erthos™

An Overview of Composting, and Compost Validation

Authored By:

Kritika Tyagi, Co-Founder & Head of Product
Paulina Fedko, Sustainability & Compliance Analyst
Felix Saraci, Product Associate

Published By: erthos™

Published Date: August 2, 2022

Table of Contents

Executive Summary

At a time when the planet is drowning in a seemingly unending stream of plastic waste, erthos, is equipping brands, manufacturers, and consumers alike with viable, sustainable alternatives to single-use plastics made using entirely of renewable resources with a minimal impact on the planet, and ultimately compost at the end of their life. The plastic waste crisis is an undeniable truth that has propelled major enterprises and CPG brands to implement strategic goals to phase out virgin plastics and plastic waste from their value chains, replacing them with cleaner, more circular alternatives. As an advanced materials science company, erthos advocates for the 4 R's model: Reduce, Reuse, Recycle, **ReTHINK**.

REDUCE   REUSE   RECYCLE   RETHINK

Addressing the plastic waste crisis requires collaboration across all industries and, ultimately, a systems change in how we interact with, and think about plastics. Shifting to reusable, or recyclable materials is a good start, however in the case of single-use plastics, in particular difficult to recycle and capture single-use plastics, the industry has to rethink the materials they have been using for decades. Compostable materials are a great solution for difficult to recycle, capture, food adjacent plastics as they allow consumers to properly dispose of their waste which can be organically recycled into retail compost, ultimately helping plants grow, and improving soil and water quality.[1] Compostable materials also allow the waste industry to address and capture food contaminated plastics in a compost facility, rather than sending them to landfills, where anaerobic digestion of organic food waste can lead to significant methane pollution, causing further damage to our planet.[2]

Currently, the market for compostable alternatives is growing rapidly; compostable materials are quickly establishing themselves as viable alternatives to traditional petroleum based plastics, and the novel technology market is rapidly growing with new innovation taking place consistently. As one of the novel technologies looking to revolutionize this industry, erthos has developed a compostable biocomposite material, which is not only compatible with existing plastic infrastructure, but is made using a variety of biobased, biogenic materials, utilizing less energy, water, and emitting less greenhouse gasses into the atmosphere than traditional plastics.

However, as the compostables industry continues to grow and expand, the regulations, policy and certifications landscape has become more dynamic, making it difficult for consumers and brands alike to stay informed on continuous developments.

As different certifications, certification bodies, and new standards emerge, the need to thoroughly examine the different definitions of compostability, and what they mean for industry players such as erthos continues to grow. This document outlines the various options available to brands and manufacturers when communicating their material's sustainability metrics to consumers, and what it means for the industry as a whole.

Different Types of Composting Methods

Within North America alone, there exist multiple types of composting facilities; a facility in one municipality could use an entirely different method of composting than their contemporaries in the next municipality. The types of composting systems and technologies employed by a facility can determine which materials they accept, and the timeframe and conditions within which such a material is to break down. For instance, the Toronto Organics Processing Facilities such as Disco and Durham, utilize wet anaerobic digestion (AD) to process organic waste material, and harness the resulting methane gas to power Toronto's grid.[3] However, due to the wet digestion system employed by the City of Toronto, they are currently ill-equipped to handle compostable materials, versus the Guelph Compost facility, which uses an In-Vessel Aerated Static Pile composting system, and can accept specific types of compostable materials.[4] Below is an overview of the different types of composting technologies, and where they are the most prevalent.

Static Pile

The static pile composting system is one of the simplest methods for composting organic waste materials. This method requires the formation of a large pile of organic material and is often dependent on passive aeration (occurs when rising hot air pulls cold air into the pile},[5] where minimal management of the compost pile is required.[6] The materials typically degrade over several years with limited mixing or turning; however, this method can be used in conjunction with windrow or turning equipment to expedite the process. Static pile composting is best used for leaf and yard waste or agricultural materials, and is most prevalent in Alberta, Newfoundland and Ontario.[6]

Windrow

Windrow composting involves the formation of organic waste materials into long piles and rows called windrows. Periodically, the windrows are turned either manually or mechanically,[7] to aerate the piles. The size of the pile is traditionally kept large enough to generate sufficient heat, and maintain high temperatures, but is also small enough to allow oxygen to flow into the windrow's core. Windrow composting is commonly used to process leaf and yard waste, agricultural materials, and smaller amounts of source-separated organics otherwise known as SSO, which include materials such as food waste, paper fibers and wood waste. This type of system is most prevalent in Ontario, as well as British Columbia and Quebec.[6]

In-Vessel

In-vessel compost facilities add organic waste material to an enclosed container or building with supplemental aeration. There are various in-vessel methods with this composting system; one of these methods is through the use of rotating drums.[6] Typically made of steel, these drums continuously turn to mix the organic waste materials, while air is supplemented to ensure there is sufficient oxygen for decomposition within the system.

Another in-vessel method involves concrete structures which form into channels or bays. The organic material is placed at one end of the structure and slowly moved to the opposite end. This method often uses a forced aeration system, typically incorporated into the facility's floor, to provide sufficient oxygen. Due to this additional aeration - the system allows the processing of a wider range of material and is commonly used for food or SSO waste. This type of system is most prevalent in British Columbia and Nova Scotia.[6]

Anaerobic Digestion

Anaerobic digestion can be more accurately described as a biogas facility, where the utilization of anaerobic digestion technology can aid in the disintegration of organic waste materials. Ultimately, this method of composting utilizes microorganisms to break down organic material in the absence of oxygen.[6] This system processes various feedstocks such as food waste, SSO, slurries, crop residues, and wastewater, and is most prevalent in Ontario and Quebec.[6]

There are various types of residential composting programs available, depending on the population's density and infrastructure availability. The most prevalent compost collection programs are:

- Municipally-run curbside programs;
- Privately-run curbside programs;
- Drop-off programs

Municipally-run curbside programs are administered and funded by a city or region, and regulated by the public sector. Privately-run programs on the other hand, are typically structured on a weight or volume-based fee. Lastly, drop-off programs can be municipally or privately run. Drop-off programs can be structured on weight or volume-based fee or sometimes even free of charge depending on the type and amount of waste.[7] Businesses would predominantly be on a fee-based program with privately-run pick-up services.

erthos

Static Pile

Method: Formation of a large pile of organic waste

Duration: Active composting time between 2-4 weeks**

Prevalent Location in Canada*: Alberta, Newfoundland, and Ontario

Windrow

Method: Formation of organic waste into rows

Duration: Active composting time between 3-12 months**

Prevalent Location in Canada*: Ontario, British Columbia, and Quebec

In-Vessel

Method: Addition of organic waste to an enclosed container with supplemental aeration

Duration: Active composting time between 2-4 weeks**

Prevalent Location in Canada*: British Columbia and Nova Scotia

Anaerobic

Method: Anaerobic digestion utilizing microorganisms

Duration: 14-40 days; depending on design**

Prevalent Location in Canada*: Ontario and Quebec

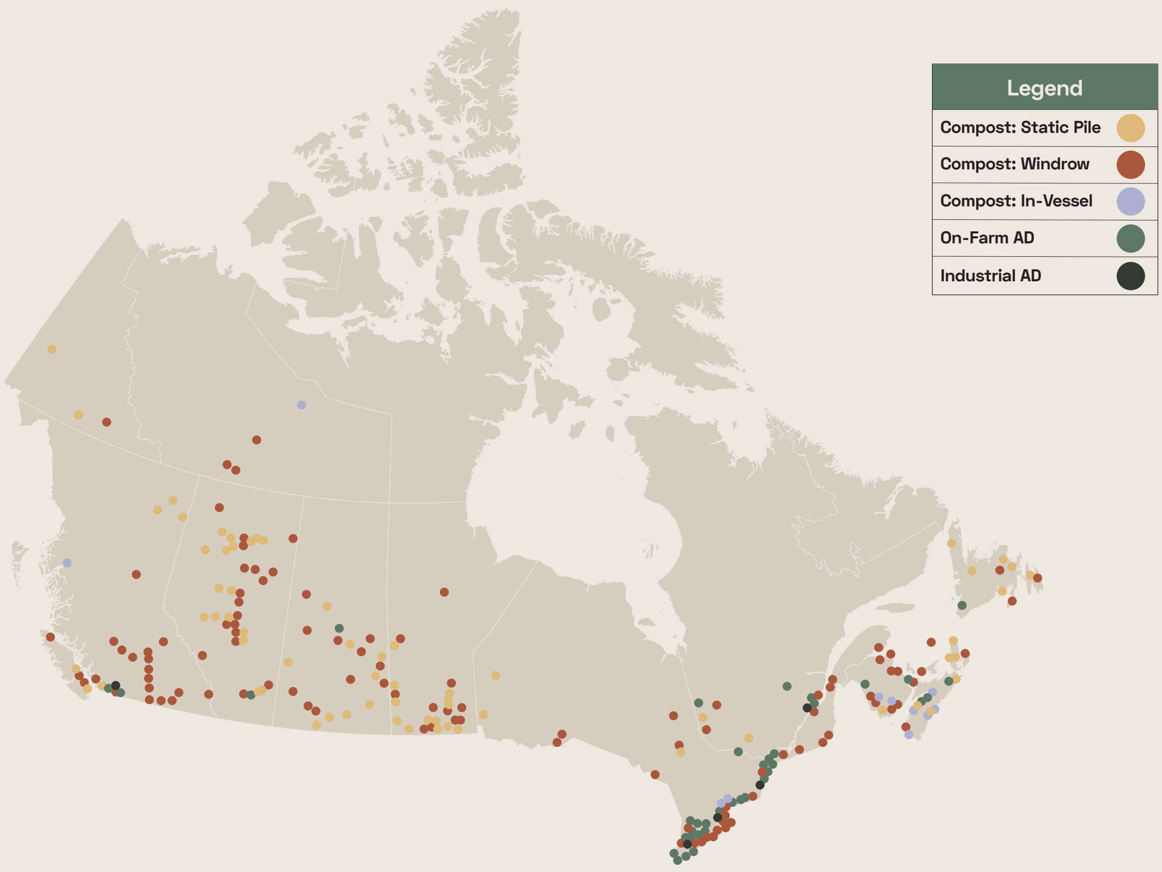
* According to EREF Source (2022)
** According to Environment Canada (2013)

Global Examples of Composting

North America

In Canada, various organic waste processing methods are practiced, the most prevalent of which differ between regions. However, based on the 2021 Environmental Research and Education Foundation (EREF) Report,[6] the most prevalent composting method was accepted to be the windrow, with almost 200 facilities out of 400 being identified as such. Of these 400 composting facilities, over 100 are located in Ontario,[6] and almost 85% of the Canadian population has access to a curbside organic management program, and 60% have access to drop-off organic management programs.[6]
Similar to Canada, In the United States, of the 101 compost facilities responding to the 2019 BioCycle edition,[8] 64 utilize the windrow composting method, making it the most predominant method of composting.

Examples of Compost Facilities by Method in Canada



Europe

The European region has significantly expanded its composting infrastructure since the European Union (EU) Landfill Directive was passed. According to a survey, a staggering 47.5 million tonnes of bio-waste was treated in over 4000 plants in Europe - with over 12 million tonnes of that bio-waste being processed by over 3000 anaerobic digestion composting plants.[9]

Germany, Austria, Denmark, UK, Lithuania and Italy have treated the most bio-waste per capita ranging from 107 to 173 kg per capita.[9] In Italy alone, there are over 330 composting facilities[10] with the highest concentration in Northern Italy.

Collection, Contamination, and Waste Stream Separation

One of the greatest challenges compostable materials face is the lack of proper infrastructure to address and support their processing. Historically, this has led to concerns within the waste management industry regarding waste stream contamination, and an inability to identify and sort compostable materials from conventional, petroleum based plastics.

Since the visual differentiation between conventional plastics and compostable materials is not distinct, it is absolutely vital for Government policies to not only define what qualifies as a compostable material, but to also establish a set of standards, regulations, and/or certifications to which the materials must adhere to or comply with, to satisfy said definitions. Additional requirements could also include proper labeling - this would not only benefit the consumer, by educating them in waste disposal methods, but also waste management stakeholders such as composters, to help them identify whether a material is a contaminant or otherwise. Acceptance of these materials must also be aligned amongst composters to avoid public confusion, and to regulate their acceptance in all facilities across the country.

Numerous regions are already working towards establishing policies and regulations to better manage the development of compostable materials, a necessary move when transitioning to a circular economy. Various policy frameworks are already under development, such as the one proposed by the EU considering "bio-based, biodegradable and compostable plastics". This framework will focus on addressing the sourcing, labeling and use of bio-based, compostable materials[11]. Other examples include Malaysia, which has a 2030 roadmap towards establishing a system that relies on zero single-use plastics, and outlines action items such as establishing the criteria for compostable materials, developing technical guidelines on these products for state governments, with a focus on supporting infrastructure for the acceptance and proper end of life management of compostable materials to plastic waste.

Introduction to Certifications and Certification Bodies

A packaging material can be designed to be either industrial (commercial) or home compostable.[12] The difference between the two classifications is based on the environmental conditions in which the material breaks down into compost. Industrial composting is a large-scale operation which requires establishing microbial conditions with elevated temperatures to facilitate the breakdown of material into compost. On the other hand, home compostable materials are capable of being broken down into compost through ambient temperatures with natural microbial communities. While both classifications encompass compostable materials, it is important to distinguish between the two when certifying compostable materials.

In order for a material to be deemed compostable, they must first demonstrate their biodegradable and disintegration properties through extensive testing based on established standards in composting conditions[13]. Once a material demonstrates compliance with the standards, third-party certification bodies will evaluate the results and provide a certification mark or label for compostability.

In North America, the standards for compostable packaging and packaging materials with "bioplastic coating" or additives, are ASTM D6400 and ASTM D6868 respectively. These methods were developed in 1999, and are rooted in scientific practices and methods.[12] For instance, ASTM D6400 provides the timeline for a material to physically disintegrate and biodegrade (chemically breakdown) in 180 days, while demonstrating set levels of non-toxicity to its surrounding ecosystem. Within the EU, standard EN 13432 generally covers similar requirements as ASTM D6400, and includes: i) characterization, ii) biodegradability, iii) disintegration, and iv) compost quality or ecotoxicity.

As discussed, material characterization and testing for certifications is performed by third party laboratories which work with certification bodies such as Biodegradable Products Institute (BPI), DIN CERTCO, and TUV Austria. These certification bodies present labels for certified compostable materials (e.g. BPI Compostable logo, Seedling Logo, and OK Compost INDUSTRIAL).

erthos

Home Compostability

Industrial Compostability

In the case of home compost testing, the temperature is lower than that of an industrial composting plant[14], which can extend the testing period to account for a significantly slower rate of disintegration. Therefore, achieving home compostability is much more time consuming and difficult and as a result, the standards and certification programs for home compostable materials are less established. In fact, within North America, ASTM does not yet have a home compost testing standard. As a result, certification bodies like BPI do not yet provide a home compost certification.

Current global tests for home compost certifications rely on the Australian standard, AS 5810, which requires disintegration in 6 months and biodegradation and compost formation within a year. When coupled with standards such as NF T 51800 (France), EN13432 and prEN 17427 (EU), materials can receive the TUV Austria OK Compost HOME mark. When evaluating the prevalence of one particular certification mark, one must consider geographical regions, jurisdictions, as well as the makeup and category of compostable materials, as the factors will influence the certification mark and certification body.

Industrially compostable materials for instance, have established standards and certifications within North America and the EU, unlike home compostable marks such as OK Compost HOME, which are not currently licensed through BPI.[12,14] Current market certifications are meant to guide the consumer towards goods which have undergone a standardized testing scheme to provide merit for materials claims. As the plastic-waste crisis grows, the need to address this waste is imminent, leading to the development of multiple technologies which claim to be compostable, biodegradable, or degradable.

While these materials may be eco-friendly, the lack of certifications may lead to a lack of uniformity across labeling, resulting in consumer confusion. In many instances, eco-friendly sustainable solutions may end up in landfills, defeating the initial purpose of their development.[15] In order for these materials to be addressed in the relevant waste streams, labeling standards and protocols must be established and accepted industry wide. As well, relevant industry certifications can provide credibility and marketing advantages within the supply chain. Whether it is with raw material suppliers, manufacturers, or brands, certifications follow a material throughout the supply chain.

Despite considering compostable packaging as preferred and eco-friendly, consumers still face confusion and a lack of familiarity with correctly classifying materials and identifying industry certifications.

A recent EU survey showed that upwards of 50% of consumers were unable to identify certification symbols and distinguish the difference between compostable and biodegradable.[16]

There is also ongoing consumer confusion about which packaging is recyclable and which is compostable, particularly when it comes to transparent, compostable materials. This is especially problematic since consumers are the first line of defense in properly sorting materials and preventing contamination, as it may not always be possible to identify a compostable material once it has been mixed with other materials.[12] One way to help consumers understand compostability, labeling, and other eco-friendly claims, is to use the How2Compost label. How2Compost is a standardized on-package label that clearly communicates composting instructions to the public, and compost certified items are eligible.

While compost certifications are certainly helpful in regulating industry labeling, claims, and consumer education, real-world composting is unfortunately far more complicated. Unlike the lab-based tests certified materials undergo, there are currently multiple composting technologies that exist in North America alone, each subjecting the compost piles to different temperatures, aeration periods, agitation, and timeframes. Compost facilities are now seeing an influx of compostable materials entering their waste streams, demonstrating that the certifications work in helping consumers locate the correct and intended waste stream for an item, however in some instances, compost facilities are now reporting an incompatibility between certified compostable materials, and existing compost technologies. This can cause contamination issues in the compost facilities, as well as further quality concerns downstream.

Why is Compost Validation Important?

One solution to this discrepancy is to incorporate in-field real world testing into material certification. This can allow consumers to understand whether the goods being purchased are compatible with real world composting conditions. Currently within North America, the Compost Manufacturers Alliance (CMA) has a certification mark available in collaboration with BPI for organizations looking to ensure their compostable materials are compatible with existing compost waste management infrastructure. Organizations can conduct in-field tests with CMA to validate their material's end of life in real-world conditions.

In-field tests help with consumer education, and help validate the real-world performance of certified products in compost facilities. ASTM standards are not built around real-world scenarios, although coordinating with field validation programs can help expand robust data sets on the performance of compostable materials in a diverse mix of real-world environments.[17] Consumers are currently not aware that there exists a discrepancy between compostability certification lab testing, and real-world scenarios of how certified products behave in compost and waste management facilities. The environments differ, and at this time this knowledge is predominantly known in the compostable materials sector but should be expanded to consumers through education and awareness.

At erthos, we recognize that certifications are one way to label and communicate end of life to consumers and recognize a certified compostable material to ensure it ends up in the right waste stream. This can help in reducing contamination, methane emissions from organic materials ending up in landfill, and, in the case of food contact packaging, can ensure food waste is composted rather than contaminating incorrect waste streams. However, as mentioned, recent studies have shown that not all certified materials are compatible with real world compost facilities. Certain fiber-based materials, for instance, may achieve compatibility with compost certifications, however they are more likely to remain intact once a compost pile has been cleared.

General trends indicate that compost tests performed in labs can be more strict than real world compost facilities, and not all certifications will translate into real-world compost facility compatibility. In situations such as the latter, BPI offers an “overs” testing where they work with composters to understand and track which certified materials are not breaking down in compost piles, and support composters in understanding how such situations can be avoided. As well, BPI has a strong relationship with CMA, where they run collaborative testing to understand the transferability of their certifications to real-world compost piles.

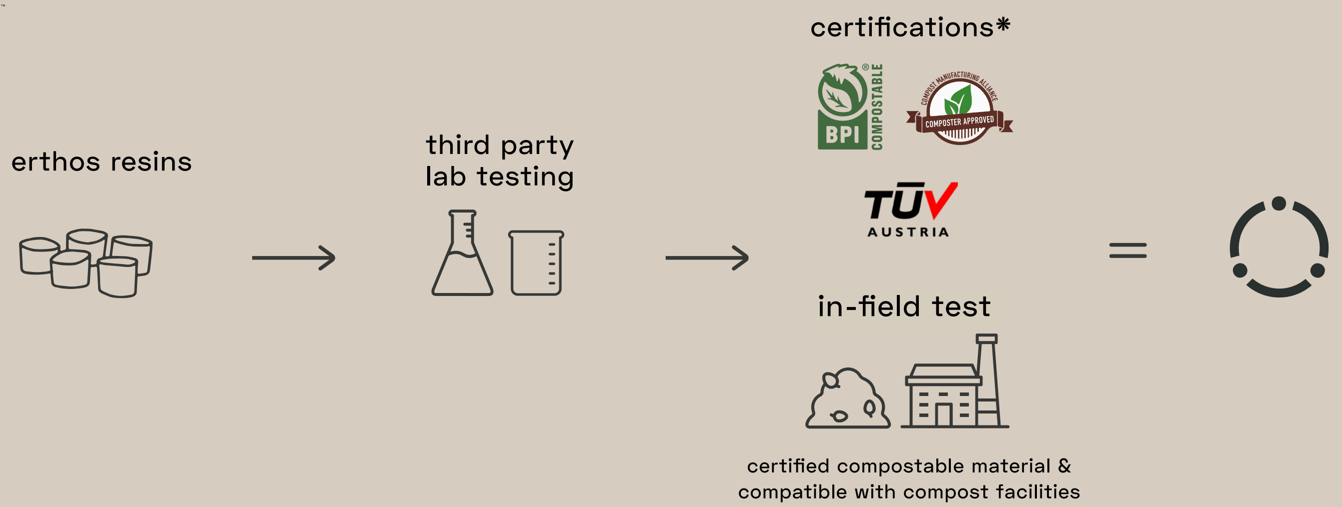
How Does This Impact erthos and Our Materials?

At erthos, we believe in adopting a similar method - as our industry is vast and varied, we believe in certifying our resin at its thickness, but also working with compost facilities to certify our materials with real world composting technologies to secure a satisfactory end of life for our materials.

For converters, brands, and manufacturers alike, certifications such as CMA's compost assurance, can validate that the materials they will be using to ultimately develop final product applications, will be satisfactorily composted once they are sorted into the right waste facility. In jurisdictions such as Canada, where only certain materials are exempt for composting and where most compost facilities currently only accept yard waste, in-field tests such as the ones provided through CMA are extremely important, as they can reassure suppliers that their raw inputs are compatible with existing infrastructure. Finally, most certification bodies such as TUV Austria, DIN Certco and BPI only license their mark for specific product applications. Traditionally, raw ingredients in resin form are likely to attain certification; however, not every application (for instance, non-food adjacent applications such as hangers) will be certified or licensed a mark. In such instances, manufacturers may claim that a material is "made using certified compostable ingredients", however they are unable to guarantee compostability for their final applications. Since certifications are provided based on material thickness and form, in-field compost tests can be extremely useful for brands which can still guarantee their product's compostability and compatibility with existing compost systems.

Currently, erthos' terrariza is being certified by BPI and TUV Austria under multiple certification schemes, and will be undergoing in-field testing with various compost technologies to ensure compatibility with our resins' end of life. We are also working with Material Recovery Facilities to ensure products developed using erthos' resins are sorted into an organic waste stream, thereby ensuring our solution is comprehensively addressed at the end of its life.

erthos



*pending

Concluding Thoughts

Certifying compostable materials is based on whether it is industrially (commercial) or home compostable. The certifications are based on several standards (e.g. ASTM D6400 and EN 13432), and awarded by third-party certifications bodies such as BPI, TUV Austria, and DIN CERTCO, among others.

With the increasing desire to be more eco-friendly, consumers are looking for beneficial alternatives to their single-use plastic products. While certifications can establish a product clearly as industrial or home compostable to enable consumer education, there are still gaps in the certification space to transfer lab-based tests to real world compatibility. As a result, erthos is currently working with both lab-based certification bodies and in-field compost facilities to ensure that our material comprehensively addresses its end of life function. Compatibility with real-world composting facilities is erthos' primary focus as it allows us to ensure all products made with our resins are satisfactorily addressed at their end of life. While lab-testing may provide us with a certain level of assurance regarding our material's safety, and allow us to communicate its sustainability, it is the desire to ensure our materials are adequately addressed in compost streams, and not contaminating existing waste management systems, that drives our innovation.

Sources

1. Ottawa Valley Waste Recovery Centre (2020) Retrieved from https://ovwrc.com/composting-facility/

2. Fight climate change by preventing food waste, WWF. Retrieved from https://www.worldwildlife.org/stories/fight-climate-change-by-preventing-food-waste

3. City of Toronto. What Happens to Organics? Retrieved from https://www.toronto.ca/services-payments/recycling-organics-garbage/houses/what-happens-to-organics/

4. AIM Environment Group. Guelph Wellington Organix Waste Processing Facility. Retrieved from https://aimgroup.ca/guelph-wellington-organix-waste-processing-facility/

5. Carry on Composting, To Turn or Not to Turn. Retrieved from http://www.carryoncomposting.com/443725799

6. State of the Practice of Organic Waste Management and Collection in Canada (July 2021). Environmental Research and Education Foundation.

7. Sustainable Packaging Coalition. (2021, January). Understanding the Role of Compostable Packaging in North America [PDF]. Retrieved from https://sustainablepackaging.org/resources/

8. Quantifying Existing Food Waste Composting Infrastructure in the U.S. Retrieved from https://www.biocycle.net/pdf/2019/FoodWasteCompostInfra.pdf

9. Treatment of Bio-Waste in Europe. Retrieved from https://www.compostnetwork.info/policy/biowaste-in-europe/treatment-bio-waste-europe/

10. Di Bartolo A, Infurna G, Dintcheva NT. A Review of Bioplastics and Their Adoption in the Circular Economy. Polymers. 2021; 13(8):1229. https://doi.org/10.3390/polym13081229

11. Bio-based. biodegradable and compostable plastics. European Commission. Retrieved from https://ec.europa.eu/environment/topics/plastics/bio-based-biodegradable-and-compostable-plastics_en

12. Sustainable Packaging Coalition. (2021, January). Understanding the Role of Compostable Packaging in North America [PDF]. Retrieved from https://sustainablepackaging.org/resources/

13. UrthPact. "Certified Compostable Products: What to Look For and What It Means". (2020, June). Retrieved from https://www.urthpact.com/certified-compostable-products-what-to-look-for-and-what-it-means/

14. TUV Austria. "OK Compost & Seedling". Retrieved from https://www.tuv-at.be/green-marks/certifications/ok-compost-seedling/

15. Kale G, Kijchavengkul T, Auras R, Rubino M, Selke SE, Singh SP. "Compostability of bioplastic packaging materials: an overview". Macromol Bosci. 2007 Mar8;7(3):255-77. doi:10.1002/mabi.200600168. PMID: 17370278.

16. Manon Dupre, "How to communicate sustainability to consumers", Amcor (2020, June). Retrieved from https://www.amcor.com/insights/blogs/how-to-communicate-sustainability-to-consumers

17. Review of Publicly Available Field Testing Results and Programs (2021). Biodegradable Products Institute.

About erthos™

erthos™ is building a massively scalable platform for better materials for a planet free from plastic pollution. Single-use products made with erthos materials are 100% compatible with existing plastic manufacturing systems, sustainably manufactured and compostable at their end of life.

erthos™

To learn more visit erthos.ca