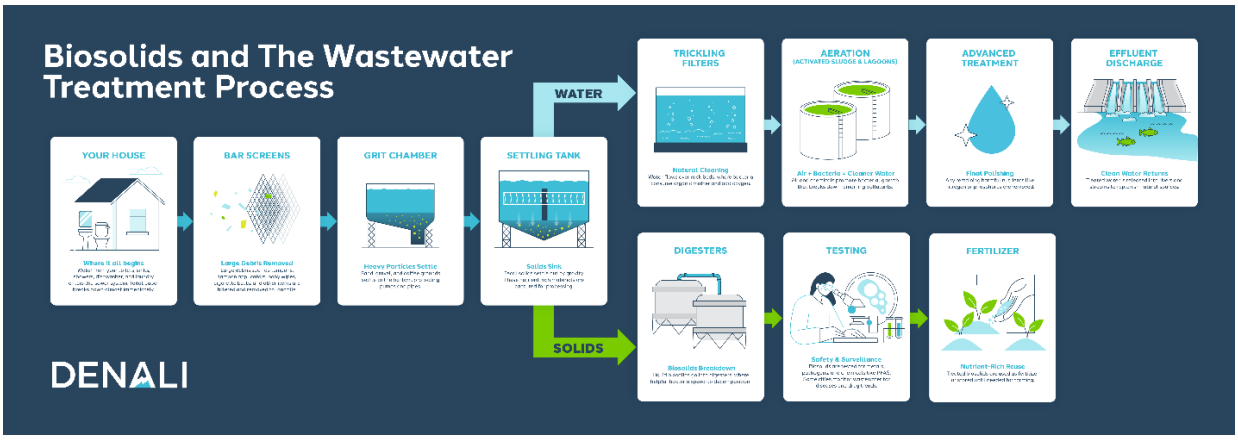
DENALI

How it Works: Biosolids and the Wastewater Treatment Process

Wastewater treatment facilities in the United States process more than 34 billion gallons each day,[1] and that wastewater contains organic materials that are rich in nutrients such as nitrogen, potassium, and phosphorus, as well as micronutrients such as nickel, zinc, and copper.[2] Biosolids are the treated organic material that can be used as fertilizer to enhance soil and increase crop production.[3] The United States has encouraged land application of biosolids for more than a century and considers it safe.[4]

Denali has decades of experience supporting numerous wastewater treatment facilities across the country by collecting biosolids that might otherwise get diverted to landfills or sent to incinerators where they would produce greenhouse gas. Ensuring biosolids are picked up from wastewater treatment plants allows plants to continue normal operations and not become overwhelmed with material, which could lead to raw sewage discharges. Biosolids also reduce the need for commercial fertilizers, which require large amounts of energy to produce and contain harsh chemicals.

Biosolids are highly regulated, within a complex regulatory framework, which varies by state, but each state must, at a minimum, meet federal standards enacted by the EPA. For example, similar to other fertilizers, biosolids are applied using best management practices within regulatory agency parameters to protect the environment and human health.



[1] https://www.epa.gov/nutrientpollution/sources-and-solutions-wastewater

[2] https://www.epa.gov/sites/default/files/2018-11/documents/land-application-biosolids-factsheet.pdf

[3] https://www.epa.gov/biosolids/land-application-biosolids

[4] https://www.engineering.iastate.edu/~jea/w3-class/456/article/article-aswpcf.html

The Biosolids Life Cycle: From Sewers to Soil

When households, businesses and schools generate wastewater, the non-organic debris are filtered by screens. During treatment, solid materials are separated from the liquid. These solids, known as sludge, undergo further processing to reduce pathogens commonly through digestion or stabilization. The treated sludge can be dewatered to remove excess moisture, resulting in a semi-solid material or handled as a liquid. Depending on the level of treatment, biosolids are classified for different uses, such as agricultural fertilizer or land reclamation.

Denali collects biosolids in liquid or dehydrated solid form in tankers or box trucks, and if approved for beneficial use, can be hauled to farms, former mine sites and even golf courses or neighborhoods when treated to rigorous standards. About 50% of biosolids are being recycled to land and are used on less than one percent of the nation's agriculture, according the EPA.

If fertilizer is not needed immediately or must be stored during inclement weather the material can be stored in lagoons, tanks, open air piles or enclosed facilities for several months up to two years, following EPA guidelines. The amount of odor drops rapidly as the biosolids dry out, and Denali endeavors to locate its biosolid storage locations away from heavily populated areas to minimize the impact on the local community.

Frequently Asked Questions:

Q: What is in biosolids?
A: Biosolids are the organic residuals generated by wastewater from homes and businesses. This material, which is treated by local wastewater treatment facilities, contains nitrogen, phosphorus, and potassium, as well as micronutrients including copper, zinc, sulfur, nickel, and pot ash[5]

Q: Are biosolids safe for agriculture?
A: Yes. The United States began adopting the practice of applying biosolids to land more than 100 years ago,[6] and in 1993 the EPA adopted formal rules and guidelines for how, when, where, and what type of biosolids can be applied to specific kinds of land under specific conditions.[7] Some states have requirements such as sub-soil injection or incorporation the end of the day, or prohibiting land application in certain conditions. If violations occur, Denali self-reports, as

[5] https://www3.epa.gov/npdes/pubs/bio4-8.pdf

[6] https://www.engineering.iastate.edu/~jea/w3-class/456/article/article-aswpcf.html

[7] https://www.epa.gov/sites/default/files/2018-12/documents/plain-english-guide-part503-biosolids-rule.pdf

mandated by state and local agencies. Regulators also ensure compliance through audits of the treatment plant to land application processes.

Q: Does Denali add chemicals or other materials to biosolids?
A: Denali does not add any hazardous or regulated chemicals to material we receive. Occasionally we use organic amendments (wood chips, lime) to assist in drying the materials, or food-grade polymers to further dewater or solidify. Biosolids are not considered a hazardous material.

Q: Why do biosolids have strong odors, and what is Denali doing about it?
A: Biosolids contain organic compounds that naturally decompose from bacterial microbes. That process creates byproducts such as methane gas, hydrogen sulfide, and ammonia that have odors. To minimize the impact, Denali sometimes adds lime to biosolids to speed up the drying process and locates storage facilities in rural areas that are not near densely populated residential neighborhoods. We also use injection or plowing methods to minimize odors.

Q: Do biosolids contain "forever chemicals" such as PFAS?
A: PFAS has become ubiquitous worldwide. Biosolids are known to contain per- and polyfluoroalkyl substances (PFAS) and perfluorooctane sulfonate (PFOS)[8], and the U.S. Food and Drug Agency, the Environmental Protection Agency, other regulatory bodies, and industry trade groups are actively studying the issue to learn more about and measure the quantities of PFAS and PFOS that are present. They are also working to reduce or eliminate these chemicals at the source of production.[9]

PFAS/PFOS are a class of thousands of chemicals that originate from sources such as commercial fertilizers, herbicides and pesticides; stain resistant sprays and coatings on furniture and carpet; firefighting foam; consumer products like fast food packaging, nonstick pans, water-resistant fabrics such as umbrellas, shampoo, and cosmetics. Often PFAS/PFOS end up in landfills and municipal wastewater treatment plants when people dispose of or use items that contain those chemicals, or when wastewater is otherwise generated. [10] A recent study of nearly 2,000 people by the National Health and Nutrition Examination Survey (NHANES) found that 97% of subjects had a detectable level of PFAS/PFOS in their bodies and bloodstream from exposure to sources like those mentioned above.[11]

[8] https://pubs.acs.org/doi/10.1021/acsestwater.1c00377?ref=recommended

[9] https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas

[10] https://ehp.niehs.nih.gov/doi/abs/10.1289/isee.2022.O-OP-024

[11] https://pmc.ncbi.nlm.nih.gov/articles/PMC4483690/

However, PFAS levels in the U.S. population have declined by more than two-thirds since 1999 when NHANES began measuring it,[12] and the production and use of PFAS and PFOS continues to drop.[13,14]

Denali and its immediate customers, and municipal partners, are not producers, manufacturers or users of PFAS/PFOS, and those chemicals don't originate from our operations. Rather, Denali, our customers, and partners are passive receivers of PFAS/PFOS from sources that already exist in households, businesses, and schools that end up in the wastewater system. Denali supports and participates in efforts to learn more about this and other emerging issues and adheres to permitted land application of biosolids under approved conditions on approved plots of land.

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According to studies, there is 20 times more PFAS in household dust than biosolids.

Q: What testing is performed on biosolids?
A: According to the Clean Water Act, the materials are required to be tested for potentially hazardous materials, the presence of metals such as mercury or lead that can leech from plumbing pipes, arsenic that naturally occurs in soil in certain regions; and pollutants. Some states may require additional testing for PFAS and radioactivity. [15] Under the Clean Water Act, biosolids used in agriculture must be tested for concentration limits of lead, mercury, arsenic, and other metals.[16] Some municipalities also perform public health surveillance on wastewater to monitor levels of COVID, influenza, and other pathogens, as well as fentanyl and other opioid drugs.[17]

Q: Why don't biosolids go to landfills or incinerators?
A: Most landfills will not accept biosolids because of its high moisture content. While it's possible to incinerate biosolids, that practice requires large amounts of energy and produces carbon dioxide and greenhouse gases, too many particulates, poor air quality, and some states ban the practice.[18] Permitted application of biosolids on designated plots of land is one of the most

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[12] https://www.atsdr.cdc.gov/pfas/data-research/facts-stats/index.html

[13] https://www.nist.gov/feature-stories/finding-forever-chemicals-wherever-theyre-hiding

[14] https://www.fda.gov/food/process-contaminants-food/market-phase-out-grease-proofing-substances-containing-pfas

[15] https://pubs.acs.org/doi/10.1021/acsestwater.1c00377?ref=recommended

[16] https://www.epa.gov/agriculture/agriculture-nutrient-management-and-fertilizer#Biosolids

[17] https://www.cdc.gov/nwss/about.html

[18] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-O/part-503#subpart-E

efficient, cost effective ways to responsibly capture, recycle, and beneficially use the organic compounds and nutrients from the nation's wastewater treatment infrastructure.

Q: Are biosolids applied to crops that humans eat?
A: Denali handles three types of biosolids: Class B, Class A, and Class A-EQ.[19] Each has their own EPA-mandated crops they can be applied to.

Generally restricted to agricultural land with stringent management practices, including restrictions for timing of harvest and grazing restrictions.

Class A biosolids have been processed to minimize the potential risk of pathogens and can be applied to agricultural crops for direct human consumption that can be eaten raw such as apples, oranges and lettuce, as well as land with human exposure such as residential yards, parks, and golf courses.

Class A-EQ biosolids are "exceptional quality" and meet the most stringent requirements for pollutant, pathogen, and vector attraction reduction. These are sold to the public for home gardens, lawns, and other applications with human contact.

[19] https://www.epa.gov/biosolids/land-application-biosolids#:~:text=Class%20B%20treatment%20processes%20significantly,Class%20A%2DEQ%20Biosolids