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Application of Chemical Analysis in Chemical Material Detection

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Abstract

Chemical production will be applied to various types of chemical materials, especially with the increasing variety of chemical materials at this stage, different types of chemical materials have corresponding performance and quality requirements. As a related enterprise, chemical analysis technology must be used in the production process of chemical materials, chemical composition, reaction characteristics, material structure of the internal reaction analysis. Therefore, this paper discusses the application of chemical analysis in chemical material detection, and puts forward the measures and suggestions to improve the quality of chemical analysis for reference.

Keywords

Chemical material detection; Chemical analysis; Applied research; Suggestion

Introduction

As the most commonly used detection method, chemical analysis has formed a very complete and scientific chemical analysis detection theory and detection system after long-term development, and can accurately complete the detection of various chemical materials, providing reliable information data reference for chemical production. However, with the increasing complexity of current chemical production processes and the increase in the types of chemical materials, it is necessary to further strengthen the research and application of chemical analysis technology, continuously improve the accuracy of chemical analysis results, and provide reliable guarantees for chemical production.

1. Commonly used chemical analysis methods in chemical material testing

1.1 Chemical analysis

Chemical analysis belongs to quantitative analysis, which mainly analyzes the chemical properties of materials through changes in the mass, reaction, and reagent consumption of chemical materials in chemical reactions. It specifically includes two types: gravimetric analysis and volumetric analysis. Gravimetric analysis refers to calculating the content of the substance to be tested based on the chemical reaction formula by measuring the weight of the precipitate of the substance in the chemical reaction. Volumetric analysis determines the titration endpoint through titration reactions and characteristic reaction characteristics, such as changes in the color of the precipitate and indicator, and then calculates the content of the substance to be tested through the concentration of the calibration substance.

1.2 Instrumental analysis

Instrumental analysis is the analysis of the chemical properties of substances with the help of corresponding instruments. Common instrumental analysis includes electrochemical analysis and photochemical analysis. (1)

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Electrochemical analysis is based on the principle of electrochemistry. This method has a very high sensitivity and is easy to operate. It can be used for the analysis of various organic or inorganic substances. It can also be automatically controlled with the help of automatic control systems. Therefore, it has been widely used in current chemical analysis. It includes a variety of different methods such as potentiometric titration, voltammetry, and conductivity. Among them, potentiometric titration is the most commonly used. It uses the change in electrode potential during the titration process to determine the titration end point. When approaching the isoelectric point, the potential in the solution will jump due to the sudden change in the concentration of the substance being measured, thereby indicating the titration end point [1]. (2) Photochemical analysis is based on the principle of spectroscopy. It is specifically divided into emission spectroscopy and absorption spectroscopy chemical analysis. Photochemical analysis can not only perform qualitative and quantitative analysis, but also structural analysis. Among them, emission spectroscopy determines the chemical composition and the content of the corresponding components by exciting the characteristic spectra of different substances. For example, atomic fluorescence spectroscopy and flame photometry are currently commonly used emission spectroscopy analysis methods. Absorption spectrum analysis is to analyze the chemical composition and structure based on the characteristic absorption spectra of different substances. Common methods include ultraviolet spectrophotometry, infrared spectroscopy, etc. Photochemical analysis methods are very sensitive and relatively simple to operate. They are often used to measure metal and non-metal elements in various chemical raw materials.

1.3 Chromatography

chromatography is that due to the different distribution of different molecules or ions in the solid phase or liquid phase, there will be differences in the flow rate in the mobile phase. In this way, the separation of components in the test substance can be achieved with the help of the flow direction. At this stage, gas chromatography, high performance liquid chromatography, and ion chromatography are commonly used. The essence of the chromatographic process is the process of distribution equilibrium between the molecules of the substance to be separated between the stationary phase and the mobile phase. Different substances will have different distributions between the two phases, which makes their movement speeds with the mobile phase different. With the movement of the mobile phase, the different components in the mixture are separated from each other on the stationary phase, and then the concentration and type of different components can be determined by chromatographic comparison. At this stage, the commonly used chromatographic analysis methods are as follows:

(1) Column chromatography. This method is one of the earliest chromatographic analysis methods. It actually uses a stationary phase to separate and extract component molecules and is generally used for separation of mixtures.

(2) Thin layer chromatography. When this method is used, it is necessary to lay out the stationary phase on a metal or glass plate, and then use a tool to place the sample on one end of the metal or glass plate. The sample is then placed into the mobile phase and separated by capillary action. This method is low-cost but has limited accuracy and is mostly used for rough sample measurements [2].

(3) Gas chromatography. Since different substances have obvious differences in boiling point polarity, etc., mixtures can be separated based on this. After the sample is vaporized, it enters the chromatographic column driven by the carrier gas (mobile phase). Due to the differences in their properties, each component will form a distribution or adsorption equilibrium between the mobile phase and the stationary phase. Through the repeated flow of the fluid, the components can undergo a repeated cycle of distribution/adsorption-desorption. During this process, the component with a high carrier gas concentration will flow out of the chromatographic column, while the component with a high distribution concentration will flow out later [3]. After the component flows out and enters the detector, the detector can generate a corresponding electrical signal. The greater the concentration or the higher the proportion of the component, the greater the electrical signal.

(4) High performance and ultra-high performance liquid chromatography. High performance liquid chromatography (HPLC) uses liquid as the mobile phase. Solvents or buffers of different polarities are pumped into the stationary phase chromatographic column through high-pressure infusion. After the chromatographic column separates the components, the sample is analyzed and detected through the detector. The principle of ultra-high performance liquid chromatography (UPLC) is basically the same as that of HPLC, but UHPLC has higher resolution, higher sensitivity and chromatographic peak capacity, and stronger ability to identify

chromatographic peaks. It is extremely suitable for the analysis of various complex components. It is one of the most important technologies in the current analysis of chemical raw materials.

2. Application of chemical analysis in chemical material testing

2.1 Detection of chemical material composition

In the current chemical production, chemical materials are constantly innovating and developing, showing characteristics such as diversification and complexity. There may be many different components in chemical materials. In order to better use chemical materials, it is necessary to accurately understand the composition of the components. Chemical analysis and detection technology can be used to qualitatively, quantitatively and qualitatively conduct comprehensive analysis of pure substances and mixtures in chemical materials, accurately understand the property structure of chemical materials, and clarify the use methods and precautions of chemical materials. Due to the different properties of different compounds, when conducting chemical analysis, it is necessary to reasonably adopt corresponding analysis methods and verify the results through different chemical analysis methods, so as to ensure the accuracy of chemical analysis results. In the past, weight analysis, volumetric analysis, electrochemical analysis, and spectrophotometry can all achieve good application results. With the development of current chemical analysis technology, chemical materials can also be analyzed by laser particle size method. This method relies on the monochromaticity and directionality of laser. When the laser encounters particle obstruction, scattering will occur. By detecting the intensity of scattered light at different angles, the particle size distribution of the sample can be detected. Based on this, it can be used to analyze the components in chemical materials [4]. It should be noted that when applying specific analytical methods, it is necessary to fully rely on established national standards or industry standards, formulate scientific and reasonable testing plans, and standardize operating procedures to minimize result errors.

2.2 Determine the reaction characteristics of chemical substances

In daily life and chemical production, various chemical materials are used. In order to avoid safety problems in the use of chemical materials, the reaction characteristics of chemical materials must be accurately mastered, such as stability, activity, etc. This requires the use of corresponding chemical analysis technology to conduct a comprehensive test of their performance. For example, some chemical materials have poor stability and are flammable and explosive substances. Safety accidents are very likely to occur in chemical reactions. At this time, it is necessary to analyze their performance under high temperature or high-pressure conditions. At the same time, it is also necessary to reasonably use chemical probes to detect the surface characteristics of the sample and judge its performance. At the same time, in chemical production, it is also necessary to manufacture products through reactions between different chemical materials. In order to verify the scientific nature of the process, chemical analysis methods can be used to analyze and judge the composition changes and final products of the chemical process during implementation, thereby providing help for process optimization and improvement. It should be noted that the methods used in chemical analysis are different, and the final judgment results may also be different. Therefore, in the reaction characteristics of chemical materials, it is necessary to use different methods in combination, such as combined chemical titration and electrochemical analysis, to ensure the accuracy and comprehensiveness of the reaction characteristic analysis results as much as possible.

2.3 Material structure analysis

The structural analysis of chemical materials is also one of the most important links in chemical analysis. By analyzing the structure of chemical materials, it can provide more in-depth data information support for chemical production and help chemical process research and optimization. Especially in the current fine chemical production, in order to make the material react according to the expected setting, it is necessary to analyze the structural changes of the corresponding material from the microscopic level. And with the continuous improvement and increase in the performance and functional requirements of chemical products, in chemical production, some products must have a specific molecular structure in order to have the corresponding performance and function. At this time, it is necessary to start from the internal molecular structure to conduct microscopic research on the material. For example, in lattice structure analysis, the diffraction spectrum can be used to determine whether it contains the required crystal plane or determine the content of a certain crystal plane according to the position and peak height of the 2θ angle. It is

necessary to determine the applicable field and structure formation process of the crystal, so as to guide chemical production and material use [5]. In the synthesis of organic matter, different configurations of substances will show differences in performance. For example, some substances have two configurations: boat-shaped and chair-shaped. If only the qualitative and quantitative methods used in the past are used, it is not possible to achieve a deep analysis of the structure of the substance. Therefore, it is currently necessary to use MRI and mass spectrometry to realize the analysis of its structural configuration. At the same time, high performance liquid chromatography or ultra-high performance liquid chromatography can be used to accurately determine the substance content of chemical materials, which has a better promoting effect on fine chemical control.

2.4 Determine the valence state and chemical form of chemical material elements

The same type of elements will have different performance differences in different valence states and chemical forms. In different valence states and chemical forms, the chemical reactions produced by chemical materials are different. In order to better ensure the quality and safety of chemical production, it is necessary to detect the elemental forms of chemical raw materials through chemical analysis technology. Since there are obvious differences in the chromatograms of different elements, the elemental forms of chemical raw materials can be analyzed by chromatography at this stage. Chromatography not only has high precision and accuracy in detection results, but also is easy to operate and has a fast detection speed. It can effectively save manpower and material resources and better serve chemical production.

3. Measures and suggestions for improving the accuracy of chemical analysis

3.1 Strictly control the chemical analysis operation process

Chemical analysis is a rigorous and systematic process, and clear chemical analysis operating procedures have been formed in the long-term development process. If irregular behaviors occur during the chemical analysis process, it will not only cause errors and affect the accuracy of chemical analysis and detection, but also may cause serious safety accidents. Therefore, in the chemical analysis process, the entire operation process must be strictly controlled. First, formulate corresponding management procedures for different chemical analysis projects, clarify the system norms that inspection and analysis personnel need to abide by in their work, and lay a good institutional foundation for chemical analysis management. Secondly, for the various instruments and equipment used in chemical analysis, combined with the operating instructions of the instruments and equipment, compile corresponding instrument and equipment operating procedures, and explain in detail the use methods and common troubleshooting methods of the instruments and equipment to prevent operators from violating regulations during the chemical analysis process, damaging the equipment and affecting the accuracy of the analysis and detection results [6]. At the same time, it is also necessary to strengthen training and skills assessment, and conduct regular special training on common and latest chemical analysis methods so that chemical analysis and inspection personnel can master the analysis methods of various raw materials. At the same time, it is also necessary to conduct skills assessment from time to time to continuously enhance the sense of responsibility and skill level of chemical analysts, effectively avoid the occurrence of irregular operating behaviors, and ensure the accuracy and precision of chemical analysis results.

3.2 Do a good job in updating and maintaining analytical instruments and equipment

Chemical analysis cannot be separated from various instruments and equipment. Especially at the current stage, the requirements for the accuracy of chemical analysis are constantly increasing, and the support of advanced chemical analysis instruments and equipment is needed. Therefore, at this stage, it is necessary to start from the two aspects of instrument and equipment update and maintenance management to lay a good material foundation for chemical analysis. On the one hand, it is necessary to reasonably configure the corresponding instruments and equipment in combination with the business conditions and strength of the enterprise to ensure that the hardware facilities can meet the requirements of chemical raw material analysis; on the other hand, it is necessary to formulate reasonable and scientific instrument and equipment maintenance management systems and measures, regularly inspect and maintain the instruments and equipment, and continue to troubleshoot faults and abnormalities in the instruments and equipment. In particular, precision chemical analysis instruments must be calibrated and maintained regularly to ensure the accuracy of the instruments and equipment and improve the accuracy of the test results.

3.3 Do a good job in the management of chemical analysis reagents and drugs

In chemical analysis, various reagents, drugs and standard substances are needed. If there are problems with the above items, it will inevitably affect the accuracy of chemical analysis and testing. Therefore, chemical companies must manage all kinds of reagents, drugs and standard substances. On the one hand, it is necessary to start with procurement management to ensure that the purchased items have corresponding certificates of conformity to ensure the quality of reagents, drugs and standard substances; on the other hand, it is necessary to start with storage management and store them reasonably according to the storage requirements of different reagents, drugs and standard substances to avoid the denaturation and deterioration of reagents, drugs or standard substances due to improper storage.

4. Conclusion

In summary, chemical analysis can provide reliable data and information support for chemical production, and is one of the most important technologies to ensure the safety of chemical production and improve the efficiency and benefits of chemical production. Therefore, in the current chemical material testing, it is necessary to pay attention to the research and application of various chemical analysis technologies, master the corresponding national standards and industry specifications, effectively control the relevant technical points, continuously improve the level of chemical analysis, and effectively ensure the accuracy of chemical analysis test results.

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