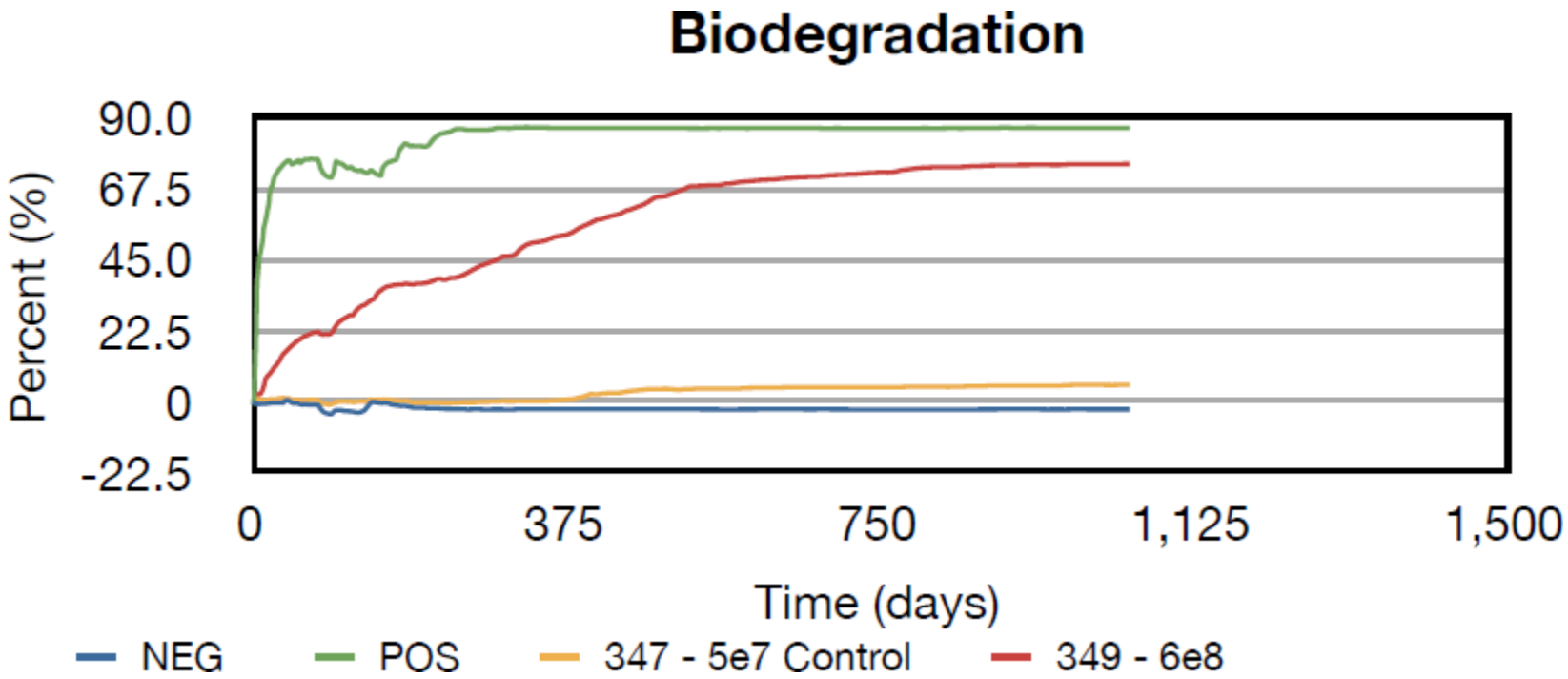
# Biodegradation Testing – ASTM D5511

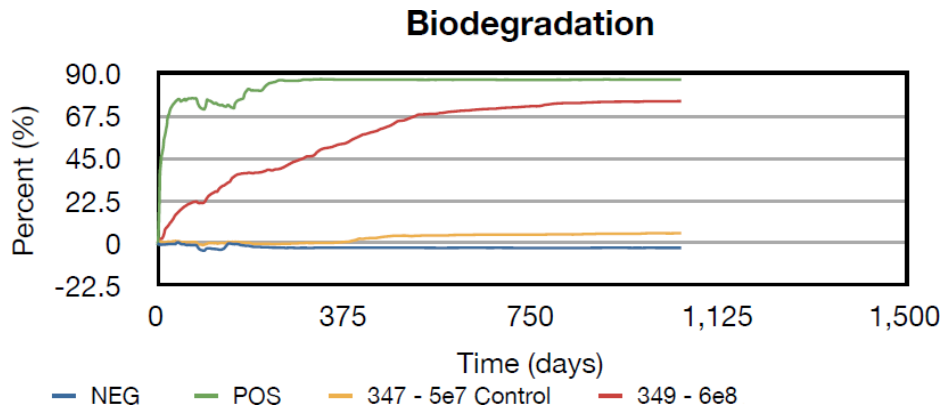



*ASTM D5511 conditions (landfill environment, anaerobic digestion)*

*During biodegradation, they turn into organic matter (biomass) and biogas which can become new resources for the environment, as well as being used for combined heat and power production.*

# ASTM D5511 Test Results Interpretation

- As part of the test, 4 test samples are used – a positive control (known to biodegrade completely – analytical grade cellulose), a negative control (known not to biodegrade – polyethylene), the actual test sample with the biodegradable additive, and the same sample without the biodegradable additive.
- The test measures total carbon in the gases (CO2 and CH4) evolved as a function of time, and assesses the degree of biodegradability based upon that for all 4 test samples.
- The test ceases when there are no more gases being released.
- The percentage of biodegradability is obtained by determining the percent of conversion of carbon from the test material to carbon in the gaseous phase (CO2 and CH4). This percentage of biodegradability does not include the amount of carbon from the test substance that is converted to biomass and that is not, in turn, metabolized to CO2 and CH4.
- Results cannot not be extrapolated past the actual duration of the test. So the remaining 13.4% for the outer material for example, is the carbon in the biomass (organic matter) left after the test ceases.
- Therefore, technically, you cannot have 100% biodegradation results. For that to happen, 100% of the test sample will need to be converted to 100% gases (CO2 and CH4) and 0 biomass left. This is also proven by the fact that the known completely biodegradable positive material – analytical grade cellulose, that is used alongside the test sample also doesn't achieve 100% biodegradation results, it still leaves some biomass behind.




**Biodegradability Facts**

This jacket will biodegrade when disposed of in the right environment*

| | % Biodegradation | # Days | # Years |
|---|---|---|---|
| Outer material* | 86.6% | 1050+ | 2.9+ |
| Lining material* | 86.6% | 1050+ | 2.9+ |
| Zipper* | 94.4% | 1677+ | 4.6+ |
| Synthetic fill* | 93.8% | 646+ | 1.8+ |
| Thread* | 94.4% | 1677+ | 4.6+ |
| Down fill** | 100% | - | - |
| Cotton labels** | 100% | - | - |
| Love | ∞ | ∞ | ∞ |

*Biodegradation tested under ASTM D5511 conditions being optimal conditions that may be found in some biologically active landfills.
**Natural matter that biodegrades over time.

# Bio 101

- ‘Biodegradable’ refers to a process where materials are broken down by microorganisms in specific environmental conditions. There are many different varied environments for biodegradation, such as in a landfill, home compost, industrial compost, marine environment.
- The biodegradability conditions (pH, temperature, oxygen, type of bacteria/fungi, organic content etc.) vary significantly between different types of biodegradable environments, which is why something that is designed to biodegrade in a landfill may not be able to biodegrade in an industrial compost or in a home compost or in the ocean and vice-versa.
- ‘Biodegradable material/product’ on its own is meaningless unless it is stated alongside under ‘what conditions’. E.g. biodegradable in a home compost, biodegradable in an industrial compost, biodegradable in a landfill.
- Bio-Down is biodegradable only in a landfill environment and not in any other environment.
- How the technology works/biodegradation happens in a landfill anaerobic (no oxygen) environment:
  - A special additive is introduced during the nylon/polyester (synthetics) manufacturing process which helps accelerate biodegradation in anaerobic landfill environments.
  - Once in a landfill environment, the additive gets activated and enables a biofilm which is formed by acids and enzymes secreted by microbes in an anaerobic environment to stick to the surface of synthetics.
  - The enzymes, cause the synthetics to become hydrophilic (or water-loving) and allows the microbes to break down the synthetics long polymer chains.
  - As the microbes break down the polymers into shorter chains (monomers), they secrete signalling molecules that attract other microbes, creating a feeding frenzy.
  - This results in the microbes consuming all of the synthetics and their excretion being the same waste as organic matter, which is $CO_2$, $CH_4$ and biomass, that is basically microbial poop.
  - All of this happens in 3-5 years as opposed to hundreds of years.