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RESIDUAL CHLORINE IN TREATED WATER: A REVIEW

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ABSTRACT

Ensuring the safety and quality of drinking water is paramount for public health. Water treatment plants employ various processes such as chlorination, sedimentation, and filtration to remove impurities and pathogens. One critical aspect of water safety is monitoring residual chlorine levels, as chlorine helps prevent microbial contamination.

This paper explores different methods for detecting chlorine in drinking water, including the Digital Colorimetric Method, Titration Method, DPD (N,N-diethyl-p-phenylenediamine) Method, and Colorimeter Method. Each method offers unique advantages in terms of accuracy, simplicity, and efficiency. The Digital Colorimetric Method involves the use of DPD tablets or powder to induce a color change in the water sample, measured by a colorimeter. The Titration Method relies on chemical reactions to determine chlorine levels through careful measurement of titrant solution volume. The DPD Method utilizes DPD reagent to produce a colored compound in reaction with chlorine, measured by a colorimeter or spectrophotometer. The Colorimeter Method employs a color indicator to detect chlorine, quantified using a colorimeter.

These methods play a crucial role in water quality assessment and monitoring efforts, helping to ensure that drinking water meets safety standards. By accurately measuring chlorine levels, these techniques contribute to safeguarding public health and maintaining the integrity of drinking water supplies.

I. INTRODUCTION

Water is super important, so it's really necessary that the water we drink is clean and safe. To make sure of this, water treatment plants clean the water by removing dirt and other stuff we don't want in it. They use processes like sedimentation and filtration to do this. It's important to keep our drinking water healthy and tasting good. There are rules in place to make sure our drinking water is safe for us to use. It is One common test used in water treatment plants is called the residual chlorine test. This test checks how much residual chlorine is left in the water after it's been treated. Residual chlorine is important because it helps prevent germs and other harmful stuff from growing in the water, keeping it safe for us to drink. For normal domestic use, residual chlorine levels at the point where the consumer collects water should be between 0.2 and 0.5 mg/l.

The goal of testing is to figure out the right amount of sodium hypochlorite solution to add to drinking water. This helps maintain a safe level of free chlorine in the water during storage in households, which usually lasts for 4-24 hours. This is different from the goal of big water treatment systems that clean water for entire neighborhoods. They aim to disinfect the water effectively at the taps. According to the World Health Organization (WHO), they need to make sure there's at least 0.5 mg/L of free chlorine in the water after 30 minutes of contact time, especially if people drink the water straight from the tap.

In our paper, researchers explored several methods for detecting chlorine in drinking water. These methods play a crucial role in ensuring the safety and quality of our drinking water supply. Among the methods discussed are the Digital Colorimetric Method, which involves the use of special tablets or powder to induce a color change in the water sample, and then measuring this change with a device known as a meter. The Titration Method, another approach we covered, relies on chemical reactions to determine chlorine levels by carefully measuring the amount of a specific chemical needed to neutralize the chlorine present. Additionally, we discussed the DPD (N,N- diethyl-p-phenylenediamine) Method, which employs chemical reactions to detect chlorine, and the Colorimeter Method, which uses a colorimeter device to measure color intensity after adding certain chemicals to the water sample. Each of these methods offers valuable insights into the chlorine content

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of drinking water, contributing to the overall efforts to maintain water safety andquality for consumers.

II. DESCRIPTION

Residual chlorine refers to the small amount of chlorine that remains in water after a certain periodfollowing its initial application. It plays a crucial role in preventing subsequent microbial contamination, thus safeguarding public health.

To combat waterborne diseases, various disinfection methods are employed to deactivate pathogens. Chlorination, along with processes like coagulation, sedimentation, and filtration, ensures that water is safe for consumption.

Chlorination, an age-old method first utilized over a century ago, remains a key approach for disinfecting water. It involves the use of chemicals to kill bacteria and viruses, although it may not be effective against some protozoan cysts. However, concerns about the formation of trihalomethanes, a carcinogenic by-product, have led some communities to reconsider the continued use of chlorination.

2.1 Significance

Disinfection: The primary purpose of adding chlorine to water is to disinfect it by killing or inactivating pathogenic microorganisms such as bacteria, viruses, and protozoa. Residual chlorine ensures that the water remains free from harmful pathogens as it travels through the distribution system to consumers.

Maintaining Water Quality: Residual chlorine helps maintain water quality throughout the distribution network. It provides a continuous disinfection barrier that prevents microbial regrowth and contamination during storage and transport, reducing the risk of waterborne diseases.

Safety Assurance: Residual chlorine levels are closely monitored and regulated by water treatment authorities to ensure that the water remains safe for consumption. Adequate residual chlorine indicates that the water has been effectively treated and is less likely to cause health problems.

Effective Disinfection over Time: Residual chlorine provides ongoing protection against microbial contamination even after the initial chlorination process. This is crucial in preventing the recontamination of water as it travels through pipes and storage tanks before reaching consumers.

Emergency Response: In cases of waterborne disease outbreaks or contamination incidents, maintaining a residual chlorine level in the water distribution system can act as a safeguard by quickly killing any pathogens introduced into the system, thereby minimizing the impact on publichealth.

Regulatory Compliance: Many regulatory agencies and health organizations set standards for residual chlorine levels in drinking water to ensure its safety. Monitoring and maintainingappropriate residual chlorine concentrations are essential for meeting these regulatoryrequirements.

Cost-Effective Solution: Chlorine disinfection, including the provision of residual chlorine, is a cost-effective method widely used in water treatment plants globally. It offers reliable and efficientmicrobial control, making it a preferred choice for ensuring safe drinking water.

2.2 Effects of Residual chlorine

Ingesting chlorine, particularly in large amounts, can indeed lead to a range of adverse health effects, including stomachaches, vomiting, and diarrhea, as well as dry, itchy skin. Chlorine is commonly used in disinfection processes, such as in swimming pools or in the purification of drinking water. However, excessive exposure or ingestion of chlorine can be harmful.

Chlorine gas, in particular, is highly toxic and can cause severe respiratory issues and even death if inhaled in significant quantities. Liquid chlorine, which is used in various industrial processes, can also pose serious health risks if ingested or handled improperly.

It's important to handle chlorine-based products with care and follow safety instructions provided by manufacturers or health authorities to minimize the risk of exposure and potential poisoning. If someone experiences severe symptoms of chlorine poisoning, such as difficulty breathing or loss of consciousness, immediate medical attention should be sought.

Health Effects of Chlorine Ingestion: Ingesting chlorine, especially in large amounts, can result in various adverse health effects such as stomachaches, vomiting, diarrhea, and dry, itchy skin.

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Common Applications of Chlorine: Chlorine finds widespread use in disinfection processes, notably in treating swimming pools and purifying drinking water.

Hazards of Chlorine Gas: Chlorine gas is highly toxic and can lead to severe respiratory problems and even fatalities if inhaled in significant quantities.

Dangers of Liquid Chlorine: Liquid chlorine, employed in diverse industrial processes, also presents serious health risks if ingested or handled improperly.

Importance of Safe Handling: It is imperative to handle chlorine-based products with caution and adhere to safety guidelines provided by manufacturers or health authorities to mitigate the risk of exposure and potential poisoning.

Prompt Medical Attention: Individuals experiencing severe symptoms of chlorine poisoning, such as difficulty breathing or loss of consciousness, should seek immediate medical assistance.

III. METHODS FOR DETERMINATION OF RESIDUAL CHLORINE

- **Digital Colorimetric method**

The Digital Colorimetric Method is a commonly used way to check for chlorine in drinking water.First, we take a sample of the water we want to test. Then, we add special DPD tablets or powder to the sample. These tablets contain a substance that reacts with chlorine, making the water turn pink.

After that, we put the sample with the DPD tablets into a machine called a colorimeter. This machine shines a specific type of light through the sample and measures how pink it is.

The colorimeter shows us on a screen how pink the water is, which tells us how much chlorine is in it. This measurement is usually given in milligrams per liter (mg/L) or parts per million (ppm). By looking at the measurement, experts can decide if the chlorine level is safe for drinking water.The Digital Colorimetric Method is a quick, accurate, and easy way to find out how much chlorine is in drinking water, helping us make sure it's safe to drink.

Residual chlorine in drinking water is typically measured using various methods.

- **Titration method**

The Titration method stands as a widely used technique for detecting chlorine levels in drinking water. This method involves a systematic process:

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Initially, a representative sample of the drinking water is collected and meticulously prepared for analysis. In the titration procedure, a chemical reaction ensues between the chlorine present in the water sample and a titrant solution containing a chemical indicator. This indicator undergoes a visible color change upon the completion of the reaction, signaling the endpoint of the titration.

Throughout the titration process, the titrant solution is methodically added to the water sample until the observed color change indicates the reaction's endpoint. This pivotal point, known as the endpoint, marks the cessation of the chlorine reaction.

Subsequently, the volume of the titrant solution required to reach this endpoint is accurately measured. By utilizing the volume of the titrant solution and its known concentration, the concentration of chlorine in the water sample can be precisely calculated.

Water quality analysts interpret this calculated concentration to ascertain whether the chlorine level complies with the designated limits for safe drinking water. the Titration method offers a dependable and precise means of detecting chlorine levels in drinking water, thereby serving as a vital tool in water quality assessment and monitoring efforts.

- **The DPD (N,N-diethyl-p-phenylenediamine) Method**

The DPD (N,N-diethyl-p-phenylenediamine) Method is a commonly used technique for detecting chlorine in drinking water.

Initially, a sample of the drinking water is collected and carefully prepared for analysis. In this method, a reagent containing DPD is added to the water sample. DPD reacts with chlorine present in the water to form a colored compound.

This reaction results in a visible color change in the water sample, with the intensity of the color directly proportional to the concentration of chlorine. To quantify the amount of chlorine present, the color intensity is measured using specialized instruments such as a colorimeter or spectrophotometer. These instruments precisely measure the intensity of the color produced, allowing for the determination of chlorine concentration in the water sample. Water quality analysts interpret this concentration measurement to assess whether the chlorine level meets the designated safety standards for drinking water.

The DPD Method is appreciated for its simplicity, accuracy, and sensitivity in detecting chlorine levels, thus serving as a valuable tool in ensuring the safety and quality of drinking water.

- **Chloroscope Method**

The "Chlorine Tester" uses the Acid Orthotolidine Method to determine the chlorine concentration in water.

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The test is based on the fact that when one or two drops of Orthotolidine reagent are added to a test tube containing the sample of chlorinated water, the water sample develops yellowish colour. The depth of developed yellow colour depends upon the chlorine content in the water sample.

Procedure to use Chlorine Tester:

Fill the water to be tested in transparent plastic/glass tubes.

Insert this third tube in the middle hole of chloroscope.

Keep one tube in right hole & another in left hole.

Close Chloroscope with the cap, yellow colour in the middle.

In the third tube put two drops of 0O.T liquid & shake. If chlorine is present then it will turn yellow.

IV. CONCLUSION

Residual chlorine is crucial for maintaining the safety and quality of drinking water by preventing microbial contamination. Despite concerns, chlorination remains a primary method for water disinfection. Various methods like Digital Colorimetric, Titration, DPD, and Colorimeter can be used to measure residual chlorine levels accurately. Residual chlorine ensures ongoing protection against contamination, helps in emergency response, ensures regulatory compliance, and is a cost-effective solution for water treatment.

Overall, chlorine disinfection, including the provision of residual chlorine, remains a cost-effective and reliable solution for ensuring public health and safety.

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