



Organic Waste Systems

STANDARDS, REGULATIONS AND TESTING OF BIODEGRADABLE POLYMERS

2011 CORESTA Joint Study Groups Meeting

Graz, Austria, 9-13 October 2011

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TOPICS

- * **OWS**
- * BIODEGRADABILITY vs. COMPOSTABILITY
- * STANDARDS vs. CERTIFICATION
- * OTHER BIOLOGICAL ENVIRONMENTS



Organic Waste Systems

FIGURES

- * FOUNDED IN 1988
- * SALES: 17 MILLION € IN 2010
- * 80 EMPLOYEES

OFFICES

- * HEAD OFFICE: GENT, BELGIUM
- * AFFILIATE: OWS INC., DAYTON, OHIO, US
- * PARTNER: DJK INTERNATIONAL, TOKYO, JAPAN

ACTIVITIES

- * DESIGN & CONSTRUCTION OF ANAEROBIC DIGESTION PLANTS FOR SOLID AND SEMI-SOLID ORGANICS
- * BIOGAS CONSULTANCY & SUPPORT
- * BIODEGRADATION TESTING AND WASTE MANAGEMENT CONSULTANCY





Organic Waste Systems

LABORATORY

- * **'ONE-STOP'** LABORATORY FOR BIODEGRADABILITY AND COMPOSTABILITY TESTING
- * COMPLETELY INDEPENDANT
- * QUALITY CONTROL: ISO 17025
- * **RECOGNIZED BY ALL CERTIFICATION BUREAUS**
- * ACTIVE IN STANDARDIZATION: CEN – ASTM – ISO
- * MEMBER OF DIN-CERTCO CERTIFICATION COMMITTEE & SEVERAL INDUSTRIAL ASSOCIATIONS (EuBP)
- * **MORE THAN 20 YEARS OF EXPERIENCE**
- * 2000+ SAMPLES TESTED FOR 500+ CLIENTS

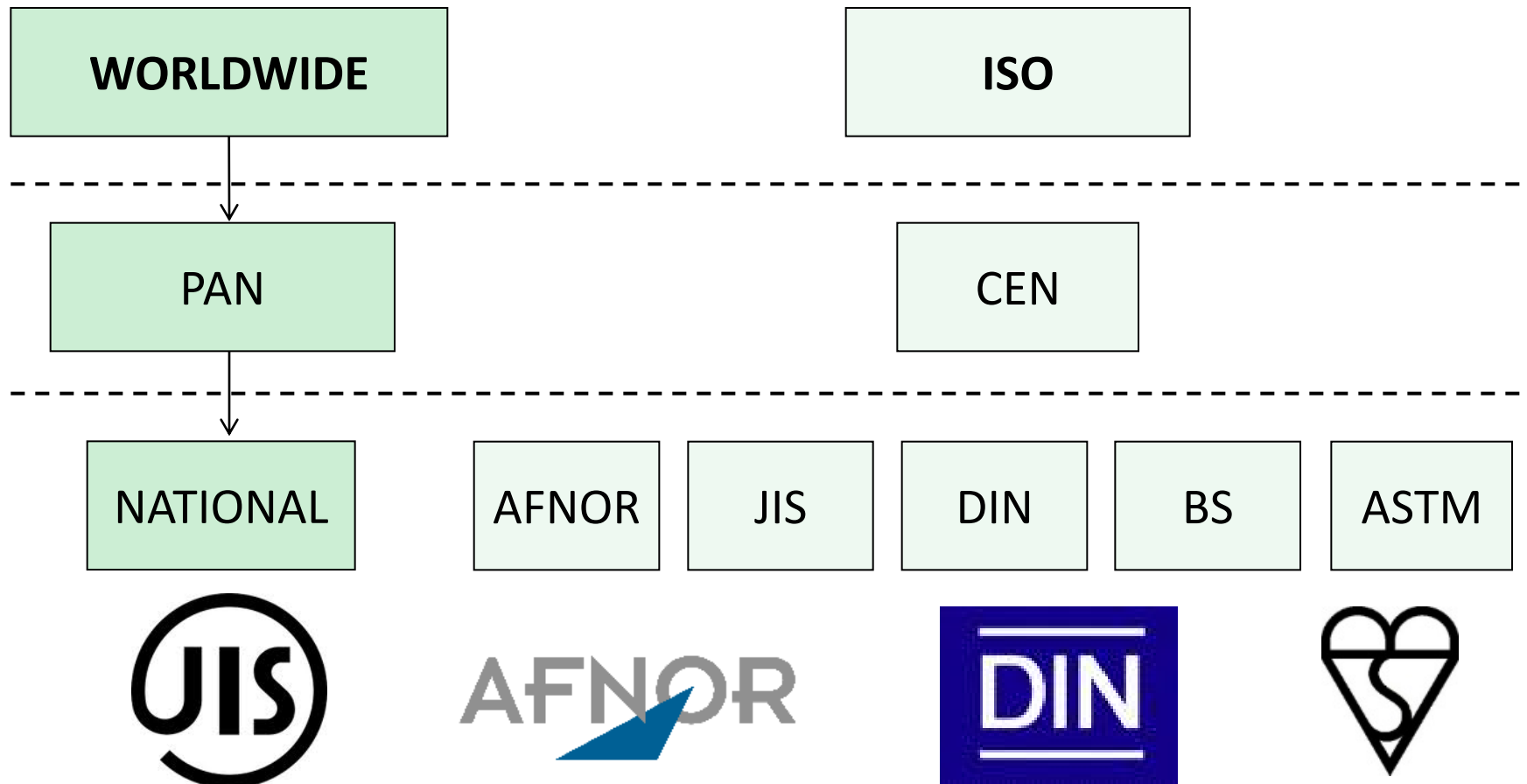


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STANDARIZATION GROUPS

* 3 'LEVELS' OF STANDARDIZATION

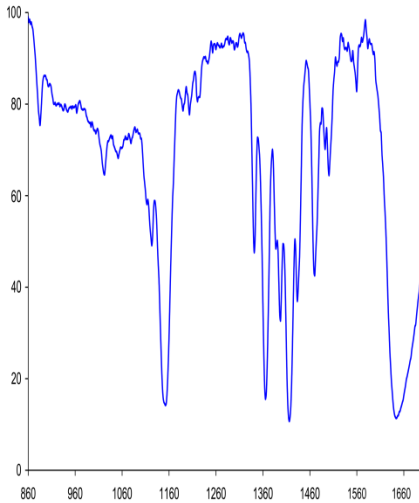


THEORY: COMPOSTABILITY NORMS

* STANDARD SPECIFICATIONS : TESTS AND CRITERIA

| | EUROPE | USA | WORLDWIDE |
|---------------|---|---|---|
| |  |  |  |
| PLASTICS | EN 14995 | ASTM D.6400 | ISO 17088 |
| PACKAGING | EN 13432 | | ISO DIS 18606 |
| PAPER COATING | | ASTM D.6868 | |

COMPONENTS OF COMPOSTABILITY



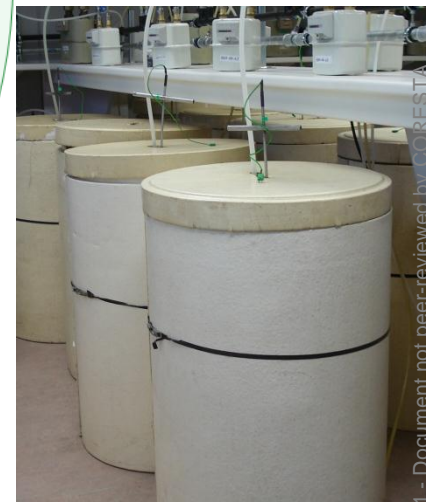
CHEMICAL CHARACTERISTICS

BIODEGRADATION
(Chemical degradation)



ECOTOXICITY
(Effect on plants)

DISINTEGRATION
(Physical degradation)



1) CHEMICAL CHARACTERISTICS - CRITERIA

* INORGANIC CONTENT:
MAXIMUM 49%

* HEAVY METAL LIMITS:
EU vs. US

| Limit value (ppm) | EU | US |
|-------------------|------|-----|
| Zn | 150 | 463 |
| Cu | 50 | 189 |
| Ni | 25 | 45 |
| Cd | 0.5 | 5 |
| Pb | 50 | 125 |
| Hg | 0.5 | 1 |
| Cr | 50 | 265 |
| Mo | 1 | 5 |
| Se | 0.75 | 4 |
| As | 5 | 19 |
| F | 100 | - |
| Co | - | 38 |

2) BIODEGRADATION - CRITERIA

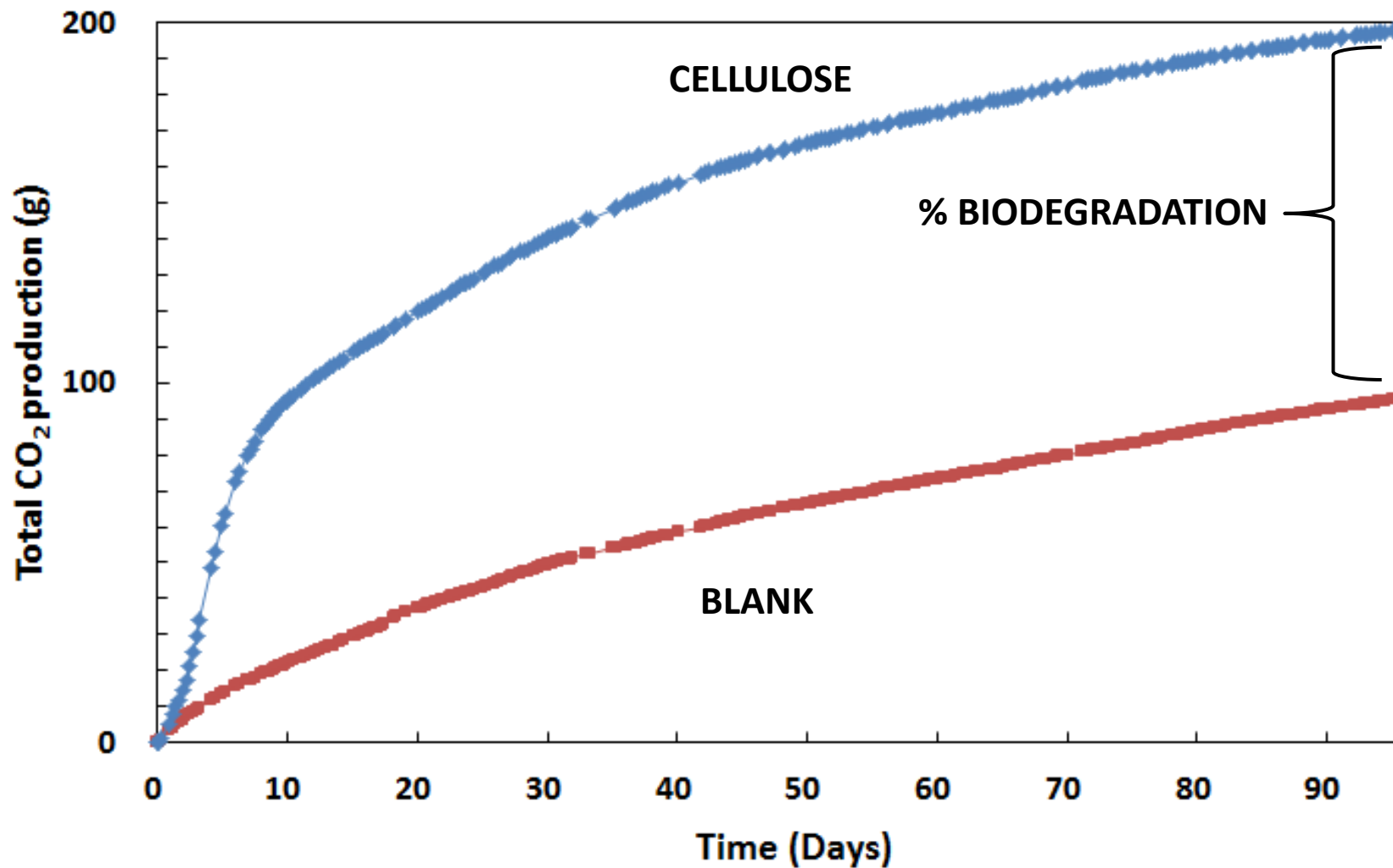
- * TEST METHODS: ISO 14855 (COMPOST)
ISO 14851 & ISO 14852 (WATER)
ISO 17556 (SOIL)

- * DURATION: MAXIMUM 6 MONTHS

- * PASS LEVEL: **90% BIODEGRADATION**
(absolute or relative to a reference)

- * EXEMPTED:
 1. 'IRRELEVANT' COMPONENTS (< 1%, Σ <5%)
 2. CHEMICALLY UNMODIFIED MATERIALS OF NATURAL ORIGIN

2) BIODEGRADATION – TEST RESULTS



3) DISINTEGRATION – CRITERIA

- * TEST METHOD: ISO 16929 (PILOT-SCALE)
- * DURATION: 12 WEEKS
- * PASS LEVEL: **90% DISINTEGRATION**
(max. 10% may remain on 2 mm sieve)
limited to **MAXIMUM THICKNESS**



3) DISINTEGRATION – TEST CONDITIONS

- * VESSELS OF APPROX. 200L
- * MIXTURE: FRESH BIOWASTE + 1% PRODUCT + 9% POWDER
- * WEEKLY TO BI-WEEKLY TURNING
- * TEMPERATURE: SPONTANEOUS INCREASE
MAXIMUM: 75°C
MINIMUM: 60°C for 1 WEEK
40°C for 4 WEEKS
- * O₂ MUST BE CONTINUOUSLY >10%
- * COMPOST USED FOR TOXICITY TESTS



3) DISINTEGRATION – TEST RESULTS

* IMPORTANCE OF **THICKNESS**, GRAMMAGE, DENSITY,...

EVOLUTION OF THE DISINTEGRATION OF SAMPLE A (44 μ m)

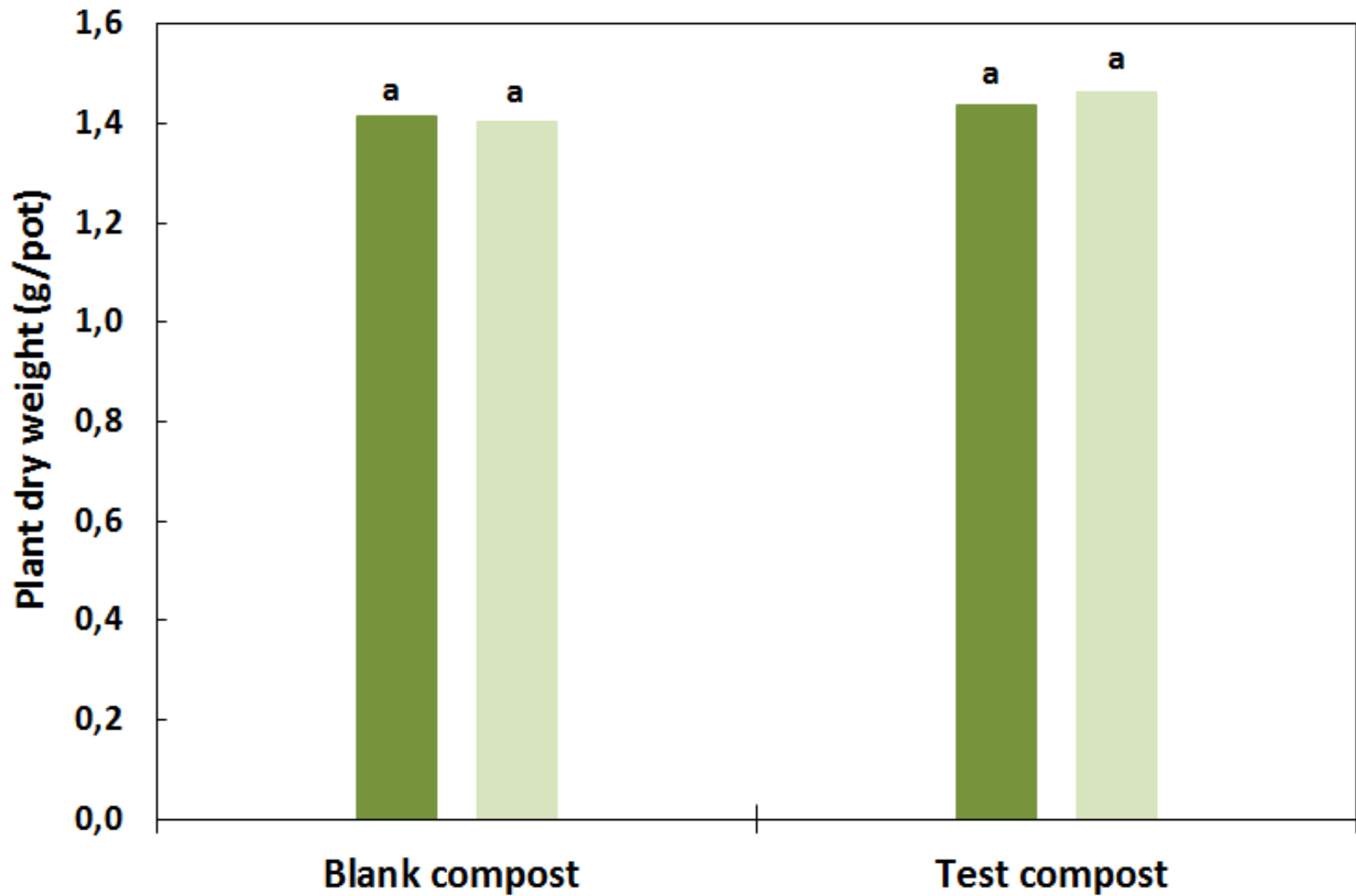


4) ECOTOXICITY - CRITERIA

- * TEST METHOD:
EN13432 + OECD208 (2 PLANTS)
- * DURATION:
2-3 WEEKS
- * PASS LEVEL:
90% GERMINATION/GROWTH
- * AUSTRALIA:
ALSO EARTHWORMS



4) ECOTOXICITY – TEST RESULTS



TOPICS

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- * BIODEGRADABILITY vs. COMPOSTABILITY
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PRAXIS: COMPOSTABILITY CERTIFICATION

* EUROPE : SEEDLING LOGO : EuBP - DIN-CERTCO



OK COMPOST LOGO : VINÇOTTE

* USA : BPI LOGO



* JAPAN : JBPA LOGO



* AUSTRALIA : ABA LOGO

* KOREA – CANADA

* And some other (smaller) ones



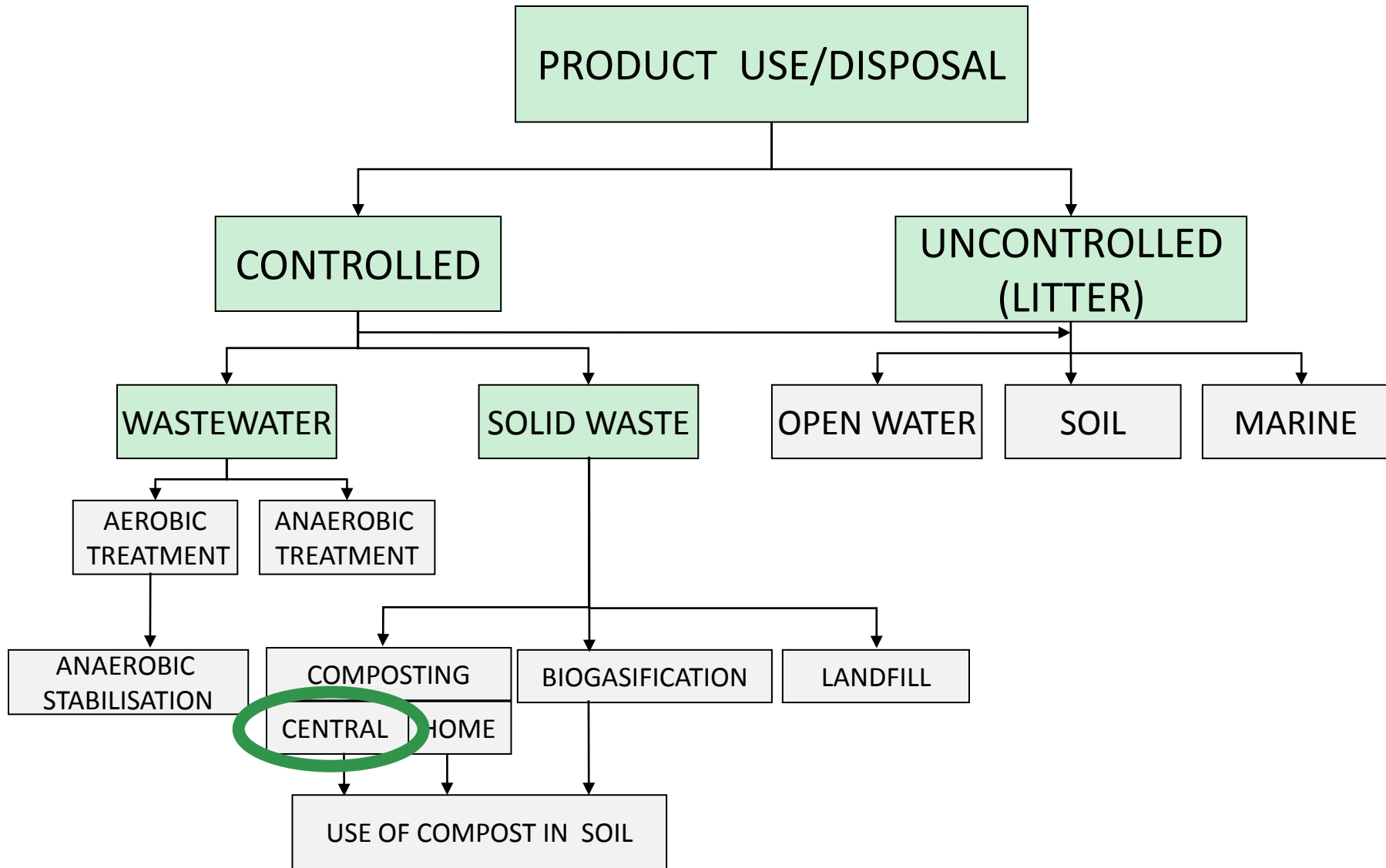
SEEDLING LOGO vs. OK COMPOST LOGO

| | | |
|---|--|---|
| |  |  |
| Agency | DIN-Certco | Vinçotte |
| Basis of certification | EN13432, ASTM D6400 & ISO 17088 | EN13432 |
| Geographical value | Germany, Switzerland, Netherlands, Austria | France, Italy, Spain, Belgium |
| Number of certified items (end of 2010) | 92 materials 2 additives 210 products | 87 materials 45 additives 119 products |

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END OF LIFE : ENVIRONMENTAL NICHES



AGGRESSIVENESS OF ENVIRONMENT

60°C

21°C



COMPOST > SOIL > FRESH WATER > MARINE WATER > LANDFILL

ANAEROBIC DIGESTION

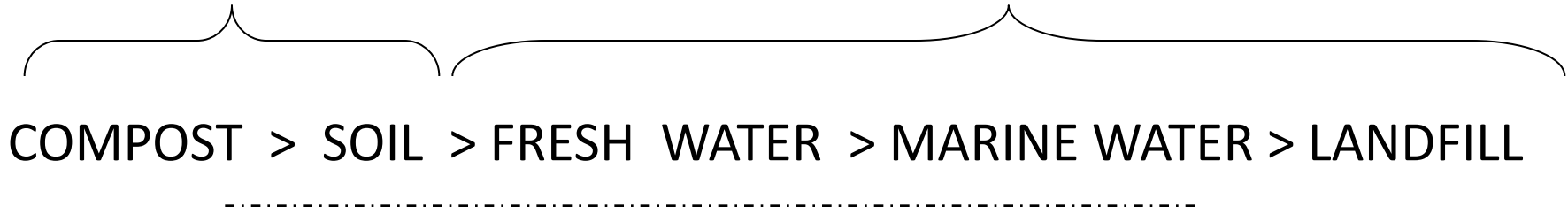
35°C - 55°C



AGGRESSIVENESS OF ENVIRONMENT

Fungi + Bacteria
+ Actinomycetes

Bacteria only



ANAEROBIC DIGESTION

Multiple Bacteria



RELATIONSHIP OF BIODEGRADATION and ENVIRONMENTAL CONDITONS

| | ANAEROBIC BACTERIA, NO FUNGI | | AEROBIC BACTERIA & FUNGI |
|----------|--|--|---|
| 50-60 °C | <p>Chemical pulp</p> <p>Starch</p> <p>PLA</p> <p>Starch/PCL</p> <p>PHA</p> | <p>THERMOPHILIC DIGESTION</p> | <p>Chemical pulp</p> <p>Mechanical pulp</p> <p>Starch</p> <p>PLA</p> <p>Starch/PCL</p> <p>PHA</p> <p>PBAT</p> <p>INDUSTRIAL COMPOSTING</p> |
| ≤ 35 °C | <p>Chemical pulp</p> <p>Starch</p> <p>Starch/PCL</p> <p>PHA</p> | <p>MESOPHILIC DIGESTION</p> | <p>Chemical pulp</p> <p>Mechanical pulp</p> <p>Starch</p> <p>Starch/PCL</p> <p>PHA</p> <p>PBAT</p> <p>HOME COMPOSTING</p> |

after B.G. Hermann et al. (2011)

HOME COMPOSTING

* **AMBIENT TEMPERATURE**

* **DIFFERENT PROGRAMS (NO STANDARD):**

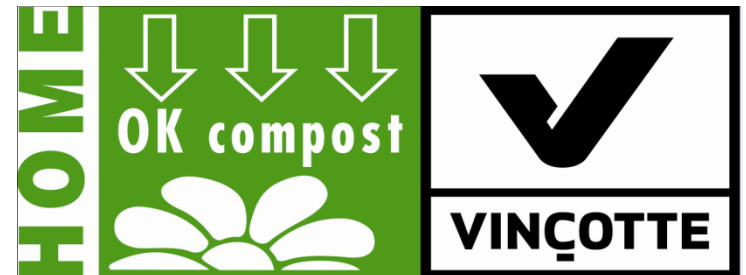
BELGIUM: OK Compost Home (Vinçotte)

UK: AfOR (in collaboration with Vinçotte)

Australia: under development (DR AS 5810)

US: BioSpecs (based on OKCH)

* **EN13432 + BIODEGRADATION & DISINTEGRATION AT AMBIENT T**



SOIL BIODEGRADATION

- * MULCHING FILMS: NF U 52-001 (FRANCE)
- * ALTHOUGH NO GENERAL STANDARD – 2 PROGRAMS:
 - BELGIUM: OK Bio Soil (Vinçotte)
 - US: BioSpecs (partially based on OKBS)
- * EN13432 (METALS & ECOTOXICITY) + BIODEGRADATION
→ DISINTEGRATION (PRODUCT SPECIFIC)



BIODEGRADABILITY IN WATER

- * OECD Guidelines for Testing of Chemicals
 - Ready biodegradability :
 - 60/70% in 28 days
 - from 10% to 60% in <10 days
 - Inherent (ultimate) biodegradability :
 - 60/70%; adaptation permitted

- * CEN TC249 WG9: Plastics
 - Biodegradability : 90% (absolute or relative) in 56 days

 - Also definition of water solubility
water dispersibility

BIODEGRADATION IN FRESH WATER

- * OECD GUIDELINES FOR CHEMICALS:
READILY vs. INHERENTLY BIODEGRADABLE
- * NO SPECIFIC STANDARD, ONLY 1 PROGRAM:
BELGIUM: OK Bio Water (Vinçotte)
- * EN13432 (METALS) + BIODEGRADATION
→ NO DISINTEGRATION (PRODUCT SPECIFIC)



MARINE BIODEGRADATION : ASTM D.7081

- * HEAVY METALS + BIODEGRADATION :
CONFORM ASTM D.6400
- * MARINE BIODEGRADATION :
30% AFTER 6 MONTHS
- * MARINE DISINTEGRATION :
< 30% AFTER 3 MONTHS >2 MM
- * ECOTOXICITY :
1 SPECIFIC AQUATIC TOXICITY TEST





Organic Waste Systems

THANK YOU!

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