Introduction to BioPBS™

A GREENER WORLD.
A GREENER YOU.

ptt MCC Biochem | BIOPBS™

Agenda

- PTTMCC company profile
- PBS, how it works

Who are we?

A joint venture of PTT and MCC

#84

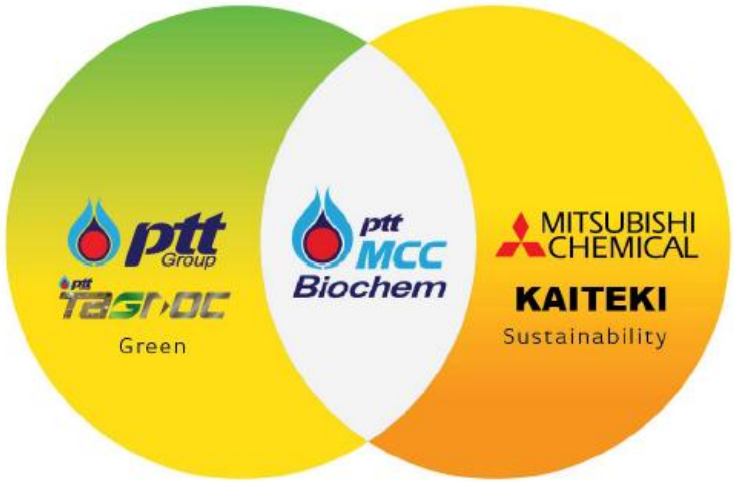
WORLD's LARGEST CORPORATION FORTUNE 500

BIOPBS

Biodegradable Plastics

#1

JAPAN'S LARGEST CHEMICAL COMPANY

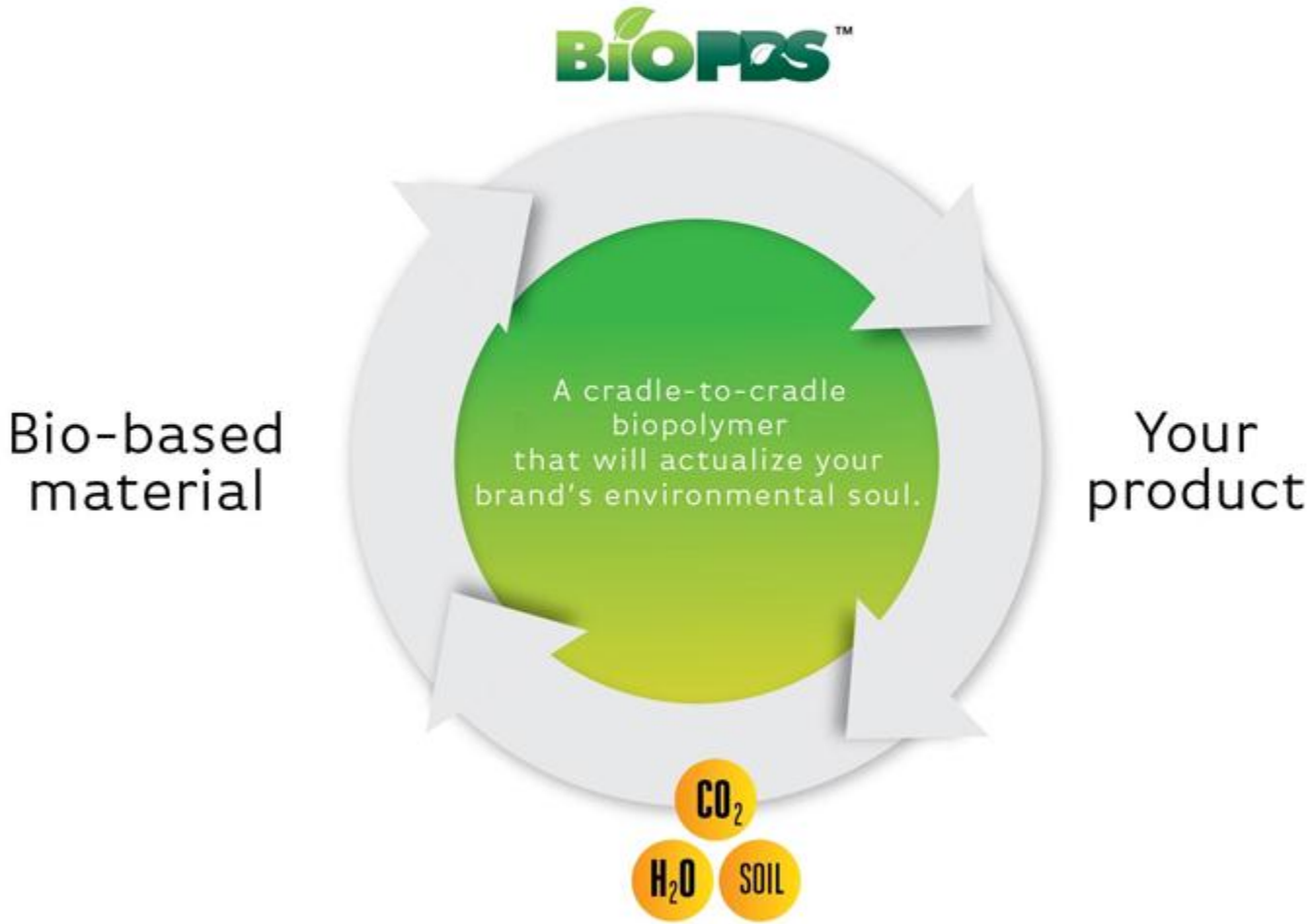


Agenda

- PTTMCC company profile
- PBS, how it works

WE'RE INTRODUCING BioPBS:

BioPBS: A FRIENDLY CATALYST TO HELP YOU BECOME AN ENVIRONMENTALLY FRIENDLIER BRAND.

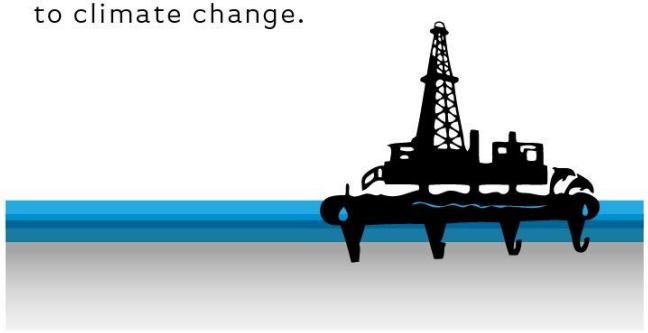


HOW? WE'RE DUAL LEVEL OF ECO-FRIENDLY.

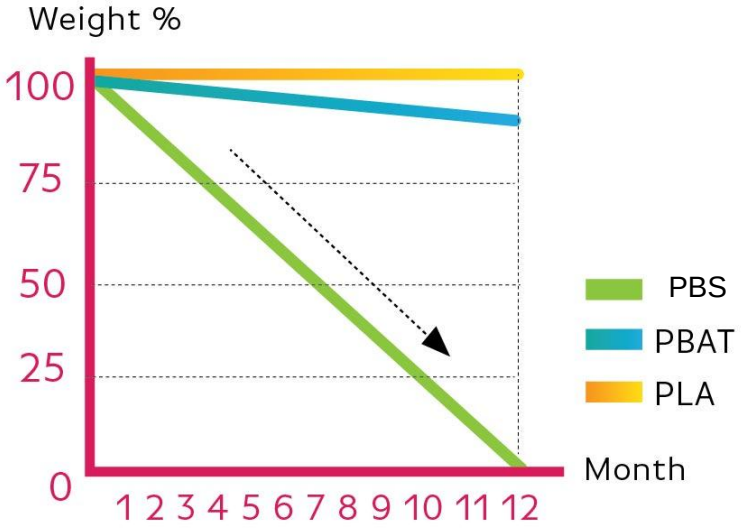
1. Renewable resource

By using bio-based material,

Compared to plastics made from petroleum, where CO_2 from the ground is brought up, contributing to climate change.



2. Biodegradability



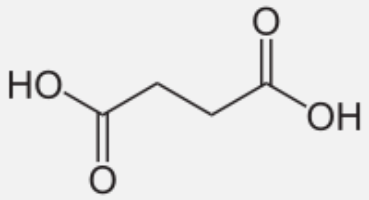
Our biodegradability is superior to others.
BioPBS degrades at room temperature.
So there's no need for special composting facilities.

What is BioPBS™?

PBS is generally produced from Succinic acid and 1,4-BDO.

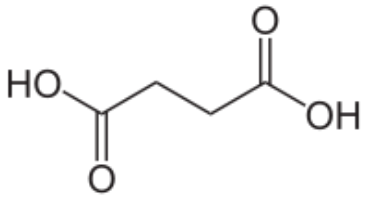
Raw sugar

fermentation



Bio-Succinic Acid

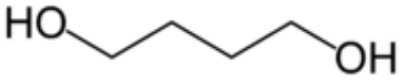
BioPBS™ Chemical Reaction



Bio-Succinic Acid

+

Change to Bio-BDO in the future



1,4-Butanediol

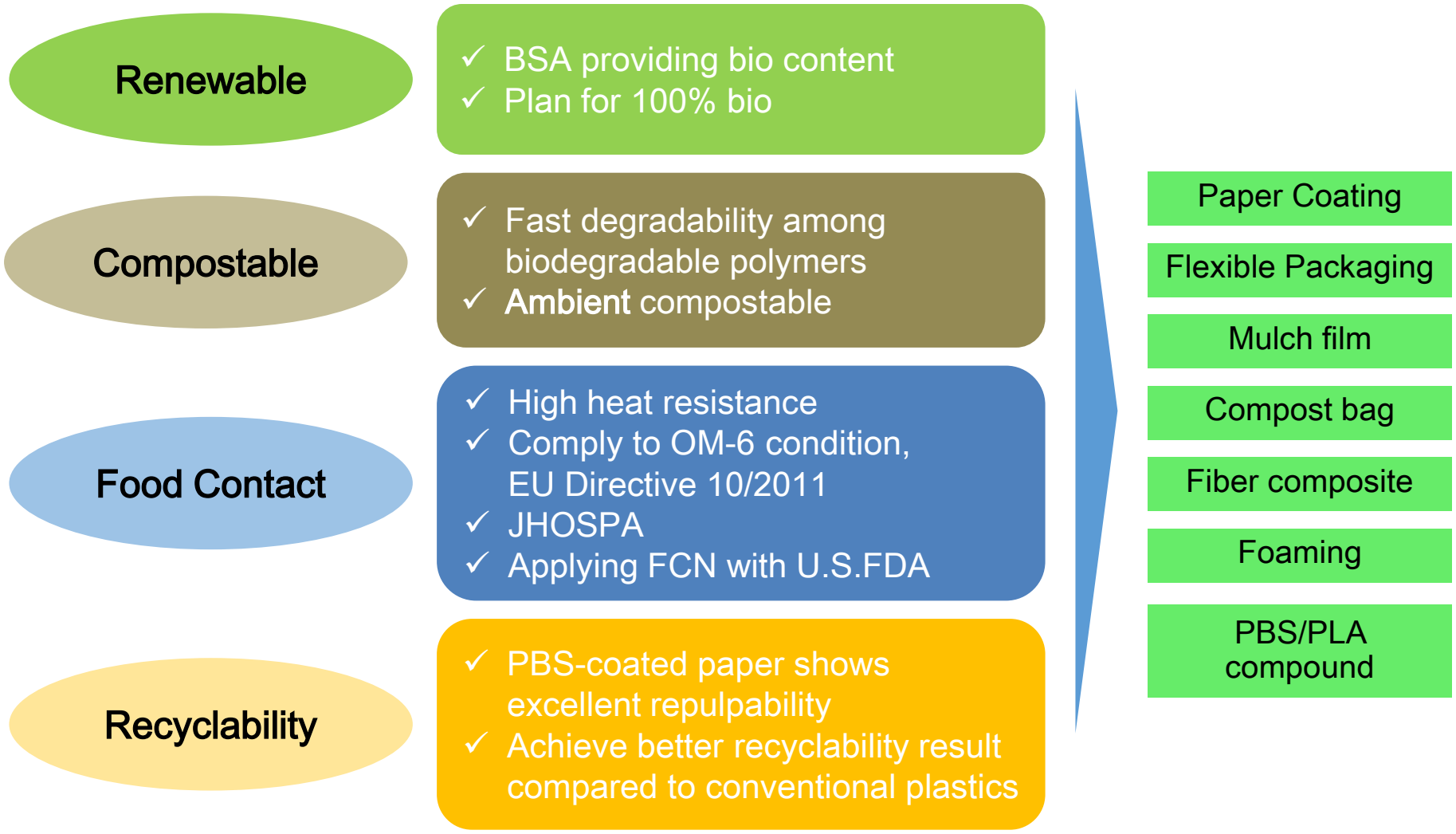
Esterification / Polycondensation

Catalyst, D

BIOPBS

+ H_2O

Why BioPBS™ is attractive?



BioPBS™ properties

Properties	Unit	BioPBS™		
		FZ91	FZ71	FD92
Melt Flow Rate (190℃/2.16kgf)	g/10min	5	22	4
Density	g/cm^3	1.26	1.26	1.24
Glass Transition Temp.	℃	-22	-22	-40
Melting Point	℃	115	115	84
Tensile Stress at break	MPa	30	30	24
Tensile Strain at break	%	160	120	380
Flexural Modulus	MPa	650	630	250
Izod Impact	kJ/m^2	7	7	47
Heat Deflection Temp. (0.45MPa)	℃	91	90	57
Rockwell Hardness (R scale)	-	103	102	56

Note: These values are typical and not to be construed as specifications.

BioPBS™ for paper coating

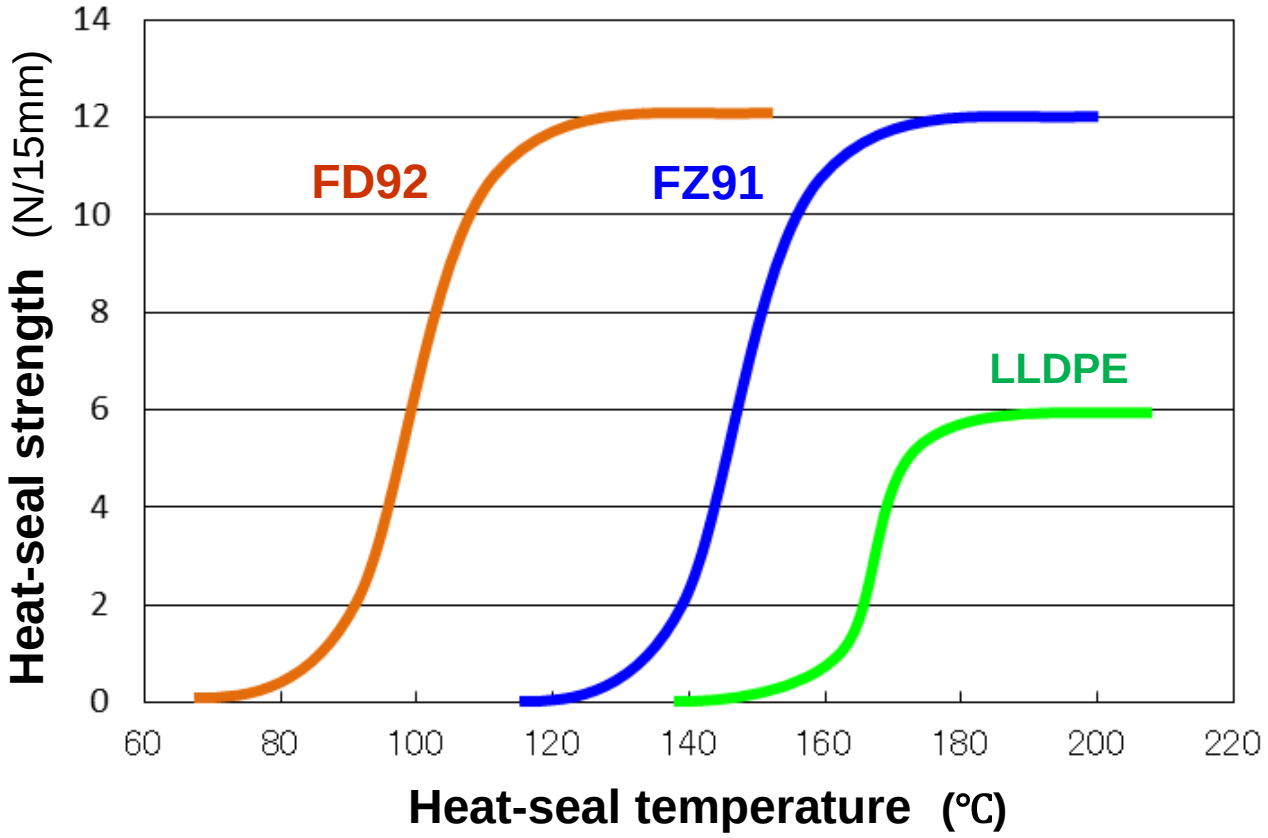
- **Excellent processibility** as good as LDPE
- Excellent **adhesion and seal strength**
- Coat **thinner** than other bioplastics
- Excellent **printability**
- Suitable for **hot food serviceware**
- **Compostable*** at ambient temperature
- **Recyclability** in paper mill

recyclable

passes WMU standard
www.wmich.edu/pilotplants

* BioPBS™ are being applied for major compostablity certificates ; AIB-Vincotte and BPI

BioPBS™ Heat Seal Property

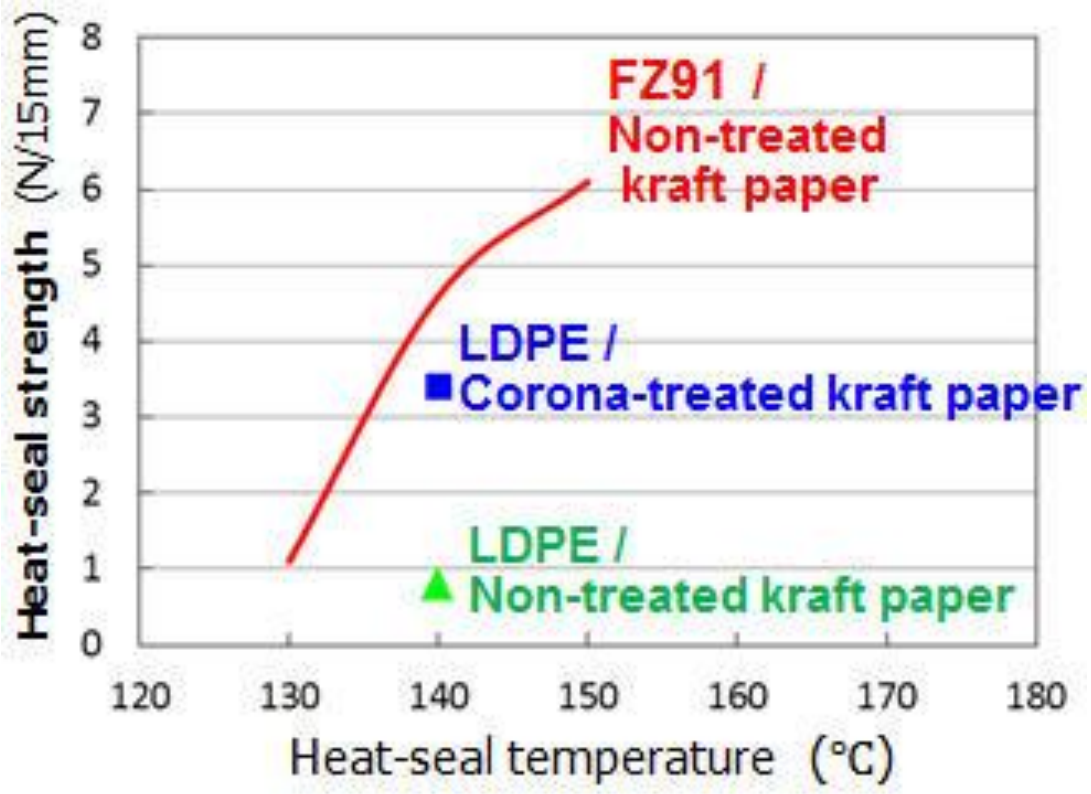


[Heat-seal conditions]		[Strength measurement conditions]	
- Pressure:	0.2 MPa	- Specimen:	20μm thickness film, width in 15mm
- Time:	1 sec.	- Chuck interval:	60 mm
- Seal width:	5 mm	- Test speed:	300 mm/min.

Excellent heat seal strength even at low temp

BioPBS™ Heat Seal Property

Polymer / Paper



Substrate: Kraft paper
Polymer layer thickness: 20μm
Heat-seal conditions: 0.2 MPa/1 sec.

Gas Transmission Rate of BioPBS™

Material	Gas Transmission Rate	
	H_2O (WVTR) [$g/m^2 \cdot day$]	O_2 (OTR) [$cm^3/m^2 \cdot day \cdot atm$]
BioPBS FZ91 (20 µm)	**620**	**770**
PLA 20 µm	680	1,900
PBAT 20 µm	900	> 2,000
LDPE 20 µm	26	8,850

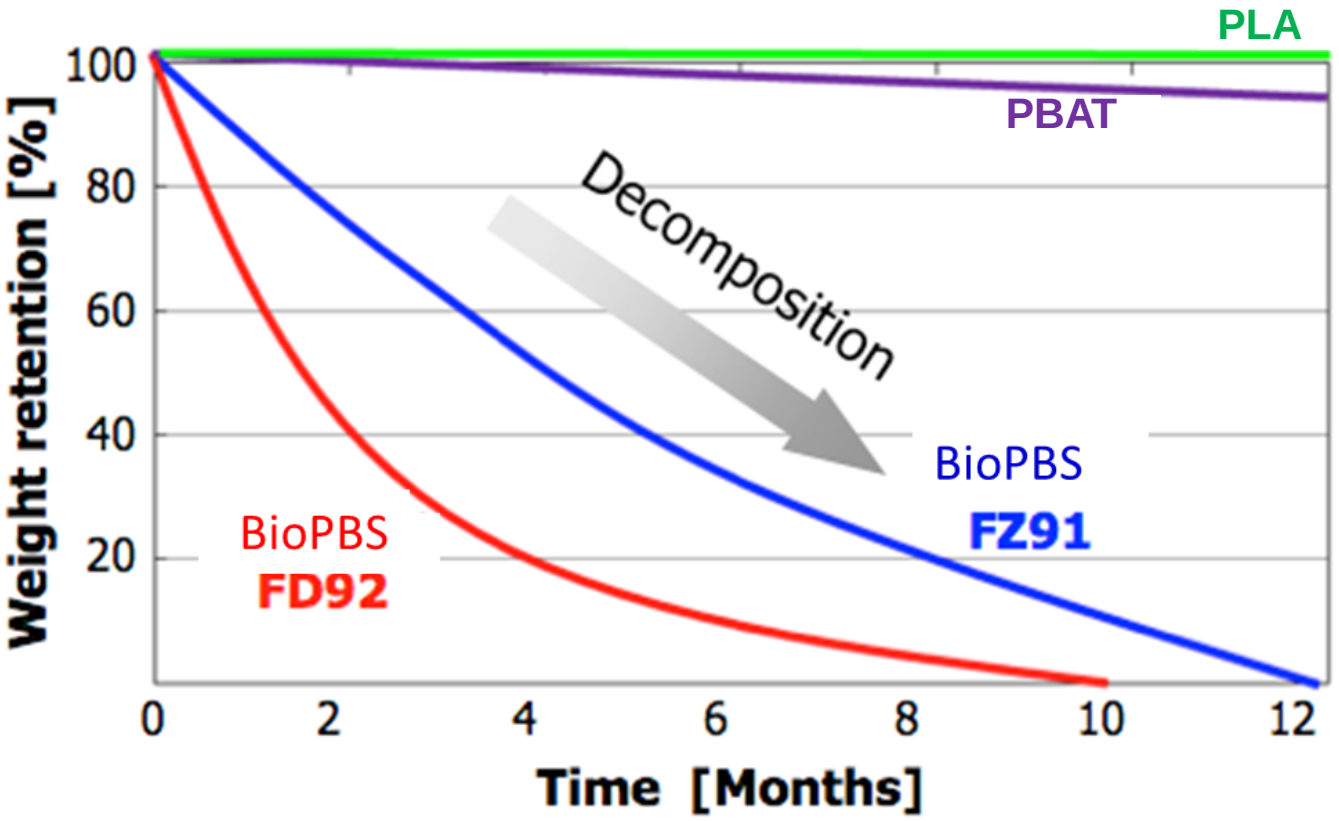
Gas Transmission Standard

H_2O (WVTR) : ASTM E96/E96m-10 → Temp. 38 °C / 90% RH

O_2 (OTR) : ASTM D3985-05 → Temp. 23 °C / 0% RH

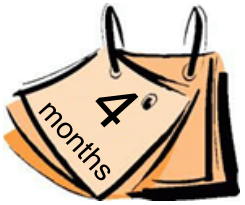
Ambient Biodegradability of BioPBS™

BioPBS decomposes into H_2O and CO_2 by microorganism in soil.
The decomposition rate is more rapid than PLA and PBAT.



200 microns sheet sample in soil at 30℃/50%RH

BioPBS™ is biodegradable in Soil



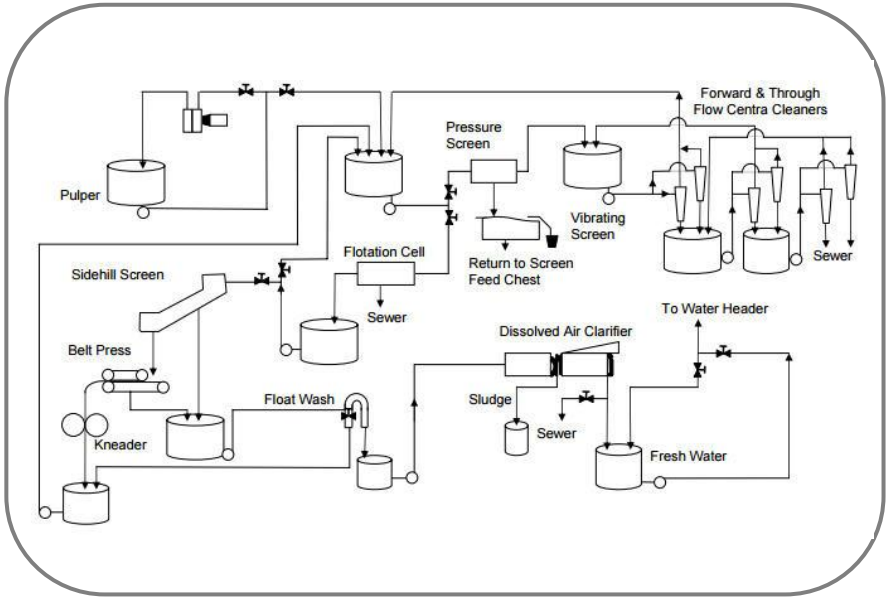
Buried in soil. No controlled conditions.

BioPBS™ Coated Paper Recycling Test by Western Michigan University

Western Michigan University is an independent third party testing and certifying source per Federal Trade Commission guidelines

Objective: To certify BioPBS-coated paper as recyclable and repulpable within the corrugated stream in paper mill.

Example: Starbucks adopted “EarthSleeve” certified by Western Michigan University



recyclable
passes WMU standard
www.wmich.edu/pilotplants

Certified Material:	BioPBS-coated cup stock paper, 2-sided coating
Repulpability Test:	✓ Pass Repulped fiber > 96%
Recyclability Test:	✓ Pass

Certification & Compliance Status

REACH Compliance	*Biodegradability & Compostability Certification*	*Food Contact Compliance*
Ready!	All under progress, tentatively to finish by OK Compost, OK Compost Home, GreenPla Mark BPI Mark **November , 2015***	EU No.10/2011 & JHOSPA Tentatively to finish by **December, 2015** FCN Under progress, tentatively to finish by **October, 2015**

* Only FZ91 grade will be certified first from BPI

FCN Progress - BioPBS™

Current scope of FCN:

Application	: All article types.
Food type	: All foods types, except alcoholic foods.
Condition of use	: **FZ grade – B to H.**
	FD grade – C to G.
Time line	: Submitted FZ FCN application to FDA – in June.
	FZ FCN will be approved by FDA – in October.

Note:
Condition B = Boiling water sterilized
Condition H = Frozen or refrigerated storage:
Ready-prepared foods intended to be reheated in container
Condition C = Hot filled or pasteurized above 150 deg.F
Condition G = Frozen storage (no thermal treatment in the container)

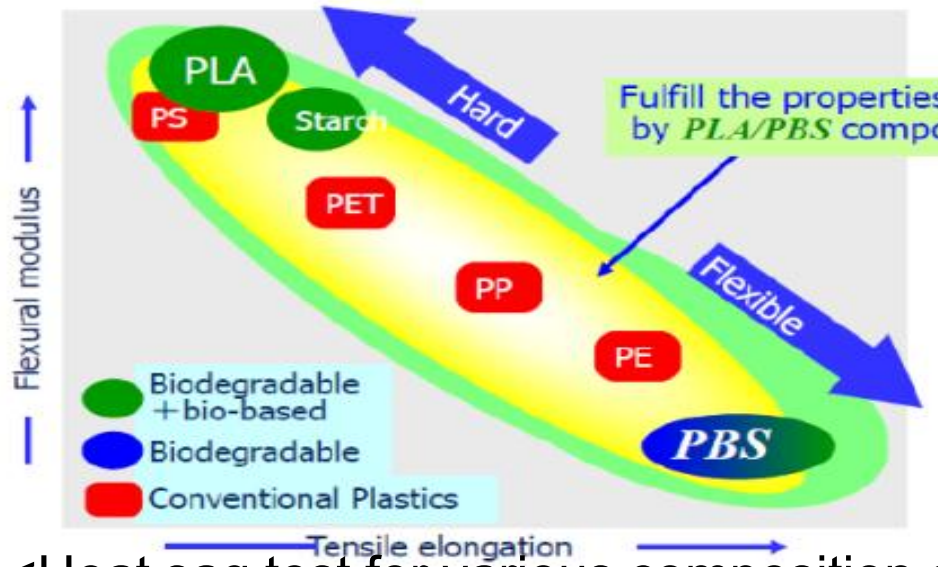
BioPBS™ for Flexible Packaging

- Excellent process in existing LDPE extrusion coating machine
- Excellent seal strength
- Compostable without composting facility
- Excellent printability without pre-treatment
- Good to retain aroma such as limonene
- Suitable* for packaging such as weak acidic, fatty and oily food

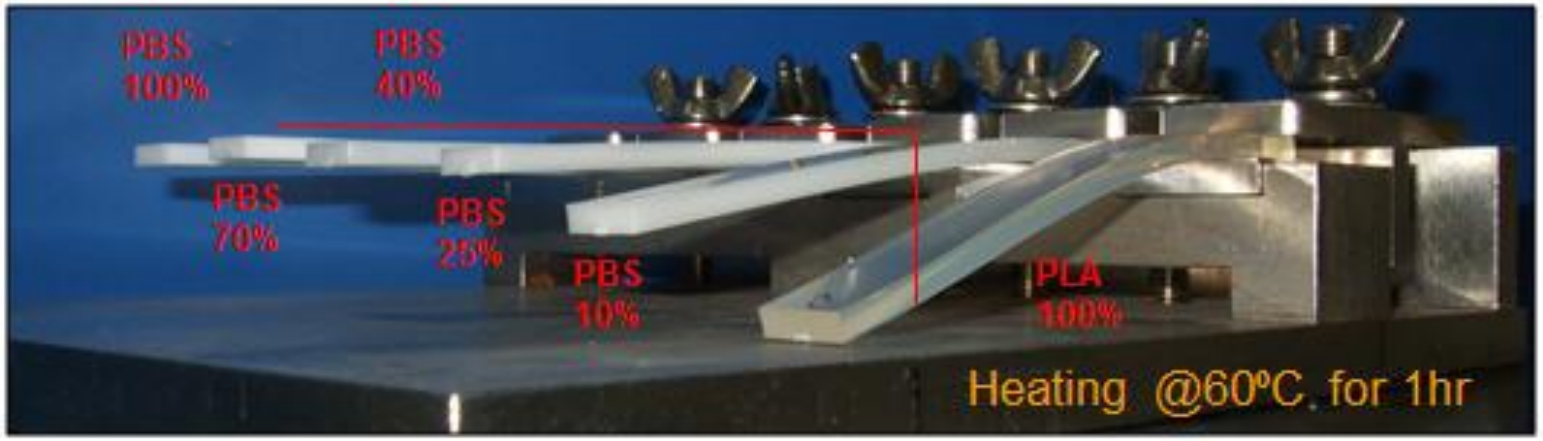
Metallized - cellulose film
Bio-PBS as sealing layer

* not actual film structure

BioPBS™/ PLA Compound

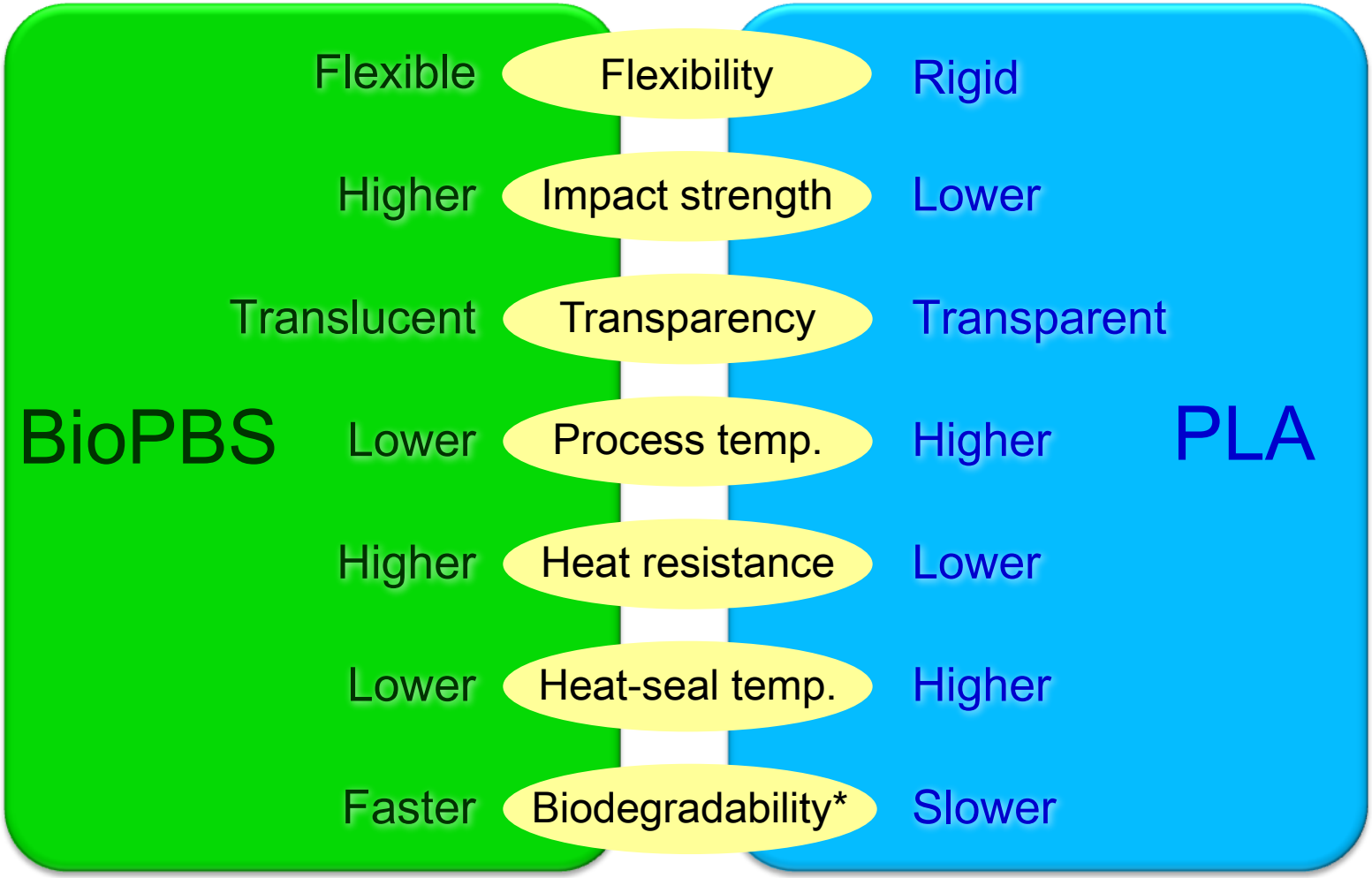


<Heat sag test for various composition of PLA / PBS>



PBS/PLA composite can improve the heat resistance of PLA and performance balance

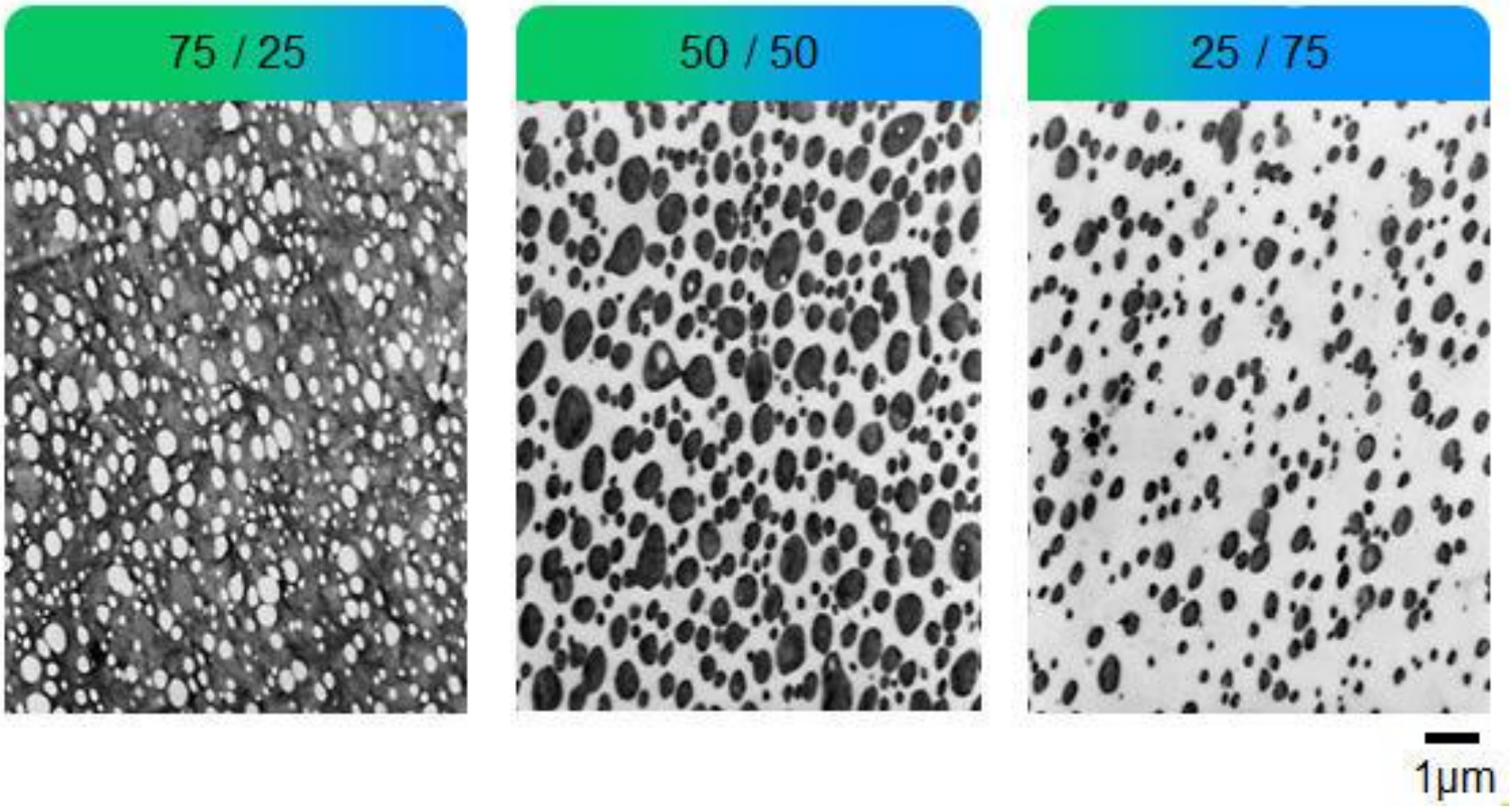
Property comparison of BioPBS™ vs PLA



* in soil at 30℃, 50%RH

Dispersion of BioPBS™ with PLA

BioPBS / PLA



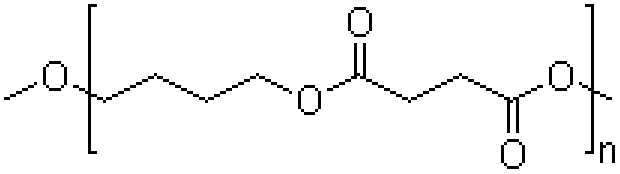
Compound of BioPBS™ with PLA shows good dispersion

Properties of BioPBS™ compound with PLA

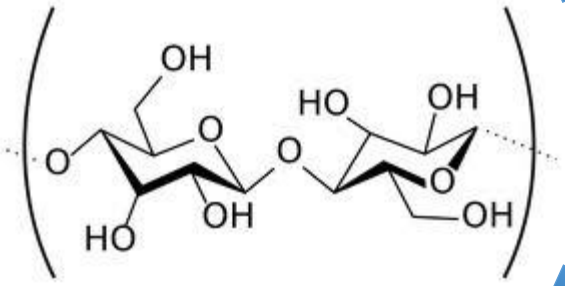
Properties		Test method	Unit	FZ91 / PLA [wt./wt.]				
				100/0	70/30	50/50	30/70	0/100
Density		ISO 1183	g/cm^3	1.26	1.26	1.26	1.26	1.25
Flexural	Modulus	ISO 178	MPa	650	1,400	1,950	2,500	3,300
	Strength		MPa	40	60	75	90	110
Tensile	Stress at yield	ISO 527-2	MPa	40	40	44	50	67
	Stress at break		MPa	30	28	27	34	67
	Strain at break		%	160	140	50	10	2
Izod impact (23 ℃)		ISO180	kJ/m^2	7	7	7	4	3
Heat deflection temperature (0.45 MPa)		ISO 75-2	℃	91	72	56	56	59
Rockwell hardness (R scale)		ISO 2039-2	-	100	105	108	112	120

Notes）These values are typical ones and are not to be construed as specifications.

BioPBS™ Affinity to Natural Fiber and Fillers

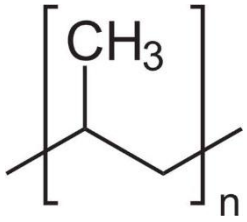


Polybutylene succinate



Cellulose

Strong adhesion between the polymer and filler due to *chemical* and *physical* interactions



Polypropylene

Weaker adhesion between the polymer and filler due to *physical* interaction only

How can you use BioPBS™ ?

The opportunities are endless.

How can you use BioPBS™ ?

Potential Applications

Thank You

ptt MCC Biochem | BIOPOS