Analysis of the Application of Gas Chromatographic Analysis Technology

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Abstract. With the continuous development of the society and the continuous improvement of the level of scientific research, the research accuracy and precision requirements are higher and higher, followed by more accurate instrumental analysis methods. Gas chromatography has been widely used in many fields for its advantages of high separation efficiency, high sensitivity, fast analysis speed and wide application range. In this paper, the application of gas chromatography in industrial research, food inspection, environmental protection and environmental monitoring is described.

1. Introduction
Gas chromatography (gc) is a new separation and analysis technique. It is a separation and analysis method established by using gas as mobile phase and based on the difference in the distribution of sample components in the stationary phase and the flowing phase, such as dissolution and adsorption. Gas chromatography has been widely used in industry, agriculture, national defense, construction and scientific research because of its advantages of high separation efficiency, high sensitivity, fast analysis speed, strong selectivity and wide application range.

2. Application of Gas Chromatography in Industrial Research Field
2.1. Determination of Fatty Acids by Gas Chromatography
The application of gas chromatography is an important research topic in the field of chemical analysis in recent years, and has attracted the attention of relevant scholars at home and abroad [1]. The accuracy and reliability of the determination results cannot be guaranteed due to the small range and limitation of the traditional method for the determination of fatty acids. The application of gas chromatography technology, not only simple operation, improve the separation efficiency, and can meet the separation and determination at the same time to complete, significantly improve the recovery rate, the various components in the sample can be classified, improve the quality of the product. At the same time, the ability to grasp the situation of various organic compounds in the chemical analysis process is conducive to the regulation of all aspects of chemical production. Figure 1 shows the sequence of 35 fatty acids according to the peak time. Followed by butyric acid, caproic acid and octanoic acid, eleven acid, lauric acid, tridecane acid, myristic acid,
nutmeg acid, pentadecane acid, shun-10-15 acid, palmitic acid, palmitoleic acid, 17-alkanes acid methyl ester, shun-10-17 carbon olefine acid, stearic acid, anti-acid, oleic acid, linoleic acid, linoleic acid, arachidic acid, linolenic acid, cis-11-20 carbon olefine acid, linolenic acid, 21 alkanes acid, 20 carbon diene acid, mountain do acid, 20 carbon triene acid, erucic acid, arachidonic acid-diene tricosane acid, 22 carbon acid, wood wax acid, EPA, 24 carbon olefine acid, DHA

Figure 1 GC chromatogram of 35 fatty acid methyl esters

2.2. Improve the Effective Analysis of Chemical Density and Precision
The application of gas chromatographic analysis technology, to avoid the influence of human factors, the use of instruments for automated analysis and detection, reduce the number of manual calculations, improve the analysis speed, and can be repeated analysis and detection, the precision and accuracy are significantly higher than chemical analysis. For the use of gas chromatographic analysis technology can achieve the analysis of a variety of components, to avoid the interaction between components, and in the process of analysis, to ensure that the gas leak, improve safety, reduce error rate, improve the analysis ability, improve the quality of gas analysis, promote the development of chemical analysis toward automation [2].

2.3. Determination of Pahs by Gas Chromatography
Polycyclic aromatic hydrocarbons (pahs) are volatile hydrocarbons produced by incomplete combustion of coal, petroleum, wood, tobacco, organic polymers and other organic compounds. Trace amounts of pahs have been found to pose a serious threat to human health, causing increasing concern. The gas chromatographic analysis method can effectively detect and analyze pahs, and the results are accurate and meet the requirements of environmental monitoring.

2.4. Application of Gas Chromatography in Petrochemical Field
In the petrochemical field, the composition of liquefied petroleum gas (LPG), the composition of naphtha monomer hydrocarbons, the composition of hydrocarbon gases, the rapid detection of chromatographic column, and the purity of phenol and aromatic hydrocarbons are analyzed by gas chromatography [3]. In the process of petrochemical production, different gases and liquids will be produced, it is necessary to apply gas chromatography for effective analysis, detection and separation, improve the accuracy of detection, the use of useful gases and liquids, dangerous components to control, to ensure the orderly chemical production process.
2.5. Application of Gas Chromatography in the Analysis of Biodiesel Products

Biodiesel, also known as biodiesel, is an environmentally friendly biofuel made from unprocessed or used vegetable oil and animal fats through different chemical reactions. Biodiesel has attracted more and more attention because of its excellent environmental protection, low temperature start-up performance, good safety performance, excellent combustion performance, reproducibility and degradability. The rapid qualitative and quantitative analysis of the chemical constituents of biodiesel has promoted the rapid development of biodiesel industry. The chemical composition analysis of biodiesel mainly includes the determination of alkyl ester content of fatty acid, glycerol and glyceride content, methanol content and steroid content [4]. The performance of biodiesel depends on its chemical composition, so it is of great significance to identify and analyze the composition of biodiesel.

3. Application of Gas Chromatography in Food Inspection

3.1. Detection of Pesticide Residues in Crops

With the improvement of people's living standards, people pay more attention to health and food safety closely related to health. With the increase of crop yield, pesticide spraying has also caused excessive problems, which not only causes pollution to the environment, but also causes increasingly serious pesticide residues. Not only rice, wheat, vegetables and fruits also have the problem of pesticide residues, residues of pesticides will harm the human body, harm to human health. With the help of gas chromatographic analysis technology, pesticide residues in vegetables, fruits and other agricultural products can be easily and quickly detected. Through different methods, different detectors are applied to detect a variety of pesticides, so as to control agricultural residues within a safe range, improve the accuracy of analysis and detection, and ensure human health. With the wide application of instrumental analysis technology, the detection accuracy is improving and the detection limit is getting lower and lower. Wang zhimin et al. established a fast method for the determination of 9 pesticide residues in grape by gas chromatography triple tandem quadrupole mass spectrometry [5]. Wang chi et al. used gas chromatography to determine the organophosphorus pesticide residues in vegetables and fruits [6]. As shown in figure 2, the peak times of the 9 pesticides were successively chlorpyrifos, chlorpyrifos, parathion, fluoronitrite, molide, bifenthrin, cypermethrin, fenvalerthrin and methylxazole.

![Figure 2. Chromatogram of 9 pesticides](image)

3.2. Testing of Food Additives

Food additives are synthetic or natural substances added to food to improve the quality of food such as color, aroma and taste, as well as to meet the needs of anti-corrosion and processing technology. People pursue natural and harmless food additives, but generally speaking, chemical food additives have a certain degree of toxicity, and only to reach a certain concentration or dose level, to show toxic effect, so when using to strictly control the amount of use. However, in daily life, the abuse of food additives has become a very serious problem for illegal businesses to pursue the interests of their
products, and illegal additives, such as melamine in dairy products and plasticizer in liquor, occur frequently. Food safety has become a national focus of concern, the key supervision, the use of additives. The use of gas chromatography technology can be used to detect the ingredients of food additives, determine the content of preservatives, and then classify them to determine the content of various additives [7]. For example, antioxidant is an additive to ensure the long-term storage of edible oil, but currently used antioxidants have certain toxicity, so its content is detected by gas chromatography, its content is monitored, and pre-treatment method is optimized to improve the accuracy of detection results. Gas chromatography flame ionization detector can also be used to analyze and detect the residues of benzoic acid, sorbic acid and other preservatives in food.

3.3. Grain and Oil Quality Inspection
If grain storage is not appropriate, it is easy to produce mildew, lead to corruption and deterioration, harm to human health, the use of gas chromatographic detection technology can be detected in grain and oil storage of mold content. To whiten flour, use the flour improver benzoyl peroxide, which can irritate the skin and respiratory system and is carcinogenic, so you need to monitor the use of benzoyl peroxide [8]. The content of benzoyl peroxide cannot be directly determined by gas chromatography, but needs to be reduced to benzoic acid. The content of benzoyl peroxide can be determined by the analysis of benzoic acid content.

3.4. Detection of Flavor Components of Fermented Beverages
Alcohol belongs to the representative of food fermented drinks, liquor, wine, beer and other alcoholic drinks in the process of fermentation will produce formaldehyde, fusel oil, acetaldehyde and other harmful components to human body as well as a lot of volatile compounds and flavor substances, such as sulfur compounds, advanced alcohols. Formaldehyde is a carcinogen, highly toxic, serious harm to human health, even life. GC/FID was used to detect formaldehyde in liquor to ensure its accuracy and sensitivity [9]. Fusel oil substances on the human body toxic side effects, if the human body after poisoning for dizziness, headache and other symptoms. Sulfur compounds, such as higher alcohol determine the taste of the product quality, using the gas chromatography technology can be rapid and accurate analysis to detect the content of methanol and fusel oil in liquor, to ensure the safety of the liquor, the other through the Hs-GC gas chromatographic analysis technique to detect the volatile compounds control, can effectively control the quality of the products.

3.5. Testing of Food Nutrients and Freshness
Meat is one of the essential nutrients of human body, the main component of lean meat is protein, the main component of fat meat is lipids. The main components of protein are amino acids. Meat is rich in amino acids, such as glycine and serine. These amino acids are closely related to meat taste. Compared with liquid chromatography, gas chromatography is more convenient for fatty acid analysis, and the sample pretreatment is simpler and takes less time. To judge the freshness of meat products, the main method is to use gas chromatography to analyze and detect the substance in meat, through quantitative analysis to effectively determine its freshness. An effective and simple indicator of freshness is the use of gas chromatography to detect the presence of trimethylamine in meat and meat products. If the content of trimethylamine is high, the freshness of meat and meat products decreases.

3.6. Detection of Harmful Substances in Food Plastic Bags
Food plastic bags are made of polyethylene, polypropylene and melamine and other raw materials, and non-food plastic bags contain polyvinyl chloride, it is also often used a plastic, is composed of polyvinyl chloride resin, plasticizer and anti-aging agent. Plasticizers mainly use titanate esters, such as dibutyl terephthalate, dioctyl phthalate, etc., aging agent is lead stearate, they are toxic. Phthalates dissolve into food when they come into contact with fatty substances, especially high temperature foods containing oils. Titanates are highly toxic, causing mutations in human genes that can cause cancer. And the polyvinyl chloride containing lead salt contains oily food, such as youtiao, Fried fish,
cooked meat products will make lead molecules diffuse into the oil, harmful to human health. In addition, polyvinyl chloride plastic products in higher temperature, such as 50℃ or so will slowly decompose harmful hydrogen chloride gas to the human body, so can’t use polyvinyl chloride plastic bags to hold food. The harmful substances in plastic bags can be effectively detected by gas chromatography, and titanate esters and lead stearate salts can be accurately detected [10].

3.7. Classification and Detection of Harmful Substances in Food

In food inspection, the application of gas chromatography technology can be used to classify and detect the harmful substances that may be contained in food, and the harmful substances can be divided into exogenous organic pollutants and endogenous organic pollutants [11]. PAHs are volatile hydrocarbons produced by incomplete combustion of coal, petroleum, wood, tobacco and other organic compounds, which are foreign organic pollutants. The PAHs residues in smoked food are the largest and carcinogenic, which can be detected by gas chromatography-mass spectrometer. Acrylamide is produced from starchy foods cooked at high temperatures (>120℃) and has the highest residue in baked and Fried foods, which can be detected by gas chromatography electron capture detector. N-dimethyl nitrosamine is easy to be produced in preserved meat products, which can lead to high incidence of cancer. Long-term consumption will lead to chronic poisoning. It can be used to detect preserved food by gc-ms. Acrylamide and n-dimethyl nitrosamines are both endogenous organic pollutants.

4. Application of Gas Chromatography in Environmental Protection and Environmental Monitoring

4.1. Soil Environmental Monitoring

Soil environment is the key monitoring object of environmental protection work. Gas chromatography can determine toxic or harmful substances in the soil, including pesticide residues, growth hormone, minerals and microorganisms in the soil [12]. The abuse of pesticides resulted in a large number of pesticides in the soil environment, and the components of these pesticides caused great harm to human health. Wu jianlan et al. used gas chromatography to determine the organochlorine pesticides in the soil, while wang haiyan et al. used gas chromatography to determine the methane in landfill gas. With the wide application of gas chromatography, the content of pesticide has been effectively determined, which provides a favorable guarantee for soil environmental monitoring.

4.2. Monitoring of Atmospheric Environment

The detection of harmful substances in the atmosphere by gas chromatography usually includes dust in the atmosphere, pollutants in the aerosol, volatile pollutants and harmful substances. Toxic gas is one of the pollutants in the air, will enter the human body with the breath, threatening health. The electronic capture detector in gas chromatography can be used to determine the content of toxic gases in the air. At present, we can monitor 12 chlorobenzene compounds. Kong fei et al. used gas chromatography to determine acrylamide in the atmosphere, su pengqi et al. measured dioctyl phthalate in the air and waste gas.

4.3. Water Environment Analysis

The application of gas chromatography in water environment analysis mainly refers to the detection of soluble gas, volatile organic compounds and metal organic compounds in water.

4.3.1. Testing of Drinking Water Quality. The safety of drinking water is related to people's health, and the detection of drinking water quality is the key to control the safety of drinking water. The water quality of drinking water is mainly tested by organic fluorine pesticides, organochlorine pesticides, organophosphorus pesticides and volatile substances. Organic fluorine pesticide belongs to nerve poison to belong to liver poison already, residual time is long, decompose not easily, serious pollution
environment, the organic fluorine in human body exceeds standard, can cause deformity [13]. In gas chromatography, the method of programmed temperature rise can effectively detect the components of organic fluorine pesticide with low detection limit. Organochlorine pesticide is one of the common pollutants in drinking water and has great harm to human health. During detection, electron capture detector and capillary column can be configured to set the program temperature rise. Organophosphorus pesticides are common pollutants in drinking water. Common organophosphorus pesticides include malathion, methyl parathion and parathion [14]. Organophosphorus can enter the body through the digestive system, respiratory system and skin, and can be distributed in various organs, especially the liver. Nitrogen and phosphorus detectors or flame photometric detectors can be configured for gas chromatography. Volatile substances refer to volatile organic compounds and semi-volatile organic compounds. Gas chromatograph, hydrogen flame ionization detector and electron capture detector can be used to detect carbon tetrachloride, toluene, benzene nitrate, trichloroethylene and other substances in drinking water, separate harmful substances and realize the detection of drinking water quality.

4.3.2. Monitoring of Toxic Substances in Water Environment. Hydrazine is a common pollutant in water environment, colorless, oily and highly toxic, if the body accidentally drink water containing hydrazine, will lead to skin poisoning or acute poisoning, not timely treatment will endanger life, so it is necessary to monitor hydrazine [15]. The use of gas chromatography can be used to monitor hydrazine in the water environment, but also to other toxic substances, such as nitrobenzene compounds, trichloroethylether, effectively and accurately determine the content of samples. Peng hua et al. constructed a solid phase microextraction-gas chromatography method for the determination of trace nitrochlorines in ambient water. Jiang xuesong et al. used capillary column gas chromatography to determine trichloroethylether in the waste water discharged by pesticide plants. The separation effect of trichloroethylether was good, and the detection limit was low. For example, zhang xuemai et al. used gas chromatography to detect 10 samples of factory water, 24 samples of peripheral water and 41 samples of surface water in taizhou city. None of the samples of factory water and peripheral water were detected, while 41 samples of surface water were detected, with concentrations ranging from 0.07 to 6.0 μg/L. This method is simple and fast, and is suitable for the determination of methyl tert-butyl ether in water samples, which provides necessary emergency technical reserve for the detection of methyl tert-butyl ether in water samples [16].

5. Conclusion
With the continuous development of gas chromatography technology, it plays an increasingly important role in production and life. Because of its high separation efficiency, fast speed and other advantages, it is widely used in petrochemical analysis, food inspection and analysis, environmental monitoring. With the improving of the scientific and technological level, gas chromatography technology in the field of instrument automation degree is higher, and with the continuous improvement of detection precision, combination of gas chromatography and other instruments will play more and more important role, its and TOF, magnetic mass spectrometer, FIMS application will make GC - MS/MS more powerful, its application field will be more widely, push industry, agriculture, national defense, scientific research and other fields of development.

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