

# **Biodegradability Products**

www.ekcos.com





# Biodegradable Product Certificate

We certify that as a result of the ASTM- 0-5511-02 test, conducted to the "ekcoscreen", we have enough elements to prove the efficacy of Eco One additive to accelerate plastic material biodegradation.

Environmental Engineer Rodngo Abraham Castro Corona

Mexico City, September 15,2014

Biodegradable Certificate

4





## INSTITUTO POLITECNICO NACIONAL

INTERDISCIPLINARY CENTER FOR RESEARCH AND STUDIES ON THE ENVIRONMENT AND DEVELOPMENT LABORATORY FOR ANALYSIS AND ENVIRONMENTAL MONITORING



Mexico City, November 30, 2017

# Results of the anaerobic biodegradation test of the Ekcos screen based on the Ekcos 1.0% additive Eco One ASTM D- 5511-02 and ISO-15985: 2014.

#### Treatment

The Ekcos screen, with 1% Eco One additive, as well as samples without additive and cellulose as negative and positive controls respectively, were cut to reduce their size to form strips of approximately 2mm, then the strips were packaged in glass bottles of 0.125L capacity, in relation to 2% by weight of total solids with the inoculum of anaerobic degrading micro-organisms and until filling 90% of the space of the bottle. To prevent air from entering the flask and inhibiting the degradation process, the flask was sealed with an aluminum cap, attached to a rubber seal that allowed gaseous samples to be taken from the inside of the flask. The vials with the samples and inoculum were purged with helium gas to evacuate all the air inside. Finally the flasks were incubated at 50 ° C in the dark and with manual shaking. Samples are periodically taken to inject into the gas chromatograph and determine the composition of the biogas methane (CH4) and carbon dioxide (CO2). The volume is measured by displacement of the plunger of a syringe, a method that allows the volume of biogas generated to be measured, reducing the possibilities of introducing air into the flasks.

The Cellulose Positive Control is used to verify that the inoculum is functional at the start of the test. The negative control is used to compare the results of a sample without the additive.





## INSTITUTO POLITECNICO NACIONAL

INTERDISCIPLINARY CENTER FOR RESEARCH AND STUDIES ON THE ENVIRONMENT AND DEVELOPMENT LABORATORY FOR ANALYSIS AND ENVIRONMENTAL MONITORING



### Results

Figure 1 shows the percentage of biodegradation of the Ekcos samples with 1% Eco One additive, the sample without Eco One additive and a positive cellulose control.



#### Figure 1. Biodegradation of the cellulose samples, Ekcos Screen with Eco One additive and without a dditive.

The cellulose positive control at the moment has completely biodegraded, the sample of the Ekcos Screen with the Eco One additive has been biodegraded 93.31% with respect to the initial mass unlike the sample without additive (Table 1)





## INSTITUTO POLITECNICO NACIONAL

INTERDISCIPLINARY CENTER FOR RESEARCH AND STUDIES ON THE ENVIRONMENT AND DEVELOPMENT LABORATORY FOR ANALYSIS AND ENVIRONMENTAL MONITORING



#### Table 1. Results of the biodegradation of plastic materials

	Sample with Eco One	Sample without Eco One	Standard
Initial mass (g)	2.0348	2.0143	APHA 2640 E
Time (days)	1288	1288	
Vol. Biogas produced (mL)	1771	4	ASTM D-5511-02
Methane concentration (%)	55.87	1.7	ASTM E-280-96
Carbon dioxide concentration (%)	44.13	98.3	ASTM E-280-96
Biodegradable mass (g)	1.8662	0	ASTM D-5511-02
Biodegradation (%)	93.31	0.00*	ASTM D-5511-02

\* At the moment, the biogas generated by the sample without the Eco One additive corresponds only to the residual nutrients of the inoculum and not to the sample without the additive.

#### Conclusion

The Ekcos Screen samples with 1% Eco One additive show a clear trend of biodegradation, since the biogas quantified enough to show a difference with respect to the sample of the same material without the additive.

Based on the previous results, the sample with the Eco One additive at 1288 days biodegraded 93.31%. Based on the previous data, there are sufficient elements that prove the effectiveness of the Eco One additive in accelerating the biodegradation of plastic materials based on the ASTM D-5511-02 and ISO-15985: 2014 standards.

Ing. Amb. Rodrigo Abraham Castro Corona

Calle 30 de Junio de 1520 s / n, Barrio la Laguna Ticomán CP 07340 Del. Gustavo A. Madero México, DF 5729 6000 Ext. 52703





eco one

# CERTIFICATION OF ENHANCED BIODEGRADATION IN ANAEROBIC CONDITIONS USING ECO-ONE® 2020

EcoLogic hereby *certifies and guarantees*, specifically for Polyolefin (all types of Polyethylene including LDPE, LLDPE, HDPE), EVA, and PP, Polystyrene (PS), Polyvinyl Chloride (PVC), Polyurethane (PU), Polyamide (PA) and Polyethylene Terephthalate (PET, PETG) based products, that enhanced biodegradation will be achieved in biologically active landfills provided Eco-One® is handled, stored and incorporated into the plastic per guidelines provided in our Technical Data Sheet (TDS) and Safety Data Sheet (SDS).

Using extensive independent third-party laboratory testing of plastic products containing Eco-One®, EcoLogic has confirmed that Eco-One® has unquestionably caused enhanced biodegradation of those products. ASTM D5511 (US) and ISO DIS15985 (International) are the primary test methods employed by the independent third-party laboratories to confirm this enhanced biodegradation. Eco-One® products allow the molecular structure of organic plastic material to be broken down. The decomposition occurs via enzymes secreted by microorganisms, in other words, decay through the actions of living organisms.

Eco-One® also demonstrated effectiveness according to:

ASTM D5338 ASTM D5988 ASTM D6691 ASTM D7475 ASTM E1963 EPA 8015

Products in various formats (flexible, rigid, semi-rigid, non-woven etc.) made using one or more of the typical production processes such as extrusion, foaming, injection molding, blow molding, biaxial orientation etc. have exhibited significantly enhanced biodegradation when containing Eco-One®.

- □ Eco-One® is Food Contact Compliant US FDA
- Eco-One® is Free of BPA, Formaldehyde, Asbestos, Phthalates, Phenol, Latex / Natural Rubber, ozone depleting chemicals, food allergens, animal products, and toxic materials such as lead, cadmium, hexavalent chromium and mercury and metals such as cobalt, nickel, manganese, iron, etc.,
  - > Eco-One® is Compliant to CA Prop 65 (California Safe Drinking Water Act), and Dodd Frank Act
  - > Eco-One® is Compliant with RoHS, SVHC, TSCA, and US CONEG (Coalition of North Eastern Governors)
- □ Final products containing Eco-One® have passed ASTM E1963 (Terrestrial Plant Toxicity Test)

If polymer products are correctly made with Eco-One<sup>®</sup>, the additive will have no effect upon the strength and other performance characteristics of the product during its useful service life.

It is the responsibility of the manufacturers of products to ensure that all regulatory requirements, and physical, chemical and barrier properties, of the finished product comply with all applicable regulations and final end use product requirements.

EcoLogic, LLC | 601 Oregon Street | Suite A | Oshkosh, WI 54902 Website: EcoLogic-LLC.com | Phone: 920.279.4782 | Email: dbuelow@ecologic-llc.com





## **TECHNICAL DATA SHEET**

Eco-One® EG35

## **Product Overview**

Eco-One® EG35

Issue Date: January 1, 2021

**Eco-One® EG35** is a masterbatch consisting of a proprietary blend of organic compounds and a carrier resin that is designed to enhance biodegradation ethylene vinyl acetate based plastics in microbe-rich landfills when used as per the recommended guidelines.

## Applications

Eco-One® EG35 can be added to all rigid, semi-rigid and flexible applications. Can also be used in PE foam, ABS and PVC.

## Properties

**Properties:** 

Appearance: Free flowing pellets Color: White to off-white Carrier: EVA Recommended use level: 0.7% - 5%, Target 1.0%

Composition (Component / CAS Number / OSHA PEL / ACGIH PEL / Wt %): Polyolefin / mixture / none established / none established / 100







## TECHNICAL DATA SHEET

### Eco-One® EG35

## **Recommended Procedure Eco-One® Addition**

#### Packaging and Loading Into Extruder:

- Eco-One® is designed to be added as a minor component in a multicomponent resin blending system. Simply add Eco-One® as one would add a colorant.
- To achieve 1% load weight ratio: 1 kg (1 lb) of Eco-One® is added to 99 kg (lb) of base resin to make 100 kg (100 lb) batch
- Reseal package containing remaining Eco-One® product and store per instructions under Storage & Handling.

#### **Extrusion Conditions:**

- · There is no need to adjust the extrusion temperature profile while running with Eco-One®.
- Melt temperatures should not exceed 329 Celsius (625 °F) for an extended period of time.
- Eco-One® is slightly hygroscopic (attracts water) this should not cause any problems.

## **Food Contact Approval**

**Eco-One® EG35** is 100% organic and is comprised of non-toxic raw materials which are independently approved for direct contact with food.







# TECHNICAL DATA SHEET

## Eco-One® EG35

### Storage & Handling

Eco-One® EG35 is typically packaged in 25 kg / 55 lb bags and in a 500-700 kg corrugated Gaylord.

**Eco-One® EG35** should be stored in accordance with good manufacturing practices. Product should be stored in a cool, dry area in a closed container. Do not let the product get wet. Reseal the product container at the end of each use in accordance with standard storage practices.

EcoLogic recommends that inventories are rotated and used within six (6) months of purchase for optimum performance.

No smoking, open flames or sources of ignition in handling and storage area. Good housekeeping and controlling of dusts are necessary for safe handling of product. When appropriate, unique handling information for containers can be found on the product label.

### **Company Identification**

EcoLogic, LLC

#### WISCONSIN

Corporate Headquarters 601 Oregon Street Suite A Oshkosh, WI 54302 Main Office: 920-279-4782 EcoLogic, LLC urges each customer or users to undertake sufficient verification and testing to determine the suitability for their own purpose of any information or products referred to herein. While the information herein is believed to be reliable and correct, nothing herein is intended and should not be construed as a representation or warranty, expressed or implied, as to results obtained by others who may make use of this information or with respect to the absence, existence or validity of patent rights, if any of others involving any composition or process herein referred to; or an inducement or recommendation for the violation of any such patent rights; and responsibility and liability therefore is disclaimed.

Confidential Property of EcoLogic, LLC





eco one

To: Valued Customer Subject: EcoLogic Eco-One® EG35 - FDA Regulatory Status Date: January 1, 2021

Dear Sir or Madam,

When used unmodified and processed in accordance with good manufacturing practices for food contact applications, Eco-One® EL30 will comply with the Federal Food, Drug, and Cosmetic Act (FDA) requirements of Title 21 of United States Code of Regulations for olefin polymers (21 CFR 177.1520). This product may be used to produce articles or components of articles used in contact with food except articles used for packing or holding food during cooking. Accordingly, it may be used under conditions of use E through G as described in Table 2 of 21 CFR 176.170(c).

It is the responsibility of the user to assess their product uses and applications and assure conformance to all applicable laws and regulations.

Should you have further questions regarding this matter, or if we can be of any assistance to you, please do not hesitate to contact your EcoLogic representative.

Respectfully Yours,

Duane Buelow President EcoLogic, LLC

EcoLogic, LLC | 601 Oregon Street | Suite A | Oshkosh, WI 54902 Website: EcoLogic-LLC.com | Phone: 920.680.9879 | Email: kwood@ecologic-llc.com





January 1, 2021

Subject: Product Declaration – Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)

Dear Valued Customer:

Thank you for your continued interest in EcoLogic and our biodegradable additive technology, Eco-One®. Please be advised that EcoLogic's Eco-One® brand of products do not require a "clear and reasonable warning" to consumers of food and beverages under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).

As a result, the Eco-One® products present no significant risk to cause cancer, birth defects, or other reproductive harm to the people of California. The Eco-One® products contain no substances known to the State of California to cause reproductive toxicity as established by the requirements of Proposition 65.

Cordially,

Duane Buelow President EcoLogic, LLC





January 1, 2021

Subject: Product Declaration - Eco-One® Safe Water System

Dear Valued Customer:

Thank you for your continued interest in EcoLogic and our biodegradable additive technology, Eco-One®. Please be advised that EcoLogic's Eco-One® brand of products do not contain any substances that would harm or leach into the water system.

Cordially,

Duane Buelow President EcoLogic, LLC



# ECO LOGIC

## eco one°

### Rate Of Biodegradation Of Plastics In Landfills Vs. Compost Facilities

Must plastic biodegrade in a landfill in the same "short period of time" as a compost facility?

There is a puzzling position in a portion of the environmental community which believes in order to claim a plastic material biodegradable in a landfill, at least 90% of the carbon substrate must be completely assimilated by the microorganisms present in the disposal channel within a "reasonably short period of time"? Our simple question is, why?

One reason presented is the safety concern with partially degraded plastic in landfills. The argument is if it takes plastic a long time to biodegrade (over a year per proponents of biodegradation in composting sites) it poses an environmental hazard. The belief is that certain components of biodegrading plastic could leach into the soil and get into ground water. However, this is an inaccurate assumption. All landfills built since 1993 conform to the October 1991 Criteria for Municipal Solid Water Landfills (40 CFR Part 258) under the Resource Conservation and Recovery Act (RCRA). These criteria include subsurface migration controls and require liners to be in place that do not allow material to leach into the soil.

So where did the notion of time come from? The answer is from industrial composting sites. These sites have a need for a defined time for biodegradation since they have to make room for the next batch of incoming organic waste. However, for a disposal channel such as a landfill where anaerobic (without oxygen) biodegradation takes place, it really does not make sense to define and impose a similar compressed time frame for plastics to biodegrade. Reason would seem to indicate, since plastics stay in landfills for a very long time – hundreds of years, it would be a true environmental win if an additive embedded in plastic would enhance biodegradability such that it would allow for significant biodegradation within several years and the resulting methane gas could be used as a source of energy.





Specifications and test methods are defined and designed to measure the rate of biodegradation for compostable plastics (60% loss of carbon for homopolymers and 90% for copolymers in 180 days). Composing sites follow a regimented procedure (controlling temperature and moisture) making it relatively easy to follow standards. Every landfill on the other hand is different. Even the new bioreactor landfills are different from each other. How can one say that plastic in these varying microbial and humidity conditions must biodegrade within a prescribed (and short) period of time?

This is precisely why a specification similar to ASTM D6400 for biodegradation in landfills does not exist, although attempts are currently underway to create one.

In the past few months a study led by a doctoral student James Levis under the guidance of Prof. Morton Barlaz at North Carolina State University, Raleigh, North Carolina has got a lot of press. It relates to the impact of the rate of biodegradation in landfills. Many have incorrectly inferred from this study that biodegradation in landfills is bad for the environment. Not only has that not been said in the report, the author points out that "In landfills with methane capture projects plastics are a tremendous untapped resource". If biodegradable plastics were designed to decay more slowly in landfills, Prof. Barlaz says, landfill operators would be able to capture more of the methane for fuel. This further embellishes the theme of this paper that it is not necessary and in fact not a good idea for plastics to biodegrade at an accelerated pace.

In conclusion, we believe any plastic product that could potentially end up in a landfill environment could include the additive Eco-One<sup>™</sup>. This would enhance the biodegradation of plastic products in a biologically active landfill and allow for methane capture for energy. This would also increase the life of the landfill because of the reduction of millions of tons of plastic that would otherwise sit there for hundreds of years.

ecologic-llc.com | 601 Oregon Street, Suite A. Oshkosh, WI 54901 | kwood@ecologic-llc.com





## Plastic Biodegradation in Landfills Helps Business Owners Tackle Non-Recycling Product Issues and Helps to Create Methane for Energy

There is a school of thought in the environmental community that biodegradable plastics in landfills is an inadequate solution to the millions of tons of plastic which sit in these mountains of waste for an indefinite time period. Some believe recycling or failing that, using professional or even home composting facilities is the only true solution and the only truly sound environmental avenue. Unfortunately, the reality is plastic is going into landfills in enormous amounts. Having a solution that will reduce the accumulated amount of plastic through enhancing its biodegradation, deals with the landscape as it is today and not how we hope it to be in 10-15 years. It is like saying the best way to deal with forest fires is to never light a match. How realistic is that?

#### The Facts:

- □ Landfills are the preferred means of Municipal Solid Waste (MSW) disposal in the US with an overall increase in MSW consistent with increases in the population.
  - Between 2000 and 2009, MSW generated increased 5%; however the portion of MSW landfilled dropped 5% highlighting an increase in recovery
  - Yet, only 34% of MSW was recovered in 2009 (recycling + composting), with the balance being sent to landfills
    - Modest increase in recovery over 2000 when it was 29%
    - Recycling rate is 25% and composting 9%
- Most agree recycling is a preferred method of dealing with plastics. However, the vast majority of plastics end up in landfills.
  - Plastics in MSW has increased from 1% in 1960 to 12% (30 million tons) in 2009
  - Of the 30 million tons only 9% of 2.6 million tons are recovered and not sent to landfills





- □ 17% of landfill weight is plastics (EPA 2009)
  - > 42% from containers and packaging (13.7% recovery rate)
    - 10.8 million tons end up in landfills
  - > 22% from nondurable goods (negligible recovery rate)
    - 6.6 million tons end up in landfills
  - > 36% from durable goods (3.8% recovery)
- □ While 62% of paperboard is recovered, only 9% of plastics are
- □ Plastic bottles constitute ~ 50% of recyclable waste in dumps
  - PET soft drink bottles only 37% recycled
  - > HDPE milk containers and large water bottles only 28% recycled
  - > 38 bn PET water bottles only 23% recycled

#### US Municipal Solid Waste Disposal Over Five Decades

Activity	1960	1970	1980	1990	2000	2009
MSW Generated (million tons)	88.1	121.1	151.6	205.2	239.1	243
Recovery for Recycling	5.6	8	14.5	29	52.9	61.3
% for Recycling	6.3 %	6.6%	9.6 %	14.1 %	22.1 %	25.2 %
Recovery for Composting				4.2	16.5	20.8
% for composting				2.0 %	6.9 %	8.6%
Combustion with energy recovery		0.4	2.7	29.7	33.7	29
% Combustion			1.8 %	14.5 %	14.1 %	11.9 %
Landfilled	82.5	112.7	134.4	142.3	136	131.9
% Landfilled	93.5 %	93.1 %	88.6 %	69.3 %	56.9 %	54.4 %





2009 EPA Publication (Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2009)



## % of Landfill Weight

- MSW contains at least 20% moisture<sup>1</sup>
  - This is just about sufficient to react the contained biomass
- Some modern landfills use leachate (rainwater stored in waste) recirculation and methods to incorporate liquid management and pumping systems to maintain higher moisture content
  - These landfills use other liquids in addition to leachate to achieve > 40% moisture in which anaerobic bacteria thrive
  - About 10% of US MSW waste ends up in these landfills





#### Is composting better than landfilling?

Contrary to popular belief compost sites also generate methane. Only in very few cases where the compost sites have adequate controls in place to collect and filter the volatile organic compounds (VOCs) and methane that is generated, would composting be an equivalent or perhaps a better option to landfilling. If the landfill converts the methane to energy then landfilling will be a better option. Less than 10% of compost sites have adequate controls in place because these controls are too expensive to implement.<sup>2</sup>

- Anaerobic mechanical and biological treatment (MBT) is a better greenhouse gas option than aerobic MBT<sup>3</sup>
  - It is better to focus on maximizing energy recovery from biological material than to generate stabilized organic products
- Emissions during transportation of waste should be considered
  - With fewer composting sites compared to landfills, transportation distances are longer<sup>4</sup>
- According to the National Resource Defense Council (NRDC) and earth911.org, only 8% of Americans compost their waste, including residents in cities like San Francisco and Seattle where composting is part of the general waste pickup
  - Products that incorporate compostable packaging have grown very slowly and have had mixed reviews
  - Confusion about what to do with these products at time of disposal has also been a factor in the slow adoption
  - Composting sites that accept plastic are a fraction of that of landfills and are not expected to grow fast enough

#### CEOs are learning quickly that proper sustainability practices are good business:

- 93% of CEOs say sustainability is critical to success
- Companies with a vision and sustainable solutions achieve above average financial performance







- Unlike other sectors of the packaging industry, sustainable packaging has showed good over the past two years bucking the economic downturn
- Greater awareness about environmental concerns, government initiatives, growing economies, and burgeoning population are identified as the drivers behind this growth
- Companies are trending toward using sustainable packaging as a marketing tool

Prominent companies are using landfill gas for energy:







#### Current industries using LFG include:

Auto Manufacturing	Pharmaceutical	Consumer Electronics
<b>Chemical Production</b>	Cement & Brick	Paper production
Food Processing	Wastewater Treatment	Prisons & Hospitals

#### How can a plastic be rendered biodegradable in a landfill?

There are a number of plastic products in the marketplace that have test data to reflect the ASTM D5511 test validation of enhanced biodegradation in a biologically active landfill. These products range from plastic water bottles to garbage bags to amenities. If the additive used in these products is Eco-One<sup>™</sup>, then it would have been mixed in at approximately 1% during the normal manufacturing process without effecting the strength or clarity of the products. If the product was recyclable to begin with, it remains so.

#### Summary:

The United States is a leader in both the manufacturing and the consumption of plastics. Unfortunately much of this plastic is not recycled and ends up in landfills and remains there for indefinite periods of time. There is a solution. Eco-One<sup>™</sup> brand of additives enhance the biodegradation of plastic products in a biologically active landfill (appropriate facilities not available in all areas) and allows for methane capture for energy. This would also increase the life of the landfill because of the reduction of millions of tons of plastic that would otherwise sit there for hundreds of years.





#### **REFERENCES:**

Andersen, J., A. Boldrin, J. Samuelsson, T. H. Christensen, and C. Scheutz, 2010. Quantification of Greenhouse Gas Emissions from Windrow Composting of Garden Waste. J. Environ. Qual., 39:713-724 (2010).

Arsova, L., R. van Haaen, N. Goldstein, S.M. Kaufman, and N. Themelis, 2008. The State of Garbage in America, 16th Nationwide Survey of MSW Management in the U.S., BioCycle, December 2008.

Jackel, U., K., Thummes, P., and Kampfer, 2005. Thermophilic Methane Production and Oxidation in Compost. FEMS Microbiology Ecology 52, 175-184.

SCAQMD, 2001. Ammonia and Volatile Organic Compound (VOC) Emissions from a Greenwaste Composting Operation. Source Test Report 01-171, Conducted at Inland Empire Composting, 1951 W. Key St., Colton, CA 92324. Sept. 27 & Oct. 4, 2001.

Sullivan, P., The Importance of Landfill Gas Capture and Utilization in the U.S., Biocycle Magazine, Earth Engineering Center, Columbia University, April 6, 2010.

Themelis, N., Ulloa, P., 2006, Methane Generation In Landfills, Earth Engineering Center & Deptarment of Earth & Environmental Engineering, Columbia University, August 2, 2006.

ECOLOGIC-LLC.COM | 601 OREGON STREET, SUITE A, OSHKOSH. WI 54901 | KWOOD@ECOLOGIC-LLC.COM





## FREQUENTLY ASKED QUESTIONS

#### What does EcoLogic® do?

EcoLogic® owns, manufactures and markets Eco-One® brand of additives for plastic products worldwide. Eco-One is an organic additive which renders traditional plastic biodegradable in landfill environments.

#### Are these products the same as starch- or sugar-based plastics (PLA, PHA, PHB, etc.)?

No. Eco-One-based plastics are not similar to corn or sugar based plastics in their properties, how they function, or how they biodegrade.

#### Is the plastic with Eco-One the same as oxo-degradable plastic?

No. Oxo-degradable plastics require oxygen and UV light or heat to initiate degradation and thus will not biodegrade in landfills. Products using Eco-One do not require either UV light or oxygen to biodegrade and will biodegrade at any depth in landfills.

#### Does Eco-One affect the recycle-ability of currently recyclable products?

No. There is no change in intrinsic viscosity of the plastic after adding Eco-One, therefore, products with Eco-One will not affect the recycling stream.

#### Is your organic additive FDA compliant?

Yes. Our additive is FDA-compliant for contact with food in polystyrene (PS), polyolefin (all polyethylenes and polypropylenes) and polyethylene terephthalate (PET) applications.

#### Do Eco-One and/or products made with Eco-One have a limited shelf life?

No. Unlike both PLA and Oxo products, Eco-One has a very long shelf life and products made with Eco-One have the same shelf life as they would have had without Eco-One.

#### Does Eco-One have any special storage requirements?

No. Unlike PLA or Oxo, Eco-One does not have special storage requirements





Do you have any test data validating biodegradation from independent laboratories? Yes. We can furnish all testing results. Please contact us.

#### How do products containing Eco-One biodegrade?

For details, please go to www.ecologic-llc.com and check-out our "How It Works" section.

#### How long does it take these products to biodegrade in landfills?

This will depend on the amount of Eco-One in the product, the conditions of the landfill and the thickness and composition of the product. The average landfill is a very good environment for biodegradation because it is warm, moist, and full of soil micro-organisms and food waste that cause the micro-organisms to eat the plastic. ASTM D5511 tests (representing biologically active landfills) carried out for durations ranging from 1 to 12 months, on a broad category of product containing Eco-One have show excellent biodegradation rates. It is important to note that biodegradation will begin and will continue leading to significant bioassimilition, shortening the time span the plastic would have occupied the landfill space from hundreds of years to several years.

#### Are any of the ingredients in the additive harmful to people or to the environment?

No. Our additive is 100% organic and is in compliance with FDA standards for contact with food.

#### Will active microbes in food (meat, cheese, etc.) or lawn care products start the biodegradation process in normal storage conditions such as a warehouse or store shelf?

No. Eco-One attracts oleophilic bacteria (oil-eating bacteria) that are present in landfills. The active microbes in food or dairy products or lawn care products are not oleophilic and not the "super" colony microbes you find in landfills, composting sites or waste water sludge plants.

#### What types of products or applications is Eco One suitable for?

Eco-One can be used for most types of flexible, non-rigid and rigid applications. Eco-One has been proven to be effective in products ranging from plastic bags to food packaging including containers to fiber used in textiles to shoe soles. Eco-One can be incorporated in most plastics that can be extruded, molded, thermoformed, spun, foamed, laminated etc.



# ECO LOGIC

# eco one°

## **PRODUCT OVERVIEW**



#### A World without plastic - hard to imagine.

Most companies that make or use plastic products share our environmental concerns about the production and disposal of plastic. Everyone is looking for a solution that maintains the benefits of traditional plastics and yet reduces their company's environmental footprint in a practical and cost-effective way. We have your solution.

eco one®

100% ORGANIC & NON-STARCH BASED

RECYCLABILITY UNAFFECTED

**Biodegradability Products** 



# ECO LOGIC

Eco-One® is a brand of organic additives which enhance the biodegradation of plastic products in a biologically active landfill (not available in all areas). ASTM D5511 tests (representing biologically active landfills) carried out for durations ranging from 1 to 12 months, on a broad category of product containing Eco-One have shown excellent biodegradation rates. It is important to note that biodegradation will begin and will continue leading to significant bio-assimilation, shortening the time span the plastic would have occupied the landfill space from hundreds of years to several years.

Finally, there is a cost-effective, easy-to-use solution for brand owners to provide consumers biodegradable plastic products.



RENEWABLE ENERGY SOURCE Methane Off-Gassing for Alternative Energy Use

eco one



COMPLIANT with Food Additive Provisions in the Federal Food, Drug, and Cosmetic Act

#### Change your footprint, not your process.

A proprietary blend of organic compounds, Eco-One is melt-compounded into a masterbatch carrier resin and then pelletized. It is easy to use and will run under existing processing conditions. The addition of Eco-One does not change the manufacturing process. Approximately 1% Eco-One is added into the plastic production process in the same manner as a color concentrate.

#### Your product, just better.





#### SAME PROPERTIES

Eco-One<sup>™</sup> becomes part of the polymer matrix. There is no effect to the chemical or physical properties of the plastic. Plastic products have the same tensile strength and identical performance, requiring limited shelf-life testing.

#### PERFORMANCE UNCHANGED

Products will perform just as well in their intended applications and usage conditions. Attributes last until the product is discarded into an active microbial environment.







#### BIODEGRADATION

Through a series of chemical and biological processes in a microbe-rich environment, Eco-One enhances the biodegradation of plastic into methane (can be converted into energy), carbon dioxide and inert humus (makes soil richer).

EcoLogic® owns, manufactures and markets Eco-One brand of additives for plastic products worldwide.

Our goal is to drive value for our customers by providing solutions to meet increasing government, industry and consumer demands for environmental sustainability and biodegradability.



# ECO LOGIC

# eco one°

## **TECHNICAL OVERVIEW**



#### The Mechanism of Biodegradation using Eco-One®

Plastics (or polymers) are made of long molecular chains of organic molecules called monomers. Polymers do not exist naturally and most are designed to be incredibly stable – as a result they do not easily biodegrade and will last in the environment for centuries and possibly forever. They are air-tight and water-tight.

Eco-One® is a brand of organic additives which enhance the biodegradation of plastic products, through a series of chemical and biological processes in a biologically active landfill. It allows the plastic to be consumed (as a food energy source) by the microbes.

#### 1. FORMATION OF BIOFILM

In a microbe-rich environment (like a landfill), Eco-One attracts microbes and these microbes start colonizing on the surface of the plastic. The enzymes secreted by the microbes render the plastic hydrophilic (water-loving). As a result, a film (bio-film) which is rich in microbes and moisture forms on and adheres to the surface of the plastic. Microbes then hydrolyze the plastic using secreted enzymes and water.





# ECOLOGIC

# eco one°

#### 2. EXPANSION OF THE POLYMER MATRIX

Aggressive accumulation of water expands the plastic matrix and gives the microbes access to the entire polymer matrix. The most likely points of attack on hydrocarbon polymers are at or near the chain ends.

#### **3. INITIAL BREAKDOWN OF POLYMER CHAINS**

The microbes break down the large "synthetic" polymer chains into simpler "organic" monomers, thus allowing for the consumption of the polymer matrix. In the process, they secrete certain signaling molecules that other microbes can detect. This signaling process, called quorum sensing, is an invitation to others to come join the feast.

Volatile organic fatty acids, hydrogen, and carbon dioxide are formed in the initial stages.

#### 4. BREAKDOWN CONTINUES

Different types of microbes join the feast. Each one uses different elements of the polymer and/or various by-products of the intermediate biological reactions as a food source, breaking down the complex polymer chains.

Certain enzymes (from microbes) begin reducing the complex polymer branching while others look for bulkier chains similar to fatty acids.

A syntrophic environment containing diverse species of microbes is established to continue the complex chemical steps of biodegradation. Throughout this process, microbes continue to multiply through quorum sensing.



mont	mmmm.	4	(mmm)
4.~~	moun	mm	mont
mm	inting	-	minin
1 mm	Ampin	him	yelo
	min	mint	imme
montin	A -	min	minute

nglinder marken unglisten nglin nglin gelinder turgen biston nummer nglister





#### 5. FINAL STAGES OF BREAKDOWN

During the biodegradation process the molecular weight of the plastic material is reduced and the molecular weight distribution is broadened. The molecular weight reduction has occurred on chains of all lengths in the original plastic material matrix.

As individual polymer chains biodegrade, biomass (humus), and biogases (methane and carbon dioxide) are left behind. The carbon dioxide produced in the intermediate steps is being consumed in each subsequent step; therefore, not much is left at the end. The methane can then be captured for energy use.





# eco one®

## Build a greener future.

For more information, contact: 920.279.4782 | kwood@ecologic-llc.com Visit us at www.ecologic-llc.com

Proud members of National Recycling Association, Flexible Packaging Association and Project Network Members of EPAs Global <u>Methane Initiative</u>.

Corporate Headquarters: 601 Oregon Street. Suite A, Oshkosh, WI 54901 www.ecologic-lic.com | 920,279,4782





**EKCOS INNOVATIONS CORP** 

12000 US Hwy 281 N Round Mountain TX 78663

Phone 925-371-1277 Email: info@ekcos.com

www.**ekcos**.com