Collections and Processing Considerations

The purpose of this Attachment is to briefly summarize the areas of research Administration has commissioned or performed to date regarding options for waste diversion technologies, specifically related to organics.

Background

In 2014 Administration commissioned CH2MHill to prepare technical memorandums on a variety of waste diversion and clean energy options. The five memorandums (titled Organics Waste Collection Program Options and Considerations, Composting Technology Summary, Anaerobic Digestion Technology Summary, Summary of Beneficial Reuse Options for Organic Wastes, and Municipal Solid Waste Thermal Treatment Technology Summary) each present a range of options, practical considerations and “lessons learned” from existing sites. The purpose of the research was not to chart a path to maximize waste diversion or greenhouse gas emission reductions but rather to present the spectrum of options and considerations associated with each.

In 2015 Administration partnered with the Saskatchewan Indian Institute of Technology (SIIT) on a study where CH2MHill advised on technical options and considerations and operating and capital costs for organics processing at the Recovery Park site.

In 2016 Administration hired KPMG to study the business case for Recovery Park, which included a review of recently developed organics processing sites, with a focus on the potential for private sector partnership/ownership. The report concluded that anaerobic digestion could be a profitable option for organics processing, pending achievement of certain conditions such as confidence in the availability of sufficient feedstock. In addition, private sector interest in processing organics was identified (full results are available in the November 14, 2016 Recovery Park Report to Standing Policy Committee on Environment, Utilities, and Corporate Services).

In 2016 Administration hired Dillon Consulting to provide a waste characterization and Draft Waste Diversion Plan. The Draft Waste Diversion Plan summarized current technology trends for organics waste diversion.

In 2017 Administration attended the Solid Waste Association of North America (SWANA) conference. One of the presentations was on the Opti-Bag™ technology being utilized in Europe. Administration has briefly self-researched this technology following the conference.

Organic Waste Collection

There are a variety of methods to collect organic waste:

1. Direct Self Haul (organic waste producer hauls their waste to a facility); or
2. City or Contracted Collection (e.g. curbside collection from residences):

   a. Curbside bag collection (manual vs. automated truck collection); or
   b. Curbside cart collection (automated truck collection).

Materials can either be front-end (source) or back end (processor) separated. The implications on collections are:

1. Source Separated Options
   a. Separate carts for each material (e.g. four separate carts: garbage, recycling, organic yard waste, and organic food waste); and
   b. Separate bags for each material.
2. Co-Mingled Options
   a. Green bin that co-mingles yard and food waste; and
   b. Co-mingle organics and waste.

Generally speaking, the more costs that are transferred to the back end (to the processor), the higher the cost will be to the municipality or the customers of a utility, but the convenience and waste diversion will also be the highest if processing is in place. A balanced approach is expected to be the most preferred option. The research suggests utilizing drop off locations (e.g. Recovery Park) combined with curbside collection as being the most appropriate solution for Saskatoon. Certainty in feedstock quality and volume is critical in order to justify the business case for processing equipment/systems.

It is not uncommon for participation rates for curbside collection of organic waste to be 80-90%, compared to 10-25% for drop off depots. However, curbside collection of 100% of yard waste is problematic due to the high volumes that occur during short periods of time (spring and fall). Large fully loaded carts filled with dense wet organic material can also be very challenging for residents to safely maneuver. Designing a curbside program to fully accommodate seasonal spikes is problematic and it is preferable to provide a depot as an available option. There should be an economic and convenience incentive to self-haul to depots when loads are large in order to achieve a stable and efficient curbside collection program.

The use of automation should generally be expected to reduce collection staff injuries and absenteeism and be more efficient than manual collection. Automated collection, however, is less flexible than manual collection and requires diligent management to maintain efficiencies.

Cost for residential curbside collection programs were stated by CH2MHill in 2014 to range from $4-$8 per household per month, but costs will vary depending on local conditions and factors such as collection frequency, number of households in the program, distance to the processing facility, sharing of resources (e.g. using the same trucks for garbage and organics), etc.

Regarding options for carts vs. bags, the new Opti-Bag™ technology being utilized in Europe is a paradigm shift in the collection industry. Rather than have a separate cart for each material with automated collection, or a separate bag for each material with manual collection, separate bags are used for each material but the bags are co-mingled in a single cart. As an alternative to this automated technology, bags could also be separated manually. When bags are delivered to a processor they are then separated based on bag colour. Companies other than Opti-Bag™ are also able to provide equipment that can sort out bags of different colours, including one supplier of equipment to an existing materials recovery facility in Saskatoon.

Source Separation into Multiple Coloured Bags, Opti-Bag Website

Delivering Multiple Coloured Bags at Sorting Facility, Opti-Bag Website

There are seven cart and bag combinations as follows:

- Two cart system where:
    - Black cart allows black garbage bags, green yard waste bags, and yellow food waste bags; and
    - Blue cart for recycling.
- Two cart system where:
    - Black cart allows garbage; and
    - Blue cart allows co-mingling or bag separation of recycling, yard waste, and food waste.
- Two cart system where:
    - Black cart that allows black garbage bags and green bags that have co-mingled yard and food waste; and
    - Blue cart for recycling.
- Two cart system where:

  - Black cart that co-mingles garbage and organics and a processing facility separates the materials; and
  - Blue cart for recycling.
- Three cart system where:
  - Black cart allows garbage;
  - Green cart allows green yard waste bags and yellow food waste bags; and
  - Blue cart for recycling.
- Three cart system where:
  - Black cart allows garbage;
  - Green cart allows co-mingling of yard and food waste; and
  - Blue cart for recycling.
- Four cart system where:
  - Black cart for garbage;
  - Green cart for yard waste;
  - Brown cart for food waste; and
  - Blue cart for recycling.

The above options show that through investment in automated separation based on bag type, automated debagging technology, and education on the use of bags, significant source separation can be achieved without requiring a cart for each material. However, in the case of the two-cart system where garbage and organics are co-mingled in the same bin, it would not be possible to bill customers based on the type of material. If there is a desire to operate a utility where customers pay a different rate for garbage compared to organics a third bin is required[1].

The choice of collection method is therefore intimately tied to model of the utility/service and desired processing approach.

<u>Organics Processing Options</u>
In Canada there is generally four main approaches to processing diverted organic material into a useful product:

1. Composting – Passively aerated and turned (windrow)
2. Composting – Aerated (air is mechanically forced through the compost)
3. Anaerobic Digestion (generates electricity and waste heat)
4. Thermal Systems (waste to energy)

Of the above four options the majority of municipalities have opted to utilize composting as the preferred method to process organics. However, the use of anaerobic digestion is increasing, but can only be economically viable when there is confidence that the significant capital investment can be repaid in a reasonable amount of time based on guaranteed feedstock volumes and

[1] It should also be noted that if the price differential is significant between materials (e.g. organics vs. garbage) this creates an incentive to "hide" garbage in the organics stream, resulting in increased contamination and processing costs.

negotiation of a long term and economically favourable power purchase agreement.

Composting – Passively Aerated, With Option to add Turner
Static pile composting (no aeration and limited or no turning) is generally the lowest cost option for composting. Prior to the purchase of a compost turner this was the approach utilized at the City's compost depots. This approach requires the largest land footprint and without adequate land can run into issues with processing materials fast enough to limit build-up of materials on site (decomposition takes 2-3 years). It is limited in its ability to process food waste due to the need to achieve optimum carbon to nitrogen ratios needed for composting.

Windrow composting is the most common method of composting. In this method a mechanical turner is used to mechanically aerate and break up long rows of decomposing compost. This is the method currently being utilized at the City's compost depot. Aeration is still largely a passive process but the mechanical turning of the material creates the porosity necessary to enable passive aeration. Composting usually takes 12-26 weeks depending on feedstock, weather, frequency of turning, and other factors. Through the use of specialized equipment composting time can be brought down to as low as 6 weeks.

Composting – Aerated Static Pile
In this approach the compost is mechanically aerated using a fan. They require less land space, less use of mechanical agitation, and provides significantly greater odor control than passively aerated processes. The composting process typically takes 6-10 weeks. The City of Winnipeg recently completed construction of an aerated static pile system. Facilities can be constructed outdoors or indoors and can include technologies such as a Gore-Tex™ wrap to control moisture levels, inhibit vectors, and provided further odor control. Compost turners and other mechanical systems can be utilized in combination with an aerated system. A variety of enclosures, such as containerized and tunnel systems, are also possible.

Anaerobic Digestion
Anaerobic digestion (AD) is the process of breaking down organic materials in the absence of oxygen. The process stabilizes the materials, reduces their volume, and produces "bio-gas" which is primarily made up of methane and carbon dioxide. This gas can be refined in order to be used in boilers, electric generators, vehicles, etc. Management of the feedstock is necessary to optimize the AD process. AD systems are generally defined based on the water content of the feedstock and therefore decisions around the volume and makeup of materials collected from a composting program dictate the AD technology needed to efficiently process this feedstock. A secondary treatment system is also required to manage the waste output from the process (digestate). Typically the secondary process is composting or conversion to fertilizer. Digestion time can range from 2-7 weeks depending on the technology utilized, followed by the time for the digestate to compost.

Thermal Systems

There is a wide range of potential thermal systems for processing waste, colloquially they are lumped together and called “waste to energy” or “energy from waste”. Thermal systems convert waste to a fuel that is a source of energy. They work best with a feedstock that is high carbon and high heat value, which implies a low percentage of organic materials (primarily food waste). Thermal systems are therefore not typically considered for processing of source separate organics. Anaerobic digestion is typically considered to be the preferred method to convert organic feedstock to useful energy. However, depending on the feedstock, certain feedstock, such as wood that is potentially contaminated with Dutch Elm Disease, may be appropriate for a thermal system. There are also options for thermal systems associated with processing bio-solid waste.