aiju
Technological Institute
for children's products & leisure

Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches

mastAlmond

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eSymbiosis

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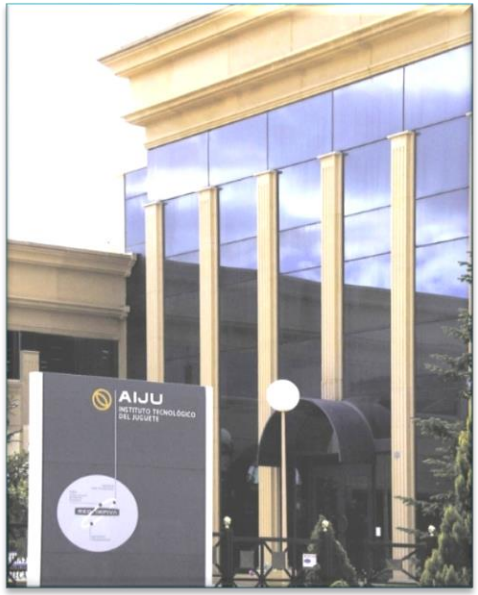
AIJU TECHNOLOGICAL INSTITUTE – *INTRODUCTION*



- AIJU is a private not-for-profit organisation aiming to boost research development and technological innovation within toy, children's products and leisure industry.

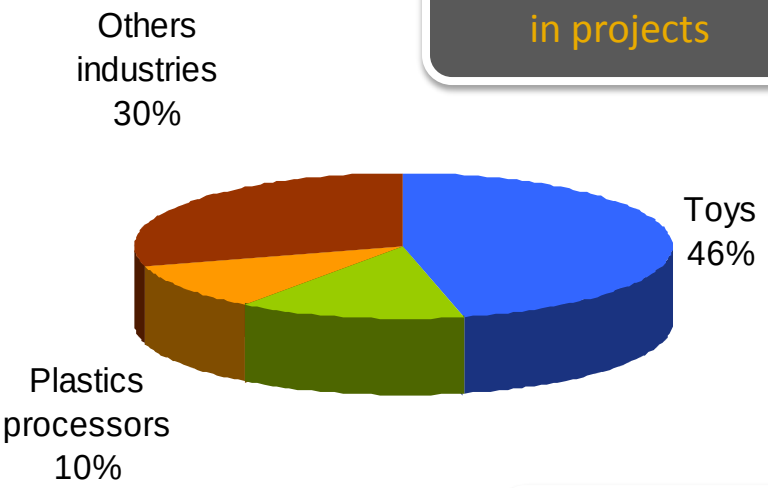
  Thus making it possible the achievement of a constant competitiveness increase and product quality improvement

- Founded in 1985.
- Located in South-East of Spain
- Premises with 5.400 m^2.
- AIJU staff: 69 professionals
- 525 Associated companies and 1.225 clients

AIJU TECHNOLOGICAL INSTITUTE – *Facts, Figures 2013 and Sectors*

- **Other-industries:**
  - Promotional marketing
  - Education
  - Automovil
  - Child care articles
  - Leisure
  - Playgrounds
  - Energy
  - Fashion
  - Medical Engeineerin
  - Food

160
Companies participating in projects



47.317
Technological services to companies

1.195
Participants in training activities

AIJU TECHNOLOGICAL INSTITUTE – *Capabilities*

- **Laboratory - Product Development Engineering**
  - Product Development & Rapid Manufacturing
  - Materials & Processes
  - Product safety
- **Pedagogy – Product**
  - User & Consumer
  - Psychopedagogy & Therapy
  - Market & Trends
- **Training**
- **Management & Innovation**
  - Advanced Management & Organisation
  - Simulation & Virtual Reality
  - Energy
  - Environment
  - ICToys

AIJU TECHNOLOGICAL INSTITUTE – *Materials & Processes*

- Analyses of Plastic Materials and finished products
- New plastic functionalities
- Dimensional verification
- New formulations
- New materials: Compounding & Extrusion
- Material identification & Characterization
- New technologies for product development
- Injection Mould Simulation
- Thermography & Mould Quality Control
- Development of Chemical Analysis Methods

MASTALMOND Project - Overview

Development a new **masterbatches based in biodegradable plastics and containing** in its formulation a high percentage of **almond shell**, a natural waste material, which will permit to cover technical requirements of two traditional industrial sectors, toy manufacturing and auxiliary furniture

Parners:

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IQAP masterbatch

Pérez Cerdá PLÁSTICOS

INJUSA®

Furniture auxiliary

Toy manufacturer

Duration: 3 years

Project: LIFE11 ENV/ES513 MASTALMOND

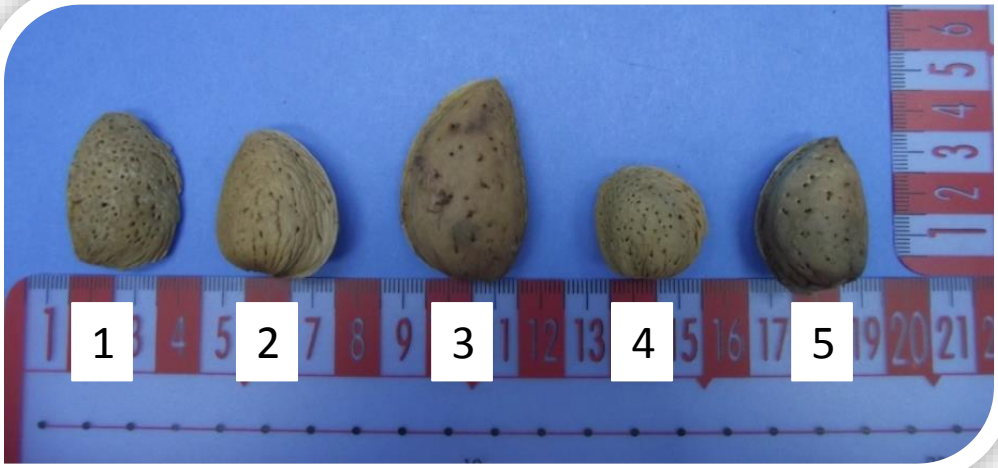
Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches - *Materials*

→ ***Plastic material*: PLA**

- Development masterbatch
- Injection molding: ErcrosBio LM 6230 (9 g/10 min, 1.25 g/cm³)

→ ***Natural waste*: *Almond shell***

- Six types of almond varieties : Comuna (1), Desmayo Rojo (2), Largueta (3), Marcona (4), Guara (5) and Mollar.
- Mixture of all of them



Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches – *Experimental Procedure*

1. ALMOND SHELL CHARACTERIZATION

- Infrared spectroscopy (FTIR)
- Thermogravimetric analysis (TGA).
- Scanning Electron Microcopy (SEM).
- Moisture Content analysis
- Compression test.

2. COMPOSITE PREPARATION

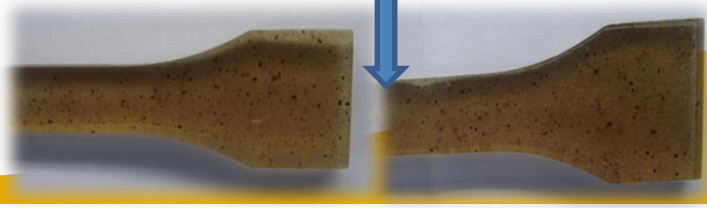
- Mill the almond shell (0.5 mm).
- Reduce moisture content: <2 wt % (Dried for 24h/80°C).
- Melt mixing PLA (80 wt%) and almond shell (20 wt %).

3. INJECTED BIODEGRDABLE PARTS

- Add 4% masterbatches development

4. MECHANICAL PROPERTIES

- Tensile test
- Flexural test
- Impact strength
- Shore Hardness



Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches – *Results*

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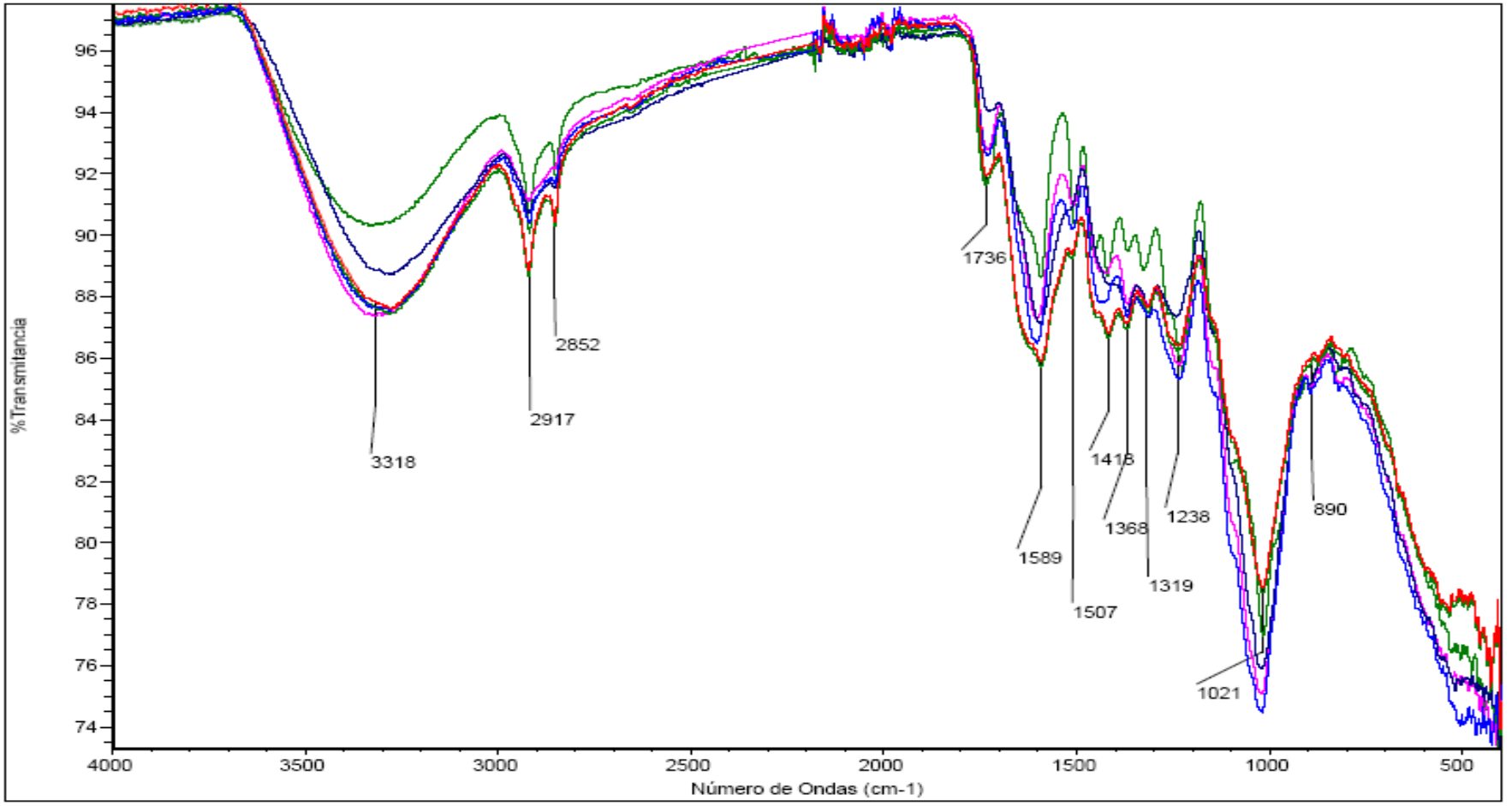
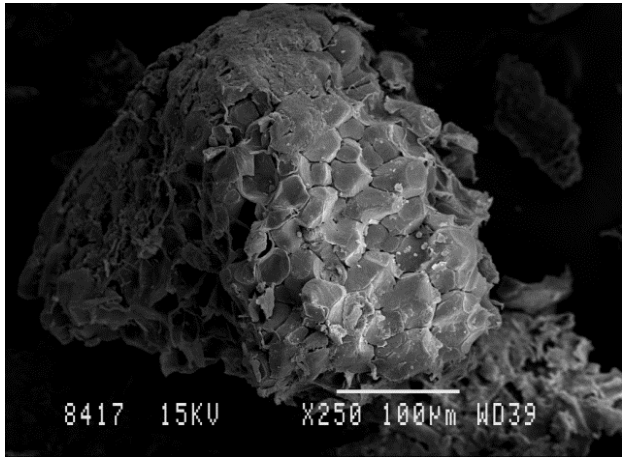
Infrared spectroscopy (FTIR)

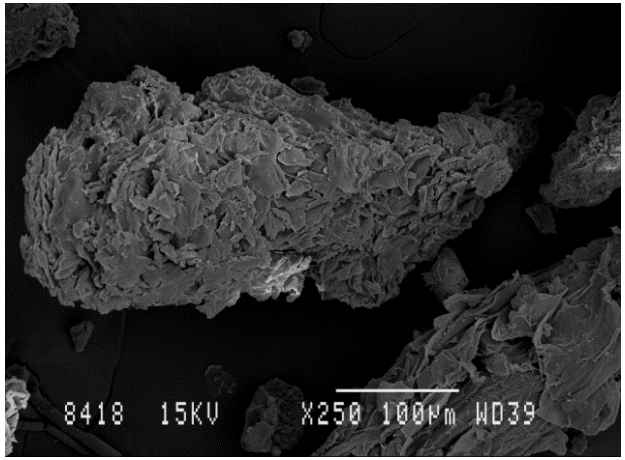


Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches – *Results*

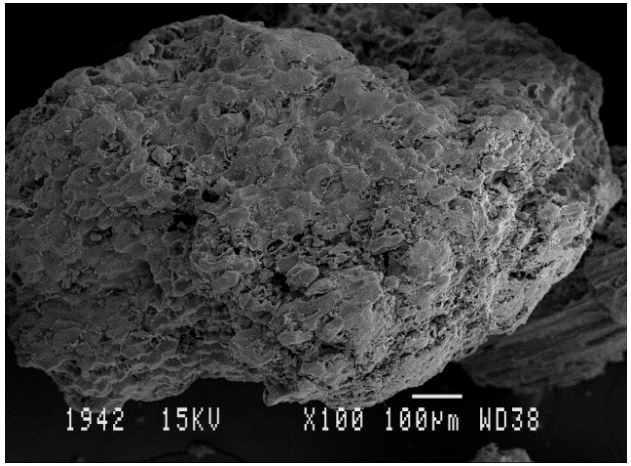
Scanning Electron Microcopy (SEM)



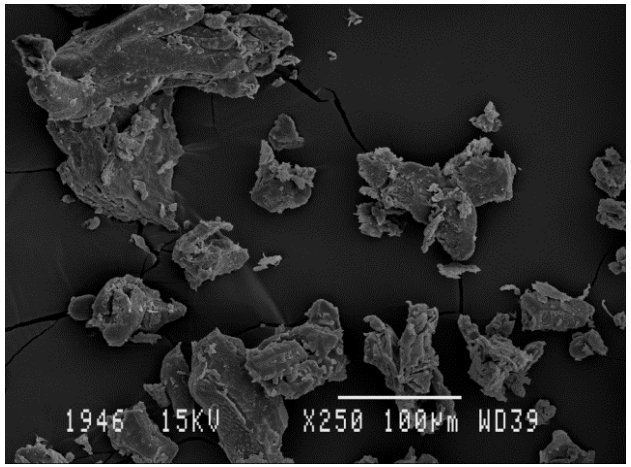
Comuna



Desmayo Rojo



Largueta

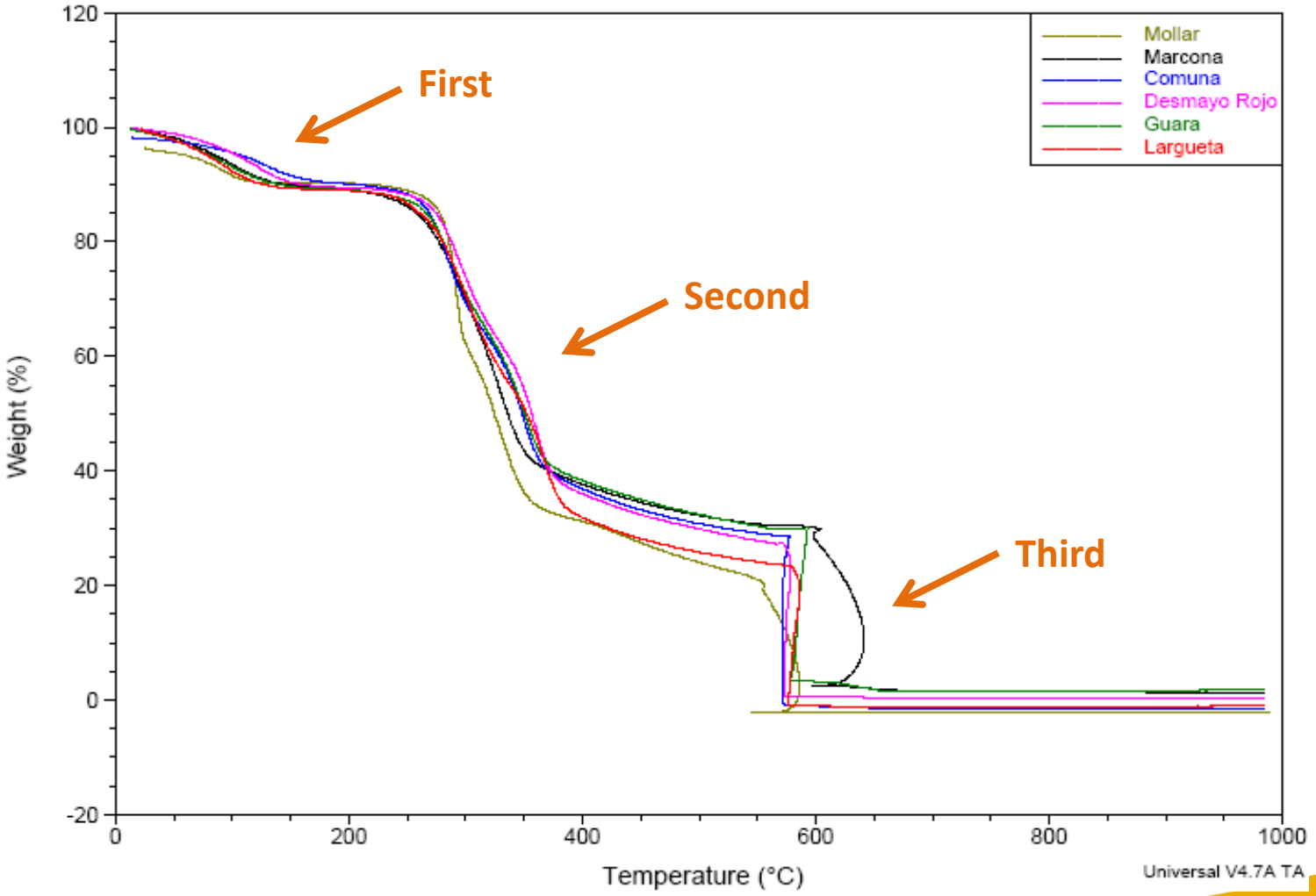


Mixture of all

Agglomeration of many fine micro particles, which led to a rough surface and the presence of pores structure.

Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches – *Results*

Thermogravimetric analysis (TGA)



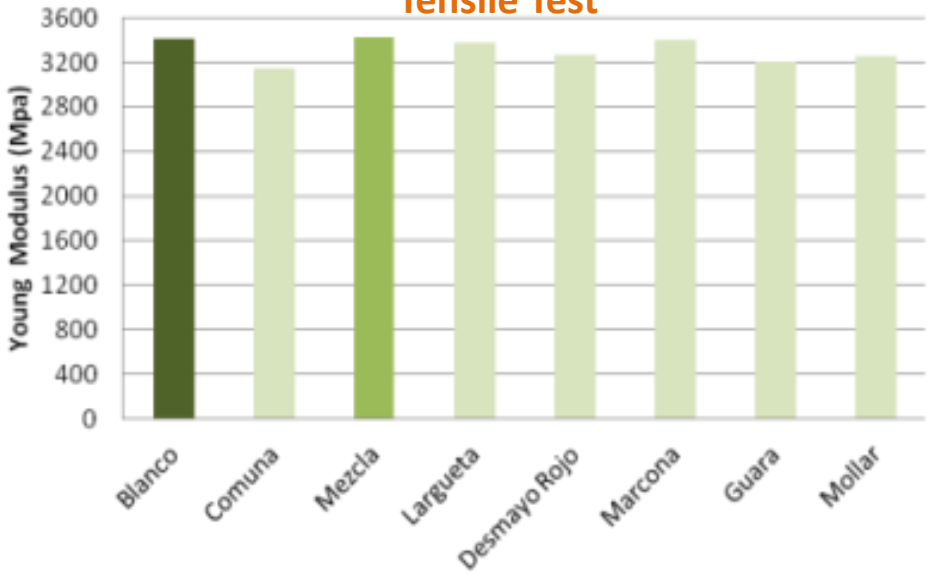
Study of the influence of the almond variety in the properties of injected parts with biodegradable almond shell based masterbatches – *Results*

Types of almond shell varieties	% Moisture Content	Compression Strength (MPa)
Comuna	12.15±0.21	---
Largueta	13.40±0.46	725±99
Desmayo Rojo	11.44±0.10	790±98
Marcona	11.54±0.23	503±49
Guara	11.31±0.47	712±77
Mollar	10.21±0.24	296±43

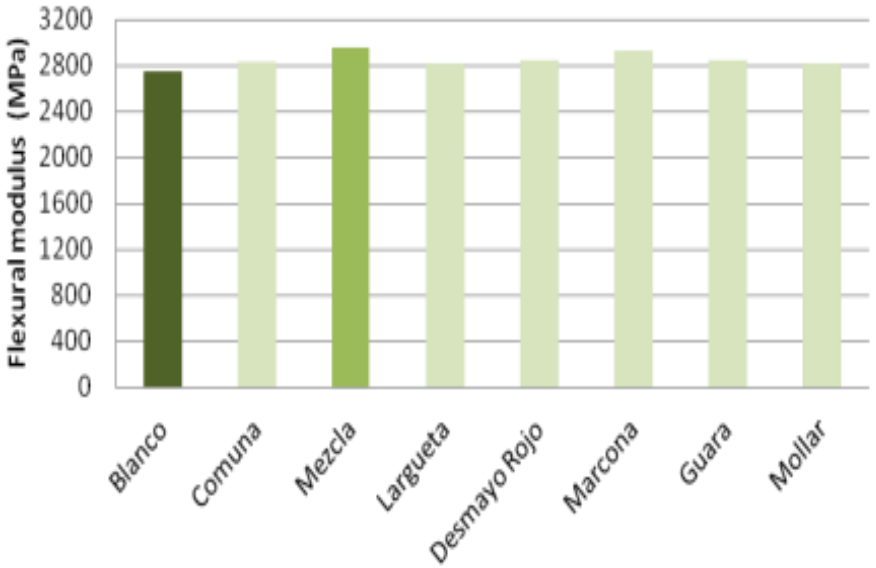
MASTALMOND Project-

Mechanical Properties

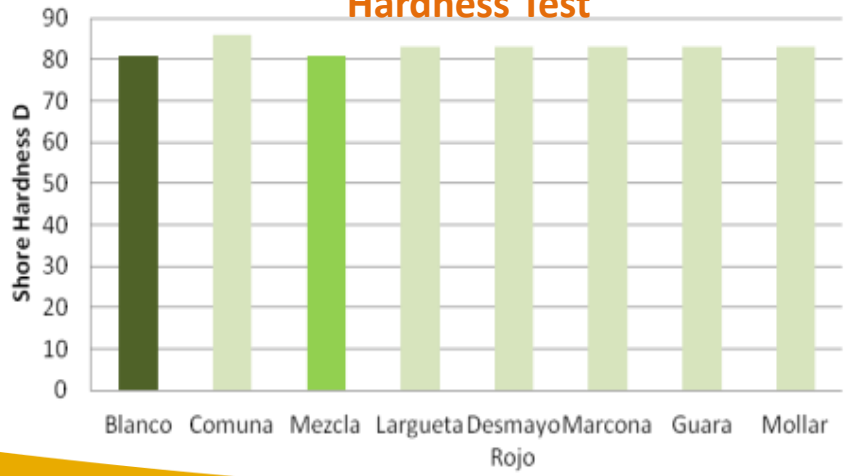
Tensile Test



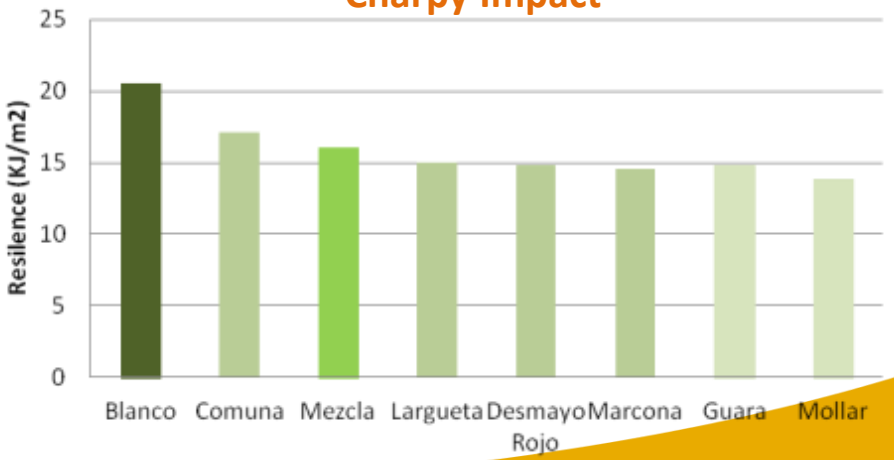
Flexural Test



Hardness Test



Charpy Impact



CONCLUSIONS MASTALMOND-Project

- The thermal descomposition of almond shell occurs in several stages depending on its main components, hemicelluloses, cellulose and lignin and does not depend on the almond variety.

- The infrarred spectras of the different varities do not differ significatively.

- Tensile and flexural strength and Shore hardness do not present significant differences between the diverse varieties, the mixture or the as-received PLA.

- The most recommended option is to work with the mixture of almond shell varieties as it presents slightly better mechanical properties than the other almond shell types separately. Moreover this is deployed in the supply chain as mixture of them, then it is easier and cheaper to acquire.

Thank you for your attention

Questions

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