

TO SANITIZE OR TO DISINFECT: THAT IS THE QUESTION



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With rising concerns over the spread of infectious diseases, viruses and germs, disinfectants and sanitizers are now more popular than ever. With so many options at your disposal and so many uses for these products, what is the best way to use these disinfectants and sanitizers? Below is a quick reference guide.

I. Basic Definitions:

The terms “**Disinfection**” and “**Sanitization**” are often used interchangeably despite the fact that they perform different functions, though such functions may overlap. **Disinfection** is any process whereby the potential of an item to cause infection is removed by reducing the number of micro organisms present. Such a process may not necessarily eliminate all micro organisms, but can reduce them to a level where they can no longer initiate infection. In sum, a disinfectant is a chemical capable of achieving disinfection. The process of **sanitization** means to reduce the number of microorganisms to a safe level. Officially, a sanitizer must be capable of killing 99.999% (known as a 5 log reduction) of a specific bacterial test population within 30 seconds. By contrast to a disinfectant, a sanitizer may not necessarily destroy pathogenic or disease causing bacteria. Thus, the main difference between a sanitizer and a disinfectant is that at a specified use dilution, the disinfectant must have a higher kill capability for pathogenic bacteria compared to that of a sanitizer. For example, an iodophor, when used at 25 ppm (parts per million of available iodine), is considered to act as a sanitizer. However that same product when applied at 75 ppm falls into the disinfectant category. Quats (quaternary ammonium compounds) and hypochlorites are other examples in which the use concentration of the product defines its classification. Very few disinfectants or sanitizers can **sterilize**, meaning to completely eliminate all microorganisms, and those that can depend entirely on their mode of application.

II. Disinfectants:

Disinfectants are frequently used (i.e. in hospitals, surgeries, kitchens, bathrooms and offices) to kill infectious organisms in high traffic areas. Critical touch point areas include bathrooms, sinks, counters, doorknobs, light switches, bed and hand rails, elevator buttons, desks, phones and computer keyboards,

Unfortunately, perfect disinfectants simply do not exist, as they, by their very nature, are potentially harmful to humans and animals. Thus, they should be used very carefully. Most disinfectants come with safety instructions, which should be read, followed, and used with appropriate care. As a general rule, they should never be mixed with other cleaning products as chemical reactions can occur.

The choice of the disinfectant to be used depends on the particular situation. Some disinfectants have a wide spectrum (kill nearly all microorganisms), while others kill a smaller range of disease-causing organisms but are preferred for other properties (they may be non-corrosive, non-toxic, or inexpensive).¹

1 Source: (<http://www.chemie.de/lexikon/e/Disinfektant/>)

III. Types of Disinfectants:

- A) Quaternary ammonium compounds (or Quats)**², such as benzalkonium chloride, are a large group of related compounds. Quats have varied germicidal activity and are generally used in low-level sanitization as they are effective against bacteria, but not against some species of *Pseudomonas* bacteria or bacterial spores. They are also effective disinfectants against enveloped viruses. Quats are biocides which also kill algae and are used as an additive in large-scale industrial water systems to minimize undesired biological growth. Their main advantages are that they are odorless, non-staining, non-corrosive to metals and are relatively non-toxic at use-dilution concentrations. As sanitizers they exhibit a wide latitude in germicidal activity when used in hard water and are effective over a wide pH range. Quats leave a non-volatile residue on surfaces to which they are applied, rendering the surfaces bacteriostatic for a given time. For this reason they are rarely used in dairies where cheese is manufactured; doing so could increase the risk of inactivating desirable bacterial cultures used in cheese production.
- B) Hydrogen peroxide** is often used in hospitals to disinfect surfaces, as well as in the food packaging industry to disinfect foil containers. A 3% solution can also be used as an antiseptic. When hydrogen peroxide comes into contact with the catalase enzyme in cells, it is broken down into water and a hydroxyl free radical. It is the damage caused by the oxygen free radical that kills bacteria. Hydrogen peroxide is preferred as a disinfectant because it causes far fewer allergic reactions than alternative disinfectants. Contrary to other chemical substances, hydrogen peroxide does not produce residues or gasses. Safety depends on the applied concentration, because hydrogen peroxide is completely water soluble. Also, it has an improved health and environmental impact compared to the other types of chemicals. These products are typically sanitizers and not disinfectants, and may not always be appropriate for high-risk applications.
- C) Alcohol**, usually ethanol or isopropanol, is wiped over skin and allowed to evaporate for quick disinfection. These substances have wide microbicidal activity, are non-corrosive, but can constitute a fire hazard. They also have limited residual activity due to evaporation, which results in brief contact times, and have a limited activity in the presence of organic material. Alcohols are more effective when combined with purified water—70% isopropyl alcohol or 62% ethyl alcohol is more effective than 95% alcohol. Alcohol, however, is not effective against fungal or bacterial spores.
- D) Bleach** is a chemical that can remove or lighten color, usually via oxidation. There are several types of bleach. Chlorine bleach usually contains sodium hypochlorite. Oxygen bleach contains hydrogen peroxide or a peroxide-releasing compound such as sodium perborate or sodium percarbonate. Bleaching powder is calcium hypochlorite. Other bleaching agents include sodium persulfate, sodium perphosphate, sodium persulfate, their ammonium, potassium and lithium analogs, calcium peroxide, zinc peroxide, sodium peroxide, carbamide peroxide, chlorine dioxide, bromate, and organic peroxides (e.g., benzoyl peroxide).
- While most bleaches are oxidizing agents, other processes can be used to remove color. For example, sodium dithionite is a powerful reducing agent that can be used as a bleach.

² See **Schedule A** for additional information on Classifications of Quats into Generations



- E) Phenolics**, are effective at sanitization and disinfection in the presence of biological fluids and are tolerant towards a certain level of organic presence. Phenolics suffer from the disadvantage that they are relatively expensive to use, and react with certain types of plastic surfaces. They are also difficult to oxidize and therefore difficult and expensive to dispose of in an environmentally suitable manner.

IV. The Proper Use of Disinfectants

The process of disinfection is important to prevent the spread of viruses and infectious diseases. Both antibacterial wipes and disinfectants are a readily available, convenient, and popular way to get the job done. But are they effective? They can be, when used correctly. However, when used incorrectly, they may actually spread germs.

- **Select the proper disinfectant:** Disinfectant products work by oxidizing the germs, breaking down their cell walls, or otherwise deactivating them. Different ingredients or combinations of ingredients kill different germs. Therefore, select a disinfectant that works on the specific germs you are trying to get rid of or select a broad-spectrum product that works on all of the germs that you might encounter. For example, to prevent the spread of MRSA, use disinfectants registered by the DIN³. Note that the DIN requires that all disinfectants be registered; this registration should not imply a sense of safety. (*Information on EPA Product Testing for the United States can be found in Schedule B.*)
- **Follow instructions:** Be sure that cleaning procedures allow for a sufficient amount of the disinfectant on the surface, as well as for the disinfectant to stay on surfaces for the full amount of time recommended by product instructions. Leaving the product on a surface for longer than recommended does not increase its effectiveness but can lead to dangerous and unnecessary chemical exposures. Leaving it on for less time than recommended can inhibit its effectiveness. Furthermore, ensure that, when using disinfecting wipes, different wipes are used when passing from one surface to another to avoid the spread of germs. This is not the place to stretch the budget.
- **Review MSDS:** Take care to review each product's material safety data sheet for other ingredients that may harm the user. For example, be wary of combined cleaner-disinfectants that contain butoxyethanol or ethanolamine. Trade magazines may also contain general information about disinfectant products and their ingredients. Some of these publications may list their articles on the Internet⁴.
- **Natural disinfectants:** As an alternative to harsh chemicals, hydrogen peroxide may serve as effective natural disinfectants. A combination of 3 percent hydrogen peroxide (the same strength you find at the drugstore) and undiluted white or apple cider vinegar put into 2 separate spray bottles, sprayed one immediately after the other, is a proven and safe way to get rid of the Salmonella and E. coli bacteria.
- **Know when to disinfect and when to clean:** In order to use disinfectants most optimally and to reduce their negative effects, it is important to educate your cleaning staff and to carefully plan a cleaning maintenance program. The use of disinfectants should be limited to high-risk touch point areas where germs and infections are easily spread. For other areas, a thorough cleaning, preferably using green cleaning products, should suffice. A discriminate use of disinfectants will also save your company both time and money.

³ <http://webprod.hc-sc.gc.ca/dpd-bdpp/index-eng.jsp>

⁴ For example, refer to <http://www.cmmonline.com>. Janitorial Products Pollution Prevention Project - Sponsored by US EPA, State of California, Santa Clara County, the City of Richmond, and the Local Government Commission. Written by Thomas Barron, Carol Berg, and Linda Bookman. 6/99.



V. High-Risk Touch Points (Often called critical touch points)

Germs hide on every surface. However, when determining which areas require disinfection, it is important to identify the high-risk touch points. In public buildings, two of the main germ 'hotspots' - bathrooms and sinks - usually get a thorough and frequent cleaning. By contrast, phones, counters, doorknobs, light switches, bed and hand rails, desks and computer keyboards are not generally cleaned on a regular basis and therefore may harbor viruses. The floor, desktops and countertops are also major sources of contamination - germs released into the air eventually land on the largest horizontal surface in the room.

The idea that floors house the bulk of a facility's bacteria flies in the face of common cleaning practices where crews work from the top down, cleaning surfaces above the floor first. Custodians' feet can pick up germs and transport them everywhere. Also, preventing custodians from cleaning cluttered desktops allow a large germ reservoir to remain untouched. Without a thorough cleaning of these key surfaces, it is impossible to shut down a microbial spread. When risk exists, building occupants should be advised to clear their desks to allow custodians to clean. Experts recommend that this practice continue until the threat of an outbreak is gone. Cleaning should remove many of the germs living on these surfaces, but the ones left behind will soon begin to grow and to re-accumulate. Therefore, to be safe, also use a disinfectant product to kill the bacteria and viruses that are present.

In order to remove all disease causing organisms, including spores, an additional sterilization process would be required. Proper disinfection requires dwell time on an already cleaned surface. One must follow the use directions on the label of the disinfectant to understand the appropriate dwell time. Surfaces must first be cleaned properly and then disinfected in order to kill bacteria and viruses from these critical touch points.

VI. Sanitizers

Recent public health threats, such as the H1N1 pandemic, have resulted in wide use of instant hand sanitizers. Many buildings and establishments have implemented hand sanitizer dispensers in high-traffic areas, such as entrances, exits, lobbies, elevators, stairs and escalators.

Also, hand sanitizers are one of the fastest growing trends in the foodservice industry. Foodservice operators have been scrambling to implement hand sanitizers in their establishments, particularly in areas where users don't have easy access to running water, such as lobbies, cash registers, hostess stations, bus boy stations, food prep areas, washroom areas, and server stations. Equally important, sanitizing cutting boards, cleaning work surface areas, knives and cooking utensils in the foodservice industry can go a long way to eliminate cross-contamination.

A **hand sanitizer**, or according to the latest FDA definition a **hand antiseptic**, is a supplement or alternative to hand washing with soap and water. Various preparations are available, including gel, foam, and liquid solutions. The active ingredient in hand sanitizers may be isopropanol, ethanol, or n-propanol. Inactive ingredients in alcohol rubs typically include a thickening agent such as polyacrylic acid for alcohol gels, humectants such as glycerin for liquid rubs, propylene glycol, and essential oils of plants.

Alcohol-based hand sanitizers have high concentrations of alcohol since the Food and Drug Administration (FDA) recommends sanitizers should contain 60% to 95% ethanol or isopropanol to effectively kill germs on the hands. Looking at the high alcohol content required, it is not surprising to see that most alcohol-based antiseptic products are highly flammable. Nonetheless, the FDA, World Health Organization (WHO), as well as the Association for Professionals in Infection Control and Epidemiology (APIC) continue to recommend the use of alcohol-based hand sanitizers in hospital setting as safe. Of course caution is



required when planning to install wall-mounted sanitizer dispensers within hallways and rooms. Hospitals must adhere to the local fire department's regulation on the placement of such dispensers. Economically, the amount of money saved by preventing the spread of infections far outweighs the possibility that a fire can start due to a hand sanitizer bottle catching on fire. The utmost caution should also be exercised regarding the storage of alcohol-based hand sanitizers. Since most alcohol-based hand sanitizers have high concentrations of ethanol, alcohol poisoning is very possible in the event of ingestion. However, a significant shift is occurring to alcohol-free foaming hand sanitizers. One of the primary reasons for this shift is that alcohol-free foaming hand sanitizers are:

- Non-irritating to the skin (no drying or chapping)
- Non-flammable
- Do not transfer alcohol smell to food items (especially relevant for the food industry)
- Significantly less expensive

Below is a table indicating the % of alcohol that can be found in hand sanitizer products. It is important to note that the claimed active ingredient does not always reflect the actual alcohol content by volume. As indicated in the table below 70% alcohol content by volume is often equivalent to 64% alcohol content by weight.

Product	Claimed active ingredient	Alcohol content by wt	Alcohol content by volume
Leading Foam 1	72% v/v	64% w/w	70% v/v
Leading Foam 2	70% v/v	65% w/w	72% v/v
Leading Gel	62% w/w	59% w/w	66% v/v

Product	Claimed active ingredient	Alcohol content by wt	Alcohol content by volume
Leading Gel	70% v/v	63,74% w/w	70% v/v
Leading Foam	70% v/v	64% w/w	70% v/v
Citrus Sanitizer	60,25% w/w	61,02% w/w	67,02% v/v

Although hand sanitizers are useful alternatives if soap and water are not available, proper hand washing remains the single most important measure for preventing the spread of germs, viruses and infection. In addition to installing hand sanitizer dispensers, it is helpful to post visual signage to remind people about the importance of hand washing and proper hand washing technique.

VII. The Proper Use of Cleaning Chemicals

Although a good cleaning program is crucial to prevent the spread of infectious diseases, it is important to be aware of the effects of the products and chemicals that we use, both in terms of our health and on the environment. Many chemicals contained in cleaners and disinfectants contribute to poor indoor air quality and have been implicated in the increase of respiratory ailments such as asthma. Exposure to and contact with cleaning chemicals can also cause eye, nose and throat irritation, skin rashes, headaches, dizziness, nausea and sensitization. Disinfectants used for routine cleaning in hospitals, food service industry, and by property managers, such as quaternary ammonium compounds, phenols and bleach, are registered pesticides. Health effects from long-term exposure to quaternary ammonium compounds include asthma and hypersensitivity syndrome.



In commercial settings, cleaning chemicals are often purchased in concentrated solutions that require mixing and/or dilution by the employee who is responsible for application. The incorrect dilution of these products contributes to the adverse health effects suffered by janitorial staff. Also, certain cleaning chemicals which are mixed together may produce synergistic effects. This means that the interaction of two or more of these chemicals produces a health effect greater than that of the individual chemical alone. For example, a quaternary ammonium compound used in combination with a bleach cleaner release a toxic gas called chloramines into the air.

By carefully choosing environmentally sound cleaning chemicals, cleaning methods and cleaning equipment, businesses can realize significant productivity gains and decrease absenteeism due to illness and other viruses. **An effective cleaning program should safeguard the health and productivity of employees by providing the highest international and domestic standards for health and safety and reducing any risk of cross contamination.** Look for a company willing to provide the necessary training and education to ensure the highest level of product usage safety for you and your customers.

About Avmor Ltd.

Headquartered in Laval, Quebec, Avmor is Canada's leading manufacturer of professional cleaning solutions aimed at the Facility Maintenance and Foodservice markets. Avmor offers cGMP (Current Good Manufacturing Practices), which is a prerequisite to be able to manufacture hand soaps that include disinfection claims and a DIN (Drug Identification number) provided by Health Canada. Avmor offers a full range of hand care products. Avmor's complete line of cleaning products include Cleaners/Degreasers, Floor Care, Washroom Care, Food Service Care, Hand Care, BioMaxx, Disinfectants and others. Some of Avmor's signature brands are **Av-mixx Dilution Control System, Biomor Biological Cleaning Solutions, Quick Stuff Food Service Cleaning System, Synergy Floor Care, EcoPure & Nanomor**, its new environmentally responsible sanitation program which features over 50 certified UL Ecologo products. For over 65 years, Avmor has remained at the industry forefront, defining product performance standards and striving for the safest and most cost-effective cleaning systems for professional use. Avmor Ltd. is a privately held company.



Source: ["Can we 'wipe out' hospital MRSA?"](#) 2008. Cardiff University School of Pharmacy. (11 July 2009)



SCHEDULE A
Generations of Quats

The most current definitions of the different generations of germicidal quats are as follows:

1st Generation: Alkyl Dimethyl Benzyl Ammonium Chlorides (ADBAC). First generation quats have the lowest relative biocidal activity. Benzalkonium chloride is one type of ADBAC quat.

2nd Generation: Substituted ADBAC. The substitution of the aromatic ring hydrogen with methyl or ethyl groups resulted in this second generation quat. However, this type of quat is not marked by itself but in combination with ADBAC.

3rd Generation: “ Dual Quats” (example: Equal mixture of ADBAC and alkyl dimethyl ethyl benzyl ammonium chloride.) This mixture of two specific quats resulted in a “ Dual Quat” offering increased biocidal activity over the ADBAC quat alone.

4th Generation: Twin or Dual Chain Quats. Dialkyldimethyl Ammonium Chloride or DDAC quat. Fourth generation quats are superior in germicidal performance and have an increased tolerance to organic loads and water hardness.

5th Generation: Mixtures ADBAC and DDAC quats. (example: octyl decyl dimethyl ammonium chloride, didecyl dimethyl ammonium chloride, dioctyl dimethyl ammonium chloride and alkyl dimethyl benzyl ammonium chloride. Fifth Generation quats (sometimes referred to a 4-chain quats) have outstanding germicidal performance and remain effective under more hostile conditions of organic load and water hardness. This is especially true for hard surface disinfectant products.



SCHEDULE B

EPA Product Testing

Sporicidal Claims

Testing is performed per the AOAC sporocidal method (DIS/TSS-9). Sixty carriers representing each of two carrier types (porcelain cylinders and silk suture loops) are required to be tested against *Bacillus subtilis* and *Clostridium sporogenes* on 3 separate lots, one of which must be ≥ 60 days old. Killing of all 720 carriers is required.

Disinfectants (limited efficacy)

Testing is performed per the AOAC UDT/GST method (DIS/TSS-1). Sixty carriers are required on 3 separate lots, one of which must be ≥ 60 days old against *Salmonella choleraesuis* **OR** *Staphylococcus aureus*. Killing of 59 out of 60 carriers is required (total carriers = 180).

Disinfectants (general or broad spectrum efficacy)

Testing is performed per the AOAC UDT/GST method (DIS/TSS-1). Sixty carriers are required on 3 separate lots, one of which must be ≥ 60 days old against *Salmonella choleraesuis* **AND** *Staphylococcus aureus*. Killing of 59 out of 60 carriers is required (total carriers = 360).

Disinfectants (hospital or medical environment efficacy)

Testing is performed per the AOAC UDT/GST method (DIS/TSS-1). Sixty carriers are required on 3 separate lots, one of which must be ≥ 60 days old against *Pseudomonas aeruginosa*, *Salmonella choleraesuis* and *Staphylococcus aureus*. Killing of 59 out of 60 carriers is required (total carriers = 540).

Supplemental Organisms

Testing is performed per the AOAC UDT/GST method. Ten carriers are required on 2 separate lots against each supplemental organism. Killing of 10 out of 10 carriers is required (total carriers = 20).

Fungicides (pathogenic fungi)

Testing is performed per the AOAC fungicidal method (DIS/TSS-6). Two separate lots are tested against *Trichophyton mentagrophytes* in a suspension test. Killing of all fungal spores in 10 minutes is required.

Virucides

Testing is performed per EPA Guidance (DIS/TSS-7). Two separate lots are tested. Inactivation of virus must be demonstrated at all dilutions when no cytotoxicity is observed or at all dilutions above the cytotoxic level when it is observed. The data must demonstrate a 3 log reduction in viral titer for both lots.

Tuberculocides

Testing is performed per the AOAC tuberculocidal method (DIS/TSS-6). Ten carriers are tested against each of 2 separate lots against *Mycobacterium tuberculosis* var. *bovis*. Killing of all carriers as well as no growth in any of the inoculate tubes of two additional media, is required.

Non-Food Contact Sanitizers

Testing is performed per EPA Guidance (DIS/TSS-10). Three lots are required, one of which must be ≥ 60 days old. Testing is performed against *Staphylococcus aureus* and *Klebsiella pneumoniae* containing 5% organic load. *Enterobacter aerogenes* may be substituted for *Klebsiella pneumoniae*. The results must show a reduction of at least 99.9% in the number of each test microorganism over the parallel control count within 5 minutes.

Food Contact Sanitizers

For Halide Chemical Products

Testing is performed per the AOAC method (DIS/TSS-4 and DIS/TSS-5)(Available Chlorine Germicidal Equivalent Concentration method) on 3 separate lots, one of which must be ≥ 60 days old, against *Salmonella typhi*. Test results must show product concentrations equivalent to 50, 100 and 200 ppm available chlorine.

Other Chemical Products

Testing is performed per the AOAC method (AOAC Germicidal and Detergent Sanitizers) on 3 separate lots, one of which must be ≥ 60 days old, against both *Escherichia coli* and *Staphylococcus aureus*. Acceptable results must demonstrate a 99.999% reduction in the number of test microorganisms within 30 seconds.

***Notes**

1. If the product is intended for use as a spray, the AOAC Germicidal Spray Test must be employed.
2. Appropriate organic soil load and hard water claims must be taken into account.

