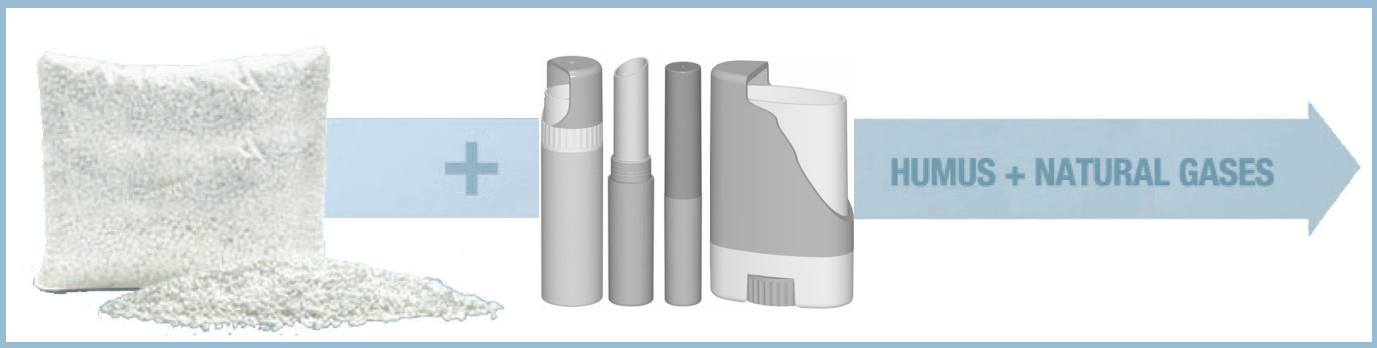
ECO SMART®

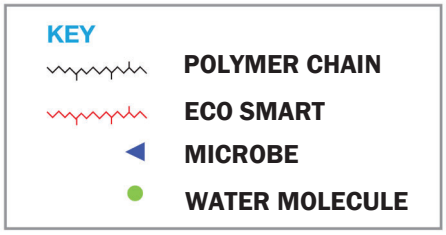
Earth friendly plastic that returns to nature®

TECHNICAL OVERVIEW

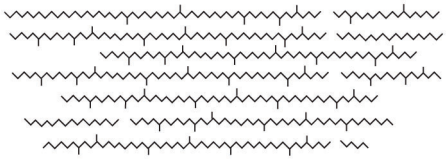


The Mechanism of Bio-degradation

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.

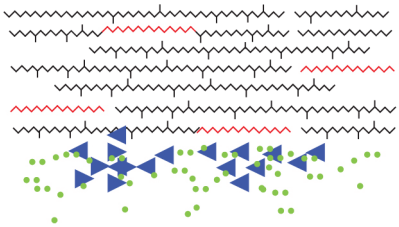


Eco Smart® containers have organic additives which enhance the bio-degradation of plastic products, through a series of chemical and biological processes in a biologically active landfill. It allows the plastic to be consumed (as a food energy source) by the microbes.



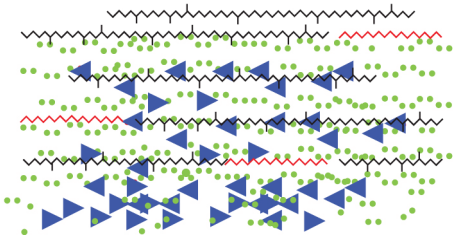
1. FORMATION OF BIOFILM

In a microbe-rich environment (like a landfill), Eco Smart 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.

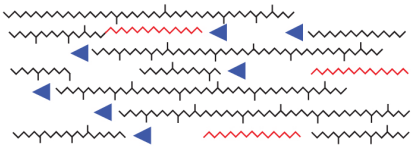


2. EXPANSION OF THE POLYMER MATRIX

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.



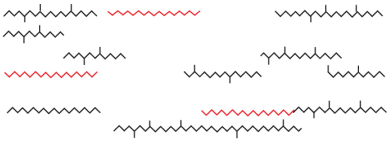
3. INITIAL BREAKDOWN OF POLYMER CHAINS



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



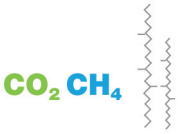
Different types of microbes join the feast. Each one uses different elements of the polymer and/or various by-products of the intermediate biological reactions as a food source, breaking down the complex polymer chains.

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.

5. FINAL STAGES OF BREAKDOWN

During the bio-degradation 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.