).

■ Analysis of Standard Solution and Sample Solution

The chromatograms of the vinyl chloride standard solution and the test solution prepared from a commercially-available synthetic polymer glove, of which the principle ingredient is polyvinyl chloride, are shown in Fig. 1.

The vinyl chloride peak in the test solution chromatogram has a smaller peak area than that in the standard solution, confirming that it is smaller than the reference value.

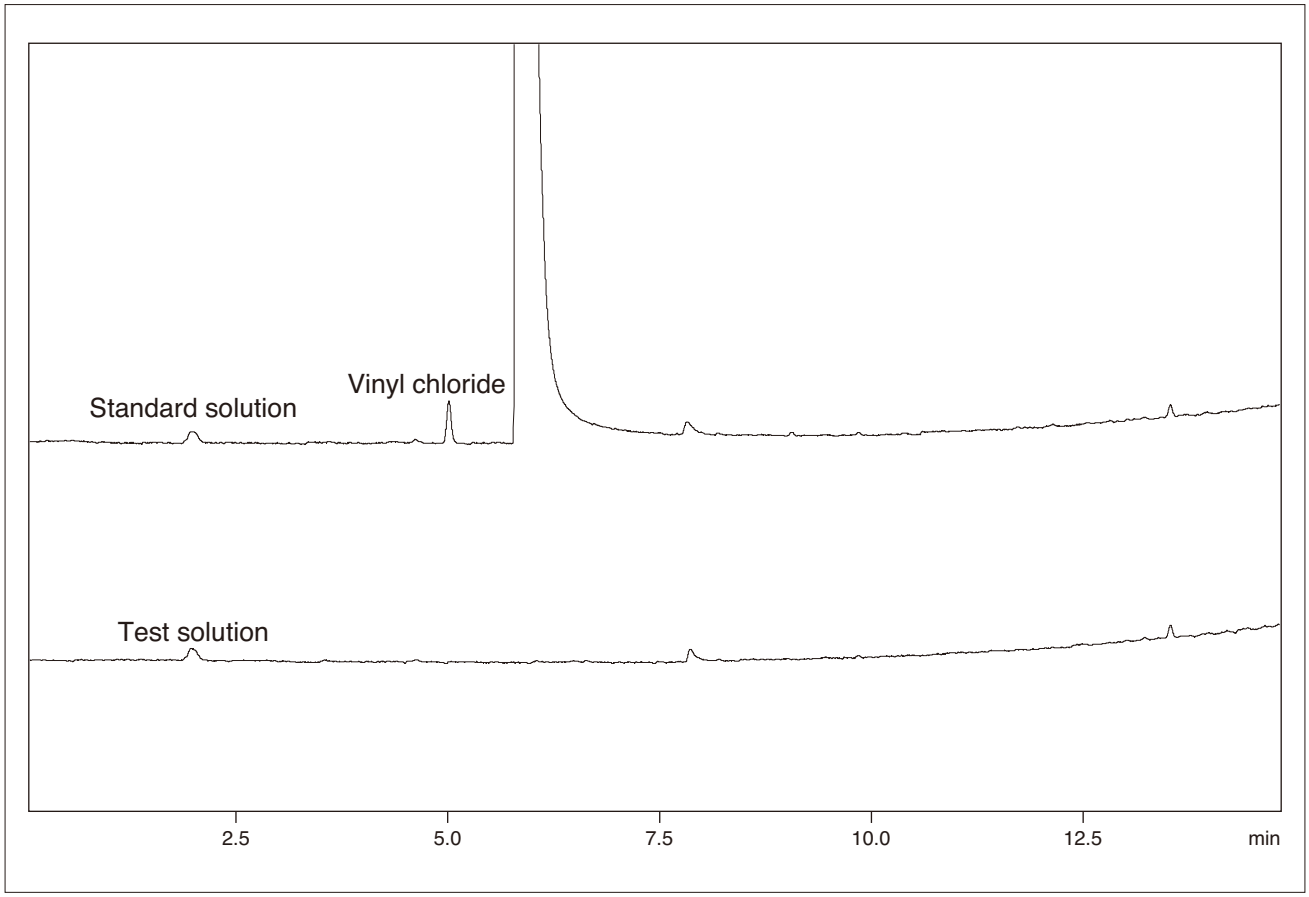

Fig. 1 Chromatograms of Vinyl Chloride Standard Solution and Test Solution

Table 1 Analytical Conditions

Model	: TurboMatrix HS-40 + GC-2010PlusAF
Column	: CP-PoraBOND Q FUSED SILICA (25 mL. × 0.25 mmI.D. df = 3 μm)
Column Temperature	: 80 ˚C (1 min)-10 ˚C/min-250 ˚C (10 min)
Injection Temperature	: 200 ˚C
Carrier Gas	: He 28.7 cm/sec
Detector	: FID
Detector Temperature	: 250 ˚C
Injection Volume	: 0.5 mL
Sample Thermostatting	: 90 ˚C, 60 min

[References]
March 31, 2006 Ministry of Health, Labour and Welfare Notification No. 201
Food Sanitation Act – Section 3: Implements, Containers, and Packaging in the Standards and Criteria for Food and Food Additives, etc.

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