CDC

Workplace Safety and Health

# NIOSH Guidance

## Controlling Potential Risks for Workers Exposed to Biosolids

### Introduction

Biosolids are organic materials resulting from the treatment of domestic sewage sludge. The purpose of the treatment is to significantly reduce the concentration of disease-causing organisms (also known as pathogens) typically associated with domestic wastewater and solids so that the materials can be recycled for beneficial uses such as soil fertilization.

The U.S. Environmental Protection Agency has established two regulatory categories of biosolids based on their pathogen content:

- Class A biosolids have undergone treatment to the point where pathogens are at virtually undetectable levels. They do not require any additional restrictions or special handling precautions and may be applied in the same way as commercial fertilizers.
- Class B biosolids have undergone treatment that has reduced but not eliminated pathogens. As a result, use of Class B biosolids also require additional measures to restrict public access and to limit livestock grazing for specified time periods after land application

Whereas EPA rules (40 CFR 503) restrict public access to treated lands in order to protect public health, these rules do not apply to workers involved with biosolids land application. Workers may come in contact with biosolids during the course of their work. The recommendations in this document are intended to provide guidance to employers and workers to minimize occupational risks through appropriate monitoring of biosolids during production and storage (if applicable), utilization of proper work practices and personal protective equipment during handling and application of biosolids, and comprehensive hazard communication and training for workers. These recommendations are not intended to address non-occupational exposure.

### How are biosolids used?

Biosolids are typically treated to Class B or Class A standards at the sewage treatment plant. In a liquid or semi-liquid state, biosolids can be transported by truck to a land application site where they are applied directly to the land using tractors, tank wagons, irrigation systems, or special application vehicles. Biosolids may undergo dewatering using polymers. Dewatered biosolids are often temporarily stored at the treatment plant or application site before being transported and applied to land using front-end loaders, trucks, tractors, or sludge-spreading equipment. Workers may come into either direct or indirect contact with biosolids during any phase of the treatment,



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transport, or application process. Currently, more than fifty percent of the biosolids generated in the United States are applied as fertilizer to improve and maintain productive soils and stimulate plant growth, rather than being sent to landfills or incinerated. Biosolids have been applied on agricultural lands and surface mine reclamation sites. EPA estimates that 7.6 million tons of biosolids will be generated for use or disposal in 2005.

**What is in biosolids that requires control of worker exposures?**

There are four major types of human disease-causing organisms (pathogens) that can be found in sewage: (1) bacteria, (2) viruses, (3) protozoa, and (4) helminths (parasitic worms). Class B biosolids contain the same types of pathogens as the source sewage but at reduced concentrations.

To protect public health, the EPA rule prescribes a *restricted period* of up to one year to limit public access to lands where Class B biosolids have been applied. These EPA restrictions do not apply to occupational access. EPA does recognize that occupational exposure can occur, and states that workers exposed to Class B biosolids might benefit from several additional precautions such as use of dust masks when spreading dry materials, the use of gloves when touching biosolids, and routine hand washing. The risk of worker exposure to infectious agents is likely greatest during and immediately after land application of the biosolids. Because the concentration of pathogens decays through natural processes, the potential for pathogen exposure decreases over time.

**Do we know these pathogens can cause disease?**

Yes, the association between poor hygiene, raw sewage, and infectious disease is well established. Most of the pathogenic bacteria and viruses in Class B biosolids are enteric, which means they are present in the intestinal tracts of human and animals. Enteric organisms that may be found in Class B biosolids include, but are not limited to, *Escherichia coli*, *Salmonella, Shigella, Campylobacter, Cryptosporidium, Giardia*, and enteroviruses. Exposure may potentially result in disease (e.g., gastroenteritis), or in a carrier state (e.g., typhoid), where an infection does not clinically manifest itself in the individual but can be spread to others. These enteric organisms are usually associated with self-limited gastrointestinal illness but can develop into more serious diseases in sensitive populations such as immuno-compromised individuals, infants, young children, and the elderly. Because data are sparse on what constitutes an infective dose, it is prudent public health practice to minimize workers' contact with soil or dusts containing Class B biosolids during the period when public access is restricted.

**Can workers be exposed to pathogens from biosolids?**

Workers could be exposed to pathogens when working with Class B biosolids during the period when public access is restricted. During a NIOSH field investigation at a biosolids land application and storage site:

- NIOSH interviewed employees who worked in all phases of the biosolids operation. Some employees reported repeated, intermittent episodes of gastrointestinal illness after working with the biosolids, either at the treatment plant or during land application.

- NIOSH observed inconsistent awareness, provision, and use of protective equipment and hygiene practices appropriate for handling Class B or sub-standard biosolids.
- NIOSH collected bulk samples from different locations within the biosolids storage site and measured fecal coliform concentration of the bulk samples. Fecal coliforms are used as an indicator for the presence of other enteric microorganisms. Enteric bacteria were also detected in air samples collected at the land applications site.
- The local Department of Environmental Services recently informed NIOSH that biosolids applied at this site intermittently exceeded (by up to 4.5-times) the EPA fecal coliform upper limit for Class B biosolids prior to the NIOSH survey.
- The sub-standard biosolids were applied at the agricultural site before the monitoring results were received from the laboratory.

NIOSH is not aware of published studies that have examined the extent of worker exposure to Class B biosolids. EPA materials do state that high-pressure spray applications may result in some aerosolization of pathogens, and that the application or incorporation of dewatered biosolids may cause very localized fine particulate/dusty conditions. Additional study of worker exposures to pathogens and other toxics possibly present in Class B biosolids will reduce scientific uncertainty on these issues and allow further refinement of worker precautions.

**What should employers do to prevent work-related diseases?**

There is a need to insure a basic level of protection for workers commensurate with that used to protect public health and the environment. Here are some recommendations for consideration:

Provide basic hygiene recommendations for workers.

Basic hygiene precautions are important for workers handling biosolids. The following list, originally developed by EPA, provides a good set of hygiene recommendations.

1) Wash hands thoroughly with soap and water after contact with biosolids.
2) Avoid touching face, mouth, eyes, nose, genitalia, or open sores and cuts.
3) Wash your hands before you eat, drink, smoke, or use the bathroom.
4) Eat in designated areas away from biosolids handling activities.
5) Do not smoke or chew tobacco or gum while working with biosolids.
6) Use gloves to protect against creation of skin abrasions and/or contact between abrasions and biosolids, or surfaces exposed to biosolids, when they occur unexpectedly.
7) Remove excess biosolids from shoes prior to entering vehicle.
8) Keep wounds covered with clean, dry bandages.
9) Flush eyes thoroughly, but gently, if biosolids contact eyes.
10) Change into clean work clothing on a daily basis and reserve work boots for use at work site or during biosolids transport.
11) Do not wear work clothes home or outside the work environment.

Additionally, NIOSH recommends the following steps to provide a more comprehensive set of precautions for use by employers and employees:

Provide appropriate protective equipment, hygiene stations, and training

Personal Protective Equipment (PPE) - Appropriate PPE should be provided for all workers likely to have pathogen exposure from biosolids. The choices of PPE include goggles, splash-proof face shields, respirators, liquid-repellant coveralls, and gloves. Face shields (that fit over the employee's hard hat) should be made available for all jobs where there is a potential for exposure to spray or high-pressure sewage leaks, or aerosolized biosolids during land application. Management and employee representatives should work together to determine which job duties are likely to result in this type of exposure, to conduct appropriate on-site monitoring, and to determine which type of PPE is needed in conjunction with a qualified health and safety professional. If respirators are needed, a comprehensive program that includes respirator fit testing, and training or retraining should be established.

Hygiene and Sanitation - Hand-washing stations with clean water and mild soap should be readily available whenever contact with biosolids may occur. In the case of workers in the field, portable sanitation equipment including clean water and soap should be provided. Cabs should be wiped down and cleaned of residual mud (or settled dust) after each use to reduce potential exposure to contaminated material.

Hazard Communication and Training - Periodic training regarding standard hygiene practices for working with biosolids should be conducted by a qualified safety and health professional which covers issues such as:

- frequent and routine hand washing (the most valuable safeguard in preventing infection by agents present in biosolids), especially before eating or smoking;
- the use of PPE, such as coveralls, boots, gloves, goggles, respirators, and face shields;
- the removal of contaminated PPE and the use of available on-site showers, lockers, and laundry services;
- proper storage, cleaning, or disposal of contaminated PPE;
- instructions that work clothes and boots should not be worn home or outside the immediate work environment; and prohibition of eating, drinking, or smoking while working in or around biosolids.

Immunizations - Ensure that all employees are up-to-date on tetanus-diphtheria immunizations, since employees are at risk of soil-contaminated injuries. Current CDC recommendations do not support hepatitis A vaccination for sewage workers, although data are sparse. This recommendation may be modified as more data are developed.

Extend good environmental practices to prevent and minimize occupational exposures

- Where feasible, substituting Class A biosolids would significantly reduce the pathogen exposure risks compared to using Class B biosolids. Generally, the most effective control for occupational safety and health hazards is to eliminate the hazard through substitution.
- Monitor the source material coming from the waste treatment facility. Check monitoring results to assure they meet specified Class B or Class A standards prior to land application operations.

- Monitor stored biosolids prior to application to assure that the biosolids are properly stabilized and that re-growth or cross-contamination from sub-standard material has not occurred.
- Where feasible, inject biosolids below the soil, or incorporate (thoroughly mix) into tilled soil. This will minimize direct contact with workers and prevent re-suspension into the air during periods of dryness.
- Avoid spreading biosolids on dry windy days to avoid aerosolization of biosolids dust.
- Avoid unnecessary mechanical disturbance and contact with land-applied Class B biosolids during the period when public access is restricted.
- Equip heavy equipment used at storage and application facilities with sealed positive pressure, air-conditioned cabs that contain filtered air recirculation units.
- Monitor worker exposures when adjusting precautions to address site-specific issues.

**For More Information**

Additional information about biosolids and preventive measures can be obtained from the following:

- National Institute of Environmental Health Sciences (NIEHS). The Beauty of Biosolids. *Environmental Health Perspectives*, Vol. 104, No. 1, January 1997. On the Internet at: http://ehpnet1.niehs.nih.gov/qa/105-1focus/focusbeauty.html.
- Environmental Protection Agency (EPA): *Title 40 Code of Federal Regulations* Part 503. Homepage on the Internet at: http://www.epa.gov/owm/bio.htm
- Environmental Protection Agency (EPA): Guide to Field Storage of Biosolids. http://www.epa.gov/owm/bio/fsguide/chapter4.pdf
- National Center for Infectious Diseases (NCID). Viral Hepatitis Resource Center: http://www.cdc.gov/ncidod/diseases/hepatitis.