

Sustainable Food Contact Material in China

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About IQTC-FCM

- **IQTC** is based in Guangzhou and is one of leading institute in China , under the organization of China Customs, with a history of more than 40 years ,dedicating to provide the technical service for government and industry, particularly on food, food packaging and consumer products
- **IQTC-FCM** ,a national reference lab ,the chairman of China Food Industry FCM experts committee, specialized in regulatory, testing and risk assessment for food contact materials



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Summary

Since the invention of food package, we've been using it for more than a thousand years....



Plastic is one of the greatest 100 inventions in human history.

- **Aerospace technology**
- **Cars and ships**
- **Electrical and electronic appliances**
- **Food packaging**
- **Modern agriculture**
- **Processing machinery**
- **Medical and pharmaceutical sciences**



Plastic food packaging: most important role to make food into a food product

Natural protection



Packing protection



Prevent chemical/biological contamination
Avoid spoilage
long distance transportation
long-term storage

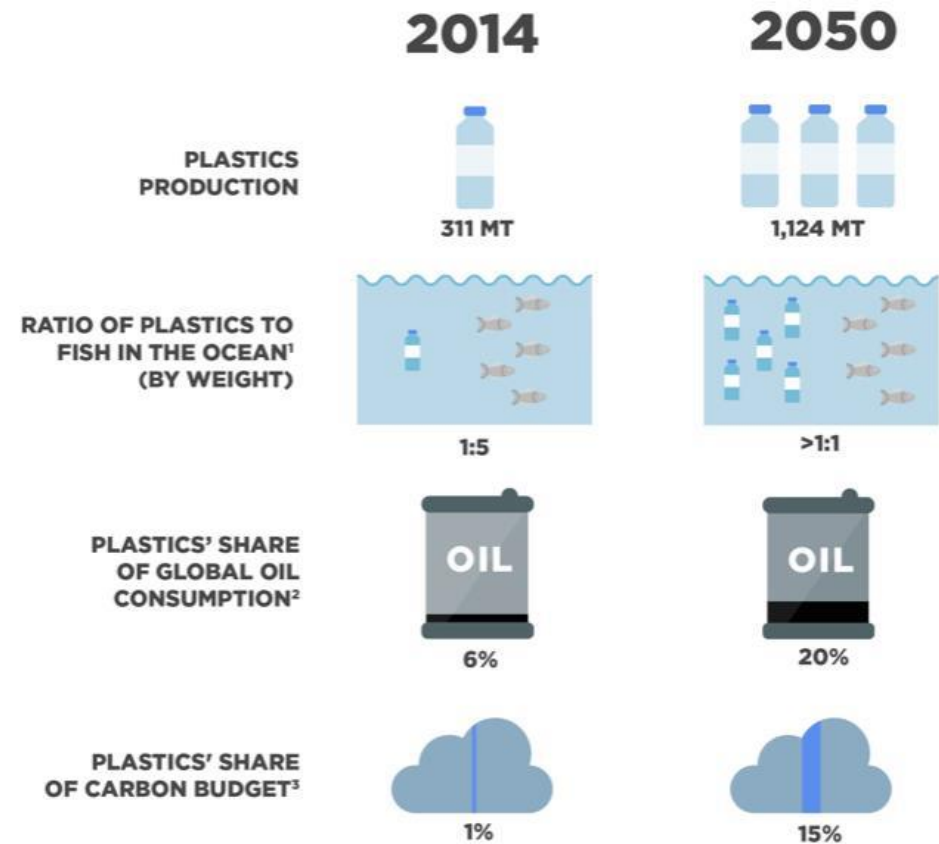
- **Build a brand**
- **Improve consumer experience**
- **Address hunger**
 - 1/4-1/3 food get spoiled
 - 815m hungry people around the world

Improper use/disposal of plastics: serious marine ecological safety problems

8 million tons of plastics end up in the ocean

Centuries to be fully biodegraded

Loss of \$130 billion per year, weight of plastic wastes in the ocean > total weight of fish till 2050



Plastic waste is huge and difficult to recycle and biodegrade

8.3 billion(1st half 2017)/6.3 billion(2015) tons of waste plastics

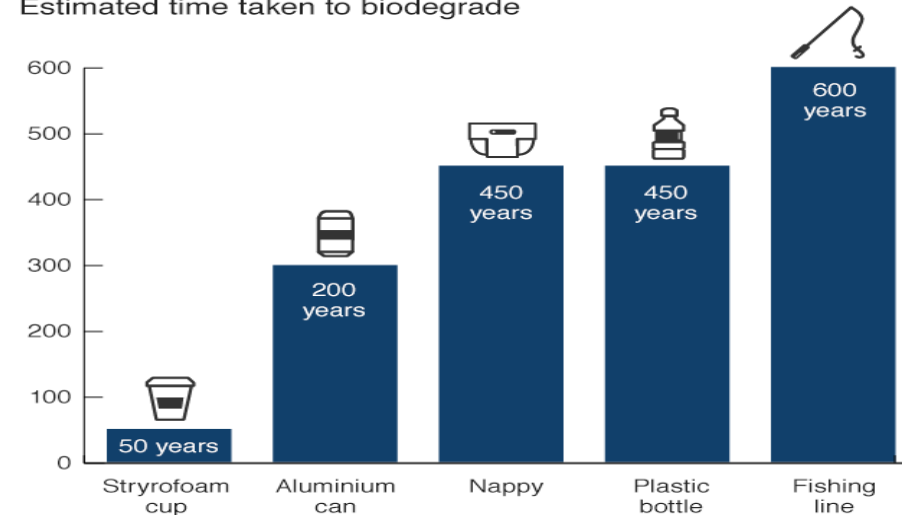
25-35% Plastic package for food

9% recycled
14% recycled

- C-C chemical bond is difficult to degrade
- Blending compounds: difficult to separate and difficult to classify
- cross-linked structure; insoluble, infusible, difficult to process

How long til they're gone?

Estimated time taken to biodegrade



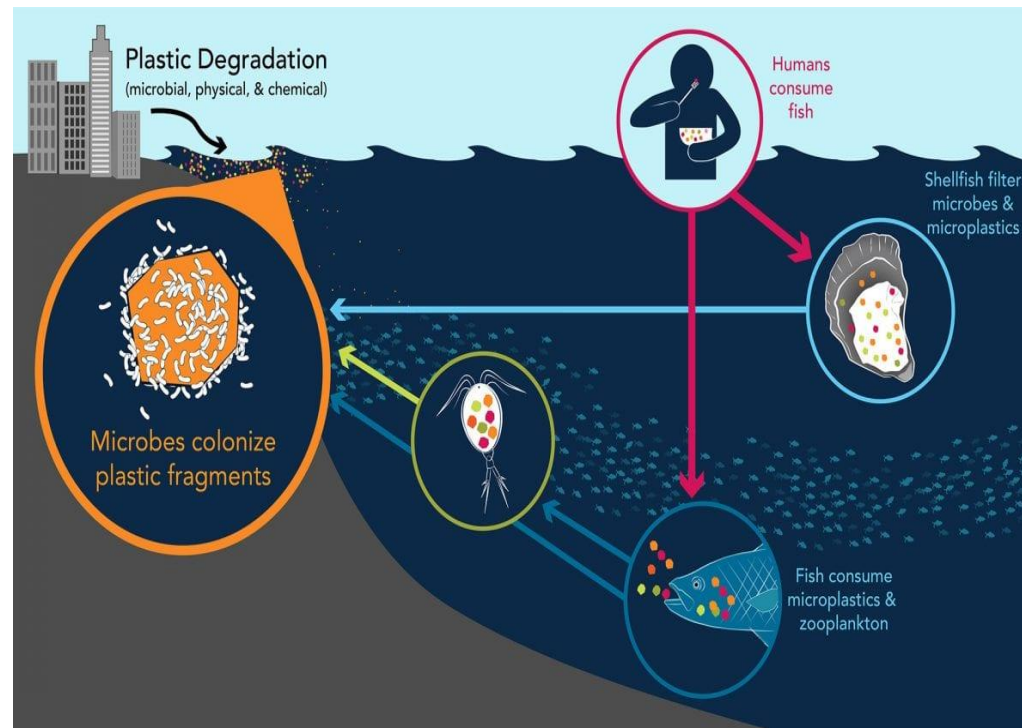
Exact time will vary by product type and environmental conditions

Source: NOAA / Woods Hole Sea Grant

Improper use/disposal of plastics: serious biological and food safety problems

Marine trash: Endanger Marine biological safety, 50% beach wastes are single use disposable plastics

Microplastics: food safety and health risks



Marine pollution of plastic micro-debris in China is at the medium level

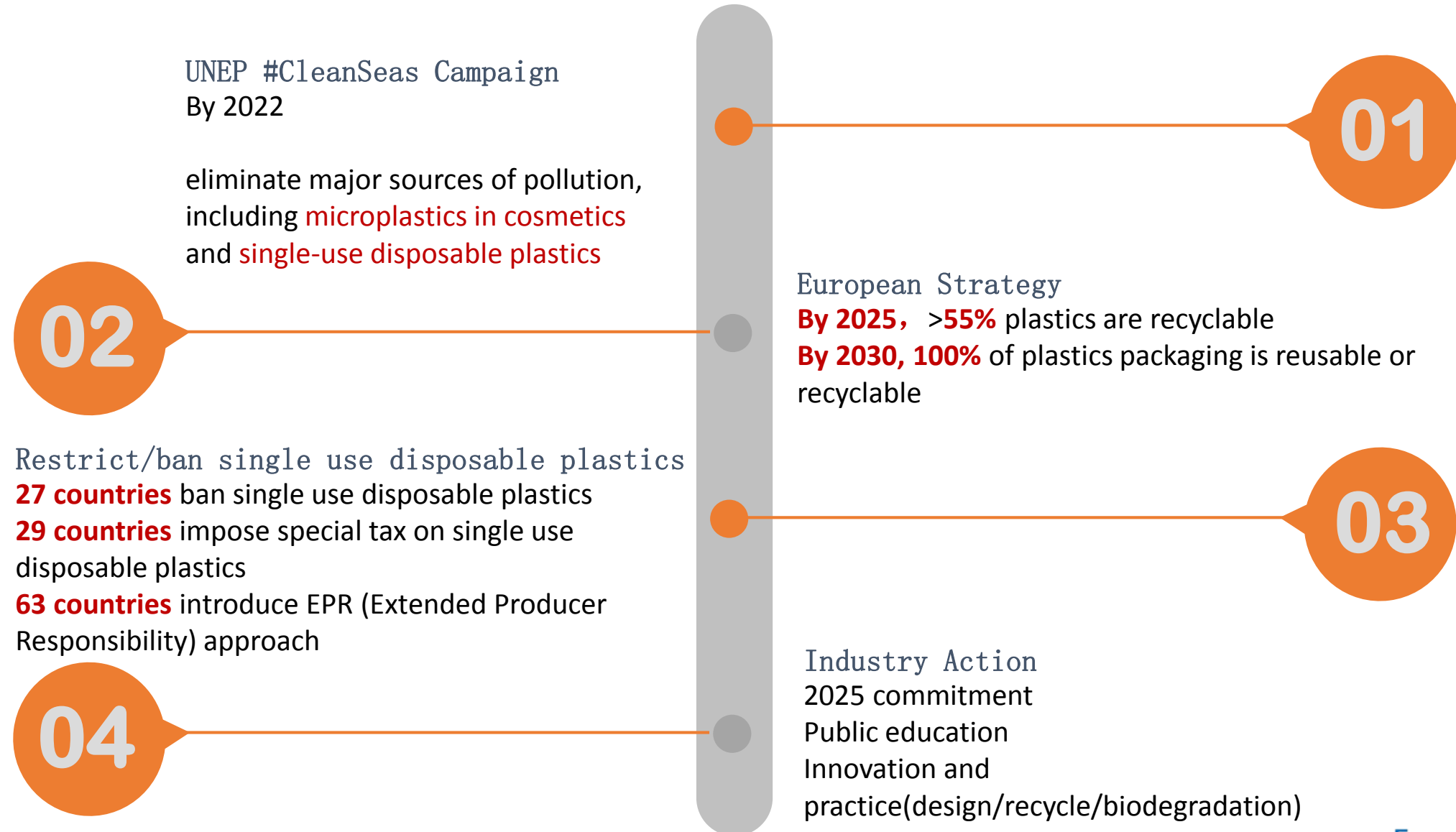
- Nearshore fish: 1.1-7.2 items per fish,
- Seashells: 0.9-4.6 items per gram of soft tissues

Source: 海洋塑料微塑料污染及应对, 中国海洋报, 2018-12-18

Global Action - Promoting Plastic Pollution Governance for Sustainable Development



Priority : Promote the sustainable development of Food Contact Materials



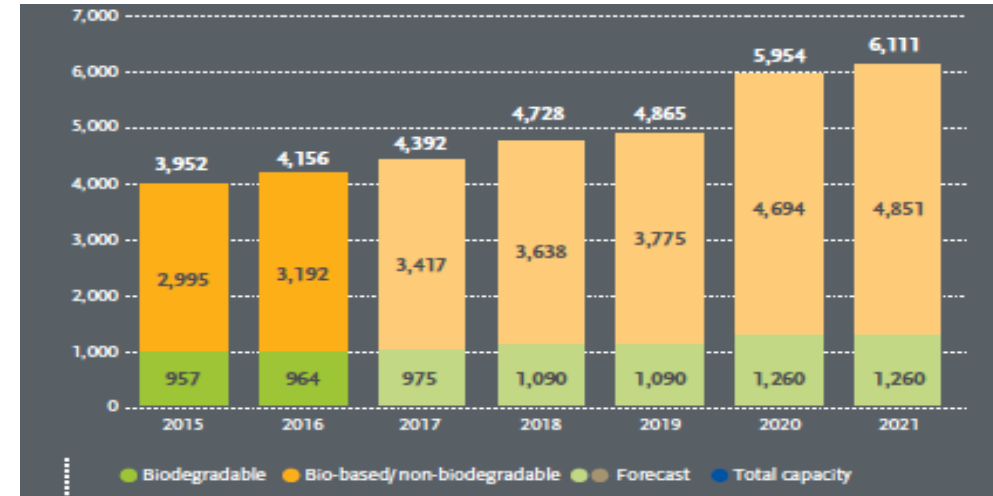
The main approach taken on FCM

- **Using biodegradable material to replace oil-based plastic**

The production volume of PLA、PHA are increasing

- **Encouraging the use of recycled materials(R-PET)**

- EC proposed to approve >100 application of R-PET in FCM in 2019
- 21% R-PET containers were used for FCM and beverage bottle*



Source: European Bioplastics, nova-Institute (2016).

* : The National Association for PET Container Resources

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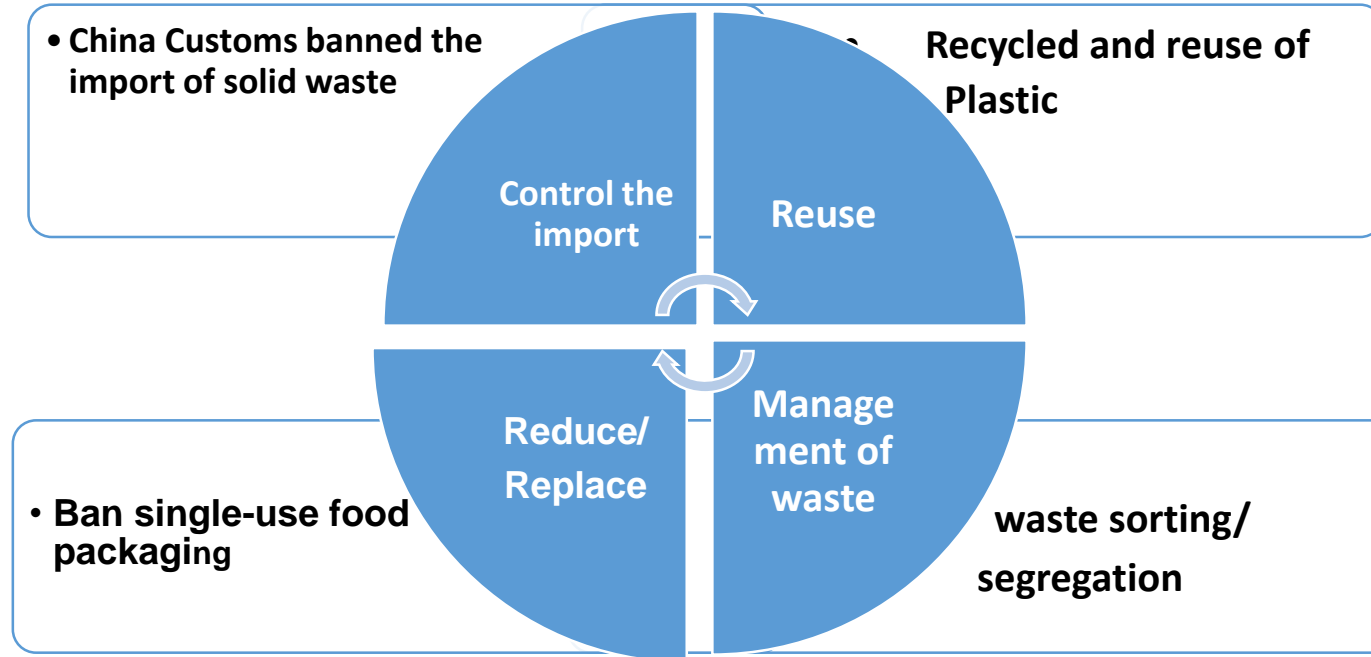
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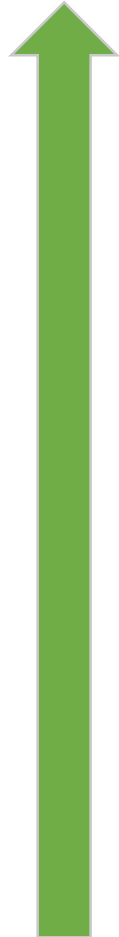
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Summary

China is active on Sustainability



China's initiative: encourage recycling



June 5, 2019: Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes (Revised Draft)

2018: Revision of the Catalogue of Imported Waste Management

2017: “Initiative to Guide The Shift Toward Circular Development ”plans to increase the recycling of major wastes from 47.6% in 2015 to 54.6% by 2020.

2015: “Specifications for the Industry of Comprehensive Utilization of Waste Plastics” and “Interim Regulations on the Announcement and Management System of Specifications for the Industry of Comprehensive Utilization of Waste” (Ministry of Industry and Information Technology)

2012: “Regulations on the Prevention and Control of Waste Plastics Processing and Utilization” (Ministry of Environmental Protection) ; Technical Specification for Pollution Control of Waste Plastics Recycling and Recycling (HJ/T 364-2007)

2010: Recycled plastic must not be used in plastic food containers, packaging materials, utensils, etc. Abolished in Dec

2008: Notice on Restricting Production and Sales of Plastic Shopping Bags (ODD, 2008)

The sheet of R-PET produced by Yingchuang was authorized to be used for manufacturing of food grade PET

2007: Regulations on the Management of Recycling Resources

China Initiative: Restricting single use disposable plastic products

In 2015, Jilin became the first province in China that banned single use non-degradable plastic products.

Single use non-biodegradable plastic bags and plastic tableware will **be banned to manufacture, sell or use** in Hainan province by 2020.

The production, sale and use of the plastic products listed in *the Catalog of Non-degradable Single Use Plastic Products Banned In Hainan Province*, in addition to bags and tableware, will be prohibited by 2025 in the province,



Impact to China Food Industry

China: largest country to produce plastics: 30%

China's food and beverage industry posted a record high of around 4.3 trillion yuan in revenue in 2018, accounted for 11.2% of the total volume of retail sales, and 4.7% of the total volume of National GDP

The waste volume obtain from take way single-use food packaging in China is staggering



Question : Can biodegradable or recycled materials be directly used to make FCMs in China?

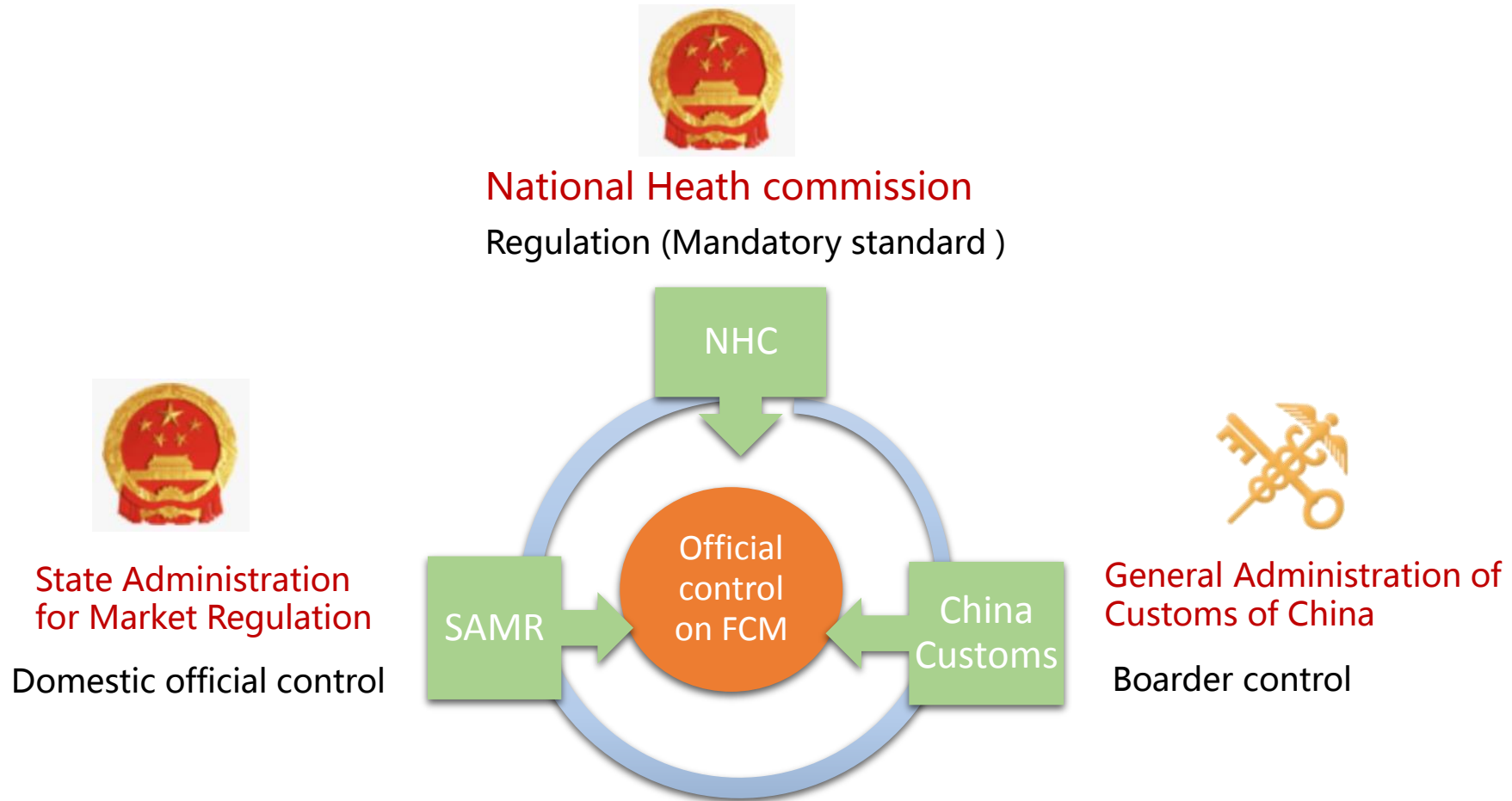


- Consumer misuse
- Non-food application
- Degradation
- Chemicals from other materials
- Chemicals used in the recycling process

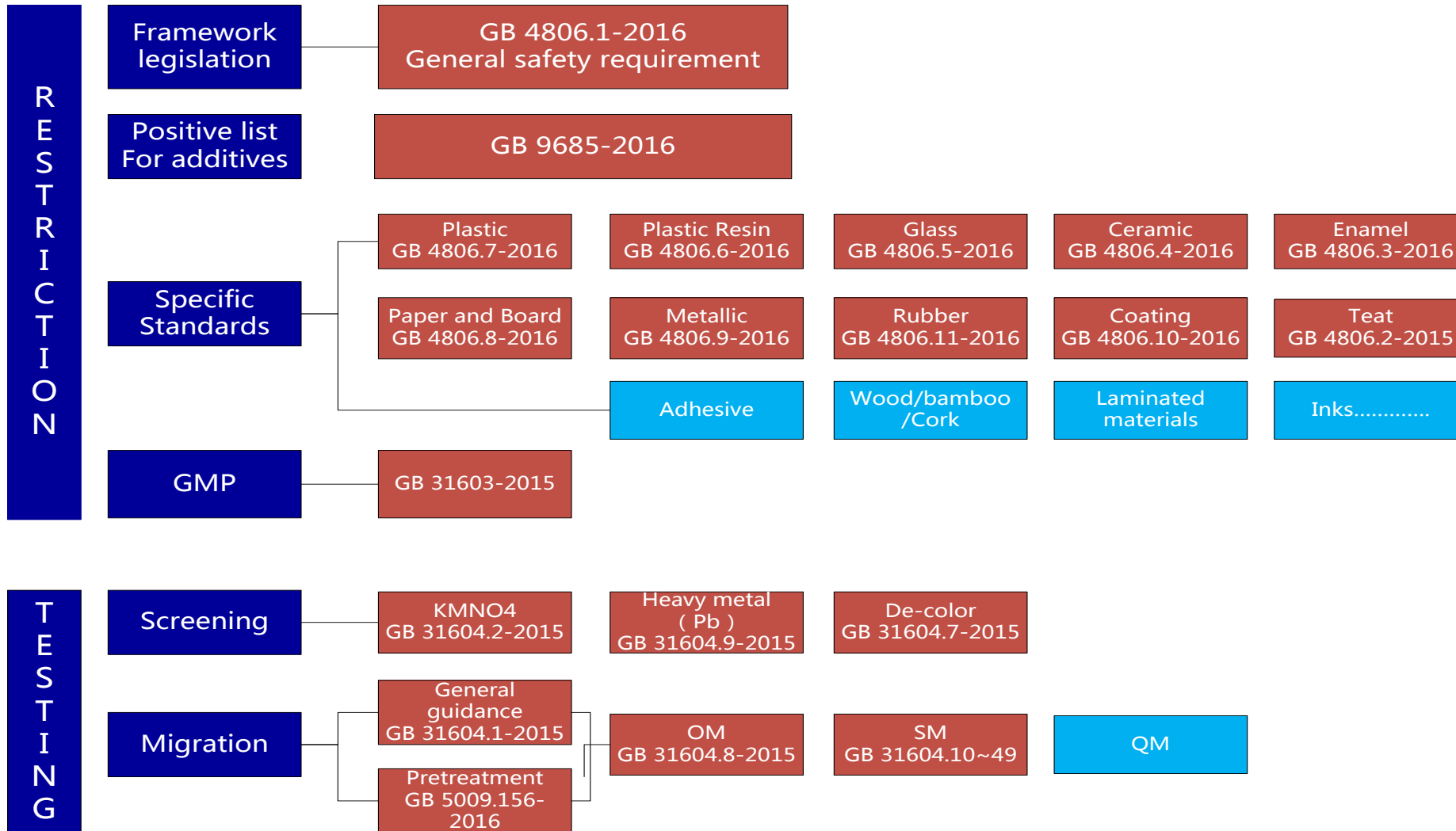
- Mineral oil
- Phthalates
- Photo-initiator
- Anti-oxidant
- Pesticides
- Oligomer

.....

The Management system on FCMs was reshaped



New GB Regulation System on FCM: Enforced Since 2017



The latest development for FCM legislations



Reviewed by Committee

GB 4806.X Multilayer material and articles
GB 4806.X Wood, Bamboo and Cork
GB 4806.X Starch based material

GB 31604.X PAAs migration
GB 31604.X NP migration
GB 31604.X acrylic acid and methacrylic acid migration



On processing/Consultation

GB 4806.X Printing Ink
GB 4806.X Regenerated cellulose film
GB 4806.X Adhesive

GB 31604.X Ethylene-2-norbornene migration
GB 31604.X Solvent residual

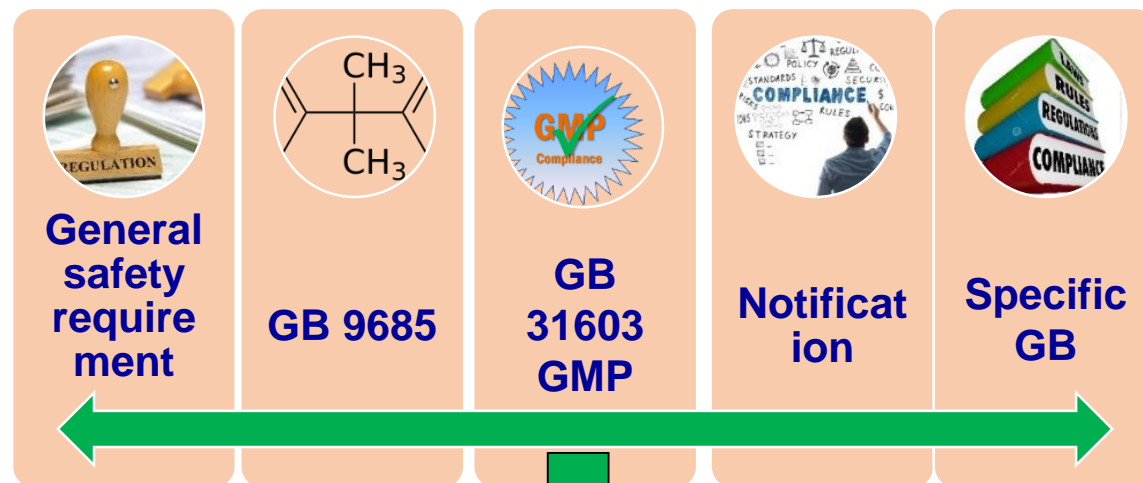
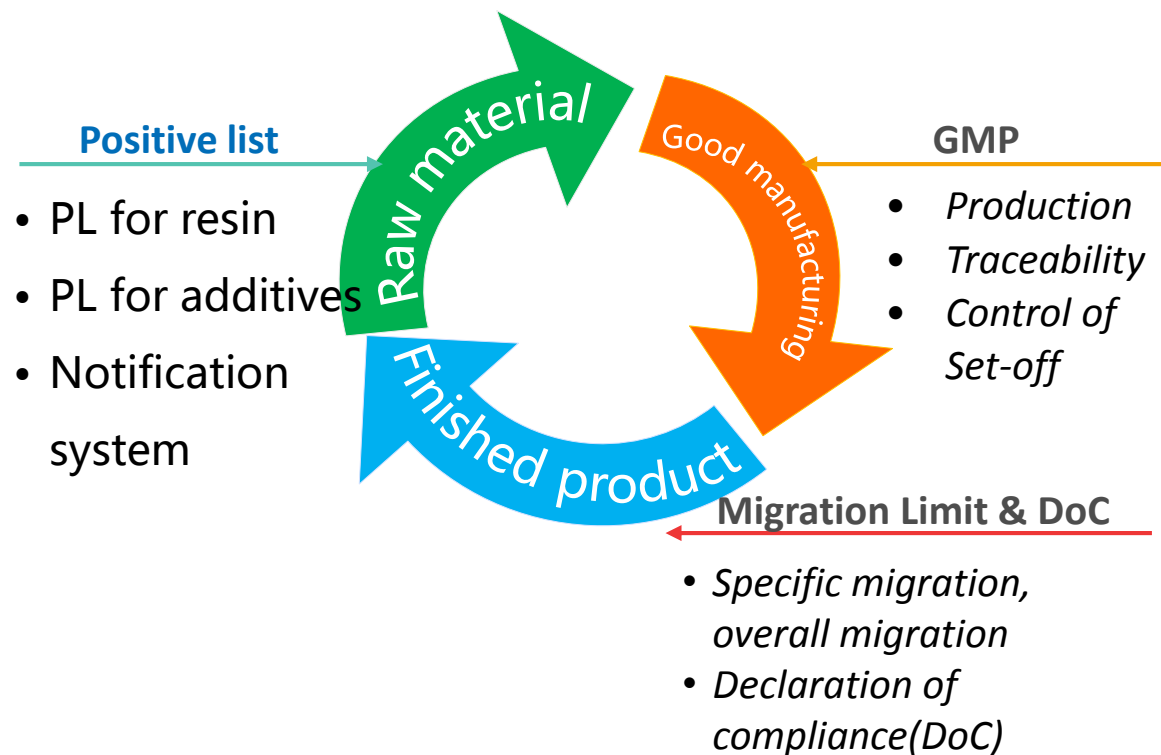


Kick off Revision

GB 4806.6 Plastic resin
GB 4806.7-2016 Plastic
GB 4806.8-2016 Paper and board
GB 4806.9-2016 Metallic
GB 4806.10-2016 Coating
GB 4806.11-2016 Rubber

GB31604.1 Guide to migration test
GB31604.30 Phthalates
GB31604.47 OBA in paper

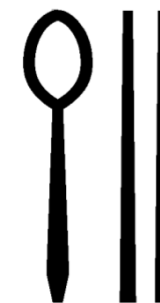
Covering the whole supply chain : from chemicals to the table



Need to full fill the requirements of GB standards

Core requirement: Three of “shall not”

- Shall not endanger the human health under intended/foreseeable use
- Shall not cause the change of composition and organoleptic characters
- Shall not cause technical effects to food



New Petition (Single approve)

Application form
Chemical identification, physical and chemical properties
Technical justification, function and condition
Manufacturing process
Quality specification, test methods and test reports
Toxicological data
Migration Study
exposure assessment
Regulatory status in other countries
Relevant documents for petition of new substance if it is imported
Other documents useful for the expert panel review (ISO Certificate etc.)
Information for public notification

Food Industry



Safety/Risk evaluation leads to solutions

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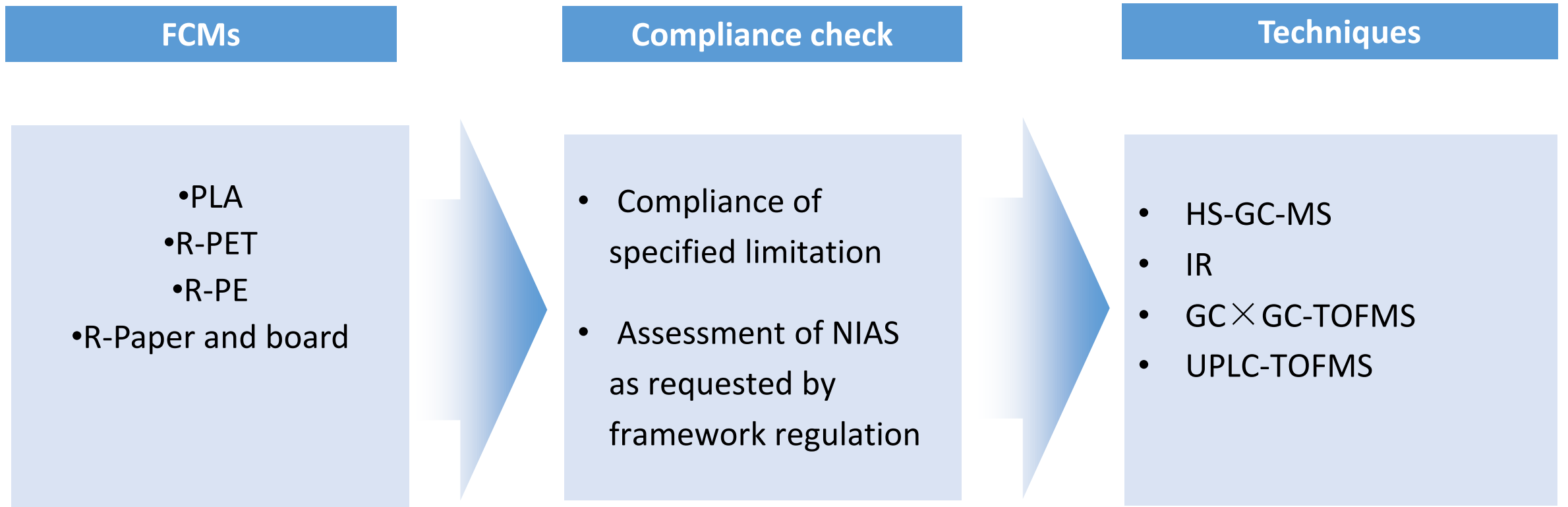
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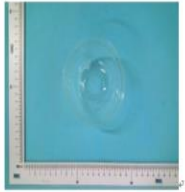

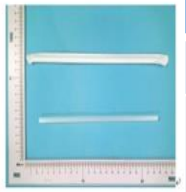



An investigation on safety of biodegradable and recycled materials intend for contact with food



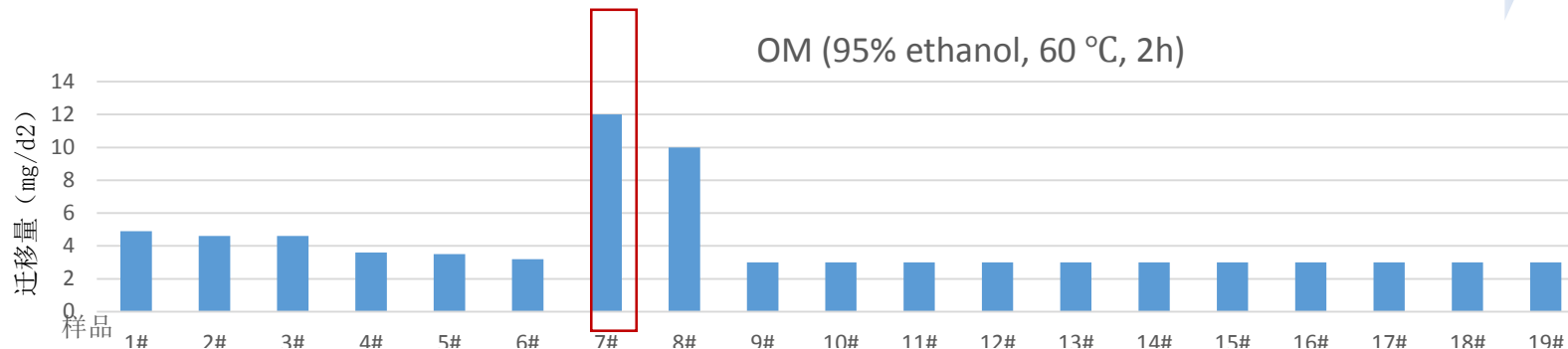
Biodegradable materials - PLA

PLA: Compliance of specified limitation

PLA , as kind of plastic , shall comply with the plastic Regulation: GB4806.7

Sample	PLA-1	PLA-2	PLA-3	Restriction/Limitation
19 samples				Sensory evaluation
				Overall migration 10% ethanol 60 °C, 2h 95% ethanol, 60 °C, 2h
				potassium permanganate consumption
				Decolor test
				heavy metal

One sample failed to comply with OML (95% ethanol, 60 °C, 2h)

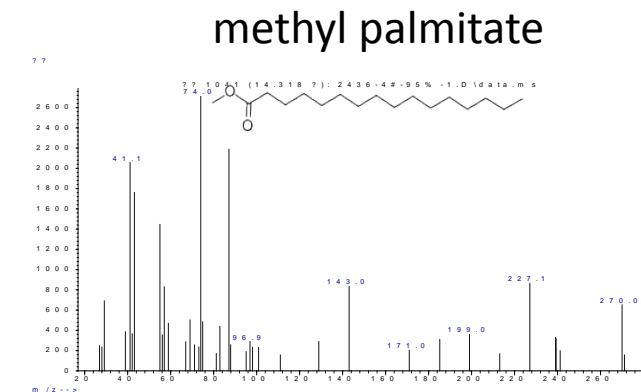
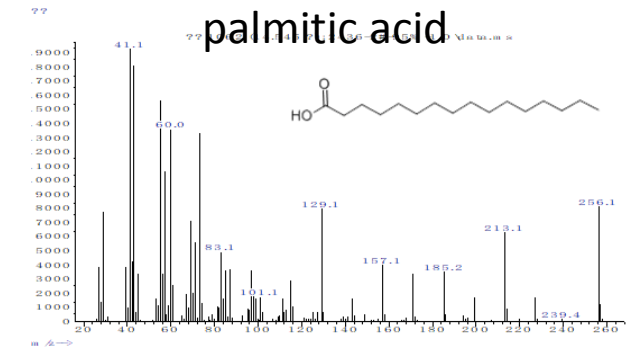


PLA : NIAS assessment

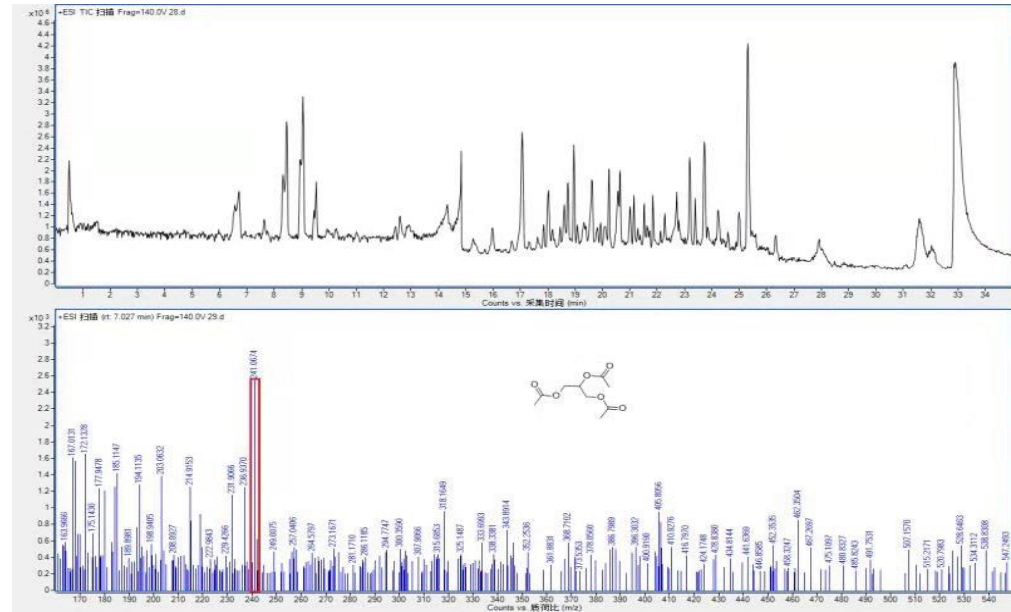
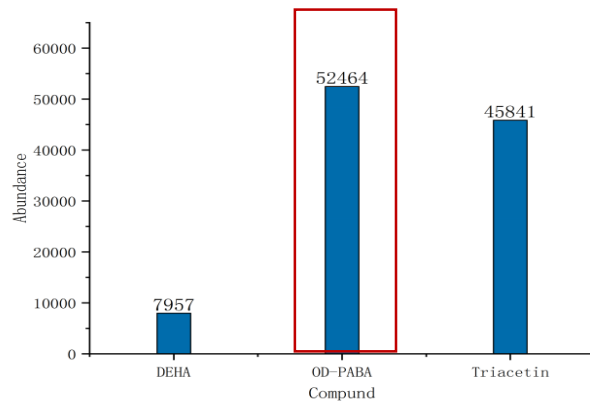
Volatile compounds are not detected by HS-GC-MS

Certain type of semi-volatile compounds were found in 95% ethanol (60 °C, 2h) by GC-MS

Mainly screened substances	Possible application	CAS No		Authorized?	Cramer classification
lactide	monomer	95-96-5/4511-42-6	IAS	Y	Class I
lactic acid	monomer	50-21-5	IAS	Y	Class I
Methyl palmitate	lubricant	112-39-0	NIAS	N	Class I
Palmitate acid		57-10-3	NIAS	N	Class I
Ethyl palmitate		628-97-7	NIAS	N	Class I
Methyl stearate		112-61-8	NIAS	N	Class I
Stearic acid		57-11-4	IAS	Y	Class I
Eethyl stearate		111-61-5	NIAS	N	Class I
DEHP	plasticizer	117-81-7	IAS	Y	Class I



Nonvolatile compounds --- UPLC-Q-TOF



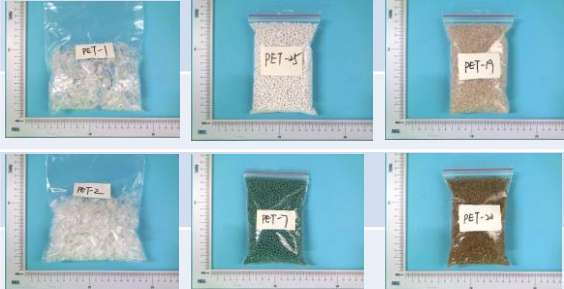
- Glyceryl triacetate, di (2-ethylhexyl) adipate (DEHA) are authorized plasticizers
- The OD-PABA is not in the list of GB 9685, but belongs to Cramer class I.

The commercial PLA sold in the market pose less safety concern.

Recycled materials

R-PET: Compliance of specified limitation

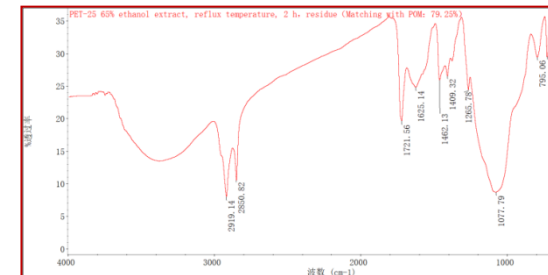
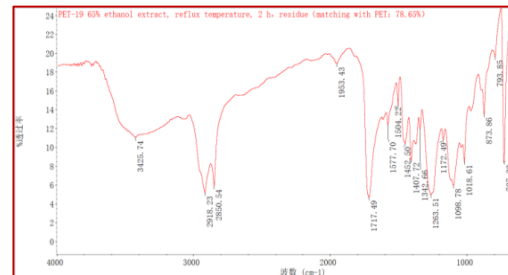
R-PET Particle shall comply with Plastic resin Regulation B4806.6

Sample		Limitation
9 samples		Lead (4% acetic acid, reflux 0.5h) water extract (reflux, 0.5h)
		4% acetic acid extract (reflux, 0.5h)
		<u>65% ethanol extract (reflux, 2h)</u>
		n-hexane extract (reflux, 1H)
		water extract (reflux, 0.5h)

> 90% compliance

- The non-compliance cases : 65% ethanol extract (reflux, 2h), n-hexane extract (reflux, 1H), water extract (reflux, 0.5h).
- Identification of non-compliance sample : the extract refer to **PET or POM polymer**(polyformaldehyde)

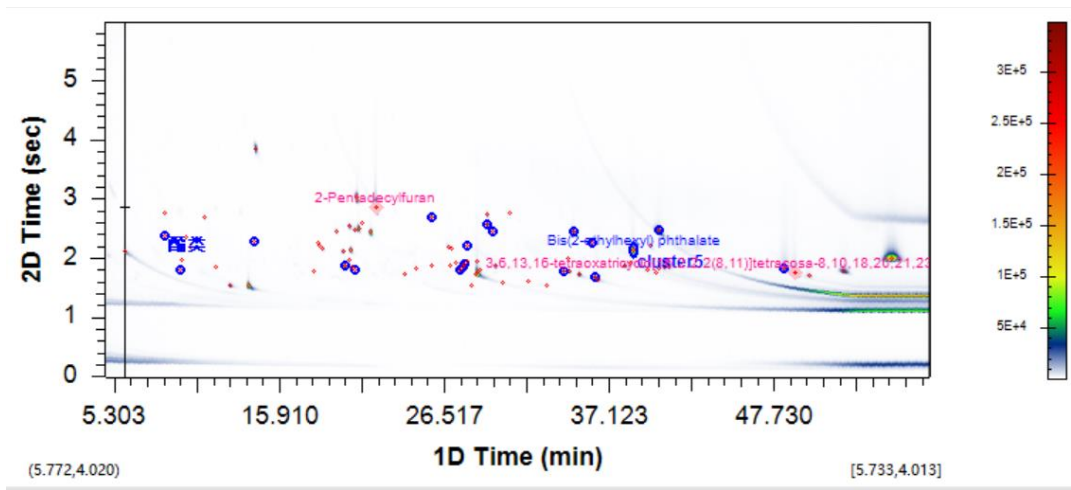
Infrared spectrum



R-PET: Volatiles and semi volatiles compounds

Semi volatile compounds : GC×GC-TOF

Column set: weak polar–nonpolar (DB-17-DB-5)



91 semi volatile compounds were found

classification of compounds	number	Proportion of peak area
Ketone	12	38.69%
ester	40	17.84%
phthalate	6	10.94%
phenol	10	7.20%
alkane	2	1.35%

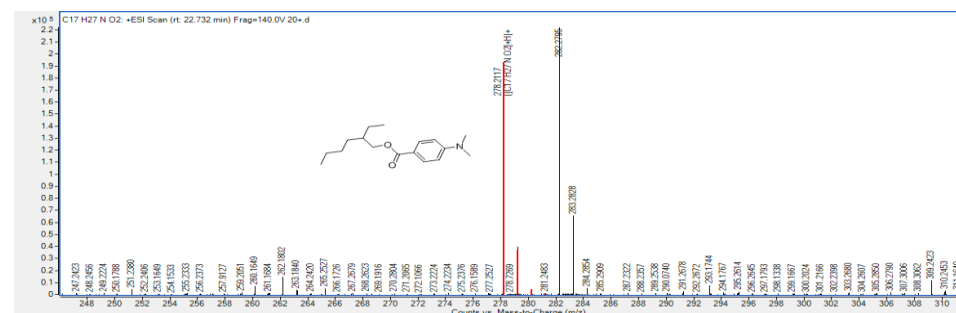
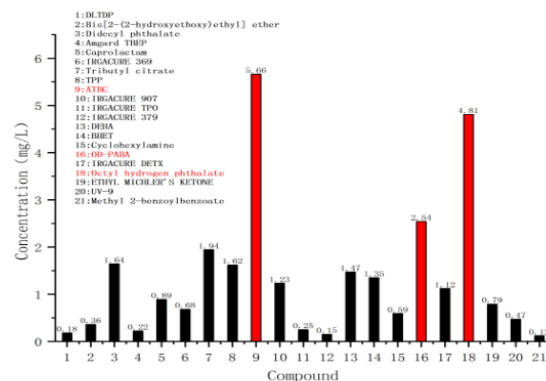
The following compounds were detected with concentration above 7 mg/kg

- DEHP, which is only allowed to be used in PVC. SML = 1.5mg / kg
- 3,6,13,16-tetraoxatricyclo [16.2.2 (8,11)] tetracos-8,10,18,20,21,23-hexaene-2,7,12,17-tetrane is classified as NIAS and Cramer III
- 2-pentadecylfuran is NIAS and Cramer III.

R-PET :Nonvolatile compounds


21 compounds were detected:

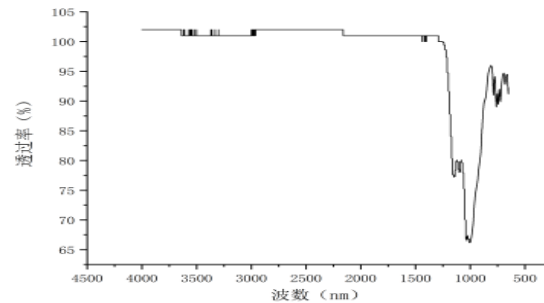
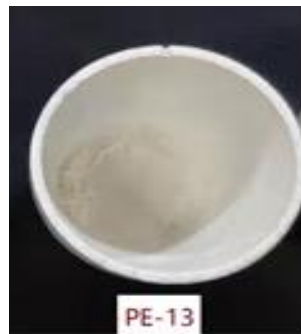
- Oligomers (Tetraethylene glycol, terephthalic acid bis (2-hydroxyethyl) ester),
- Fungicides (4-chlorobenzoic acid),
- Antioxidants (antioxidant 245, etc.),
- Surfactants (sulfonated Di-isoctyl succinate),
- Plasticizers (o-benzene, citric acid ester),
- Photo-initiators (photo-initiators 907, etc.),
- flame retardants (tris (butyl-oxyethyl) phosphate).
- UV absorber (UV-9)...



- Number of semi volatile and non-volatile compounds were detected in R-PET particles
- Some of compounds are NIAS, not in the positive list , caution and further investigated is needed if they are used for FCMs.

R-PE: Compliance of specified limitation

Sample		Limitation	compliance
9 Particle samples		Loss on drying (90 °C ~ 95 °C, 2h) burning residue (90°C~95°C, 2h)	Y
		all qualified n-hexane extract (reflux, 2h)	Y
		burning residue	7 samples no comply

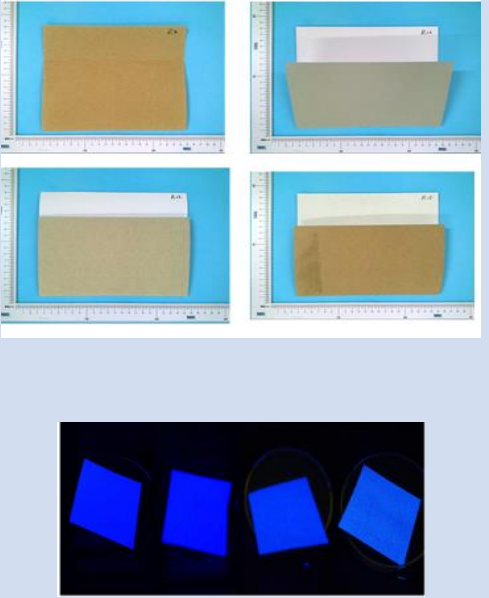


albite

- Inorganic filler may be the main cause of non-compliance

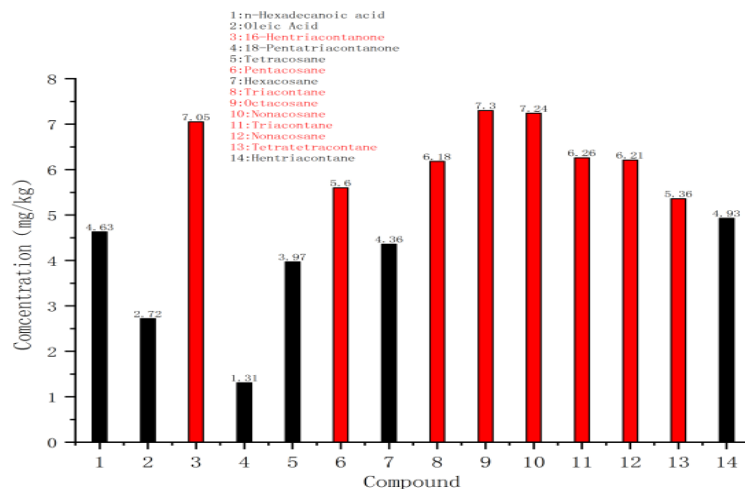
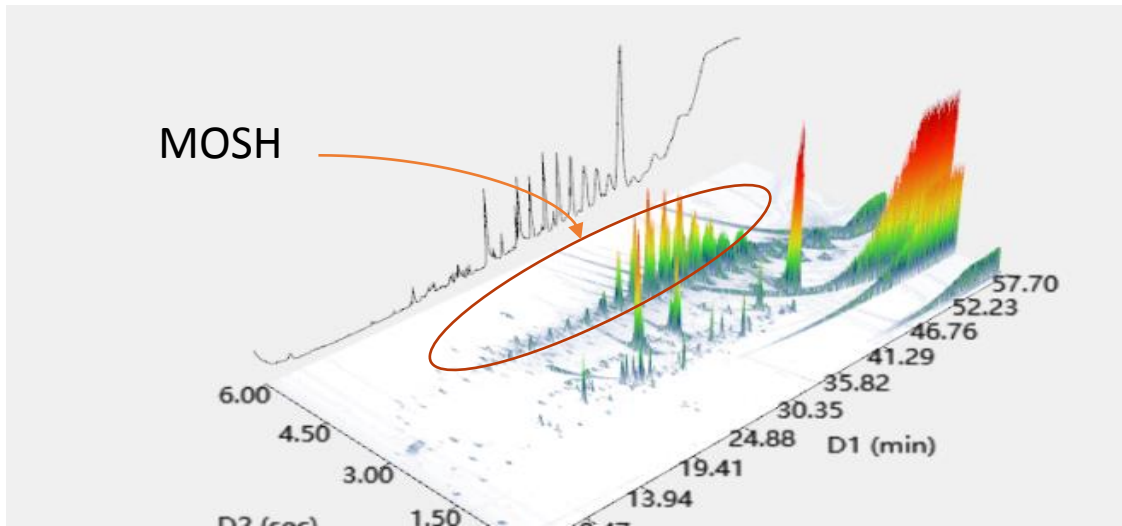
R-Paper: Compliance of specified limitation

- Check the compliance against GB 4806.8
- All tested samples does not comply

Sample		Limitation	compliance
7 samples		Sensory (sample)	Y
		Heavy metals (as Pb) (4% acetic acid, 60°C, 2h)	Y
		As	Y
		Formaldehyde extractive (water, 80°C, 2h)	Y
		Migration of BPA (4% acetic acid, 70°C, 2h)	Y
		Overall migration (10% ethanol, 70°C, 2h)	Y
		Overall migration (4% acetic acid, 70°C, 2h)	Y
		Extractable chloropropanol(water,80°C,2h)	N
		Pb	N
		Potassium permanganate consumption (distilled water, 60°C, 2h)	N
		Fluorescent substances (at wavelength of 254nm and 365nm)	N
		Sensory (simulant)	N

R-Paper: volatiles and semi volatiles compounds

Semi volatile compounds analysis : GC×GC-TOF



253 compounds detected

classification of compounds	number	Proportion of peak area
alkane	52	56.67%
nitrogen compounds	7	13.67%
ketone	8	8.39%
acid	13	6.16%
Polyphenyl ring compounds	5	2.37%
ether	5	1.97%
alcohol	10	1.61%
Halogen compounds	3	1.57%
cycloalkane	19	1.23%
benzene compounds	18	0.76%
ester	12	0.46%
phenolic compounds	2	0.43%
sulfur compounds	3	0.22%

- Mineral oil is commonly detected in recycled paper;
- The characteristic compounds in recycled paper are hexadecylic acid, octadecanoic acid (crameri), 16-31 ketone, 18-35 ketone (crameri class II);
- The content of characteristic compounds were usually above 10 ppm by semi quantitative analysis.

Project team



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- Sustainability is hot topic in the world, China is active
- Food safety is the bottom line , China has reshaped the management system on FCMs
- The studied of commercial PLA FCMs pose less safety concern ;There are certain type of high concerned compounds found in the recycled materials, which may pose a safety concern with their toxicity characterization.
- More investigation are needed for the migration of recycled materials and degradable materials to provide more accurate data for the risk assessment
- For recycled materials and degradable materials(except PLA、PBAT、PBS) intended to be used for food contact, the new petition process for every single case is necessary

You' re welcomed to visit us



Safety is non-negotiable
Sustainability of FCM is demanded