HETA 2001-0316-2865
Independent Leather
US Environmental Protection Agency Superfund Site
Gloversville, New York

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PREFACE

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Lisa Delaney of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS), Atlanta Field Office (AFO). Field assistance was provided by Angela Weber. Desktop publishing was performed by Pat Lovell. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Hazards at Independent Leather Environmental Protection Agency Superfund Site (EPA)-Gloversville, New York

In July 2001, NIOSH assisted the EPA at a Superfund Site of the former Independent Leather in Gloversville, New York. NIOSH evaluated the potential for exposures to anthrax and other microorganisms during the clean-up of animal hides, fleshings, and hair that were abandoned when the tannery closed in 1994. NIOSH also provided recommendations on work practices and procedures for removing the biological waste.

What NIOSH Did

We toured the buildings to look at microbial growth.
We reviewed records of previous owners.
We spoke to EPA and remediation workers about the site.
We researched the hazards of anthrax.

What NIOSH Found

No guidelines or standards exist that address the hazards associated with the remediation of tanneries.
The potential for exposure to anthrax is minimal, and infection in humans due to breathing anthrax spores is rare.
Visible mold growth was present throughout the buildings.
Employees are adequately trained for chemical but not biological hazards.

What the EPA Can Do

Train workers on biological hazards, and proper mold clean-up methods.
Continue current PPE use and remediation activities, including the use of an isolation barrier.
Mist area with water before remediation work to reduce dust and mold in the air.
Discard porous material contaminated with mold in a sealed bag.
Clean non-porous materials with a detergent solution or bleach for reuse.

What Remediation Employees Can Do

Follow all safety rules and procedures.
Wear the recommended PPE (full-face respirator), suit, gloves, and boot covers while working.
Contact a medical professional if you suspect you are infected with anthrax.

CDC Workplace Safety and Health

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for HETA Report # 2001-0316-2865

National Institute for Occupational Safety and Health NIOSH

Health Hazard Evaluation Report 2001-0316-2865
Independent Leather
US Environmental Protection Agency Superfund Site
Gloversville, New York
September 2001

Lisa J. Delaney, M.S.

SUMMARY

On May 21, 2001, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance (TA) from the United States (US) Environmental Protection Agency (EPA) concerning a Superfund Site at a former tannery, Independent Leather, in Gloversville, New York. The EPA asked NIOSH to determine the health hazards to remediation workers from exposure to biological contaminants at the site. Sources of biological contaminants at this site included animal hides, fleshings, and hair, which were abandoned when Independent Leather declared bankruptcy in 1994. EPA employees were concerned about the potential for exposure to anthrax and other microorganisms during planned remediation activities. NIOSH was specifically asked to evaluate potential employee exposures during remediation and to recommend proper remediation guidelines and personal protective equipment (PPE). No health effects were reported.

NIOSH investigators conducted a site visit on June 26-27, 2001. The purpose of the site visit was to review the scope of the project, evaluate work practices and PPE, and discuss strategies to minimize exposures to biological contaminants. The site visit consisted of an opening conference, a walkthrough of the EPA hazardous waste site, and informal interviews with the EPA site coordinator and remediation contractor regarding their work activities and the superfund site.

Based on our review of this site and proposed scope of work, the potential for zoonotic disease from remediation activities at this tannery is minimal. Most zoonotic diseases can only be spread while the animal is still alive and would not survive outside a living host for extended periods. While *Bacillus anthracis* (*B. anthracis*) can sporulate and survive for many decades, the potential exposure to remediation workers is minimal due to the characteristics of the bacteria (low secondary aerosolization potential and high infectious dose concentration). The likelihood of environmental transmission of anthrax, while theoretically possible, is considered to be remote. Visible microbial contamination, consistent with mold growth that would occur in unmaintained facilities, was present throughout the site. Remediation of the site will result in the disruption of these microbiological reservoirs. Precautions to prevent dissemination and reduce the potential for exposure to these bioaerosols is warranted.

The remediation protocols established by the EPA and the contractor were found to be prudent, and the precautions and PPE requirements are likely sufficient in protecting workers during remediation activities. Additional suggestions to further ensure the potential exposures to biological contaminants are minimized include training workers on the hazards of biological contaminants and appropriate work practices.

The potential for remediation worker exposure to anthrax spores at the former tannery appears to be minimal. However, conditions within the abandoned buildings were conducive for promoting mold growth. Prudent precautions, including PPE and work practices, should be taken to reduce potential bioaerosol exposures. Recommendations are provided on PPE, training, and work practices.

Keywords: 4953 (Refuse Systems), superfund site, remediation, biological contaminants, anthrax, zoonotic disease, tannery

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INTRODUCTION

On May 21, 2001, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the US Environmental Protection Agency (EPA) regarding a Superfund Site at a former tannery, Independent Leather, in Gloversville, New York. The request concerned remediation workers' potential exposures to biological contaminants from animal hides, fleshings, and hair, which were abandoned when Independent Leather declared bankruptcy in 1994. NIOSH was specifically asked to evaluate potential employee exposures during remediation and to recommend proper remediation guidelines and PPE. No health effects were reported. In response to this request, NIOSH investigators conducted a site visit on June 26-27, 2001. Following the site visit, recommendations were provided to the EPA via teleconference.

BACKGROUND

Independent Leather Manufacturing, a tannery located in Gloversville, New York, operated from 1880-1994. Independent Leather declared bankruptcy in 1994 and the property was abandoned leaving behind equipment, files, chemicals, and processed and unprocessed hides, fleshings (pieces of skin and fat), and animal hair of unknown origin. The facility is now a US EPA Superfund hazardous waste site. It is situated in a residential area with houses and a walking path within 50 yards of the property. The site is unsecured and consists of 2 buildings, which are readily accessible to the public. The roof of building 2 has partially collapsed and flooding has occurred on the ground level of each building. Homeless people were reported to have lived in both buildings.

On June 25, 2001, the US EPA began preparations to cleanup the former Independent Leather tannery site. At that time, no remediation work inside the building had begun. Initially, the primary focus of the cleanup was chemical contamination removal, particularly chromium. However, concerns regarding exposure to infectious agents from the animal products and microbial growth arose and prompted the NIOSH request. Earth Tech, an environmental remediation and waste services consultant, was contracted to conduct the cleanup with oversight by a US EPA on-scene coordinator.

Independent Leather processed animal hides into leather and suede, which were then sold to leather products manufacturers to make gloves, purses, and other leather goods. During the tanning process, hides were received in building 2 and prepared for the tanning process using sodium sulfide or an equivalent chemical. Hides were then sent to building 1 for tanning and coloring before shipment to other vendors. The tannery used both domestic and imported hides, but the types of animals and the country of origin is unclear. The manner in which these skins were cured and disinfected prior to shipment is unknown. While the specific process details are not available, based on industry standards we can generalize the activities that took place at the tannery. The preservation state of the hides or skins dictates how they are prepared. In preparation for tanning, the hides were washed and disinfected, then soaked in lime to loosen the epidermis and hair roots. Unwanted hair, proteins, and fats were then removed. Hides were placed in large tumblers containing a chromium solution for tanning. The tanned leather could then be treated with a aniline dye for coloring.[1]

METHODS

The purpose of the site visit was to review the scope of the project, evaluate work practices, and discuss strategies to minimize exposures to biological contaminants. The site visit consisted of an opening conference, a walkthrough of the EPA hazardous waste site, and informal interviews with the EPA site coordinator and remediation contractor regarding their work activities and the superfund site. During the opening conference, we provided information about NIOSH, reviewed the scope of our activities, and discussed specific issues and concerns with meeting participants. Additional research after the site visit included a literature search on the biological hazards associated with tanneries and potential anthrax exposure and consultation with infectious disease researchers at the CDC.

EVALUATION CRITERIA

There is a lack of specific recommendations, guidelines, or regulatory guidance for worker protection against infectious agents during remediation of waste sites such as this tannery. When assessing workplace conditions where environmental evaluation criteria have not been developed or are not applicable, NIOSH field staff may utilize guidelines and recommendations developed by public health agencies or professional associations, accepted industry practice, or criteria for safe work practices published by standard setting organizations. In some situations, workplace evaluations and recommendations may be based on "state of the art" industrial hygiene and occupational medicine concepts, principles, and practices, or by analogy to other similar settings. Additionally, to assist with this project, infectious disease and biosafety experts were consulted. The literature was reviewed to obtain the most current references. Note that evaluation criteria may change over the years as new information on the risk of acquiring infections, exposure routes, efficacy of control systems, or safe work practices become available.

Anthrax

Anthrax, *Bacillus anthracis* (*B. anthracis*), is a large, gram-positive, spore-forming bacterial rod that is acutely infectious. Anthrax most commonly occurs in wild and domestic lower vertebrates such as cattle, sheep, goats, camels, and antelopes. Humans can become infected when exposed to infected animals or tissue from infected animals. Anthrax is also considered one of the greatest biological warfare threats, however, this type of anthrax has been manipulated and is found in higher concentrations than would be present by inadvertent anthrax exposures in the environment.[2,3]

Anthrax infection can occur through three routes: dermal, inhalational, and gastrointestinal. The infectious dose for humans has not been established but it is dependent upon a number of factors including route of infection, nutritional and other states of health of the infected person, and virulence of the particular strain. Symptoms vary depending on how the infection was contracted. Dermal exposure to anthrax (cutaneous anthrax) accounts for approximately 95% of anthrax infections. Anthrax infection through the skin occurs when *B. anthracis* contacts a cut or abrasion of the skin. The infection begins with a small red bump which develops into an ulcer with a black necrotic center. The infection can be treated with an antimicrobial therapy. Inhalation of *B. anthracis* (pulmonary anthrax) can cause hemorrhage and necrosis of multiple organ systems and usually results in death. Humans may also become ill after eating contaminated meat (gastrointestinal anthrax). Symptoms from the ingestion of anthrax may include nausea, loss of appetite, vomiting which is followed by abdominal pain, vomiting of blood, and severe diarrhea. Gastrointestinal anthrax results in death in 25% to 60% of cases.[3,4,5] However, anthrax infection is readily treatable if diagnosed in the early stages of infection.[6]

Since 1991 only three cutaneous anthrax infections have been documented in the United States.[7,8] In the United States, only 1 case of inhalational anthrax has been documented since 1976 and no gastrointestinal anthrax infection has been documented.[8] Retained as spores within soil, *B. anthracis* can remain viable for decades until favorable conditions permit dispersion and germination. However, the secondary aerosolization potential for these spores is low due in part to the clumping potential of spores with the soil into larger particles. This clumping characteristic along with the requirement for a high infectious dose (8,000-10,000 spores) may explain the rarity of human inhalation infection.[2]

Microorganisms

Microorganisms (including fungi and bacteria) are normal inhabitants of the environment. Fungi comprise 25% of the biomass of earth;[9] therefore, human exposure to fungi is ubiquitous. Although there are thousands of fungal species, reports of human and animal diseases have involved fewer than 100 species.[9] Saprophytic fungi (i.e., those utilizing non-living organic matter as a food source) inhabit soil, vegetation, water, or any reservoir that can provide an ample supply of nutrients. Under the appropriate conditions (optimum temperature, pH, and with sufficient moisture and available nutrients) saprophytic microorganism populations can be amplified. Through various mechanisms, these organisms can then be disseminated as individual cells or with soil or dust particles or water droplets.

Fungi can produce adverse health effects by three known mechanisms: (1) immunologic hypersensitivity to the fungus (allergy), (2) fungal infection (i.e., mycosis), and (3) mycotoxicosis, a reaction to toxins produced by the fungus.[10] Health effects related to allergenic responses are based, partly, on a genetic predisposition.[11] Allergic diseases typically associated with exposures in indoor environments include allergic rhinitis (nasal allergy), allergic asthma, allergic broncho pulmonary aspergillosis, and extrinsic allergic alveolitis (hypersensitivity pneumonitis).[12] Allergic respiratory diseases resulting from exposures to microbial agents have been documented in agriculture, biotechnology, office, and home environments.[13,14,15]

Acceptable levels of airborne microorganisms have not been established and no legal regulations exist for evaluating the potential health effect of microbial contamination or remediation. Relationships between health effects and environmental microorganisms must be determined through the combined contributions of medical, epidemiologic, and environmental evaluation.[16] The current strategy for on-site evaluation involves a comprehensive inspection of problem areas to identify sources of microbial contamination and routes of dissemination. In those locations where contamination is visibly evident or suspected, bulk samples may be collected to identify the predominant species. However, associating health effects with airborne microbial contaminants can be difficult.

Personal Protective Equipment

Protective clothing and equipment are designed to shield or isolate individuals from the chemical, physical, or biological hazards that may be encountered during their work.[17] Personal protective equipment (PPE) is generally considered the last line of defense, and is utilized after every effort to eliminate the hazard through feasible engineering or administrative controls has been implemented. PPE places the burden of protection on the employee, and if the equipment fails, exposure could occur. PPE can be an effective control technique for occupational hazards; however, PPE effectiveness depends on proper use by the wearer.[18] PPE is also appropriate in some situations as a backup in the event of an engineering control failure or for jobs of short duration. Selection of PPE appropriate for a given task should be made from assessment of the worksite hazards, which includes an evaluation of each activity. Hazard assessments require a good understanding of the work tasks, knowledge of the potential routes of exposure, the opportunities for exposure in the task assessed (nature and extent of worker contact), and the potential for adverse health outcomes if exposure were to occur. Accident and incident reports should be reviewed to identify those injuries or exposure incidents (whether or not infection occurred) that could have been prevented by the proper use of PPE. Most approaches for selecting the appropriate PPE incorporate the following process:[8]

1. Determination of the hazards most likely to occur

2. Assessment of the adverse effects of unprotected exposure

3. Identifying other control options that can be used instead of protective clothing or equipment

4. Determining the performance characteristics needed for protection

5. Evaluating the need for decontamination

6. Assessing any constraints that may hinder the use of PPE (e.g., ergonomics, safety, vision, dexterity)

Once it is determined that PPE is required for a task, its use should be mandatory. PPE should be individually assigned whenever possible. Written procedures should be in-place to ensure consistent selection and use of PPE. Affected users must be informed of the need for PPE, consequences of not wearing the appropriate PPE, and how to properly inspect, wear, maintain, and store the PPE. Users must also be informed of all limitations associated with the use of PPE and must be aware that the equipment does not eliminate the hazard. Finally, periodic inspections and evaluations of the PPE program should be conducted to ensure that procedures are consistently followed, to identify any process changes that may have occurred, and that the selected PPE is still appropriate for the given task.

SITE OBSERVATIONS

Building 2 is a 2-story warehouse that is located closest to the public walking path. Building 1 is a 4-story building; its roof partially collapsed during the 2001 winter, allowing snow to enter the building. During that winter, the EPA coordinator reported that 2 to 4 inches of liquid was observed on the basement floor. The EPA plans to demolish building 1 after the site clean up because it is not structurally sound. Visible mold growth and a musty odor were detected in both buildings.

In building 2, there are two large open dumpsters containing unprocessed animal hides, skins, hair, and fleshings. In addition to the intact hides, animal hair and parts of the hides were discarded on the floor. The animal products have been present since the site was abandoned in 1994. Many of the hides appear to be deer, which is most likely of domestic origin. There are also barrels bearing the label "Product of Ethiopia" in the building. The manner in which these skins were cured and disinfected prior to shipment is unknown. A wastewater characterization study and engineering report, conducted in 1983, indicated Independent Leather primarily used sheepskins from Iran or New Zealand that were shipped in an acid curing solution. However, no documentation was found describing the process at the time the tannery closed in 1994.

Building 1, where most of the tanning operations took place, contains more hazardous chemicals than building 2. There is chromium contamination throughout the building. Stagnant liquid was found inside some of the wooden tumblers. A sheepskin with wool was observed on the floor. Animal hair and small pieces of skins and hides were also scattered throughout the building.

The remediation workers at the site are currently trained in hazardous waste remediation and are included in a hazard communication and respiratory protection program. Following the site visit, the EPA reported constructing an isolation barrier on the ground floor of building 2 by closing the doors and sealing the windows with plastic. This area is maintained under negative pressure and all air exhausted to the outside is filtered using a high-efficiency particulate air (HEPA) filter. All remediation workers were reported wearing full face respirators with high efficiency particulate filters, Tyvek® suits, boot covers, gloves, and hard hats. Animal hides and other by-products are placed in sealed barrels, which are wiped down with a bleach solution before shipment to an incinerator.

DISCUSSION

Anthrax is common in southern and eastern Europe, the Middle East, South and Central America, and several countries of Africa and Asia. The US Department of Agriculture's

(USDA) Animal and Plant Health Inspection Service (APHIS) restricts the importation of animals and animal products from countries where anthrax infections occur. These imported products must be certified by foreign animal health officials, quarantined, or cleaned and disinfected at import centers prior to entry into the US. Sporadic outbreaks of anthrax infection have occurred in the US. In August 2000, a steer was found dead and later slaughtered for consumption in Minnesota. *B. anthracis* was isolated from the steer and the people who consumed the contaminated meat were treated with antibiotics, although they were not diagnosed with anthrax infection. In 1999, 120-150 cattle died of anthrax in North Dakota.[5] As previously noted, only three cases of anthrax infection (cutaneous) have been reported in the United States since 1991.

The inhalation hazard of anthrax spores during this remediation work is minimal based on the dose necessary for infection and the low secondary aerolization potential of anthrax spores.[6,19] According to the World Health Organization (WHO), "substantial exposure is evidently necessary before risk of inhalation anthrax becomes significant."[6] The most common route of anthrax infection in humans is through dermal exposures, when spores come into contact with skin abrasions.

Because importation records are not available to determine the manner in which the hides, skins, and other animal products were treated prior to arrival at the tannery and the origin of the hides is uncertain, the potential for the presence of *B. anthracis* spores at the site and a resulting exposure to these spores for remediation workers cannot be ruled out. Some studies suggest that the de-hairing process, which uses a sodium sulphide liming mixture with calcium hydroxide, may kill any spores that were present.[20,21] While the likelihood of exposure is minimal, prudent precautions should be taken to protect workers during these activities. No guidelines currently exist for remediation workers exposed to biohazards under these circumstances. As such, the focus for minimizing risk is to reduce the likelihood of skin exposure through use of PPE and work practices (i.e., wet method of decontainment, barrier isolation).

Decontamination is recommended anytime a worker has direct physical contact with biological agents such as anthrax spores. Guidelines for decontamination of surfaces, PPE, and skin vary and there is no consensus on the appropriate method. Effective disinfection of spores is extremely difficult and may not be achievable. WHO has guidelines on decontamination but suggests that these be tailored to specific situations.[6] WHO suggests disinfecting surfaces with a three-stage approach: (1) disinfecting surfaces with either a 10% formaldehyde or 4% glutaraldehyde solution for 2 hours; (2) cleaning with hot water to remove any debris; and (3) final disinfection using either 10% formaldehyde, 4% glutaraldehyde, 3% hydrogen peroxide, or 1% peracetic acid with a 2-hour contact time. Incineration or autoclaving are recommended for contaminated clothing or tools. WHO recommends soaking miscellaneous non-disposable items overnight in a 4% formaldehyde solution or 2% glutaraldehyde. However, the use of these chemicals involves an occupational risk to workers which should be considered before use.

Decontamination of PPE using a bleach solution (sodium hypochlorite) is mentioned as the disinfectant of choice by other sources.[4] It is important to note that bleach is sensitive to pH such that inactivation of spores is inhibited at alkaline pH. Using hypochlorite in solution (around room temperature) without adjusting the pH of the solution to neutral or acid could result in an overestimation of its sporicidal effectiveness.[22] In general, the effectiveness of decontamination procedures to inactivate spores is still in question.

In the event of PPE failure resulting in skin contact with anthrax, recommendations for cleaning and disinfecting the skin vary. Copious soap and water washing of the skin that is contacted by anthrax has been recommended.[23] Other recommendations include wiping grossly contaminated skin areas with 0.25 to 0.5% hypochlorite, followed by thorough soap and water washing.[24] Regardless of decontamination procedures, there is consensus on the importance of post-exposure surveillance by health care professionals and any skin lesions developing after exposure should be immediately reported to a physician.

The growth and survival of microorganisms in environmental reservoirs require: (1) a suitable nutrient source; (2) adequate available water; and (3) an appropriate temperature. These conditions, when combined with high porosity materials, are optimum for microbial growth. In both buildings at this site these conditions were present; i.e., water intrusion from snow melt and rain storms, organic material in the dirt floors and dumpsters, and cool temperatures. Microbial contamination was visually apparent in various locations including the wooden tumblers, beams, and stagnant water reservoirs. An odor, attributable to microbiological growth, was strongly present in both buildings. Given the extent of microbial contamination, the microbial reservoirs will unavoidably be disturbed and disseminated during remediation. It is important that all remediation activities be conducted with an awareness of the potential bioaerosol exposures and with minimal disturbance of contaminated materials. Under these conditions, isolation barriers are necessary to contain airborne spores and other biological matter. Barriers alone disrupt the pathways between remediation zones and adjacent environments, but disseminated aerosols almost invariably find breaks in any barrier system. Therefore, negative pressure relative to adjacent areas is recommended to ensure containment. It is critical that the exhausted air streams be appropriately filtered using a HEPA filter to guard against re-entry of microbially contaminated air back into the zone of remediation and/or to other areas that are considered uncontaminated. EPA personnel indicated such barriers and ventilation systems were constructed following the NIOSH visit.

While remediation workers generally have extensive training on hazards associated with chemical exposures, most do not have experience with biological hazards (anthrax or other microorganisms). PPE procedures established at the site to deal with the chemical hazards, in addition to decontamination and containment procedures, should be sufficient to protect workers from the potential biological hazards at this site.

CONCLUSIONS

The likelihood that anthrax spores are present is minimal at this tannery, however the presence of spores cannot be ruled out and appropriate precautions are warranted. The potential for inhalation exposure is minimal, therefore the primary concern for workers is dermal contact during remediation activities. There is a lack of specific recommendations, guidelines, or regulatory guidance describing safety and health criteria for worker protection during remediation of waste sites such as this tannery. The conditions for the growth and survival of microorganisms were present in both buildings, and visible mold growth was observed. Based on discussions with EPA personnel on work practices and PPE use, the precautions taken by remediation workers are prudent and appropriate and should adequately prevent exposure to biological hazards.

RECOMMENDATIONS

Based on our evaluation, the following recommendations are provided. These address PPE usage, appropriate training, and work practices to reduce exposures to bioaerosols during remediation.

1. Personnel should continue to wear full-face respirators with a dual high efficiency particulate air filter and organic vapor cartridge, disposable protective clothing covering the head and shoes, and gloves during remediation activities. The respirator will ensure workers are protected from the inhalation hazard of bioaerosols. The PPE will prevent dermal exposures to spores in the rare instance that anthrax is present.

2. Remediation workers should be trained on proper clean up methods, proper PPE, and potential health hazards associated with exposures to molds and anthrax. Workers should be trained to seek treatment with a health care professional if they suspect infection. This training should be done in compliance with the OSHA Hazard Communication Standard (29 CFR 1910.1200), and the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120).

3. Workers who have direct skin contact should immediately wash their hands vigorously with soap and water. If workers observe any skin lesions or other medical problems subsequent to direct contact, they should seek medical treatment by a health professional.

4. All wastes potentially contaminated with anthrax spores (e.g., hides, skins, and any other animal products) should be considered hazardous. PPE such as disposable protective clothing should be also be considered hazardous. This waste should be placed in a waste container and safely transported to a site for incineration.

5. To suppress the dust, hair, and microbial contamination, the surfaces should be misted with water prior to remediation work. Non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood and concrete) materials can be cleaned and reused. Cleaning should be done using a detergent solution or a 5-10% bleach solution. Porous materials such as wallboards and insulation should be removed in a sealed plastic bag and discarded. There are no special requirements for the disposal of moldy materials.

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