

DEMONSTRATION 3

BIOSOLIDS

LEARNING OBJECTIVES:

☒ ***At the conclusion of Demonstration 3, participants will be able to:***

1. Define “biosolid” and “sludge.”
2. Explain processes in which sewage sludge is treated to significantly reduce pathogens.
3. Explain disposal methods for biosolids and sludge.
4. Explain how land application recycles nutrients and organic matter present in biosolids.
5. Discuss Best Management Practices for transporting biosolids.
6. List Best Management Practices for land application of biosolids to protect water quality and reduce risks to health.

☒ ***Terms to be familiar with:***

- Biosolid
- Sludge
- Pathogen
- Anaerobic digestion
- Aerobic digestion
- Lime stabilization
- Lagoon
- Best Management Practices
- Pollution sensitive sites such as Sinkholes and Karst.

☒ ***Before you begin:***

1. You will need the black liner and grass felt pieces provided in the kit.
2. Understand that opinions differ on the actual definition of sludge and “biosolids” and, in turn, opinions differ on the safest use and disposal of biosolids and sludge. If they are not applied or treated properly, they could pose potential health concerns to the public. In the United States, Canada and most industrialized countries, there are federal and often local and state or provincial regulations that apply to the disposal and use of biosolids and sludge; therefore, the definition, treatment and use of biosolids can differ from jurisdiction to jurisdiction.

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3. Refer to the back of this guide for a variety of definitions (including biosolids) and links to other sources and to get your audience involved in their own research on the subject.

INTRODUCE PARTICIPANTS TO DEMONSTRATION 3

In Demonstration 2, we talked about the sewage/wastewater treatment process. Remember that some solids settled to the bottom of the tanks. What happens to this sewage sludge? It can either be incinerated, land filled or treated to reduce odors and pathogens to become biosolids.

That's what we're talking about in Demonstration 3. We're going to talk about biosolids and sludge and the different disposal methods and/or recycling uses.

Biosolids are currently being placed at landfills, incinerated, stored for future use or used on the land.

Some biosolids are in liquid form and some are in solid form. Many wastewater treatment plants choose to dewater their biosolids, creating a thick solid cake. And some may incinerate some or all of the biosolids. Incineration produces heat that can be captured and used for energy.

Other processes for converting biosolids into usable forms are air drying, advanced lime treatment and composting. Efforts are being made to convert biosolids into energy.

☒ *Using a spoon, scoop some sludge (also will have some water) from the round and rectangular secondary clarifier and place in digester container and set on the model.*

DISCUSS Sludge is collected during the primary and secondary wastewater treatment processes. If the sludge is to become biosolids, it will go on for further processing to “digest” or reduce pathogens.



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Processes in which sewage sludge is treated to significantly reduce pathogens:

- **Anaerobic Digestion.** In this most commonly used process, because of its low cost, the sludge is pumped into an Anaerobic Digester. It's very warm inside the digester and there is no oxygen. The sludge will sit in this sealed, oxygen-free environment for 2 to 4 weeks. Microorganisms that like to live in a warm, oxygen-free environment eat and digest (break down) the sludge. This helps reduce the harmful bacteria living in the sludge. The anaerobic digesters have covers to collect the flammable methane gas that the bacteria produce. This gas is a reusable byproduct of sludge treatment and is often collected, stored and burned to heat buildings or fuel engines.
- **Aerobic Digestion.** In this process, sewage sludge is mixed with oxygen to maintain aerobic (with oxygen) conditions for a specific time at a specific temperature. The sludge is mixed or injected with air for 2 to 3 weeks or longer (similar to what we saw in the aeration basin). The decomposable solids in the sludge are converted to carbon dioxide, water and nitrate, and the sludge particles are allowed to settle and separate.
- **Lime Stabilization.** Lime (calcium oxide) is added to sewage sludge to raise the pH level and produces a lot of heat which kills most pathogens and stops biological activity, so that odors are not produced by the degradation of the remaining organics. Maintaining the pH level is important. A major difference between lime-stabilized biosolids and biosolids treated by other methods may be the pH or lime content. The high lime content or pH of the biosolids makes lime-stabilized biosolids useful for liming fields to sweeten the soil.

☒ ***When the sludge has completed a process to reduce pathogens and odors, it is then called BIOSOLIDS.***

Biosolids, then, are treated sludges that have met the regulatory standards for use as a fertilizer or soil conditioner, including the required pathogen reduction requirements.

In the U.S., two types of Biosolids are defined under the U. S. Environmental Protection Agency's Part 503 rule — Class A and Class B. Similar biosolids treatment and rules are used in Canada, Europe and many other places around the world.

ASK *What do we do with biosolids?*

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NOTE: As previously noted, opinions differ as to the proper treatment, use and disposal of sludge and biosolids. The following discussion describes a variety of methods of disposal and applications for reuse that are in use today in some states/provinces and countries. Not all areas follow the same guidelines or allow the use of biosolids.

- ☒ **PLACE BLACK LINER** in bottom of lagoon and pour biosolids from the digester in the lagoon.



DISCUSS Liquid biosolids are commonly stored in lagoons. Lagoons used for biosolids storage should be constructed with a liner that will not erode as the biosolids are removed. Field storage is used for temporary or seasonal storage of dewatered biosolids. The field storage sites are usually located at or near the land application site and are managed so that biosolids come and go on a relatively short cycle, based on weather conditions, crop rotations and land or equipment availability. Since farm fields are filled with growing crops during the summer or frozen in the winter, biosolids are stored for extended periods so they can be applied to the fields in the spring before the crops are planted or in the fall after harvest. Whether biosolids are stored in a lagoon or on the land, the length of storage is dependent on the laws in the particular area. Special best management practices are important to ensure runoff does not occur in uncovered storage facilities. Detailed recordkeeping, monitoring and testing are required. Some states also severely limit biosolids storage.

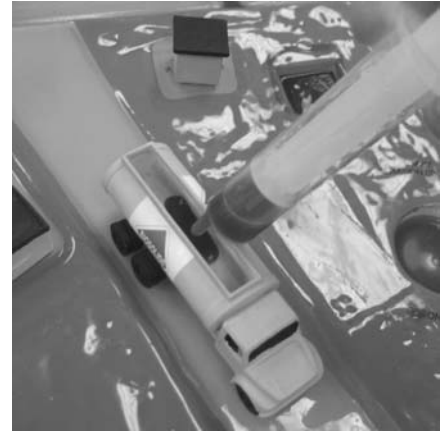
Check YOUR state/province guidelines and rules for use and disposal of biosolids.

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⊗ **USE SYRINGE (or PIPETTE) to transfer biosolids to the biosolids truck and drive the truck to the FARM.**

DISCUSS If used in liquid or cake form, biosolids can be transported from the Wastewater Treatment Plant or storage lagoon in large trucks. In most areas, licensed biosolids transportation drivers operate these trucks. Some best management practices for the transportation of biosolids include:

- Avoid residential areas for all haul routes
- Use trucks designed to prevent spillage onto roads (for example, you wouldn't want to transport liquid biosolids in a dump truck)
- Clean up a spill immediately should one occur



NOW, LET'S TALK ABOUT LAND APPLICATIONS OF BIOSOLIDS.

⊗ **PLACE WET* BUFFER STRIPS on edges of FARM FIELD and next to the small depressed area by the edge of the FARM.**

(*To help the felt stay best, get it wet by dipping it in the river before placing it.)

⊗ **USE SYRINGE to carefully apply biosolids to FARM FIELD.**

DISCUSS Biosolids can be applied using the same types of equipment that farms use to apply manure. Cake manure is usually spread on the surface. Liquid manure can either be spread on the surface or injected under the ground where the roots of the growing plants will be able to get at the nutrients quickly.



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☒ **MAKE IT RAIN over the FARM FIELD (with your spray bottle).**

DISCUSS A buffer strip can be grass or other vegetation that helps hold the soil in place, reducing runoff of pollutants on the land to the water. See how the buffer zone prevents runoff to the stream. You don't want to apply biosolids or any fertilizer too close to a water supply well, or reservoir, sinkhole, lake, pond or water supply intake in a stream. Here you see that we have a buffer zone in place to ensure biosolids are not washed off to the stream.

You also don't want to spread biosolids (the same as with the use of manure) during rain or on frozen fields that will thaw during the spring thaw.

☒ **REMOVE buffer strips and MAKE IT RAIN once more.**

DISCUSS Without the buffer zone in place, biosolids may run off and/or leach into the water supply.



☒ **POINT TO depressed area on farm.**

And as mentioned earlier, it's important to consider pollution-sensitive sites when planning application of biosolids on the land. This area represents a sinkhole on the landscape. In karst terrain (where you have dissolving rock), sinkholes are points where surface water enters the groundwater system. So it's important to have best management practices, such as a buffer zone, in place to prevent contamination of groundwater.

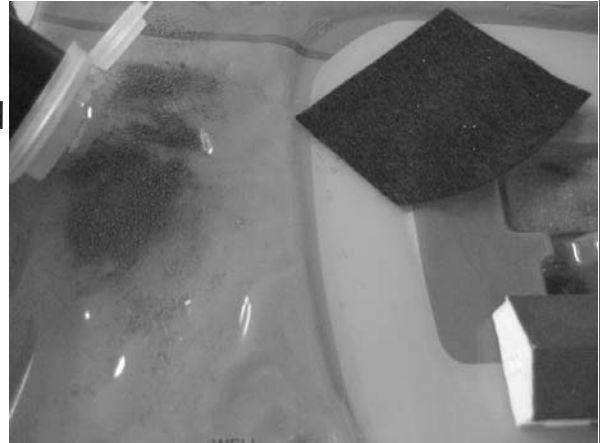
Other best management practices should be considered or developed to alleviate odor nuisance or potential health concerns for those living down wind.

☒ **Alternative Demonstration:** Depending on your area, this depression can also be used as an example of another pollution-sensitive area such as a surface body of water (pond) or even a wetland.

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☒ **Arid Range Land** — *SPRINKLE* some dry biosolids on the arid range land.

DISCUSS Dry biosolids are used in some places as topsoil material for arid rangelands. These biosolids help prevent erosion by encouraging water to enter the ground and allowing the soil to hold more water for increased plant growth. The growth of vegetation on the rangeland can support more agricultural uses such as cattle.



Best management practices to prevent soil erosion apply here as well. Vegetation and trees help stabilize stream banks and buffer zones, farm fields, etc., which in turn reduces soil from blowing and eroding. For example, applying biosolids in an area when there is a lot of wind is not recommended.

DISCUSS . . .

- **Abandoned Mines.** Biosolids are also being used at abandoned mines, where there is little or no vegetation to hold topsoil, resulting in erosion that can pollute nearby streams and waterways. The mixture of organic and inorganic matter with nutrients in biosolids counteracts the toxic substances and enables more vegetative growth, thus retarding erosion.
- **Food Crops and Gardens.** These are typically Class A biosolids that have been treated through composting and are used to promote good crop growth.
- **Forest Areas.** Biosolids are generally applied to areas of free harvest to promote regrowth after reforestation.
- **Landfill.** The landfill must be permitted to allow placement of biosolids at its facility. In some instances, biosolids are used as a cover at landfills.
- **Incineration.** Heat produced through this method is sometimes captured and used for energy. In some instances, the ash has been used to make bricks or cement.

IMPORTANT NOTE ON LAND APPLICATION & USES OF BIOSOLIDS

Some best management practices for land application of biosolids to ensure protection of water quality and public health include:

- **Evaluate the site:** Before applying biosolids, the biosolids land applier should thoroughly evaluate the farm, checking the water supply, soil characteristics, slopes, vegetation, crop needs and how far the crop is from surface water and groundwater. If the biosolids are dry, they might be in a cake or pellet form and could be applied using a traditional manure spreader – again, by a biosolids application professional and following an evaluation of the land. Areas with karst topography require additional evaluation.
- Check the minimum border requirement around application sites.
- Check the minimum border requirement around home sites, water wells and sinkholes (karst areas).
- Determine if the particular biosolid can be applied based on the intended crop.
- Determine the number of days required before harvesting or grazing by cattle.
- Determine the nitrogen and phosphorus limitations and proper application requirements.
- Identify any odor issues.
- Determine state/province, local and federal regulations (differ by state/province).
- Eliminate pollution-sensitive sites from consideration.
- Identify any health issues.

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Other important considerations in the application of biosolids include:

- Buffer zones
- Depth to groundwater
- Wetlands protection
- Harvest and grazing requirement
- Threatened and endangered species protection
- Site-specific pollution-sensitive issues such as
 - ✓ Field slope limitations
 - ✓ Restrictions for frozen or saturated soils
 - ✓ Requirements for public-use sites
 - ✓ Soil conservation practices
 - ✓ Other site restrictions

☒ **SUMMARIZE key points and ask if there are any questions.**

USER NOTE: Be sure to share your experiences, including photos, with us so we can share with other users through our web site and also continue to improve our products and demonstrations. Email, call or write us at info@enviroscapes.com, (703) 631-8810, ext. 12, or JT&A, inc., 14524-F Lee Road, Chantilly, VA 20151.

