



## Summary

# Technical Document on Municipal Solid Waste Organics Processing

Biodegradable material such as food waste constitutes approximately 40% of the residential waste stream in Canada, therefore diversion of organic materials is essential to reach high diversion targets. The environmental benefits of diverting organic materials from landfill include reduced methane emissions (a potent greenhouse gas) and decreased leachate quantities from landfills. From a life-cycle perspective, other benefits, such as the production of valuable compost and renewable energy, can also be derived from the diversion of organic materials from disposal depending on the processing method selected.

This document provides science-based, objective and user-friendly information on the various aspects of municipal solid waste (MSW) organic waste management processing. It draws on lessons learned and expert knowledge of professionals, practitioners and academics in the field of organics management across North America. The extensive and varied experience of all contributors and reviewers is brought together in 18 comprehensive chapters describing the technical aspects and key considerations involved in processing organic wastes. The document covers a wide range of topics from the science and principles of composting and anaerobic digestion, to the description of proven processing technologies, biogas utilization, facility design, odour control, and compost quality, as well as other related issues such as procurement approaches and system selection. This document presents valuable information for professionals involved in organics waste diversion including government officials, facility operators, waste management specialists and stakeholders.

Chapter 1, Introduction to Municipal Solid Waste Organics, introduces the typical composition and quantities of MSW organics including food waste, and leaf and yard waste. Common issues and challenges facing successful implementation of organics diversion programs are also discussed.

Chapter 2, Benefits of Organic Waste Diversion, highlights the importance of organic matter, an essential component of soils, which plays a fundamental role in soil conservation, crop production and fertility maintenance. Recycling organic matter back into the soil is a part of carbon cycling, an emerging and important environmental issue. The environmental, social and economic benefits of sound MSW organics management are also explained.

Chapter 3, Science and Principles of Aerobic Processing, examines the biological process involving a succession of different micro-organisms decomposing organic materials in the presence of oxygen and converting them into a biologically stable product. The seven steps of the process, the microbiology and the key process parameters to successful composting are also described.

Chapter 4, Science and Principles of Anaerobic Processing (Anaerobic Digestion), presents an overview of the anaerobic digestion process and the main characteristics of various digester designs including high solids versus low solids, single versus two-stage, and mesophilic versus thermophilic systems. Typical mass balances, chemistry and microbiology, and key process parameters are also discussed. Digestate and biogas characteristics and quantities are also described.

Chapter 5, Aerobic Processing Technologies, reviews the two main classifications of composting systems: passively aerated and turned systems, and actively aerated systems. Five passively aerated and turned systems as well as seven actively aerated systems are described in terms of their characteristics including typical annual capacity, active composting time, aeration methods, space requirements, and relative construction and operation costs. Advantages and disadvantages of each system are also presented.

Chapter 6, Anaerobic Processing Technologies, provides an overview of the three main types of anaerobic digestion systems: high-solids-stackable, high-solids-slurry and wet (low-solids) digestion systems. Each technology type is summarized under key considerations such as waste preparation, moisture addition, digester design, digestate, effluent and net energy production. Flow diagrams illustrate the various technologies.

Chapter 7, Biogas Conversion and Utilization Options, discusses the energy content of biogas in terms of the methane content, the range of energy uses, the level of biogas treatment and the respective technologies. Low-, medium- and high-grade uses of the biogas are described. A short section on biogas safety is also presented.

Chapter 8, Facility Siting, describes typical facility siting approaches including typical setback distances from various uses. Environmental, proximity/access and land-use considerations are summarized when siting an organic waste processing facility.

Chapter 9, Additional Facility Design Considerations, highlights the various factors that must be accounted for in addition to ensuring an efficient biological process. These factors include health and safety, fire prevention, site security, building ventilation, compost specifications, winter operation, seasonal variations, self-hauled deliveries, signs, corrosion protection and provincial/municipal requirements.

Chapter 10, Common Supporting Infrastructure, provides an overview of the various operating areas and supporting infrastructure that are common to both aerobic and anaerobic processing facilities. The common supporting infrastructures include the feedstock receiving area, the amendment storage area, the compost curing area, the finished compost storage area, the residuals storage area and the leachate/effluent/stormwater management infrastructures.

Chapter 11, Common Supporting Equipment, discusses the range of supporting equipment commonly used at organic waste processing facilities, including front-end loaders, conveyor systems as well as mixing, screening and size reduction equipment. Each type of equipment is described and assessed listing its advantages and disadvantages.

Chapter 12, Collection Programs, summarizes source-separated organics collection programs including drop-off depots, community collection sites and curbside collection programs. Typical diversion rates are discussed as well as their respective advantages and disadvantages.

Chapter 13, Organics Processing Facility Procurement Approaches, outlines the four most common procurement approaches used in the organics industry in Canada, including Design-Bid-Build, Construction Management At-Risk, Design-Build and Design-Build-Operate. Advantages and disadvantages of each approach are presented.

Chapter 14, Odour Control and Management, addresses perhaps the greatest challenge the organic waste processing industry faces. This chapter provides details on odour sources and measurement, as well as best practices for treating and managing effectively these odours. Applications, advantages and disadvantages of these control technologies options are presented with schematics and photos.

Chapter 15, Nuisance Management and Controls, provides a brief overview of the other nuisances that can be caused by organic waste processing facilities, including dust, litter, noise, insects, birds and animals. The sources of these nuisances and the control measures are described.

Chapter 16, Compost Quality Standards, summarizes the compost quality standards for finished compost product quality to protect human health and prevent environmental degradation. These standards include the *Fertilizer Act*, the Canadian Council of Ministers of the Environment Guidelines for Compost Quality and the Bureau de Normalisation du Québec Organic Soil Conditioners – Composts. The standards are presented in tables and include the maximum trace elements concentrations, maturity, pathogens, foreign matter, moisture content, organic matter and labelling.

Chapter 17, Compost Market Considerations, discusses the many aspects to consider for successfully marketing compost products. This chapter addresses the topics of compost markets, market development, distribution, bulk versus bagged products, competing products and transportation.

Chapter 18, System Selection, demonstrates how the various components in the previous chapters can be brought together with existing or planned programs to form an integrated system. Five common technology combinations from the simplest to the more sophisticated systems are presented. Each combination is illustrated and presented according to common criteria including waste quantity, waste diversion potential, collection program, user convenience, compost quality, compost markets, energy, greenhouse gas reductions and relative costs.

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