SHIMADZU APPLICATION NEWS

SPECTROSCOPIC ANALYSIS No. A262

Determination of Formaldehyde by UV-Visible Spectrophotometry

The UV-Visible spectrophotometer is one of the most popular instruments that are applied for the measurement of concentration of a specific component in a substance. Furthermore, since it is easy to operate and available at a comparatively low price, it is used in diversified fields. Introduced in this article is an example of measurement of formalin which exists in what are familiar with us such as clothing and the walls in our house.

■ Determination of Formaldehyde in Air

There is a possibility that formaldehyde exists in construction materials of the house, which evaporates into the air in the room. So it is important to measure samples taken from the construction materials of the house. In this article, measurements of samples carried out at several places in the house by the combination of the vapor phase extraction method and acethylacetone colorimetric method are introduced. Fig. 1 shows the flow chart of the analytical method and Fig. 2, the results of the measurement. For the sampling, a vapor concentrator, VPC-10, was used, and for the absorption liquid in the absorption vessel, distilled water was used.

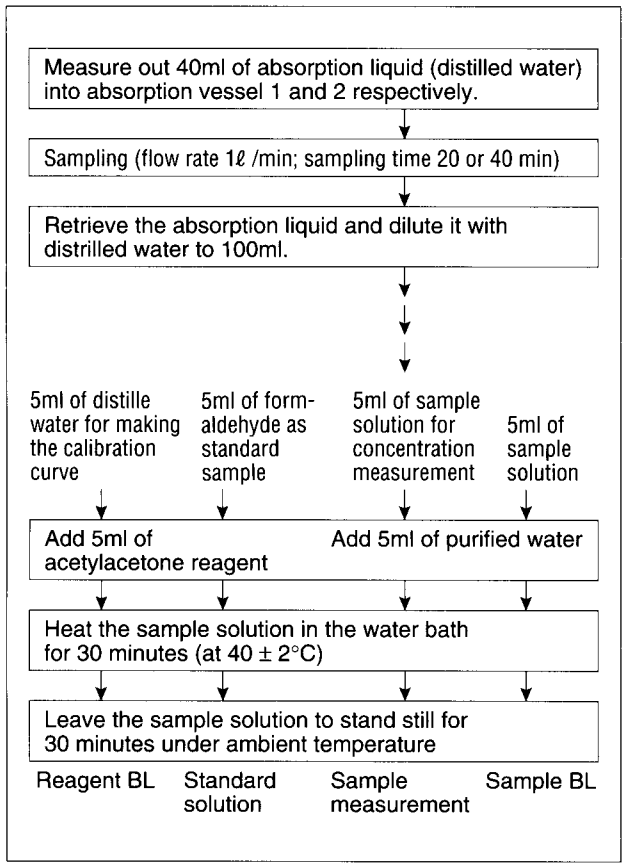
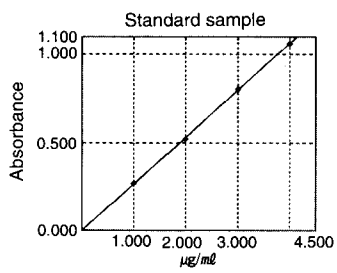


Fig.1 Flow Chart of Analytical Method for Formaldehyde in Air



Wavelength : 412.0 nm
Slit width : 2.0 nm

Multiple point calibration curve
Conc = K1 A + K0
K1 = 3.762 K0 = 0.00526

Chi-Square : -0.00118
Number of data : 6

ID	Conc.	Abs.	
1	0.08126	0.020	
1	0.08051	0.020	
Average :	0.08088	0.020	→ Result (in the absorption liquid) of room 1
Standard deviation :			
2	0.1452	0.037	
2	0.1459	0.037	
Average :	0.1456	0.037	→ Result (in the absorption liquid) of room 2
Standard deviation :			
3	0.06170	0.015	
3	0.05793	0.014	
Average :	0.05981	0.014	→ Result (in the absorption liquid) of room 3
Standard deviation :			

Result of measurement of formaldehyde in air :

Room 1	0.302 ppm (20 min)
Room 2	0.272 ppm (40 min)
Room 3	0.223 ppm (20 min)

Fig.2 Determination of Formaldehyde in Air

■ Determination of Formaldehyde in Clothes

Formalin (formaldehyde) is used in the process of making clothes for the prevention of fading of color or for the sake of shape retention. But if formaldelhyde remains in clothes, it may cause skin trouble such as itching or rashing. For this reason, the manufacturers of clothes are required to keep the residue of formaldehyde less than the stipulated value. Particularly, with respect to clothes and underclothes for babies, "JIS L1041 (1983)" was enacted as the standardization of the method of testing of the Ordinance No.34 of the Ministry of Health and Welfare (1974).

Among various kinds of analytical methods indicated in JIS, the acetylacetone method (Fig. 3), which is simple and convenient, is often applied.

Examples of measurement of formaldehyde in underwear and underclothes for babies are shown in Fig. 4 and 5. A certain quantity of a sample cut into small pieces is immersed in water and heated for 30 minutes at 40°C and is left to be cooled down. Then, in the presence of excessive ammonium acetate, acetylacetone is acted upon the sample, 3, 5-diacetyl-1, 4-hydrolutidine, which is yellow in color and has the maximum absorbance at around 415nm, is generated. This absorbance was utilized in measuring the concentration of the sample using a solution of formaldehyde diluted with distrilled water as the standard solution.

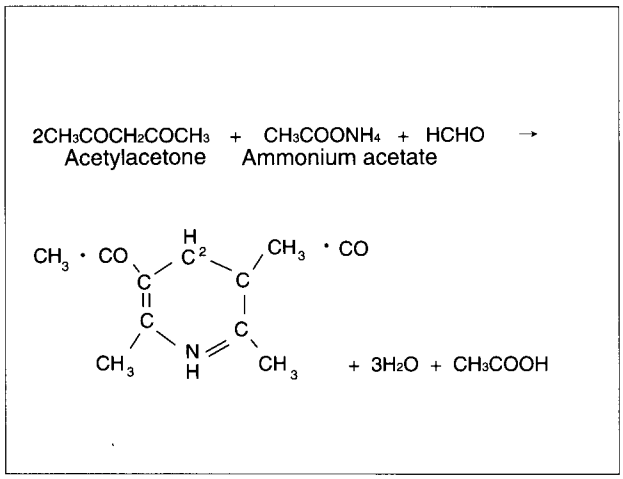


Fig.3 Chemical Reaction Formula for Acetylacetone Method

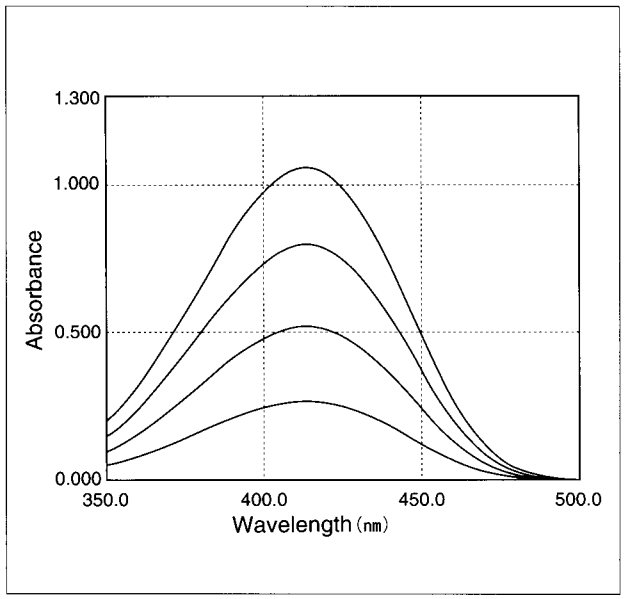
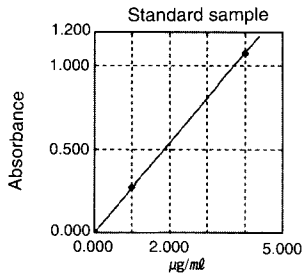


Fig.4 Absorption Spectra for Formaldehyde Standard Solutions



Wavelength : 412.0 nm
Slit width : 2.0 nm

Multiple point calibration curve
Conc = K1 A + K0
K1 = 3.723 K0 = -0.00386

Chi-Square : 0.00105
Number of data : 4

ID	Conc.	Abs.	
1	0.03336	0.010	
1	0.03411	0.010	
Average :	0.03373	0.010	← Result of meas't of underwear
Standard deviation :		0.000	
2	0.01475	0.005	
2	0.01437	0.005	
Average :	0.01456	0.005	← Result of meas't of baby wear
Standard deviation :		0.0001	

Fig.5 Determination of Formaldehyde in Underwear and Baby Wear

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