Frequently Asked Questions

EcoPure Product Questions

How does EcoPure work?

EcoPure® accelerates the biodegradation of treated plastics in microbe-rich environments. Plastics treated with EcoPure® have unlimited shelf life and are completely non-toxic. Bio-Tec discovered an organic compound within crude oil that is burned out during the cracking process that is synthesized with nutrients and then grafted onto to the plastic polymer chain. Adding EcoPure® to a petroleum based resin attracts microbes to the product allowing them to control their PH level and become quorum sensing and colonize on the surface of the plastic. Once the microbes have colonized on the plastic they secrete acids that break down the polymer chain. Microbes utilize the carbon backbone of the polymer chain as an energy source. The difference between EcoPure® treated plastic and traditional plastic is that EcoPure® creates an opportunity for microbes to utilize plastic as food.

What is the manufacturing process for using EcoPure® additives?

Using the additive in the manufacturing process is easy to do and usually does not require equipment modification. The EcoPure® additive is added via a standard commercial gravimetric hopper just as you would add a colorant into the extruder feed-throat. Ours products are usually loaded at 0.7%-4% by weight.

Does EcoPure® change the physical characteristics of treated plastic?

There are no noticeable changes to the physical characteristics of plastic such as tensile strength, glass temperature, melting temp, transition rates, etc. Some of these values are identified in the TDS (Technical Data Sheet). We encourage customers to test the performance of EcoPure® combined with specific materials.

Does plastic with EcoPure® decrease in performance when operating at elevated temperatures?

No. Tensile strength and the physical properties are maintained even in elevated temperatures. Temperatures that exceed the normal operating range for each specific resin would experience the same loss of properties as the standard plastic.

Do EcoPure® treated products have limited shelf-life?

No, EcoPure® products do not have a limited shelf life.

What prevents plastics made with EcoPure® from degrading while in inventory or on the shelf?

EcoPure® treated products must be disposed of or kept in active microbial environments in order to biodegrade. Most warehouse and retail environments do not contain the microbes needed for biodegradation.

Are there any special handling requirements of the EcoPure® additives?

Always make sure to seal unused portions of the EcoPure® additive due to its slightly hygroscopic nature. It is also a good idea to rotate the lot every six months to ensure good quality control. Do not run the additive at over 600F as this has not been tested and the results cannot be guaranteed.

Are products with EcoPure® FDA approved?

EcoPure® is not toxic and is safe for use in food-contact applications. EcoPure® has been independently tested for toxicity and has been certified as FDA compliant.

How do you know that EcoPure® is food safe?

Keller and Heckman, an internationally recognized law firm that specializes in regulatory affairs. Keller and Heckman has analyzed EcoPure® and has determined that it is safe for use in food contact applications. K&H has issued Bio-Tec Environmental letters validating the safety of EcoPure® when in contact with food.

Does EcoPure® contain any heavy metals?

EcoPure® does not contain any compounds that would be considered heavy metals, light metals or metal ions. EcoPure® is a combination of true organic compounds coming from oil and other nutrients found in the environment.

Does the EcoPure® additive contain any cancer causing compounds?

No. All of the organic compounds contained in EcoPure® are considered safe for food contact and have no known adverse health effects. The compounds are also not found on the toxic and potentially harmful substance list of CA Prop 65. This California legislation identifies certain toxic and potentially harmful substances and describes limitations for their use.

What is California Prop 65?

CA Prop 65 is legislation within the state of California that identifies certain toxic and potentially harmful substances and provides limitations for their use. No compounds within the EcoPure® additive are listed in Prop 65. Read more - http://oehha.ca.gov/Prop65/background/p65plain.html

Does EcoPure® contain microbes?

No, EcoPure® is an additive composed of organic compounds that attract microbes when placed into microbe-rich environments. There are no enzymes or microbes within the EcoPure® additive.

What plastics can EcoPure® be used in?

The EcoPure® additive can be used with virtually any petroleum-based resin.

Can customers use the regrind from plastics made with EcoPure®?

Yes, however it is recommended to implement quality control to ensure the approved amount of material is being loaded into the resin.

Are products made with EcoPure® certified recyclable?

Currently there are no recognized standard certification programs for recyclability. We have provided a number of independent laboratories with samples of plastic made with EcoPure®. These samples were then subjected to various testing methods to determine if EcoPure®-treated products are suitable for recycling. These tests indicated that EcoPure® does not affect the recyclability of treated products.

What recyclability tests have been performed on EcoPure® products?

The following tests have been performed on PET bottles treated with EcoPure® to verify recyclability. These are standard tests used to determine the quality of PET plastic regrind. These tests are suggested as part of the American Post-consumer Recycling Critical Guidance document. • Haze and Transmission via ASTM D 1003B • Intrinsic Viscosity via ASTM D 4603 • Acetaldehyde via ASTM F 2013 • Fluorescence Visual Visual Black Specks and Gel.

Biodegradation Testing Questions

How do you know that a plastic product made with EcoPure® completely disappears? Have you tested this?

ASTM D 5511 tests are currently being performed that show significant rates of biodegradation of EcoPure® treated materials. Please contact Bio-Tec Environmental to review our biodegradation test results.

What is the ASTM standardized testing methods for biodegradation?

• D6400 Standard Specification for Compostable Plastics – Defines the testing parameters for performing the D5338 Test Method

• D5338 Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions – Standard test method for aerobic biodegradation for industrial compost environments.

• D5511 Standard Test Method for Determining Anaerobic Biodegradation of Plastic Materials Under High-Solids Anaerobic Digestion Conditions – Standard test method for anaerobic biodegradation for landfill environments.

What's the difference between the ASTM D6400 standard and the ASTM D5511 test?

The ASTM D6400 is a standard specification that is used to evaluate the results obtained from ASTM D5338 compostability testing. The ASTM D5511 is a test method that evaluates the biodegradability of plastic in anaerobic, or oxygen-less, conditions. The ASTM D6400 standard is not used to evaluate data obtained from D5511 testing.

Which ASTM biodegradable testing standards have EcoPure® products been tested according to?

Plastics made with EcoPure® are biodegradable in both

aerobic and anaerobic environments. The customary disposal method of plastic bottles being either recycled or landfill we feel the most applicable test methods would be for anaerobic (landfill) environments. We therefore test EcoPure® products under the scrutiny of the ASTM D 5511 which is a standard test method for determining anaerobic biodegradation of plastic materials under high-solids anaerobic digestion conditions.

Do EcoPure® products meet ASTM 6400 standards?

Plastics made with EcoPure® are biodegradable in both aerobic and anaerobic environments. The customary disposal method for plastic is landfilling, not composting, so Bio-Tec Environmental engineered EcoPure® to perform best in anaerobic environments. EcoPure® is not designed to biodegrade plastics in the timeframe required for professional composting facilities, and so probably does not meet the D6400 standard.

Will plastic made with EcoPure® biodegrade in the marine environments and have you tested this?

EcoPure® products should biodegrade in any active microbial environment, including lakes, oceans and streams. Our testing confirms that EcoPure®-treated products biodegrade in both aerobic and anaerobic environments, but we have not tested EcoPure® in a marine environment at this time, and make no specific claims regarding marine-degradability.

What happens to a product made with EcoPure® that ends up in a roadside ditch?

Biodegradation of EcoPure® products will occur anywhere there is an active microbial environment. Sitting on the dirt next to the road will subject the bottle to an active microbial environment; however the entire bottle will not be subjected to the microbial environment simultaneously and will result in a much longer biodegradation period. Plastic litter also has an unfortunate habit of blowing in the wind and floating on water, which might serve to disrupt some microbe colonies during the biodegradation process, which might then slow the process down.

What are the benefits of placing EcoPure®-treated products in a landfill?

Over 75% of plastic bottles and over 94% of all plastics in general end up in landfills. EcoPure®-treated plastic that ends up in a landfill will fully biodegrade over a period of time. Landfill environments are anaerobic in nature and produce methane gas as a by-product of anaerobic fermentation taking place deep within. Methane can be harvested from landfills and is a source for clean, inexpensive energy. The Clean Air Act requires all landfills to reclaim methane and other Green House Gasses (GHG) and either burn it or use it to produce energy. Read more - http://en.wikipedia.org/wiki/Clean_Air_Act Methane from landfills is an inexpensive form of "green" energy that is readily available at landfill sites around the globe. Read more – http://www.methanetomarkets.org Plastic Degradation Technology Questions

What are oxo-degradable additives and how do they work?

Oxo-degradable additives introduce metallic salts into traditional polymers, making them susceptible to rapid degradation when in the presence of sunlight and oxygen. This process breaks the polymer chains into small pieces, causing the waste plastic to disintegrate in the environment.

What is PLA (Polylactic Acid) and how does it work?

Polylactic acid (PLA) is a polymer derived from starchy plants such as corn. To make PLA, corn kernels are milled and dextrose is extracted and fermented, producing lactic acid as a by-product. This lactic acid is then refined and used to produce raw PLA pellets. PLA is presumed to be biodegradable, although the role of hydrolysis vs. enzymatic depolymerization in this process remains open to debate. Composting conditions capable of degrading PLA are found only in industrial composting facilities where high temperature (above 140F), high relative humidity (RH), and a 2/3 mixture of organic food based materials can be controlled in order to supply the necessary nutrients that promote chain hydrolysis. This is required to break down the polymer structure before microbial activity can break down the remaining material.

What are PHB and PHA bioplastics?

Polyhydroxyalkanoates, or PHAs, are linear polyesters produced in nature by bacterial fermentation of sugar or lipids. More than 150 monomers can be combined within this family of polymers to produce materials with different, useful properties. These plastics are biodegradable and are used in the production of bioplastics. They can be either thermoplastic or elastomeric materials, with melting points ranging from 40 to 180 °C. The mechanical and biocompatibility of PHA can be changed by blending, modifying the surface, or combining PHA with other polymers, enzymes and inorganic materials, making a wide range of applications possible. Read more - http://en.wikipedia.org/wiki/Polyhydroxyalkanoates

Which type of degradable plastic is the best for the environment? Oxo-degradable, PLA, or EcoPure®?

For a truly biodegradable and commercially viable product EcoPure® is the best technology on the market. It is a proven, versatile technology that has many advantages over competing technologies. Oxo-degradable products fragment into small pieces of plastic that are often mistaken for food by animals, and will not degrade at all unless in the presence of sunlight, moisture, and oxygen. Oxo-degradable plastic basically needs to be littered to degrade, and we feel that this is an irresponsible solution to the plastic waste problem. PLA production requires components sourced from food-crops, which we feel should be eaten rather than used to make plastic. The corn used to produce PLA is a Genetically Modified Organism and requires heavy pesticides in the farming process, and out-competes viable neighboring food-crops. This material is touted as being compostable, but only composts in commercial/industrial grade facilities, which are unavailable in most areas of the world.

Landfill and Biodegradation Questions

What is biodegradation?

Biodegradation is a process by which complex molecules are changed into simple molecules through the actions of microorganisms.

What is a Microbe?

Microbes, or microorganisms, are the smallest organisms on the planet and require the use of a microscope to see them. There are a huge variety of organisms that can be classified as "microbes." They can live alone or in colonies. They can help you or they can hurt you. These creatures make up the largest number of living organisms on the planet. There are trillions and trillions of microbes on the Earth. Microbes include bacteria, fungi, some algae, and protozoa. A microorganism can be heterotrophic or autotrophic. These two terms mean they either eat other things (hetero) or make food for themselves (auto). Think about it this way: plants are autotrophic and animals are heterotrophic. A protozoan like an amoeba might spend its whole life alone, cruising through the water. Others, like fungi, work together in colonies to survive.

What are the differences between biodegradation and degradation?

Biodegradation: The process by which an organic material degrades through the action of microorganisms over a period of time. Biodegradation can occur in either aerobic (with oxygen) or anaerobic (without oxygen) environments.

Degradation: The process by which a material is broken down into smaller pieces but never completely disappears. Plastic degradation can be initiated by the presence of oxygen, UV light, and heat. In many cases these products begin to degrade the moment they are manufactured, resulting in an abbreviated shelf-life.

What is the difference between Aerobic and Anaerobic Biodegradation?

Aerobic biodegradation is the breakdown of organic matter by microorganism in the presence of oxygen. Anaerobic biodegradation is the breakdown of organic matter by microorganism when oxygen is not present.

Is the EcoPure® biodegradation process strictly anaerobic/aerobic or a combination of both?

It is a combination of both aerobic (with oxygen) and anaerobic (without oxygen). Microbes found in both environments will be attracted to the plastic with EcoPure® and will colonize on the plastic which will result in complete biodegradation.

Isn't composting the only form of biodegradation?

No, there is much confusion surrounding the term "biodegradation." Different organizations that support different types of biodegradable plastics do represent composting as the only form of biodegradation. ASTM defines biodegradable plastic as "a degradable plastic in which the degradation results from the action of naturally-occurring micro-organisms such as bacteria, fungi, and algae." These types of organisms exist in composting environments, but also exist in different environments, as well. "Composting" is not the definitive process of biodegradation.

What is a landfill?

A landfill is a site for the disposal of waste materials by burial and is a traditional form of waste treatment. Landfilling is common around the globe. There are two basic landfill operations for handling waste disposal: dry tomb and bioreactor. A "dry tomb" sanitary landfill involves burying waste and attempting to maintain dry conditions in order to minimize biodegradation, as well as leachate and biogas production. This landfill design is commonly used in developed nations. In a bioreactor landfill, controlled quantities of liquid are added and circulated throughout waste in order to accelerate the natural biodegradation of buried waste. Bioreactor landfills are present at several test locations and may replace current landfill designs. Read more - http://www.epa.gov/landfill/

What is a bioreactor?

A bioreactor landfill operates to rapidly degrade organic waste. The increase in waste degradation and stabilization is accomplished through the addition of liquid and air to enhance microbial processes. A bioreactor landfill has the capability to produce significant amounts of methane gas, which can be used for clean energy production. The Advantages of Bioreactor Landfills: • Decomposition and stabilization of wastes in years instead of decades • Lower waste toxicity due to both aerobic and anaerobic conditions • Reduced leachate disposal costs • Possible 15 to 30 percent increase in landfill space due to an increase in the density of waste mass • Significant increased LFG generation that can be used for energy generation • Reduced post-closure care Read more: http://www.bioreactor.org/

Besides methane production, why would do we want plastic to biodegrade in landfills?

Currently, approximately 85% of all plastics produced in the U.S. end up in landfills. This plastic waste builds up in landfills, taking hundreds of years to biodegrade. It makes environmental sense to put an additive into existing plastic resins which will not impact the physical properties of that plastic, if recycled will have no negative impact on the recycling stream, and if landfilled will naturally biodegrade creating methane which can then be used as a source for clean, inexpensive energy.

What is considered an active microbial environment?

Landfills and compost piles are considered to be active microbial environments.

What environmental conditions need to be present for EcoPure® to activate?

There are three types of microbial environments: suspended, dormant, and active. Plastics treated with EcoPure® require an active microbial environment in order to biodegrade. In environments such as warehouses, offices, and retail locations the microbial environment is suspended or dormant and does not provide the circumstances needed for biodegradation to occur. An active microbial environment is one that contains active fungal and bacterial colonies and would be extremely dirty in either aerobic or anaerobic conditions. This allows the microbes to colonize on the plastic and begin to digest the polymer.

What are the stages of biodegradation in a landfill environment?

1. Aerobic Phase (first few days) – This is the phase when aerobic microbes are becoming established and moisture is building up in the refuse. While standard plastic absorption capability is relatively small, the additive causes further swelling, weakening the polymer bonds and creating molecular spaces where moisture and microbial growth can rapidly begin the aerobic degradation process. Oxygen is replaced with CO2.

2. Anaerobic, Non-Methanogenic Phase (roughly 2 weeks to 6 months) - After oxygen concentrations have declined sufficiently the anaerobic processes begin. During the initial stage (hydrolysis), the microbe colonies eat the particulates, and through an enzymatic process, reduce large polymers into simpler monomers. The secreted monomers mix with the organic additive, causing additional swelling and opening of the polymer chain and increased quorum sensing. This further excites the microbes to increase their colonization and consumption of the polymer chain. As time progresses, acidogenesis occurs where the simple monomers are converted into fatty acids. CO2 production occurs rapidly at this stage.

3. Anaerobic, Methanogenic Unsteady Phase (6 to 18 months) - The microbe colonies continue to grow eating away at the polymer chain and creating increasingly larger molecular spaces. During this phase acetogenesis occurs, converting fatty acids into acetic acid, carbon dioxide and hydrogen. As this process continues, CO2 rates decline and hydrogen production eventually ceases. 4. Anaerobic, Methanogenic Steady Phase (1 year to 5 years)

The final stage of decomposition involves methanogensis. As colonies of microbes continue to eat away at the remaining surface of the polymer, acetates are converted

into methane and carbon dioxide, and hydrogen is consumed. The process continues until the only remaining element is humus. This highly nutritional soil creates and improved environment for the microbes and enhances the final stage of decomposition.

When a plastic made with EcoPure® breaks down into biomass, what makes up that biomass?

Biomass is essentially organic matter similar to soil or dirt. It is made up of nutrients and the remains of bacterial colonies.

What are the typical bacterial strains that feed off of EcoPure®?

The specific microbes for consuming plastics have taken years for Bio-Tec Environmental to identify and are considered confidential information within Bio-Tec.

Won't microbes consume and digest traditional plastic?

Yes, microbes are very similar to other organisms in that they move to areas where food and other necessities are available or plentiful. Microbes that find their way onto traditional plastic might begin to consume it, but would more likely disdain it in favor of easier food. We believe that un-treated plastic might take hundred of years to be completely digested by microbes.

What is microbial quorum sensing?

Microbes use quorum sensing to coordinate certain behaviors based on the local density of the bacterial population. Microbes that use quorum sensing constantly produce and secrete certain signaling molecules (called autoinducers or pheromones). These microbes have a receptor that can specifically detect the signaling molecule (inducer). When the inducer binds the receptor, it activates transcription of certain genes, including those for inducer synthesis. As the microbial population grows the concentration of the inducer passes a threshold, causing more inducer to be synthesized. This forms a positive feedback loop, and the receptor becomes fully activated. Activation of the receptor induces the up regulation of other specific genes, causing all of the cells to begin transcription at approximately the same time. This coordinated behavior of microbial cells can be useful in a variety of situations such as multiplying. Read more – http://en.wikipedia.org/wiki/Quorum_sensing

Does microbial digestion consume the entire polymer chain or just the EcoPure® additive?

Tests have been completed to show that biodegradation is occurring on the entire polymer chain versus just consuming the EcoPure® additive present in the treated plastic. ASTM testing has consistently shown biodegradation of treated materials far in excess of the amount of EcoPure® being used.

What byproducts are produced during the process of biodegradation?

Products treated with EcoPure® biodegrade as a result of microbial digestion. The process of microbial digestion can take place in either aerobic (with oxygen) or anaerobic (without oxygen) conditions. These conditions determine what by-products are produced. In aerobic microbial environments the by-products will be carbon dioxide, water, and humus. Humus is the degraded organic material in soil, which causes some soil layers to be dark brown or black. In soil science, humus refers to any organic matter that has reached a point of stability, where it will break down no further. For anaerobic microbial environments the by-products will be carbon dioxide, methane, and humus.

Are the by-products of biodegradation harmful to our environment?

Biodegradation is a natural process that is essential in maintaining our planet's ecosystem and nutrient cycles. We at Bio-Tec Environmental believe that we as humans should strive to keep our world clean and not leave today's waste for future generations to deal with. The waste gasses produced through the process of plastic biodegradation are manageable and even economically useful.

Do polymers still remain in the soil after biodegradation?

No, the microbes utilize the carbon backbone of the polymer chain. Microbes use the carbon for energy and leave nothing of the polymer behind when the process of digestion is complete.