Biosolids Product Profile – Dried Biosolids

Biosolids are produced from the stabilization of solids generated during the wastewater treatment process. Biosolids can be beneficially used in agriculture to provide multiple benefits, including improved soil fertility and water retention, carbon sequestration, and replacement of synthetic fertilizers.

Some biosolids can also be used as a biomass energy source or for other specialty uses. This profile describes dried biosolids - how they are produced, their typical characteristics, and the markets in which they can be used.

What are Dried Biosolids? How are they Produced?

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Dried biosolids are produced by removing moisture from stabilized solids using one of four main drying processes, described below. These processes significantly reduce moisture content and associated hauling costs, resulting in highly valuable products with a broader market than dewatered biosolids (cake).

Biosolids Drying Technologies

Air Drying:

Air drying involves spreading solids over hardened earth or paved beds, typically at a thickness of about one foot, and allowing the solids to dry passively for at least three months. While air drying is simple and requires little energy, it requires a large footprint and is an open-air process, making it susceptible to producing odors. Air drying is used by six out of 31 San Francisco (SF) Bay Region agencies that participated in the [Bay Area Clean Water Agencies (BACWA) 2021 Biosolids Trends Survey](), out of which two are current members of the Bay Area Biosolids Coalition (BABC).

Solar Drying:

Like air drying, solar drying involves spreading solids over a paved bed, typically at a thickness of about one foot. In solar drying, the process is enclosed in a greenhouse-type structure to enhance drying. There are currently no solar dryer installations in the SF Bay Region.

Thermal Drying:

Thermal drying involves heating the solids to evaporate the water and dry the solids. Heat can be provided through either direct contact with heated air or indirect (e.g., through a metal plate) contact with hot oil or steam. The energy source for the heat can be a fuel (e.g., natural gas, digester gas), electricity, or recovered heat. There are different types of thermal dryers, including rotary drum dryers, belt dryers, and paddle dryers. Thermal drying is a relatively complex process typically used by larger facilities. There are currently no thermal dryer installations in the SF Bay Region. However, there is one planned thermal dryer installation at the West County Wastewater Water Quality and Resource Recovery Plant.

Biodrying:

Biodrying uses a combination of composting and thermal drying to remove moisture. The composting stage produces biologically generated heat, which results in biodrying using about 50% less energy compared to thermal dryers. There is currently one biodryer installation in the SF Bay Region at the Silicon Valley Clean Water Wastewater Treatment Plant. In addition, the City of Brentwood and the Town of Windsor are planning on adding new biodryer and pyrolysis facilities.

Class B, Class A, and EQ Dried Biosolids

Dried biosolids products may be designated as Class B, Class A, or Exceptional Quality (EQ) biosolids, depending on their treatment level and pathogen and metal concentrations. The requirements are specified by the Environmental Protection Agency (EPA) in [40 CFR Part 503.]()

Class B biosolids treatment results in a significant reduction in pathogens, but pathogens are still present in very low concentrations. In Class A biosolids, pathogens are essentially eliminated through further treatment. To meet Class A or B designations, biosolids must:

- Meet pathogen reduction requirements,
- Meet vector attraction reduction requirements, and
- Be below the ceiling concentration limits for 10 heavy metals.

To meet the EQ designation, biosolids must meet Class A requirements and meet the more stringent pollutant concentration limits for 10 heavy metals.

The most common pathogen reduction methods for dried biosolids are:

- Air drying qualifies as a process to significantly reduce pathogens (PSRP). To produce a Class B product, solids must be dried for a minimum of three months with the average daily ambient temperature above 0°C (32°F) for two of the three months. Some air-drying facilities obtain Class A designation by conducting ongoing testing of fecal pathogens.

- Solar drying is not listed as either a PSRP or a process to further reduce pathogens (PFRP). To produce either a Class B or Class A product, solar dryer facilities must conduct ongoing testing of fecal pathogens. Some technology providers guarantee Class A through a batch solar drying process.
- Thermal drying qualifies as a PFRP. To produce a Class A product, solids must be dried to at least 90% solids. In addition, either the solids or the heated air in contact with the solids must be at least 80°C (176°F) when exiting the dryer.
- Biodrying produces a Class A product by meeting time and temperature requirements.
- In addition to the Class A requirements listed above, all Class A biosolids must be tested for fecal pathogens.

The most common vector attraction reduction methods for dried biosolids are:

- Drying digested solids to at least 75% solids. *
- Drying undigested solids to at least 90% solids. *

**An important limitation to consider when obtaining permits for land application of dried biosolids is that the California Biosolids General Order prohibits land application of Class B biosolids drier than 50% solids. However, this limitation can be overcome by obtaining a Water Discharge Requirement (WDR) permit instead of a permit under the General Order.*

Typical Dried Biosolids Characteristics

Parameter	Average (Range)
Total Solids – air-dried[1]	80% (50-90%)
Total Solids – solar dried[2]	>90% for undigested; >75% for digested
Total Solids – thermal-dried[3]	>90%
Total Nitrogen (%-dry weight)[4]	5.5% (1.3-7.6%)
Volatile Solids (%-dry weight)[4]	64% (57-76%)

Source:

1. *2021 BACWA Biosolids Trends Survey.*
2. *Minimum solids content to meet vector attraction reduction requirements.*
3. *Minimum solids content to meet Class A designation as a PFRP.*
4. *2010 data from 15 BABC member facilities.*

Typical Solids and Nutrient Content

The characteristics of dried biosolids vary depending on the drying process, whether the solids are treated by digestion upstream of drying, and the specific influent wastewater characteristics. In addition, different drying processes produce different forms of products (pellets, granules, etc.) which may have different suitability for the various specialty markets. The table below provides a range of typical dried biosolids characteristics.

Markets for Dried Biosolids

The markets for dried biosolids depend on whether the dried product is designated as Class B, Class A, or EQ biosolids. Common markets for dried biosolids are summarized below:

- **Bulk Agriculture:** Dried biosolids can be used in bulk agriculture for feed and fiber crops, food crops, and rangelands. If the dried biosolids are Class B, use restrictions specified in 40 CFR Part 503 apply. Due to these restrictions, Class B biosolids are most commonly used for animal feed and fiber crops or for food crops that do not touch the soil. If the product qualifies as Class A, it can be used on any type of crop.
- **Specialty Markets:** Producing a Class A or EQ dried biosolids product opens the available markets beyond bulk agricultural land application. EQ biosolids can be bagged and sold commercially. Class A and EQ biosolids can be used by soil and fertilizer blenders as a soil amendment or to provide supplemental nitrogen and micronutrients. They can also be used by nurseries, sod farmers, golf courses, athletic fields, and parks as a fertilizer substitute.

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Photo courtesy of Synagro.

- **Energy Markets:** Since dried biosolids have a low moisture content, they can be used in cement kilns and biomass-to-energy facilities as a substitute for coal or woody biomass.
- **Land Reclamation:** Dried biosolids can be used for land reclamation of contaminated sites or mines and fire-impacted land, depending on site-specific conditions. There is growing interest in California in using biosolids for reclamation of fire-impacted land, given the increased incidences of wildfires.

SF Bay Area References

Some examples of SF Bay Area utilities that produce a dried product and their uses are:

- *West County Wastewater* uses air drying to produce a Class B biosolids product at about 85% solids, which is used as alternative daily cover in a landfill. West County Wastewater is in the process of constructing new dewatering and thermal drying facilities to produce an EQ product, which will expand options for biosolids beneficial use and reduce biosolids going to landfill.
- *The City of San Jose* uses air drying to dry anaerobically digested solids to produce a Class A biosolids product at about 80% solids. Like West County Wastewater, they use their product as alternative daily cover in a landfill. However, the City plans to replace their lagoons and drying beds with mechanical dewatering to produce a dewatered biosolids (cake) product that will be beneficially used rather than landfilled.

Carbon Sequestration Benefits

Beneficial use of dried biosolids for agriculture results in carbon sequestration and offsets the use of synthetic fertilizers, both of which constitute carbon sinks or negative greenhouse gas emissions. Each dry metric ton of biosolids is estimated to result in 0.15 and 0.24 metric tons of CO_2 equivalents for carbon sequestration and fertilizer offsets, respectively.

*Values calculated using the *BEAM*2022 Biosolids Greenhouse Gas Accounting Model.*

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