Composting Biosolids for a Greener Tomorrow

TransAqua

GREATER MONCTON WASTEWATER COMMISSION

COMMISSION DES EAUX USÉES DU GRAND MONCTON

OVERVIEW

The Greater Moncton Wastewater Commission (GMWC) has developed an innovative approach and a very efficient process of producing value-added products at its new biosolids composting facility.

Biosolids, a byproduct of wastewater treatment, is combined with forestry waste such as bark and green waste to produce high quality Type AA compost. The composting facility, started in 2005, was the result of several years of research and development. The facility has been expanded over the years and features added to improve the operation. Annually, the facility can process 30,000 tonnes of biodegradable material with minimum energy and labour, and produce a valuable product.

WHO IS TRANSAQUA?

TransAqua (GMWC) was created in 1983 with a mandate to implement a regional wastewater collection and treatment system for the Atlantic Canada communities of Dieppe, Moncton and Riverview. The serviced population is over 110,000. The current wastewater conveyance and treatment assets of the GMWC consist of 34.2 km of collector sewers and tunnels, eight (8) sewage lift stations, one large pumping station, the wastewater treatment facility and the biosolids composting facility. The treatment facility, located in Riverview, will use a four-step Biological Nutrient Removal process to meet the federal effluent regulations at the end of 2020.

WHY COMPOST?

The byproduct of wastewater treatment is biosolids which is extracted from the primary clarifiers and from the biological process. This organic product is dewatered via high-speed centrifuges and stabilized using lime. The resulting biosolids are transported to the composting facility. Composting biosolids with other readily available wastes results in a very stable material that can be used in many soil-building applications.

TransAqua now views biosolids as a key ingredient in its composting process. Biosolids mixed with byproducts from the forestry industry (bark) and local green wastes (branches, leaves, grass, and general yard waste) generates a high-quality compost once processed at the Transaqua facility. Biosolids act as a catalyst or inoculator in high temperature composting. The compost is then screened to bring about horticultural products (potting soil, mulch, soil conditioner) and reblended to produce topsoil. This compost is also used in land reclamation, in agriculture, and forestry. Composting is a very environmentally sustainable approach for dealing with waste byproducts.

WHAT IS COMPOSTING?

The Composting Process can be applied to a wide variety of wastes from human activity and from commercial and industrial operations. The process is accomplished by various microorganisms that break down organic matter and produce carbon dioxide, water, energy and the relatively stable organic product. Composting proceeds through three phases: the mesophilic (moderate temperature) phase, the thermophilic (high temperature) phase and the cooling maturing phase. At temperatures of 55ºC and above, microorganisms that are human or plant pathogens are destroyed. High temperature accelerates the breakdown of proteins, fats, complex carbohydrates like cellulose. Mesophilic microorganisms take over the final phase of maturation of the remaining organic matter. Carbon and Nitrogen are the most important elements in the composting process. Carbon provides both energy source and the basic building block making up approximately 50% of the mass of microbial cells. Nitrogen is a crucial component of proteins, nucleic acids, amino acids, enzymes and coenzymes necessary for cell growth.

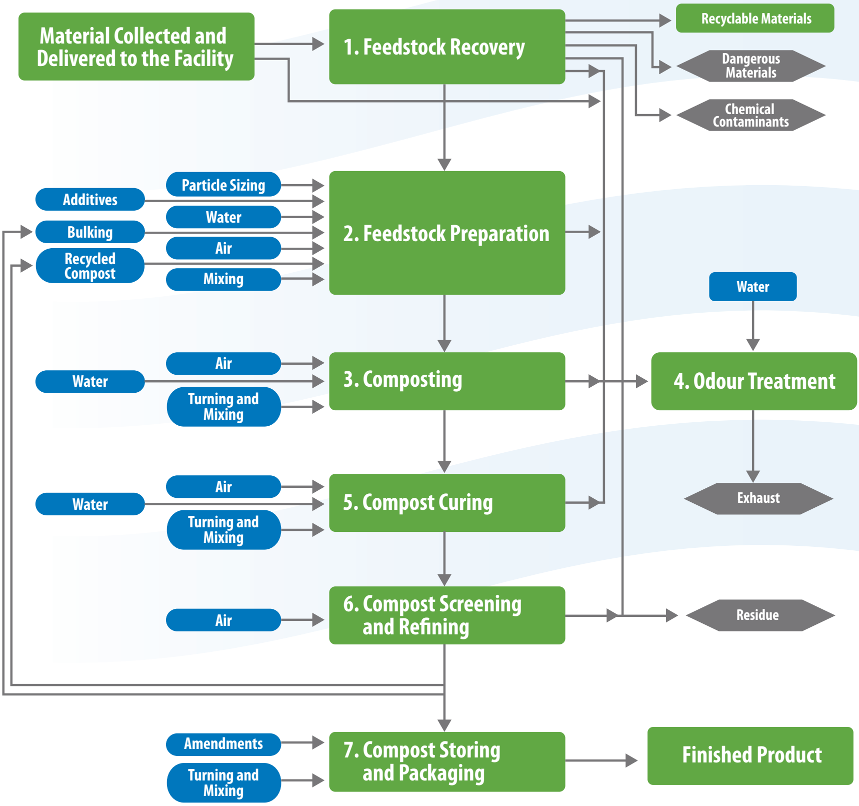
During the long curing stage, the fungi and actinomycetes population predominates and proliferates on the remaining less degradable organic matter such as chitin, cellulose and lignin. Once the complex organic compounds are broken down into smaller and more soluble forms, they can enter the cell and become food and energy for microorganisms. Also, during the curing stage, there is a gradual increase in the humus fraction. Humus is the most resistant compound to degradation in nature and one of the major mechanisms for retention of nutrients (nitrogen, phosphorus) and micronutrients as well as water.

HOW IS IT MADE?

GMWC's biosolids, once dewatered at 30%, are used as a key ingredient in high temperature composting in conjunction with a variety of carbon-based products such as forestry byproducts like bark and shredded green waste (branches, leaves, grass and general yard waste). The carbon-based byproducts make up over two thirds of the mixture

The feedstocks including biosolids are mixed in a dedicated area of the compost site with a windrow turner. The thoroughly mixed feedstocks are then placed on the active compost pad.

The main process is carried out on three outdoor concrete pads each measuring 56 metres by 50 metres. Two air trenches per compost windrow provide air and allow drainage of excess leachate and water. An enclosure, at the end of each compost pad, houses the aeration blowers, the electrical and control systems and other associated equipment. The enclosure is also used to pre-heat the air that is drawn from outside and pumped into the pressurized air trenches. The process utilizes a positive aeration system and a proprietary cover system.



The composting facility was designed to operate with minimum energy and minimum greenhouse gas emissions. It incorporates an innovative heat-recovery system. The system uses extremely low quantities of electricity, requires no air scrubbing and has no biofilters. The key to the composting process is the mix ratio of biosolids with the bark and green waste. The added ingredients provide the required carbon and bulking to facilitate aeration. The process can generate temperatures of over 70 °C for an extended period. Windrows are 50 metres long, 8 metres at the base and 3 metres high. During the active phase, these are turned three times by a large loader.

Following the active composting phase, the material is placed on a large curing pad for at least ten months. The temperature gradually decreases while the degradation of organic matter continues at a much lower rate. The compost is conditioned by turning and screened to a finished consistency.

WHAT CAN IT BE USED FOR?

Value-added products include a Compost Mulch for horticulture use, a Compost Soil Conditioner for improving organic content and texture of soils, as well as topsoil. The products are marketed under the label "Gardener's Gold Mulch" and "Gardener's Gold Soil Conditioner".

Today, this compost is used in many applications by the public, landscape contractors and other businesses for horticultural use, in the manufacture of topsoil, in land reclamation projects, in top dressing lawns, in agriculture and gardening.

BENEFITS OF COMPOST IN SOIL

Water Retention:

Healthy soil is an important factor in protecting our waters. Compost increases soil's ability to retain water and decreases runoff, which pollutes water by carrying soil, fertilizers and pesticides to nearby rivers and lakes.

Disease Suppression:

By recolonizing with beneficial microorganisms, compost can reduce the need for chemical pesticides since it contains beneficial microorganisms that may protect plants from diseases and pests. It helps at restoring a healthy microbial population to the soil.

Source of Organic Matter:

Provides food for microorganisms and an excellent habitat for microorganisms. Increased porosity improves water retention and the water infiltration rate.

Provides Crop Nutrients:

Compost can partially replace synthetic fertilizers. Compost contains macro and micro-nutrients often absent in synthetic fertilizers. Compost releases nutrients slowly, unlike synthetic fertilizers.

THE ROLE OF COMPOST IN REDUCING GREENHOUSE GAS

Composts can be made at the local level with minimum technology and can significantly improve soil organic content and its ability to hold moisture in addition to the fertilizer value.

The controlled process of composting under the cover system, like an in-vessel system, allows for the minimization of methane and nitrous oxide releases.

The energy required to operate the twelve-windrow system is minimum compared to other large mechanized in-vessel composting systems.

The benefits to the environment from compost include water retention in soil, carbon sequestration and fertilizer offsets. Many studies have shown that compost can reduce the amount of synthetic fertilizer because composting represents a recycled, low input form of slow-release fertilizer. Therefore, the net GHG emission is reduced because the energy-intensive fertilizer production and associated GHG emission are reduced.

It was estimated that the GMWC composting facility contributed to a carbon benefit of almost 2 kiloton CO_2 equivalents per year. This number represents the emissions from over 400 typical vehicles burning fossil fuel.

QUALITY OF COMPOST

The compost produced fully complies with established limits of the Canadian Council of Ministers of the Environment (CCME), for Class A. Compost of this quality can be used in any application, such as agricultural land, residential gardens, horticultural applications, the nursery industry, etc. The standards are based on four criteria for product safety and quality (maturity, foreign matter, trace elements and pathogens), which ensure product satisfaction and consumer confidence.

Table 1 shows a comparison of trace elements in the GMWC compost as compared to the Category CCME Class “A” compost.

Table 1 Concentration of trace elements in composted biosolids

Trace elements	**GMWC compost*** (mg.kg^{-1} dry weight)	**Category A (CCME)**** Maximum concentration within product (mg.kg^{-1} dry weight)
Arsenic (As)	<1	13
Cadmium (Cd)	<1	3
Cobalt (Co)	4.77	34
Chromium (Cr)	24.44	210
Copper (Cu)	104.81	400
Mercury (Hg)	0.27	0.8
Molybdenum (Mo)	2.58	5
Nickel (Ni)	10.55	62
Lead (Pb)	10.13	150
Selenium (Se)	0.17	2
Zinc (Zn)	274.12	700
Fecal Coliform (MPN/g dry)	75	1000
Salmonella (P-A/25g(ml))	Negative	3
Organic Matter (%)	67.00	-

* sampling results 2018 (average of Lots 1-9)
** CCME (Canadian Council of Minister of Environment) revised 2005
*** CQA Compost testing based on CCME

In addition to the quality standards listed in the table, the compost must also meet the requirements for foreign objects and be mature prior to distribution. The long-term curing and fine screening ensure that the material will be very stable and free of foreign objects.

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