

Workers Exposed to Class B Biosolids During and After Field Application

Key Points

- Workers may be exposed to disease-causing organisms while handling, applying or disturbing Class B biosolids on agricultural lands or mine reclamation sites.
- Class B biosolids are sewage sludge that has undergone treatment by processes that significantly reduce pathogen concentrations. These processes include aerobic and anaerobic digestion, air drying, composting, and lime stabilization. According to the U.S. Environmental Protection Agency (EPA), Class B biosolids may contain pathogens in sufficient quantity to warrant restricted public access and special precautions for exposed workers.
- Class A biosolids are sewage sludge that has undergone treatment by processes that further reduce pathogen concentrations resulting in an end product that is virtually pathogen-free. These processes include irradiation, composting, heat drying, heat treatment, pasteurization, thermophilic aerobic digestion, and alkaline stabilization. Class A biosolids do *not* contain pathogens in sufficient quantity to warrant restricted access or special precautions and may be applied the same way as commercial fertilizer.
- NIOSH collected air samples for bacteria and endotoxin (a component of some bacteria), and bulk sewage sludge samples for fecal coliform bacteria at a Class B biosolids land application processing facility. Potentially pathogenic bacteria were found in bulk samples and in some air samples. Employee gastrointestinal illnesses at that facility may have

been caused by ingestion or inhalation of Class B biosolids.

- Whereas EPA rules restrict public access to treated lands in order to protect public health, these rules do not apply to workers involved with applying biosolids to land. The recommendations in this document are intended to provide guidance to employers and workers to minimize occupational risks from Class B biosolids through the use of engineering controls, personal protective equipment, and worker training. These recommendations are not intended to address non-occupational exposure.

About Biosolids

Sewage sludge is typically treated to Class B requirements at the sewage treatment plant. Class B biosolids, in a liquid or semi-liquid state, can be transported by truck to a land application site where they are directly applied 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, transport, or application process. The biosolids are applied as fertilizer to improve and maintain productive soils and stimulate plant growth. Biosolids have been applied on agricultural lands and surface mine reclamation sites.

Description of Hazard

There are four major types of human pathogenic organisms found in biosolids: (1) bacteria, (2) viruses, (3) protozoa, and (4) helminths (parasitic worms). The concentration of organisms in biosolids depends on the type and concentration of pathogens present in the source sewage and the degree to which those organisms are removed or killed by the pre-treatment process.

The hazard that is associated with Class B biosolids is a function of the number and type of pathogens in the treated sludge relative to the minimum infective dose and the exposure level. Under the EPA biosolids rule (40 CFR 503), Class B biosolids must contain less than two million colony forming units (CFU) of fecal coliform per gram of total solids (dry weight). 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. 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.

In other settings, 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 immunocompromised 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 restricted periods.

During investigations at a Class B biosolids land application and at a Class B biosolids storage site:

- NIOSH interviewed five employees at a Class B biosolids land application operation. All five employees reported at least one episode of gastrointestinal illness after working with the

biosolids, either at the treatment plant or during land application. The environmental sampling results indicated that the gastrointestinal illnesses were possibly of occupational origin.

- NIOSH collected bulk samples from different locations within the biosolids storage site. The mean fecal coliform concentration of the bulk samples was 220,000 CFU per gram of sample (wet weight). Fecal coliforms are used as an indicator for the presence of other enteric microorganisms. There remains a significant exposure risk. This example illustrates the importance of minimizing exposure to Class B biosolids during the restricted period.
- NIOSH collected air samples at the Class B biosolids land application and storage site. Enteric bacteria were detected in the air. The presence of enteric bacteria in air samples is sufficient justification to implement engineering controls and work practices that minimize employee exposure to biosolid aerosols.

The detection of enteric bacteria in a limited number of air and bulk samples confirms the potential for workers to be exposed to organisms which have been associated with gastrointestinal symptoms and illness. Operations where employees are potentially exposed to Class B biosolids include transport, loading, unloading, and application activities. Other potentially exposed workers include compost workers, surface miners working around reclamation sites, and farmers.

Recommendations for Prevention

The recommendations contained in this document apply to workers at Class B biosolids land application sites. These recommendations are different from those required for the general public which are regulated by Title 40, Code of Federal Regulations, Part 503 (40 CFR 503).

- Class B biosolids should be incorporated (thoroughly mixed) into the soil to prevent suspension into the air during periods of dryness. After application, mechanical disturbance and contact with Class B biosolids should be avoided for the restricted period.
- Hand-washing stations with clean water, mild soap, and paper (disposable) towels should be readily available whenever contact with Class B biosolids may occur. In the case of workers in the field, portable equipment, including clean water and soap, should be provided.
- Since employees are at risk of soil-contaminated injuries, management should ensure that all employees are up-to-date on tetanus-diphtheria immunizations.

- Current CDC recommendations do not support hepatitis A vaccination for sewage workers. Data are sparse; thus, this recommendation may be modified as more data are developed.
- Periodic training regarding standard hygiene practices and the use of personal protective equipment should be conducted.

Actions That Should Be Taken

As a rule, the most effective control for occupational safety and health hazards is to eliminate the hazard through substitution. In this case the use of Class A pathogen-free biosolids would eliminate the hazard; however, this report addresses reducing worker risk where Class B biosolids are used. When using Class B biosolids, engineering controls and work practices should be used to prevent exposures. Personal protective equipment, including respiratory protection, should be used when engineering controls are not feasible; before engineering controls are installed; or when installed engineering controls are being repaired or maintained.

Engineering Controls:

- The storage time for dewatered (filter cake) Class B biosolids should be minimized at both the water treatment facility and in the field to prevent the growth of pathogens.
- The Class B biosolids should be incorporated (thoroughly mixed) into the soil, where feasible. Where incorporation is not feasible, workers exposed to the land-applied biosolids should use personal protective equipment during the restricted period.
- Mechanical disturbance of applied Class B biosolids should be avoided during the restricted period.
- Heavy equipment used at storage and application facilities for Class B biosolids should be equipped with sealed positive pressure, air-conditioned cabs that contain filtered air recirculation units to reduce the potential for exposure to airborne microorganisms and endotoxin.

Personal Protective Equipment:

Appropriate personal protective equipment should be required for all job duties likely to result in exposure to Class B biosolids. The choices of personal protective equipment 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, high-pressure sewage leaks, or aerosolized biosolids during land application. Gloves should be used when touching biosolids or surfaces exposed to biosolids. Management and employee representatives should work together to determine which job duties are likely to result in this type of exposure and which type of equipment is needed. A qualified health and safety professional should provide training or retraining in the appropriate use of personal protective equipment.

Hygiene and Sanitation:

Hand-washing stations with clean water and mild soap should be readily available whenever contact with Class B biosolids may occur. In the case of workers in the field, portable sanitation equipment including clean water and soap should be provided. Biosolids should be removed from shoes prior to entering enclosed vehicles, and 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 Class B biosolids should be conducted which covers issues such as:

- the frequent and routine hand washing (the most valuable safeguard in preventing infection by agents present in Class B biosolids), especially before eating or smoking, and after contact with Class B biosolids or surfaces exposed to biosolids;
- the use of personal protective equipment, such as coveralls, boots, gloves, goggles, respirators, and face shields;
- the removal of contaminated personal protective equipment and the use of available on-site showers, lockers, and laundry services;
- the proper storage, cleaning, or disposal of contaminated personal protective equipment;
- the use of clean, dry bandages to cover cuts and wounds;
- the instructions that work clothes and boots should not be worn home or outside the immediate work environment; and
- the prohibition of eating, drinking, or smoking while working in or around biosolids.

For More Information

Additional information about Class B 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>

National Center for Infectious Diseases (NCID). Viral Hepatitis Resource Center:

<http://www.cdc.gov/ncidod/diseases/hepatitis>.

To obtain more free information about this hazard or other occupational safety and health issues:

Call NIOSH at 1-800-35-NIOSH
(1-800-356-4674)
or visit the NIOSH Web site at
www.cdc.gov/niosh

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