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Presented:	Monday, Feb 06, 2017
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Type:	Presentations

For Information Only

Waste Disposal/Processing Methods

Resolution

For Information Only

Finance Implications

No financial implications.

Background

In Greater Sudbury, household waste is categorized into seven waste streams and handled as follows:

Signed By

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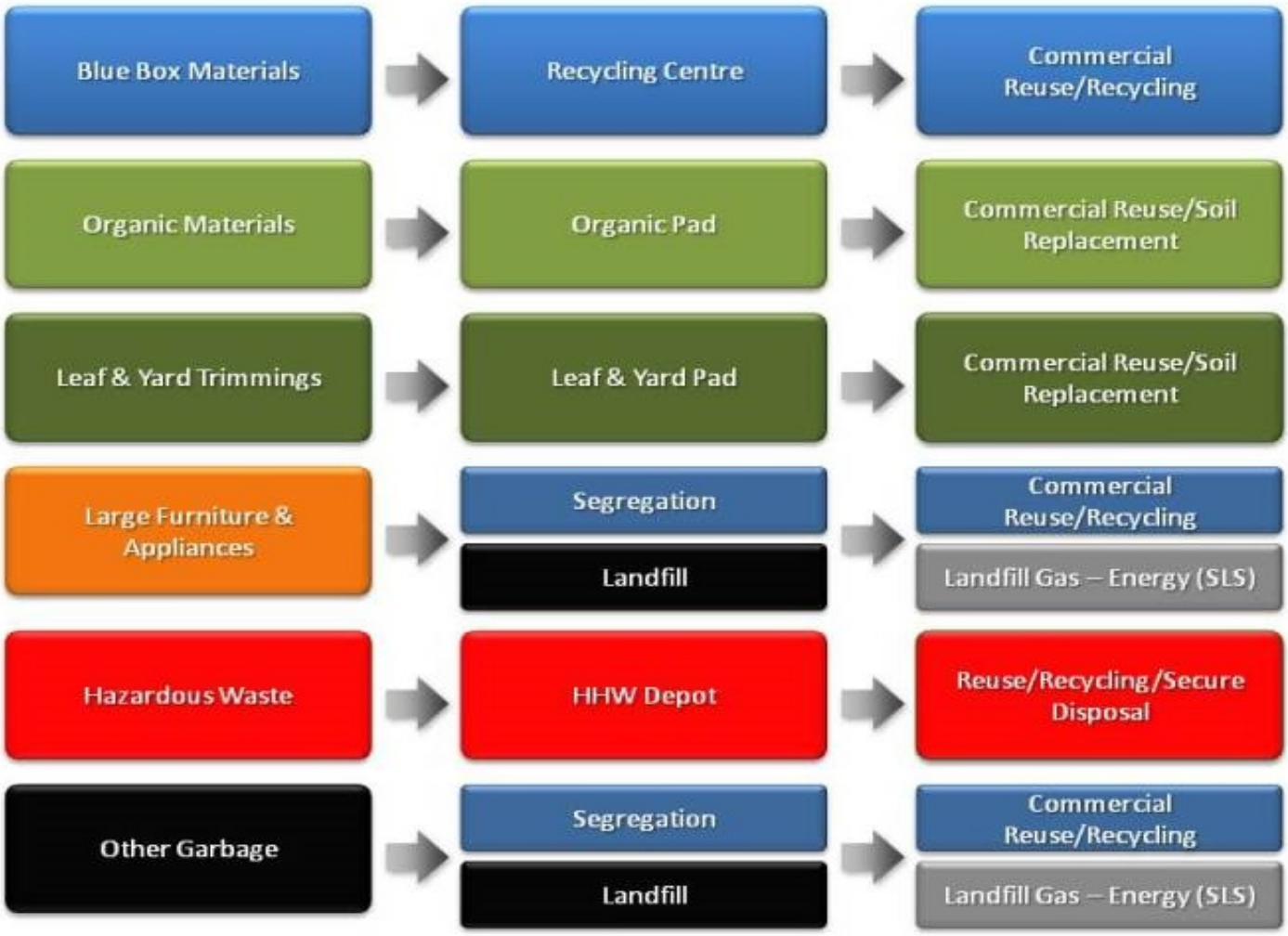


This requested report has been written to provide the Committee with a brief introduction of the most commonly used methods of waste disposal and processing. The report will provide a high level overview on the various composting and disposal methods, including waste to energy alternatives. Details on various reuse and recycling processes have been excluded.

WASTE DISPOSAL/PROCESSING METHODS

COMPOSTING

Composting is a biological decomposition process in which solid waste ultimately degrades organic materials to carbon dioxide, water and a stabilized residue called finished compost. Finished compost can be used as a mulch, soil conditioner or a top soil replacement. Depending on the type of household, approximately 20 to 40% of waste can be composted.

These are the various composting processes or methods:

Windrow Method

Windrows composting is carried out where the waste is piled up in triangular strips/rows about 1-2 m high by 3-4 m wide and allowed to degrade. Regular turning of the piles is necessary to add oxygen, which helps the composting process and avoids odours in the heaps. This is a simple process but requires a large land area to cope with the long processing time.

The City of Greater Sudbury uses the windrow process to compost its leaf & yard trimmings and organic materials.

Aerated Static Pile Method

The aerated static pile method involves forming compostable materials into large piles, which are aerated by drawing air through the pile or forcing air through the pile. The pile is not turned. Extracted and processed microbes are also used to enhance the microbial activities for reducing the time and land requirements.

Enclosed Aerated Windrow Method

An aerated windrow is essentially a hybrid between a windrow and an aerated static pile. It uses both forced air (to more directly control oxygen levels and temperatures) and pile agitation, which accelerates the physical breakdown of composting materials and thus the composting process.

Enclosed Aerated Static Pile (Non-Vessel)

This technology uses aerated static pile composting in a heavy-duty plastic (polyethylene) silage bag. Air is blown into the bags and exits through small ports on the sides of the bag.

Modular In-Vessel Containers (Static)

Contained composting systems are modular and individual containers are added as volume increases. The number of units or modules determines the scale of operation. This category of in-vessel systems uses a static composting method which means that turning or stirring of the material is provided when the material is unloaded. Fans supply oxygen and remove moisture and heat. In most cases, air is introduced at the base of the material and flows up through the composting mass. In other examples, air is pulled through the material. In either aeration mode (positive or negative), process air is treated through a biofilter, frequently housed in a separate container.

Modular In-Vessel Tunnels (Static)

Tunnel composting systems are essentially aerated containers that have forced aeration through a floor system, internal air circulation and usually a biofilter. They are loaded from one end and operate in batch mode after the tunnel is fully loaded. Multiple tunnels can be used to attain a nearly continuous operation. Tunnel dimensions vary considerably.

In-Vessel Bays (Mechanical Agitation)

Agitated beds compost materials in “beds” contained by long channels with concrete walls. A turning machine, travelling on top of the beds, agitates and moves the materials forward. Forced aeration is provided through the floor of the channel; the top of the channel is open. Therefore, an agitated bed is technically not a vessel, but falls into this category because it is typically enclosed in a building.

Anaerobic Digestion

Anaerobic digestion is the biological breakdown of organic materials in the absence of oxygen. In the process, biogas containing methane and carbon dioxide is produced. This biogas can be used as a fuel to generate energy. The material remaining after digestion is a partially stabilized organic material, which can then be aerobically cured and used as compost.

THERMAL TREATMENT (ENERGY FROM WASTE)

Thermal treatment is a waste disposal process that involves the destruction of waste using high temperatures. There are two main types of thermal treatment approaches:

Conventional Thermal Treatment

Conventional energy from waste systems are the simplest of thermal treatment systems. Systems operate with excess air to ensure complete destruction of the waste. Systems are designed to ensure nearly total conversion of carbon to energy. Conventional energy from waste technology is very flexible with regards to feedstock type and quality. However, poor quality feedstock can have a negative impact on energy production and/or heat generation.

During processing, the waste is dumped into a storage pit or bunker and then transferred to a combustion chamber which converts the waste into residue ashes and hot gaseous products. The process reduces the volume of waste to

one tenth of the original volume. The ash produced from the burning is collected to recover metals and the balance is shipped for landfilling. Hot gases generated during the combustion processes are used to produce heat, steam or electricity in co-generation projects. The storage bins maintain negative pressures to prevent smell. The plants are also equipped with gas scrubbers and hazardous particulate filters.

Advanced Thermal Treatment

Advanced thermal treatment systems are more complex than conventional energy from waste systems. The three main types of advance thermal treatment systems are as follows:

Pyrolysis (blazing)

Pyrolysis is a process which involves high temperature breakdown of waste (300 to 500^{o}C) in the absence of air. An ongoing energy source is required to generate the heat required to initiate and maintain the pyrolysis process. Pyrolysis requires a very consistent and controlled waste feedstock, usually requiring waste to be pre-processed. The main products resulting from the pyrolysis process are a synthetic gas (syngas), pyrolysis oil and char. The products represent about 50 percent of the initial volume of the original matter. Municipal solid waste is not only heterogeneous, but may differ greatly from one batch to the next, therefore to date, pyrolysis of solid waste has had limited application worldwide but has been used at both pilot-scale and full-scale with some degree of success.

Gasification

Gasification is a high temperature (greater than 700^{o}C) advanced thermal treatment process that does not involve combustion. Controlled amounts of oxygen and steam are used in the gasification process to covert waste into carbon monoxide, hydrogen and carbon dioxide. Similar to pyrolysis, a consistent and controlled (i.e. pre-processed) waste feedstock is required. The main product is a syngas with a very low carbon ash residue. The syngas produced from both the gasification and pyrolysis process is relatively low quality but can be combusted in a secondary process to fuel conventional steam boilers.

Plasma Gasification

Plasma gasification is also a gasification process, but utilizes electrical energy and high temperature (greater than 2000^{o}C) to breakdown waste into its elemental gases. Due to the high levels of energy required associated with high energy costs, plasma gasification is generally not used on its own for processing waste. More typically, if used, it is in a secondary stage to a pyrolysis or gasification system.

REFUSE DERIVED FUEL

Refuse derived fuel is produced through the processing of solid waste for use in thermal treatment facilities. Refuse derived fuel can also be used to create energy and/or heat for power plants or other operations such as cement kilns. The solid waste is sorted, shredded, dried and densified as a waste product, for further use as a fuel in the combustion process. The production of refuse derived fuel has a high risk unless a long term user of the material can be secured.

SANITARY LANDFILLING

Sanitary landfilling is an engineered method for disposal of solid wastes on land, trenches or depressions. Waste is disposed in layers, compacted and covered, along with other environmental control measures to mitigate or minimize the adverse impacts associated with waste degradation.

Intermediate covers are provided during waste disposal operations and a final cover is installed once the area has reached its limit of waste. A cover will minimize infiltration, limit the release of gases, suppress vector problems, limit potential fires and provide a suitable surface for re-vegetation.

Sanitary landfill sites also include surface water management designs to divert storm water which would otherwise infiltrate into the site.

Modern sanitary landfills or landfills of a certain size will collect and treat landfill leachate and gases.

Leachate is the contaminated liquid that seeps through a solid waste disposal site. This liquid may enter the landfill from external sources like rainfall, surface and groundwater, waste deposited or may be produced from decomposition of the waste. Leachate generation rates and characteristics vary widely from landfill to landfill, with the age of the landfill, and even within a given landfill.

Landfill gas is generated during the decomposition of waste. Landfill gas management includes active or passive venting systems and may involve flaring of landfill gases or gas to energy recovery systems.

Modern landfill requirements will also require double bottom liners to contain leachate.

WASTE EXPORTING

Waste export options refer to disposal of wastes outside the jurisdiction and/or control of the City. Export options can be landfill and non-landfill disposal of waste at public or private facilities. In order to be economical, waste exporting typically involves the construction of a waste transfer station, with or without compacting features.

Next Steps

The various waste disposal/processing methods will be reviewed in greater detail during the Solid Waste Master Plan update, scheduled to commence in 2021. The plan will ultimately determine the preferred methods to be used once our current sites have reached capacity in 25 to 30 years or so.

In the meantime, staff will continue to monitor new technologies, legislative changes and opportunities to extend landfill life. This includes, but is not limited to, the expansion of the organic program and the reuse or recycling of additional construction, demolition or renovation type waste materials.

Environmental Services

Waste Disposal and Processing Methods

Presented by:
Chantal Mathieu and Aziz Rehman
February 6, 2017

Greater Grand Sudbury

Managing our Waste Streams

Overview

The Committee had requested a high level report on various waste disposal and processing methods, including waste to energy processes. Today's presentation will provided a brief overview of:

- Composting Methods
- Thermal (Heat) Treatment Methods – Waste to Energy
- Sanitary Landfills
- Waste Exporting

A more detailed report will be provided as part of the Solid Waste Master Plan Update, scheduled to commence in 2021.

Composting

- Windrow Method

The City utilizes the windrow method to process its leaf & yard trimmings and organic materials.

Composting

- Aerated Static Pile Method

Composting

- Enclosed Aerated Windrow Method

Aeration pipes located in concrete floor

Composting

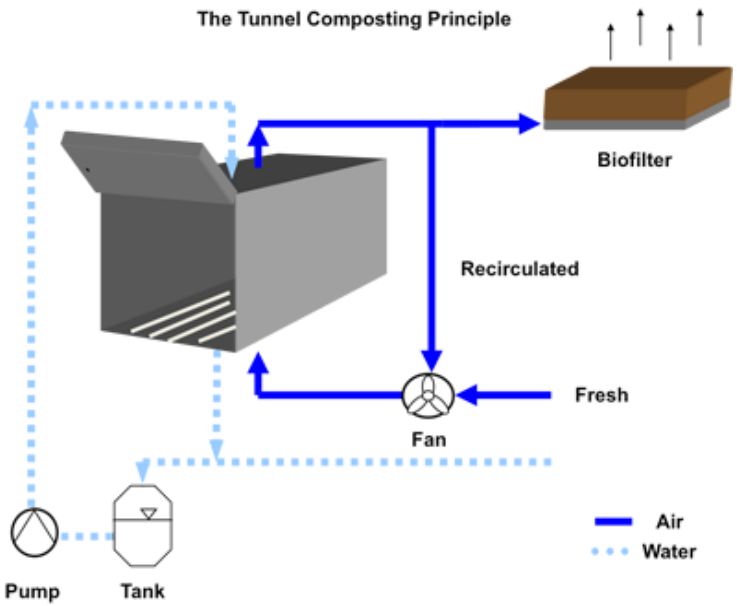
- Enclosed Aerated Static Pile (Non-Vessel)

Composting

- Modular In-Vessel Containers (Static)

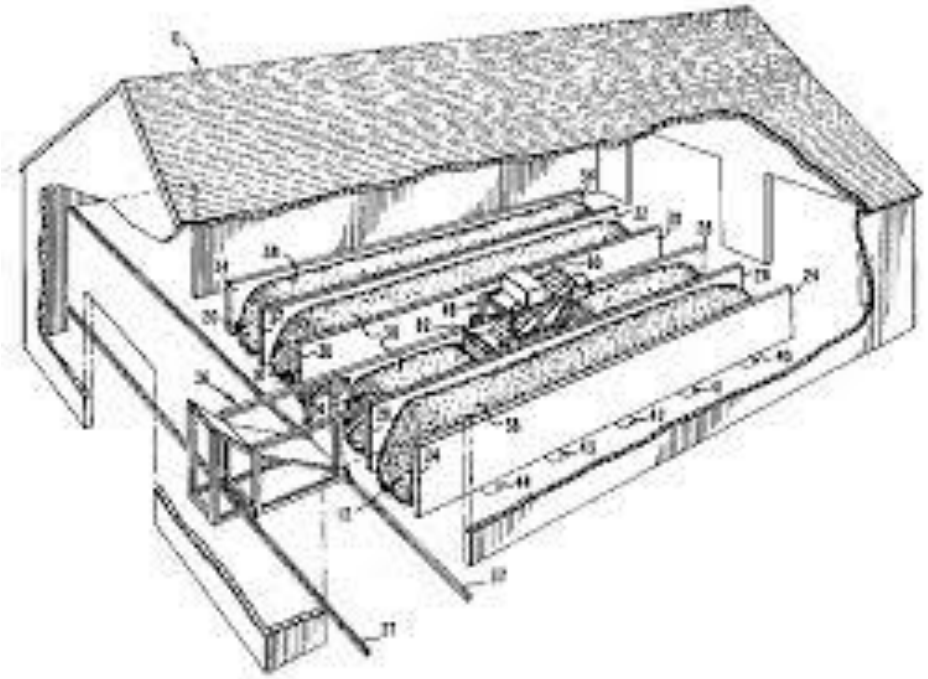
Composting

- Modular In-Vessel Tunnels (Static)



Composting

- In-Vessel Bays (Mechanical Agitation)



Composting

- Anaerobic Digestion

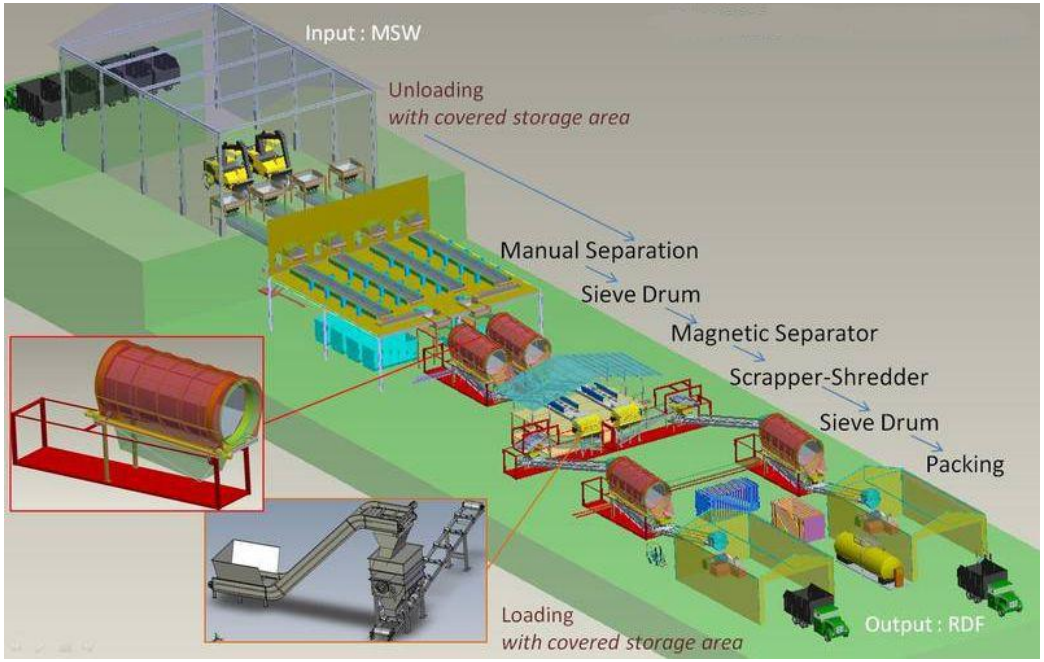
Thermal Treatment Methods (Energy from Waste)

- Conventional Thermal Treatment

Thermal Treatment Methods (Energy from Waste)

- Advanced Thermal Treatment
  - *Pyrolysis*
  - *Gasification*
  - *Plasma Gasification*

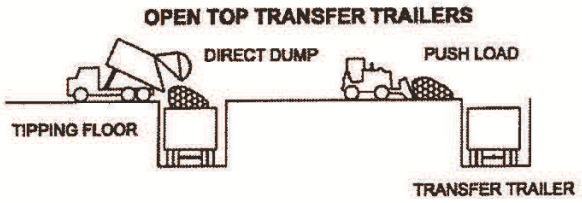
Refuse Derived Fuel

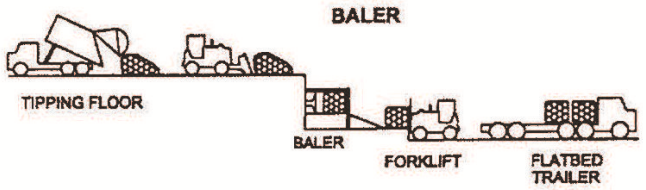


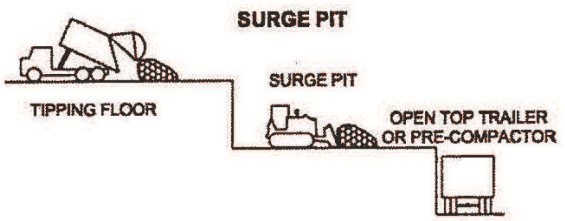
Sanitary Landfills

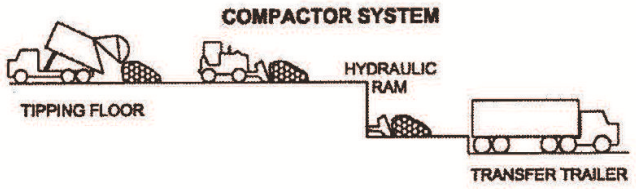
Sudbury Landfill & Waste Diversion Site

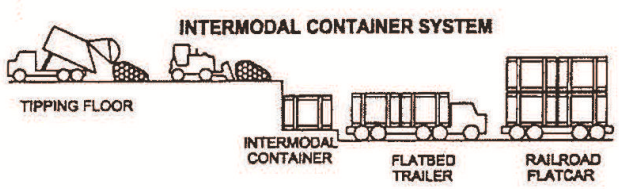
Waste Exporting

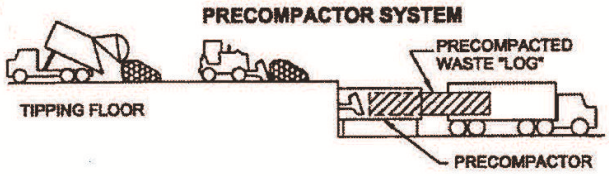












Next Steps

- Monitor new technologies
- Monitor rapidly changing legislation
- Expand programs
- Initiate Master Plan Update