International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Automatic Detection and Application of GC-1690 Gas Chromatograph

Lisha Gao

Tianjin Key Laboratory of Information Sensing and Intelligent Control, School of Automation and Electrical Engineering, Tianjin University of Technology and Education, Tianjin 300222, China

Abstract: ***This paper takes the GC-1690 gas chromatograph as an example to describe the working principle and the host structure of the GC-1690 gas chromatograph in detail. Through the experiment, the method of using the instrument was described. The analysis of the experiment using the N2000 chromatography workstation has certain significance for the detection and research of pesticide residues, food, petroleum and petrochemicals, medicine and health.***

Keywords: GC-1690, gas chromatograph, N2000, automatic detection

1. Introduction

Nowadays, high-performance physical separation technology has been applied in various fields of life. This technology has been used in chemical analysis and with appropriate detection methods. It has become a chromatographic method. There are many types of chromatography methods. From different perspectives, There are different classification methods. There are two phases in the chromatography, one phase is the mobile phase, the other phase is the stationary phase, and the gas is the mobile phase. It is called gas chromatography. Gas chromatography is a kind of chromatography method. It is a widely used separation analysis method [1]. Gas chromatography can be divided into two types according to the different stationary phases used. Gas-solid chromatography using a solid adsorbent as a stationary phase, and gas-liquid chromatography using a monomer coated with a fixative as a stationary phase, is done in this paper. The experiment used gas-liquid chromatography.

In the global gas chromatograph market, automation of laboratories and research facilities has been greatly developed. Hangzhou GC1690 series high performance gas chromatograph adopts international advanced technology and integrates the advantages of domestic gas chromatograph to develop the latest generation of gas chromatograph. According to the needs of users, it can flexibly select hydrogen flame ionization (FID), thermal conductivity (TCD), flame. Photometric (FPD), nitrogen and phosphorus (NPD) detectors can be used for constant, terrace or even trace analysis of organic, inorganic and gaseous compounds below 399 °C.

2. Brief Introduction of GC-1690 Gas Chromatograph

2.1 Working principle

The GC-1690 gas chromatograph uses a gas as the mobile phase. When the sample is "injected" into the injector by a microsyringe, it is carried by the carrier gas into a packed column or capillary column. Due to the difference in the distribution or adsorption coefficient between the mobile phase and the stationary phase of each component in the sample, under the flushing of the carrier gas, the components are repeatedly distributed between the two phases, so that the components are obtained in the column. Separate, and then use the detector attached to the column to detect the components in order according to the physicochemical properties of the components [2]. The working principle diagram is shown in Figure 1.

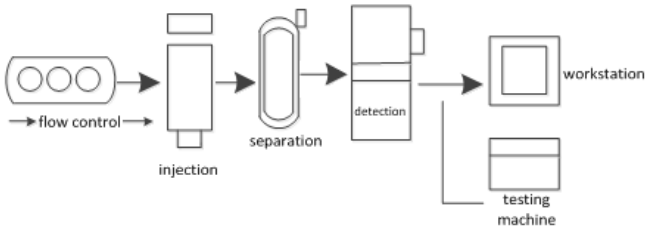

Figure 1: Working principle of GC-1690 gas chromatograph

2.2 Basic Composition

The GC-1690 gas chromatograph consists of detectors, injectors, flow control components, column ovens, temperature control and detector circuit components. The instrument has a total of six heating zones: oven, injector, detector, thermal conductivity, auxiliary 1 and auxiliary 2.

The middle part of the basic instrument is the column box, the upper part of the right side is the microcomputer temperature controller, and the lower part of the right side is the control panel of the detector. Optional: FID micro current amplifier, ECD constant current FM pulse control circuit board, FPD micro current amplification Board, NPD micro current amplifier board, TCD constant current board; the top of the instrument is the flow control component and the gas path panel, the rear part of the oven is the detector installation position, optional installation: FID detector, ECD detector, FPD detection, NPD detector, TCD detector; the front of the oven is a double packed column injector or a dual capillary injector. The left front part of the oven is a single capillary injector or a packed column injector, and the top of the instrument is a pneumatic controller [3].

3. Experimental Testing

3.1 Instrument Operation Process

3.1.1 Preparation before starting

1) According to the experimental requirements, select the appropriate column;
2) The gas connection should be correct, and open the carrier gas leak detection;
3) The signal input port corresponding to the signal line connection.

3.1.2 Boot sequence

1) First open the nitrogen and hydrogen total valve switch;
2) Set the sample temperature to be set;
3) View actual temperature, including: column temperature, injector, detector, capillary injector;
4) Set the actual temperature, including: column temperature, injector, detector, capillary injector;
5) Turn on the air generator, when the injection temperature and detection, temperature reach 100 degrees or more, and turn on the computer and workstation, you can ignite;
6) Sample when both baseline and temperature are stable;
7) Polarity and sensitivity settings.

3.1.3 Shutdown sequence

1) First close the air and hydrogen main valve;
2) Lower the temperature and reduce the oven temperature to 50 degrees;
3) When the column temperature reaches 50 degrees or so, the instrument power can be turned off.
4) The nitrogen main valve was closed after half an hour [4].

3.2 N2000 Chromatography Workstation

The N2000 Chromatography Workstation is a chromatography workstation with universal compatibility and cost-effectiveness. It is widely used in many chromatographies fields due to its simple and clear interface, simple and practical, superior performance and high cost performance [5]. The N2000 Chromatography Workstation performs chromatography data acquisition, calculation, statistics, comparison, reporting, retrieval, and storage functions, as well as devices with extended functions such as chromatograph control and network support. The whole workstation consists of data acquisition host and supporting software. It adopts dual-channel and external design, and has automatic identification of solvent peak, trailing peak, sawtooth peak and front and rear shoulder peaks. The parameters are automatically adjusted during the analysis (peak width, slope), baseline. Automatic tracking, automatic division of chromatographic peak types and other functions, while providing powerful manual integration functions, such as addition and subtraction peaks, peak baseline adjustment and cutting mode adjustment. Divided into online workstations and offline workstations.

3.3 Experimental Results and Analysis

Take a liquor on the market as an example. Open the N2000 online chromatography workstation, set the serial port and channel, carrier gas (nitrogen) flow rate: 60ml/min [(40-60) ml/min], hydrogen flow rate: 50ml/min [(30-60) ml/min], air flow: 500ml / min [(400-600) ml / min], select FID detector, split injector, N2000 chromatography workstation to open channel 1, column temperature selection program temperature; integration method is an area normalization method. The chromatogram is a ordinate with a change in composition (converted to an electrical signal, expressed in mv), and the outflow time is an abscess. This curve is the outflow curve, as shown in Figure 2. In addition, after the experiment is finished, the spectrum can be post-processed by offline workstations, such as manual integration and comparison of spectra, and the spectrum, integral parameter table, time program table, component table, system evaluation, etc. can be pasted and output to Other software for editing the report.

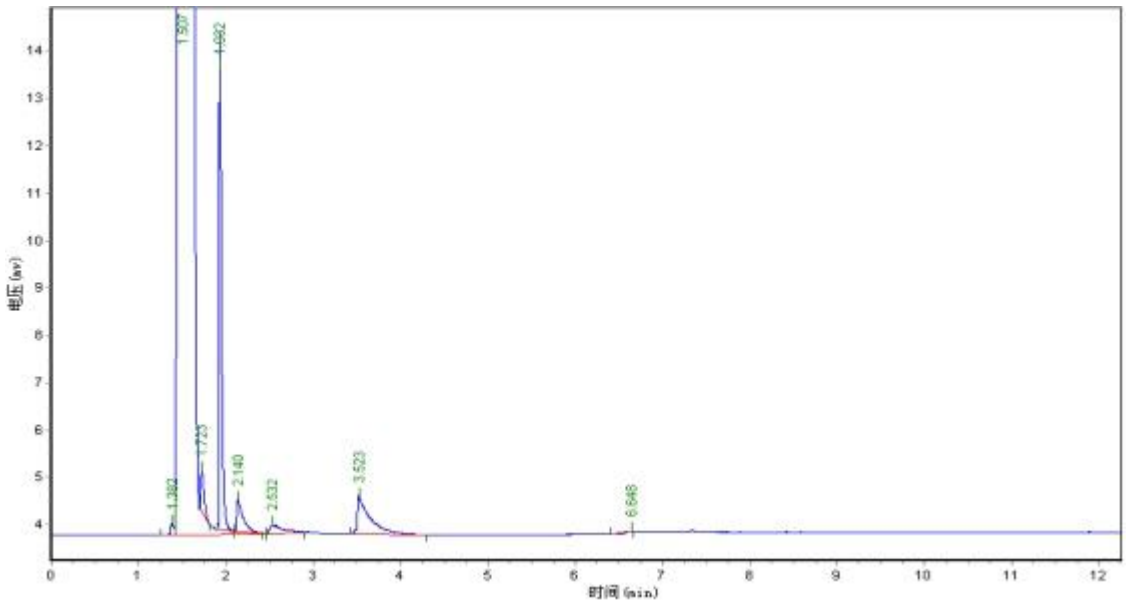

Figure 2: The Analytical Spectral Diagram of Liquor used in this paper

Through chromatographic analysis, it can be seen from Fig. 2 that the substances contained in the wine can be clearly separated. There are eight chromatography peaks in the chromatogram. These eight peaks represent eight substances, which peak at eight times, and the results are analyzed. As shown in Table 1, Through the analysis of the results, the correlation coefficient of the components contained in the measured object has its retention time, peak height, peak area and content. The gas chromatograph performs qualitative and quantitative analysis of the substance. If the chromatographic analysis is combined with mass spectrometry (MS) or nuclear magnetic resonance (NMR), the stereostructure of the substance can be analyzed.

Table 1: Experimental analysis results table

Peak number	Keep time	Peak height	Peak area	Content
1	1.382	229.697	837.047	0.0123
2	1.507	1028838.688	6775164.500	99.4682
3	1.723	940.071	2172.600	0.0319
4	1.932	10210.218	19799.301	0.2907
5	2.140	645.053	3295.300	0.0484
6	2.532	154.846	1772.400	0.0260
7	3.523	799.154	8270.700	0.1214
8	6.648	6.032	75.150	0.0011
Total		1041823.758	6811386.998	100.0000

4. Application

4.1 Pesticide Residue Detection

In order to increase the yield of crops, pesticides, herbicides, rodenticides, plant growth regulators, etc. are widely used in crops, resulting in pesticide residues in agricultural products and livestock products exceeding the standard, causing invisible, hidden dangers to the lives and health of the people [6]. And dangerous. Therefore, research and development of pesticide residue analysis technology instruments are an effective means to fundamentally detect pesticide residues and ensure food safety, and can quickly and effectively ensure the health of crops.

Gas chromatography is an effective analytical method in pesticide residue analysis technology, which can ensure high separation efficiency, high selectivity, rapid and sensitive analysis of residual pesticides [7]. The effects of organochlorine pesticide residue analysis, herbicide residue analysis, organophosphorus pesticide residue analysis, and pesticide residue analysis are particularly significant.

4.2 Food Analysis

With the improvement of people's living standards and the frequent exposure of food safety issues such as melamine, antibiotics, and medicinal liquor, people's attention to food safety and its nutrient content is increasing, so food analysis plays a key role. Food analysis includes both food additive and component analysis, in which both gas chromatography can take advantage of it.

At present, the application of gas chromatography technology in food safety testing mainly includes: analysis of pesticide residues in vegetables, fruits and tobacco; drug residues in livestock and aquatic products; analysis of Clenbuterol and trimethylamine content; analysis of additive content in food; oil Analysis of acrylamide in fried foods; analysis of flavor components and quality control of beer, wine and beverages; analysis of fatty acid composition in edible vegetable oils [8].

4.3 Analysis of Petroleum and Petrochemical Industry

Due to the high separation capacity and low application cost of gas chromatography technology, gas chromatography technology has been widely used in domestic and international petroleum industry analysis. Samples with boiling points below 200 °C can be quantitatively separated and detected by monomer or by group, such as refinery gas analysis and monomeric hydrocarbon and group composition analysis of gasoline fractions; for samples with boiling points higher than 200 degrees, Quantitative analysis according to the distillation range, such as the analysis of the composition of diesel fuel and the simulated distillation of various oils; quantitative detection of specific components in the sample, such as the quantitative analysis of monomeric sulfide in gasoline [9].

At present, based on multi-dimensional chromatography switching technology, the petroleum industry analysis needs such as chemical analysis, crude oil analysis, refinery gas analysis, oil analysis, gasoline additive analysis, aliphatic hydrocarbon analysis, aromatic analysis, etc. Chromatography analysis systems have also been well applied.

4.4 Medical and Pharmaceutical Analysis

Traditional methods of drug analysis, focus on the scope of chemical analysis, which are shortcomings such as slow speed, high consumption, and inaccurate analysis. The appearance of gas chromatographs largely circumvents these problems. Gas chromatography uses a capillary column with a very small inner diameter, and the analysis speed is greatly improved, which brings great convenience to the pharmaceutical analysis industry [10].

Gas chromatography has the advantages of high sensitivity and high separation effect in pharmaceutical and chemical testing, and is widely used in pesticide residues of Chinese herbal medicines. In addition to a single gas chromatography. Gas chromatography-mass spectrometry effectively combines the advantages of gas chromatography and mass spectrometry, and has a wider range of applications and advantages.

5. Conclusion

With the advancement of technology, the development of gas chromatography has promoted the development of various fields. In turn, the development of these fields has also promoted the development and application of gas chromatography. Gas chromatographs will develop towards a more intelligent and miniaturized trend. This will solve the problem that the traditional gas chromatograph has a single function, cannot be upgraded, and has poor reliability [11]. More automation, more convenient and faster gas chromatographs will be more popular with users, and more importantly, for our country, the development of a gas

chromatograph with independent intellectual property rights will become a new challenge.

References

[1] Qu Jiuhui. Physical technology-A method of clean water treatment that deserves attention [J]. Water supply and drainage 50 (04): 1.
[2] Jingshilian.GC-4400 portable photoionization gas chromatograph [J]. Modern Scientific Instruments 2005 (05): 19-21.
[3] Information on:http://www.hzjiedao.com/xzzx1.asp
[4] Information on:https://baike.so.com/doc/1602057-1693577.html
[5] Information on:https://wenku.baidu.com/view/a13c44a3fad6195f302ba68c.html
[6] Xu Yan.Discussion on Gas Chromatograph and Its Application[J].Life Science Instruments,2010,8(03):40-42.
[7] Li Changhai, Lin Longhai. Consideration on the principle composition and Application of Gas Chromatography [J]. Modern Manufacturing Technology and equipment! 2016 (01): 29-31 33.
[8] Ma Jiafeng, Hou Peng. Application of Gas Chromatography in Food Safety Detection [J]. Chinese Pharmacoeconomics 13 (02): 126-128.
[9] Yi Chaohui. Application of Gas Chromatography in Petroleum and Petrochemical Analysis [J]. China Petroleum and Chemical Standards and quality (05): 156-157.
[10] Zhang Yi. Gas chromatography and its application in drug analysis [J]. Hebei Chemical Industry Co., Ltd. 35 (08): 85-86 88.
[11] Zhou Xuebin. A brief Analysis of the Application and Development trend of Gas Chromatograph [J]. China Petroleum and Chemical Standards and quality (03): 32.