ENA™ BIOTEC
Earth Nurture Additives

KhaiEL
Share Innovation

The Only 3rd Generation Micro-Biodegradable Additive

EN 13432 | ISO 14855 | ISO 15985 | ASTM D5511 | ASTM D5338

Made with FDA approved ingredients for foods contact
EU FCM plastic 2011/10 version is available

THE ONLY TECHNOLOGY IN THE WORLD

ENA™ makes conventional plastics biodegradable in landfills, anaerobic digesters, compost facilities, and the ocean.

KEEPS CONVENTIONAL PLASTIC

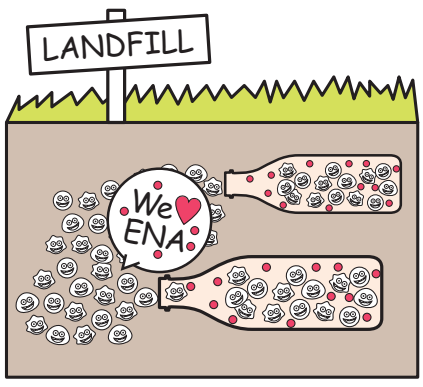
ENA™ stands for Earth Nurture Additive for rendering the conventional plastic, polypropylene and polyethylene biodegradable

ADD BIODEGRADABLE

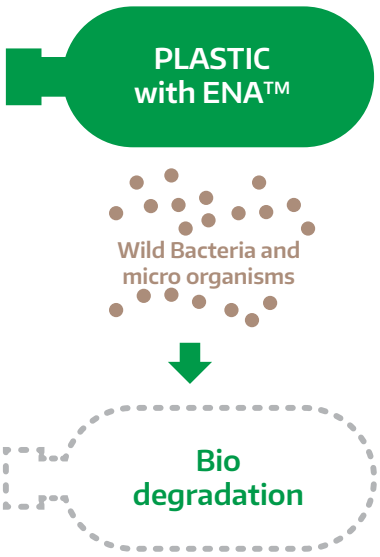
ENA™ harnesses the power of complex interactions in various microbial enzymatic systems to cause conventional plastics to biodegrade in moist, microbe laden environments including soil, landfills, and compost heaps.

ENA™ BIODEGRADATION PROCESS

1. ENA additive attracts vast numbers of microbes.
2. The microbes excrete enzymes and acids.
3. These enzymes & acids decompose the polymer.
4. Depending plastic thickness and local conditions the plastic will biodegrade 1 to 60 months.
5. Remnants are humus, biogas & water.



MECHANISM OF ENA™



ENA additive is designed to correct that situation so that all conventional plastics will appear to a wide range of wild micro-organisms to be an appetizing and attractive nutritional source.
They then migrate in massive numbers to the plastic and do what they do naturally and excrete digestive enzymes and acids that then break down the plastic into humus, biogas and water that can be easily absorbed by the surrounding environment.

WHAT IS BIODEGRADATION?

The internationally recognized definition :

THE CHEMICAL DISSOLUTION OF MATERIALS BY NATURALLY OCCURRING WILD BACTERIA AND MICRO-ORGANISMS OR OTHER BIOLOGICAL MEANS

This process should take place in a natural environment in keeping with the laws of nature.

THE HISTORY OF BIODEGRADABLE PLASTIC

1ST GENERATION

ADD STARCH FILLER

There have been efforts to make plastic biodegradable since the 1970s. The first wave consisted of putting some starch filler in plastic. The result was that the starch biodegraded somewhat, but the plastic was unaffected. Today polylactic acid has been developed as new, but it doesn't degrade unless it is subjected to prolonged higher heat than occurs in nature.

2ND GENERATION

OXO-DEGRADABLE

The second effort was to put chemicals in plastic, oxo degradable chemicals that responded to heat or ultra-violet light by causing the plastic to oxidize somewhat, in the presence of oxygen. This sometimes resulted in fragmented plastic, but no proof of ultimate biodegradation was ever established.

2.5TH GENERATION

OXO-BIODEGRADABLE

The next effort was to reduce molecular weight of the materials after typical disposal condition by using oxo technology then it produce CO2 and biogas. But, it is still longer period of time to biodegrade, and there is still physical property issues as well.

3RD GENERATION

MICRO BIODEGRADABLE : ONLY ENA™

KEEP PLASTIC PROPERTIES | **FAST DEGRDATION** | **SAFE & WIDE APPLICATION**

Highly effective for most troublesome plastic products.

PROBLEM OF PLASTIC MADE FROM FOOD (PLA PLASTIC)

Plastic made from food, manufactured from starch often derived from genetically modified food only degrades in an industrial composting facility.

2.6 tons of corn needed to produce 1 ton of plastic. One billion people worldwide are continually hungry.

The corn used to make PLA plastic would alleviate this suffering. PLA products are unacceptable for recycling with conventional plastics.

COMPARE CHART

	BIODEGRADABLE PLASTIC TECHNOLOGIES			
	ENA™	Polylactic acid Compostable Bioplastic	Oxodegradable Additives	Starch mixed with Plastics
Additive added to conventional plastics	YES	No, the material itself is compostable	Yes	Yes
Method of degrading	Stimulates wild microbes to eat plastic in landfills, soil, or natural bodies of water	Intrinsically degradable, but only in commercial compost facilities, will not degrade in landfills	Chemically breaks down plastic when baked in oven or intense UV, followed by biodegradation - if baking is sufficient	The plastic does not degrade; only the starch degrades, leaving the plastic intact
Common names of brands	ENA™	PLA, corn plastic, Natureworks Igneo	Symphony, EPI, Wells Reverte, D2W, Noebeide	Generic
Liklihood of biodegrading in landfiils	100%	Will not biodegrade in landfills	Unlikely, due to absence of pretreatment	Starch portion only degrades in landfills - plastic will not

ENA™ ADVANTAGE

EASIER TREATMENT : LANDFILL

A warm, moist environment, rich in micro-organisms, such as in a landfill or an industrial composting facility can cause thin film products (12 microns) to biodegrade in as little as one month. The thicker the plastic the longer the biodegradation time. Plastics with ENA™ will biodegrade with or without oxygen, UV light, heat and mechanical stress. In an oxygenated environment they decompose into humus, carbon dioxide, and water. In an oxygen deprived atmosphere they decompose into humus, biogas and water. Plastics with ENA™ of less than 30 microns is also recommended for composting.

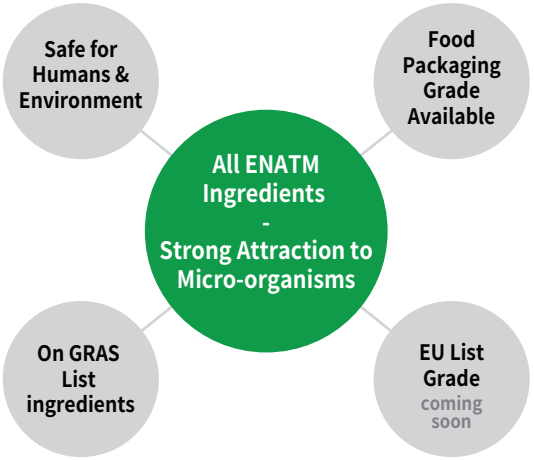
RECYCLABLE PLASTIC

Normal conventional plastics can also be RECYCLED normally. Whereas corn based PLA plastic are not recyclable and oxo-biodegradable plastics are not usually accepted by recycling companies.

SAFE AND WIDER USE ADDICTIVE

Our ENA™ additive ingredients and all other product ingredients are included in the FDA's GRAS list. These products have an unlimited shelf life and will behave in exactly the same manner as their conventional plastic counterparts except that they will biodegrade naturally, in a relatively short time, when discarded in a moist environment containing microbes.

APPROVED SAFETY WITH ENA™



ENA™ contains a wide range of nutritional ingredients whose sole purpose is to attract micro-organisms in vast numbers to the discarded plastic items. These bacteria then excrete digestive enzymes and acids that decompose the polymer.

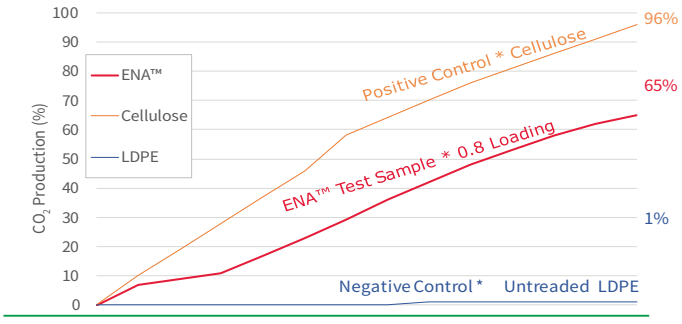
All ingredients are completely harmless to humans and the environment. ENA™ is safe for people, and for the environment. It is composed entirely of materials approved for foods contact in the United States.

Each and every item can be found on the GRAS list of ingredients that may be added to food packaging during plastic production. (EU list grade coming soon)

The consequence of this is that a certificate of conformity for food safety under US law and for food contact safety can be issued by the manufacturer of ENA™ to all plastics producers worldwide.

TEST RESULTS

ASTM D5338 & ISO 14855 (AEROBIC BIO DEGRADABILITY)



Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ENA™	0	7	9	11	17	23	29	36	42	48	53	58	62	62
Cellulose	0	10	19	28	37	46	58	64	70	76	81	86	91	96
LDPE	0	0	0	0	0	0	0	0	1	1	1	1	1	1

ASTM D5511-02

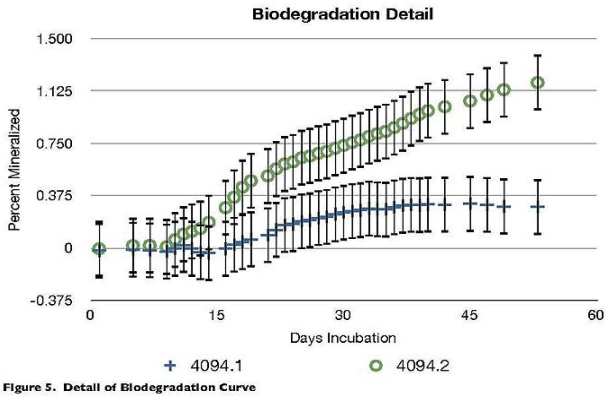


Figure 5. Detail of Biodegradation Curve

APPLICATIONS

ENA™ is highly effective for causing the biodegradation of the most troublesome plastic products :

POLYETHYLENE AND POLYPROPYLENE FILMS.

Polyethylene and propylene films are used for everything from packaging and shopping bags to farming films, such as mulch films. These films are the most expensive and difficult plastic products to recycle, due to low weight per cubic meter, sorting issues, and contamination by foods, soil, and other materials.

Packaging

Shopping bags

Farming Films (e.g. mulch films)

ONGOING R&D

ENA™ PETRO

FOR EARTH NURTURE ADDITIVE FOR BIODEGRADING PETROLEUM-CONTAMINATED SITES.

An important distinction between ENA-Petro and some other products is that it is completely non-toxic to the environment.

ENA™ XENOBIO

EARTH NURTURE ADDITIVE FOR PROMOTING THE BIODEGRADATION OF XENOBIOTIC CHEMICALS.

ENA-Xenobio is non-toxic, low cost, natural, and it does not displace contaminants to other locations.

ABOUT US

ENA™ BIOTEC
Earth Nurture Additives

Learn more about us at
www.enabiotec.com

MICRO BIO-DEGRADABLE TECHNOLOGY + BIOREMEDIATING TECHNOLOGY

Earth Nurture and KhaiEL have formed a new company to exploit Earth Nurture technology in the bioremediation of many industrial effluents and toxic spills, as well as making and distributing ENA™ masterbatch for making conventional plastics biodegradable. The new company, ENA Biotec, is incorporated in South Korea. Our projects include bioremediating secondary and tertiary amine containing wastewater from gas sweetening plants and fertilizer factories, dye wastwater bioremediation, and bioremediating many other toxins including petroleum products, BTEX compounds, polycyclic aromatic hydrocarbons, and wastes from the manufacture and distribution of herbicides and pesticides.

KOREA
17, Gosan-ro 148 Beon-gil, Gumpo-si, Gyeonggi-do, South Korea
info@khaiel.com

USA
17604-11. Ave. N.E. Arlington, WA, 98223, USA
tim@enabiotec.com