

Application of Test Paper Method in Analysis and Testing

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Abstract

Test paper has the characteristics of the scene quickly test pollutants, have been applied in many fields. This paper reviews the research progress in different areas of the test paper method, this paper introduces the test method to test the characteristics of the pollutant effect; At the same time its application in environmental testing method is discussed.

Keywords

Test paper; Environment examination; Research progress.

1. Current situation at home and abroad

In recent years, With the rapid development of China 's national economy and the progress of science and technology, People's living standards have been constantly improved, Material conditions have been greatly enriched, And living conditions have been constantly improved. How to detect various environmental pollutants quickly and accurately, For the prevention of accidents, It is very important to reduce or eliminate all kinds of potential safety hazards. The conventional instrument analysis method needs a long time to collect samples for environmental pollutants, transport, Handover, The test results can be obtained after laboratory analysis, These methods have high accuracy and detection limit ^[1], But highly dependent on instruments, High requirements for personnel professionalism, And the operation is tedious and time-consuming, Cannot meet the needs of rapid measurement on site. Test paper method is easy to carry Simple operation, Fast measurement speed and other characteristics, It plays a more and more important role in the field rapid determination. At present, the test paper method has been widely used in food, Water Quality, Agriculture, Health care and other fields, It also plays a role in some other fields.

2. An overview of the test paper method

The method of making test paper is simple, Generally, the developer is mixed into a solution, Dip on paper base, Drying in a proper way, Like natural air drying, Cold air drying, Drying and vacuum drying, etc. During the measurement, the way of contact between the test paper and the tested object is natural diffusion, Pull through, The tested sample drips onto the test paper or directly inserts the test paper into the solution, etc^[2]. After the sample contacts the test paper, Chemical reaction on test paper, The color of the test paper changes or generates a high gradient, Then compare it with the standard colorimetric card or scale, Conduct visual qualitative or semi quantitative analysis. Low cost of test paper method, Fast detection speed, And it has certain sensitivity and specificity, Be easy to carry about, Easy operation, The method is reproducible.

2.1 Application of test paper method in water quality detection

After 1970s, With the development of global industrial production and the prosperity of social economy, A large number of industrial wastewater and urban domestic wastewater are discharged into the water body, Increasingly serious water pollution, Water pollution directly endangers public

health and safety, Impact on economic sustainability. Especially in recent years, water pollution emergencies occur frequently, Seriously affecting people's drinking water safety, Huge impact, It is the most important to detect the change of pollutant concentration in the early stage of event development or even in the embryonic stage^[3]. Thus, It is of great application value to develop on-site water quality rapid detection technology, Among them, the test paper method may be the most widely used, One of the most active technologies.

Xu Zhenglong^[4] developed a new test paper for the determination of heavy metal lead and cadmium in water, Lead test paper based on pH = 5.5 sodium acetate acetic acid solution, Reaction of lead with 4 - (2-pyridylazo) - phloroglucinol (PAR), The test strip changes from yellow to light pink, Using the test paper to determine the acid making wastewater, There was no significant difference between the results of electroplating wastewater and FAAS; Preparation of cadmium test paper, Under acid condition, Cadmium ion reacts with iodine ion to form $(CdI_4)^{2+}$, The reaction between $(CdI_4)^{2+}$ and the test strip, Test paper changes from pink to purple, For the determination of Smelting Wastewater, Cadmium content in electroplating wastewater, There was no significant difference between the results and AAS. Zhao Xiujie et al.^[5] impregnated the biological dye malachite green (BG) on the quantitative filter paper to prepare the lead detection test paper and studied the reaction conditions of the test paper and Pb (II), The results show that, Add ascorbic acid to water sample in turn, KI and HNO₃, Adjust the concentration to 0.010, 0.15, 0.40 mol/L, The ternary ion association complex BG₂ [Pb₄] formed by Pb (II) and malachite green on the test paper, The color of the association compound is directly proportional to the concentration of Pb (II) in the water sample, The detection limit of Pb (II) is 0.50 mg/L, The interference ions in water samples can be masked by 0.5% cysteine. The paper has good selectivity for Pb (II), Good repeatability, Simple operation process, It can meet the needs of rapid detection of Pb (II) in water samples. Guo Yuxiang et al.^[6] developed a test paper for rapid detection of heavy metal cadmium in environmental water, Adding ascorbic acid and potassium iodide to water sample, The concentrations were 0.005 mol/L and 0.15 mol/L respectively, Use HNO₃ to adjust the pH value of water sample from 0.4 to 1.0, Reaction of CD (II) with test paper to form blue complex, Color depth is directly proportional to CD (II) concentration in water. Zhan Chunmei et al.^[7] made test paper for aluminum, And its application is verified. Immerse the test paper in salicylfluorone immersion solution for 10 min, After twice soaking, Dry at 60°C for 15 min and put it in photoelectric colorimeter, Detection at 560 nm, The reaction time is 6 min. The obtained standard curve has a good linear relationship in the range of 0-1 UG / ml aluminum content, There was no significant difference between the test paper method and Chromazurol S spectrophotometry. Duan Bo et al.^[8] Based on the principle of Spectrophotometric Determination of chromium with diphenylcarbazide, After comparison and screening, A test paper for the determination of chromium in environmental water was developed.

2.2 Application of test paper method in agricultural inspection

The use of chemical fertilizer and pesticide is very common in the process of agricultural development in China, Features: high strength, High frequency, But the efficiency is low^[9]. A large number of chemical fertilizer and pesticide residues not only cause serious environmental pollution, It is also easy to harm human health. To establish a rapid detection method in the field of agriculture to control environmental pollution, It is of positive significance to ensure the quality of agricultural products and maintain human health. Because of its low price, the test paper method, Convenient and quick, Simple operation, Easy to carry and other features become a good choice.

Zhou rongling et al.^[10] discussed the best reaction conditions^[10] of test paper and tannin, A rapid method for the determination of tannin in Sorghum by Fe (SCN)³⁻ chitosan test paper was proposed, The results show that, At pH 7.0-9.0, Tannin reacts with the chromogenic substance on the test paper to form a purple red stable compound, The color of the test paper is directly proportional to the tannin concentration in the sample, Determination of tannin concentration by comparison of standard chromatogram. Liu Chang et al.^[11] developed a rapid test paper based on enzyme inhibitor method to detect pesticide residues in fruits and vegetables. This paper uses duck plasma cholinesterase as the

detection enzyme, 2,6-dichloroindophenol acetate as substrate. Visual judgment of pesticide residues based on color change after reaction, Strong positive, Weak acid and negative colors are white, Light blue and blue. The detection time of this method is only 13 minutes, The detection limit is 0.001-6mg/kg. Sha Lingjie et al.^[12] passed the goal of cabbage, Field experiment of cabbage and cucumber, In this paper, the rapid measurement of Cucumber in the field by the method of reverse colorimeter nitrate test paper was studied, Nitrate content in petiole juice and soil of cabbage and cabbage, Nitrogen application rate, Relationship between nitrate content and yield in vegetable food. Zhang Xiaomei^[13] compared the reflectometer-K⁺ test paper method, Atomic absorption spectrometry, Three methods for determination of K⁺ in leaf vein juice of tobacco plant by ICP-AES, Determination of the feasibility and the best range of the reflectometer-K⁺ test paper method for the determination of potassium content in tobacco plants.

2.3 Application of test paper method in other fields

According to different test substances, The test paper method has been applied in many aspects, With the development of the times and the progress of science and technology, More and more people are exploring the test paper method in the field of higher technology content.

Zhang Wenzhe et al.^[14] take the multistage fiber structure of filter paper as the template, SERS test paper was prepared by physical vapor deposition and evaporation of silver film for 30 minutes, The minimum detection limit can reach 10-10mol / L, SERS activity can be maintained in 9 hours after exposure to air, Sealed nitrogen can keep its activity unchanged after 30 days storage, Make it possible to apply SERS detection in daily life and production. The probe molecule RCU based on rhodamine was designed and synthesized by Yang Hongbao et al.^[15], Selective recognition of Cu²⁺ can be realized, RCU itself has no color in the test system of HEPES buffer solution (2×10^{-5} mol / L, pH = 7.4), When Cu²⁺ is added, the solution turns pink, And the addition of other common metal cations has no color change. Probe molecules recognize low concentration of Cu²⁺, The detection limit is 6.37×10^{-8} mol / L. At the same time, probe molecules can be used for the test paper detection, Cu²⁺ in water sample can be detected at low concentration, It has certain practical value. Che Hongxia et al.^[16] realized the quantitative detection and analysis of lactoperoxidase for the first time by the test paper method instead of the traditional test tube method with the help of portable photoelectric colorimeter, Detection index based on reflection value, From buffer pH, Concentration of tetramethylbenzidine (TMB), Hydrogen peroxide (H₂O₂) concentration, And surfactants, Optimize the conditions of making test paper; Pass the precision test, Analysis of the correlation between the minimum test concentration and the test tube method, Evaluate the reliability and accuracy of test paper detection method.

3. Expectation

The test paper method is a fast detection method applied in the field, With ease of operation, Low cost, Strong replicability and other characteristics are widely used in the detection of food, water quality, agriculture, medical health and other fields.

It is found that the establishment of a new chromogenic agent and a high sensitive chromogenic system provides a better guarantee for the rapid and accurate detection of the test paper method on the spot.

Introduction of organic reagents and multicomponent complexes, Enhance the stability time of developer, Extend the shelf life of test paper, Promote the development of photometric analysis.

Add proper amount of surfactant, Improve the stability of the reaction, Improve the sensitivity of detection method, Speed up response Enhance the reaction signal between the substance to be tested and the developer.

Find the right masking agent, The most possible elimination of interference ions, Improve the accuracy of detection method.

From traditional qualitative or semi quantitative detection to accurate quantitative analysis, It provides a broad development space for the application of test paper method. Develop efficient color system for other testing items, Research and manufacture more test paper with excellent performance, So that in the sensitivity, Detection range, Greater breakthrough and better development prospect in response time.

References

- [1] Zhou Huanying, Gao Zhi Xian, Cui Xiao Liang, Application of test paper method in food quality and other rapid detection [J], Journal of preventive medicine of PLA, 2003, 21 (2) :148-151.
- [2] Cai Wenting, Zhang Jia, Zhao Jie, et al., Application of test paper method in the field of food and water quality detection [J], Anhui Agricultural Science, 2015, 43 (3) :214—216.
- [3] Yi Ying, Study on the technology of rapid on-site detection of water quality [D], Xiangtan: College of chemical engineering, Xiangtan University, 2013:1-58.
- [4] Xu Zhenglong, Development of a new test paper for the determination of heavy metals in water [D], Shenyang: School of environment and chemical engineering, Shenyang University of Technology, 2013:1-76.
- [5] Zhao Xiujie, Ying Ming Xu, Fei Xuening et al., Rapid determination of Pb (II) [J] in water samples by biological staining paper method, Journal of Agricultural Environmental Science, 2006, 25 (4) :1006- 1009.
- [6] Guo Yuxiang, Ying Ming Xu, Sun Youguang et al., Rapid detection of heavy metal cadmium in water by test paper method [J], Journal of Agricultural Environmental Science, 2006, 25 (2) :541-544.
- [7] Zhan Chunmei, Tian ran, Zheng Dongmei et al., Study on Rapid Determination of aluminum content in water by test paper method [J], food industry, 2015, 36 (3) ,295-297.
- [8] Dubo, Yuan Bin, Lu Song, Rapid detection of heavy metal chromium in water by test paper method [J], Industrial water treatment, 2008, 28 (10) :68-70.
- [9] Yi Pengbo, Current situation of agricultural pollution in China and its control progress [J], Business Manager, 2014 (30) :384.
- [10] Zhou rongling, Zeng Na, Dai Yu, et al., Rapid determination of tannin in Sorghum by paper test [J], Analysis Laboratory, 2013, 32 (7) :36-39.
- [11] Liu Chang, Lu Lei, Li Shuqian et al., Rapid detection of organophosphorus and carbamate pesticide residues in fruits and vegetables by test paper method [J], Chinese Journal of food, 2012, 12 (6) :154-158.
- [12] Sha Lingjie, Li Zheng Ying, Zhu Li, et al., Rapid measurement of nitrate level in vegetables by reflectometer nitrate test paper method and its application [J], Journal of Agricultural Environmental Science, 2005, 24 (5) :994-999.
- [13] Zhang Xiaomei, A preliminary report on the rapid determination of tobacco potassium content by potassium ion test paper method [J], Basic science of Agriculture, 2006, 22 (6) :142-145.
- [14] Zhang Wenyi, Xiao Xinze, Liu Xueqing, etc, Preparation and quality assurance of surface enhanced Raman test paper [J], Journal of University Chemistry, 2013, 6 (34) :1385-1388.
- [15] Yang Hongbao, Du Jian Jun, Zhou Li et al, Visual recognition of copper ions in water by dye probe molecules and application of test paper [J], Journal of Chemical Engineering, 2015, 66 (2) :591-596.
- [16] Hong-xia CHE, Bo TIAN, Li-na BAI et al, Development of a test strip for rapid detection of lactoperoxidase in raw milk [J]. Che et al. Zhejiang Univ-Sci B (Biomed & Biotechnol) .2015.16 (8) :672-679.