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# Research Progress in the Application of Gas Chromatography/Mass Spectrometry Technology

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## Abstract

**In recent years, people's pursuit of the quality of production and life has gradually improved, and people have paid more attention to life health and environmental pollution. Gas chromatography/mass spectrometry technology can effectively determine complex organic matter qualitatively and quantitatively. This article reviews the application of gas chromatography/mass spectrometry technology in the determination of organic matter in soil and solid waste, water quality, food, biology, etc. in recent years, and briefly describes the current problems and application prospects of the technology.**

## Keywords

**Gas Chromatography/Mass Spectrometry, Volatile Organic Compounds, Semi-Volatile Organic Compounds, Purge-Trap, Progress.**

## 1. Introduction

Organic compounds are the material basis of life and are inseparable from human production and life. Organic compounds are widely found in soil, food, and air. However, some organic compounds can cause harm to the ecological environment and human health [1]. Gas chromatography/mass spectrometry (GC/MS) technology is widely used in soil pollution monitoring, water quality testing, food and Biological testing and other aspects [2]. Among many organic pretreatment methods such as purge and trap, static headspace, solid phase extraction, etc., purge and trap and headspace are more commonly used [3]. The research on the detection and application of organic matter in waste, water quality, food and organisms is reviewed, and the current problems and application prospects of this technology are briefly described.

## 2. Application of Gas Chromatography/Mass Spectrometry Technology

### 2.1 Soil and Solid Waste Testing

The environmental protection industry in my country has issued the standard HJ 605-2011 "Determination of Volatile Organic Compounds in Soils and Sediments Purge and Trap/Gas

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Chromatography-Mass Spectrometry" for the determination of volatile organic compounds in soils and sediments. And 65 kinds of volatile organic compounds (VOCs) in the sediment were measured [4]. Wang N. et al. [5] used purge and trap-gas chromatography-mass spectrometry technology to determine 54 kinds of volatile organic pollutants in the soil, including halogenated hydrocarbons, chlorinated hydrocarbons, and benzene series. (SCAN) method, the selective ion scanning (SIM) method is more advantageous for the quantitative analysis of multiple components in the soil obtained by segmented scanning. The detection limit of this method is 0.20×10-9 ~ 1.20×10 -9, the recovery rate of collective standard addition is between 82.0%-112.5%, and the accuracy is 0.1%-14.5% higher than the SCAN method. Wan W. et al. [6] measured volatile organic compounds in petrochemical soils. The established method is that the purge and trap temperature is 70 °C, the time is 11 min, the desorption time is 1 min, and the linear range is 5-200 ng/g, R2 >0.99, the detection limit is 0.1-0.5 ng/g, the RSD is 0.9%-12.5% (n=6), and the recovery rate of soil blank addition is 68.7%-128.7%. This method shows that different concentrations of volatile organic compounds (VOCs) in petrochemical soils can be detected in different ways. Low-concentration VOCs can be directly measured by purge and trap gas mass spectrometry. Very few high-concentration samples need to be extracted with methanol. The liquid is pre-treated, but for unidentified alkanes and C9 and above aromatic contaminants samples, in addition to standard methods, new detection and analysis methods need to be developed. Chen S. F. [7] used headspace-GC/MS technology to optimize the conditions of the method to determine 31 volatile organic compounds in the soil, verifying the feasibility of the method. Zhong D. D. et al. [8] studied the pretreatment of volatile and semi-volatile organic pollutants in solid waste and the GC-MS determination method and proposed that the pretreatment technology and analytical instruments should be strengthened for the sample matrix and differences. Comprehensive research and development, establish multi-component simultaneous monitoring, and carry out research on the leaching toxicity of organic pollutants in hazardous solid waste. The above studies have shown that gas chromatography-mass spectrometry is widely used in the determination of volatile and semi-volatile organic compounds in soil and solid waste.

## 2.2 Water Quality Testing

The continuous advancement of my country's urbanization process has caused the issue of water pollution to arouse people's attention. At present, my country's water conservancy and environmental industries have respectively issued standards SL 393-2007 "Purge and Trap Gas Chromatography-Mass Spectrometry" and standard HJ 639-2012 "Determination of Volatile Organic Compounds in Water Quality. Chromatography-Mass Spectrometry" [9-10]. Lin Q. et al. [11] applied purge and trap-gas/mass spectrometry internal standard method to determine 2-isobutyl-3-methoxypyrazine, 2-isopropyl-3-methoxypyrazine and β- Ionone, β-Citral, 2,4,6-Trichloroanisole, 2,3,6-Trichloroanisole, 2,3,4-Trichloroanisole, Isophorone 8 Two kinds of odorants were analyzed, the ion monitoring method was selected to quantify and the matrix spiked to verify the accuracy and precision of the results. The concentration of 8 kinds of odorants was linear within the range of 0.1~2.0 μg/L, and the detection limit was 0.04-0.07 μg/L, the recovery rate is 70%-117%, and the RSD2.1%-17.8, which proves that the method can accurately and stably analyze the odorous substances in surface water, groundwater and drinking water. Determination. Guan T. Y. [12] used solid phase extraction-GC/MS to quickly, sensitively and accurately determine the Atlas law in surface water. Feng X. F. [13] used dispersion liquid-liquid microextraction-GC/MS to determine trichlorobenzene in seawater. The detection limits of different sample methods were 1.5 μg/L, 0.5 μg/L, 2.0 μg/L, and the standard was recovered. The rate is 97.8%-102.5%, and the relative standard deviation is 2.8%-6.6%. Compared with headspace, liquid-liquid extraction, and solid-phase extraction, this method has low detection limit, high enrichment factor, convenient operation and low interference. advantage.

## 2.3 Food Testing

Food quality and safety issues have attracted the attention of the public in recent years. GC-MS technology plays an important role in food inspection due to its high sensitivity and fast analysis speed. Wang P. [14] discussed the application of gas chromatography and GC-MS in pesticide residue

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analysis, and emphasized the feasibility of gas chromatography and GC-MS in pesticide residue analysis. Zhou Y. [15] applied GC-MS technology to analyze 15 volatile components of 4 different cinnamon barks. The minimum recovery rate of this method was 96.4%, which showed that this method has better performance in the determination of cassia bark volatile organic compounds. Good stability. Liu J. [16] used GC/MS to discuss the residues of organochlorine and carbamate pesticides in strawberries. The test results showed that the method was used to determine the residues of organochlorine and carbamate pesticides in strawberries, and the recovery rate was as high as 90%. % Above, the relative standard deviation value is controlled at about 10%, which proves that the accuracy and precision of the measurement results of this method are high, and it meets the requirements of food testing safety. Xu B. [17] explained the application of GC-MS in food inspection, and explained that this technology plays a role in effectively classifying and detecting substances in food inspection and optimizing food inspection technology. This technology can be used for pesticide residues in fruits and vegetables. Testing, melamine testing in dairy products, food additives testing and plasticizer testing in liquor. The above fully demonstrates that GC-MS technology provides convenient, fast and accurate detection methods for inspection and testing in the food industry, but the establishment of standard methods still requires more in-depth research and analysis by researchers.

### 2.4 Biological Testing

The continuous development and breakthrough of biomedical disciplines has made the GC/MS technology widely used in this field. Xia J. Y. [18] studied the screening of biotransformed conjugated linoleic acid Lactobacillus, taking Lactobacillus as the research object, in-depth exploration of the law of its biotransformation of conjugated linoleic acid, and applying the method of GC/MS to preliminary screening The isoform composition of the CLA product transformed by the strain was determined. Guan Q. L. [19] et al. used dispersion liquid-liquid microextraction-gas chromatography tandem mass spectrometry to determine escitalopram in biological samples. This method has the advantages of environmental protection, rapidness, and low consumption of organic solvents. Forensic appraisal of phthalopram-related cases provides a reference. Yang G. L. [20] and others used GC-MS combined technology to determine urine biomarkers after nutrition treatment of pregnancy complicated with diabetes, which can effectively evaluate the effect of nutrition treatment with pregnancy complicated with diabetes.

### 2.5 Others

Hu G. P. [21] applied solid-phase micro-extraction-portable gas-mass spectrometry technology to quickly identify occupational hazards in a graphite factory, spraying workshop, and a gas station. He explained that the technology is often used in VOCs and environmental chemical analysis ( In terms of water, soil, air, etc.) detection, it overcomes the shortcomings of traditional GC-MS sample pre-processing technology. It integrates sampling, extraction, concentration, and sample injection, speeds up the detection speed, and can enter heavily polluted areas. Xie J. et al. [22] explored the application of GC-MS technology in the detection and analysis of plant volatile oil, and discussed in detail the detection, qualitative and quantitative analysis of plant volatile oil with different extraction methods. Wang X. Y. [23] uses yeast as raw material to prepare biodiesel and uses GC-MS to control the main components of methyl myristate, methyl palmitate, methyl hexadecenoate, methyl stearate, and methyl oleate. Perform quantitative analysis. Ji N. [24] et al. used micro-cell thermal extraction-GC/MS to determine the volatile organic compounds of automotive interior materials, benzene, toluene, ethylbenzene, xylene, styrene, and TVOC to determine low VOC. The material provides a reference for the design and selection of automotive interior parts. Zhang Z. L. [25] and others used gas chromatography-mass spectrometry to detect three antioxidants in food paper products, and within the range of 0.01-0.50 mg/L, the correlation coefficients of the three antioxidants r> 0.9990, plus standard The recovery rate was 90.7%-98.2%, the RSD was 2.4%-4.5%, and the S/N was 0.25 mg/kg.

## 3. Conclusion

Gas chromatography-mass spectrometry technology has the advantages of high sensitivity, good accuracy, less organic reagents and less environmental pollution, which makes the technology widely used in the fields of soil, solid waste, water quality, food and biology. However, the further development of this technology needs to be improved from two aspects: the detection method of organic matter and the improvement of the equipment itself. The establishment of standards for the determination of organic matter is currently mainly focused on environmental testing. The establishment of standard methods for organic matter in food flavors, biological samples and other fields still requires researchers to in-depth research and verification; when the content of soil organic matter is high, standard methods are excluded In addition, other simple and effective methods also need to be explored and verified; the improvement of gas chromatography-mass spectrometry technology equipment can start from the sample pretreatment equipment, such as purge and trap concentrated water samples to test the ideal water removal method and liquid-liquid extraction consumption. Problems such as long time and difficulty in automatic operation. It is believed that the establishment of standard methods in different fields and the improvement of equipment will allow gas chromatography-mass spectrometry technology to be more widely used in many applications.

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