HOW IT WORKS
Food Processing Residuals & Dissolved Air Flotation

DENALI

For many decades, Denali has played a vital role in the food processing ecosystem by gathering, transporting and storing nutrient-rich food processing residuals (FPRs) from poultry, hog, cattle and other livestock processors until the material can be used as fertilizer to support sustainable agriculture.

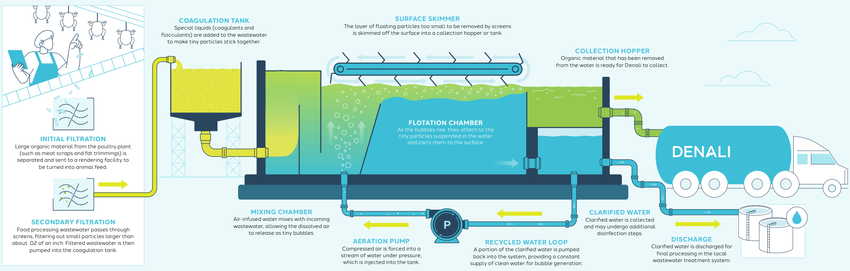
Denali also delivers and applies that recaptured FPR matter to farmers so they can use the organic-based fertilizer that's high in protein, nitrogen, phosphorous, potassium and copper to support healthier, higher-yielding crops such as hay, wheat, corn and soybeans. Diverting food waste from landfills also supports a U.S. government goal to cut food loss and waste by half by 2030.[1]

RESPONSIBLE CAPTURE & RECYCLING

Denali works with livestock processing plants, dairy plants, food manufacturers, bakeries, beverage plants, pet food plants and animal feed plants to responsibly capture FPR material. Depending on the type of plant, the FPR material can contain small bits of meat, fat, protein, blood and fibrous material that would otherwise go to landfills and can't be put directly into municipal wastewater treatment systems until it is refined. Food processing plants cannot operate and continuously supply our grocery stores and restaurants without the capture and recycling services provided by companies such as Denali, and they typically don't handle those processes themselves because it requires specialty equipment, training, knowledge, permits and resources.

Processing plants use a process called dissolved air flotation (DAF) to screen particles larger than 0.02-0.04 inches (about the thickness of a business card). Then they apply tiny dissolved air bubbles that bind to more of the organic material so it floats to the surface to be skimmed and recycled into products such as animal feed.

The food processing residuals are now a mostly liquid solution of organic material with microscopic bits of protein and many nutrients that can be used as organic-based fertilizer to enrich soil for crops.



FPR STORAGE & LAND APPLICATION

Denali has two primary types of storage facilities for food processing residuals — open air lagoons and closed storage — that must be permitted by the state. Some states or local municipalities require additional permits or approvals such as site-specific permits, stormwater permits that prevent run-off pollution, transportation permits, storage permits, land application permits, vessel registration and nutrient management plans that calculate the amount of nutrients that can be applied to a specific field for optimal crop growth.

Open air storage lagoons, which are typically cement-lined pits in the ground, were common in the industry in previous years because they were easy and inexpensive to construct. However, open air storage often results in strong odors from decay and decomposition of organic matter, similar to the way household garbage smells when heat, moisture and microbes are present.

Denali currently has open air lagoons in Arkansas and Alabama, and is no longer building new open air storage facilities. Denali is making ongoing strategic infrastructure investments and is planning to close its open air lagoon in Arkansas by January 2026, or as soon as necessary permits and approvals are obtained and work can begin.

Denali has shifted to closed storage facilities for FPRs, which are typically riveted metal circular containers built on a platform, with flexible covers and mixing equipment that significantly reduce and contain odors. Another benefit of closed storage facilities is that gravity helps drain and transfer FPR organic-based material more quickly and easily. Construction of new closed storage facilities must be permitted, and each permit can take several months or even years to get approved by state and other municipalities. FPR material might be stored for days, weeks, months or even years depending on numerous factors including current and forecasted weather, demand from farmers and permits required to apply to the material to land, which can be a complex and lengthy process.

Some states have specific rules about when and how FPRs can be applied to land. For example, some states don't allow land application when there is a 50% or greater chance of rain in the forecast to lower the risk of runoff. And if it begins to rain unexpectedly, land application must halt immediately. Denali endeavors to follow all rules and regulations, in addition to its own internal processes and procedures. Should violations occur, Denali self-reports the violation and conducts internal reviews to improve its processes in the future.

FREQUENTLY ASKED QUESTIONS

Q: What is in food processing residuals?

A: Food processing residuals are watery organic-based materials that remain when poultry, hogs, cattle and other livestock are processed. Large solids such as beaks, feet, feathers, hoofs and skin have already been removed. Particles of fat, protein, meat and fibrous materials that are thicker than a business card (0.02-0.04 inch) have been skimmed and removed. Coagulants, flocculants and polymers that have been used in wastewater treatment for years and proven safe — and can later be broken down in the soil by microorganisms — are added to make tiny particles stick together during the DAF process. After DAF, Denali collects the remaining FPR material, which contains protein, nitrogen, phosphorous, potassium, copper and other nutrients that can be used as natural organic-based fertilizer for crops, which helps make progress on the U.S. government goal of reducing food waste by half by 2030.

In addition to the nutrients that are immediately available to plants in FPR fertilizer for the current growing season, the microbes continue to break down the material into micronutrient forms that the plants can use over years, which puts more organic matter back into the soil. Another benefit of FPR organic fertilizer is that it creates pockets in the soil structure so plant roots can reach water and nutrients, and lets the soil hold more water to prevent the soil from drying out and compacting.

Q: Do you add chemicals or other materials to FPRs?

A: No, Denali does not add chemicals or other materials to FPRs it collects. This is one attractive feature of organic-based fertilizer that farmers use to amend their soil. If the FPR dries out too much during storage, Denali sometimes needs to add water to rehydrate it to a certain liquid stage so it can be applied to land. Sometimes Denali adds lime if a field needs additional lime, or water to rehydrate FPR material to an ideal consistency and thickness.

Q: Why do FPRs have strong odors, and what is Denali doing about it?

A: FPRs contain organic materials that decompose and produce odors when moisture, heat and naturally occurring bacterial microbes are present to break down the matter — similar to the way household garbage, landfills and compost piles can create odors. This is a natural process as decomposition creates byproducts including gases such as methane gas, carbon dioxide, ammonia, amines and hydrogen sulfide.

With open air lagoons, FPR material is stored for about a year on average until it is time to apply it to land ahead of a new growing season. The lagoons naturally form a "crust" layer of fats and oils on top, which blocks air and creates a perfect environment for anerobic digestion and decomposition of the FPR material into organic fertilizer. With closed facilities, Denali is working to close its open-air lagoon storage facilities, and has switched to closed storage facilities to reduce odors in the communities where we operate. Denali uses TerraGator machinery that can inject FPR fertilizer into the soil underneath the top surface layer, which greatly reduces odors. Some farmers also choose to use disc implements to work the FPR fertilizer into the soil more deeply, which further minimizes odors.

Q: How much FPR material do you apply to land?

A: FPR fertilizer is more than 90% water, so it may look like a large amount is being applied. The exact amount that Denali applies depends on the size of the field where we are applying; the optimal amount needed to support crops such as hay, wheat, corn or soybeans; and the permitted amount allowed by state and/or local authorities.

Q: Do FPRs contain "forever chemicals" such as PFAS?

A: The U.S. Food and Drug Agency, the Environmental Protection Agency, other regulatory bodies and industry trade groups are studying food waste streams, municipal water systems, soil and other parts of our environment to learn more about the presence and attempt to survey and measure the quantities of per- and polyfluoroalkyl substances (PFAS) that are present.[2,3]

PFAS is a class of thousands of chemicals that originate from numerous sources such as livestock feed; commercial fertilizers, herbicides and pesticides; stain resistant sprays and coatings on furniture and carpet; paints and stains; firefighting foam; and consumer products like fast food packaging, nonstick pans, water-resistant fabrics such as rain jackets and umbrellas, shampoo and cosmetics; certain foods we eat; and even the dust in our homes.

Often, PFAS and another sub-group chemical called perfluorooctane sulfonate (PFOS) end up in landfills and municipal wastewater treatment plants when people dispose of trash and items that contain those chemicals, or when people excrete the chemicals through urine or feces and those chemicals go back into water supplies.[4] A recent study of nearly 2,000 people by the National Health and Nutrition Examination Survey (NHANES) found that 97% of the subjects had a detectable level of PFAS, PFOS or other chemicals in a similar class from exposure to those sources.[5]

Denali does not create, manufacture or add PFAS/PFOS or any other chemicals to the food processing residuals that it collects from food processing plants and later applies to land for farmers and other recipients. The food processing plants are regulated by the USDA and FDA, and must use equipment, cleaners and sanitation methods that are food safe.

Because PFAS/PFOS don't easily break down, once they enter water supplies, livestock or fish, animal feed, soil, consumer products or other pathways, they continue to exist. The EPA, FDA and other regulatory agencies do not currently require PFAS/PFOS testing for food processing residuals. Denali supports and participates in efforts to learn more about PFAS/PFOS and other emerging issues, and adheres to permitted land application of food processing residuals under approved conditions on approved plots of land.

Q: Are FPRs toxic?

A: Food processing residuals are generally considered safe and non-toxic because they are derived from livestock processing plants that are regulated and overseen by the U.S. Food and Drug Administration as they produce the poultry, pork, beef and other meat that humans consume. FPRs are monitored through soil samples to ensure heavy metals amounts are low.

Denali has a team of more than 20 highly trained environmental professionals with degrees in agronomy, soil science, engineering and environmental sciences. Denali participates in and are members of numerous environmental and industry associations such as the Soil Science Society of America, Certified Nutrient Management Planners, Certified Crop Advisors, the Water Environment Associations, the Farm Bureau, the Poultry Federation, and the U.S. Composting Council. We are also members of watershed partnerships, biosolids associations, Farmer and Cattlemen's associations, State Farm bureaus, water associations, food industry associations, poultry federations and recycling coalitions across the U.S.

Q: Do FPRs get into the local water supply?

A: Denali does not apply FPR fertilizer when it is raining, in adherence to state and local regulations and rules where we operate. Some states restrict when and how FPRs can be applied, for example when there is a 50% or greater chance of rain in the forecast. Denali can request a variance or exception if we are confident that it will not rain and/or when our storage facilities become too full and cannot accommodate more FPR material. When rain occurs, Denali immediately stops applying FPR fertilizer. If there is a violation, we self-report it and conduct an internal review to improve our practices in the future.

Q: What happens when FPR storage facilities get too full?

A: Storage facilities sometimes get too full, especially during rainy seasons or periods of heavy or extended rainfall that prevent us from applying FPR fertilizer on permitted land. There are regulations for how full storage facilities can be, with varying thresholds by state, and Denali is in violation and can be fined when storage exceeds those defined levels. If Denali stops accepting FPR materials from processing plants, they would have to shut down operations, which would interrupt food supplies and put jobs at risk.

Q: Why don't you build more storage facilities?

A: Denali has an ongoing assessment of when, where and what size of storage facilities would be beneficial to our processing plant customers and local farmers. Building a new facility can take many months or even years from start to finish due to complex permit applications that can take several months or even years for review and approval, engineering and site preparation work, construction of the facility and commencement of operations.

Q: Why don't you stop accepting additional FPR material from processing plants?

A: Processing plants don't typically have their own FPR storage facilities because that is not their primary focus of business and operations, and it requires specialty equipment, storage and land application vehicles. Processing plants cannot operate without the help of FPR capture and recycling services such as Denali, and they would have to shut down and potentially lay off workers and cut off vital supplies of food such as poultry to grocery stores and restaurants if Denali stopped accepting FPR material.

Denali collaborates closely with each processing plant customer to understand its projected waste volume and needs, and we have a team of highly trained and experienced professionals who are constantly monitoring levels at storage facilities, weather forecasts, demand for FPR fertilizer by local farmers, and permitted opportunities to land apply as we manage our operations.

Q: Why are there so many vehicles involved?

A: Collecting, transporting, storing and land applying FPR fertilizer requires specialty heavy equipment including storage facilities, tanker trucks, TerraGator tractors with specialized applicators that deposit the fertilizer under the soil, hoses and other types of machinery. Denali acknowledges the logistics load that our operations place on local communities, and we work with state and local officials on mitigation efforts such as paving dirt roads when feasible and optimizing transportation routes to minimize the impact.

1. https://www.fda.gov/news-events/press-announcements/fda-usda-epa-enhance-efforts-reduce-food-loss-and-waste-welcome-usaid-interagency-collaborative
2. https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas
3. https://www.epa.gov/system/files/documents/2021-08/emerging-issues-in-food-waste-management-persistent-chemical-contaminants.pdf
4. https://ehp.niehs.nih.gov/doi/abs/10.1289/isee.2022.O-OP-024
5. https://pmc.ncbi.nlm.nih.gov/articles/PMC4483690/

LEARN MORE AT DENALICORP.COM