



CHANG WOEN
Recycling & Shredding Technology

HCM, Vietnam, 07/May./2019

Mr. Ted KAO
Sales Manager

Topic :

PET BOTTLES **RECYCLING** **FOOD GRADE** PACKAGING APPLICATION



1. **RECYCLING** v.s. **FOOD PACKAGING**

2. WHO is **CHANG WOEN MACHINERY** ?
3. **HOW DIFFICUT** is it in the washing line to achieve **FOOD GRADE** output ?
4. What **other plastic** can be recycled ?



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RECYCLING v.s. FOOD PACKAGING

SEXY Topics, ever since year 2015



RECYCLING ?

Before year 2015, RECYCLING = COST DOWN

Output Application :

- ✓ Fiber Grade
- ✓ Filament Grade
- ✓ Sheet Grade
- ✓ Bottle Grade

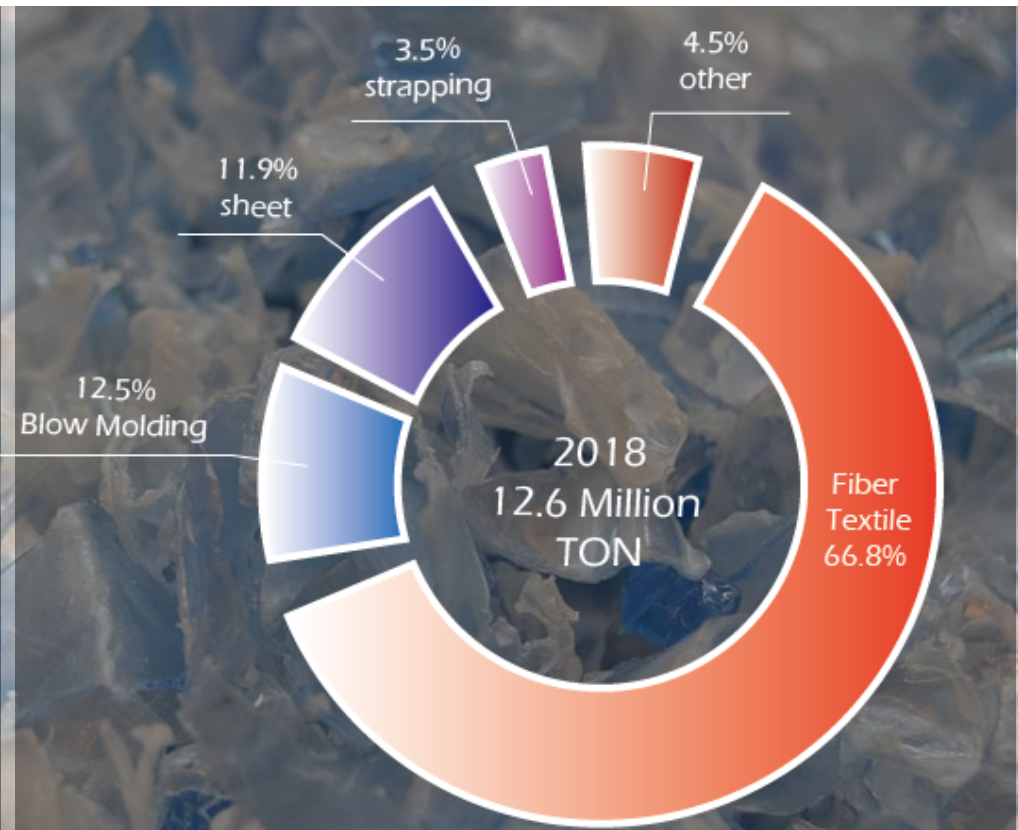
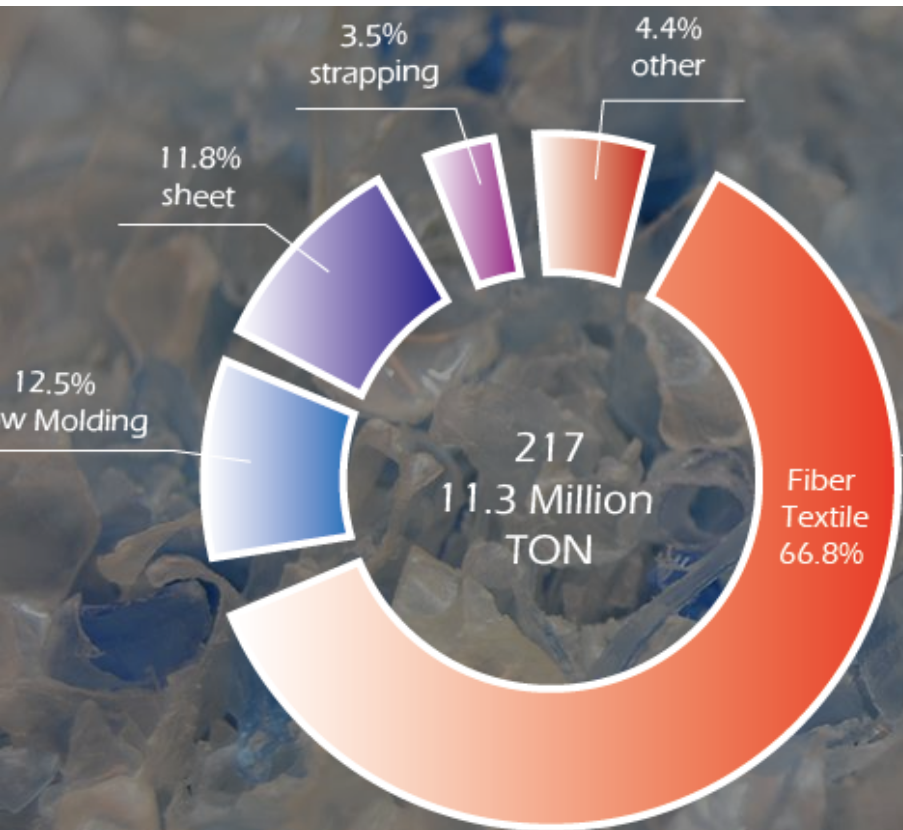
Will it survive the low crude oil price environment ?



Total PCR PET bottle collection in 2016

Trend of rPET Application 2015 to 2018

1. Total collection, 16% increased.
2. Sheet & Food Grade increased.



Total PCR PET bottle collection in 2017

Total PCR PET bottle collection in 2018



Demands for rPET in
Textile Application

NOW

Booming up to 12.6 Million Ton/Yr capacity by all kinds of big brand textile & sport wear



Ad. from **adidas**



Easy to
throw out.



Better to
throw on.

Ad. from **Everlane**



Demands for rPET in Food Grade Package

NEXT

Expect for 2.85 ~3.0 Million Ton/Yr capacity to be achieved in year 2020.

A EUROPEAN STRATEGY
FOR PLASTICS
IN A CIRCULAR ECONOMY

To ensure that all plastic packaging is recyclable by 2030



“EVIAN will make all of its plastic bottles from 100% recycled plastic by 2025”



“To collect and recycle 100% of its bottles by 2030”



“IKEA is committing to circularity.”



“Embracing a circular economy with PET as a reusable material.”



“we believe we have a responsibility to bring innovative and sustainable solutions to the consumer.”



“A common EU target for recycling 75% of packaging waste by 2030.”



“Adidas will only use recycled plastics by 2024.”

What reasons drive brand owner for recycling activities ?

1. CO2 emission
2. Closed Loop /Sustainability
3. Consumer Conscious
4. Good for Earth

What drives brand owner for recycling activities ?

1. CO2 emission

Year 2008

PAS 2050/ISO 14067

Life Cycle Assessment

Auditor : SGS

Customer : FENC

Washing Line : ChangWoen

2019

ISO 14067:2018

Carbon Footprint Verification,
CFV

Auditor : Thailand FDA

Customer : Indorama

Washing Line : ChangWoen

RECYCLING

1 ton

of PLASTIC BOTTLES

SAVES

1½ tons

of CO2

What drives brand owner for recycling activities ?

2. Closed Loop /Sustainability



What drives brand owner for recycling activities ?

3. Consumer Conscious

What consumer thinks nowadays

Source | WRAP, UK.

Using Recycled Content In Plastic Packaging : The Benefits

www.wrap.org.uk

83% believe that products in recycling packaging are having a positive impact on the environment.

86% of respondents felt that it would be “very” or “quite” good if packaging contained recycled plastic.

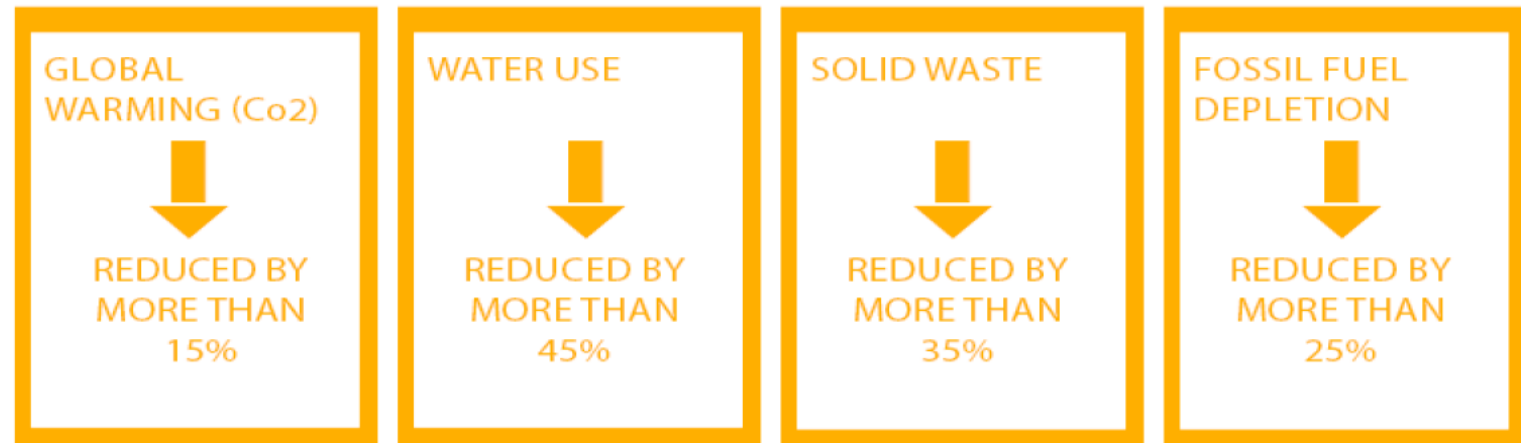
78% said that they would feel more positive about a product or manufacturer whose pack contained recycled plastic.

An amazing **90%** of respondents said that manufacturers and retailers should “just get on with it” and use as much recycled plastic as possible.

What drives brand owner for recycling activities ?

A2011 LCA compared vPET, rPET & PLA
Results of LCA shows that in a direct comparison with vPET, rPET & PLA would represent the following environmental benefits :

4. Good for Earth



Based on 350 ml juice bottle – numbers can vary based on individual LCA's source. RMIT University Report LCA research.

Trends in EU in bottled water industry



Nestle & Danone are both producing bottles with rPET content of **25~50%**

Trends in EU in bottled water industry



In Europe, **Evian** is manufacturing its water bottles with **50%** rPET content.

In the UK, several other water bottles are at 25-30% and aiming to get to 50%

Trends in EU in bottled water industry



A UK non-profit water bottle, **Belu** is at **50%** recycled content using rPET content.

Examples of rPET package in Juice Beverage



In the US, **Naked** have launched the reNEW bottle made of **100%** post-consumer recycled PET content.

M&S, Sainsbury supermarket own juice bottles now contain **50-100%** rPET content.














Examples of rPET package in Juice Beverage

In the UK, **Innocent**, Light colored Juice bottle such as Orange and Apple at 35% rPET content.



Brand Owner's Targets & Timeline on Recycling

Brand Owner	Partner(s) & Investment(s)	Year																			
		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034		
Nike	NBA	20% rPET																			
Nestlé Waters NA	How2Recycle® Closed Loop Fund	50% recycled content			100% recycled or renewable content																
Danone					100% recyclable / 25% rPET Carbon neutral																
Textile Exchange					25% rPET																
Ikea					100% recyclable																
Adidas					100% rPET																
Unilever					100% recyclable / 25% rPET																
Pepsico					100% recyclable, compostable, or biodegradable																
Walmart					0 waste to landfill 100% recyclable packaging in private label products																
Volvo					25% recycled content																
Coca-Cola					50% recycled content																

A brief conclusion of chapter 1.

RECYCLING v.s. FOOD PACKAGING



Never goes back !

1. **RECYCLING** v.s. **FOOD PACKAGING**
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CHANG WOEN Numbers



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BUSINESS AREAS/SECTOR

Wash Tech

36

Washing line for
HDPE bottle、
LDPE、PP film
PET bottle
RDF line & Sorting line
8.5 million USD/year

Shredder/ Crusher

72

Crusher 200 units/year
Shredder 120 units/year
15.1 million USD/year

History

34^Y

Established 1985
1st PET washing line Asia 1992
1st B2B for PET recycling 2007



Taiwan

- 1992, 1st PET washing line Taiwan
- 2004, 1st Trial for Food Grade Application
- 2007, B2B delivered to Coca-Cola



The No. 1 machine maker for recycling activities in plastic material & industrial waste material.



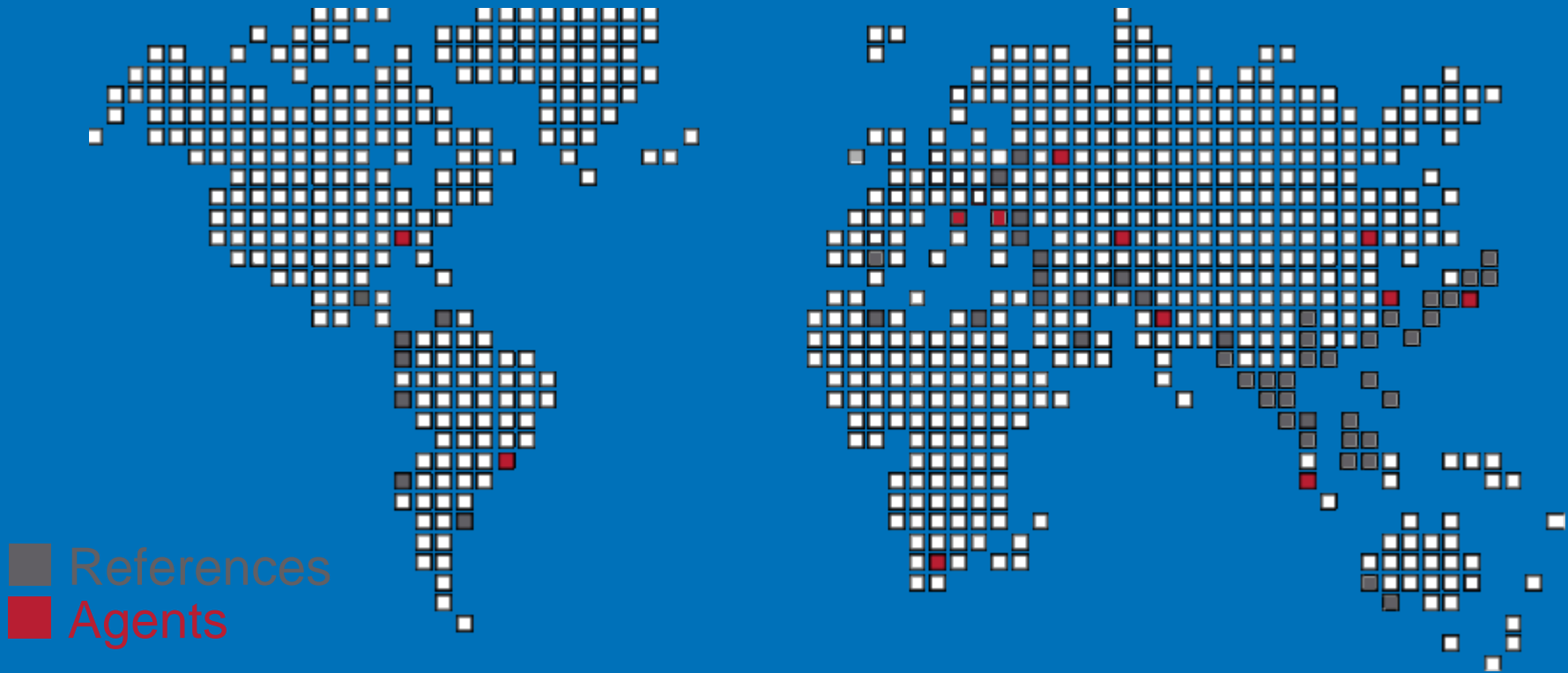
19 references in SEAN countries for rPET Food Grade Application & Fiber Application



34 years History as established in 1985.



CHANG WOEN *References & Agents Worldwide*



U.S., California
Vietnam, HCM
Japan, Tokyo

Greece, Crete
Italy, Breccia
Turkey, Istanbul

Russia, St. Petersburg
South Africa, Cape Town
Brazil, Sao Paolo



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CHANG WOEN *Manufacturing*



72 references of all kinds
washing line in Japan

Taiwan Quality



Unlike Chinese



265
references
in Asia





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WE ARE NOT VERY BIG
WE KNOW RECYCLING BUSINESS **INSIDE OUT**

Sport Wear 2018 FIFA



This is
FIFA Jersey



NIKE Sport Wear


**NIKE
BETTER
WORLD**



This is
Jersey



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Adidas 運動品牌 | Ocean Plastic Waste



PARLEY

FENC
Taiwan

Case Study 2018
Ocean Plastic Recycling



18 bottle/pair



Ocean Clean Up



Adidas 運動品牌 | Ocean Plastic Waste



250 Hr Collection



Manual Sorting



Hot Washing



70 Tons Bottle Input



Trommel, 54% Loss



Crushing



Adidas 運動品牌 | Cycle of Bottles to Sport Wear

1



MARINE PLASTIC WASTE IN COASTAL AREAS SUCH AS THE MALDIVES...

2



...IS COLLECTED BY PARLEY AND ITS GLOBAL CLEAN UP NETWORK...

3



...BALED AND SENT TO PARLEY SUPPLY CHAIN PARTNERS...

7



...WHICH IS USED TO CREATE ADIDAS X PARLEY PRODUCTS.

6



...TO BECOME A HIGH PERFORMANCE POLYESTER YARN: PARLEY OCEAN PLASTIC™...

5



4



...WHERE THEY ARE SHREDDED AND REWORKED...

FROM PLASTIC WASTE TO PRODUCT
THE JOURNEY OF AN ADIDAS X PARLEY PRODUCT



水果盒/雞蛋盒 Thermoforming Sheet/ Tray Package

FDA approval

120~250 micron



This is
**Thermoforming
Tray**



泡殼盒/玩具包裝盒 Thermoforming Sheet/ Tray Package



Blister for Electronics Package

Thermoforming Toy Package



Personal Care Package



This is
Thermoforming Tray



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可口可樂 碳酸飲料品牌 PET寶特瓶

This is

Coke Bottle



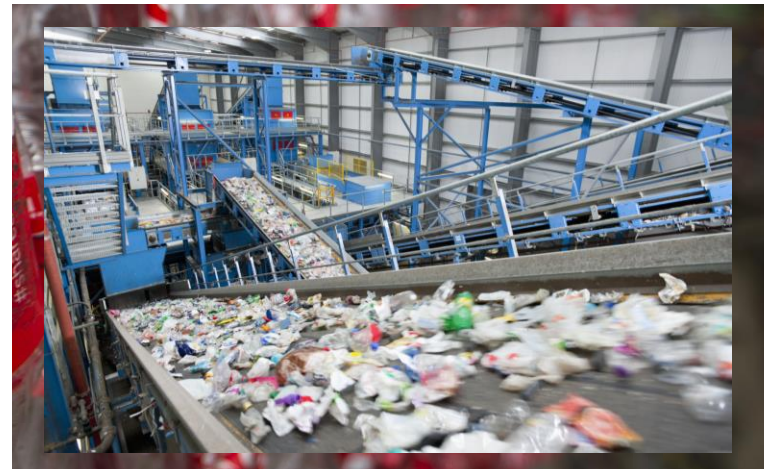


Recycling Process Segregation, Sorting, Washing, De-contamination

2019 Update :

Incorporate with
Indorama &
Wellman &
ChangWoen

for Food Grade
approval certification
in Thailand.



Our Customer List rPET Business Related – PET Resin Maker





PET Washing Line Capacity V.S. Local Bottles Collection

Thailand
15,000/35,000 TPM

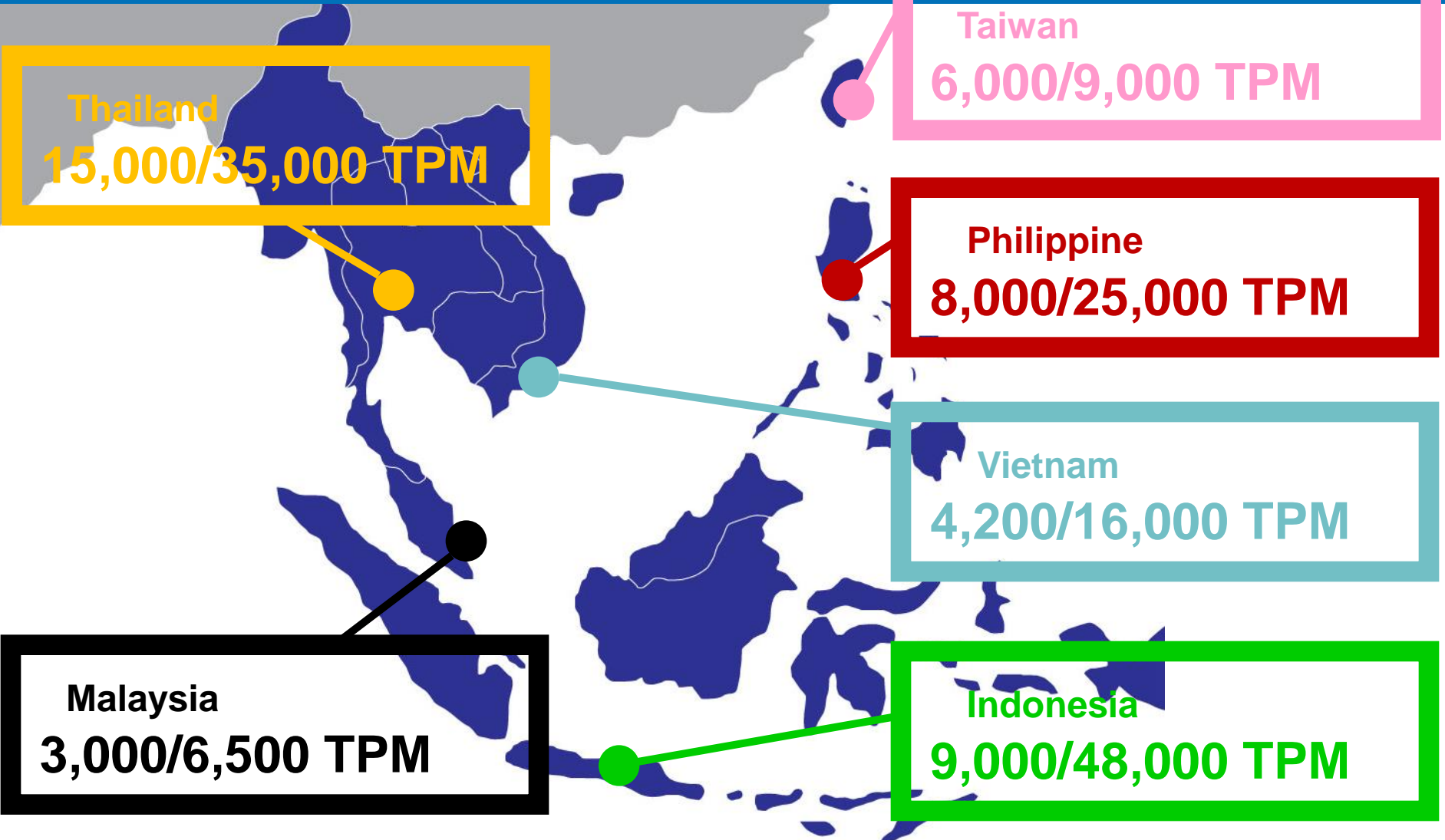
Taiwan
6,000/9,000 TPM

Philippine
8,000/25,000 TPM

Vietnam
4,200/16,000 TPM

Malaysia
3,000/6,500 TPM

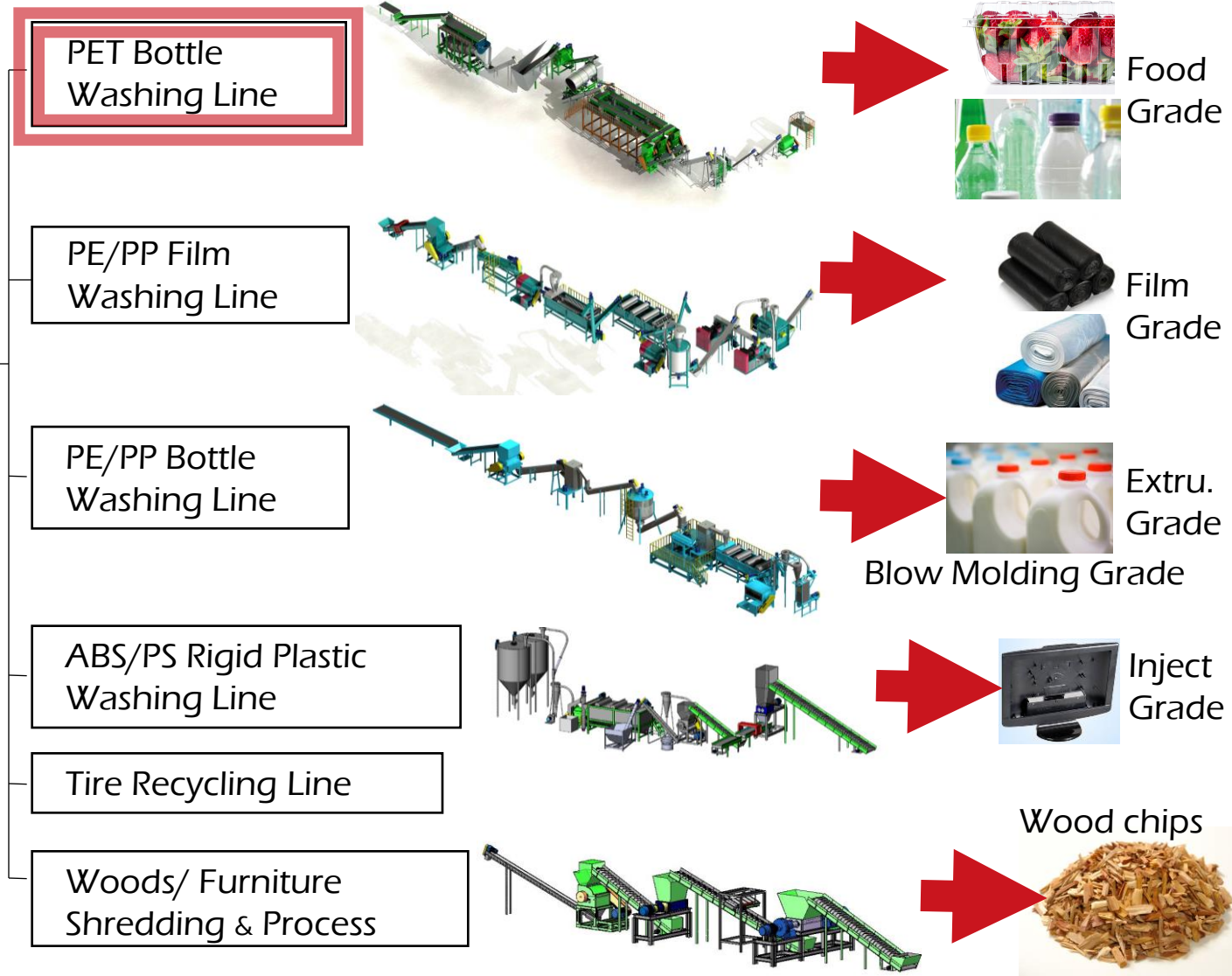
Indonesia
9,000/48,000 TPM





CHANG WOEN Product Structure

CHANG WOEN



CHANG WOEN PET Recycling



Taiwan
No Compromise

PET,
Not a waste if you know how to distinguish it and recycle it.

Bottle Source :

- Post Consumer Bottle
- Cooking Oil Bottle
- Beer Bottle

0.5 TPH ~ 6.0 TPH input capacity

Output application :

- Fiber Grade
- Filament Grade
- Sheet Grade
- Bottle Grade





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CHANG WOEN PET Recycling

Case Study

Taiwan



1st Food Grade B2B for PET recycling in Asia 2007



CHANG WOEN PET Recycling

Case Study

Taiwan

Bottle Pre-Wash

- ✓ Most dirt removal
- ✓ Distinguish PVC bottle
- ✓ Chemical Re-usage



Label Remover

- ✓ Shrinkage Label
- ✓ Dust
- ✓ 1,600 Ton lifetime of nails





CHANG WOEN PET Recycling

Case Study

Taiwan



Crusher

- ✓ Less powder generated
- ✓ Stable performance on ampere
- ✓ Clean cut for flakes output
- ✓ Quick maintenance -1 hr Knife change

Turbo Friction Wash
Removes Ink & Sticker



台灣再生工業股份有限公司



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CHANG WOEN PET Recycling

Case Study

Thailand



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Taiwan | Japan | Italy | Greece | Guatemala

Shredder | Size you decide, Capacity we deliver



CHANG WOEN PET Recycling

Case Study

Thailand



Before Wash



After Washed

INDORAMA
VENTURES
ECORAMA

PCR PET FLAKES

INDORAMA POLYESTER INDUSTRIES PCL.

NAKHONPATHOM, THAILAND



CHANG WOEN PET Recycling

Case Study

Thailand



Hot Washing



Floating Tank

INDORAMA
VENTURES
ECORAMA

PCR PET FLAKES

INDORAMA POLYESTER INDUSTRIES PCL.

NAKHONPATHOM, THAILAND



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CHANG WOEN PET Recycling

Case Study

Indonesia





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CHANG WOEN PET Recycling Case Study

Malaysia





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CHANG WOEN PET Recycling Case Study

Malaysia



CHANG WOEN PET Recycling

We can do

FIBER GRADE

Taiwan supplies 52% of clothes to World Cup soccer players by 2014. And the figure will come up 75% by 2018.

And 100% of those clothes suppliers & yarn suppliers use Chang Woen washing line to produce the PET bottle flakes in the beginning.



CHANG WOEN PET Recycling

We can do SHEET GRADE

According to records, annual consumption of PET sheet made of virgin PET for food package industry only consumes 17% of total PET production by year 2017, says **17 million** tons per year, which has been raised **20%** from year 2018.


It's predicted to be raised another **15~20%** of consumption by 2020.



CHANG WOEN PET Recycling

We can do

BOTTLE GRADE



250,000 tons of PET material consumed for bottle package will be recycled material introduced by 2025, says Coca-Cola.

200,000 tons of rPET is targeted to obtain for package for our personal cleaning content product by 2025, says Unilever.

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The concept of 10 ppm

Which one is virgin PET?



Which one is 100% RPET



The concept of 10 ppm

What is the concept of 10 ppm contamination?





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品質規範表 A2 (短纖維級)
Specification of Product Quality (Staple Fiber Grade)

管制項目 Property	品質規範 Specification	備註 Test Method
1 實質黏度 at 25°C Intrinsic Viscosity	0.70±0.03	
2 容積密度 g/cm ³ Bulk Density	0.38±0.05	ASTM D1895
3 水分 Max. % Moisture	< 1.2	
4 PVC Max. PPM	< 80	
5 鋁片 Max. PPM Aluminum	< 10	
6 懸浮固體 Max. PPM Floatable Contamination (HDPE、PP、Labels、Glues)	< 150	
7 懸浮 PE Max. PPM	< 50	
8 總雜質率 Max. PPM Total Contamination	< 200	



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品質規範表 A0 (特用長纖維級)
Specification of Product Quality (Ultra Filament Grade)

管制項目 Property	品質規範 Specification	備註 Test Method
01 實質黏度 at 25°C Intrinsic Viscosity	0.71±0.03	
02 容積密度 g/cm ³ Bulk Density	0.33±0.05	ASTM D1895
03 水分 Max. % Moisture	< 1.0	
04 PVC Max. PPM	< 5	
05 鋁片 Max. PPM Aluminum	< 3	
06 懸浮固體 Max. PPM Floatable Contamination (HDPE、PP、Labels、Glues)	< 10	
07 懸浮 PE Max. PPM	< 30	
08 總雜質率 Max. PPM Total Contamination	< 50	
09 白度 Whiteness, L value	≥ 68.0	
10 白度 Whiteness, Lb value	1.5 ±1.5	
11 熱烘烤色變異 Heat baking (160°C, 1hr)	No color changes No agglomeration No crystal caking	

Quality Standards/ Request for FDA & Coca-Cola PCR CLEAR PET Flake :

ATTRIBUTE SPECIFICATION

01	INTRINSIC VISCOSITY	(0.71 - 0.80) dL/gm
02	CIE (L, a, b)* COLOR	3.0 MAX. "b*" value
03		50.0 MIN "L*" value
04		-1.00 + 1.0 "a*" value
05	FINES	0.4% MAX.
06	FLAKE pH	7.00 ± 0.5
07	VOLATILES	< 1 ppm
08	MOISTURE CONTENT	1% MAX
09	BULK DENSITY	23-33 lbs/ ft3
10	FLOATABLE CONTAMINATION	< 10 ppm
11	PVC CONTAMINATION	< 10 ppm
12	GLUE CONTAMINATION	< .005 % Residue
13	PETG CONTAMINATION	< 10 ppm
14	METAL CONTAMINATION	< 5 ppm
15	OTHER – NON MELTING	< 10 ppm
16	GREEN PET CONTAMINATION	< 100 ppm
17	Other Color Flake (not incl light blue)	< 10 ppm

+ 1976 CIE L,a,b – CIE 1931 10° Observer angle – D65 Illuminant Reflectance method.



500 kg of flakes in 1 Jumbo bag



PVC 5ppm = 2.5 g flakes
= 40 pcs flakes

P.O. 10ppm = 5 g flakes
= 85 pcs flakes

What key points are there for recycled material into Food Grade application?

1. Ensure recycling process is food safe.
2. U.S. FDA & E.U. EFSA regulations
3. Decontamination Processes
4. Challenge test

What key points are there for recycled material into Food Grade application?

1. Ensure recycling process is food safe.
Any material applied to food contact uses are highly regulated and monitored as well as recycled material.

IMPORTANT

But, global regularity frameworks vary among countries.



US
FDA

v.s.



EU
EFSA

What key points are there for recycled material into Food Grade application?



US
FDA

Focus is on potential dietary exposures to substances & **safety** of such **exposure**.



v.s. EU
EFSA

Focus is on levels of substance and plastic **migration** into food.

What key points are there for recycled material into Food Grade application?

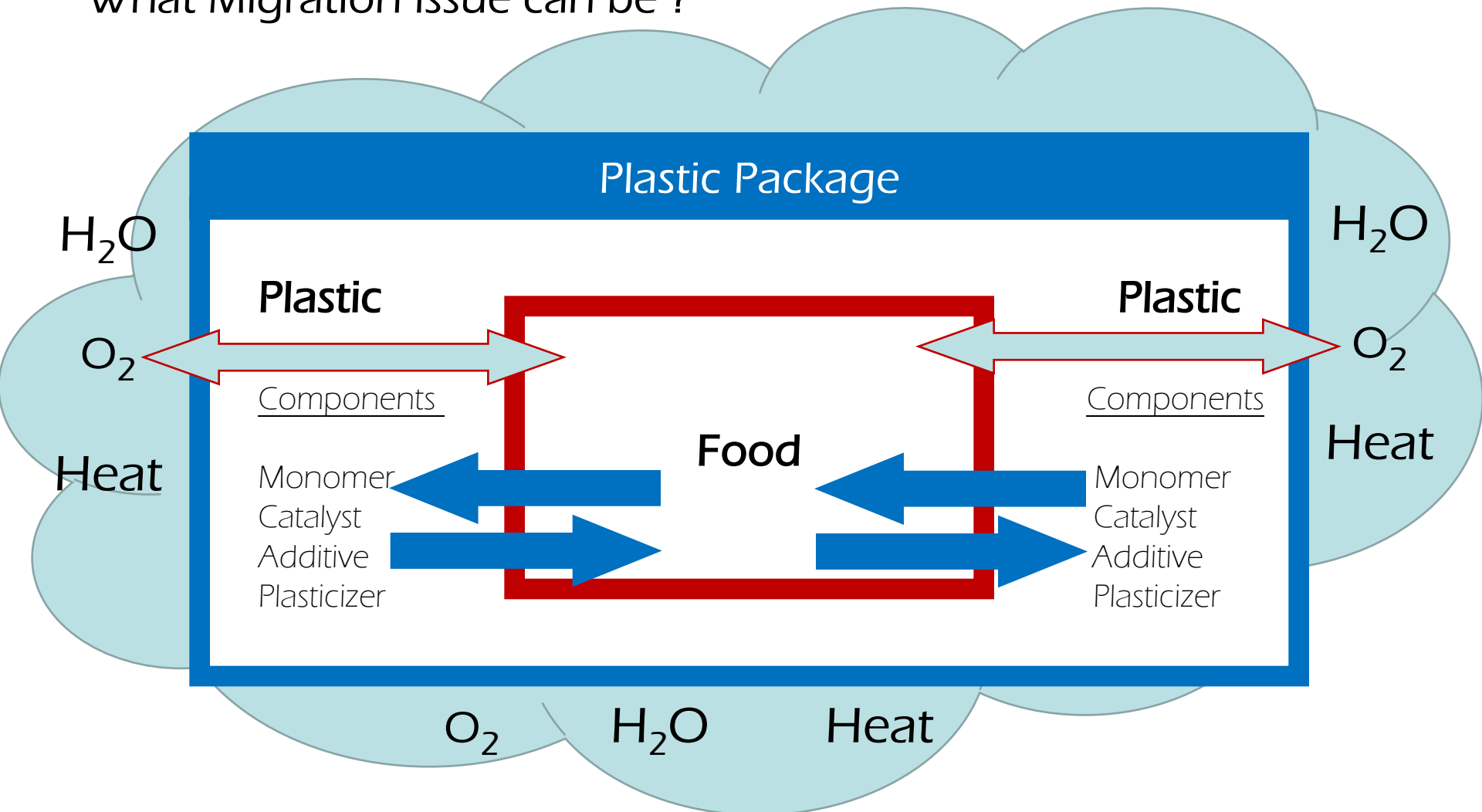
Good news is that most countries agree on that materials must be **inert** in order to protect the purity of food, such as :



1. Migration of substances shall not **endanger human health**.
2. Migration cannot bring an **unacceptable changes** in the composition of food.
3. Migration cannot deteriorate the characteristics of food.
4. Packaging material are complex, those migration of chemical substances may impact to food, whether virgin or recycled. **Reducing migration from packaging** to the food is always important !

What key points are there for recycled material into Food Grade application?

What Migration issue can be ?



What key points are there for recycled material into Food Grade application?

2. U.S. FDA & EFSA regulations



(A) Definition

Within FCN (Food Contact Notification sys.), the Food Contact Substance is defined by the FDA in U.S. as :

“ Any substance intended for use as a component of materials used in manufacturing, packing, packaging, transporting, or holding food and have a technical effect on the food. ”

What key points are there for recycled material into Food Grade application?

2. U.S. FDA & EFSA regulations



(B) Case-by-Case

To address any safety concerns around recycling, the FDA considers each proposed use of recycled plastic on a case-by-case principle and issues advice as to whether the recycling process is expected to produce plastic suitable for food-contact applications.

What key points are there for recycled material into Food Grade application?

2. U.S. FDA & EFSA regulations



(C) List of Submissions as guidance

The FDA provides a “List of Submissions” for which the agency issued a favorable opinion on the suitability of a specific process for producing post-consumer recycled (PCR) plastic to be used in the manufacturing of food contact articles as further guidance.

These requirements are described in 21 CFR, Parts 174 through 179.

What key points are there for recycled material into Food Grade application?

3. Decontamination Processes

How can we Decontaminate during recycling process?

In Washing Line

De-Label	PVC removal	Impurity	Clean Cut
Sticker	Color		

In Extrusion

Heat	Vacuum	Volatiles	
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What key points are there for recycled material into Food Grade application?

3. Decontamination Processes

The initial level of contamination was 600-800 ppm obtained by soaking the flake in contact with the contaminants for 14 days at 40 deg C.

Simulates the PET bottle being abused with contaminants for **1 year** at ambient conditions.

The limiting levels specify the limit that will not transmit more than 10 ppb to the food with the most aggressive simulant for fatty foods.

What key points are there for recycled material into Food Grade application?

3. Decontamination Processes

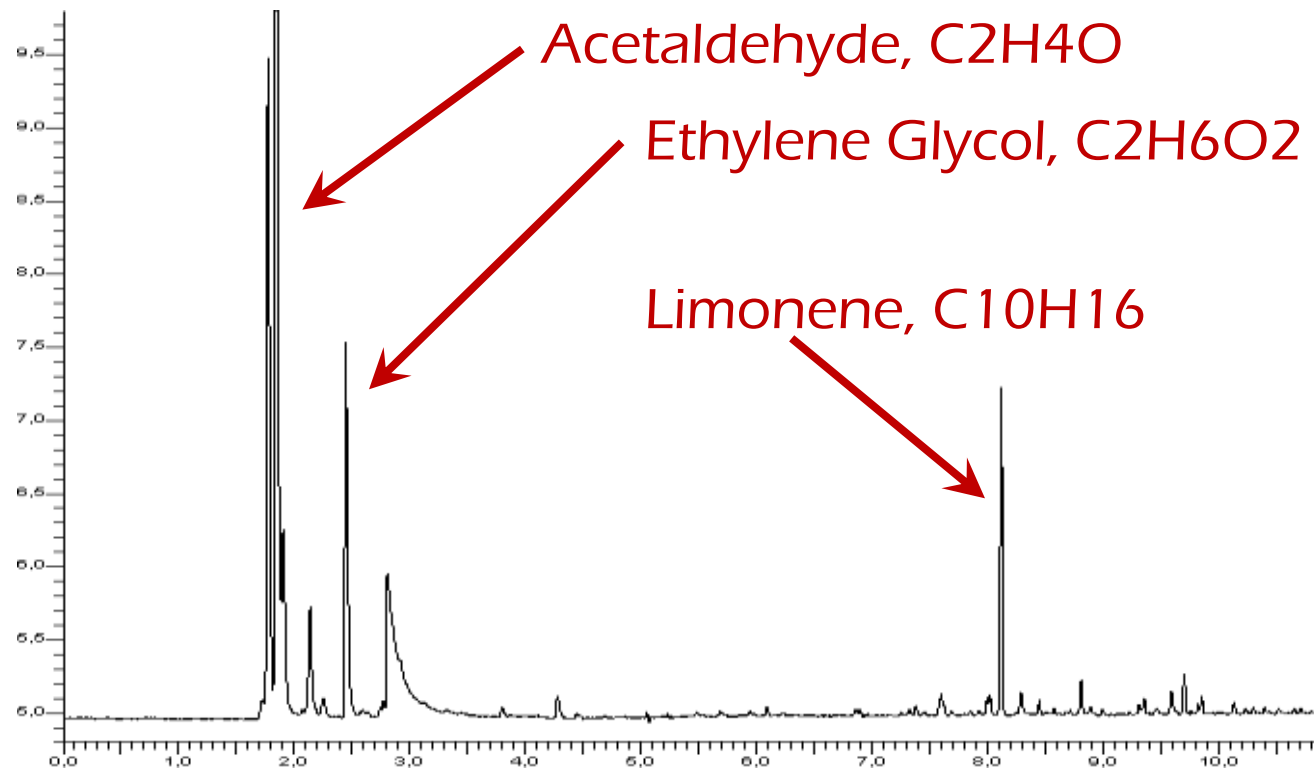
What surrogates of contamination shall be de-con. and what will be examined ?

Surrogate Chemical	Flake Initial ppm	Flake After wash ppm	Flake After High Temp Decontamination ppm
Chloroform	592±77	300±24	<0.1
Toluene	736±163	237±32	0.2±0.01
Chlorobenzene	649±83	225±26	0.4±0.03
Phenylcyclohexane	795±186	507±104	0.6±0.45
Benzophenone	694±180	419±88	1.2±0.99

What key points are there for recycled material into Food Grade application?

3. Decontamination Processes

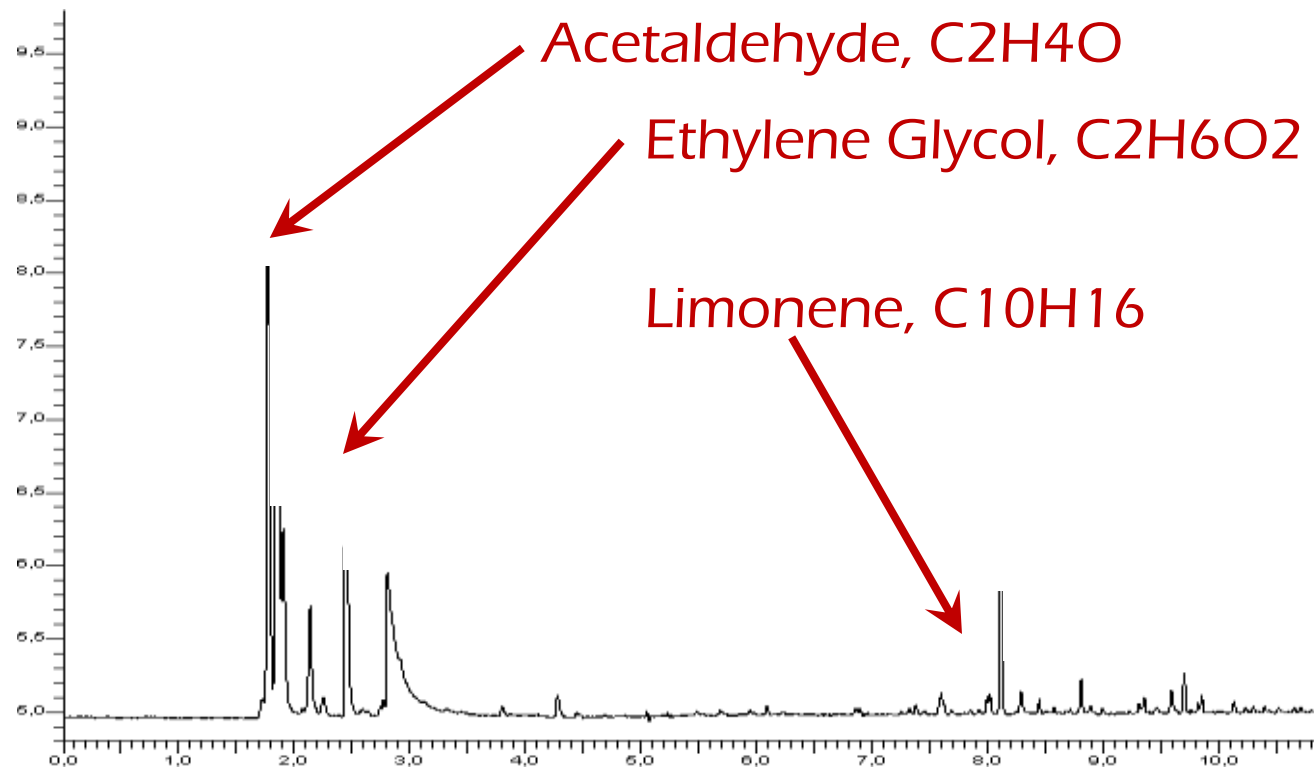
Input Flake



What key points are there for recycled material into Food Grade application?

3. Decontamination Processes

Washed
Flake



What key points are there for recycled material into Food Grade application?

4. Challenge test



A challenge test is meant to simulate drastic contamination of plastic packaging by consumers with commonly available toxic substances and the ability of a process to remove these contaminants.

Long story short, they **put surrogates of contamination into rPET flakes**, and challenging if your recycling process can remove it or not.

What key points are there for recycled material into Food Grade application?

US FDA Validation of Recycling Processes

4. Challenge test



- Any recycling process must demonstrate its ability to remove **potential contaminants due to consumer misuse**.
- A series of representative chemicals or their surrogates are used to spike the plastic flake in a “Challenge Test”.
- 100% of flake is contaminated for **2 weeks at 40 deg.C** (Flakes absorb up to 10 times more contaminants than bottles)

What key points are there for recycled material into Food Grade application?

4. Challenge test



How does “Challenge Test” work?

- Once the contaminants are mixed with the flakes, sealed and stored for 2 weeks at 40°C with periodic agitation.
- After the contaminants are drained and flakes are rinsed, the concentration of each surrogate is then determined in the polymer.
- The challenged polymer is then subjected to the proposed recycling process, and the reprocessed polymer should be analyzed for residual contaminants.

What key points are there for recycled material into Food Grade application?

4. Challenge test



- Recycled plastics must be obtained from an authorized process and the process shall work under a Quality Assurance system.
- The main legislation controlling all food contact materials and articles is European Regulation (EC) number 1935/2004.
- These national regulations also create **offences for failing to comply** and the penalties that may be imposed by the Courts.

What key points are there for recycled material into Food Grade application?

Regulation EC 1935/2004 on materials and articles intended to come into contact with food, and

4. Challenge test



Article 3 of the regulation :

– Any material or article intended to come into contact directly or indirectly with food must be sufficiently inert to preclude substance from being transferred to food in quantities large enough to :

- Endanger human health or
- To bring about an unacceptable change in the composition of the food or
- A deterioration in its organoleptic (taint and odor) properties.

What key points are there for recycled material into Food Grade application?

Regulation EC No. 282/2008 on recycled plastic materials and articles intended to come into contact with foods

4. Challenge test



The recycling process must be one that is ultimately approved by the European Food Safety Authority (EFSA) and has been **demonstrated in a challenge test** to be effective in removing any harmful materials that may have contaminated the packaging. In all cases the recycled material must comply with the requirements of Article 3 of regulation (EC) No 1935/2004.

What key points are there for recycled material into Food Grade application?

EFSA has more limit and examined on recycling process as technical detailed as following :

4. Challenge test



Process Validation and Process details
Hazard Analysis Critical Control Points
Analytical test procedures
Challenge test results with surrogates
Decontamination efficiency of recycling process
Manufacture of test products
Migration test results
Microbiological and Sensory (Taste and Odor) test results
Trial audit

A brief conclusion of chapter 3.

HOW DIFFICUT is it in the washing line to achieve **FOOD GRADE** output ?

1. It's difficult, but it's been well proven worldwide.
2. E.U. EFSA is much strict than U.S. FDA
3. Decontamination V.S. Challenge test

Listen to Expert !!!!

Chang Woen Machinery
is at your service at all time



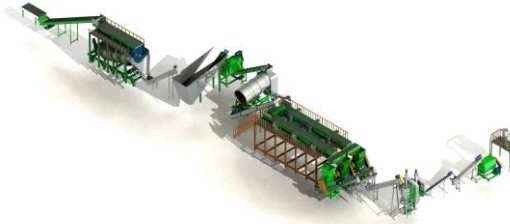
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CHANG WOEN Product Structure

CHANG WOEN

PET BOTTLE
WASHING LINE



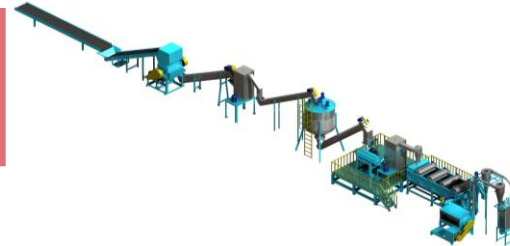
FOOD
GRADE

PE/PP FILM
WASHING LINE



FILM
GRADE

PE/PP BOTTLE
WASHING LINE



EXTRU.
GRADE
BLOW MOLDING GRADE

ABS/PS RIGID PLASTIC
WASHING LINE



INJECT
GRADE

TIRE RECYCLING LINE

WOODS/ FURNITURE
SHREDDING PROCESS



WOOD CHIPS



CHANG WOEN HDPE Recycling



Taiwan
No Compromise

HDPE,
Not a waste if you know how to distinguish it and recycle it.

- ☑ Milk Bottle
- ☑ Grease & Cooking Oil Bottle
- ☑ Shampoo Bottle
- ☑ Pesticide Bottle

HDPE line adopted by Unilever in Indonesia

HDPE line adopted by P&G in Russia

0.5 TPH ~ 4.0 TPH input capacity

Blow Molding Bottle

Injection Molding Bucket /Crates

Injection Molding Home Appliance





CHANG WOEN HDPE Recycling in Tainan, Taiwan

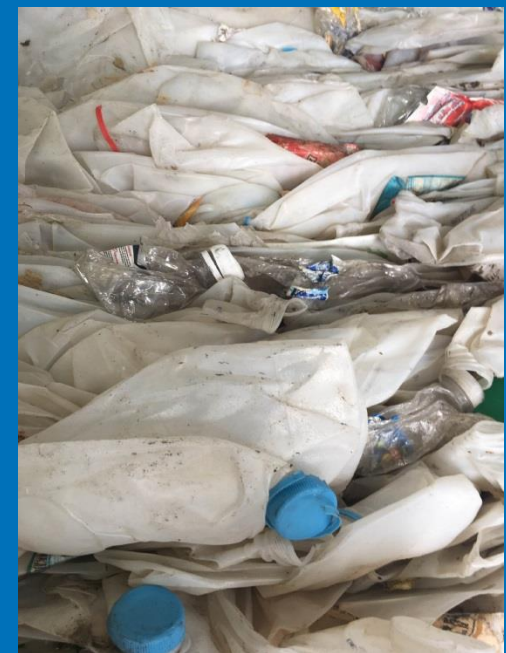


Input capacity: 4.0TPH
Loss of Contamination: 10~20%
Output capacity: 3.6TPH
Motor List: 299.25kw
Power consumption: 239.4kw

Simple+ Wash



CHANG WOEN HDPE Recycling in Tainan, Taiwan



CHANG WOEN HDPE Recycling in Tainan, Taiwan



CHANG WOEN HDPE Recycling in Tainan, Taiwan

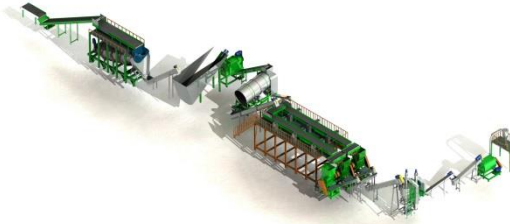




CHANG WOEN Product Structure

CHANG WOEN

PET BOTTLE
WASHING LINE



FOOD
GRADE

PE/PP FILM
WASHING LINE



FILM
GRADE

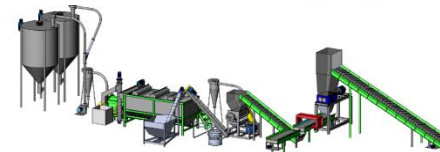
PE/PP BOTTLE
WASHING LINE



EXTRU.
GRADE

BLOW MOLDING GRADE

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INJECT
GRADE

TIRE RECYCLING LINE

WOODS/ FURNITURE
SHREDDING PROCESS



WOOD CHIPS





CHANG WOEN LDPE/PP Film Recycling



A.G. Film

Recycling





CHANG WOEN
Recycling & Shredding Technology

CHANG WOEN LDPE/PP Film Recycling



Post Consumer Film

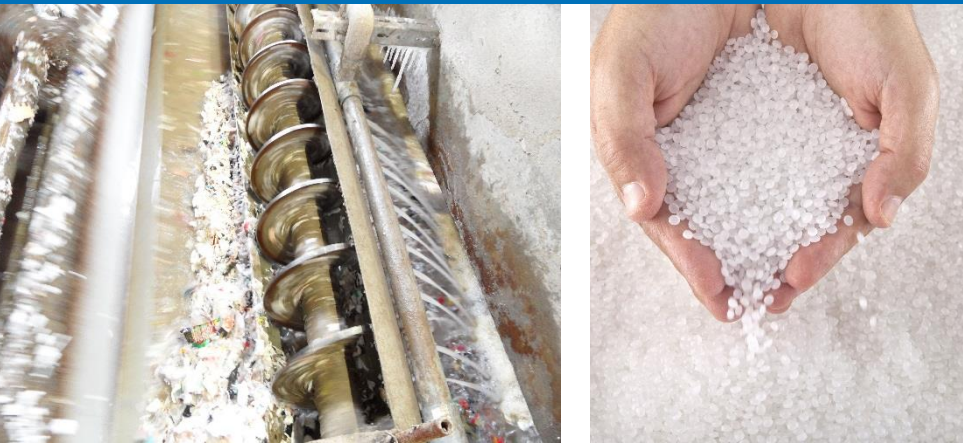
Recycling





CHANG WOEN
Recycling & Shredding Technology

CHANG WOEN LDPE/PP Film Recycling



In House Film Recycling

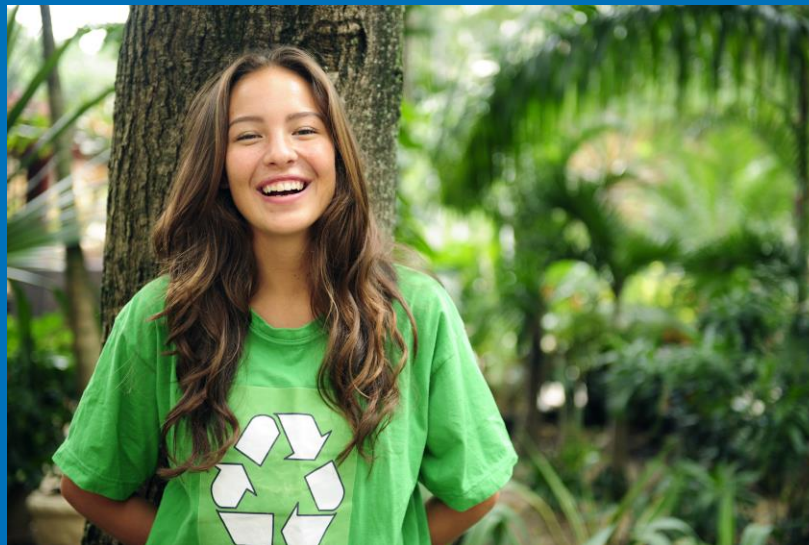


THANK YOU

HCM, Vietnam, 07/May./2019



CHANG WOEN
Recycling & Shredding Technology



Present



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RECYCLING
FOR A
BETTER
WORLD