



# UBE

**Sustainable Solutions with Nylon /**

Nicola Bucchioni  
UBE NYLON Atlantic Team Leader

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# Who We Are /

# Who We Are /



Founded: June 1st, **1897**  
(Consolidated in 1942)



Employees:  
**11,010**



Group Companies:  
**140**



Market cap:  
**€ 2,3 Billions**

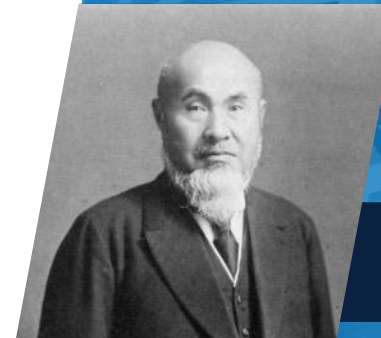


R&D Expenses  
per annum:  
**€ 111 MM**



Turnover:  
**€ 5,5 Billions**

UBE CITY  
宇部市



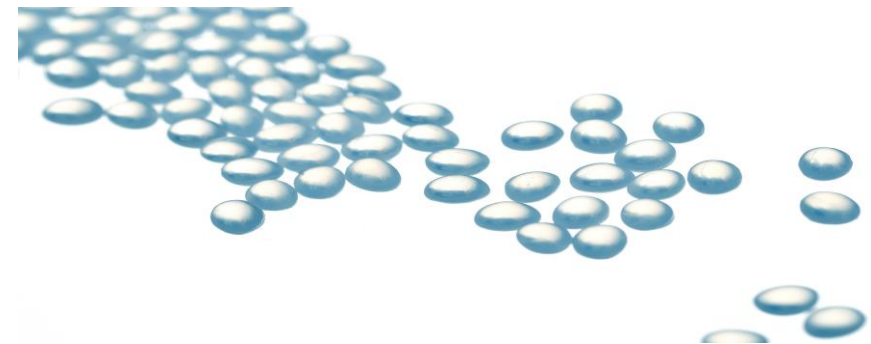
Founder:  
**Sukesaku Watanabe**



# UBE NYLON / Castellón (Spain) Plant



**UBE NYLON capacities in the world = 200 K MT**



**UBE NYLON capacities in Europe = 70 K MT**

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# Meaning of Sustainability /



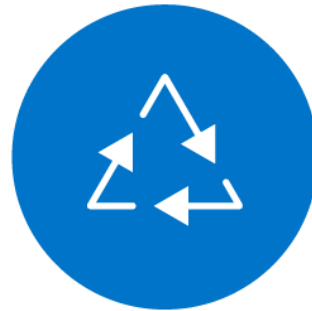
# What Does It Mean to Be Sustainable In The Film Industry? /



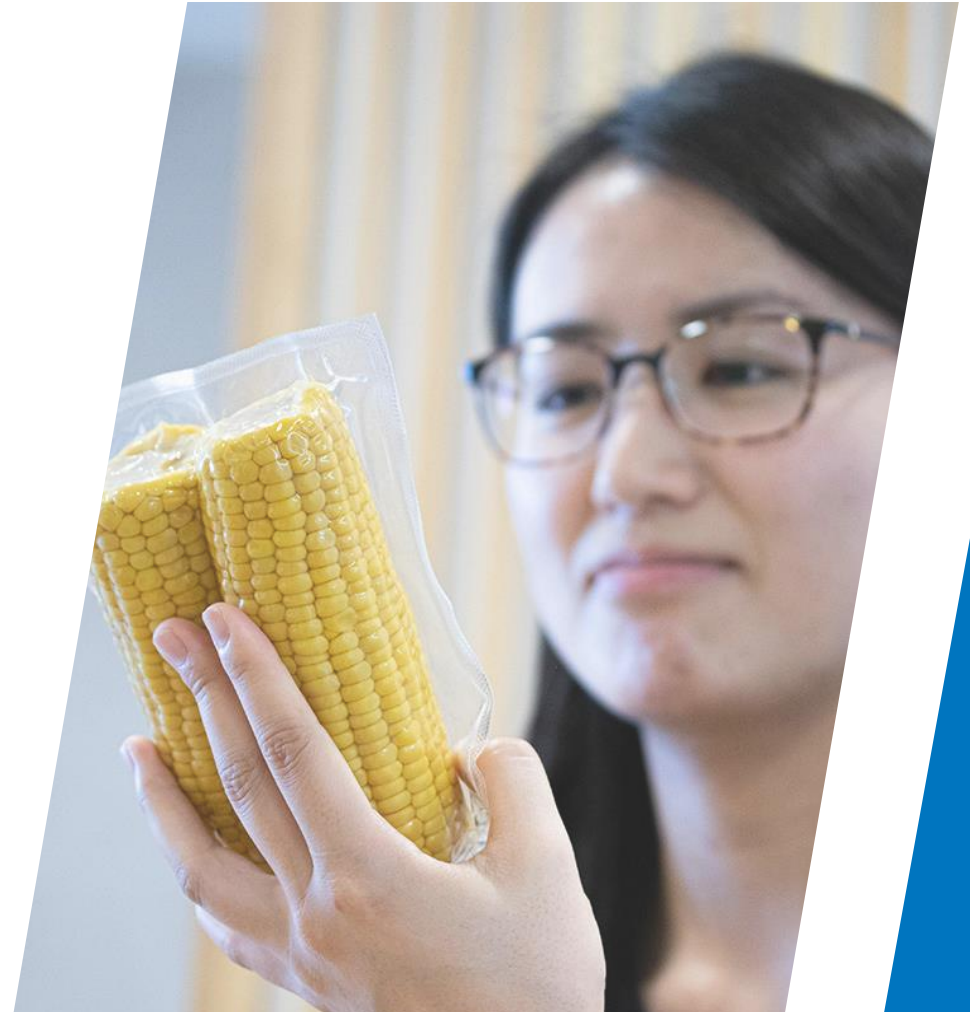
**CO<sub>2</sub> EMISSIONS  
REDUCTION**



**MATERIAL  
REDUCTION**



**MATERIAL  
RECYCLE**



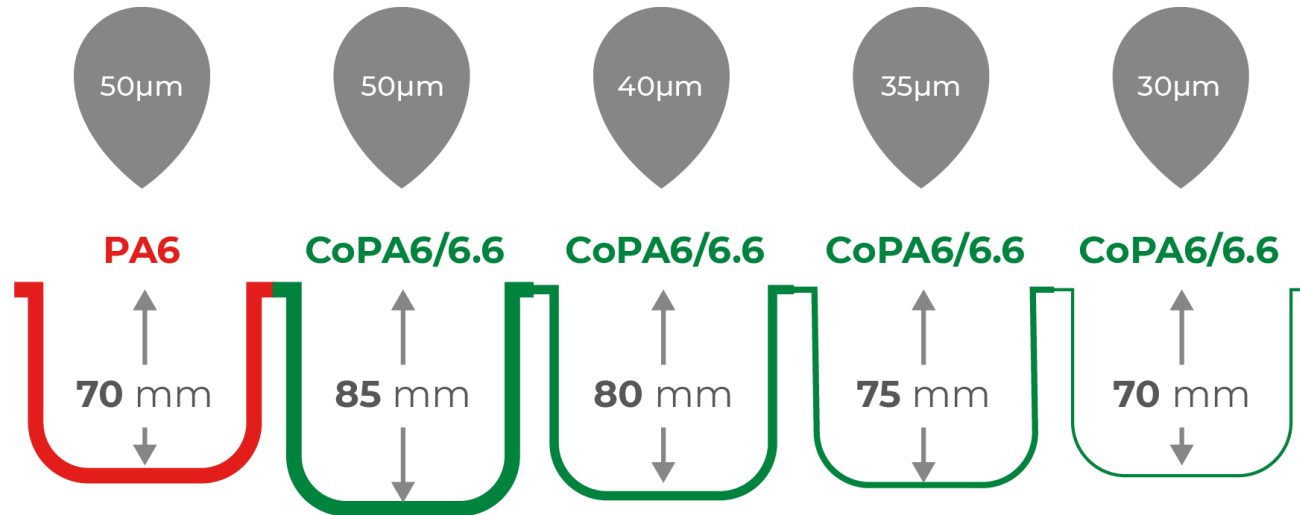
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# The UBE first way to Sustainability / Material Reduction





# Reducing thickness with special PAs /



## Max. Thermoforming Depth (mm)

### Film

Process: Airblown  
Structure: Monolayer

### Mold

Ø: 91 mm  
Depth: Adjusted until break

### Heating

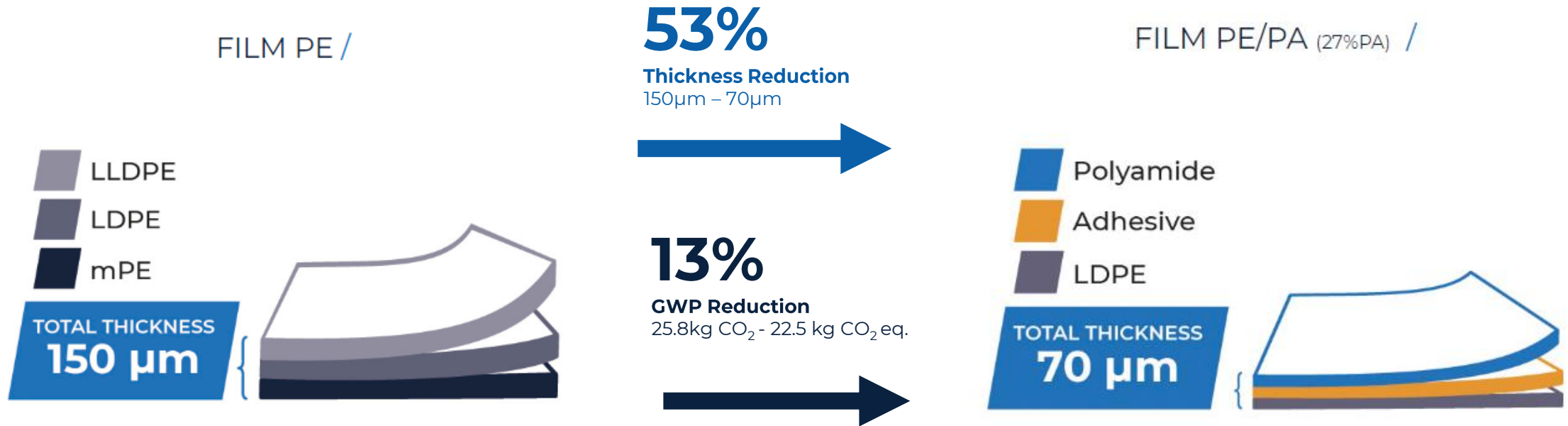
Temp: Optimal  
Time: 3s

Tested dried as mold





# Reducing thickness with multimaterial packaging/



Higher performance of **PA allows reduction** of material and, as a consequence, a reduction of the **GWP**

# Light & thin multilayer flexible packaging/ Best choice for e-commerce

The PA based multimaterial solution performed at best transportation simulation

**Loading Simulation**

**Transportation Simulation**

**Unloading Simulation**



Drop Test



Vibration Test



Drop Test



**Leak Tests (with and without water bath) /  
Multimaterial vs. Monomaterial flexible  
packaging for cheese**



# Thinner PA based multilayer packaging/

Winner of the supply chain simulation



**The 70 microns PE/PA PACKAGES  
had -50% FAILURE RATE than the  
150 microns PE PACKAGES**

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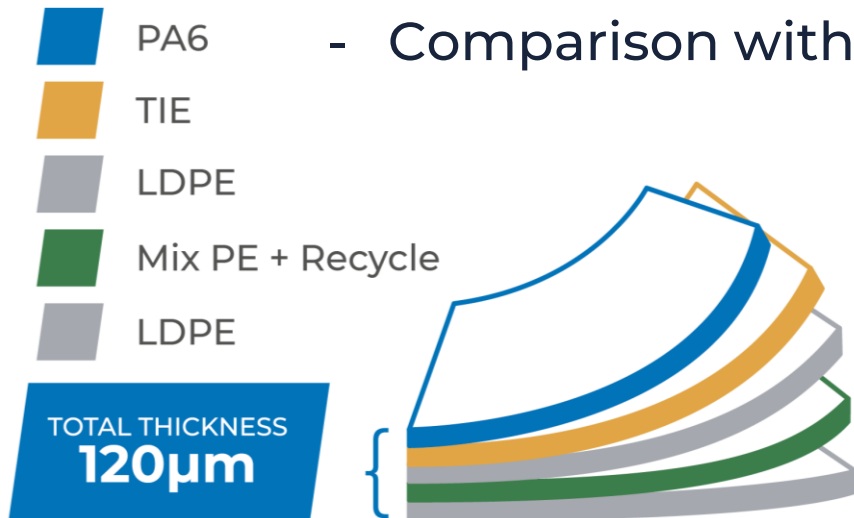
# Nylon & Mechanical recycling / Post-Industrial PEPA films.



# rPEPA in a multilayer film /

## Replacement of PE layer

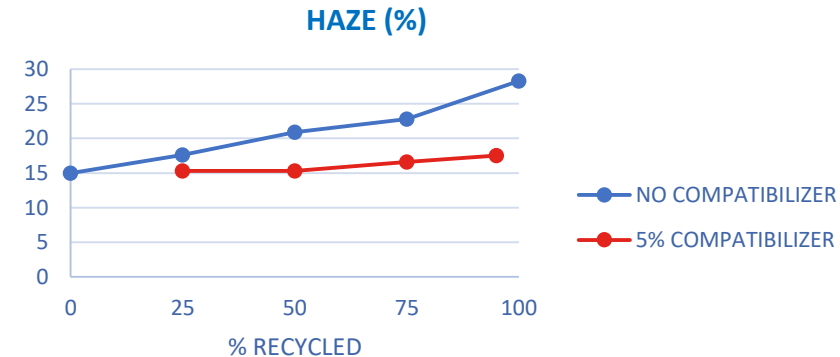
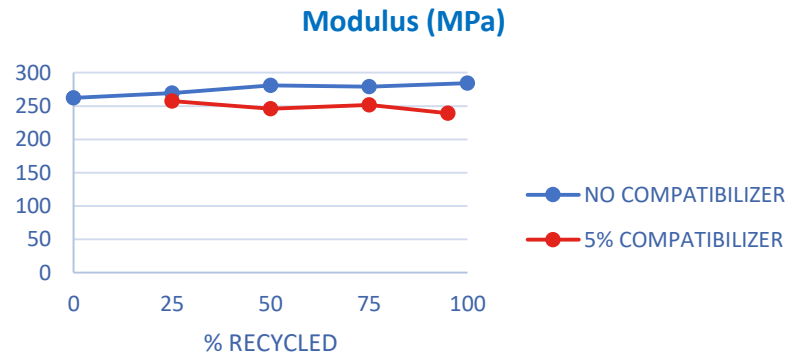
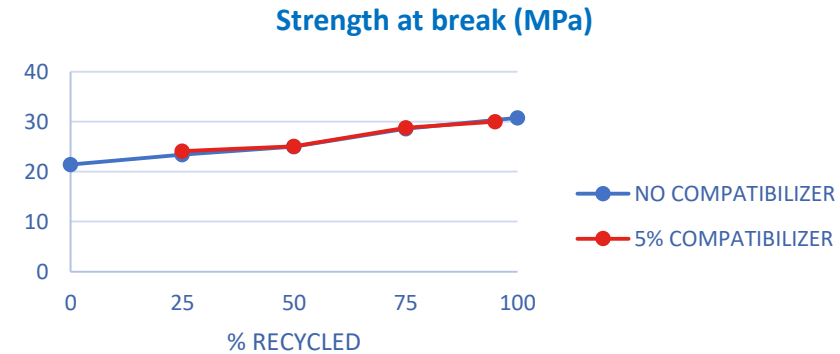
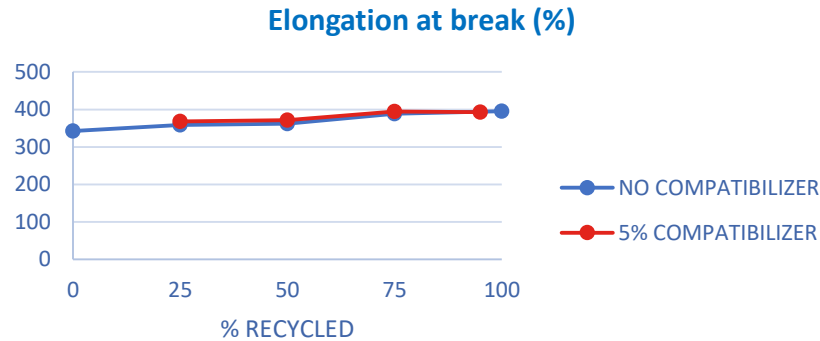
- rPEPA with 24% content in PA
- Comparison with / without compatibilizer



The extrudability of this film with rPEPA was very good!

	PA6 (outer)	TIE	LDPE	Mix PE + Recycle	LDPE (inner)
Thickness	20 µm	8 µm	16µm	60µm	16µm

# rPEPA in a multilayer film /



- rPEPA not only keeps mechanical properties, it also improves them at higher percentage.
- The increase of modulus or haze can be compensated by the use of 5% of commercial compatibilizers.



# Post-Industrial rPEPA in a MLF for non-food application



Welding layer: LDPE

Core layer: rPEPA

Core layer: rPEPA

**UBE**  **Flextech**<sub>srl</sub>

# Post-Industrial rPEPA in a MLF for non-food application



Welding layer: LDPE

Core layer: rPEPA

Core layer: rPEPA



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Successful use of rPA (1) /  
Injection Molding.





# 100% rPA for Injection Molding/



## First Proof of Concept

UBE formed a partnership with a Spanish Sport Apparel Brand and the recycler APK, provider of a 100% rPA from solvent based delamination recycling.

As a result of the combined R&D effort, a successful prototype was produced.

Now the Spanish Sport Apparel Brand plans to produce all its sunglasses with this material.

The recycled sunglasses will be promoted at the “Vuelta Ciclista a España”.

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Successful use of rPA (2)  
Monofilaments for lawn-  
cutters.





## 100% rPA for Monofilaments/



### Second Proof of Concept

100% monomaterial high viscosity PA films were recycled at a Partner/Recycler.

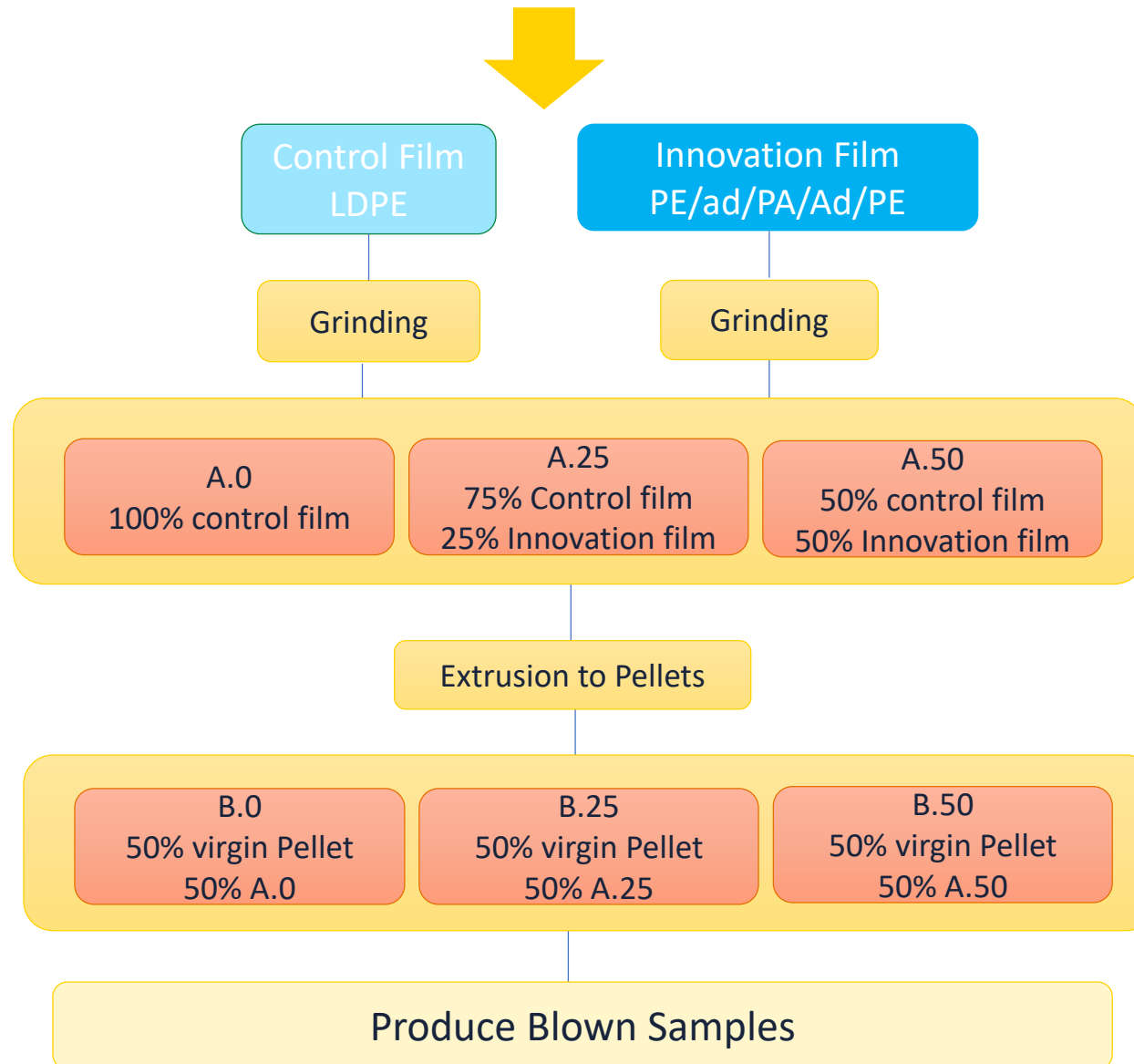
This material was extruded successfully at one leading Monofilament Company for producing new PA lawn-cutter monofilaments.



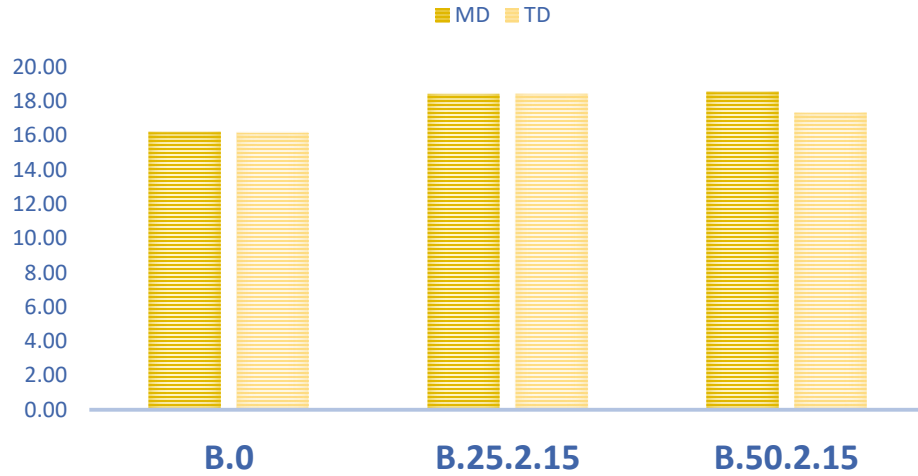
Nylon & Mechanical  
recycling /  
PEPA Post-industrial films,  
an additional study.

# Recyclability of Multilayer Film PE/Ad/PA/Ad/PE

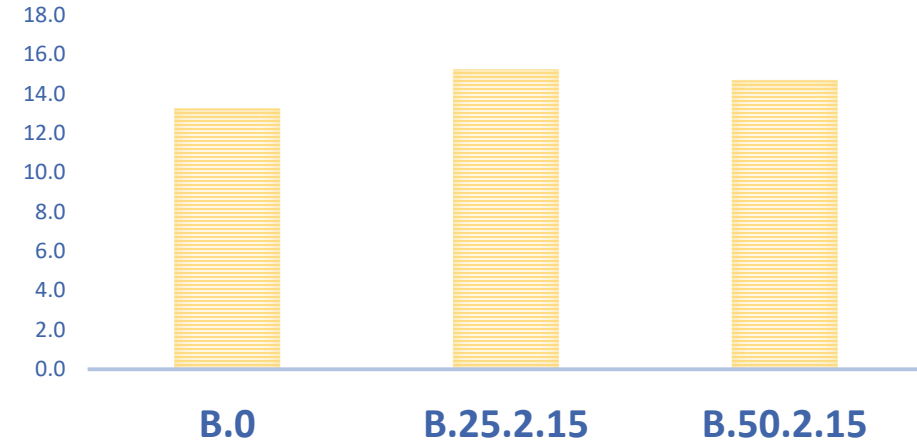
PA : PA6/66 15%



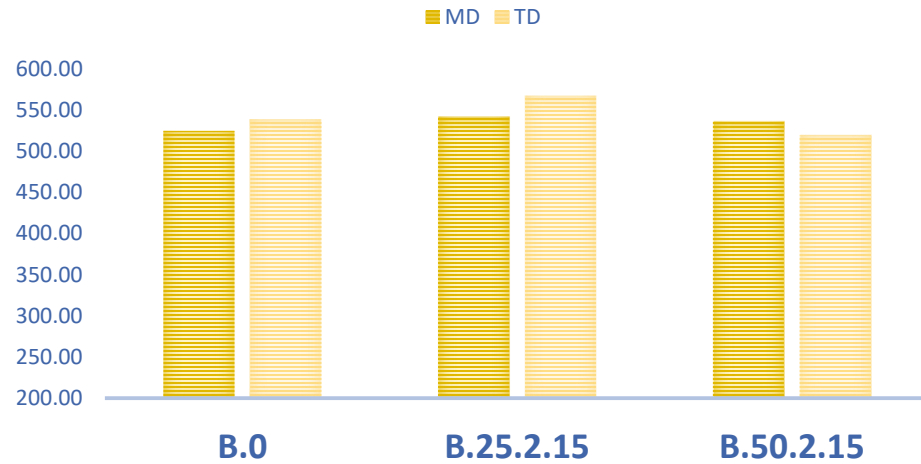
### TENSILE STRENGTH AT BREAK (MPA)



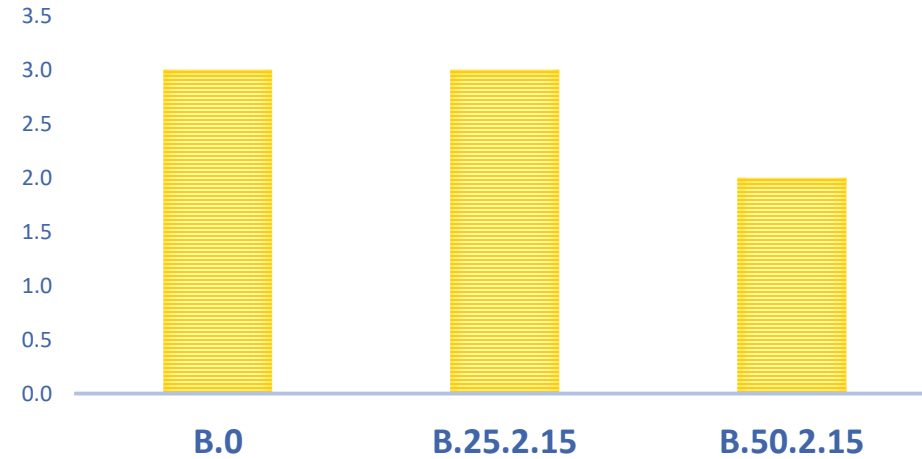
### HAZE %



### ELONGATION AT BREAK (%)



### GELS



**BO-** LDPE Control Film

**B25.2.15-** rPEPA PA6/66 15%

**B25.2.15-** rPEPA PA6/66 15%



**B50.2.15-** rPEPA PA6/66 15%



**BO-** LDPE Control Film



**B25.2.15-** rPEPA PA6/66 15%



- Good extrusion performance
- No change on pressure at die-head
- DSC Shows no peak >150degC
- Mechanical properties compared to control film
- No increase on Gel number
- Good optical properties

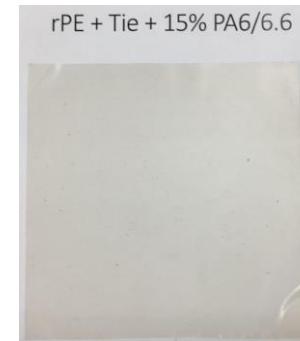
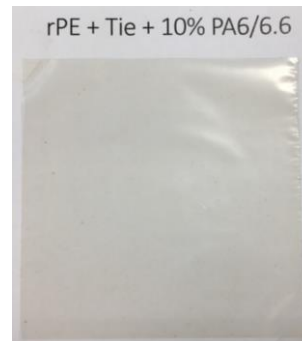
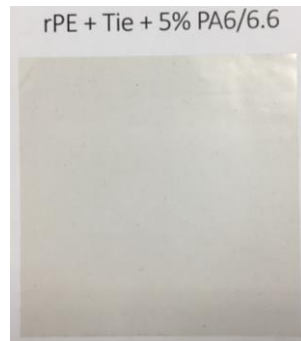
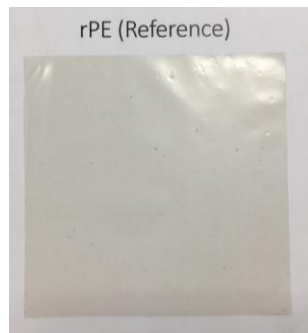
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Nylon & Mechanical  
recycling/  
PEPA Post-Consumer films.



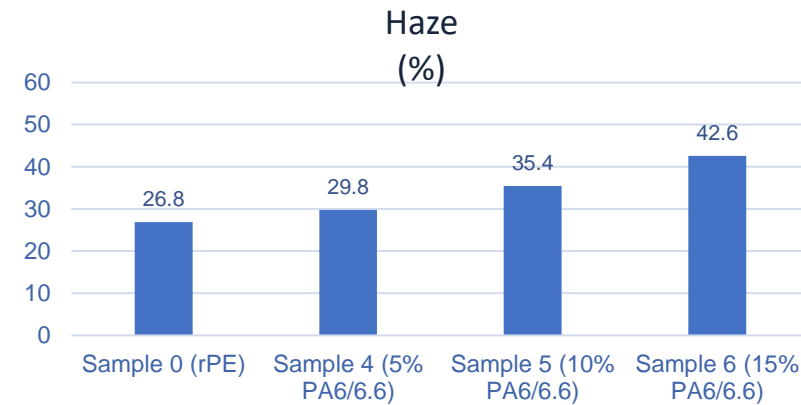
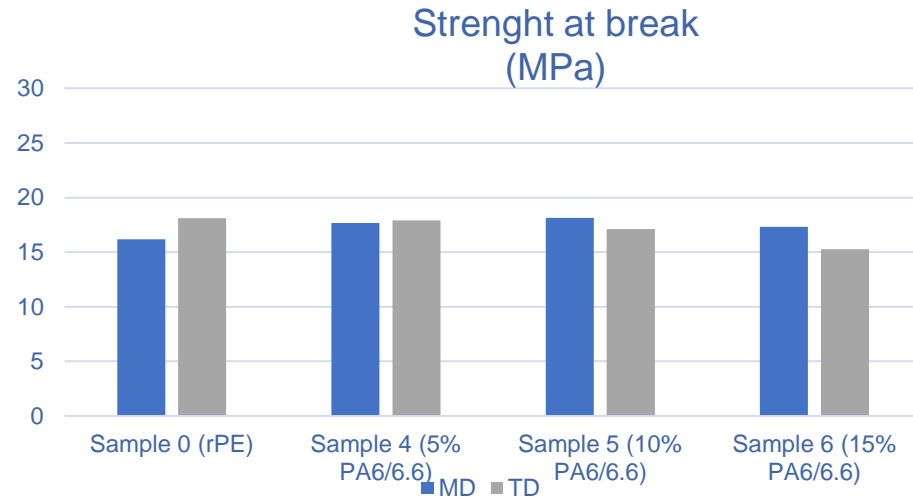
# Post-consumer rPE + virgin PA /

- The sources of rPE are wrapping and packaging from [logistic centers and supermarkets](#)
- It has been added a controlled quantity of PA6/6.6 by compounding with very satisfactory results.



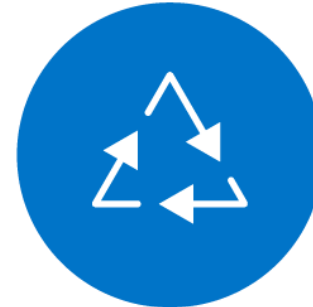
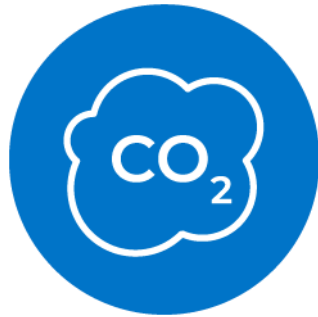


# Post-consumer rPE + virgin PA /



- Post- consumer rPE + virgin PA has confirmed to perform similar to post-industrial rPE.
- Main properties of the films post-consumer rPE + virgin PA are kept vs. the post-consumer rPE . Only for applications where reduction of haze is required, it will be suggested to use compatibilizers.

# Wrap-up: Nylon is Sustainable /



**CO<sub>2</sub> EMISSIONS  
REDUCTION**

**MATERIAL  
REDUCTION**

**...and yes,  
MECHANICALLY  
RECYCLABLE**

# Q+A Time

## Questions?

[n.bucchioni@ube.com](mailto:n.bucchioni@ube.com)

UBE Corporation Europe S.A.U.  
Poligono Industrial El Serrallo s/n  
E-12100 Castellón, Spain

UBE Europe GmbH  
Immermannstrasse 65B  
D-40210 Düsseldorf, Germany

