

KANEKA Biodegradable Polymer Green PlanetTM

Anaerobic Digestible Bio-Waste Bags

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Organic Recycling



Biodegradable bio-waste collection bags

(1) increase the collection of organic waste and its diversion from residual waste or

(2) reduce plastic contamination

→ European Waste Framework Directive mandates that Bio-waste to be separated and recycled at source or collected separately by the end of 2023

- Current estimated bio-waste collection (food & garden) is at an average within Europe of about 32%
(Ref. Bio-waste generation in the EU: Current Capture levels and future potential, Zero Waste Europe, 2020)

→ Organic waste management infrastructure differs across the EU

- Industrial composting
- Home-composting → encouraged within the European Waste Framework Directive
- Anaerobic digestion → encouraged within Farm-to-Fork strategy

Biodegradable Polymers in Various Environments

NOTES

-  proven biodegradability
-  proven biodegradability under certain conditions or for certain grades
-  biodegradability not proven

The biodegradability of plastics derived from these biodegradable polymers can only be guaranteed if all additives and (organic) fillers are biodegradable, too. Dyeing and finishing of cellulosic fibres, for example, may prevent their biodegradation in the environment.

Biodegradability depends on the complex biogeochemical conditions at each testing site (e.g. temperature, available nutrients and oxygen, microbial activity, etc.). Therefore, these generalised claims about biodegradation can only serve as approximations and need to be confirmed by standardised testing under lab conditions. In-situ behaviour can vary, depending on the mentioned conditions, size of the plastic, grade of the polymer and other factors. For instance, biodegradation testing is often performed after milling, showing the inherent nature of the material to biodegrade. In reality, the same level of biodegradation will be obtained, be it possibly within a different timeframe.

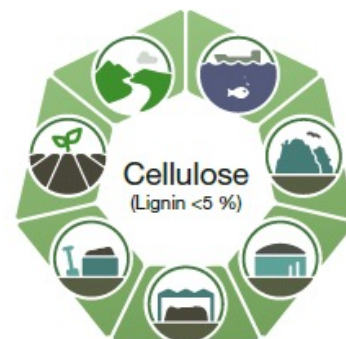
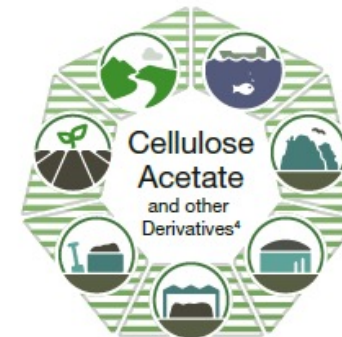
¹ PLA is only likely to be biodegradable in thermophilic anaerobic digestion at temperatures of 52°C.

² Biodegradability in home composting and in soil of PBAT is only proven for certain polymer grades.

³ Complete biodegradation of materials with a high lignin content is not easily measurable with standard biodegradation tests, but does take place (slowly). Instead of CO₂, especially humus is produced by the biodegradation of lignin-rich materials.

⁴ The biodegradation of CA in all environments is only proven for certain polymer grades.

⁵ Incl. P3HB, P4HB, P3HB4HB, P3HB3HV, P3HB3HV4HV, P3HB3HX, P3HB3HO, P3HB3HD



ENVIRONMENTS

Details on test conditions and, if available, applicable pass/fail criteria.



MARINE ENVIRONMENT

Temperature 30°C,
90% biodegradation within a maximum of 6 months
(Certification: TÜV AUSTRIA OK biodegradable MARINE (ISO under preparation))



FRESH WATER

Temperature 21°C,
90% biodegradation within a maximum of 56 days
(Certification: TÜV AUSTRIA OK biodegradable WATER)



SOIL

Temperature 25°C,
90% biodegradation within a maximum of 2 years
(Certification: TÜV AUSTRIA OK biodegradable SOIL; DIN Certco DIN-Geprüft biodegradable in soil)



HOME COMPOSTING

Temperature 28°C,
90% biodegradation within a maximum of 12 months (Certification: TÜV AUSTRIA OK compost HOME; DIN Certco DIN-Geprüft Home Compostable)



LANDFILL

No standard specifications or certification scheme available, since this is not a preferred end-of-life option



ANAEROBIC DIGESTION

Thermophilic 52°C / mesophilic 37°C;
standard specification not yet available, but 90% generally considered as completely biodegradable



INDUSTRIAL COMPOSTING

Temperature 58°C,
90% biodegradation within a maximum of 6 months
(Standard: EN 13432)

Kaneka Corporation



A technology-driven solutions provider in 4 strategic solution units “**materials**”, “**quality of life**”, “**health care**” and “**nutrition**”

- Headquarters Tokyo & Osaka, Japan
- Founded in 1949
- **Macromolecular and Fermentation technologies**
- 104 subsidiaries worldwide (**Kaneka Belgium NV**)
- Regional holding companies in 3 key locations:
Europe-Asia-Americas



Annual sales
€ 4,4 billion



Employees
11.200



Line of Business

- Vinyls and Chlor-Alkali
- Performance Polymers
- Foam & Residential Techs
- E&I Technology
- PV & Energy Management
- Performance Fibers
- Medical Devices
- Pharma & Supplemental Nutrition
- Foods & Agris

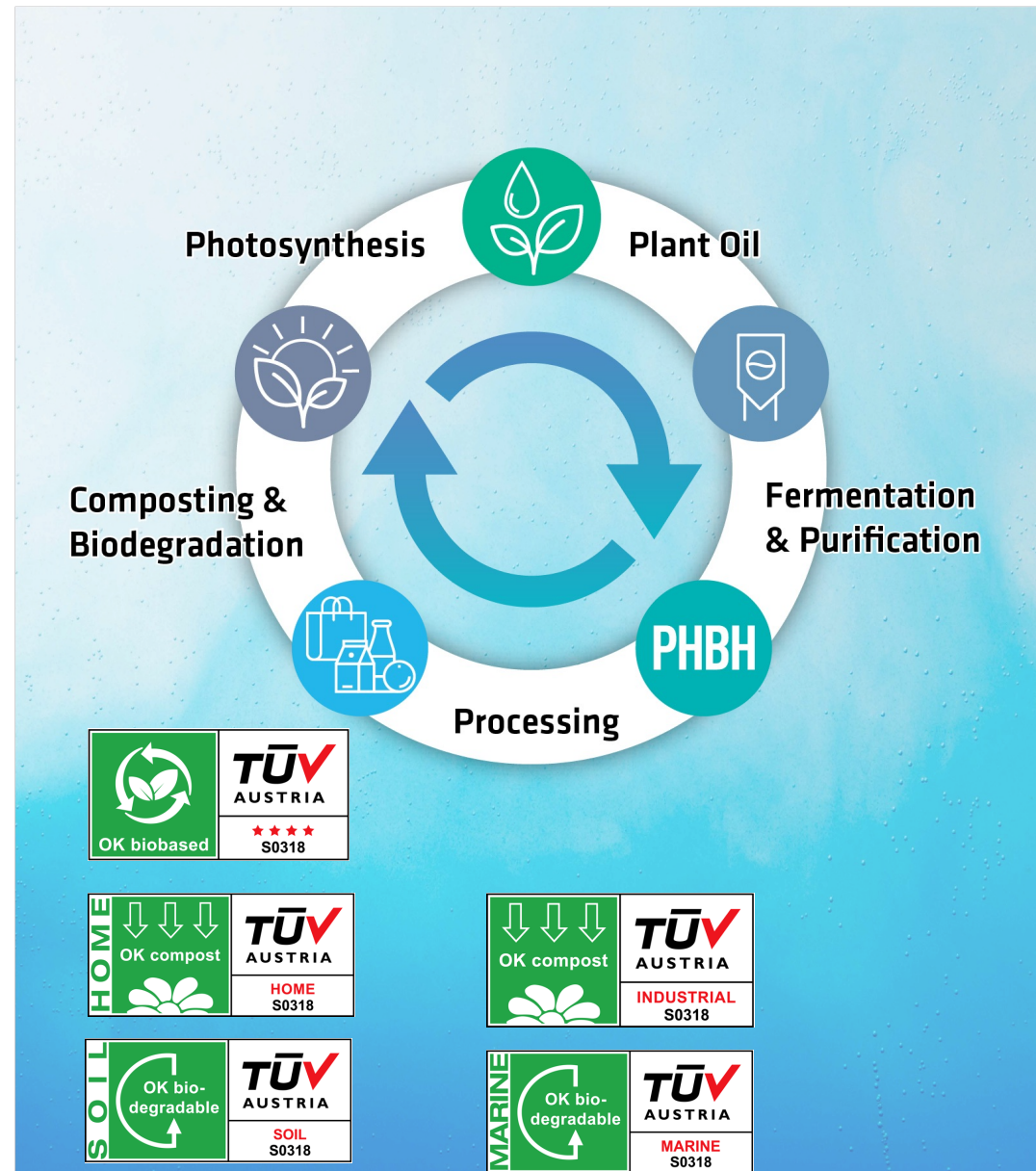
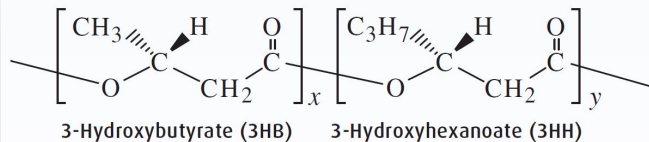
KANEKA Biodegradable Polymer Green Planet™



A **natural biopolymer** produced by fermentation.

Biodegradable in aerobic and anaerobic conditions

PHBH (polyhydroxyalkanoate)



Requirements for biogasification

Anaerobic digestible waste bags - Review on requirements for biogasification

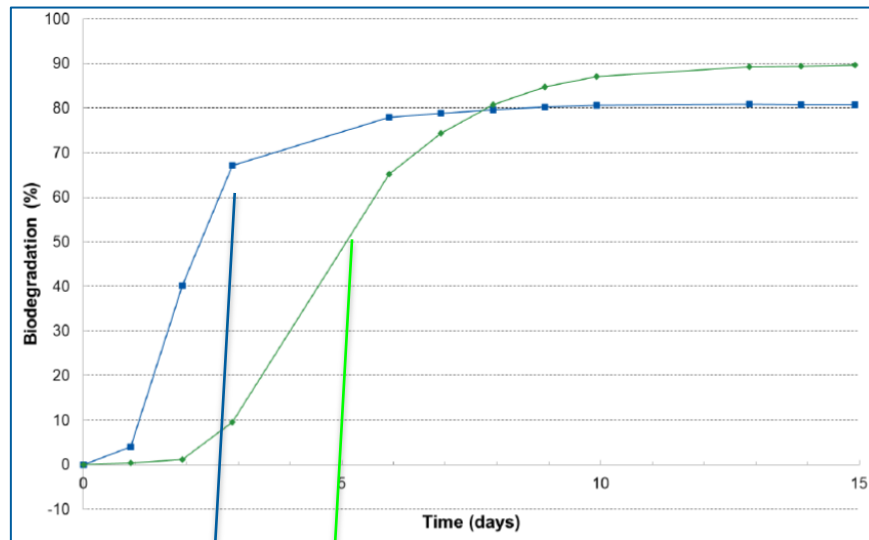
	EN 13432		Open-Bio proposal*	
	Industrial compost	Anaerobic Digestion	Anaerobic Digestible – Convertible	
	55 –60°C	?? (Mesophilic/thermophilic)	mesophilic	Thermophilic
Disintegration (pilot scale testing)	12 weeks/	5 weeks as combination of anaerobic digestion and aerobic stabilization	4 weeks	3 weeks
	10% remain on 2 mm sieve			
Biodegradation (laboratory)	6 months Min 90% CO ₂ relative	2 months 50% biogas absolute	30 days 90%	20 days 90%
Requirements on eco-toxicity and material characterization				

REVIEW ON STANDARDS FOR BIOGASIFICATION

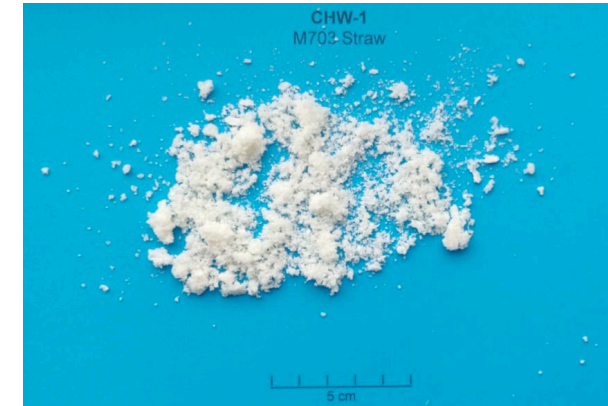
OPEN BIO, DELIVERABLE 6.6, 2014

Anaerobic Biodegradation Green Planet

→ Biodegradation



Net biogas production (NL/kg)		methane	CO2
Cellulose	651 - 658	51,9 - 52,8%	47,2 - 48,1 %
Green Planet™ M704	937	59,4 %	40,6%
Green Planet™ X151C	917	58,0 %	42,0 %
Green Planet™ X131A	890	57,3 %	42,7 %



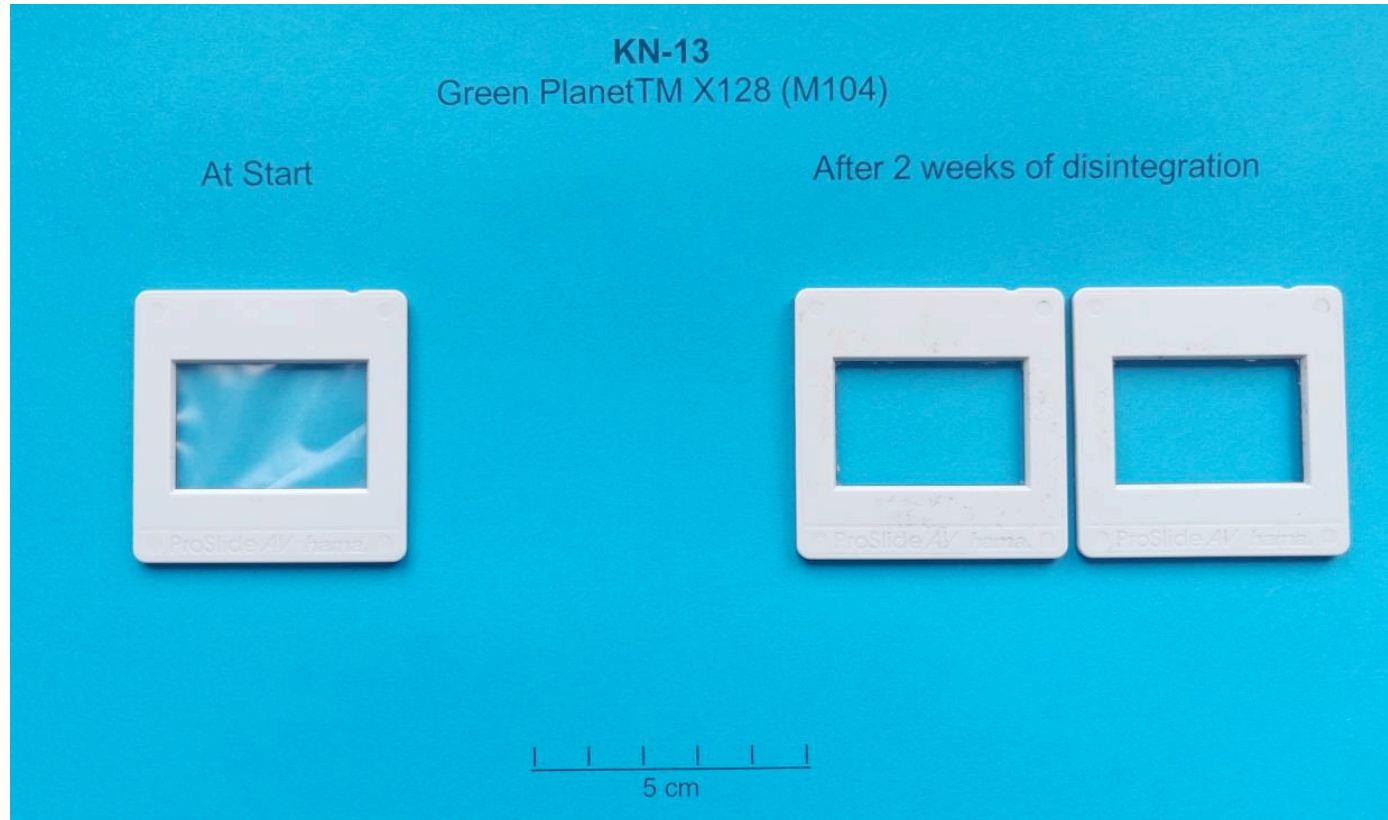
ISO 15985 / ASTM D551 standard Test Method for Determining Biodegradation of Plastic Materials Under **High Solids Anaerobic-Digestion Conditions at 37°C** (Test facility by OWS N.V.)

M704: 15 gram milled test material within 1000 gram inoculum (2,5 l vessel)
151C and X131A: 11 gram powder material within 700 gram inoculum (2l vessel)

Inoculum: pre-treated household waste as a sole substrate

Anaerobic Digestible Waste Bags

→ Disintegration



Qualitative disintegration test under high solid anaerobic digestions / modified ISO 15985)

Mesophilic (37 +/- 2°C)

Visual monitoring after 14 days; 28 days,...

(Test Facility by OWS)



Thickness: 40 – 55 micron

After first monitoring of 2 weeks, the test item Green Planet™ X128 (M104) has completely disintegrated.

Summary

It has been demonstrated that Green Planet™ bio-waste collection (40 – 55 micron) bags are anaerobic digestible on top of being industrial and home-compostable

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REVIEW ON STANDARDS FOR BIOGASIFICATION

OPEN BIO, DELIVERABLE 6.6, 2014

- 120 micron film green planet™ fully disintegrate around 6 weeks within pilot scale composting
- Mesophilic more severe conditions as thermophilic
- Green Planet™ is certified industrial and Home Compostable (TÜV Austria Belgium)

Up-scaling verification test

→ Pilot Scale: Fermentation test – batch procedure/ VDI 4630

VDI n° 4630 “Fermentation of organic materials, characterization of the substrate, sampling, collection of material data, fermentation tests / 353 gram bags within 72 liter inoculum (agriculture and industrial origin) / Mesophilic (38°C) / Innolab facilities

- “No indication of potential inhibition on anaerobic biology was detected during the tests
- no foam reactions noted.
- the biogas and methane yield is higher than the theoretical maximum. These results may indicate a positive synergistic effect in biology where the degradation of the test substrate leads to an increased mineralization of the seed culture”.



→ Next step: Industrial verification test with Green Planet™ Bio-waste bags



**Thank You
for your attention**