ISO standardization related to biodegradability of plastic materials in marine, soil, composting or digesting condition

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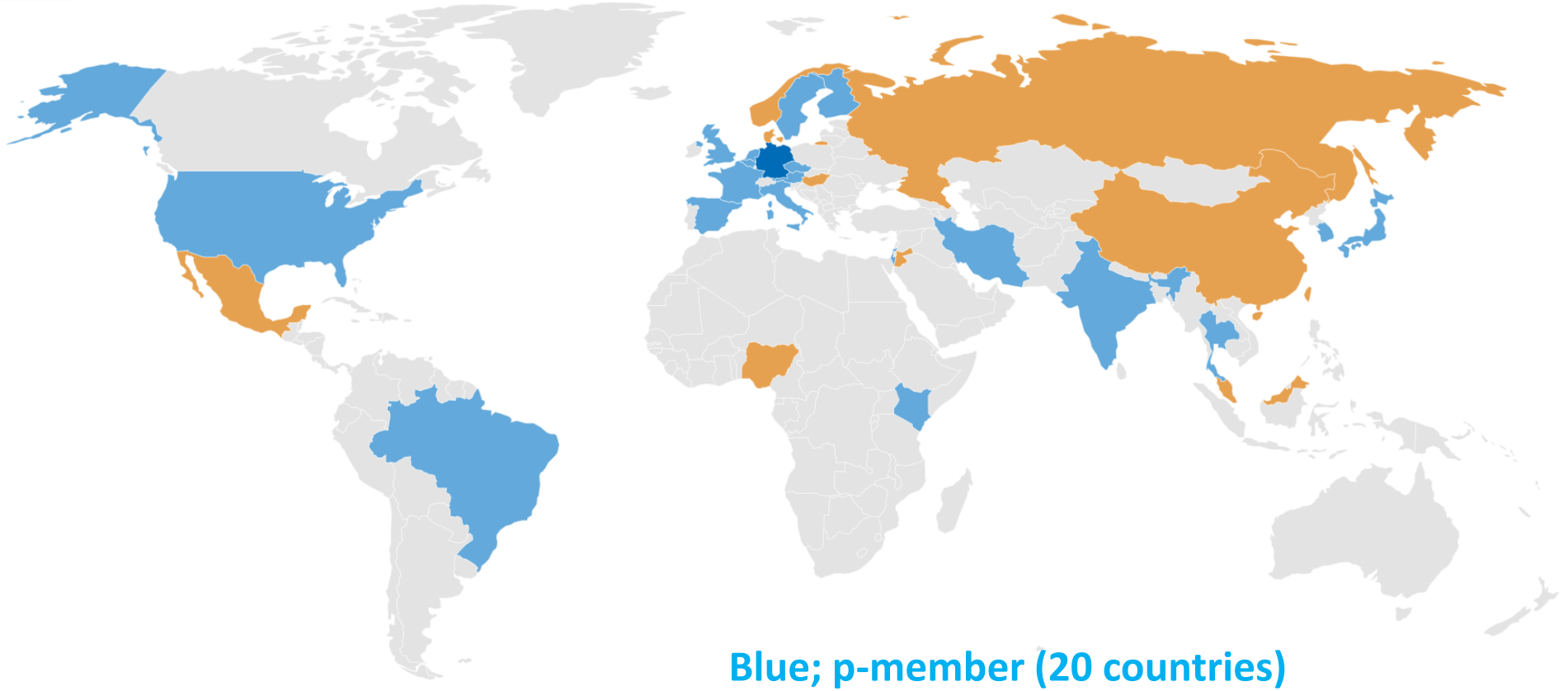
ISO/TC 61 「Plastics」 Technical committee

Japanese domestic discussion organization
Japan plastics industrial federation (JPIF)

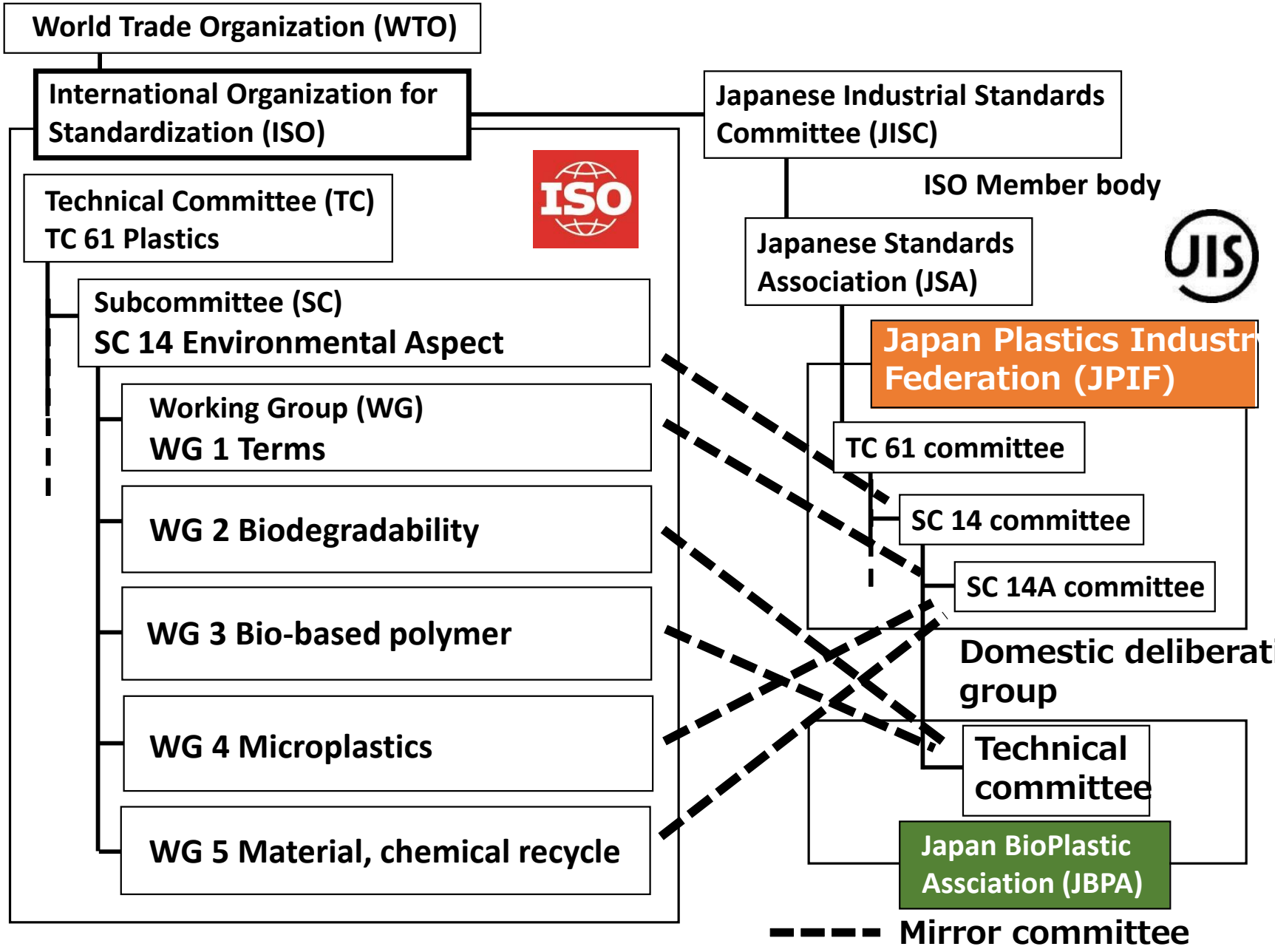
- **SC 1 「Terminology」 Sub committee**
- **SC 2 「Mechanical behavior」**
- **SC 4 「Burning behavior」**
- **SC 5 「Physical-chemical properties」**
- **SC 6 「Ageing, chemical and environmental resistance」**
- **SC 9 「Thermoplastic materials」**
- **SC 10 「Cellular plastics」**
- **SC 11 「Products」**
- **SC 12 「Thermosetting materials」**
- **SC 13 「Composites and reinforcement fibres」**
- **SC 14 「Environmental aspect」**

ISO; International organization for standardization

ISO/TC 61(Plastics)/SC 14(Environmental Aspect) Participation countries



Blue; p-member (20 countries)
Blown; o-member (9 countries)


World Trade Organization (WTO)
International Organization for Standardization (ISO)
Japanese Industrial Standards Committee (JISC)
ISO Member body
Technical Committee (TC)
TC 61 Plastics
Japanese Standards Association (JSA)
Subcommittee (SC)
SC 14 Environmental Aspect
Japan Plastics Industr
Federation (JPIF)
Working Group (WG)
WG 1 Terms
TC 61 committee
WG 2 Biodegradability
SC 14 committee
SC 14A committee
WG 3 Bio-based polymer
Domestic deliberation group
WG 4 Microplastics
Technical committee
WG 5 Material, chemical recycle
Japan BioPlastic Association (JBPA)
Mirror committee

Projects of ISO/TC 61/SC 14/WG 2

NO.1

No	Project	Title	Status
1	ISO 14851	Aerobic biodegradability in aqueous medium by oxygen demand	Published in 1999
2	ISO 14852	Aerobic biodegradability in aqueous medium by evolved carbon dioxide	Published in 1999
3	~~ISO 14855~~	~~Aerobic biodegradability under controlled composting conditions~~	Published in 1999 Separate to Part 1 & 2
4	ISO 16929	Disintegration under composting conditions in a pilot-scale test	Published in 2002
5	ISO 17556	Aerobic biodegradability in Soil	Published in 2003
6	ISO 20200	Disintegration under composting conditions in a laboratory-scale test	Published in 2004
7	ISO 14853	Anaerobic biodegradability in an aqueous system	Published in 2005
8	ISO 15985	Anaerobic biodegradability under high-solids conditions	Published in 2004
9	ISO 17088	Test scheme and specifications	Published in 2008
10	ISO 14855-1	Aerobic biodegradability under controlled composting conditions	Published in 2005
11	ISO 14855-2	Aerobic biodegradability under controlled composting conditions in a laboratory-scale test	Published in 2007
12	ISO 10210	Preparation of samples for biodegradation testing	Published in 2012
13	ISO 13975	Anaerobic biodegradation under controlled slurry phase systems	Published in 2012

Projects of ISO/TC 61/SC 14/WG 2

NO.2

No	Project	Title	Status
14	ISO 18830	Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sandy sediment interface — Method by measuring the oxygen demand in closed respirometer	Published in 2016
15	ISO 19679	Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sediment interface — Method by analysis of evolved carbon dioxide	Published in 2016
16	ISO/D 2IS 2403	Assessment of the inherent aerobic biodegradability and environmental safety of non-floating materials exposed to marine inocula under laboratory and mesophilic conditions — Test methods and requirements	Under discussion
17	ISO 22404	Determination of the aerobic biodegradation of non-floating materials exposed to marine sediment — Method by analysis of evolved carbon dioxide	Published in 2019
18	ISO/DIS 22766	Determination of the degree of disintegration of plastic materials in marine habitats under real field conditions	Under discussion
19	ISO/NP 23517	Biodegradable mulch films for use in agriculture and horticulture — Requirements and test methods	Under discussion
20	ISO/NP 23832	Test method for determination of degradation rate and disintegration degree of plastic materials exposed to marine environmental matrices under laboratory conditions	Under discussion
21	ISO/CD 23977-1	Determination of the aerobic biodegradation of plastic materials exposed to seawater — Part 1: Method by analysis of evolved carbon dioxide	Under discussion
22	ISO/CD 23977-2	Determination of the aerobic biodegradation of plastic materials exposed to seawater — Part 2: Method by measuring the oxygen demand in closed respirometer	Under discussion

Sample preparation

ISO 10210 (JIS K 6949)

Specification (requirements)

(Compostable)	(Mulch)	(Marine)
17088 (-)	CD 23517 (-)	CD 22403 (-)

AWI ↓ NP ↓ WD ↓ CD ↓ DIS ↓ FDIS ↓ ISO

Test methods

Test environments

Japanese proposal

- **Aquatic**
  - **Marine**
    - **Aerobic**
      - Seabed
      - 18830 (-)
      - 19679 (-)
      - Marine water
      - CD 23977-1,2 (-)
    - Field test
      - DIS 22766 (-)
  - **Fresh water**, **Sludge**
    - **Aerobic (activated sludge)**
      - 14851 (K 6950)
      - 14852 (K 6951)
    - **Anaerobic (digestive sludge)**
      - 14853 (-)
      - 15985 (K 6960)
      - 13975 (K 6961)
- **Terrestrial**
  - **Soil**
    - **Aerobic**
      - 17556
      - (K 6955)
  - **Compost**
    - **Aerobic**
      - 14855-1 (K 6953-1)
      - 14855-2 (K 6953-2)
  - **Landfill**
    - **Biodegradation**
    - **Disintegration**
    - **Aerobic**
      - 16929 (K 6952)
      - 20200 (K 6954)

(Japanese Industrial standard)

Field test in marine

ISO/DIS 22766 Proposed by Germany

Below test methods in laboratory

Pelagic (surface / floating)

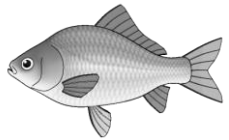
Eulittoral

ISO 22404 proposed by Italy
ASTM D7991

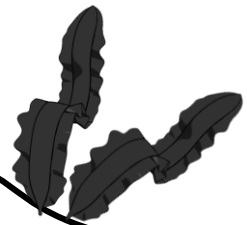
Deep ocean
no test method available

ISO/CD 23977-1, 2 Proposed by Germany
ASTM D6691

Chemicals
ISO 16221
OECD 306



Sea water



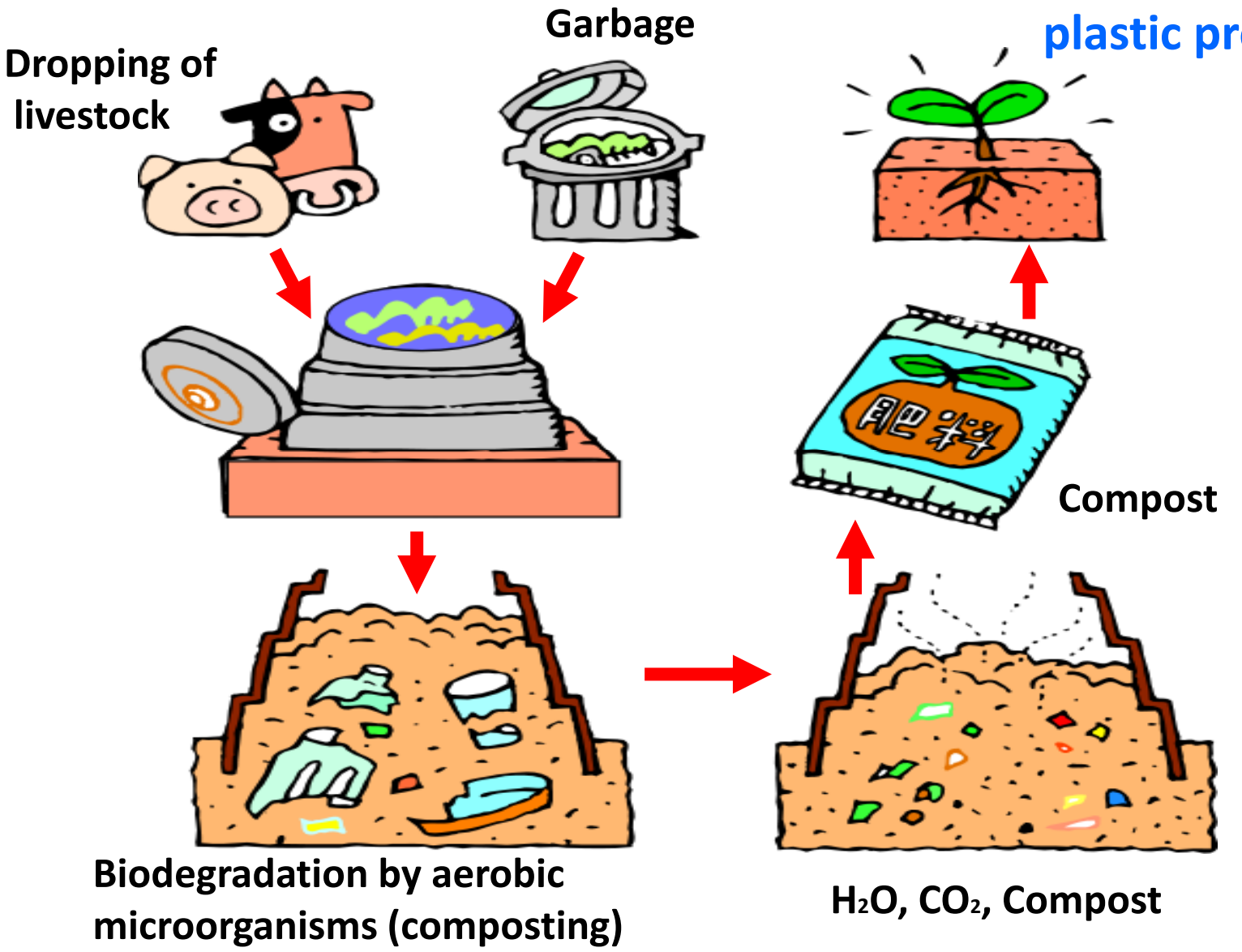
Sublittoral

ISO 18830
ISO 19679
Proposed by Italy

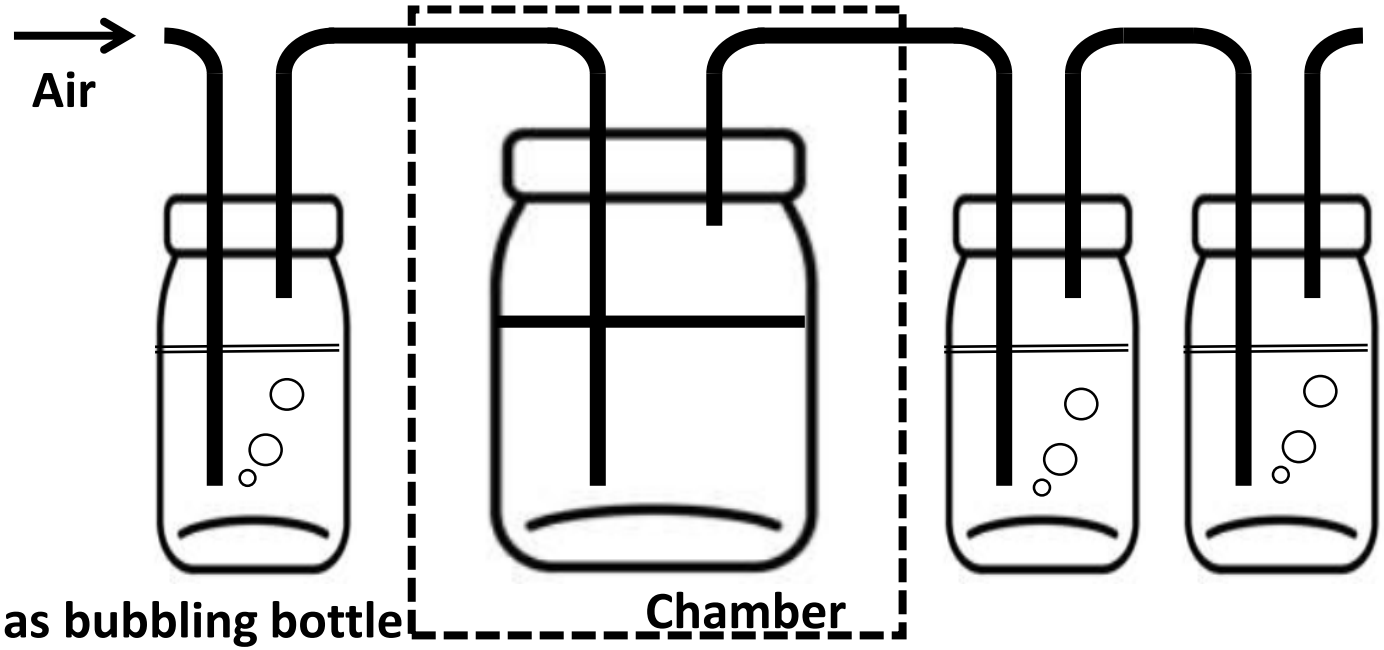
ASTM D7081-05 (Withdraw in 2014)
Specification of biodegradable non-float plastics materials in marine
ISO/CD 22403 Proposed by Italy
Test methods and requirements
(Biodegradability >90 % in 2 years
ISO/CD 23832 Proposed by Italy
Biodegradation rate and disintegration

Composting environment

Recycling of garbage resources with biodegradable plastic products



Determination method of biodegradability



Gas bubbling bottle
(Allkaline sol.)

Reaction vessel
(Activated sludge, compost etc.)
Test material

Blank: N=3
Positive control: N=3
(Cellulose powder)
Test material: N=3

$$\text{Biodegradability} = \frac{\text{Evolved } CO_2 \text{ amount from sample} - \text{Evolved } CO_2 \text{ form blank}}{\text{Theoretical evolved } CO_2 \times \text{Carbon content} \times (44/12))} \times 100\ (\%)$$

Theoretical evolved CO_2 for PLA ($nC_3H_4O_2$, = 72 (C=36)) 10 g
Carbon 5 g × 44/12 = 18.3 g

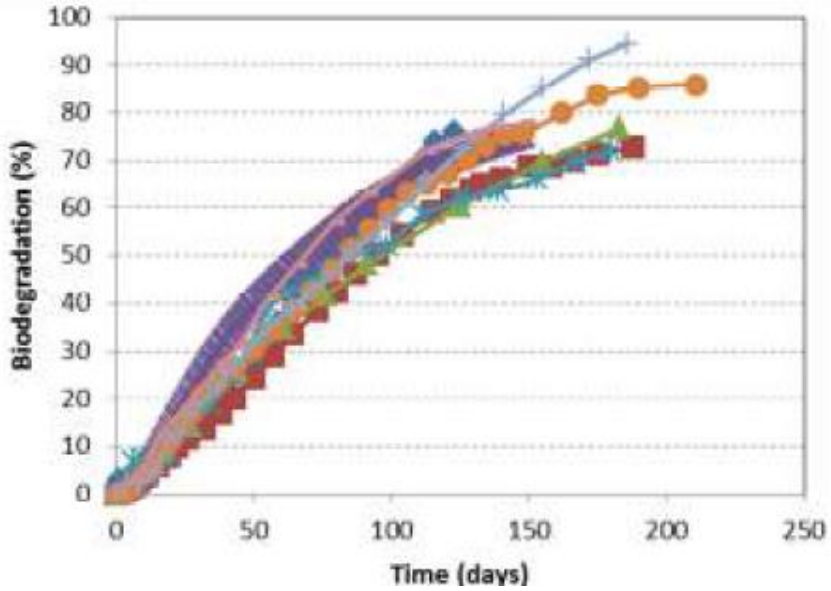
$$\text{Degree of disintegration} = \frac{\text{Remaining sample mass}}{\text{Initial sample mass}} \times 100\ (\%)$$

Marine environment

ISO 18830

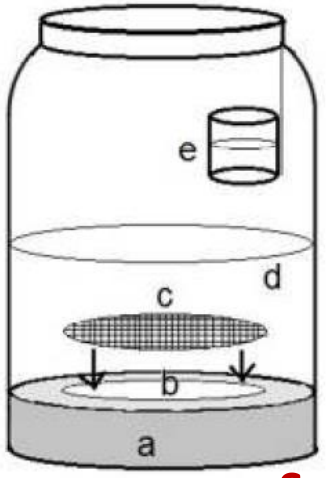
Aerobic biodegradation in marine by oxygen demand

Biodegradation of PBSeb in sea water at 25 °C



ISO 19679

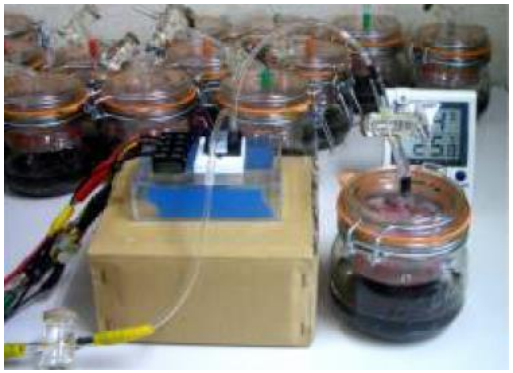
Aerobic biodegradation in marine by evolved carbon dioxide



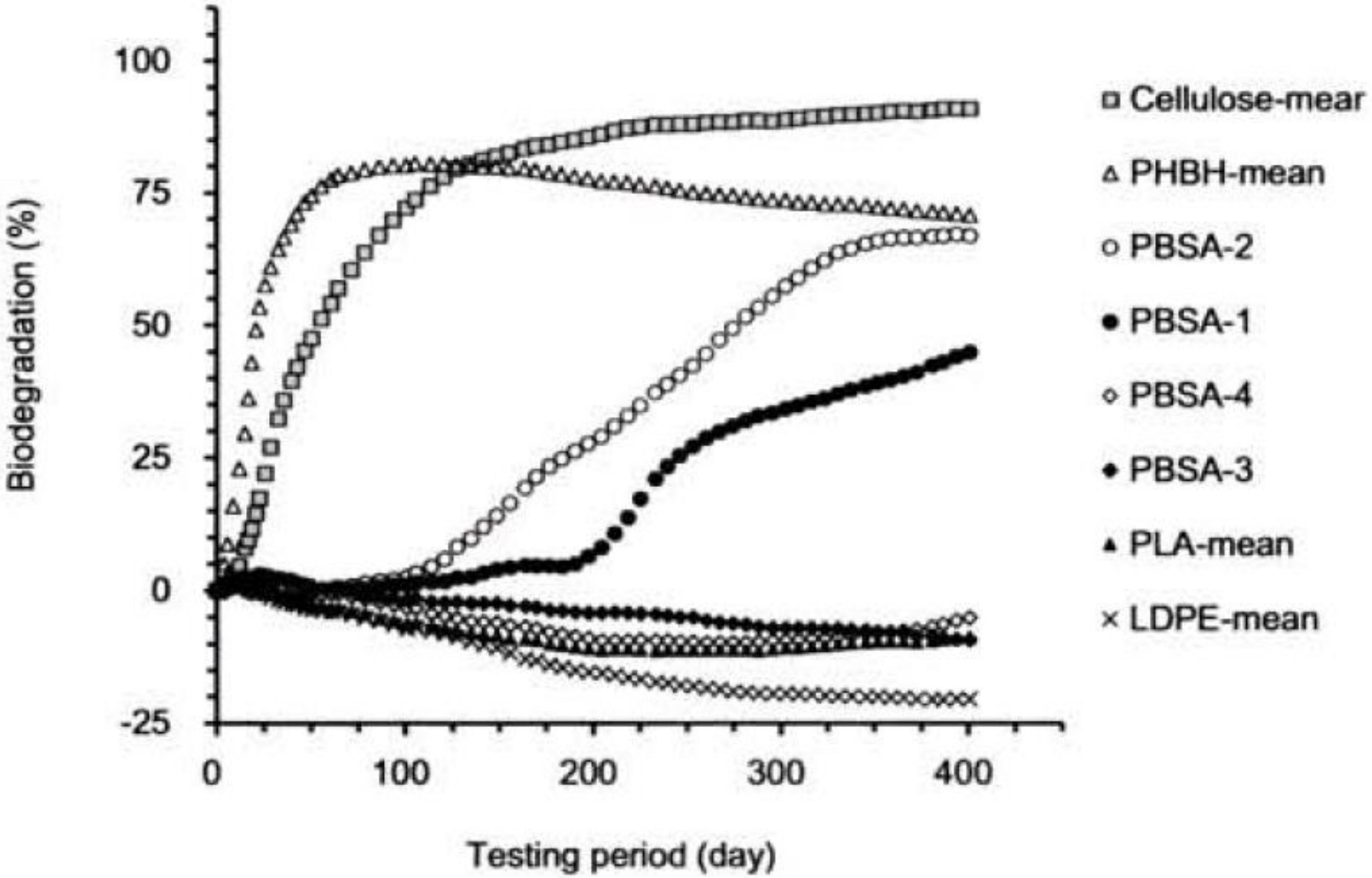
Sea water

Sample sheet

Sediment



Biodegradation of plastics in marine conditions (ISO 19679 (27 °C, 401 days)



Outline of Roadmap for Development and Implementation of Marine Biodegradable Plastics

May 2019

経済産業省
Ministry of Economy, Trade and Industry

		2019	2020	2021～25	～2030	～2050
Social implementation of practical technology (MBBP1.0)	Improve reliability for marine biodegradation	Establish organization → Summarize issues	ISO standard proposal 【AIST,JBPA】	Test study for enhancing biodegradation function evaluation 【NEDO, etc.】		
	Expansion of production facilities and cost improvement for mass production	Enhancement of mass production capacity	Improving bioprocess of manufacturing 【NEDO, etc.】			
	Demand development	Promoting domestic and foreign exhibitions and business matching 【GLOMA】		Public procurement	Detergent bottle Agricultural multi-film	
	Certification / Separate collection and processing	Shopping bag garbage bag straw, cutlery		Certification System 【JBPA】	Separate collection and processing	
Multi-utilization through composite material development (MBBP2.0)			Cost reduction of cellulose nanofiber, etc., improve moldability of composite materials 【NEDO, etc.】			Mask Packing cushion
Research and development of innovative materials (MBBP3.0)		Analysis of marine biodegradability mechanism 【NEDO, etc.】 Addition of biodegradation control function Discovery of new microorganisms【NITE】 Alternative materials for fishing gear【Fisheries Agency, AIST】		Creation of innovative materials applying marine biodegradability mechanisms		Fertilizer coating Fishing gear (buoy)

MBBP: Marine Bio-degradable Bio-based Plastics, AIST: National Institute of Advanced Industrial Science and Technology,
NEDO: New Energy and Industrial Technology Development Organization, NITE: National Institute of Technology and Evaluation, JBPA: Japan BioPlastics Association

Thank you for your kind attention!