Biosolids Management

Overview

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What are Biosolids?

Biosolids are nutrient-rich organic materials resulting from the treatment of wastewater or sewage at the Kamloops Sewage Treatment Centre (KSTC). Wastewater is water that has been used and discarded down any drain in a home, such as dishwashers, washing machines, sinks, showers, and toilets. Kamloops produces an average of 12,500 bulk tonnes of biosolids each year—enough to fill one football field.

The City of Kamloops is managing KSTC's stockpiled biosolids and ongoing daily production through a new two-year agreement with Arrow Transportation Systems Inc. (Arrow), while considering long-term biosolids management through a number of different approaches.

Biosolids Management

Short- and Long-Term

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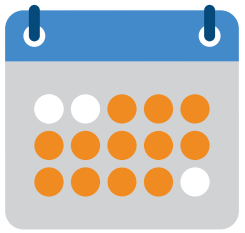
Short-Term

Over the next two to four years, Arrow Transportation Systems will manage the removal of accumulated biosolids and ongoing daily production through a partnership with the Little Shuswap Lake Indian Band (LSLIB). The agreement was awarded to Arrow in early 2019 and recognizes the City's commitment to social, economic and environmental conditions regarding biosolids use in Kamloops.

Arrow and NutriGrow, a soil solutions company in Arrow's Environmental Division, are proven market leaders in biosolids management and have a fleet of specialized vehicles designed for the safe transportation of biosolids. Throughout the contract, Nutrigrow will manage the beneficial reuse of the City's nutrient rich biosolids in accordance with all applicable Provincial regulations.

The process, managed by NutriGrow according to stringent environmental and regulatory standards, will be monitored by independent, third-party qualified professionals. The facility where the biosolids will be taken produce a high-quality, nutrient-rich compost that can be blended into soil.



Long-Term

The 12,500 bulk tonnes of biosolids produced every year are processed at the KSTC. This includes treated sewage from Tk'emlúps te Secwépemc through an existing sewer agreement.

The City is working with Stantec Consulting Ltd. to develop a long-term strategy for biosolids management. The City has also formed a Biosolids Management Stakeholder Committee to seek feedback and input from a variety of stakeholders on a long-term strategy for the management and beneficial reuse of biosolids produced at the KSTC.

The process for developing the long-term biosolids strategy is comprehensive. It involves collecting data; establishing decision-making frameworks; evaluating technologies from around the world; and applying analyses that take into consideration the environment, the economy and social factors. The City is currently within Stage 6 of the process based on the following graphic.

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Methodology/Process

The following roadmap outlines key phases in developing the long-term biosolids strategy.

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2017 → 2018 → 2019

STAGE 1 Retain Stantec for development of long-term strategy

STAGE 2 Establish stakeholder committee

→ Define stakeholder committee structure and objectives

STAGE 3 Develop pre-screening criteria

→ Identify challenges specific to Kamloops and eliminate management options not feasible for Kamloops

STAGE 4 Develop triple bottom line analysis

→ Define environment, economic, and social criteria for evaluation options

STAGE 5 Determine short list of feasible management options — use triple bottom line analysis to evaluate the long list of alternatives

→ Conduct public engagement on shortlisted options

STAGE 6 Identify preferred options

→ Present Council with process, public input, and proposed combination of options

STAGE 7 Long-term implementation strategy

→ **Kamloops City Council for approval** — Kamloops City Council will make the final decision to adopt the strategy at the end of the process.

Triple Bottom Line

Evaluation Process

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A triple bottom line (TBL) evaluation process was established by the Biosolids Stakeholder Committee to allow for each of the many options reviewed based on economic, environmental, and social impacts. The evaluation criteria included:

Environmental Impacts

A 50% weighting for specific environmental impacts including carbon footprint, energy reliance, and potential pollution discharges to the environment.

Economical Impacts

A 30% economical weighting for capital costs, operations, and maintenance costs.

Social Impacts

A 20% social weighting for compatibility with adjacent land, impacts such as noise, traffic, odor, and public acceptance.

The Biosolids Management Stakeholder Committee is nearing completion of the TBL evaluation. The goal will be to produce a robust group of options for consideration for the long-term management of biosolids.

All management options that passed the pre-screening process were evaluated using the extensive TBL criteria. From that process, a current shortlist of options include:

- High Rate Biomass Production
- In-Vessel Composting
- Land Application
- Liquefaction (Liquid Fertilizer Production)
- Pyrolysis
- Thermal Drying
- Thermal Oxidization (Gasification)
- Windrow Composting

High-Rate Biomass Production

High-rate biomass is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

High-rate biomass production involves growing short-rotation trees such as willows and hybrid poplars, and utilizing biosolids to assist in rapid growth of these trees, which are harvested every three to four years. Biosolids are applied to the biomass sites seasonally every year. The lifetime of the tree plantation can last up to three decades. The harvested trees are processed further, depending on the end use. This option can be used synergistically with a composting process because wood chips are an extremely suitable material for biosolids composting. Dried wood chips can also be used as a fuel source for many applications such as boiler fuel.

What is the end use or product?

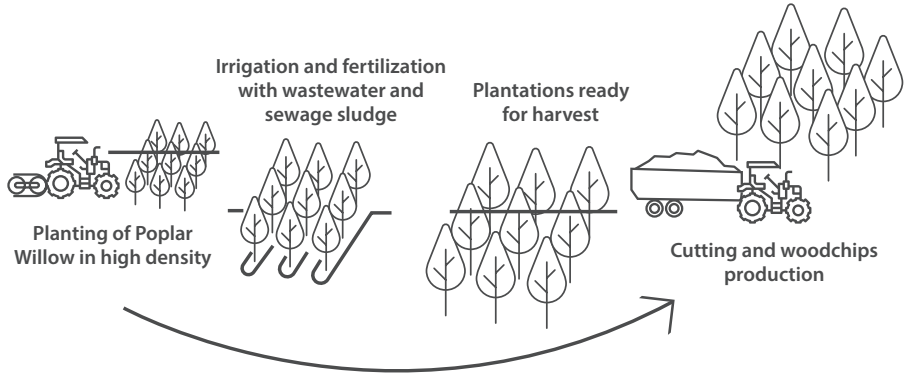
Trees are harvested and made into wood chips—a carbon-neutral fuel source that can be used in biosolids composting and other processes that require fuel. Wood chips can also be used for landscaping.

Does this allow for composting of organics/yard waste?

The woodchips generated from this technology support composting, which could help in processing more moist organic waste that may not have otherwise been composted.

How are contaminants removed?

Pathogens are killed and organic contaminants are degraded due to number of natural physical, chemical, and biological processes within the soil/plant system including sunlight and beneficial bacteria. Organic materials and nutrients such as nitrogen and phosphorus are absorbed in to the plant biomass.



High-rate biomass production process.

High-rate biomass production.

In-Vessel Composting

In-vessel composting is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

In-vessel composting is a technology in which biosolids are composted within an enclosed container. The main advantages of in-vessel composting are the ability to contain air emissions, have shorter composting times, and a smaller production footprint. This technology requires amendment materials such as woodchips, sawdust, and/or yard waste.

What is the end use or product?

This technology would produce compost that meets Organic Matter Recycling Regulations (OMRR) Class A requirements, which can be used for a variety of purposes such as compost products in flower beds, vegetable gardens, or on lawns.

Does this allow for composting of organics/yard waste?

Yes, curbside organics and yard waste can be included in the composting process.

How are contaminants removed?

A large number of various micro-organisms including bacteria, fungi and other organisms such as worms breakdown the organic contaminants in the biosolids. Pathogens are reduced through heat generated from biological reactions. Pathogens are also killed by natural competition between the large number of beneficial micro-organisms.

In-vessel composting facility.

Land Application

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Land application is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

In this option, the nutrients and other beneficial components of the biosolids are harnessed by applying biosolids to agricultural lands as fertilizer and as soil amendments. This process is governed by the provincial Ministry of Environment and Climate Change Strategy through OMRR. OMRR requirements are one of the strictest in the world and take into account the following to ensure environmental and public health protection.

- amount of biosolids to be applied
- location
- notification requirements to stakeholders and citizens
- timing restrictions and monitoring

What is the end use or product?

Biosolids may be used to enhance the agricultural yield of many crops. The end use is the soil enhancement, which results in a higher crop yield.

Does this allow for composting of organics/yard waste?

Not applicable

How are contaminants removed?

A large number of natural chemical, physical, and biological processes operate within the soil matrix that kill pathogens and break down the organic contaminants. Organic materials and nutrients such as nitrogen and phosphorus are absorbed by the plants.

Land application.

Liquefaction (Liquid Fertilizer Production)

Liquefaction is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

Liquefaction involves applying heat and alkaline materials to biosolids and making them into a homogenous liquid. The end-product is a liquid fertilizer certified by the Canadian Food Inspection Agency (CIFA), which can be used for a variety of agricultural purposes including the fertilization of food crops. The transportation of this product from production site to end use can be through enclosed reactors, piping systems, storage, and tanker trucks. This product requires storage during the winter when application is not feasible.

What is the end use or product?

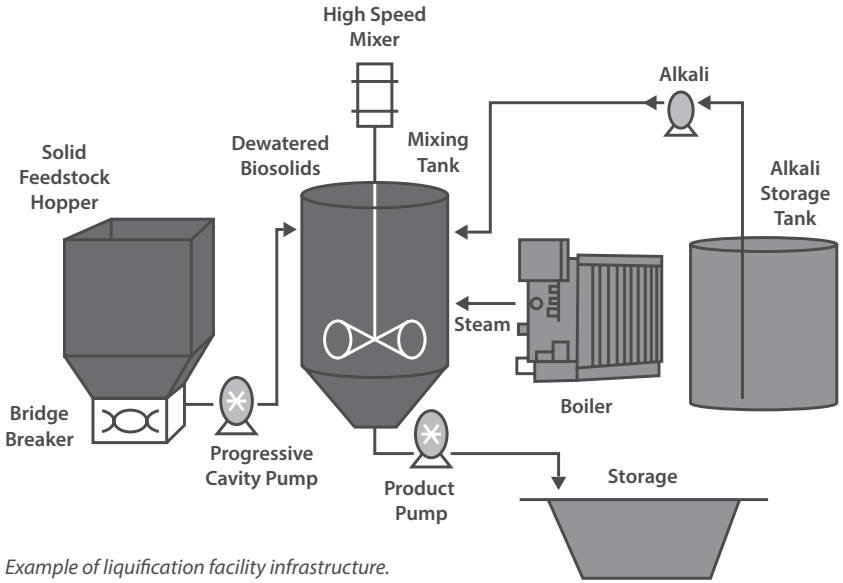
The end product is a pathogen-free, CFIA-approved liquid fertilizer that may be injected into the agricultural lands.

Does this allow for composting of organics/yard waste?

No

How are contaminants removed?

Due to high alkalinity (pH) and heat within the process, pathogens are killed and organic contaminants are broken down.



Example of liquification facility infrastructure.

Liquid fertilizer facility.

Pyrolysis

Pyrolysis is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

Pyrolysis is a thermal technology in which heat is applied to biosolids under limited oxygen and high pressure to produce fuel (known as syngas) and solids (known as bio-char). This happens in two stages. First, biosolids are dried and then gasified under heat and pressure in a closed chamber. Gas is generated through a second stage, which can be recaptured and used in the biosolids drying process (first stage).

What is the end use or product?

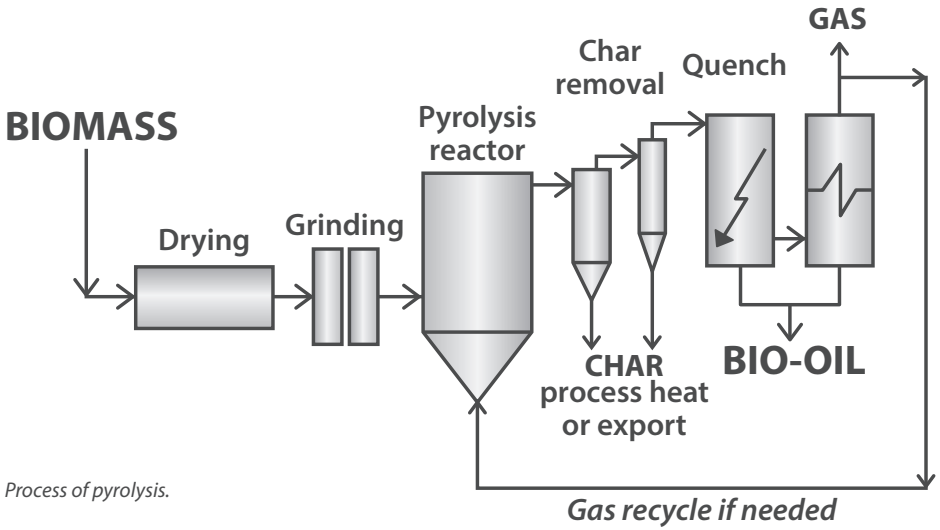
Bio-char can be used for commercial and agricultural purposes such as commercial water purification and as a soil supplement.

Does this allow for composting of organics/yard waste?

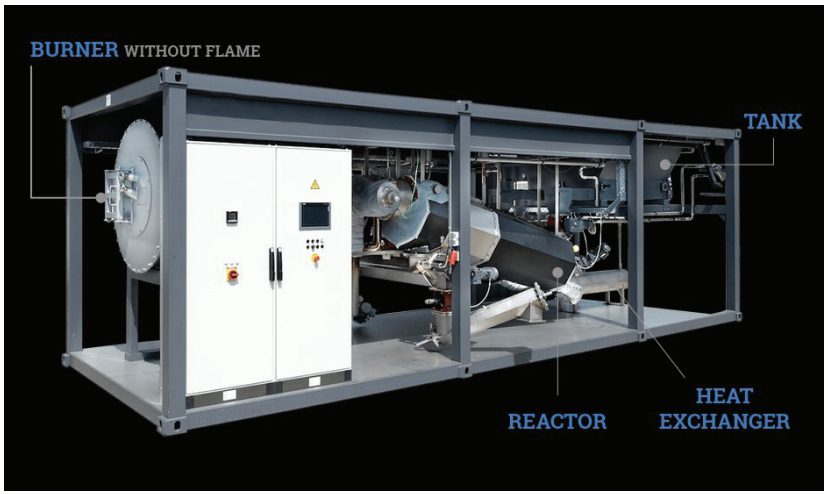
Not applicable

How are contaminants removed?

Pathogens are killed and organic contaminants are broken down due to intense heat and pressure.



Process of pyrolysis.



Pyrolysis facility.

Thermal Drying

Thermal drying is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

Thermal drying technology applies heat to evaporate water from wastewater solids, which also reduces the volume and improves the quality of wastewater biosolids. Currently, the biosolids produced at the KSTC contain about 80% water. With thermal drying, heat is applied to biosolids to reduce moisture to less than 35%. The end product has an energy value similar to low-grade coal and can be used as a fuel replacement in operations such as boilers. Dried biosolids can also be used as a soil enhancement product.

What is the end use or product?

The end product is a Class A biosolids as per OMRR regulations. Class A biosolids can be used in a variety of applications with little or no restrictions.

Does this allow for composting of organics/yard waste?

Yard waste can be included in the drying process. High moisture curbside organics may increase drying time, which could increase the cost of processing.

How are contaminants removed?

Heat is applied, which breaks down the organic contaminants and kills most pathogens.

Thermal drying facility.

Thermal Oxidization (Gasification)

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Thermal oxidization is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

Thermal oxidation is the combustion or burning of organic solids in biosolids to form carbon dioxide and water. The remaining solids are an inert material commonly called ash. Exhaust air in this process is treated to remove potential air contaminants to meet regulated air quality requirements. Given the KSTC's location, relatively tall exhaust stacks would be required.

What is the end use or product?

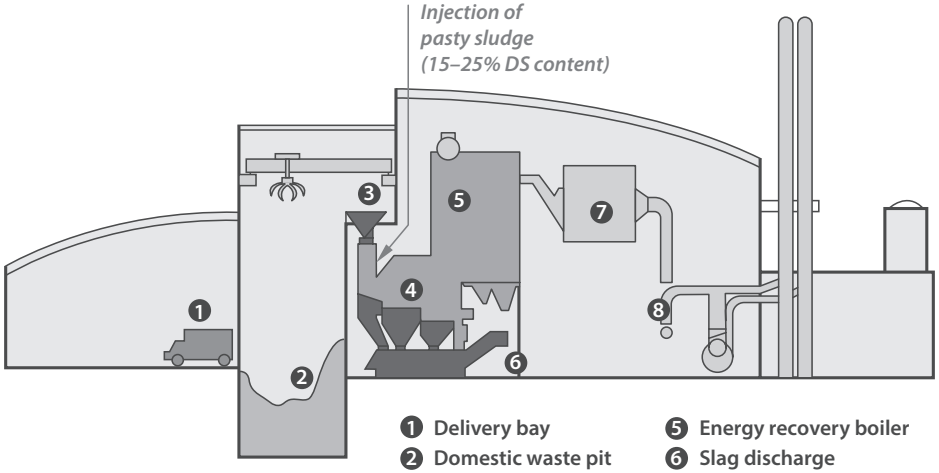
The end product is a small quantity of ash, which can be landfilled. In some countries, the ash is land applied to harness the mineral content including phosphorus. If other dry products such as dry solid wastes are included in the oxidation process, heat can also be recovered.

Does this allow for composting of organics/yard waste?

Solid wastes can be included in the oxidation/incineration process.

How are contaminants removed?

Extreme heat will breakdown organic materials and kill all known pathogens.



Thermal oxidization (incineration) facility.

Thermal oxidization (incineration) facility.

Windrow Composting

Windrow composting is one of eight long-term biosolids management options the City is considering following an evaluation of various technologies over the past year.

What is it?

Windrow composting is a technology in which biosolids are composted in windrows in an open environment or in an enclosed building. Biosolids are then stored in long and narrow windrows and, over time, natural biological reactions would occur. Occasional mixing of the material is required. This technology requires amendment materials such as woodchips, sawdust, and/or yard waste.

What is the end use or product?

Biosolids may be used to enhance the agricultural yield of many crops. The end use is the soil enhancement, which results in a higher yield crop.

Does this allow for composting of organics/yard waste?

Yes, curbside organics and yard waste can be included in the composting process.

How are contaminants removed?

Similar to in-vessel composting, a large number of micro-organisms including bacteria, fungi, and other organisms such as worms breakdown the organic contaminants in the biosolids. Pathogens are reduced through heat generated from biological reactions. Pathogens are also killed by natural competition between the large numbers of beneficial micro-organisms.

Open environment windrow composting.