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Analysis of common faults of Agilent GC7890A gas chromatograph

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Abstract: Agilent GC7890A gas chromatograph is an important analytical instrument commonly used in the laboratory, with high precision, high sensitivity and good stability. However, with the growth of use time, the instrument may encounter some common faults, such as the FID detector baseline abnormality, the occurrence of irregular ghost peak, and the large baseline noise. These faults will not only affect the normal use of the instrument, but also may cause adverse effects on the experimental results. Therefore, the analysis of the common faults of Agilent GC7890A gas chromatograph and the corresponding treatment methods are of great significance to ensure the accuracy of the experimental results and the normal operation of the instrument. This paper first provides an overview of the basic information, functional characteristics of the Agilent GC7890A GC, and the range of applications in the laboratory. Then, the installation and maintenance precautions of the instrument are introduced in detail, including the requirements of the installation environment, installation steps, daily maintenance and regular maintenance. Finally, this paper analyzes the common faults of FID detector, including baseline error, no response, random ghost peak and high baseline noise, and proposes the corresponding treatment methods and preventive measures.

1. Introduction

As an important analytical instrument, gas chromatograph is widely used in chemical, biological and environmental fields. The Agilent GC7890A gas chromatograph is favored by the majority of users for its excellent performance and stability. However, any instrument and equipment in the long-term use of the process will inevitably appear failure. Therefore, it is of great significance to understand and master the common faults and treatment methods of Agilent GC7890A-GC, to ensure the accuracy of the experimental results and the normal operation of the instrument[1] .

2. Overview of the Agilent GC7890A-type gas chromatograph

2.1 Basic information and functional features of the instrument

Agilent GC7890A gas chromatograph is a high-performance gas chromatography analysis

instrument, with high precision, high sensitivity, high resolution and other characteristics. The instrument uses an advanced electronic control system and data processing software to enable rapid and accurate sample analysis. At the same time, its flexible injection system and a variety of detector selection enable the instrument to adapt to the analysis needs of different fields and different samples[4] .

Specifically, the Agilent GC7890A-type GC has the following functional features:

(1) High precision and high sensitivity: the instrument adopts advanced detector and signal processing technology, which can realize the accurate detection of trace substances.

(2) Flexible injection system: the instrument supports a variety of injection methods, such as automatic sampler, headspace sampler, etc., which is convenient for users to choose flexibly according to different samples.

(3) A variety of detector selection: the instrument can be equipped with many different types of detector, such as FID, ECD, NPD, etc., to meet different analysis needs.

(4) Strong data processing ability: the instrument is equipped with advanced data processing software, which can realize the rapid processing and analysis of experimental data and improve the experimental efficiency.

2.2 Scope of application in the laboratory

The Agilent GC7890A GC has a wide range of applications in laboratories, mainly involving the following areas:

(1) Qualitative and quantitative analysis of organic compounds: through the analysis of gas chromatography, the content of various components in organic compounds can be accurately determined, providing important data support for chemical synthesis, drug research and development and other fields.

(2) Environmental pollutant monitoring: the gas chromatograph can be used to detect pollutants in the atmosphere, water, soil and other environments, providing a scientific basis for environmental protection and pollution treatment.

(3) Food safety testing: the gas chromatograph can be used for the detection of additives, pesticide residues and other harmful substances in food, to ensure food safety and consumer health.

3. Notes for installation and maintenance

3.1 Instrument installation

The installation process of the Agilent GC7890A GC needs to follow certain steps and requirements to ensure the normal use and stable performance of the instrument[5] . During installation, note the following considerations:

(1) Installation environment requirements: the instrument should be installed in a dry, ventilated, dust-free indoor environment, to avoid direct sunlight, high temperature, high humidity and other harsh conditions. At the same time, the power supply should be stable and well grounded to avoid power interference and safety risks.

(2) Installation steps: install according to the requirements of the instrument manual, including the connection of each component, the connection of the gas circuit, the installation of the detector, etc. During the installation process, attention should be paid to the tight connection between the parts, smooth air path and correct detector position.

(3) Commissioning after installation: After the installation, the instrument needs to be debugged and calibrated, including checking the sealing of the gas path, adjusting the sensitivity of the detector, optimizing the chromatographic conditions, etc. Sample analysis shall be performed before

ensuring the best instrument performance.

3.2 Instrument maintenance

In order to ensure normal operation and extended life of Agilent GC7890A GC, regular maintenance and maintenance is essential. The following are some suggestions and precautions for instrument maintenance:

3.2.1 Daily maintenance

Routine maintenance is the basis for ensuring the stable operation of the instrument. Laboratory personnel shall check the operating status of the instrument daily, including the air source pressure, the detector baseline stability, the cleanliness of the injection system, etc. At the same time, the dust of the instrument should be cleaned regularly to keep the instrument clean and tidy. In addition, consumables such as injection needles and injection pads should be checked and replaced regularly to prevent contamination and blockage from affecting the analysis results[6]. At the same time, laboratory personnel should maintain and replace the column regularly to ensure the performance and separation effect of the column.

3.2.2 Periodic maintenance

In addition to routine maintenance, the Agilent GC7890A GC requires regular depth maintenance [7]. This includes cleaning and calibrating detectors, checking circuit boards and wiring, replacing aged parts, etc. These maintenance work shall be carried out by professionals to ensure quality maintenance and instrument safety. In addition, manufacturers usually provide regular maintenance and calibration services. Laboratory personnel can choose the appropriate maintenance cycle and service content according to the use of the instrument and the manufacturer's suggestions. Through regular maintenance, the potential problems can be found and solved in time to ensure the long-term stable operation of the instrument.

4. Common faults and handling methods

4.1 The FID detector has an abnormal baseline and no response

(1) Fault phenomenon: After the instrument is connected, the baseline of FID detector is abnormally high, reaching more than 30,000 uV. The temperature and flow display of the instrument are normal, and the FID detector fires and burns normally, but the output signal of the instrument does not respond after the sample injection.

(2) Preliminary inspection: ① Check the contact between the FID detector line plug and the FID signal amplification circuit board to confirm that the contact is good.② Use a flashlight to inspect the vent on the FID detector and find a foreign body about 2mm in diameter inside the FID detector, which is burning and emitting red light.

(3) Treatment method:

The upper end of the FID detector is designed to be open, which causes the insect to fall into the inside of the detector from the FID detector, and disturbs the FID detector signal. Although this event is a low probability event, it is recommended that Agilent instrument manufacturers improve the FID detector by adding a metal mesh shield at the outlet of the FID detector to effectively avoid foreign bodies such as insects from falling into the FID detector. As shown in Table 1.

Table 1: The FID detector has an abnormal baseline and no response processing method

Processing steps	elaborate
Power cooling	The instrument was powered off to cool to room temperature
Turn on the FID detector	Turn on the FID detector for further inspection
Discover foreign body	A burnt insect was found on the top part of the FID detector
Remove foreign body	Remove the charred insects
Cleaning drying	The detector was thoroughly washed and dried by acetone analysis
Install the test machine	Power on the test machine after the installation is completed

4.2 Irregular ghost peak and severe reproducibility

(1) Fault phenomenon: after the power supply was connected, the analytical instrument operator observed the ghost peaks in the chromatogram during the sample injection operation, and the reproducibility of these ghost peaks was seriously deteriorated. At the same time, the baseline noise is also significantly larger, which seriously affects the analysis results.

(2) Preliminary inspection: According to the observed fault phenomenon, the preliminary judgment is that this problem may be caused by the sample inlet pollution or the insufficient purity of the carrier gas. Therefore, after the instrument was cooled and cut off, the air circuit interface of the instrument was checked and confirmed that there was no air leakage. Then, open the instrument inlet, for further observation, found that the internal pollution of the liner is serious, there are many black pollutants.

(3) Treatment method: after determining that the pollution is the cause of the failure, decide to carry out thorough cleaning and maintenance work.① Open the instrument inlet and remove the liner and the shunt plate with forceps. It is found that the pollution in the liner is serious, there are obvious black pollutants, and there is also a certain degree of pollution in the shunt plate.② The liner of the same specification was replaced and the shunt plate was thoroughly cleaned using acetone analysis.③ The er and liner O-ring were replaced to ensure good sealing.④ After completing these operations, the parts are reinstalled and the tester is powered up.

Table 2: Treatment methods of irregular ghost peak and reproducible serious variation

Processing steps	elaborate
Removing parts	Open the instrument inlet and remove the liner and shunt plate
cleaning and maintenance	Wash the shunt plate thoroughly with acetone analysis and replace the liner of the same specification
Replace parts	Replace the cushion and liner O-ring
Install the test machine	Power on the tester after installing the parts

The main reason for the failure is that the instrument maintenance is not in time, the instrument maintenance work is not paid seriously, and the inspection and replacement of the liner and cleaning the shunt plate are not in time, resulting in serious pollution of the liner and shunt board. Therefore, in order to avoid the occurrence of similar faults, it is necessary to pay more attention to the scientific maintenance of the instrument, replace the liner regularly, clean the shunt plate according to the plan, and keep the instrument clean and dry. At the same time, strengthening the maintenance skills training of the instrument operators, improving their maintenance awareness and skill level, is also an important measure to ensure the long-term and stable operation of the instrument. As shown in table 2.

4.3 High baseline noise

(1) Fault phenomenon: the operator of the analysis instrument reported that after the replacement of the cylinder gas, the baseline noise suddenly increased significantly.

(2) Preliminary inspection: ① Observe the temperature and flow display of the instrument, which are normal.② After cooling and power off of the instrument, check the air tightness of each interface of the instrument gas circuit, and no leakage point is found.

(3) Treatment method: ① The instrument operator describes the deterioration of the baseline noise soon after the replacement of the cylinder gas, and it is preliminarily determined that the baseline deterioration may be related to the purity of the cylinder gas.② The cylinder gas was taken in a tin foil bag and detected by chromatography, showing obvious impurity peaks in the spectrogram.③ Replace the cylinder gas and replace the gas trap trap of RMSN-2.④ Power-on test machine, the instrument baseline returned to normal, troubleshooting.

The chromatograph requires high gas purity. In this fault, the gas purity of the previously replaced cylinder was far lower than 999.999%. In addition, the instrument trap was not replaced in time, so it failed, resulting in the baseline noise of the instrument. After the fault is restored, the problem has been fed back to the purchasing department to avoid the recurrence of similar phenomena. During daily use, gas purity and trap trap status should be checked regularly to ensure proper operation and accurate analysis of the instrument. As shown in table 3.

Table 3: Fault handling record table

time	Fault description	scope of examination	treatment measure	bear fruit
XX year XX month XX day	The instrument baseline noise is suddenly increased	Observe the temperature and flow display and check the air tightness	No abnormalities were found	normal
XX year XX month XX day	Noise continues after cylinder gas replacement	Preliminary judgment of the gas purity problem	Sample samples to detect the cylinder gas	Discover impurity peaks
XX year XX month XX day	Verify the gas purity problem	Replace the cylinder gas and replace the gas trap trap	Power test machine	The baseline returned to normal

5. Conclusion

This paper will discuss the common faults of the Agilent GC7890A gas chromatograph, and aims to provide technical support and operational guidance for the general laboratory personnel. Through the research of this paper, it is hoped to help laboratory personnel to better understand and master the use and maintenance skills of the instrument, reduce the occurrence of faults, and improve the accuracy of experimental results.

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