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ceta.org/members-covid-19/

Incorporating Wet Steam Cleaners into Disinfection Processes Against COVID-19

Introduction to Wet Steam Cleaners

A wet steam cleaner incorporates a heat source and a heat exchanger (usually a pipe or tubing coil) to heat the water flowing through the heat exchanger which is superheated to typically 212-350° F (100-177° C) and limited to 100-464 psi (0.7-3.2 MPa) max. These temperatures are above the atmospheric boiling point; however, no steam is generated in the product due to the elevated pressure generated by the water pump and discharge nozzle. The superheated water is always in liquid form (inside the coil and hose) due to the elevated pressure. However, upon exit of the discharge nozzle, as pressure is reduced, the superheated water immediately vaporizes/flashes to saturated (or wet) steam. The temperature of the saturated steam at the exit side of the discharge nozzle is given by the ASME Steam Tables; for example, 327.2° F (164°C) for a water pressure of 101.526 PSI (0.7 MPa) absolute. The higher the temperature the greater the expansion force as the water vaporizes/flashes to steam, the greater the cleaning power.

Wet steam is widely used in food, beverage, and other manufacturing industries for its natural (thermal) sanitizing effects.

While high temperature accompanied by wet steam can remove or inactivate most known microorganisms including viruses, there are certain limitations to its applications stemming from unique characteristics of wet steam.

Understanding the novel coronavirus (SARS-CoV-2)

Viruses are protein cells that can only grow inside a host such as humans. They are not technically "alive" on their own and cannot be "killed." However, a virus can be inactivated, or its infectivity can be affected by chemical and other disinfectants as well as environmental factors such as temperature and humidity. Viruses can survive on surfaces from a few hours to a few days depending on the type of surface. It travels in droplets of saliva between human to human, and recent studies suggest it is also airborne.† Based on its structure, SARS-Cov-2 is believed to be highly sensitive to heat and moisture, but highly contagious. SARS-Cov-2's viral envelopes are of lipid layers: Enveloped viruses like SARS-CoV-2—which rely on a protective lipid coating—are the easiest type to deactivate. In contrast with many gastrointestinal viruses like norovirus which have a tough protein shell called a capsid, viruses with this fatty wrapping are relatively vulnerable.††

†New coronavirus may spread as an airborne aerosol, like SARS from New England Journal of Medicine, CDC
††"How does EPA know the disinfectants that should deactivate the COVID-19 coronavirus" from EPA, EPA List N, "Viral Envelope" from John Hopkins Medicine

Thermal removal or inactivation of pathogens

Temperature of 176° F (80° C) or higher on contact surfaces is known to remove most bacteria and inactivate most viruses. With extended exposure time from a few seconds to 30 minutes (depending on the pathogen), even 140° F (60° C) temperature is able to remove or inactivate pathogens. WHO recognizes viral inactivation by heat and recommends boiling drinking water in the regions where communicative diseases are common.†

†WHO Technical Brief: Boil Water

Understanding differences among Cleaning, Sanitizing, Disinfecting and Sterilizing

There is often a confusion among these terms, particularly between sanitizing and disinfecting. It is paramount for a sanitation professional to understand the differences and what a particular sanitation protocol is expected or intended to achieve. The COVID-19 pandemic is caused by a virus, and "disinfection" is the main goal.

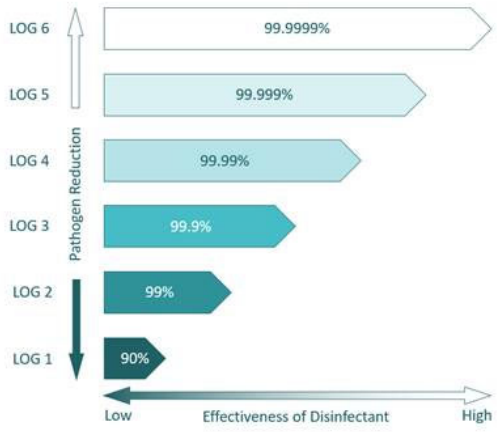
The Centers for Disease Control (CDC) definitions for cleaning, sanitizing, disinfecting, and sterilizing are:†

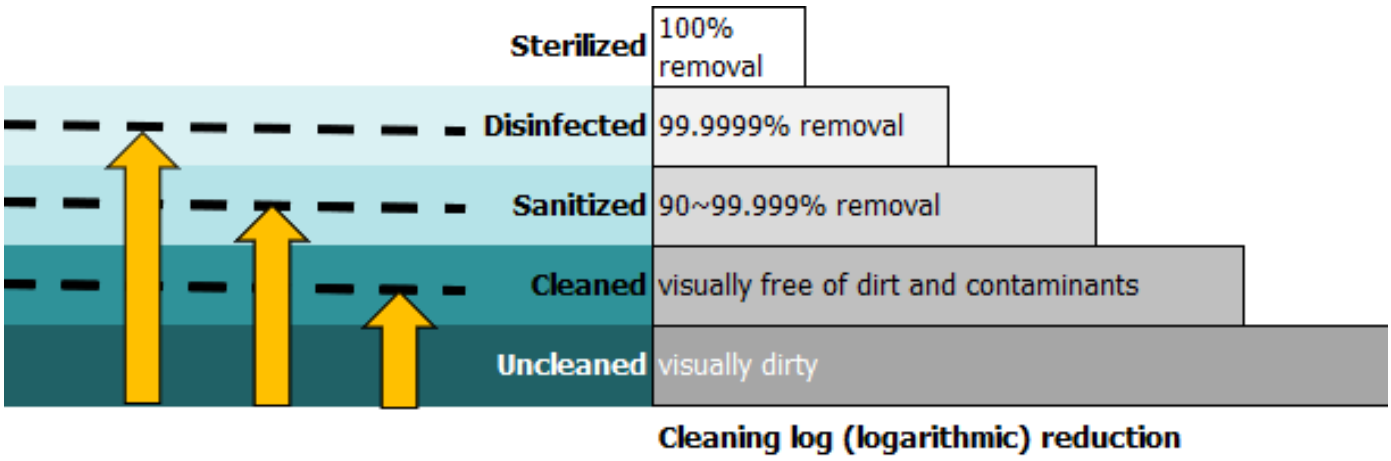
Cleaning: removes germs, dirt, and impurities from surfaces or objects. Cleaning works by using soap (or detergent) and water to physically remove germs from surfaces. This process does not necessarily kill germs, but by removing them, it lowers their numbers and the risk of spreading infection.

Sanitizing: lowers the number of germs on surfaces or objects to a safe level, as judged by public health standards or requirements. This process works by either cleaning (which physically removes germs from surfaces or objects) or disinfecting (which kills germs) to lower the risk of spreading infection. Sanitizing is generally a little gentler than disinfecting. Removing or deactivating pathogens down to an "acceptable" level, often by 1 to 5 log reduction (90-99.999%).

Disinfecting: refers to using chemicals to kill germs on surfaces or objects. This process does not necessarily clean dirty surfaces or remove germs, but by killing germs on a surface *after cleaning*, it can further lower the risk of spreading infection. Removing or deactivating unwanted microorganisms down to 6 log reduction (99-99.9999%).

Sterilizing: a process that destroys or eliminates all forms of microbial life and is carried out in health-care facilities by physical or chemical methods. 100% removal or inactivation of microorganisms.



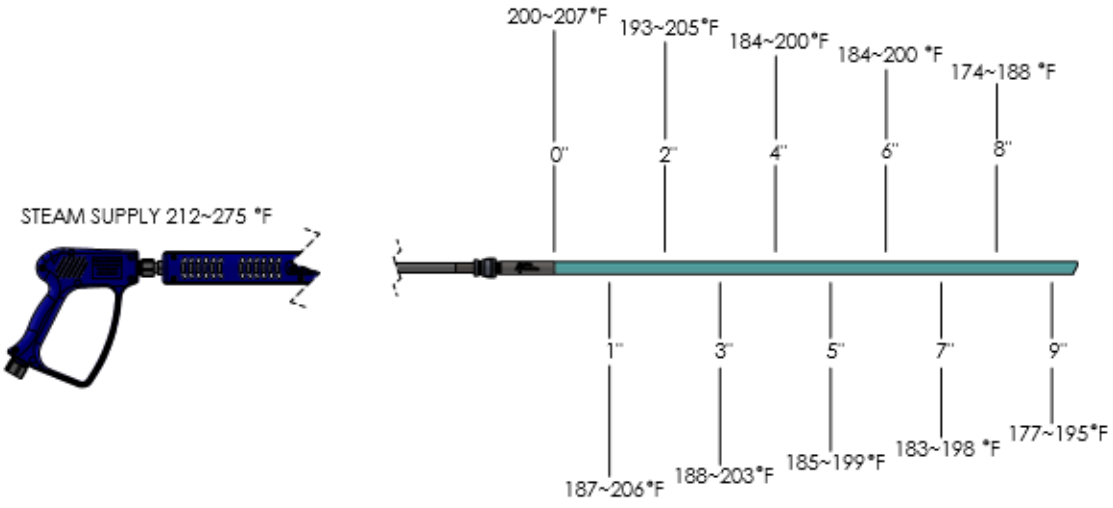


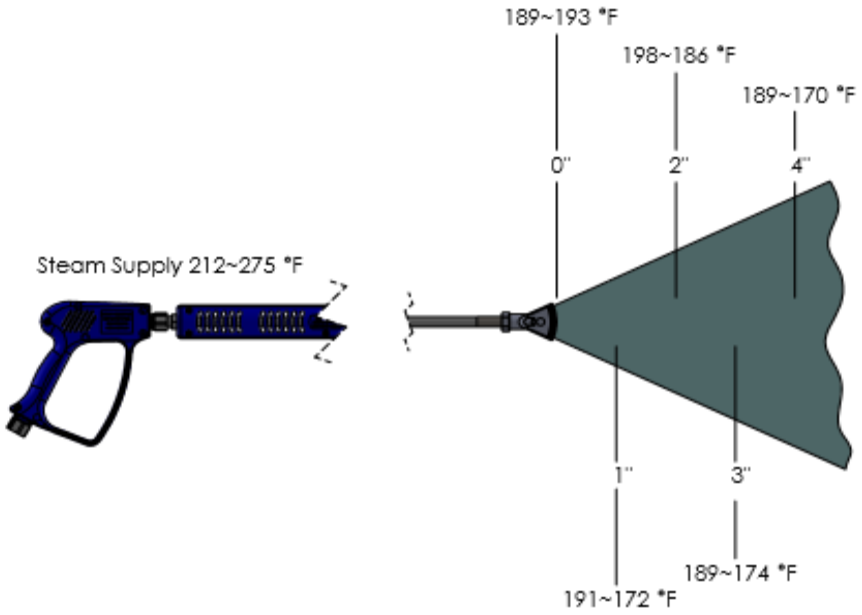
Wet Steam is a time-tested method to clean and sanitize. Wet steam is capable of disinfecting in controlled environments only where a lethal temperature can be guaranteed.

Wet steam temperature

Depending on the steam nozzles design as the steam exits the nozzle the impact force as well as temperature decreases at different distances of travel.

Below illustration is an example of steam temperature based on the distance between the steam nozzle and the contact surface. Respective temperature is based on using an Arctic Steamer (operating temperature adjusted as indicated 212°F/100°C to 275°F/135°C) in 75°F/23°C ambient outdoor temperature.† The consistency of steam volume and temperature affect the residual heat capacity as well. Comparing two steamers with the identical steam temperature rating, a steamer with more volume will transfer higher temperature on contact surfaces due to its higher residual heat capacity.





Test Conditions: Elevation: 880'
Barometric Pres.: 30.14-30.09
Boiling Point: 210.7°F

Distance to contact surface, ambient temperature, residual heat capacity of steamer equipment must be considered and planned accordingly to achieve successful thermal disinfection.

†Steam Temperature Testing by American Pressure Inc.

Cases for and against wet steam in disinfecting efforts

Concerns surrounding using wet steam for disinfecting purposes can be summarized as following:

- Ensuring contact surface temperature (keeping close distance, which could make a longer process)
- Ensuring contact surface time - depending on the pathogen and temperature it takes <1 sec to >30 minutes of exposure time
- There are no known 6 log reduction data on viruses in the coronavirus family currently

On the other hand, wet steam has many practical benefits as well.

- Compensates for poorly cleaned or uncleaned surfaces which may create a barrier to disinfectant effectiveness
- Better penetration on porous surfaces
- Appropriate for chemical-sensitive environments
- Safe for human inhalation
- No hazmat storage or training required

Wet Steam Method

Wet Steam Cleaning is a cleaning method used generally in areas equipped for wash water run off like wash bays or exterior areas for cleaning and sanitizing a wide variety of surfaces.

The Problem

It is also notable to point out that surfaces thought to be resistant to bacteria and viruses by composition, may not be as resistant to sustaining bacteria and viruses once that same surface has built up a biofilm on that surface. Biofilms can live on residue from body oils, pollen, waste products, food, animal, or insect defecation, as well as moisture from rain and or humidity. This biofilm then takes up residence allowing microbes, bacteria, and viruses to grow just as they do on a petri dish in a lab. If you do not remove the biofilm, then you simply cannot effectively reduce the numbers of bacteria and viruses occurring on a surface according to the Centers for Disease Control (CDC) and World Health Organization (WHO). To return a once resistant surface to that resistant state you must conduct an initial deep cleaning, removing the biofilm, before the sanitation/disinfection process.

The Solution

Wet Steam Cleaning can be a very effective tool for cleaning, sanitizing, and disinfecting surfaces that have possibly been inhabited with bacteria and viruses. Please follow the steps outlined below.

Personal Protective Equipment (PPE)

Wet Steam Cleaning has hazards associated with the task i.e. pressurized water, high temperature water/steam, chemical usage, possibly high decibel ratings and the environment (Depends on the product). Here is a common list of PPE for Wet Steam Cleaning hazards.†

Pressurized Water/High Temperature Water/Steam:

- Eye Protection in the form of safety glasses, chemical splash/impact goggles or a face shield.
- Skin protection in the form of gloves and protective coveralls.
- Foot protection in the form of rubber boots with steel toes.

Chemical Usage:

- Lung protection in the form of an N-95 respirator for protection against any particulate i.e.. pollution, silica, common dust, smoke, or flu.
- Half or Full-Face Respirator for any chemical usage with vapor levels beyond nuisance and/or suggested by the SDS sheet of the chemical.

High Decibels:

- Hearing protection should be worn when decibel levels exceed standards.

Environment:

- A wide brimmed hat is also recommended to protect against sun and overspray.
- Sunscreen when working outdoors and exposed to sun
- Hi Vis Clothing around high traffic areas

Each Wet Steam Cleaning worker must wear the proper PPE for the application as laid out by the SDS sheet of the chemicals being applied as well as considering any environmental dangers that exist.

†OSHA 1910 Table of Contents

Examples

Wet Steam cleaning application examples by American Pressure Inc.

Equipment

A standard wet steam cleaner system can be used to perform any cleaning project. Some systems have the ability to add cleaning agents (soap/detergent/surfactants).

There are two basic types of systems for applying cleaning agents:

1. Upstream systems where cleaning agents that are compatible with the system flow through the pump and system and can be applied at system pressure.
2. Downstream injection systems (sometimes called a pulse pump) that inject the cleaning agent after the heat exchanger or even after the nozzle.

Recommended steps

As demonstrated above, wet steam has many benefits and shortcomings in deployment. Due to environmental constraints in deployment of wet steam and incomplete knowledge of the new virus, it is advised that wet steam is used in conjunction with EPA approved disinfectants† for combating COVID-19 at this present time. However, it should be noted that many disinfectants should never be added directly to steamer's water system as they may cause damage the equipment (like elastomers) and be harmful and unsafe to the user, but also may compromise the chemical bond and integrity of the disinfectant's active ingredient from being exposed to high temperature above its boiling point.

The following steps are recommended.

(1) Wear proper personal protective equipment (PPE): N95 or better mask, goggles, gloves, and a full suit are recommended to protect sanitation professionals against inhaling chemicals and exposure to the virus
(2) Clean first: Remove visible particles first before disinfecting (wet steam can be used for cleaning in certain cases with or without cleaning agents)
(3) Use proven disinfectant chemical recommended by respective government†
(4) Use wet steam to remove chemical residue and/or to utilize heat to inactivate remaining viruses
-Keep distance of 4" or less between nozzle and surface.

†EPA List N: Disinfectants for Use Against SARS-CoV-2 (COVID-19) by EPA

Conclusion and Disclaimer

The COVID-19 causing virus known as the novel coronavirus is so new that at this present time, there is no validation available for steam specifically for SARS-CoV-2. Above information and recommendations based on existing scientific data on known pathogens and what is known about viruses in general. Currently using wet steam is recommended as an additional tool to enhance sanitation, not as a

sole "disinfectant" to combat COVID-19.

Refer to the CDC website for the most up-to date information about the novel coronavirus (SARS-CoV-2) and how to protect yourself and prevent its spread.

Additional references:

CDC (Centers for Disease Control and Prevention)
- CDC Coronavirus (COVID-19)
- CDC Cleaning and Disinfection for Households
- CDC Cleaning and Disinfection for Community Facilities

WHO (World Health Organization)

EPA (Environmental Protection Agency)
- EPA Coronavirus (COVID-19)

OSHA (Occupational Safety and Health Administration)
- OSHA COVID-19 Control and Prevention

OSHA 1910 Standards:

- 1910.133(a)
- 1910.133(a)(1)
- 1910.133(a)(2)
- 1910.133(a)(3)
- 1910.133(a)(4)
- 1910.133(a)(5)
- 1910.133(b)
- 1910.133(b)(1)
- 1910.133(b)(1)(i)
- 1910.133(b)(1)(ii)
- 1910.133(b)(1)(iii)
- 1910.133(b)(2)
- 1910.138(a)
- 1910.138(b)
- 1910.132(a)
- 1910.136(a)
- 1910.136(b)
- 1910.136(b)(1)
- 1910.136(b)(1)(i)
- 1910.136(b)(1)(ii)
- 1910.136(b)(1)(iii)
- 1910.136(b)(2)
- 1910.134(a)(1)
- 1910.134(a)(2)
- 1910.134(d)(1)
- 1910.134(d)(1)(i)
- 1910.134(d)(1)(ii)
- 1910.134(d)(1)(iii)
- 1910.134(d)(1)(iv)
- 1910.95(b)(1)
- 1910.95(b)(2)