TAKASAGO ELECTRIC, INC.

Influence of the internal-volume upon accurate analysis

In order to verify the influence of the internal-volume of a solenoid valve on chromatographic analytical accuracy, a research project was performed using two different valve types: The standard valve and the zero-internal-volume valve.

The internal-volume of the standard solenoid valve is composed of a flow path and a valve chamber. Media in the flow path are not trapped but there is space where such media are apt to be structurally trapped in the valve chamber. This space is called the 'Dead-volume'. It sometimes causes a decline in the purity and cleanliness of the media, which creates a negative effect on analysis accuracy. The Zero-internal-volume valve has a special design that eliminates the internal-volume in the valve chamber. In this test we compared the analytical accuracy obtainable using the above valves.

The details of the research and the results are as follows:

Comparative Table of the Internal-Volume

Port	COM	NC and NO (Each port)	Total (Three ports)
Zero-internal-volume valve (Model: MTV-3-NM6NA)	14 cubic millimeters	7 cubic millimeters	28 cubic millimeters
Standard valve (Model: MTV-3-NM6)	26 cubic millimeters	66 cubic millimeters	158 cubic millimeters

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Diagram 1: Results of the Measurements

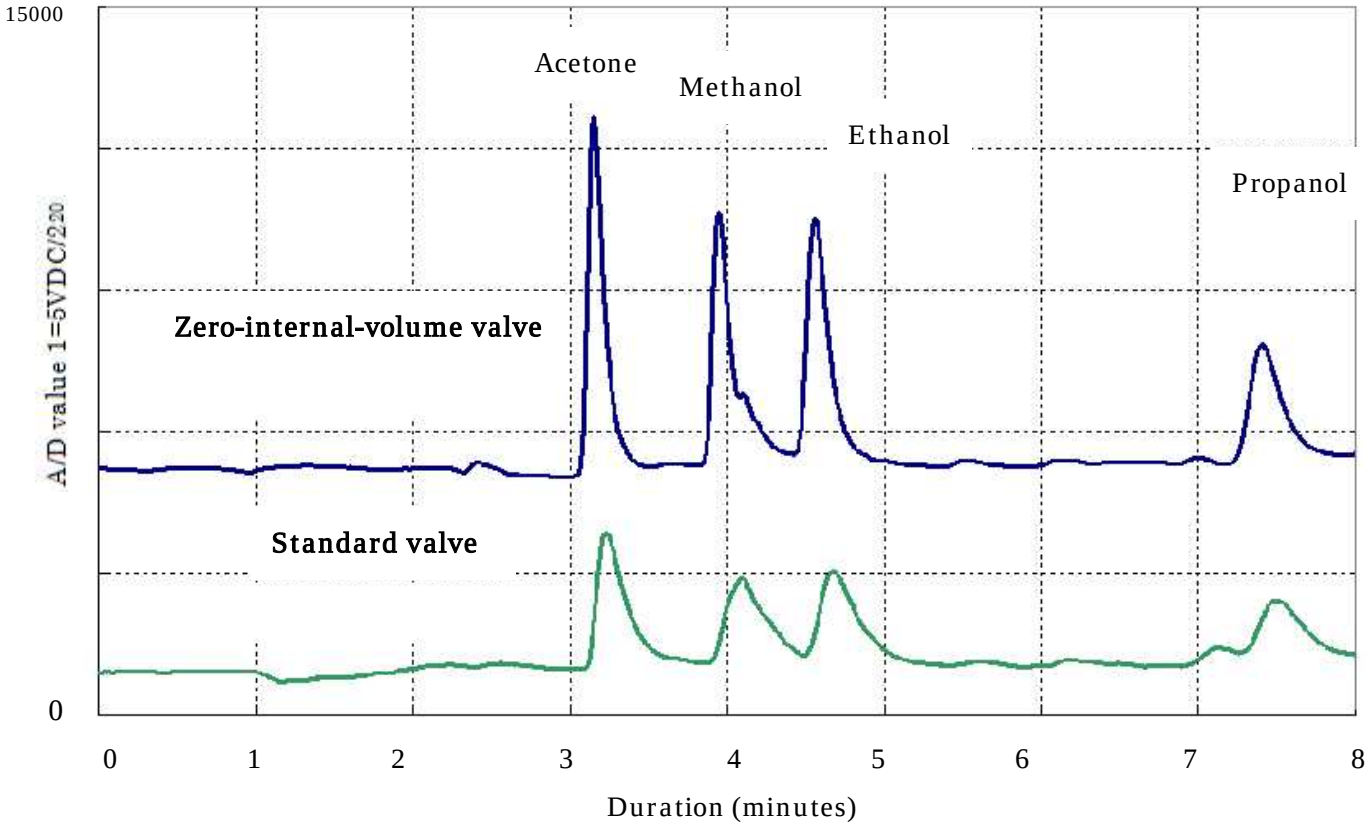


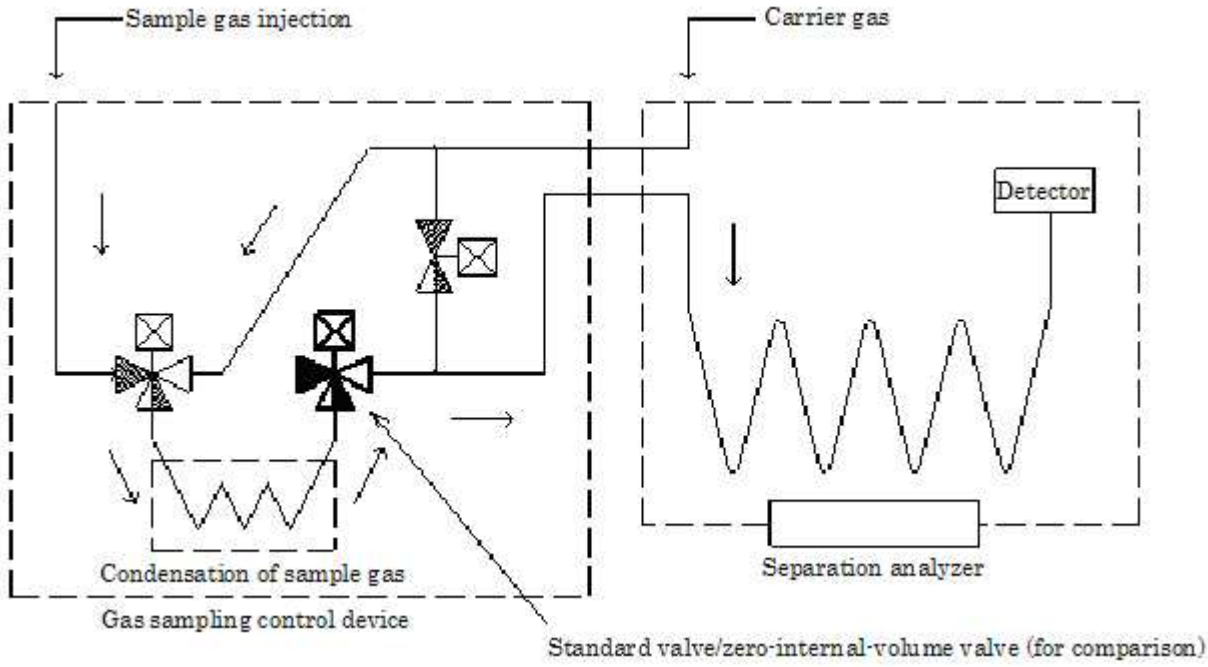
Diagram 1 shows the results of the analysis of a standard sample gas using a Zero-internal-volume valve and a standard valve. As can be seen from the diagram, the peaks obtained using the standard valve are obtuse. In addition, the roots of each peak are wide and there are parts in which some ingredients mix. In comparison, the peaks for the Zero-internal-volume valve are acute and the widths of the roots of each peak are not wide. The acuteness of the peaks shows that the performance in separation was of high quality. As a result, we can confirm that the Zero-internal-volume valve improves the performance of a gas sampling control device and the accuracy in chromatographical analysis.

Details of the Measuring Method

Sample gas was collected by low-temperature condensation at the concentrator (a trap made of stainless steel) in a gas sampling control device, and then placed in an analyzer after heating and removal from the concentrator. Ideally the flow path from the concentrator to the analyzer should be zero.

The circuit for fluid control is composed of solenoid valves as follows:

Separation Circuit Chart



Details of the Separation Conditions

Column: HP-INNOWAX (inner diameter: 0.25mm, length: 30m, cross-linked polyethylene glycol stationary phase of 0.25 μm)
Carrier gas: He (Pressure: 79 kPa)
Column temperature: 45 degrees centigrade
Gas chromatograph (Detector): GC-17A (Method: FID)
Standard sample: Acetone, Ethanol and Methanol (1ng injection)

Notes:

1. The gas sampling control device that was used for the above experiment was developed in a joint research project with the Nagoya Institute of Technology.

2. The above experiment was carried out in a joint research project with the Nagoya Institute of Technology.

Reference:

'Chromatography – Mechanism of Separation and Application' Takao Tsuda, 2nd edition, Maruzen, 1995 (published in Japanese)