



Accumulation of (bio)degradable plastics in soil

- **OWS**
- Different end-of-life options
- Expert statement
(commissioned by European Bioplastics)

COMPANY PROFILE

- DRANCO technology – UG, 1983 (pilot in 1984)
- Founded in 1988
- Consolidated sales (2015-2017): 20 million €/yr
- Export: 90%
- 80 employees
- Head office: Gent, Belgium
- Affiliates: OWS Inc., Dayton, Ohio, USA
DRANCO N.V.
BES GmbH, Germany
- Partner: DJK International, Tokyo, Japan



CONTRACT RESEARCH LABORATORY

- '**One-stop**' laboratory for biodegradability & compostability testing
- Strictly independent
- Quality control: ISO 17025
- **Recognized by all certification bureaus worldwide**
- Active in standardization: CEN/ASTM/ISO
- Member of several certification committees & industrial associations (EuBP, BBP,...)
- More than 30 years of experience
- 10,000+ samples tested for 1,250+ clients

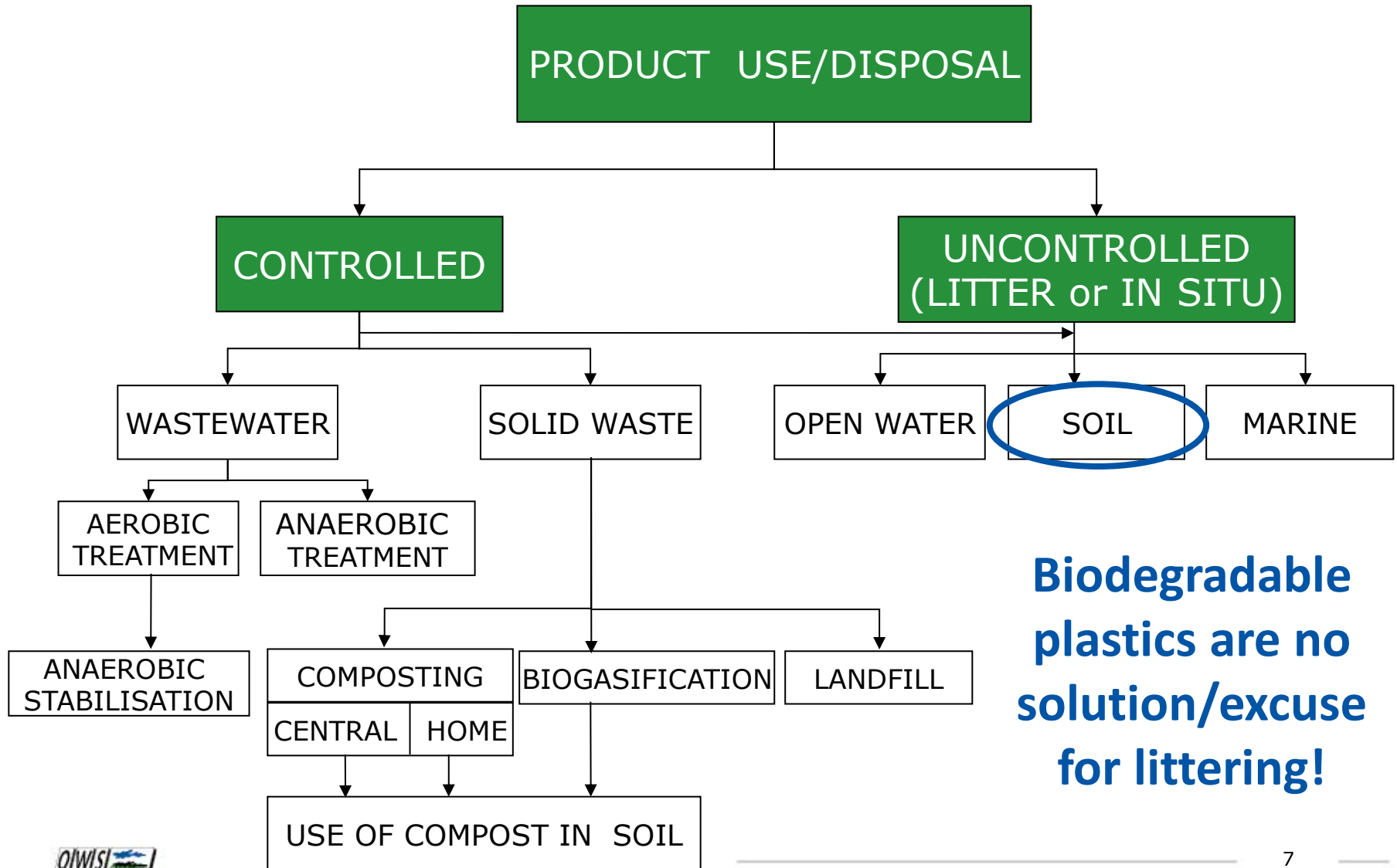


REFERENCES

Base Polymers	BASF, Bio-Fed, Corbion, Du Pont, FKUR, NatureWorks, Novamont,...
Paper & Board	Ahlstrom, Huhtamaki, Int. Paper, Kuan Chun Paper, Pactiv, UPM,...
Packaging	Alcan Packaging, Amcor, Mondi Packaging, Sealed Air, Tetra Pak,...
Consumer Goods	Henkel, Kimberly-Clark, Lenzing, Nestlé, P&G, Sara Lee, SCA, Unilever,...
Inks & Masterbatches	PolyOne, CIBA, Chimigraf, Flint, Sun Chemical, Wacker,...
Films & Bags	Because We Care, Cortec, Kafrit, Sabic, Sphere, Wuhan Huali,...
Food Service Ware	Medac, Minima, Seda, Smurfit Kappa, Solo Cup,...
Other categories	Smithers-Oasis, EBPA, EuBP,...
Oxo-degradable	CIBA, Goody (ACCC), Wells Plastics, Symphony, EPI, EconVerte,...
Enzyme-mediated	Enzymoplast, ECM, Bio-Tec,...

- OWS
- **Different end-of-life options**
- Expert statement

ENVIRONMENTAL NICHES



**Biodegradable
plastics are no
solution/excuse
for littering!**

AGGRESSIVENESS OF ENVIRONMENT

60°C

21°C

compost > soil > fresh water > marine water > landfill

anaerobic digestion



AGGRESSIVENESS OF ENVIRONMENT

Fungi +
Bacteria +
Actinomycetes

Bacteria only
(Fungi inactive)

compost > soil > fresh water > marine water > landfill

anaerobic digestion
Multiple Bacteria



BIODEGRADATION vs. ENVIRONMENTAL NICHE

	AEROBIC (WATER) + ANAEROBIC BACTERIA, NO FUNGI	AEROBIC (COMPOST & SOIL) BACTERIA & FUNGI
High T (50-60°C)	Chemical pulp Starch PLA Starch/PCL PHA THERMOPHILIC DIGESTION	Chemical pulp Mechanical pulp Starch PLA Starch/PCL PHA PBAT INDUSTRIAL COMPOSTING
Low T (≤ 35 °C)	Chemical pulp Starch Starch/PCL PHA MESOPHILIC DIGESTION WATER	PBAT PHA Starch/PCL Starch Chemical pulp Mechanical pulp HOME COMPOSTING SOIL

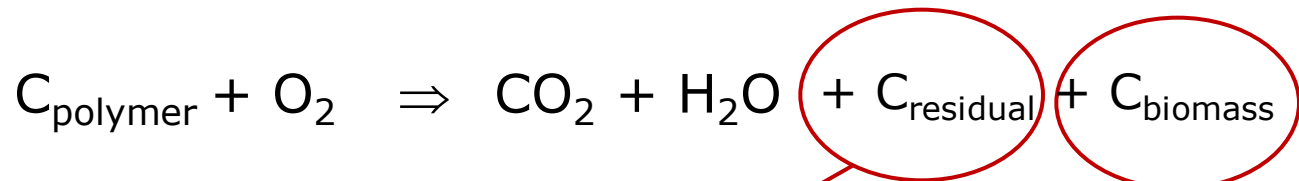
RELEVANT LEGISLATION & STANDARDS

- Revision of the **EU Fertilisers Regulation**
 - Mulching films
 - Controlled release fertiliser coatings
 - Growth media
 - (Body bags)
 - European standard **EN17033**
 - Heavy metals & Fluorine content
 - Biodegradation
 - Plant toxicity
 - Earthworm toxicity
 - Toxicity towards micro-organisms
 - No disintegration!
- } **Environmental safety!**

- OWS
- Different end-of-life options
- **Expert statement**
 - **What is “complete” biodegradation?**
 - **Accumulation of plastics in soil**

“COMPLETE” BIODEGRADATION

- Only scientific correct parameter is conversion to CO₂
- General opinion: “complete” = 100%
- Biochemical pathway of biodegradation:



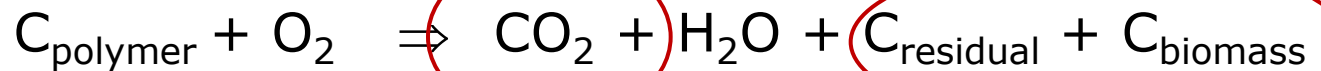
Intermediate degradation products

Biomass growth

- **Not all C_{polymer} is converted to CO₂!**

“COMPLETE” BIODEGRADATION

- Biochemical pathway of biodegradation:



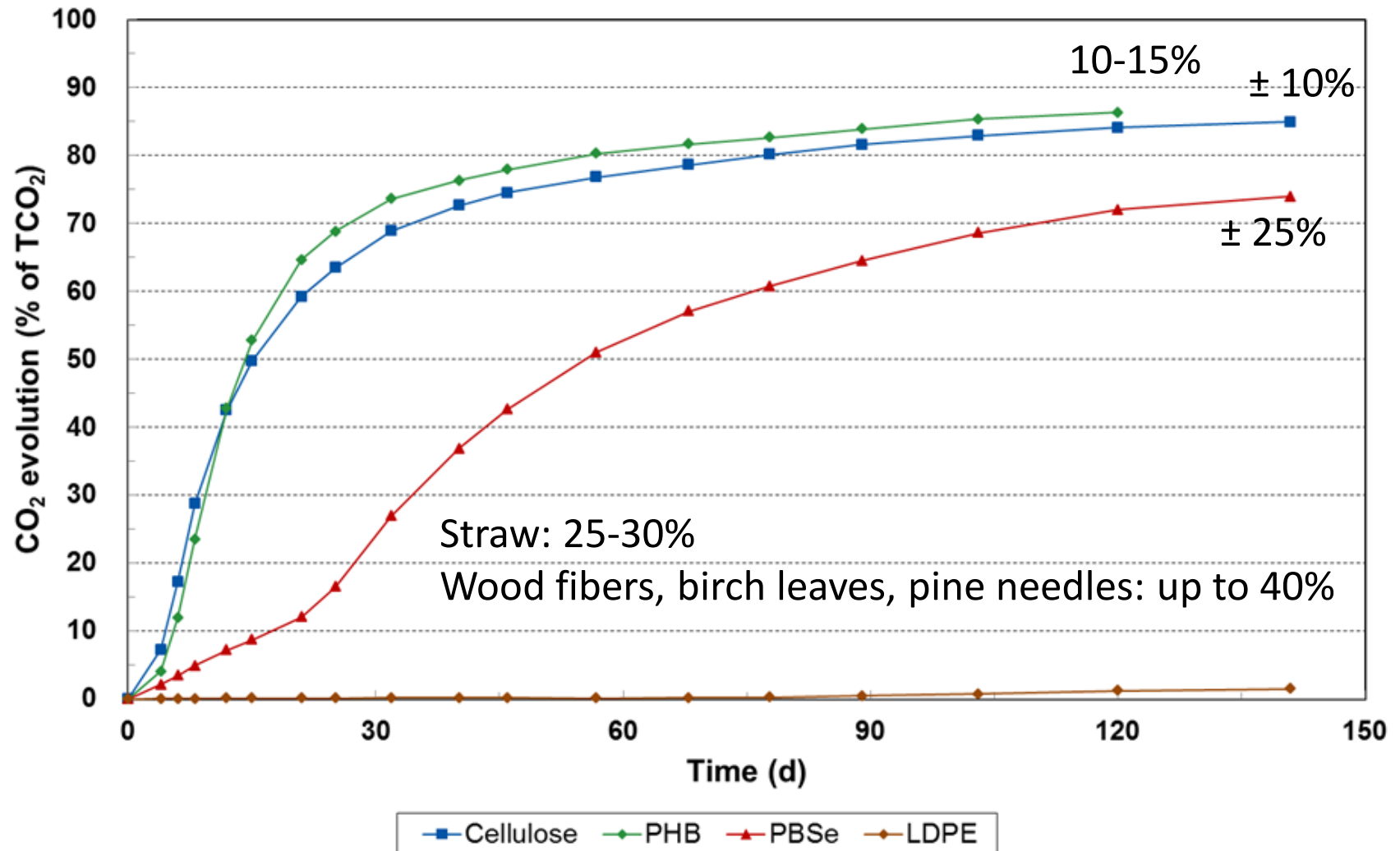
Can be quantified

Cannot be quantified

- EN 17033 (2018) standard on soil biodegradation :
complete biodegradation = **90%** (absolute or relative)

“COMPLETE” BIODEGRADATION – $C_{biomass}$

$C_{biomass}$ typically varies between 10% and 40%



ACCUMULATION IN SOIL

- **(LD)PE mulching film** (15-50 μm)
- Removal is costly and labor intensive
- Contamination hinders recycling
- Accumulation increases with decreasing thickness¹:
 - 25 μm PE film: 10% remains in/on soil
 - 20 μm PE film: 25% remains in/on soil
 - 10 μm PE film: **68%** remains in/on soil

-
- **Soil biodegradable mulching film** (15 μm)
 - No need for removal
 - Complete biodegradation within maximum 2 years under laboratory conditions

¹: APE Europe (Agriculture Plastic Environment), industry association for the non-packaging agri-plastics presentation by Bernard Le Moine at Agricultural Film 2014

ACCUMULATION IN SOIL

20 µm **LDPE film** – 1 cultivation period/year



463 kg/hectare after 10 years
4.6 tonnes/hectare after 100 years
(accumulation continues over time)

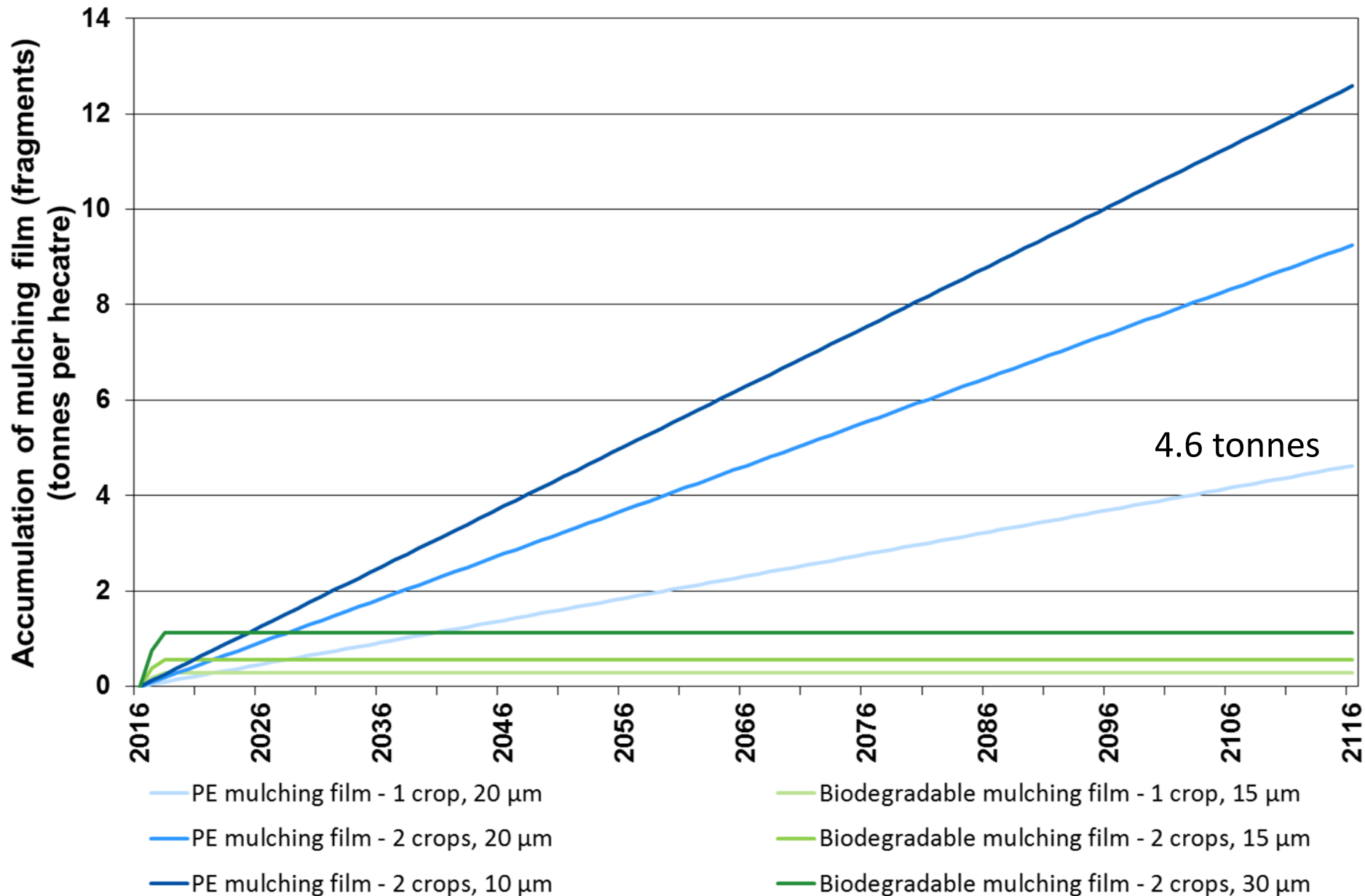
15 µm **soil biodegradable film** – 1 cultivation period/year



188 kg/hectare after the first year

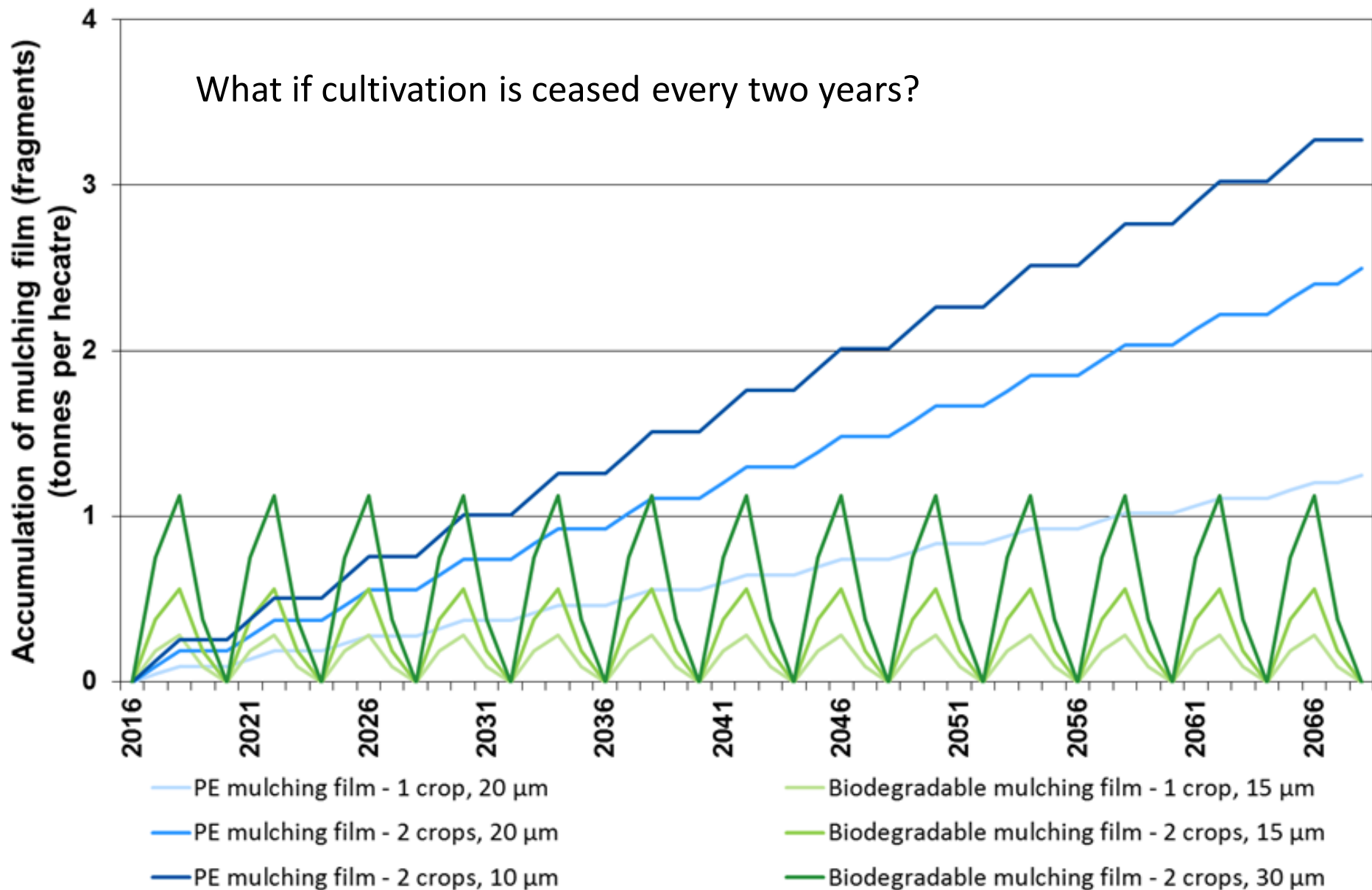
281 kg/hectare after the second year
(= maximum accumulation level!)

ACCUMULATION IN SOIL



ACCUMULATION IN SOIL

What if cultivation is ceased every two years?



CONCLUSIONS

- Complete biodegradation does not mean “100% conversion to CO₂”.
- Conventional (LD)PE mulching films accumulate at a rate of 463 kg per hectare per decade¹.
- Soil biodegradable mulching films have a maximum accumulation level of 281 kg per hectare¹, returning to no accumulation if cultivation is ceased for two years.
- (LD)PE mulching films cannot be downgauged as this increases the relative level of contamination and decreases the recovery rate.

¹: Assuming one cultivation period per year and a thickness of 20 µm for LDPE and 15 µm for soil biodegradable mulching films

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Expert statement : (Bio)degradable mulching films **NEW**

The first part discusses the biochemical pathway of biodegradation and more particularly the meaning of complete biodegradation in soil. The second part touches on the possible accumulation of plastics in the soil as a result of repetitive use of both non-biodegradable and biodegradable mulching films.

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OWS nv, Dok-Noord 5, B-9000 Gent, Belgium

Email: sam.deconinck@ows.be

Website: www.ows.be

