# Guidelines for Discharging Anthrax Decontamination Wastewater to Publicly Owned Treatment Works (POTWs)

## I. Introduction/Background

The Environmental Protection Agency's (EPA) response and cleanup of the anthrax events in the Fall and Winter of 2001/2002, especially the Capitol Hill, New Jersey, Florida, and Brentwood Post Office incidents, showcased the Agency's emergency response capability under unique and challenging circumstances. The type and scope of the response involving a bio-terrorism incident was unprecedented. The clean-up procedures developed in response to the biological attack required all equipment, materials and personnel leaving the site be decontaminated by washing with an aqueous disinfectant solution. New procedures had to be developed quickly for detecting, monitoring and cleaning buildings and materials, while protecting the workers and protecting public health and the environment. However, the cleanup itself was only one of the challenges faced and resolved by the Agency staff.

The response teams were not sure how to safely dispose of the wash down liquid or decontamination wastewater. Options considered included incineration, hazardous waste landfill, direct discharge to rivers and streams, and treatment at the local wastewater treatment plant (publicly owned treatment works or POTW). Since there was no established procedure for disposing of the decontamination wastewater, response teams decided to store the decontamination wastewater in 55-gallon drums. Hundreds of these drums were sealed, labeled as bio-hazardous material, and stored on site for ultimate disposal.

In response to the need to find a safe and economical way of disposing of this decontamination wastewater and to give POTWs the confidence to accept such waste, the EPA was asked to explore the feasibility of discharging decontamination wastewater into the local collection or sewer system and ultimately to a POTW. EPA assembled a team of experts from the Centers for Disease Control and Prevention (CDC), States and the Association of Metropolitan Sewerage Agencies (AMSA) to develop this protocol.

## II. Applicability

This document contains information and guidelines for safe handling, treatment (disinfection) and disposal wastewater generated during the decontamination of a buildings or similar property that has been demonstrated to have Bacillus anthracis spore contamination.[1]. This information should be used by the site Incident Commander (IC),

[1] This document is designed to be used in conjunction with the *National Response Team Technical Assistance for Anthrax Response*, September 2002. Decontamination activities should be conducted in

clean up personnel (or response team), wastewater utility managers (or wastewater authority), public works officials, POTW operators and public health agencies. This information may also be useful to emergency response teams, disaster coordinators, local fire and rescue squads, local law enforcement personnel, and local government officials.

No anthrax decontamination wastewater from buildings or similar property should be discharged to the local collection system or treatment plant until the water is treated in accordance with the guidelines contained in this document and proper notification has been made. In addition, no decontamination wastewater should be discharged until agreements have been reached with and approved by the local utility manager, POTW operator and public health officials (i.e., local and/or state health departments). These agreements should specify, at a minimum, the exact volume and rate of flow that the decontamination wastewater will be discharged to the collection system or treatment plant and the exact time and location of the discharge (See Section III. 6.).

## III. Anthrax Decontamination Wastewater Management Protocol

### 1. Notification:

NOTE: Notification of the proper authorities in accordance with the *National Response Team Technical Assistance for Anthrax Response* should occur prior to beginning any decontamination activities.

Once the decontamination wastewater is properly contained/stored[2] and the decision is made to discharge the wastewater to the sewer, the individual in charge of clean-up operations or IC should contact the wastewater authority that will ultimately receive the wastewater at its treatment plant. EPA strongly recommends that communication with wastewater authorities be established prior to initiating disinfection of the decontamination wastewater.

The IC should work with the wastewater authority to ensure the protocol for disinfection meets the authority's needs. Once disinfection is complete, the IC should notify the wastewater agency and formally request (in writing) approval for discharge of the decontamination wastewater. Section III. 6. of this protocol provides more detail on discharge requirements and written authorizations.

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accordance with the *National Response Team Technical Assistance for Anthrax Response* and local, state and federal guidelines, regulations and emergency response plans.

[2] The *National Response Team Technical Assistance for Anthrax Response* provides information on the storage of decontamination water in Chapter 8. Generally, it is recommended that decontamination wastewaters be stored in sealed containers with appropriate labels. Containers that will be transported off-site must comply with the Department of Transportation's (DOT's) Hazardous Materials Regulations, unless complete destruction of anthrax spores can be demonstrated. Consult the *National Response Team Technical Assistance for Anthrax Response* for additional information on storage, transportation, off-site treatment and disposals.

The ultimate decision to allow the discharge of the decontamination wastewater into the sewer lies with the wastewater authority.

## 2. Health and Safety Considerations

Workers conducting sampling or disinfection of decontamination wastewater or otherwise involved in activities that places them at risk for exposure to *Bacillus anthracis* (anthrax) should wear personal protective equipment (PPE), including respiratory devices, protective clothing, and gloves in accordance with the *National Response Team Technical Assistance for Anthrax Response*.

Workers should also take the appropriate precautions when handling disinfection agents.

## 3. Disinfection (See also Appendix A)

Decontamination wastewater generated at anthrax remediation sites may result from the use of disinfectant solutions to clean contaminated equipment and surfaces and may contain viable spores. This waste may also contain residual concentrations of the disinfectants used at the site. All liquid waste should be collected in proper containers and subsequently treated on-site.

Since spore concentrations at these remediation sites may be high (greater than $10^6$ CFU (colony forming units) per gram of collected material[3]), treatment of the decontamination wastewater is required in order to achieve the greatest sporicidal effect. The exact decontamination wastewater disinfection protocol applied at a particular site will vary according to pH, temperature and contact time[4].

Based on the available information, the EPA recommends the following approach for disinfecting anthrax decontamination wastewater. Although other disinfectants can be used, EPA strongly recommends the use of a sodium hypochlorite solution:

- The decontamination solution itself is a 0.5% or greater solution of sodium hypochlorite. Before adding sodium hypochlorite, measure the free chlorine

[3] Colony counts will be expressed in number of CFUs per weight of material (for example HEPA socks) or in terms of surface area.

[4] Experiments conducted at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) have demonstrated the efficacy of a dilution of 1:20 (2625 mg/L) and 1:10 (5250 mg/L) household bleach in suspension tests against anthrax spores (resulting in 99.9% inactivation of a 4-5 log concentration of spores with in 15 minutes, and up to a 3 log reduction in viable spores after 5 minutes of contact time) (Hawley RJ, Eitzen, jr EM. Biological weapons—a primer for microbiologists. *Ann Rev Microbiol*. 2001; 55:235–53).

More recent data, from the EPA Office of Pesticides Programs suggests that a dilution of 1:10 bleach at pH in the range of 6.7-7.0 passes the Association of Official Analytical Chemists' (AOAC) sporicidal test method for liquid chemical sterilants at 25°C. This test method is used to determine the efficacy of chemical sterilants used in medical devices reprocessing and sterilization.

concentration of the decontamination wastewater. The CDC guidelines for state health departments on handling anthrax recommend that a 0.5% bleach solution is effective. EPA recommends for precautionary measures that a 1% solution be used in wastewater. The IC will make the final decision on which solution to use based on site-specific factors. Sodium hypochlorite should be added as necessary to achieve a 0.5% (or 1%) solution (see Table 1 below and Table A1, in Appendix A)[5]. EPA recommends that the solution be mixed sufficiently with a paddle of inert material to ensure equal distribution of the sodium hypochlorite. Mechanical agitators should not be used.

- The pH of the solution should be tested with a pH meter[6]. EPA recommends that the solution have a pH of approximately 7 for maximum effectiveness. Vinegar may need to be added to achieve neutral pH. Higher pH will effect contact time.

- EPA recommends a minimum contact time of one (1) hour. Contact times for maximum effectiveness will increase if the solution is not at a pH of approximately 7 (See Appendix A). Moderate differences in temperature should not dramatically impact contact times[7].

Prior to discharge, the treated liquid waste should be sampled for the presence of viable spores (See Section III. 5. for sampling protocol and lab coordination).

Table 1 provides sample volumes of household bleach needed to achieve 0.5% and 1% solutions given a certain volume of decontamination wastewater and assuming no existing chlorine residual.

[5] Household bleach or commercial grade sodium hypochlorite may be used to achieve the 0.5% or 1% solutions. Commercial grade sodium hypochlorite is approximately five (5) times as concentrated as household bleach so measurements must be adjusted accordingly.

[6] Data from EPA Fort Mead Labs suggests adjusting pH based on testing done in the laboratory. When pH is adjusted to seven then a 1:10 dilution of household bleach inactivates ALL spores in the AOAC Sporicidal Carrier test. -- ALL spores are inactivated after a 60 minute contact time.

[7] EPA believes that a 1% bleach solution has a hypochlorite concentration of 6900 mg/L (assuming the 1% is weight of sodium hypochlorite per volume of solution). EPA estimates that, under poor inactivation conditions of temperature = 4C, pH = 8.6, the time necessary for a 1% bleach solution to inactivate anthrax is 3000mg-min/L for 99% inactivation. With a 1% bleach solution, this is a contact time of only 26 seconds.

**Table 1.[8] 0.5 % Overall Bleach Solution**
(Volumes are in gallons)

| Liquid Decon Wastewater (WW) | Household Bleach 6.0 % Sodium Hypochlorite | White Vinegar | Minimum Treatment Container Size Liquid WW + Bleach + Vinegar | Recommended Treatment Container Size |
|---|---|---|---|---|
| 55 | 5.5 | 5.5 | 66 | 79 |
| 100 | 12 | 12 | 124 | 144 |
| 500 | 50 | 50 | 600 | 720 |
| 1000 | 100 | 100 | 1200 | 1440 |

Example: If 55 gallons of decontamination liquid were collected in a container, then add 5.5 gallons of bleach, followed by 5.5 gallons of white vinegar to the container in order to achieve a 0.5 % overall bleach solution.

**1.0 % Overall Bleach Solution**
(Volumes are in gallons)

| Liquid Decon Wastewater (WW) | Household Bleach 6.0 % Sodium Hypochlorite | White Vinegar | Minimum Treatment Container Size Liquid WW + Bleach + Vinegar | Recommended Treatment Container Size |
|---|---|---|---|---|
| 55 | 15 | 15 | 85 | 102 |
| 100 | 26 | 26 | 152 | 182 |
| 500 | 130 | 130 | 760 | 912 |
| 1000 | 260 | 260 | 1520 | 1824 |

## 4. Chlorine Residual and Other Parameters of Concern

In most cases, the residual chlorine resulting from disinfection according to these guidelines will not pose a problem in the collection system or at the POTW. In fact many POTWs employ some form of pre-chlorination for odor control, to control slim growth,

[8] The recommended treatment container size is 20% larger than the minimum treatment container size, taking into consideration that mixing may occur.

to reduce ponding and control filter flies, or to control Nocardia foam, for example. In most cases chlorine dosage for these applications runs between 3-10 mg/L. For example, a one million gallon per day (MGD) plant that uses 10 mg/L of chlorine to control slim growth in the collection system, would be applying approximately 85 pounds of chlorine per day.

Residual chlorine in the decontamination wastewater may also react with other chemicals in the collection system. Chlorine is a strong oxidizer and will react, sometime violently, with chemicals such as strong acids, amines, hydrocarbons, ammonia and ammonium compounds, hydrogen, and solvents to release chlorine gas, hydrogen chloride, and form toxic fumes and gasses. The utility manager and the POTW operator must determine if there are any industrial chemicals in the wastewater or collection system that could react with the residual chlorine in the decontamination wastewater. In some cases alternate points of discharge should be considered to avoid any potential adverse impacts.

The discharging of decontaminated wastewater that has been disinfected in accordance with these guidelines should fall within an acceptable range of local limitations and federal pretreatment standards. However, in addition to receiving a written agreement, the utility manager and the treatment plant operator must be contacted before any decontamination wastewater is discharged to determine if there are any special precautions that must be taken to lessen the impact of residual chlorine. For example, due to extreme hydraulic fluctuations, a POTW may not be able to handle the discharge during low flow periods when sufficient volume is not available for dilution. An exact time and flow rate for discharging the decontamination wastewater should be established. Overloading a plant's hydraulic capacity during peak flow periods also could be of particular concern to very small wastewater plants.

Where smaller POTWs are involved with large decontamination activities or where in-stream chlorine concentrations are critical due to sensitive environmental systems, chlorine residual will be a greater concern and dechlorination of the decontamination wastewater may be necessary. The decontamination wastewater can be dechlorinated by adding sodium bisulfite, sodium meta-bisulfite, or sulfur dioxide. Sodium bisulfite and sodium meta-bisulfite are supplied in solid granular form, while sulfur dioxide is supplied as a gas. Sodium bisulfite, sodium meta-bisulfite, or sulfur dioxide can also be supplied in liquid form as sulfurous Acid at 6-12 % sulfur dioxide in solution. The recommended dosage for complete dechlorination is one (1) ppm of sodium bisulfite, sodium meta-bisulfite, or sulfur dioxide per part of chlorine residual. Extreme caution should be used when adding sodium salts or acid to water. Addition of sodium bisulfite, sodium meta-bisulfite, or sulfurous acid to water may result in a violent exothermic reaction with the release of extremely toxic sulfur dioxide gas[9].

In addition to chlorine residual, POTWs may also request that other parameters meet local and/or federal limitations. For example, a wastewater treatment plant may request that wastewater discharged to the sewer system meet certain standards for total suspended

[9] Additional guidance on dechlorination can be found in the Water Environment Federation's Manual of Practice FD-10 "Wastewater Disinfection," 1996.

solids (TSS) and pH. Standards for these parameters will be outlined in the written agreement between the response team and the wastewater authority (See Section III.6). At no time shall the discharge of pH be lower than 5.0 standard units.

## 5. Sampling

Sampling of the decontamination wastewater should be conducted in accordance with the *National Response Team Assistance for Anthrax Response* to the extent that the provisions apply to wastewater sampling.

The following provides specific guidelines for sampling decontamination wastewater to verify effectiveness of disinfection:

- Composite samples comprised of decontamination wastewater from the top, middle, and bottom of the storage container should be collected (mixing is not necessary).10 EPA recommends a sample size sufficient enough to ensure it is representative of the container. Some labs recommend samples be as large as 10 percent of the storage container volume.

- The number of composite samples taken (i.e., the number of storage containers sampled) will be a site specific decision. Samples should be representative of the entire amount of decontamination wastewater. For example, early washes may be more contaminated and samples should be taken to ensure they are representative of temporal differences in the wastewater and different decontamination approaches. Laboratories will only certify as to the presence or lack thereof of *Bacillus anthracis* in the samples presented for testing, so the IC should ensure the samples are sufficiently representative.

- Wastewater treatment authorities may have their own sampling plan that dictates the use of duplicates and field blanks. EPA recommends following these plans where applicable.

## 5a. Laboratory Coordination

The laboratory selected to conduct the sample analyses should be consulted by the team developing the sampling plan. CDC requires that laboratories to be registered to handle and analyze for anthrax. Anthrax is a "selected agent" and only labs registered under the select agents are authorized to do this. To help public health laboratories across the nation prepare for and respond to acts of terrorism, including bioterrorism, CDC has

[10].Bacillus anthracis is hydrophobic and may not act as evenly distributed particles. Taking samples from the top, middle, and bottom of the storage container should be sufficient to ensure a representative sample of the container being evaluated

developed the Laboratory Response Network (LRN). The LRN was also designed to strengthen relations between the medical care community and public health system.

Membership in the LRN is primarily limited to state, federal laboratories (DOD, CDC and EPA). This network of laboratories can accept specimens and samples from hospitals, clinics, the FBI and other law enforcement groups, emergency medical services, the military, and other agencies. Other entities that wish to access the LRN can work through their state health department.[11]

Use of any other labs would risk the health and safety of the work force, the security of the nation, and the stability of the national public health system.

Labs should be asked to provide any recovery parameters for the tests they perform.

### 5b. Packaging and Transporting Samples

There are strict requirements for packaging and transporting anthrax samples to ensure that the general public and workers transporting the samples are protected from exposure. These requirements include:

- Rigorous packaging designed to withstand rough handling and prevent leakage;
- Appropriate marking and labeling that identifies the contents of the package;
- Documentation of the hazardous contents of the package and emergency point-of-contact; and
- Training of transportation workers on how to handle the contents in the event of an emergency.

The packaging and transporting of anthrax samples are subject to various regulations established by the U.S. Department of Transportation (DOT), the International Air Transport Association (IATA), CDC, the U.S. Postal Service (USPS), and the Occupational Safety and Health Administration (OSHA). It is also important to consult with the analytical laboratory receiving the samples to determine whether they have additional packaging or shipping requirements. Additional details on shipping and packaging procedures for anthrax samples according to CDC guidelines can be found at www.cdc.gov/od/biosfty/shipregs.htm[12].

### 6. Discharge Authorization Letter/Discharge Permit

[11] EPA recommends at a minimum that the lab selected be a LRN Level B or C laboratory, to ensure the lab has the capabilities to handle environmental (water) samples. EPA also maintains a list of laboratories capable of conducting analyses for *Bacillus anthracis* in water matrices. Samples associated with EPA's response to the anthrax attacks in the Fall of 2001 were analyzed at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), a Level D facility. The LRN was established to ensure adequate laboratory capabilities in the event of a widespread bioterrorism attack.

[12] Information obtained from *National Response Team Technical Assistance for Anthrax Response*.

Once the decontamination wastewater has been successfully disinfected and the relevant parameters are within the appropriate limits, the IC should formally request (in writing) approval for discharge of the decontamination wastewater. The formal request should include a statement that "analyses did not reveal the presence of viable *Bacillus anthracis* (anthrax) in the samples tested," (or similar wording) accompanied by a copy of the laboratory results, as well as analytical results for any appropriate parameters (such as total suspended solids (TSS) and chlorides) and the results of any analyses dictated by local requirements. The pH level should be indicated in the formal request.

EPA strongly recommends that wastewater authorities establish a formal (written) agreement that stipulates the conditions of the authority's approval of the discharge. Wastewater authorities will approve the discharge in one of two general ways (the exact mechanism used by a wastewater authority may vary). If the site of the clean-up activities is already permitted by the wastewater authority for other discharges, the authority may choose to modify the existing permit or agreement to specify the conditions under which the discharge of the decontamination wastewater may take place.

Wastewater authorities may also use an authorization letter to "permit" the discharge. Authorization letters are often used to permit "one-time" (non-routine) discharges that do not need a formal permit.

Regardless of the authorization mechanism, EPA recommends that the approval stipulate the conditions required of the discharge:

- Anthrax Viability and Wastewater Parameter Levels – The approval should acknowledge the receipt of the laboratory results indicating "analyses did not reveal the presence of viable *Bacillus anthracis* (anthrax) in the samples tested" (or similar wording) and the analytical results for other wastewater parameters.

- Quantity – The approval should indicate the total amount of decontamination wastewater to be discharged (i.e., twenty, 55-gallon drums of decontamination wastewater).

- Time/Date – The approval should establish a date and time for the discharge to commence. Wastewater authorities may wish to time discharges during high flow periods.

- Discharge Point – The approval should indicate where the discharge is to take place. For example, the approval may stipulate that the discharge take place at a manhole or cleanout located on the premises. EPA recommends that, if possible, the discharge should take place as close to the plant headworks as possible. If the discharge does not take place on the property where the incident occurred, the on-scene coordinator must make the necessary arrangements to transport the containers to an approved discharge point. Once the decontamination wastewater has been

disinfected, the material will likely not be a hazardous material for purposes of transportation using motor vehicles on public roads, but federal, state, and local DOT regulations should be consulted.

- Flow Rate – The wastewater authority may also want to stipulate a flow or discharge rate. For example, the authority may require the wastewater to be discharged at a flow rate of five gallons per minute as an additional precaution.

## Appendix A – Inactivation of Anthrax Spores with Chlorine

Studies from the late 1950's demonstrated that pH and temperature are important in the inactivation and killing of anthrax spores in suspension (Brazis AR, Leslie JE, PW Kabler, Woodward RL. The inactivation of spores of *Bacillus globigi* and *Bacillus anthracis* by free available chlorine. *Appl Microbiol* 1958;6:338-342). These studies suggested that significant reduction in the number of anthrax spores (four to five log reduction) could be achieved with chlorine levels between 0.6-0.74 mg/L in the pH range of 6.2-7.2 with a contact time of 24 hr (4°C and 22°C).

**Table A1 -** Inactivation of spore suspensions of *Bacillus anthracis (anthrax)* the effect of pH, chlorine concentration, temperature, and contact time (Adapted from Brazis et al, 1958)[13].

| **Temp °C** | **pH** | **Free Chlorine mg/L** | **Colony Forming Units (CFU)/ml at: $T_{(0\ hr)}$** | **1 hr** | **2 hr** | |
|---|---|---|---|---|---|---|
| 4 | 6.2 | 7.1±0.1 | 92,000 | <1 | 0 | |
| | 7.2 | 9.3±0.1 | 88,000 | 4 | <1 | |
| | 8.6 | 92.3±1 | 130,000 | 5 | 0 | |
| | 10.5 | 402±2 | 130,000 | 110,000 | 64,000 | |
| 22 | 6.2 | 2.2 | 110,000 | 1 | 0 | |
| | 7.2 | 2.4±0.1 | 110,000 | 1 | 0 | |
| | 8.6 | 24.4 | 110,000 | 150 | <1 | |
| | 10.5 | 445 | 110,000 | 20,000 | 26 | |

| **Temp °C** | **pH** | **Free Chlorine mg/L** | **Colony Forming Units (CFU)/ml at: $T_{(0\ hr)}$** | **12 hr** | **24 hr** | **48 hr** |
|---|---|---|---|---|---|---|
| 4 | 6.2 | 0.65±0.05 | 110,000 | 1 | <1 | <1 |
| | 7.2 | 0.74±0.06 | 140,000 | 2 | <1 | <1 |
| | 8.6 | 4.8±0.1 | 130,000 | 180 | <1 | <1 |
| | 10.5 | 48±2 | 110,000 | 52,000 | 2,200 | <1 |
| 22 | 6.2 | 0.2±0.08 | 110,000 | <1 | <1 | <1 |
| | 7.2 | 0.33±0.16 | 120,000 | 2 | 2 | <1 |

[13] Response personnel are not likely to encounter these elevated CFU levels in the field.

| **Temp °C** | **pH** | **Free Chlorine mg/L** | **Colony Forming Units (CFU)/ml at: $T_{(0\ hr)}$** | **12 hr** | **24 hr** | **48 hr** |
|---|---|---|---|---|---|---|
| | 8.6 | 2.4±0.7 | 110,000 | 11 | 4 | <1 |
| | 10.5 | 20±1.6 | 140,000 | 17,000 | <1 | <1 |

As pH increases above 7.2 it was found that higher levels of chlorine and contact times were required to obtain equivalent kill. Therefore, any efforts to disinfect anthrax laden decontamination wastewater must carefully track temperature, pH, chlorine levels, and contact times.