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VERSION: This Technical Talk replaces and supersedes all previous versions.

Introduction

Disinfectants and sanitizers are chemical substances or mixtures of substances and are registered through the US EPA with efficacy (kill) claims for microorganisms at a certain concentration of chemical active(s) with specific contact times. The chemical identity and concentration of each active can be found on the product or EPA master label, which correlates to the EPA Registration number for that disinfectant/sanitizer. Many of these products are sold as concentrates, which are then diluted with water at the point of use either manually or using a dilution system (sometimes called a dispenser or proportioner). Ready-to-Use (RTU) solutions may then be stored and applied in a variety of ways, but the user must reference the on-product label for the specific applications and directions in which to use this product. It is important to note that it is a violation of Federal law to use a disinfectant in a manner that is inconsistent with its labeling. There are a number of factors that could cause the chemical active concentration in these solutions to vary from the intended concentration indicated in the EPA registration. Dyes are often added to these products and can be a rough indicator of concentration, but dye color can be affected by factors such as water hardness, pH, and temperature, so its usefulness is limited for verification of disinfectant or sanitizer concentration.

Measuring disinfectant or sanitizer active concentration "in the field" after dilution or during product use can be a valuable technique for verifying the accuracy of your dilution and help to ensure the efficacious nature of your disinfecting and/or sanitizing solution. It can also help to determine if steps in your process are adversely affecting disinfectant or sanitizer concentration. However, it is important to understand the application and limitations of your measurement technique to gain the maximum benefit.

It is a violation of Federal Law to use a disinfectant in a manner that is inconsistent with its labeling.

Evaluating Measurement Methods

Determining the chemical identity of your disinfectant and/or sanitizer active ingredients is the first step in evaluating potential measurement methods. One of the most commonly used actives are quaternary ammonium chloride compounds (quats), but other actives such as chlorine bleach (sodium hypochlorite), NaDCC (sodium dichloroisocyanurate), phenolics, or peracetic acids and/or hydrogen peroxide products can also be found. There are a variety of products for measuring quats, peroxide, or chlorine in the field, but in some instances, there may be no field-use products for some of the other active ingredients. You may need to consult with an analytical laboratory about potential testing of actives where no field measurement method exists or if you need more accurate results than can be obtained using field methods.

There are several suppliers of these field measurement methods. Always follow the manufacturer instructions for use and how to interpret results.

Starting Your Measurement Program

Federal, state, and/or local health regulations may require users of quaternary ammonium solutions to have appropriate test kits available to verify the concentration of disinfectant solutions.

We recommend that end users periodically check their disinfectant and/or sanitizer active concentration levels to help ensure dilution and active ingredient accuracy. This can be accomplished via the use of test strips, titration kits, and/or analytical methods. The frequency of disinfectant and/or sanitizer measurement it to be determined by the end user or facility. Factors that may determine the frequency of checks include: type and number of dilution systems, number of personnel with access to the dilution systems, level of education and/or training of personnel with access to the dilution systems, age of systems, facility protocol and type of institution, amongst other factors.

The remainder of this Tech Talk will focus on measuring quat or chlorine actives in disinfectants and sanitizers with field-use methods, though that does not imply that only quat or chlorine products are prone to problems that may affect their concentration.

Regulators and inspectors who may review the results of these measurements should be asked to keep in mind that those records reflect efforts to evaluate and improve the disinfection and sanitization process by taking advantage of the ability to easily measure certain actives in the field. Therefore, it would be unfortunate to penalize the user for low quat results, for example, while no field measurement results may be available for other active ingredients to help with process improvements.

After identifying the chemical identity of your active ingredient(s), determine what the RTU concentration should be, based on the EPA registration of the product. It is best to obtain the EPA-approved RTU ppm value for the disinfectant active from the product manufacturer, but the following formula can be used to approximate the parts per million (ppm) value from the ingredient information on a product label if you are not able to obtain it from your supplier.

How to calculate RTU PPM QUAT in a disinfectant:

(Sum of % Actives)\(dilution) x 10,000 =___ ppm of your QUAT
Example: Quat concentrations listed on label are Quat A: 13.238% Quat B: 13.238% Inert Ingredients: 73.524%

Dilution rate listed on the label is 1:365

Add the total active ingredients and use the above equation to approximate the PPM QUAT.

Sum of % Actives: 13.238% + 13.238% = 26.476%

26.476% / (365) X 10,000 = 725 ppm

Test Strips

Test strips represent one common field measurement method for determining quats or chlorine actives in disinfectants and sanitizers. Test strips usually have individual segments on them that will change color in response to certain level of the active chemical being measured and will cover a range of concentrations (example 0 up to 10,000 ppm) typical to disinfectants or sanitizers. They are easier to use than titration kits; however, the color variation between concentration readings can be subtle and the concentration increments can be too large (such as several hundred ppm) to make them useful in determining small differences in concentration levels.

When using test strips, it is important to choose a test strip with a measurement range that brackets the expected active concentration; for example if measuring an active concentration of 600 ppm, select a test strip with a range that is both above and below the target level, with the smallest increments possible.

Titration Kits

Titration kits can be used to obtain a more accurate active concentration reading than test strips; however, it is important to know that titration kits will also have a margin of error. The website for one commonly used supplier, LaMotte, is www.lamottte.com and their #3042 Titration Kit covers a range of quat concentration found in many quat based disinfectant products. However, as an example of margin of error with field measurement as previously mentioned, a range of plus or minus 50 ppm can be expected for this particular kit. Additionally, a Gage R&R statistical study performed by 3M to assess the reproducibility and repeatability of the LaMotte #3042 kit confirmed these results. From a practical perspective, this means that when the “real” level of quat is, for example, 710 ppm, a range of 660 to 760 ppm can be reasonably expected. It is important to obtain this margin of error information from the manufacturer of any field measurement kit so that results can be interpreted appropriately.

In addition to the margin of error inherent in the titration kits, there is also the potential for user error when conducting the titration or interpreting results. This type of error may impact the results significantly, so it is important to use a standard, repeatable process.

Analytical Method

While the use of an analytical method performed by a reference lab is not practical for a field measurement on-site, it may be an option if greater measurement accuracy of a disinfectant or sanitizer active ingredient concentration is required or desired. There are many reference chemistry analytical laboratories throughout the US that have a capability to quantitate disinfectant active concentration using validated analytical methods, such as high performance liquid chromatography (HPLC). The use of this type of analytical chemistry laboratory measurement is more costly and requires additional time to reproduce results compared to test strips and titration kits.

3M Chemical Disinfectant Concentrate Mass Weighing

A procedure to deterimine active ingredient concentration of 3M chemical disinfectants is mass weighing of the concentrate container before and after dispensing.

- Prior to testing, ensure that the dispensing unit and hoses/tubes are in good working order and free of leaks when supplied with water.
- Ensure caps for chemical supply are free of residue and allow full flow of chemical concentrates.
- Carefully weigh the chemical concentrate bottle and record the value in grams.
- Carefully weigh the container to be dispensed into in grams.
- Dispense the chemical concentrate from the system as normal into the container, capturing all dispensed liquid.
- Record the "total dispensed amount" into collection container (example: 5 gallons). (Note: you will need to pre-weigh the container and tare the scale to "0" prior to re-weighing after dispense).
- Remove the concentrate bottle and weigh it again. Record the weight of bottle after dispensing in grams.
- Calculate: weight of chemical dispensed = weight of bottle before dispense – weight of bottle after dispense.
- Calculate: Dilution 1: X = (total dispensed amount - weight of chemical dispensed)/ weight of chemical dispensed.
- Verify dilution is within acceptable dilution range for subject chemical concentrate according to the product technical document.

Summary

Measuring the concentration of your disinfectant or sanitizer solution can be a useful way to help ensure the effectiveness of your process and efficacious nature of your solution. Test strips and titration kits are the two primary field measurement methods used, but carefully following manufacturer directions and understanding the limitations of any method is important when interpreting results. It is important to use a method intended for the type of active and expected concentration in your disinfectant or sanitizer. Other aspects of your measurement program (such as how often to test) will depend on a number of variables, including the reliability of your products and the consistency of your processes.

Commercial Solutions
3M Center, Building 220 12E-04
St. Paul, MN 55144
1-800-328-0033
3M.com/Facility

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