- OBSERVANCE OF THE "WORLD CITIES DAY 2018" -

THE 2018 ANNUAL SESSION OF GLOBAL FORUM ON HUMAN SETTLEMENTS

Mr. K. Jim Jem

General Manager Greater China,

Total Corbion PLA,

Visiting Professor of JiangNan University

Beating Global Warming & Plastics Pollution Problems by 5 R's & Bio-plastics

- Global Environmental Crisis
- 5 R's: Reduce, Reuse, Re-cycle
  + Renewable & Replacement
- Bio-based & Bio-degradable Plastics
- Applications & Examples

GFHS Annual Conference, Bangkok, UN Asia HQ, Oct 30-31, 2018
甄光明　Dr. K. Jim Jem, Greater China GM, Total Corbion PLA JV
Visiting Professors of universities; Ex- China Chief Rep of NatureWorks

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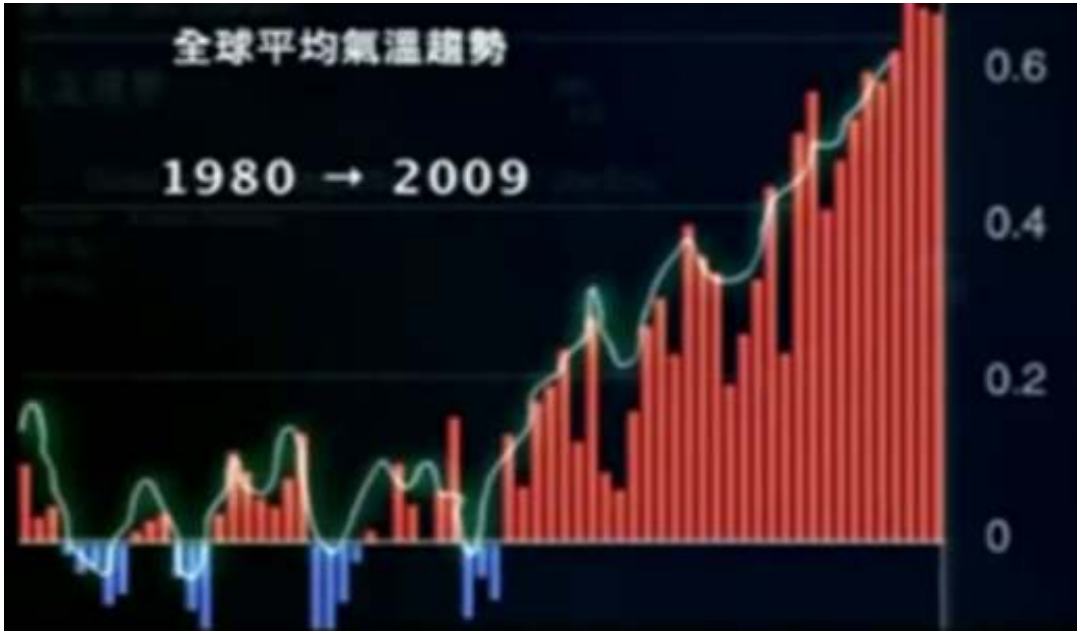
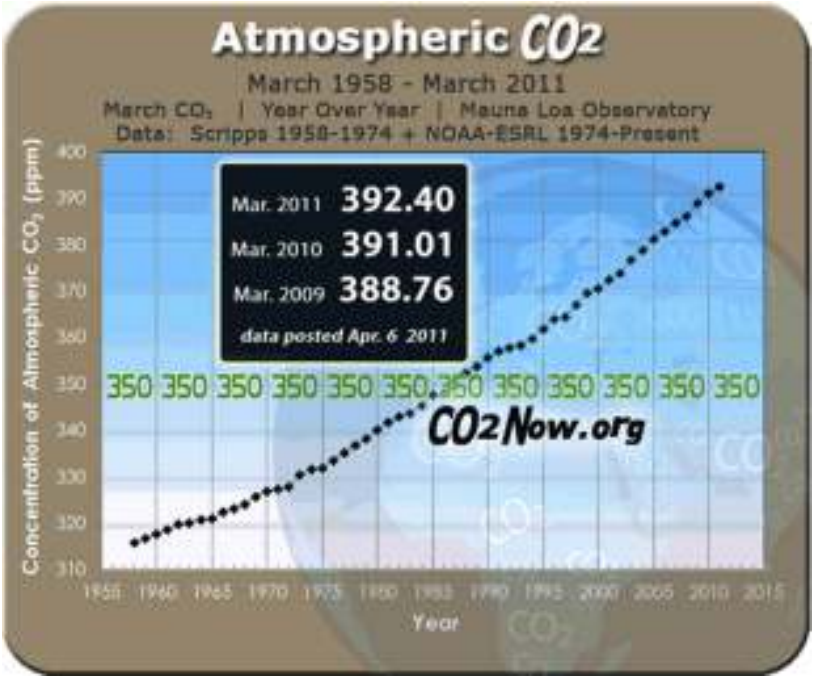
Global Warming vs. Green House Gases

- *Current Warming: 1.0 C above ave.*
- *CO_2 Level: 400 ppm*



Data from +/- 2 C Movie



From Earth Systems Research Lab (ESRL)/NOAA

Copenhagen COP 15 2009 & Paris 2015: By 2020, USA shall reduce 17% of the total carbon emission from its 2005 level. China shall reduced 40-45% of its carbon emission per GDP from its 2005 level.
Carbon reduction is the global consent now. With 1.5-2 degree C temp raise, melting of Ever-Frozen land release methane which causes more dramatic Green House effects than CO2, sea level may increase 61 meters due to ice melting.

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Global environmental crisis: global warming & plastic waste pollution

- Traditional plastics from petroleum results in global warming and solid waste pollution

Global warming

Globally 4% of GHG from MSW waste…

Ocean plastic pollution

>80% from Asia…

Source: WEF 2016

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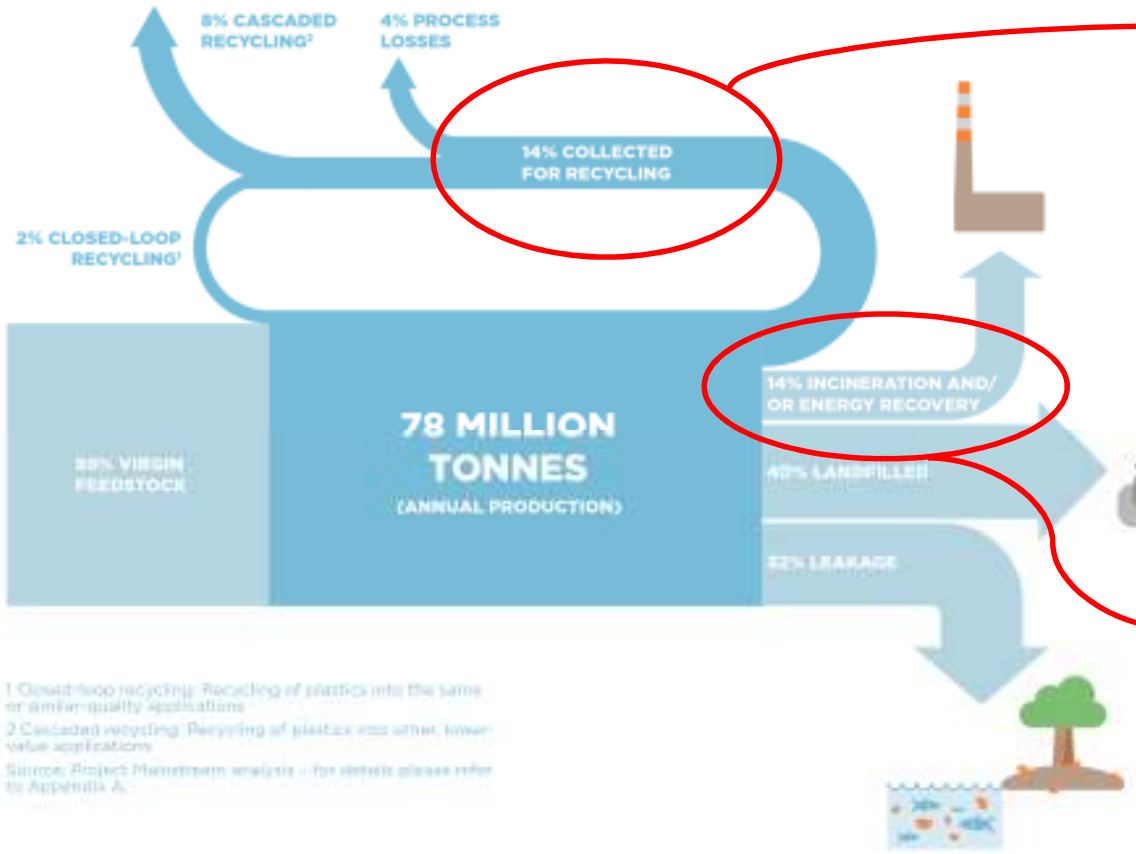
Why only 14 % of waste is being recycled ?



- Multi material packaging
- Difficult cleaning
- Difficult separation
- Separation from color
- Separation from additives
- Loss of quality (degradation)
- Down-cycling (not for food contact)

- Food with high water content not suitable for incineration
- It can go to composting and AD

Adapted from Source: World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, *The New Plastics Economy – Rethinking the future of plastics* p.27 "Global flows of plastic packaging materials in 2013" (2016, http://www.ellenmacarthurfoundation.org/publications).

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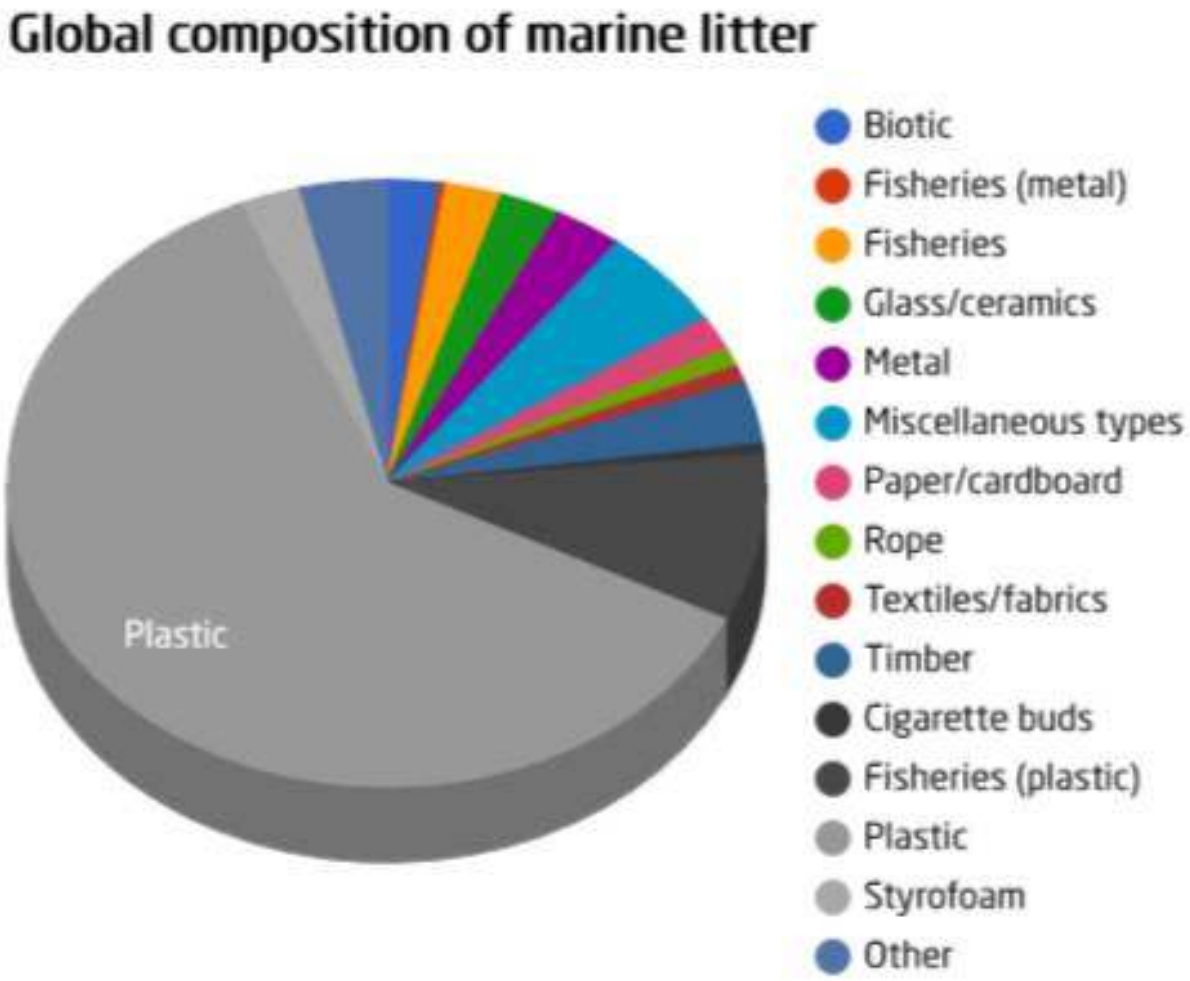
Garbage in the Sea: 75% Plastics



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Plastics' Life Span in the sea

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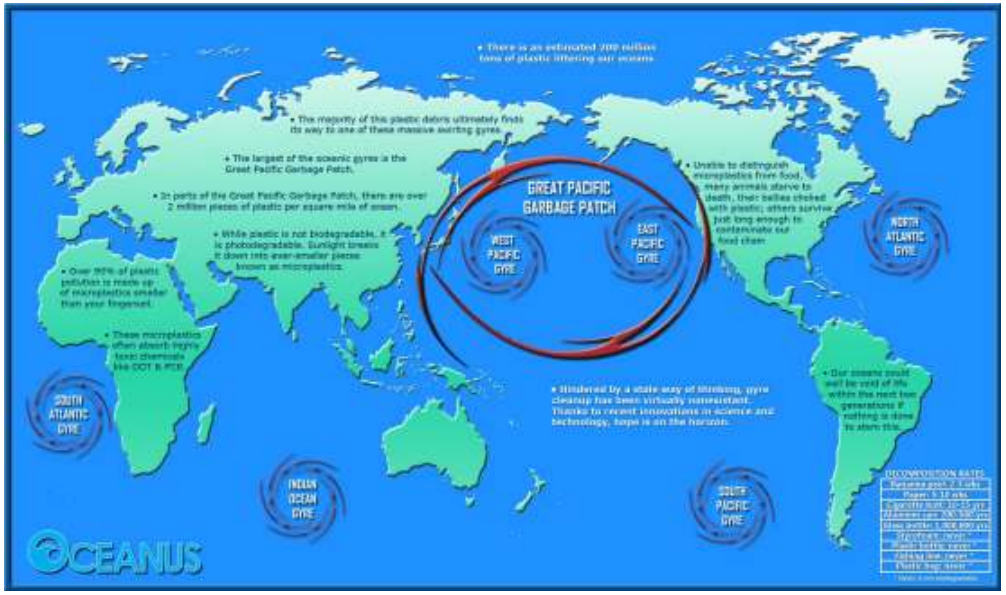
Great Pacific Garbage Patch:
Handerson Island as an example

Global plastic production: 300 million tons/yr. Total: 9.1 billions tons so far.
Only ~10% recycled. 3-8 millions tons/yr dumped into the sea.
83% Plastics pollution in the sea come from 20 countries. China is number one.
By 2050, there will be more waste plastics than fishes in the sea.



Handerson Island in the south Pacific Ocean: The most polluted island
28 million pieces of waste plastics, weight 17 tons, 671 pieces/sq meter

Plastic Nightmare for Marine lives







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Plastic straws and micro-beads: PM 2.5 in the sea (and on the land)

Plastic straws are facing global ban due to that poor turtle. But we only have seen the beginning of a much bigger problem when these ~150 million tons of waste plastics in the sea start to break down into micro-beads. On Oct 24, 2018, European Parliament just proposed to ban all dispossible plastic products.

Micro-beads from cosmetics (facing global bans) or from the broken waste plastics and synthetic plastic fiber from cloth rinsing will cause more and more pollution. Currently, ~600 plastic fiber & micro-beads per kg of sea salts. In Oct 2018, scientists just identified micro-plastic-beads in all tested human bodies.

How to resolve the plastic pollution problems? Traditional vs. New approaches

Traditional approaches:

Incineration: Limited due to high costs and air pollution

e.g. burning the plastic garbage to generate some energy,,,

Disposing: Land filling (polular for under-developed countries)

e.g. Just bury it.

Exporting: (importing of waste plastics banned by China, now Thailand, etc.)

e.g. Shipping the plastic garbage from rich countries to less developed countries

Termination: Not realistic for many applications

e.g. Banning all traditional non-degradable plastic bags, egg containers,,,, for disposable or even some durable applications

3 R's: Reduce, Re-use, Recycle

Reduce: Restricting traditional non-degradable plastics by charging extra fees, etc.
Re-use: e.g. Use the same PET water bottle again for personal usage
Recyle: e.g. Collect all PET bottles then turn into fiber products

4th R: Renewable (from & back to the nature)
5th R: Replacement (by bio-plastics)

Bio-based Plastics: From plants (bio-based) instead of petroleum-based. Reduce carbon foot print & global warming. May be bio-degradable (e.g. PLA) or may be not (e.g. bio-PE).

Bio-degradable Plastics: Reduce Solid Waste Pollution. May from petroleum source (e.g. PBAT) or may from bio-based (PLA, PHA). May produce bio-gas and be compost into fertilizer (back to the nature).

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Bio-Plastics: Bio-based vs. Bio-degradable

Represent a fraction of the total plastics market

PBAT (& PBS/A)

- Biodegradable, typically from oil
- Primarily used in blends with starch and PLA

Bio-PET

- Drop-in replacement for oil-based PET
- Currently only 30% bio-based, not degradable
- Used for bottles

Bio-PE

- Drop-in replacement for oil-based PE
- 100% bio-based, not degradable
- Produced from bio-ethanol with low yields

Starch (and cellulosic fiber)

- Bio-based & biodegradable
- Cheap but with low property performance
- Used as a filler for other (bio)plastics

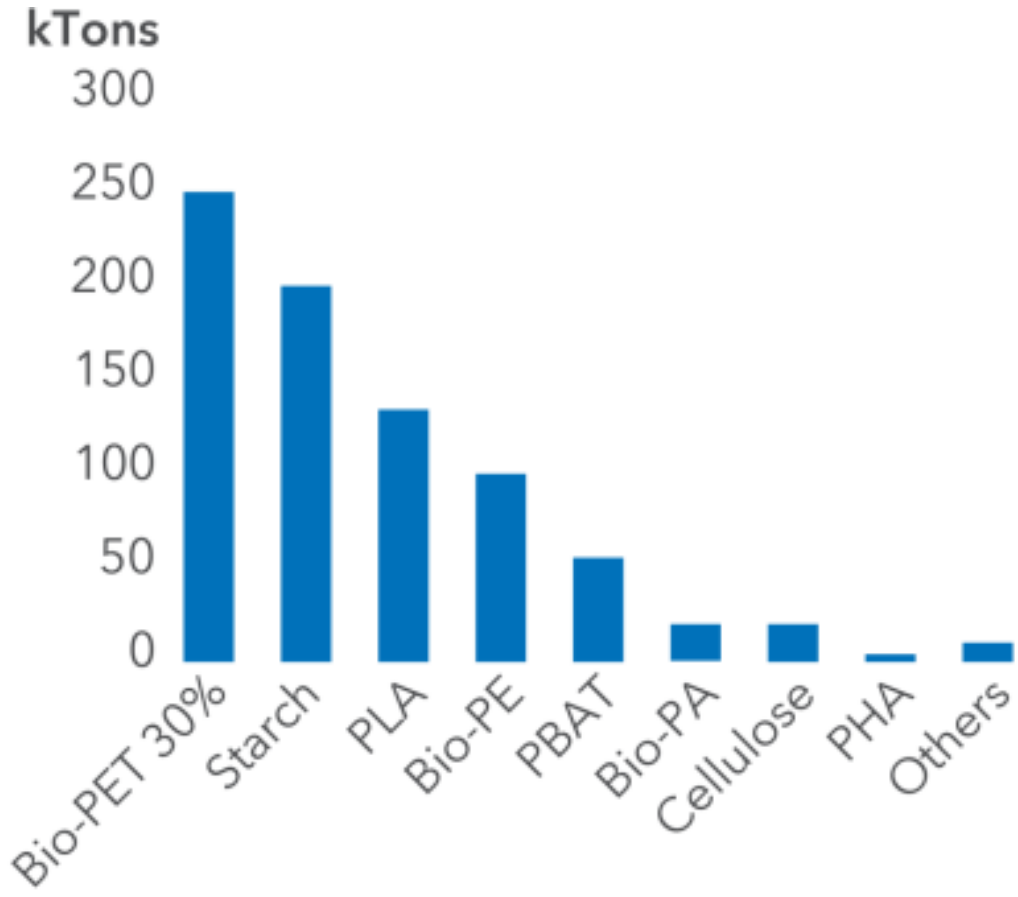
PLA

- Bio-based & biodegradable
- High stiffness but brittle
- Transparent for cold applications

PHA group

- Bio-based & biodegradable
- Early stages of commercialization

~1 million tons of bio-plastics in 2017



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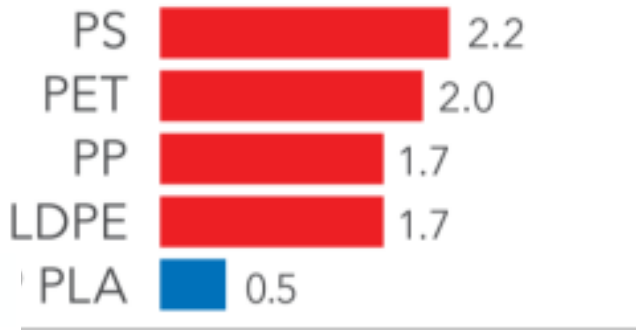
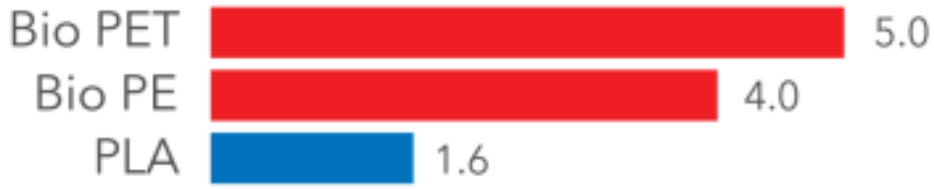
Bio-based plastics (e.g. PLA, PHA, and bio-PBS)
Lower carbon emission to reduce global warming

Carbon Footprint Emissions from production of common polymers*



Carbohydrate Usage of Bioplastics
(kg sugar per kg plastic)



Sources: www.lca.plsaticseurope.org and Int, Journal Life Cycle Assessment, *LCA of the manufacture of lactide and PLA…* 3 Aug 2010.

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Improve BioPlastics' performance for high added value markets

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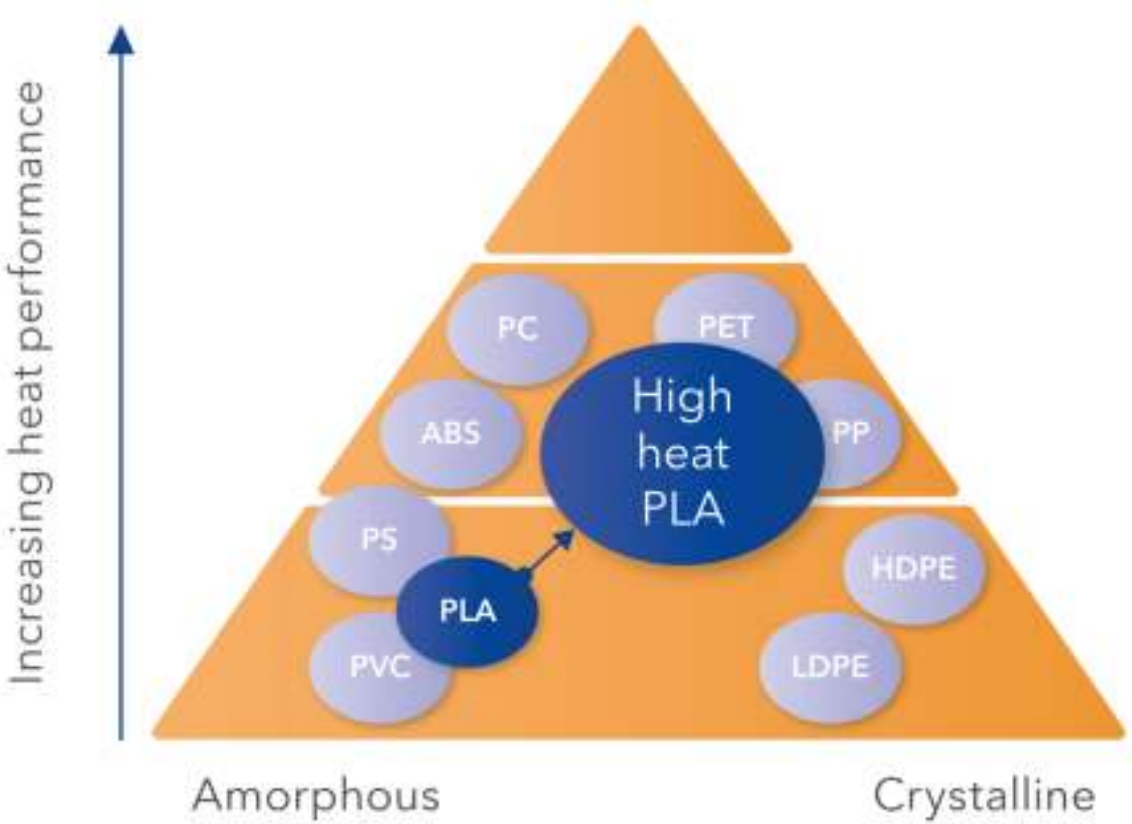
Improve Bio-Plastics (e.g. PLA) to match traditional plastics

PLLA and PDLA homopolymers:

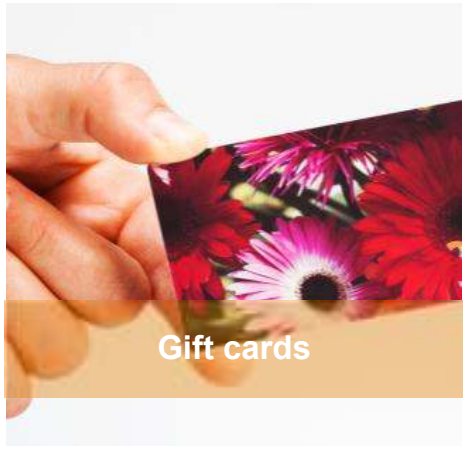
- Crystallize fast = improve processing economics
- Improve heat performance



PLA technology from Total Corbion PLA can replace PS, PP and ABS-like materials in applications where heat performance is a key requirement.

Bio-Plastics in commercial applications today


Cups & lids

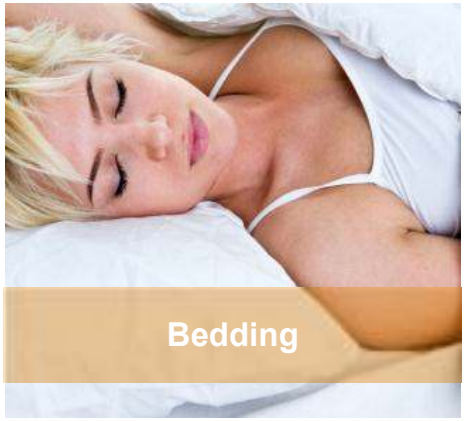

Gift cards

Coffee capsules


Packaging films & labels


Consumer goods packaging


Food packaging containers


Bedding


Apparel

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Bio-Plastics PBS/PLA for food package, cups, etc

Benefits:

- Bio-based & bio-degradable, Recyclable and compostable
- High heat resistance if needed
- Food contact safe. Natural materials.
- Good processing economics, fast speed and cycle time similar to PS
- Can be processed on existing polymer lines

Coffee Cups

Fruit package

Coffee Capsules

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BioPlastics/PLA fibers for apparels, fillers, non-woven bags, etc

Benefits:

- Bio-based and bio-degradable
- Mite resistant, non-allergenic, microbe-static, etc.
- Reduce cotton usage (& virtual water)
- Reduce micro-fiber pollution

Apparels & filler

Wet wipes

Non-woven bags, tea bags, diapers, etc.

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BioPlastic/PLA for Consumer Electronics: cell phone cases, computer housings, etc.

Benefits:

- High heat resistance
- Biobased & bio-degradable
- Excellent high gloss finish
- Excellent impact resistance
- High dimensional stability allows for tight tolerances

Cell phone case

纳通 NATON

Bio-plastic speaker

Touch screen computer

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BDP/PLA/Starch for Agriculture applications injection molded root trainers for trees/rice

Benefits:

- Bio-based & biodegradable
- Strength & stability
- Better root growth
- Automation to reduce labor needs
- Thailand: local made for local usage

Thai Rubber Association

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BDP/PLA for 3D printing: Medical, Culture, Art & Design

Benefits:

- Bio-based, biodegradable, and re-cyclable
- Safe for families, schools and studios
- No toxic vapor. Sweet odor.

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The different EOL (End-Of-Life) for Bio-degradable plastics

Recycling

Landfill

Incineration

EOL for Bio-Plastics

PLA

De-Polymerization

Bio-Gas

Composting

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Acknowledgement

For our own Earth

Thank you:

Acknowledgement: Naton Medical Group

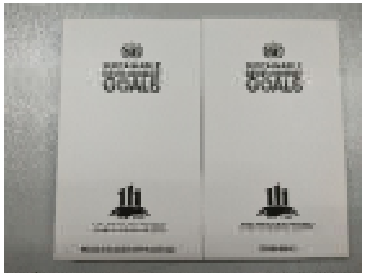
Naton Medical Group Founded in 1996， with over 3,300 employees

Dedicated to medical and healthcare sector, Naton provides quality products and services to patients.

Naton is a product and service provider for medical implants covering whole industrial chain

Focused on orthopaedics, Naton continue to develop medical implants and expands to related areas

Naton has a complete patent layout in the core technology of biodegradable materials. Its products cover spine, trauma, CMF, sports medicine, dentistry, biological materials and other fields.



Naton has been committed to the research and development of industrial and medical PLA . The PLA composite technology developed by Naton, which has independent intellectual property rights and reaches international advanced level.
The PLA composites has obtained the industrial compost degradation certification of German DIN CERCO.
The PLA composites have been successfully applied in high-end medical equipment and industrial fields, such as tableware, credit cards, automobiles, medical supplies, electronic appliances, etc.
All of the iPhone cases of NATON are made of bio-based degradable materials.

Acknowledgement: Puyang Yurun Group

Puyang Yurun New Material Co., Ltd. is located in Nanle, Puyang, HeNan Province in China. Yurun specializes in the research and development of polylactic acid (PLA) fiber products such as bedding, household clothes, T-shirts, natural deodorizing socks, autumn trousers, etc, In 2017, it won the "Best Partner of the Year" award of China Chemical Fiber Industry Association, and also won the "Best Application Award of Eco-friendly Materials" and "Innovation Award Enterprise“ in the second China Eco-Fabric Design Competition.

PLA fiber products are good to yourself and to the environment. They are micro-static, mite resistant, non-allergenic, and neutual to human skin. They reduce cotton usage, virtual water demand, and micro-fiber pollution to the environment.