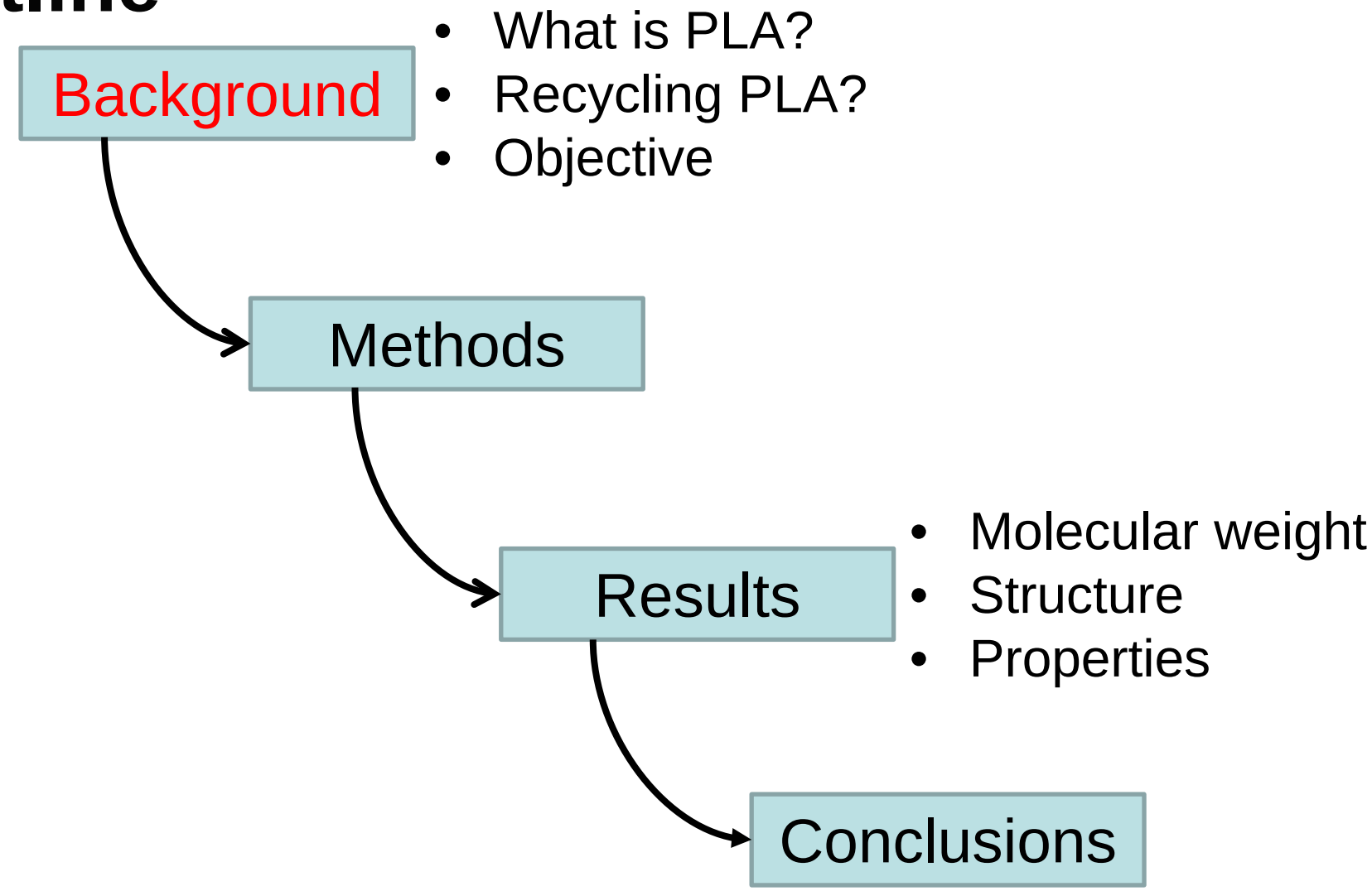
Effect of simulated mechanical recycling processes on the properties of poly(lactic acid)

F.R. Beltrán, V. Lorenzo, J. Acosta, M.U. de la Orden, J. Martínez Urreaga

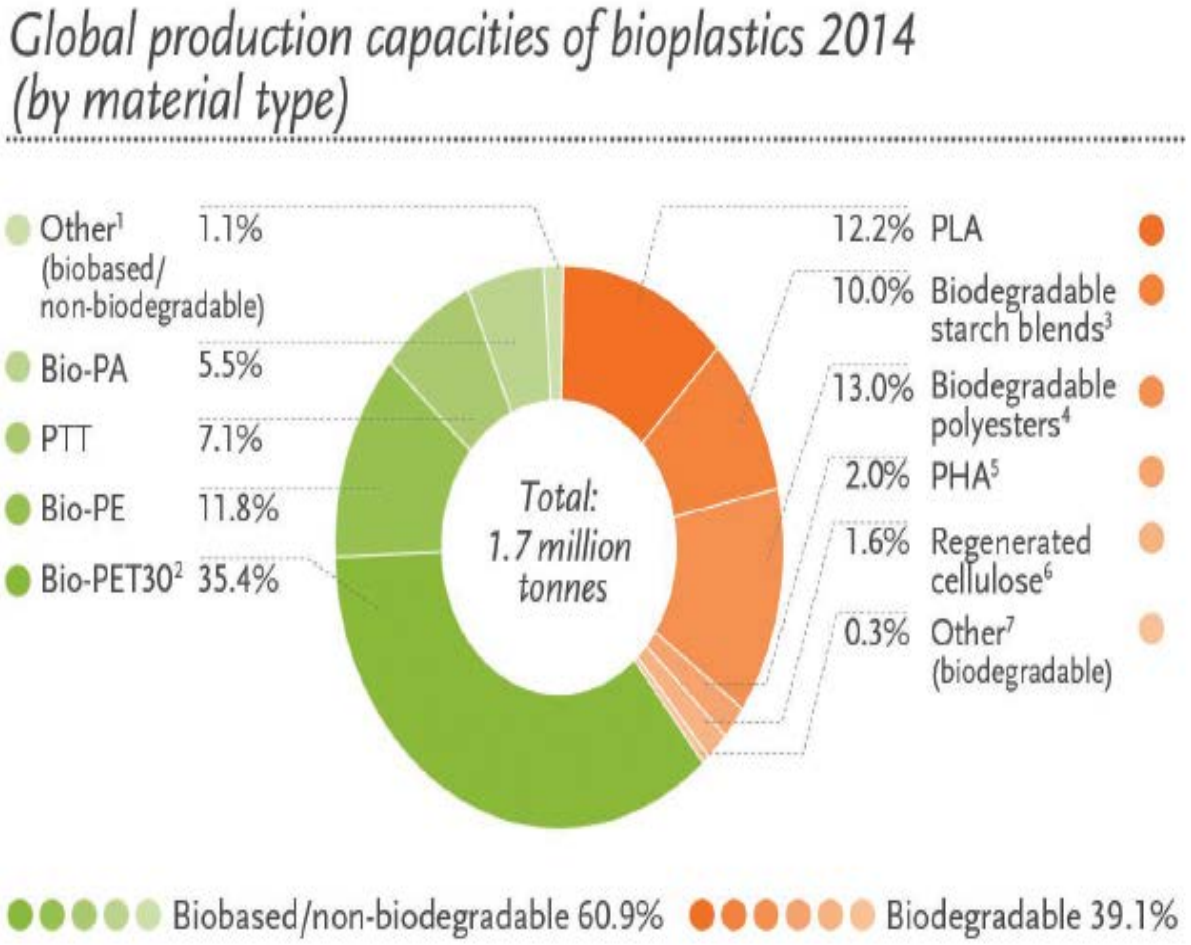
4th International Conference on Sustainable Solid Waste Management, Limassol, 23–25 June 2016

Outline


Background
What is PLA?
Recycling PLA?
Objective
Methods
Results
Molecular weight
Structure
Properties
Conclusions

What is poly(lactic acid)?

- PLA comes from lactic acid obtained from corn, potato, etc.
- PLA production was 200,000 t in 2014
- PLA production will grow from until 500,000 t in 2020.

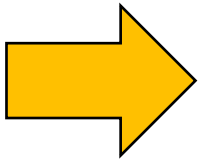


Source: PlasticsEurope and nova-Institute

It is important to recycle PLA?

Growing production:
- Social problems

Mechanical Recycling



Increased use:
- Environmental problems

- Risk of contamination of other plastics
- Cost of separation and viable recovery systems
- Effect of the mechanical recycling on the performance

Objective

Study the effect of degradation in use and different simulated mechanical recycling processes on:

- Molecular weight
- Structure
- Optical
- Mechanical
- Gas barrier properties of PLA

Outline

Background

- What is PLA?
- Recycling PLA?
- Objective

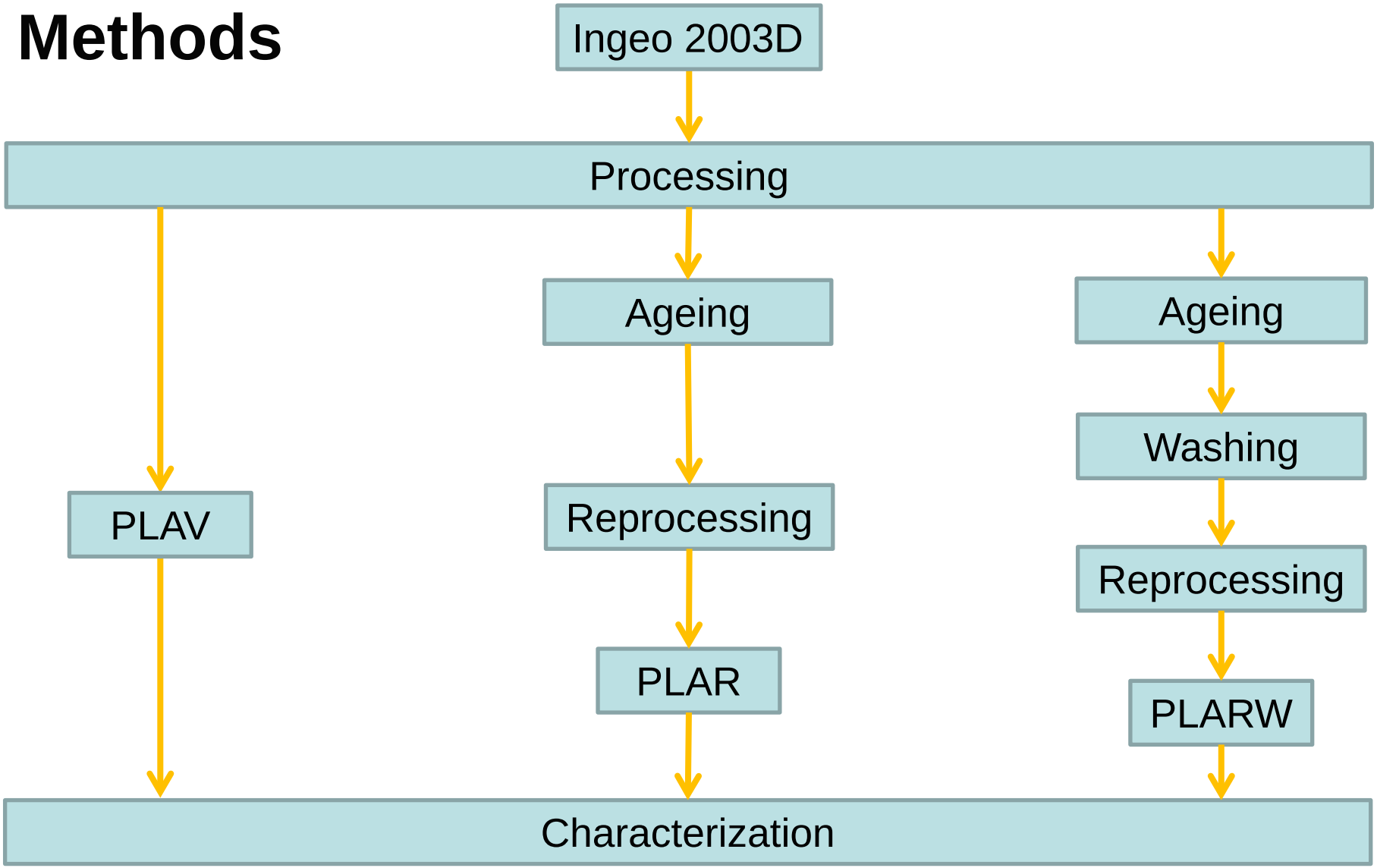
Methods

Results

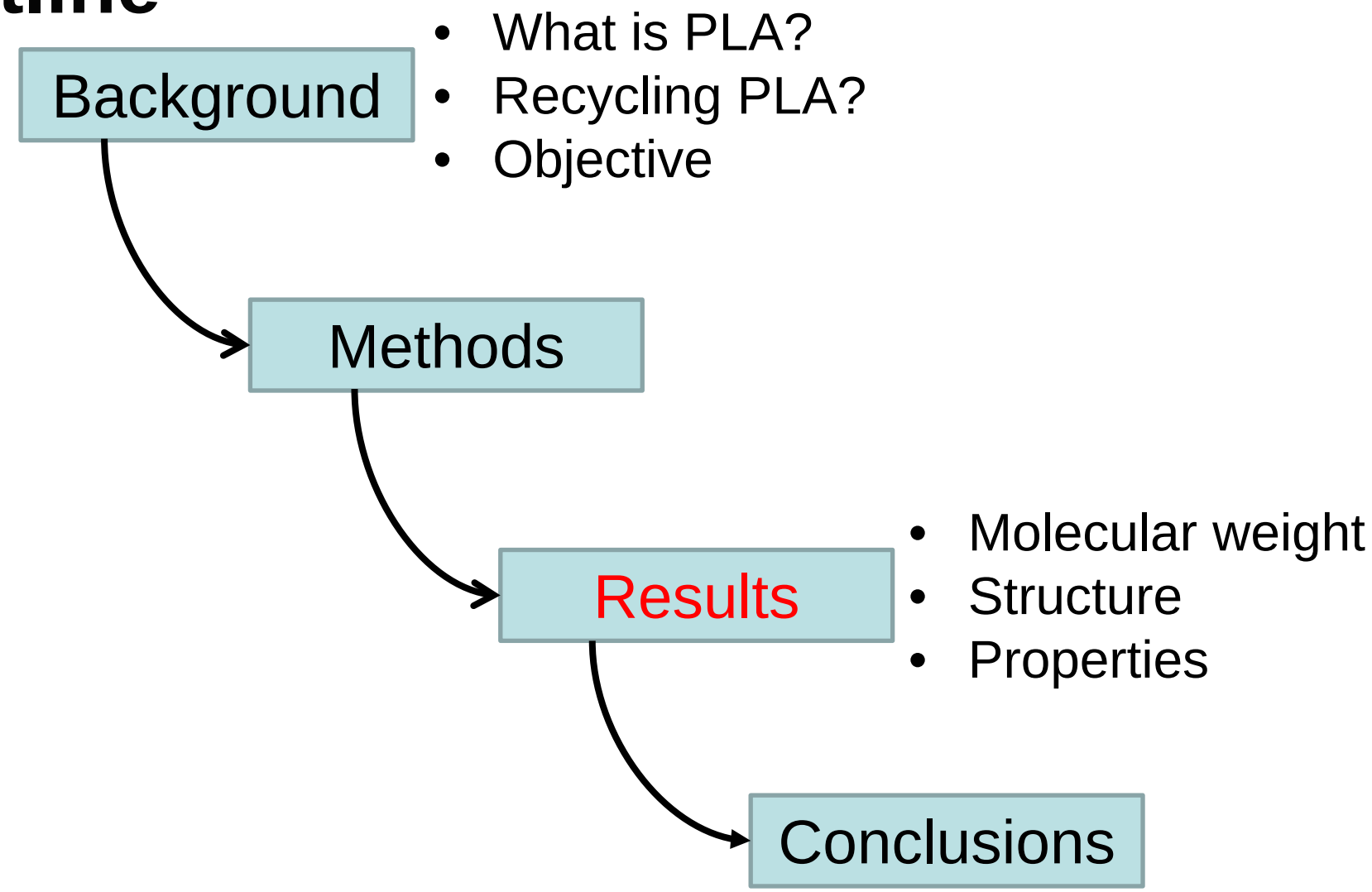
- Molecular weight
- Structure
- Properties

Conclusions

Methods

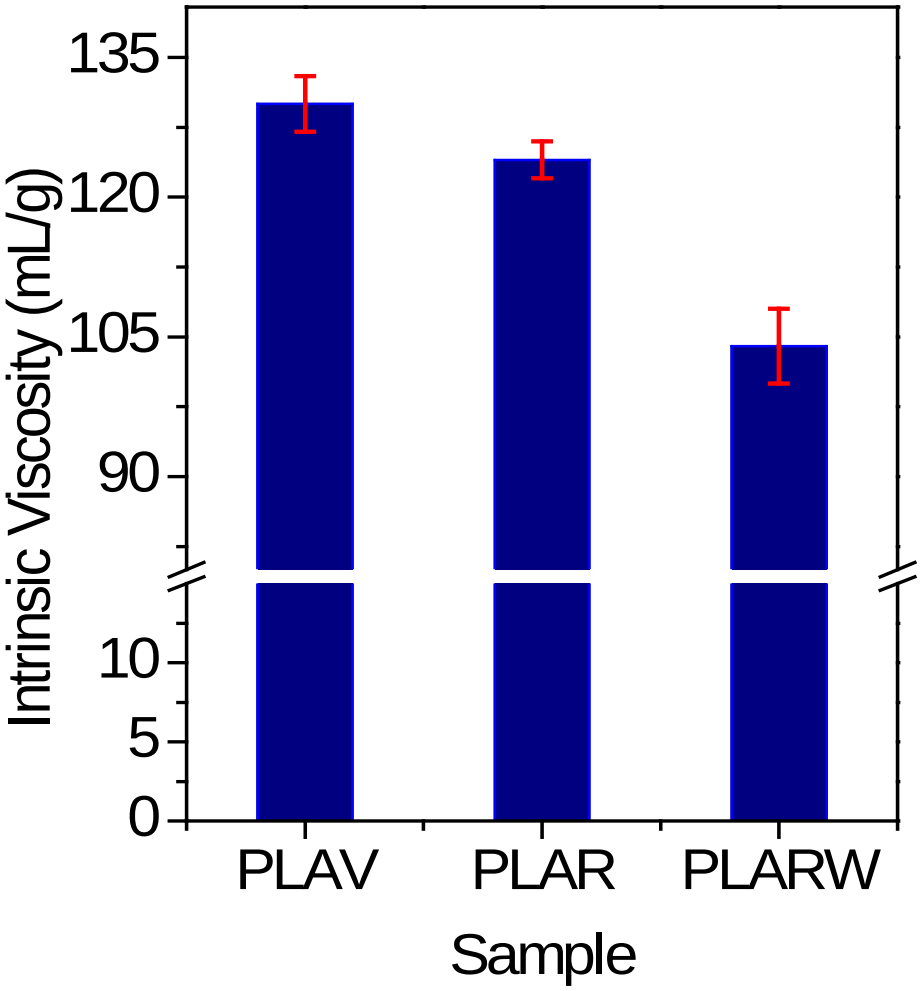

Ingeo 2003D
Processing
PLAV
Ageing
Reprocessing
PLAR
Ageing
Washing
Reprocessing
PLARW
Characterization

Outline


Background
• What is PLA?
• Recycling PLA?
• Objective
Methods
Results
• Molecular weight
• Structure
• Properties
Conclusions

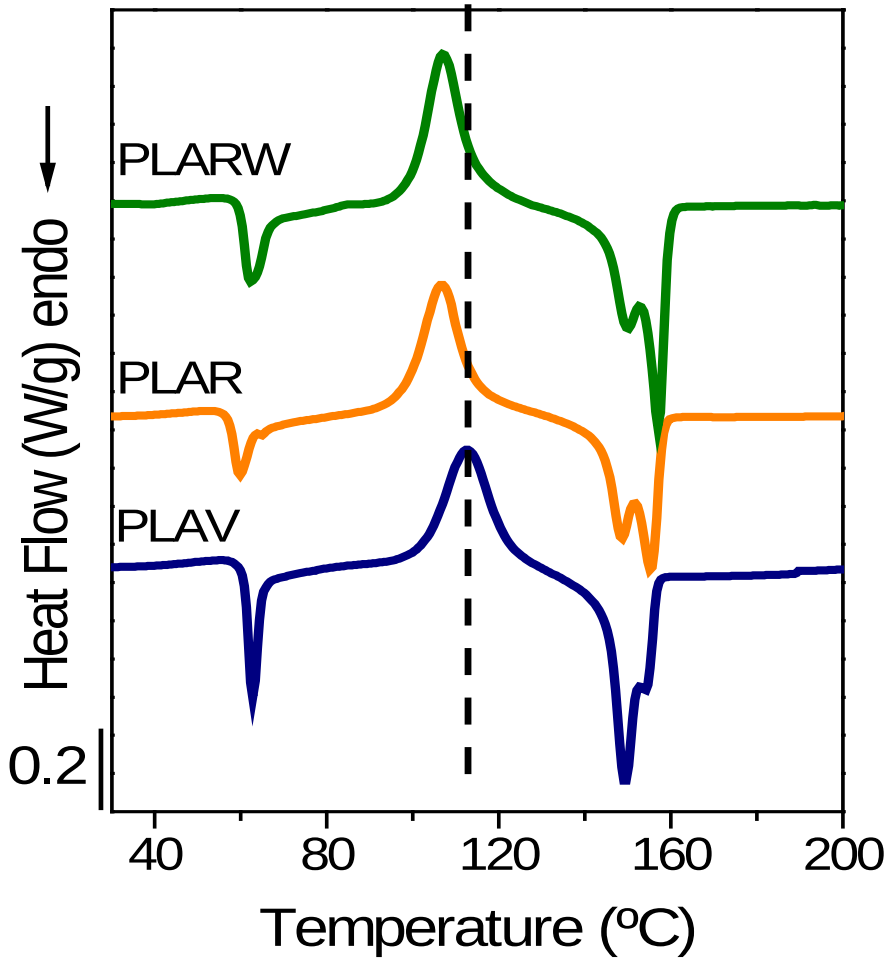
Results: Effect on the molecular weight

- PLA is susceptible to degradation during use and mechanical recycling
- Both recycled materials present a decrease on their intrinsic viscosity.
- The washing step plays an important role in the degradation of PLA



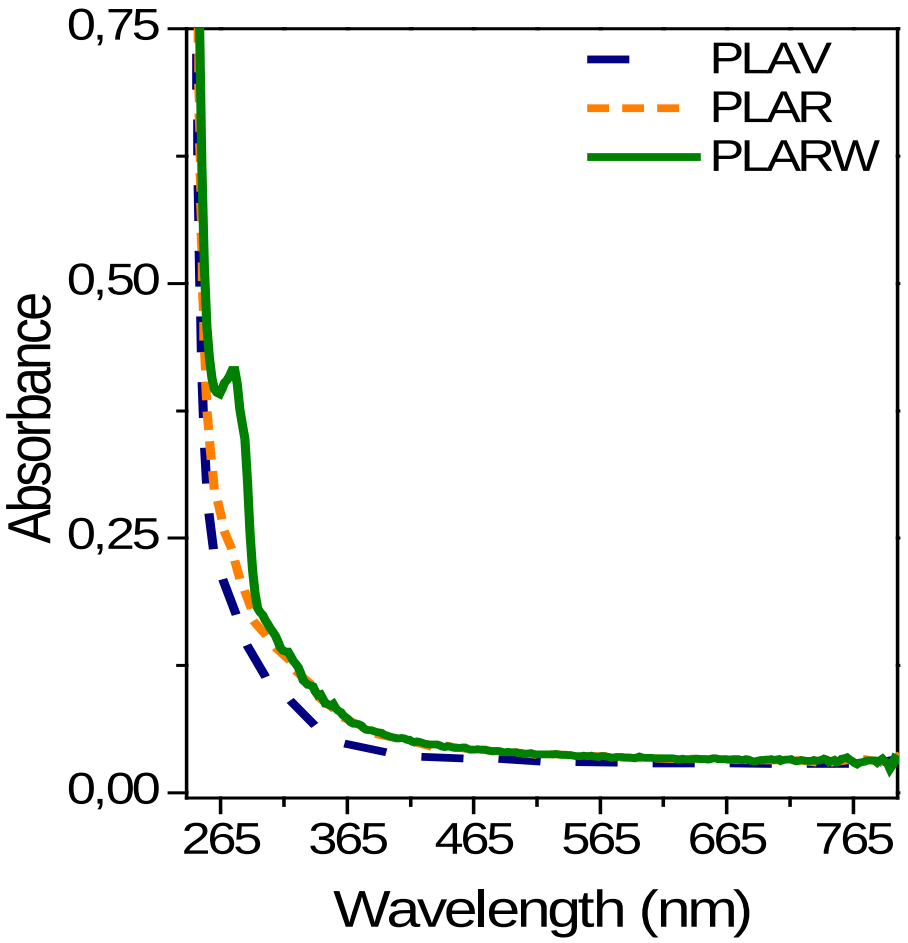
Results: Effect on the structure

- The degradation of PLA favours the crystallization and the formation of more stable structures
- No observable changes in the crystallinity of the different materials



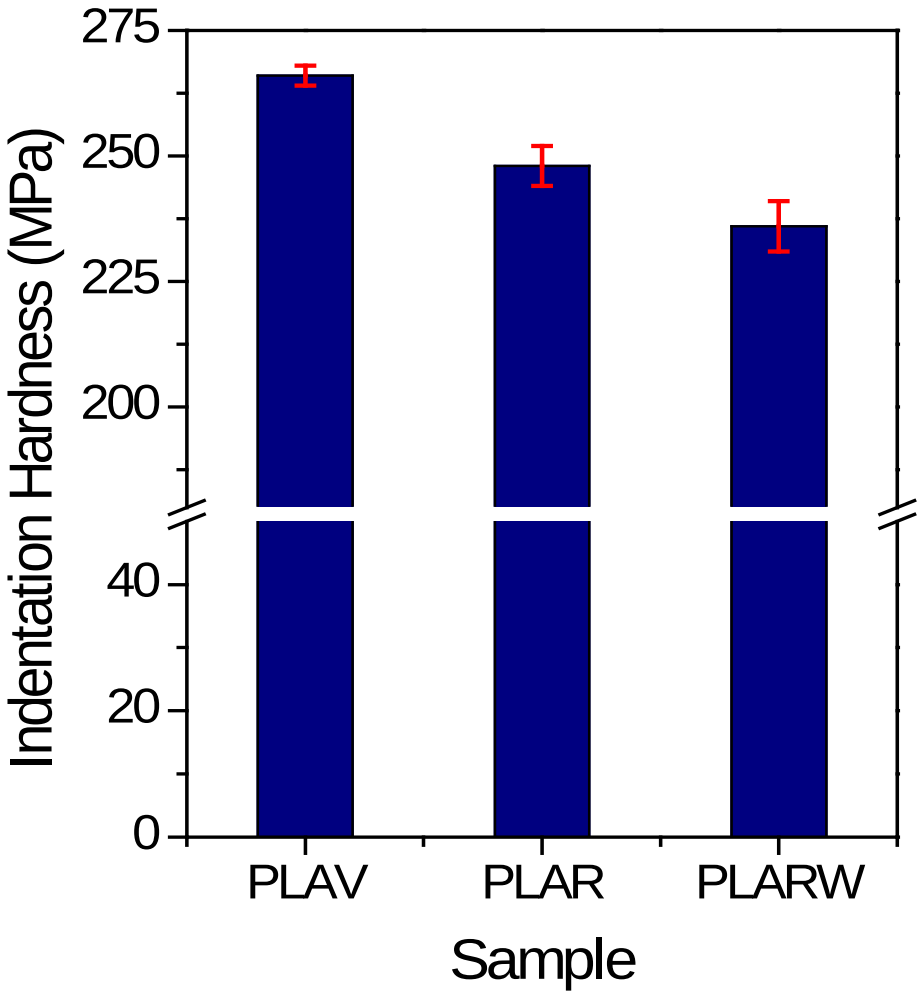
Results: Optical properties

- Recycled materials present an absorption band at 270 nm, due to degradation during recycling.
- Transmission in the visible region is not affected, being above 90 % in all cases.



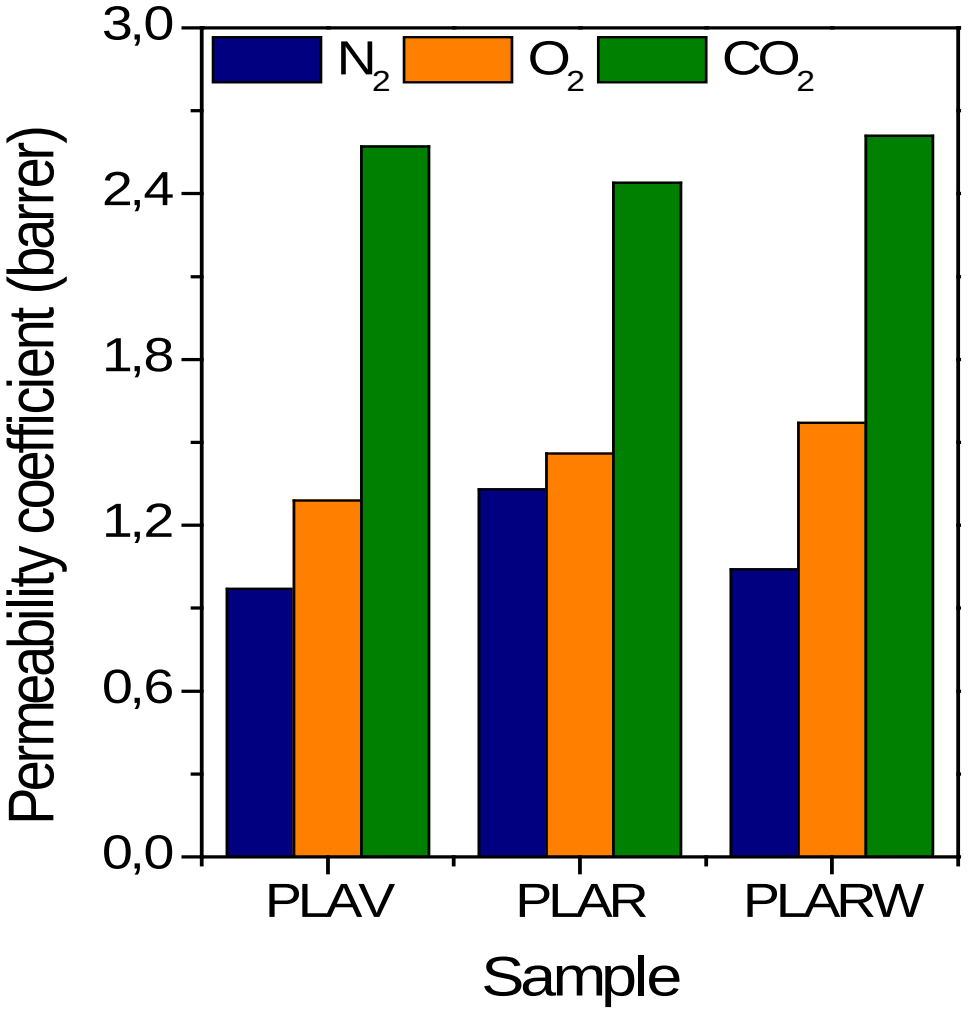
Results: Mechanical properties

- Both PLAR and PLARW present lower hardness than PLAV (7 and 10 % lower).
- This decrease is caused by the degradation of the polymer during the reprocessing.

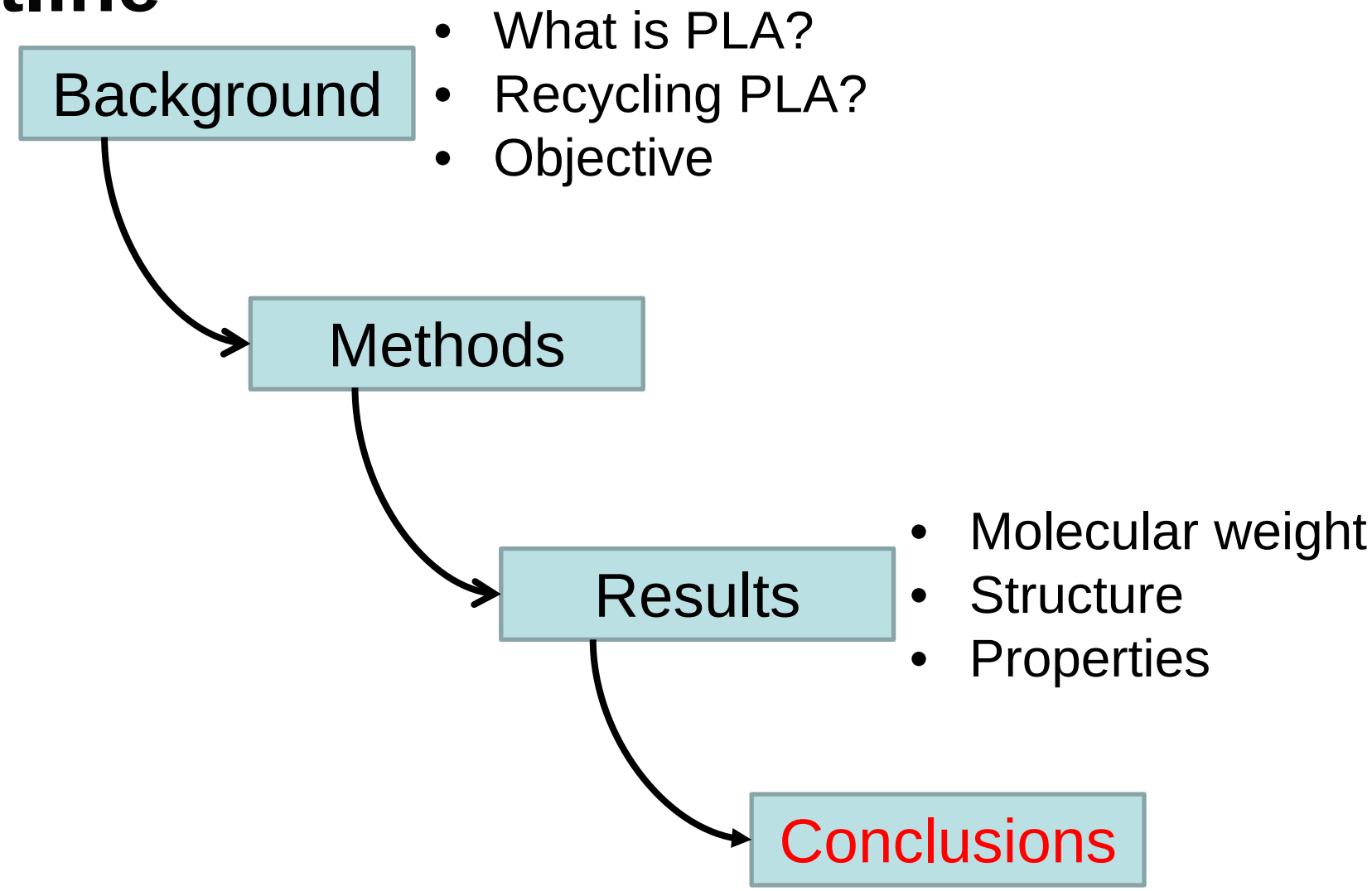


Results: Gas barrier properties

- Gas barrier properties are very important in food packaging applications
- Recycling processes do not cause significant changes in the permeability coefficient of different gases



Outline


Background
What is PLA?
Recycling PLA?
Objective
Methods
Results
Molecular weight
Structure
Properties
Conclusions

Conclusions

Mechanical recycling caused the degradation of PLA, especially in the case of the material subjected to the washing step.

The effect of this degradation on the structure, optical, mechanical and gas barrier properties is limited.

Our results suggest that mechanically recycled PLA can be used in food packaging applications.

Thanks for your attention

Contact information:
e-mail: f.beltran@alumnos.upm.es