

How to Clean and Disinfect FMD Virus

The Foot-and-Mouth Disease virus is vulnerable to extremes of pH. Both acids (e.g. citric acid) and bases (e.g. caustic soda or sodium hydroxide) can destroy virus. Approved and recommended agents are listed below.

Note: To be effective, such disinfectants must be applied properly (e.g., in the right concentration, at the right temperature), and they must remain in **direct** contact with the target surface for sufficient time. In particular, before applying disinfectant, the surface must be free of dirt, dust, manure, mud, and other debris.

1) Clean

The goal is to remove as much debris as possible. Such material can shield contaminants from the action of chemical disinfectants. Pre-cleaning is also important because many disinfectants are less potent in the presence of organic material.

Scrape, brush, or sweep the surface to remove all solids (dirt, feed, manure, bedding, and other debris). If it is dusty, moisten the area to control dust and minimize aerosolization.

Caution: Proper disposal of solid waste, dirt, bedding, manure, and other organic material is important. Local regulations may require burning, burial or composting. Personnel should wear protective clothing (e.g. gloves, face masks, goggles, or headwear) and rubber boots.

2) Wash

The goal is to reduce the amount of contaminants on the surface as much as possible.

Soak surfaces with water and detergent or other cleaning agent; then wash by spraying, wiping, or scrubbing. Steam and high pressure washers (200-1000 psi) can be useful, especially for cleaning porous surfaces. Washing solution may also be applied with a simple, low pressure (90-120 psi) garden hose applicator.

Proceed from the cleanest areas to the dirtiest and from the highest level (ceiling) to the lowest (floor). Equipment that can be removed should be brushed and soaked in detergent before disinfection. Hoses, connectors, troughs, or drains can serve as reservoirs for pathogens and should be cleaned last.

After washing, thoroughly rinse all surfaces at low pressure to remove any residue. Some disinfectants (i.e., hypochlorite) can be inactivated by soaps and detergents. To reduce the risk of excess dilution of the disinfectant, areas should be allowed to drain or dry before application.

Caution: Use extra care in high pressure spraying to minimize spreading contaminants via aerosolization. Personnel should wear protective clothing (e.g. gloves, face masks, goggles, or headwear) and rubber boots.

3) Disinfect

The goal is to deactivate remaining FMD virus.

Read the entire product label and follow instructions carefully to ensure that the application is as safe and effective as possible.

Be sure to:

- Use the proper concentration. Because effectiveness against the virus depends on the pH of the dilution, do not combine acid and alkali agents. When mixed, they neutralize one another.
- Apply disinfectant at the correct temperature. Because some disinfectants are ineffective at low temperatures, the agent and/or the surface may require heating during cold weather.
- Thoroughly wet the surface. One gallon of diluted disinfectant is ordinarily applied to approximately 100-150 square feet (9-14 m) of surface area (about 0.4 L/m).
- Apply disinfectant from the highest level (ceiling) to the lowest level (floor).
- Allow the disinfectant solution to “sit” and work for the recommended length of time. Disinfectants need time to work. Minimum contact time is usually at least 5-10 minutes.

Caution: Personnel should wear protective clothing (e.g. gloves, face masks, goggles, or headwear) and rubber boots.

Selection of the proper disinfectant will depend not only on the microorganism suspected but also environmental factors (e.g. temperature, pH) and safety issues.

The following products are recommended to inactivate FMDV.

USDA Recommended Disinfectants for FMDV:¹

Product	Dilution	Mixing Instructions	Contact Time ²	Notes
5.25% Sodium Hypochlorite (NaOCl) “household bleach”	3%	Add 3 gallons of chlorine bleach to 2 gallons of water; mix thoroughly.	10 min.	Approved for this use by FDA. Caution with fumes and splashing.
Acetic acid (CH ₃ CO ₂ H)	4 - 5%	Add 6.5 ounces of glacial acetic acid to 1 gallon of water; mix thoroughly.	10 min.	Vinegar is a 4% solution of acetic acid.
Potassium Peroxymonosulfate and Sodium Chloride “Virkon S”	1%	Follow label directions.	10 min.	See Virkon S label.
Sodium Carbonate (Na ₂ CO ₃) “soda ash”	4%	Add 5.33 ounces of sodium carbonate to 1 gallon of hot water (or 1 pound to 3 gallons of hot water); mix thoroughly.	10 min.	The solution is mildly caustic, but can dull painted and varnished surfaces.
Sodium Hydroxide (NaOH) “lye”	2%	Add 1/3 cup of NaOH pellets (2.7 ounces of the lye) to 1 gallon of cold water; mix thoroughly.	10 min.	This solution is highly caustic. Use protective rubber clothing, gloves and safety glasses. WARNING: Always add the lye to the water. Never pour the water over the lye.
Citric Acid ³ (C ₆ H ₈ O ₇)	3%	Add 4 ounces of citric acid solid to 1 gallon of water (or 30 grams to 1 liter of water); mix thoroughly.	15 min.	Safe for clothes and body decontamination. Particularly useful when added to detergent..

¹ USDA-APHIS, “Disinfectants for Foot-and-Mouth Disease – Field Use,” [National Emergency Response to a Highly Contagious Animal Disease Executive Summary](#) (March 30, 2001), Appendix III, p. 14. CFSPH, “EPA and USDA Approved Disinfectants for Foot-and-Mouth Disease Virus,” Prevention Practices for FMD, [FMD Response Package](#) (Iowa State University, June 2006) Appendix D, p. 10. See also Glenda Dvorak, [Disinfection 101](#) (CFSPH, Iowa State University, February 2005) and William A Geering, Mary-Louise Penrith, and David Nyakahuma, [FAO Selection of Disinfectants in Manual on Procedures for Disease Eradication by Stamping Out](#) (FAO, 2001), Part 3, Chapter 3.

² Assuming proper application (keeping surface wet, reapplying if necessary) to a non-porous surface that has been thoroughly pre-cleaned.

³ EPA has approved select uses of Citric acid (CAS #77–92–9 and 5949–29–1) as a pesticide in an emergency “only when no suitable EPA-registered products are available for use against FMDv” and for: “Hard, nonporous and porous food and nonfood surfaces including, but not limited to, the following: any federal, state, or private indoor or outdoor use site, such as: agricultural and non-agricultural equipment and facilities; transportation equipment and facilities; quarantine equipment and facilities; laboratory equipment and facilities; and footwear/personal protective equipment associated with the above use sites.” EPA, [FIFRA Section 18 Emergency Exemption Label](#) (Rev. October 20, 2012). Maria T. Boroja, Letter Granting a [Quarantine Exemption](#), File 12DA02 (October 22, 2012).

EPA-Registered Pesticide Products That May Be Used Against FMD in Farm Settings⁴

Product Name (EPA Reg. #)	Manufacturer	Active Ingredient(s)	Pest and Use Site(s)
Oxonia Active (1677-129)	Ecolab, Inc. 370 N. Wabasha Street St. Paul, MN 55102 800-332-6522	Hydrogen peroxide Peroxyacetic acid	Food and mouth disease virus in/on livestock barns, livestock premises, animal quarters, animal cages, milking equipment, dairy equipment, and agricultural premises
Lonza DC 101 (6836-86)	Lonza, Inc 90 Boroline Road Allendale, NJ 07401 800-365-8324 201-316-3200	Alkyl dimethyl benzyl ammonium chloride Didecyl dimethyl ammonium chloride Octyl decyl dimethyl ammonium chloride Dioctyl dimethyl ammonium chloride	Foot and mouth disease virus in/on livestock premises, livestock feeding and watering equipment, and livestock equipment
Aseptrol S10-TAB (70060-19)	BASF Catalysts, LLC 100 Campus Drive Florham Park, NJ 07932 732-205-5000	Sodium chlorite Sodium dichloroisocyanurate dihydrate	Foot and mouth disease virus in/on animal cages, animal stables, animal feeding/watering equipment, animal equipment, and animal transportation vehicle
Aseptrol FC-TAB (70060-30)	BASF Catalysts, LLC 100 Campus Drive Florham Park, NJ 07932 732-205-5000	Sodium chlorite Sodium dichloroisocyanurate dihydrate	Foot and mouth disease virus in/on livestock premises, livestock feeding equipment, livestock watering equipment, livestock equipment, livestock transportation equipment, hog barns/houses/parlors/pens, animal quarters, animal cages, animal feeding and watering equipment, animal equipment, animal transportation vehicles, and shoe baths
Virkon S (71654-6)	E.I. du Pont de Nemours & Co P.O. Box 80402 1007 Market Street Wilmington, DE 19880 800-441-7515	Sodium chloride Potassium peroxymonosulfate	Foot and mouth disease virus in/on animal feed equipment, livestock barns, livestock pens, livestock stalls, livestock stables, livestock equipment, cattle feedlot, hog farrowing pen premises, hog barns/houses/parlors/pens, animal quarters, animal feeding and watering equipment, animal equipment, agricultural premises, agricultural equipment, animal transportation vehicles, and human footwear

⁴ “Products listed for use against foot and mouth disease were not generated from the NPIRS database. This list was generated by EPA on December, 2011.” USDA-APHIS, [Potential Pesticides to Use Against the Causative Agents of Selected Foreign Animal Diseases In Farm Settings](#), (USDA-APHIS, 2011), p. 15. This same list appears in the Revision (October 31, 2012), pp. 28-29. See also [General Farm Biosecurity Practices – Guide to Disinfectants](#) (UVM, October 6, 2010)