

# Analysing use of NIR sorting technology for capture of bioplastics

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# Structure

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# Introduction to C-PlaNeT Project

- Circular Plastics Network for Training (C-PlaNeT).
- 8 Universities, 20 Industrial Partners.
- Duration: 01.01.2020 – 31.12.2023.
- **15 Early Stage Researchers (ESRs) – Including this presenter (ESR 7)**

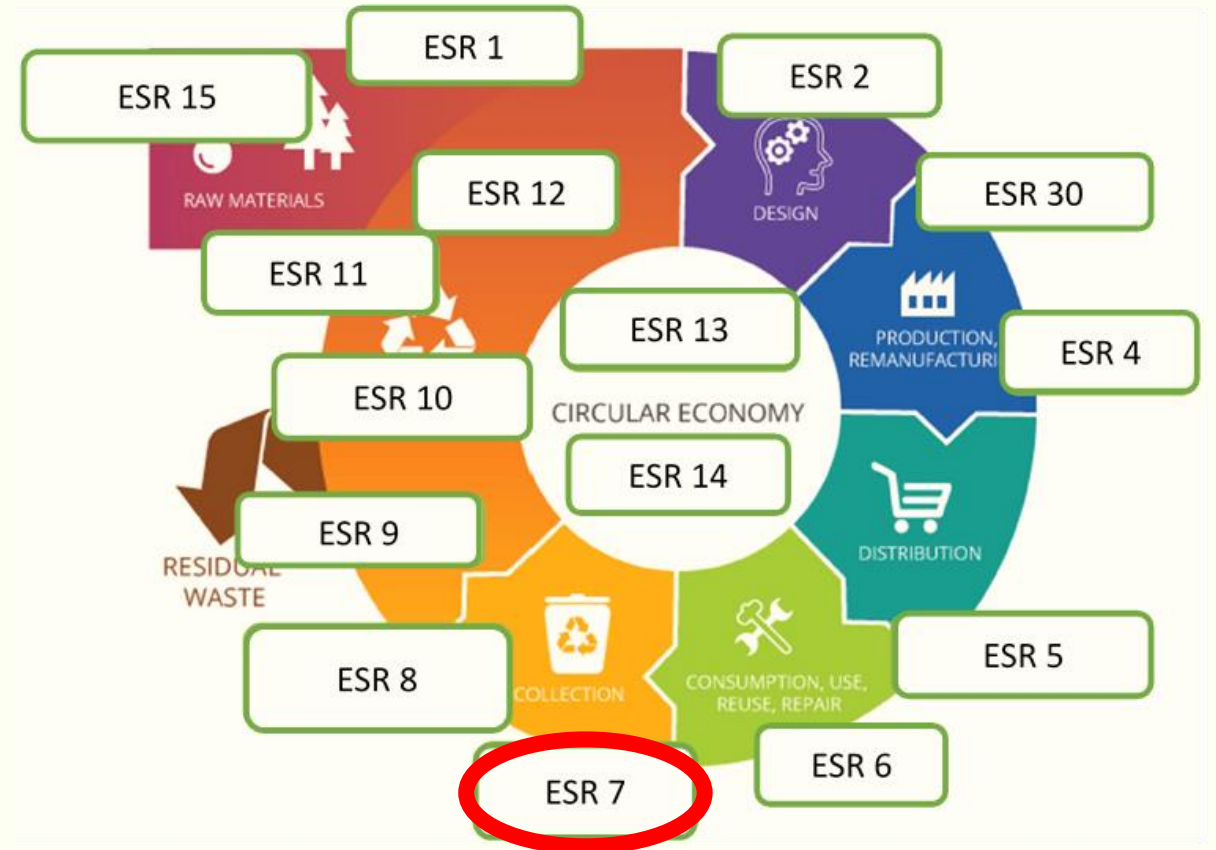
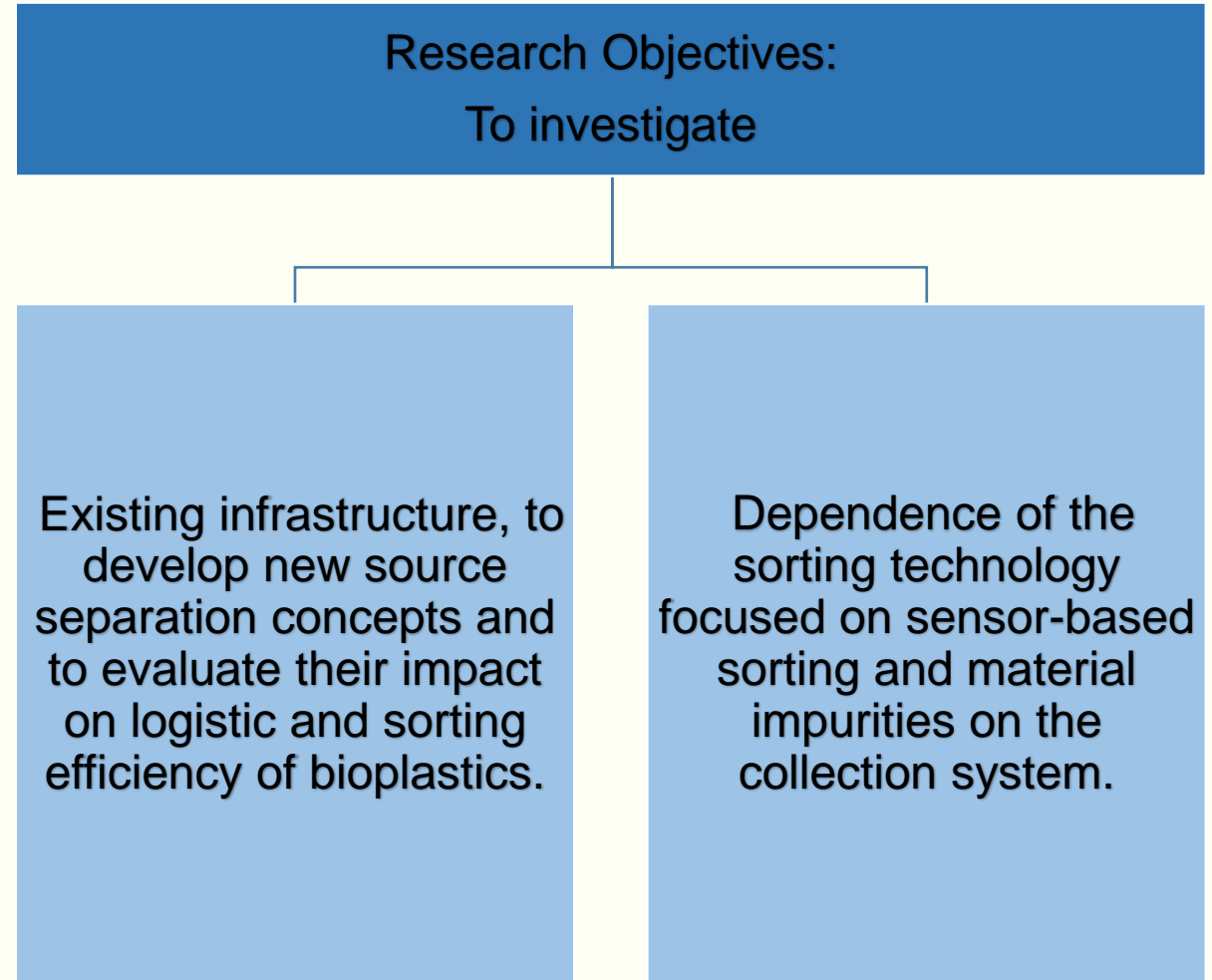


Image Source: Annex 1 to the Grant Agreement - 859885 -C-PlaNeT\_(Description of the Action) Part B

# Introduction to ESR 7

**Title:** Development and evaluation of waste collection and sorting systems for bioplastics.

**Aim:** Investigate the recyclability of bioplastics and improve their capture from the plastic waste stream through waste collection and sorting.



# Background: What are Bioplastics?

- Bioplastics – 3 main groups
- 1% share in plastic produced<sup>1</sup> - growing dynamically<sup>2</sup>
- Largest bioplastics market share: drop-in plastics
- 53% share of packaging applications<sup>3</sup>

<sup>1</sup> European Bioplastics, 2018; <sup>2</sup> Briassoulis et al. 2020; <sup>3</sup> European Bioplastics, 2020

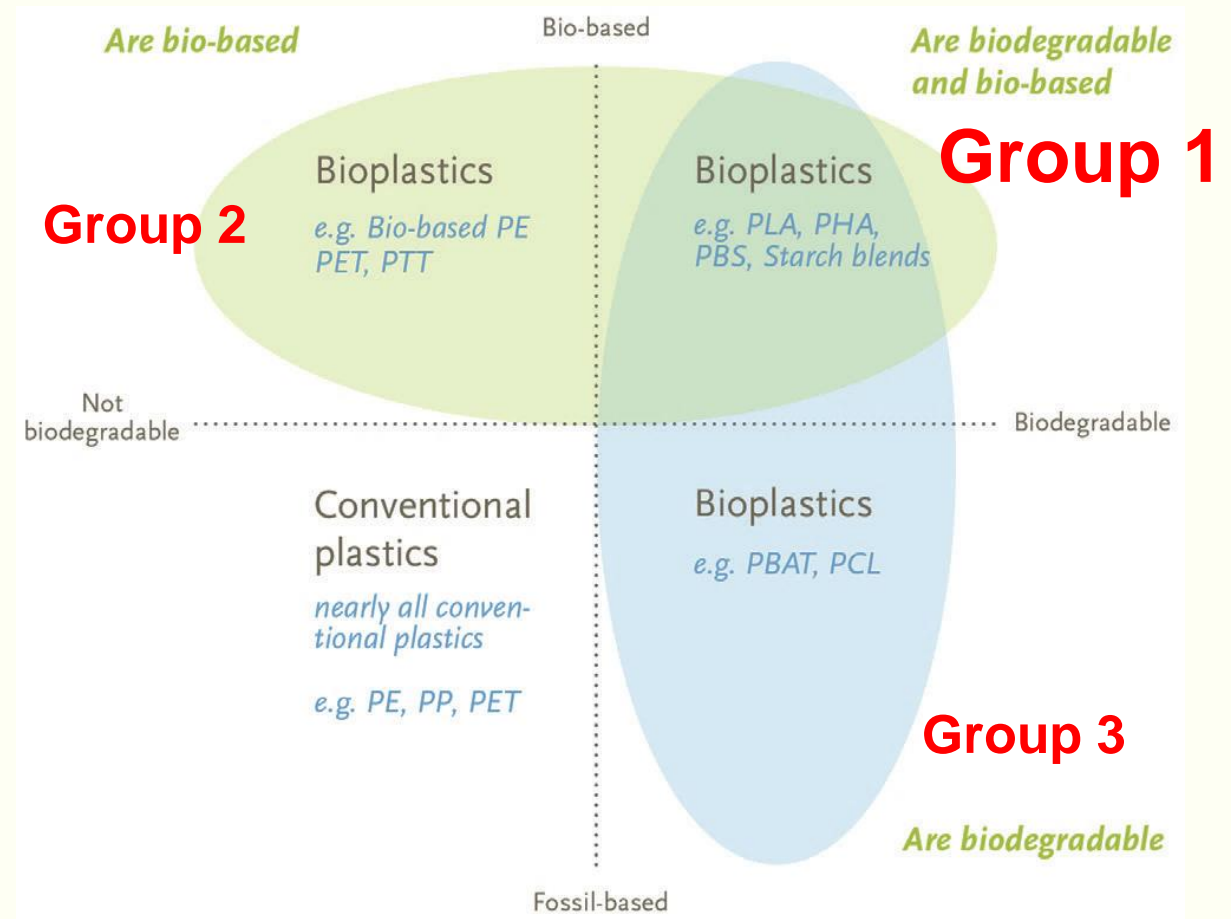


Image Source: European Bioplastics, 2020

# Paper: Analysing use of NIR sorting technology for capture of bioplastics

# Aim & Background

**Aim:** To analyse the use of NIR sorting technology for PLA material.

## Background

- Many NIR analyses conducted with PLA & PET<sup>1</sup>.
- Another analysis successfully sorted out PLA cups from mixed plastic sample (HDPE, PP, PET, PS)<sup>2</sup>.
- Effect of material thickness on the absorption was demonstrated by another analysis<sup>3</sup>.

<sup>1</sup> Niaounakis, 2019; Müller et al., 2014; Cao and Sharma, 2013

<sup>2</sup> Chen et al. 2021;

<sup>3</sup> Masoumi et al., 2012

# Research Questions

## Research Questions:

1. Does the PLA spectrum significantly differ from that of the seven conventional plastics considered?
2. Does a change in grade and thickness affect the PLA spectrum?
3. Can PLA products be detected using a recipe made from virgin PLA?
4. Any other factors affecting PLA detection/ejection?



# Equipment Used (2)

## NIR Sorting Set-up in MUL



# Equipment Used (1)

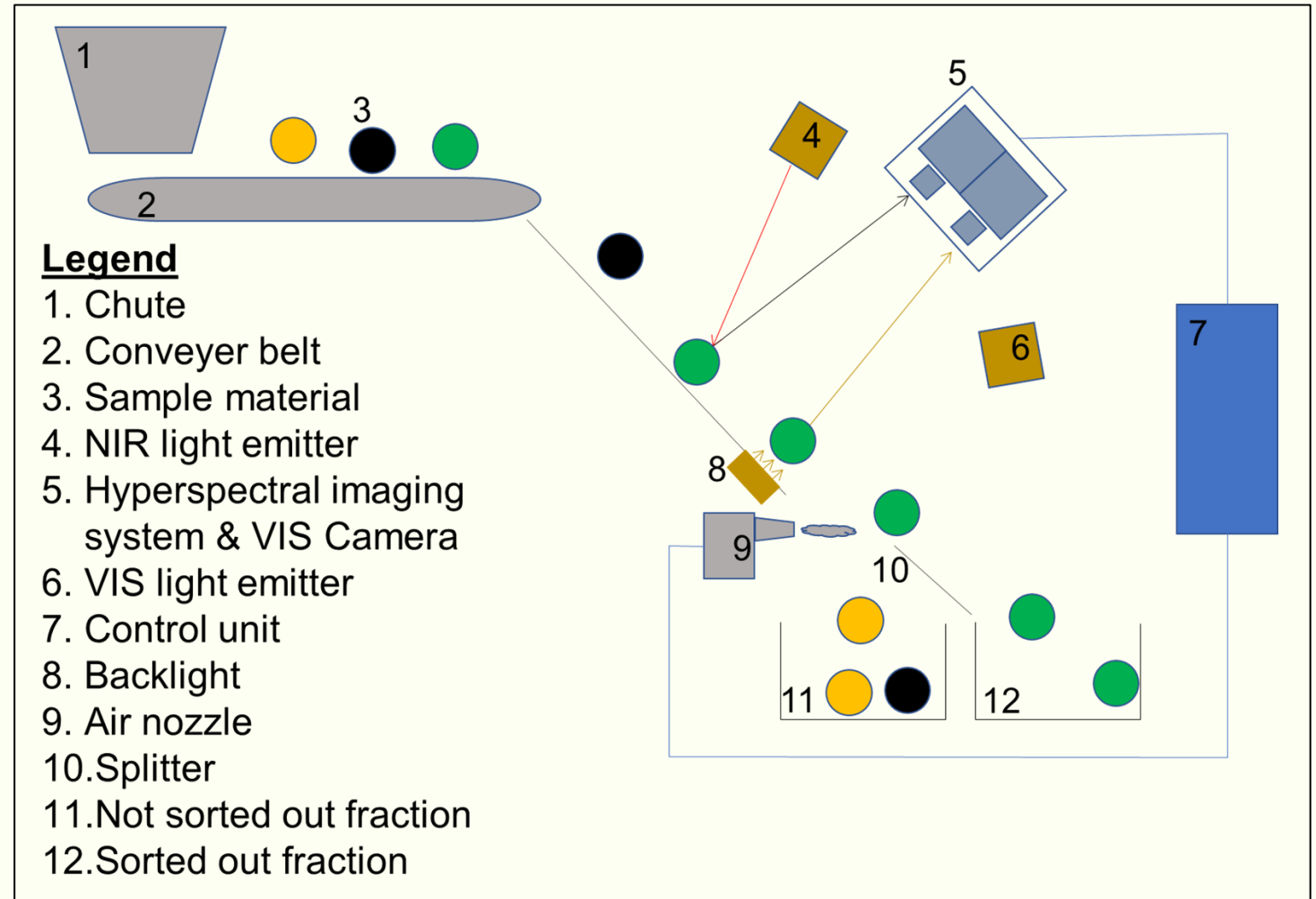
## NIR Sorting Set-up in MUL

### Creating a recipe

- basically, teaching the sorter the material

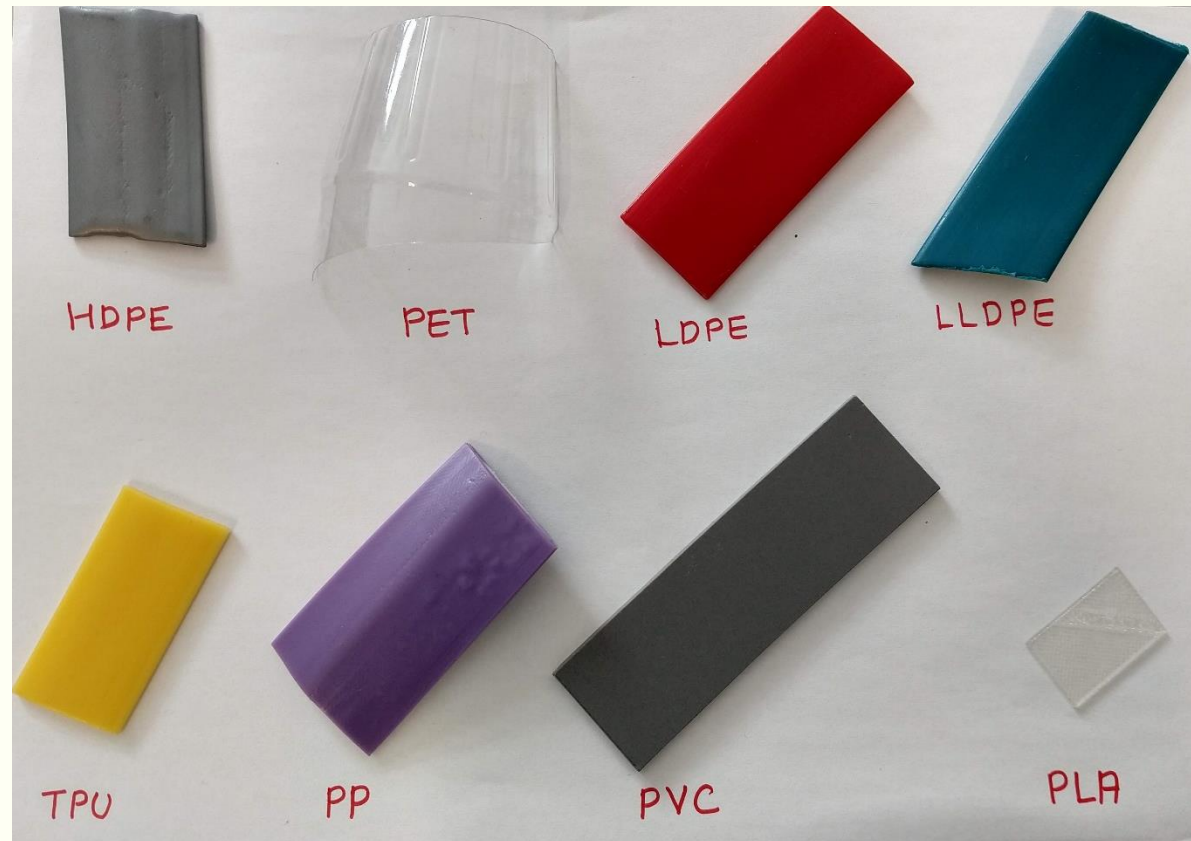
### Sorting the waste

- created recipe is tested



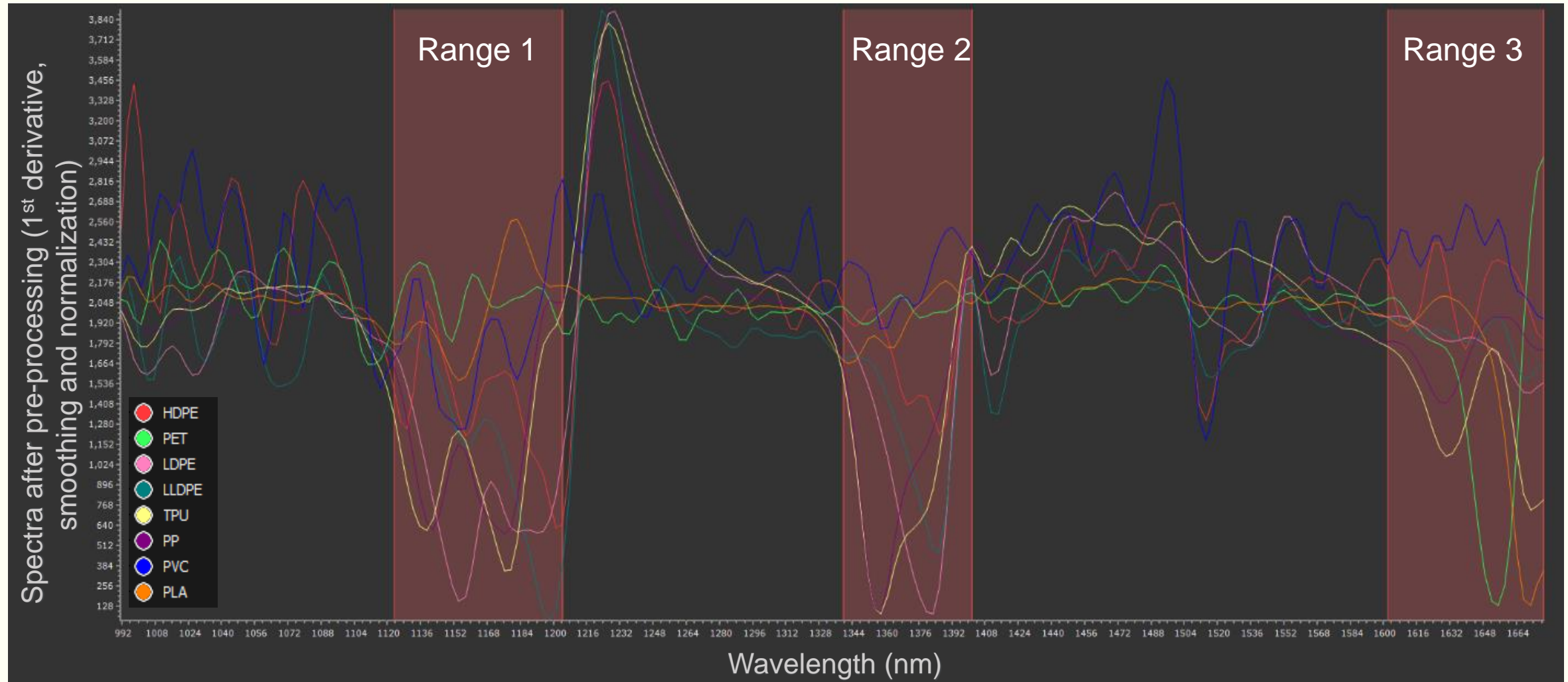
# Experiment 1 – Samples

Comparing spectra of seven conventional plastics with virgin PLA (L175\_1mm).



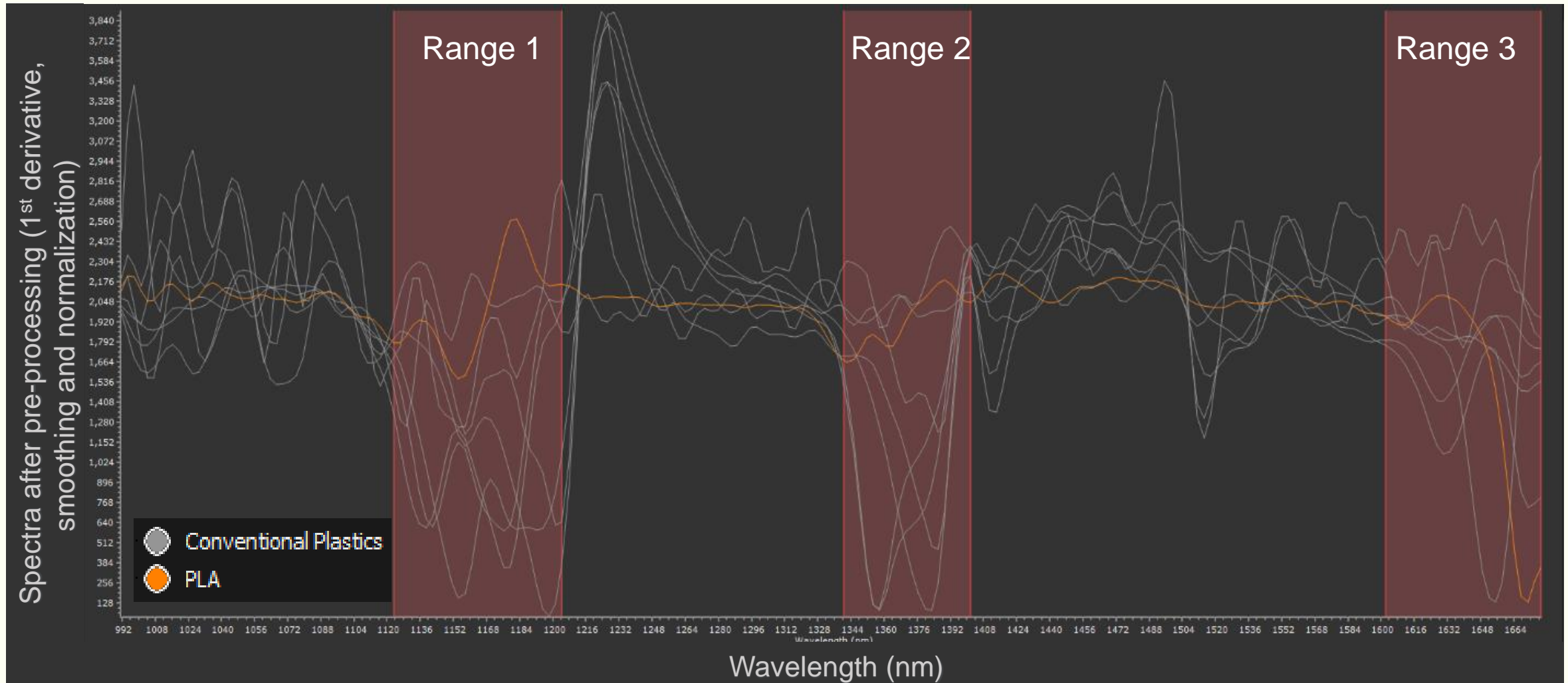
# Experiment 1 – Results (1)

## Conventional Plastics v/s PLA



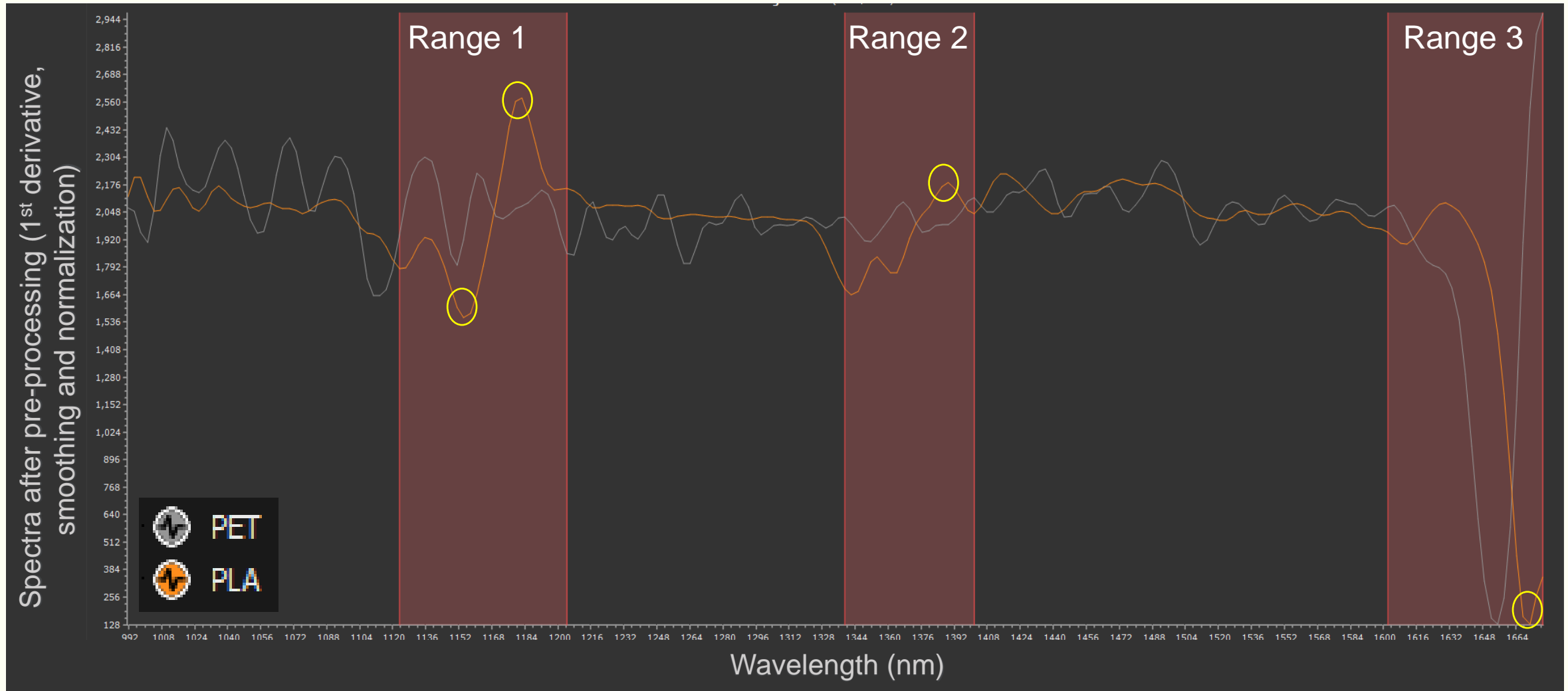
# Experiment 1 – Results (2)

## Conventional Plastics v/s PLA



# Experiment 1 – Results (3)

## PET v/s PLA



## Experiment 2 - Samples

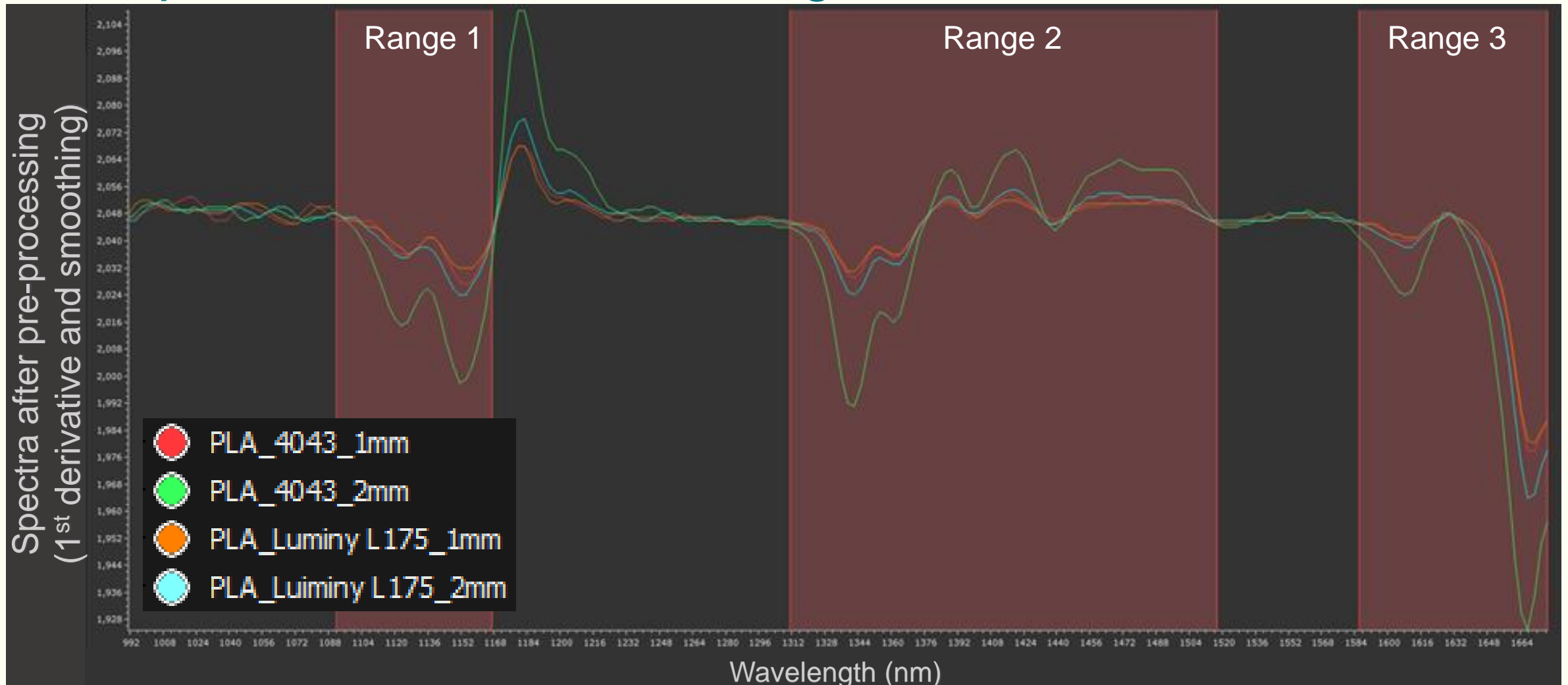
Comparing spectra of two grades of PLA – 1 mm & 2 mm thickness each

- PLA L175 - Luminy® L175, manufactured by Total Corbion.
- PLA 4043 - Ingeo™ Biopolymer 4043D, manufactured by NatureWorks.



# Experiment 2 – Results

## Comparison between different grades and thickness of PLA





# Experiment 3 – Samples

## Packaging Product Company Samples



Lid-Cup 1



Cup 1



Cup 2



Cutlery 1  
Knife



Container 2



Cutlery 2  
Spoon

## 3D Print Lab Samples



Yellow Face  
Shield



White  
Design

## Samples from Restaurant and Private Collection



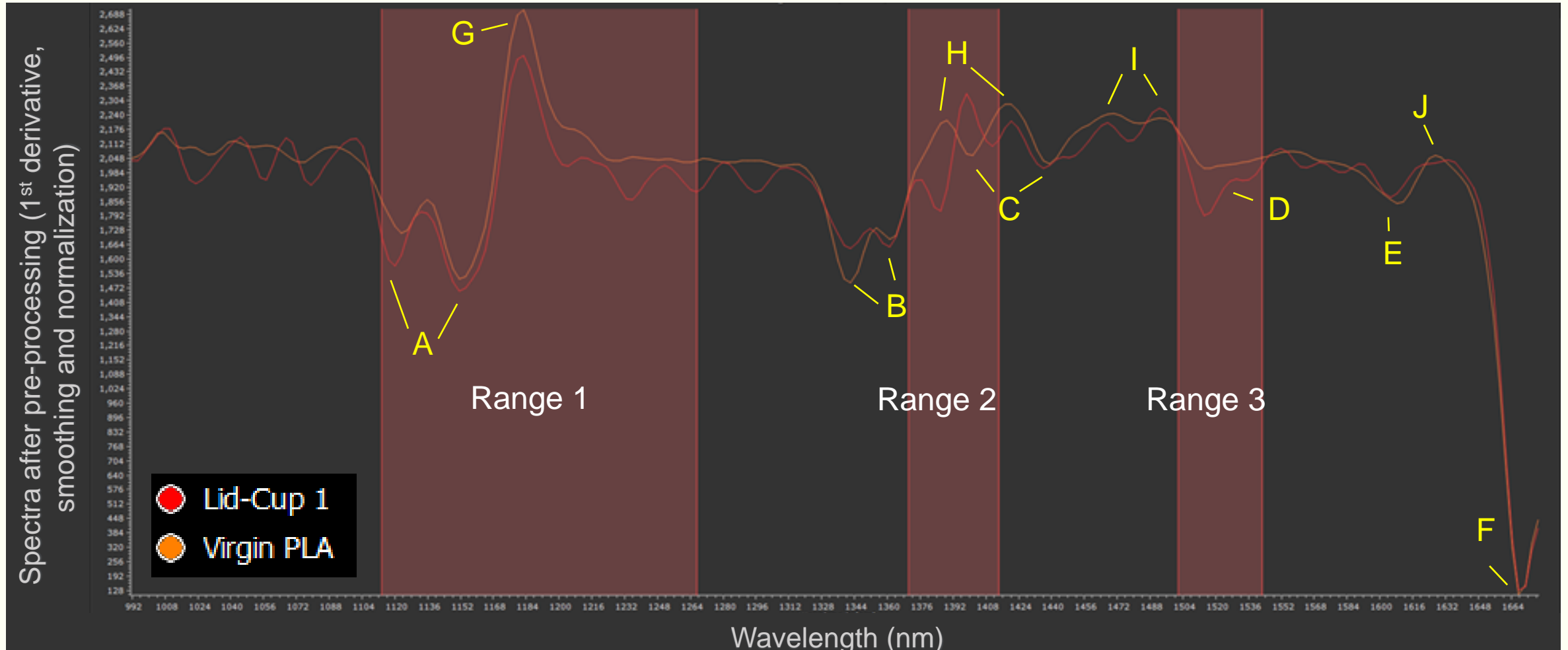
Lid-  
Container-  
Takeaway



Green Bottle  
Opener

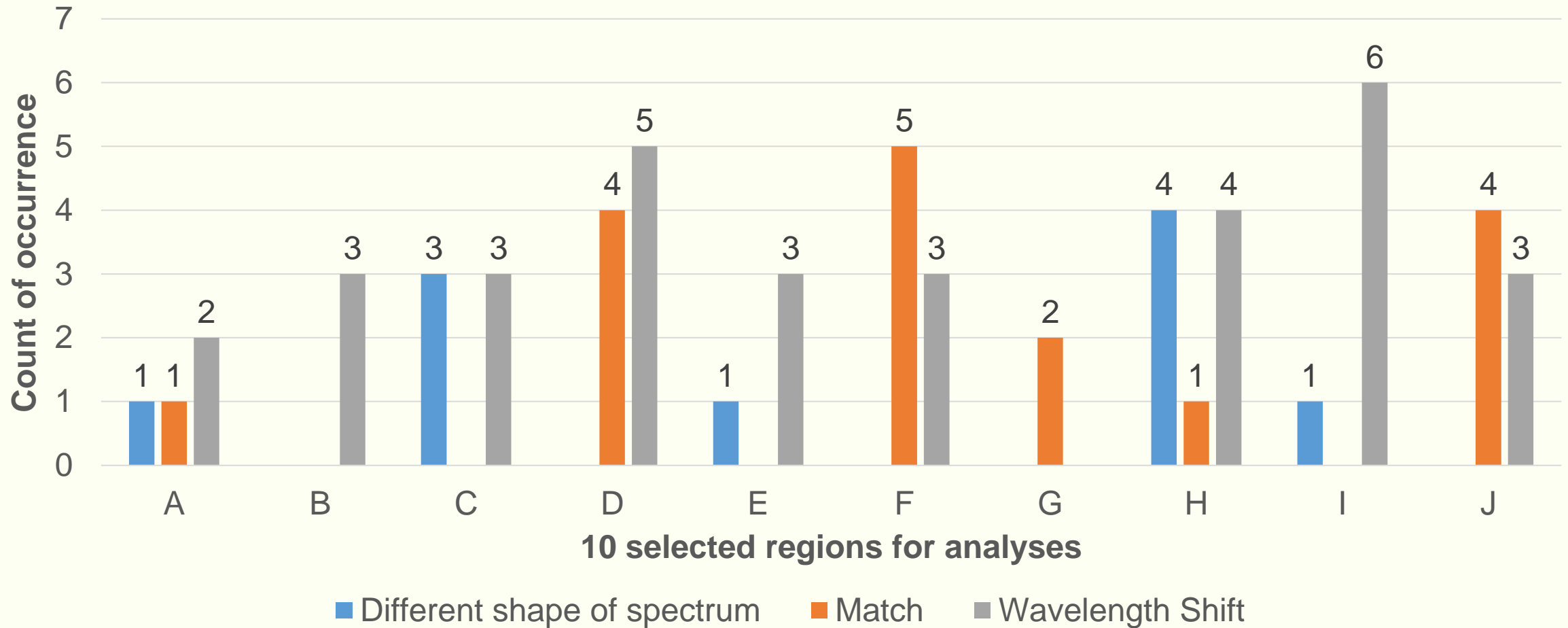
# Experiment 3 – Results (1)

## Comparison between virgin PLA and Lid-Cup 1 product spectra



# Experiment 3 – Results (2)

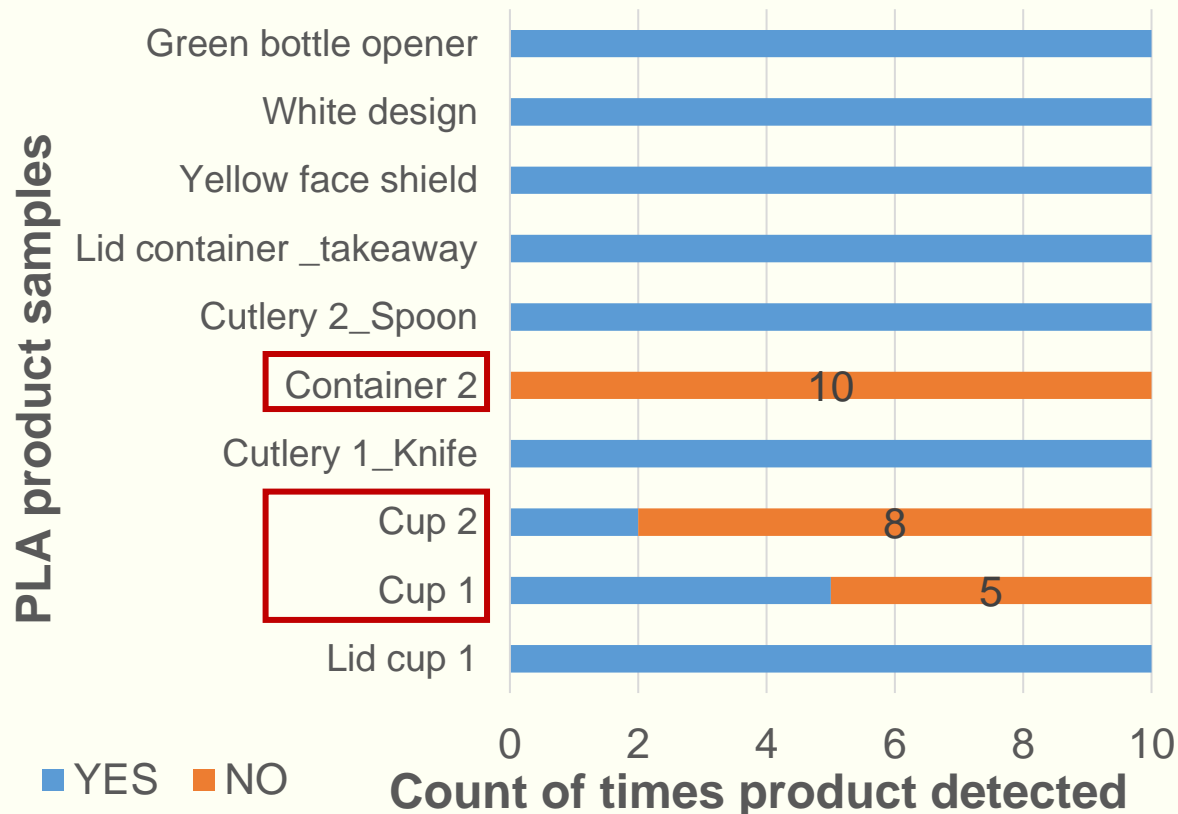
## Comparison between PLA sample product and virgin PLA spectra



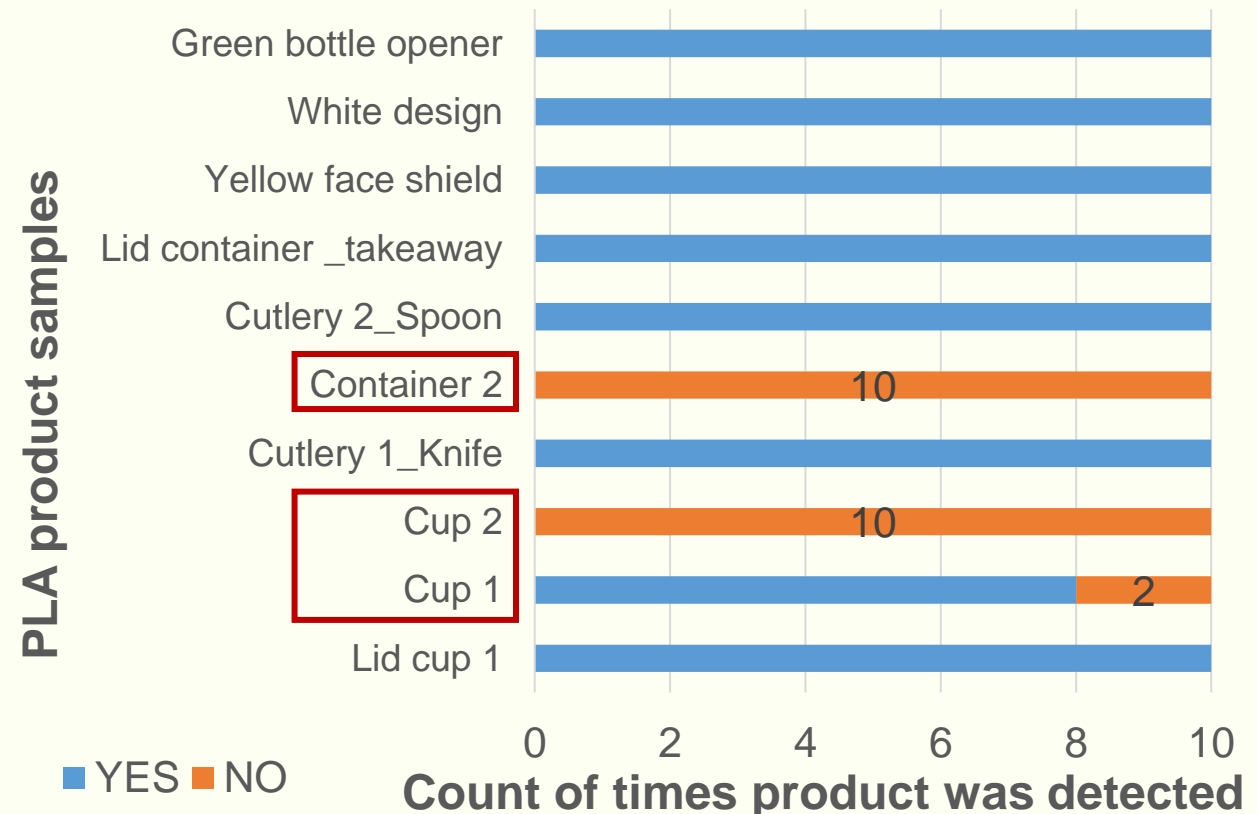
# Experiment 3 – Results (3)

Testing ejection of PLA product samples using virgin PLA recipe @ 20 % backlight intensity

## Experiment I (Sequence)



## Experiment II (Product repetition)

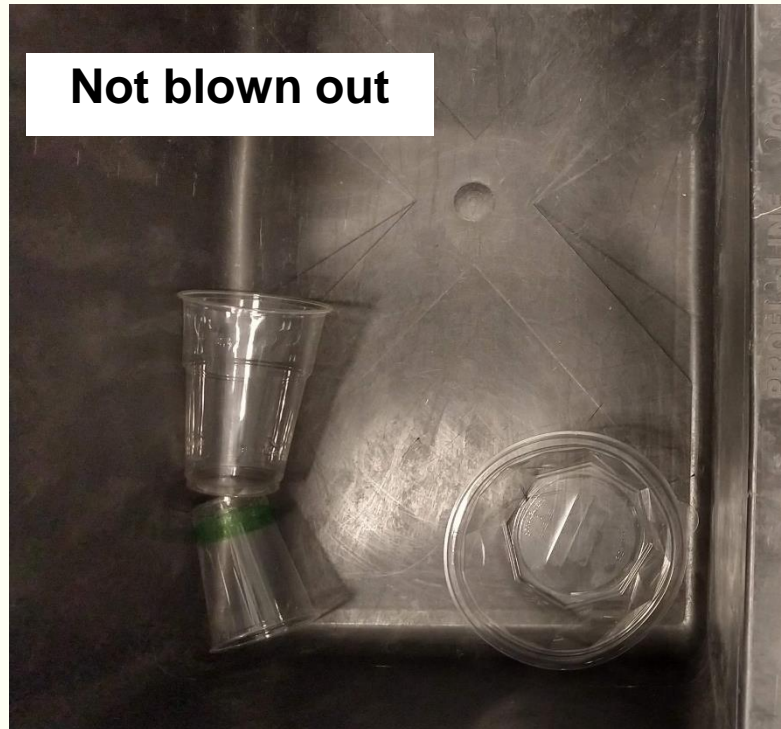


# Experiment 3 – Results (4)

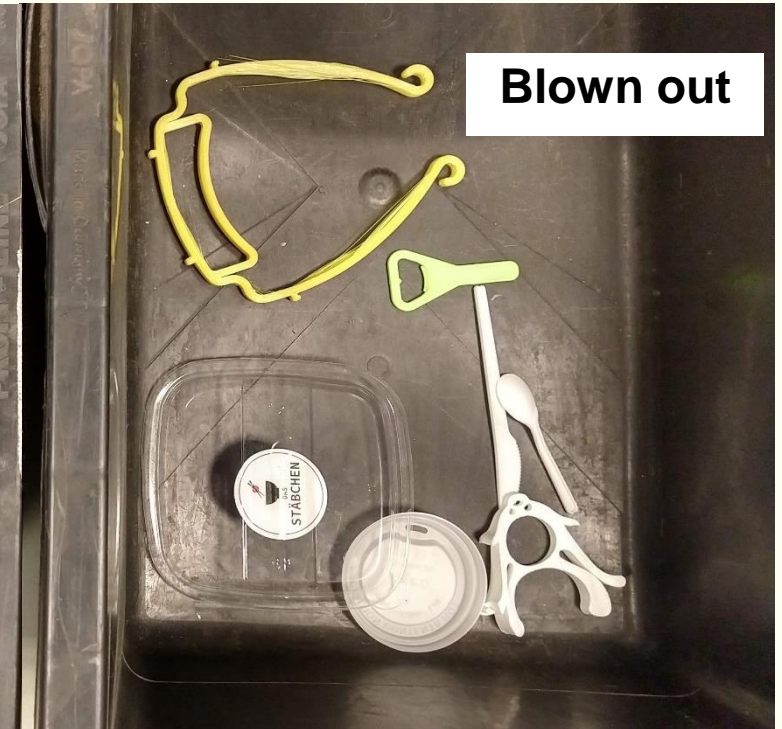
## Sample Outcome @ 20 % backlight intensity

PLA Products

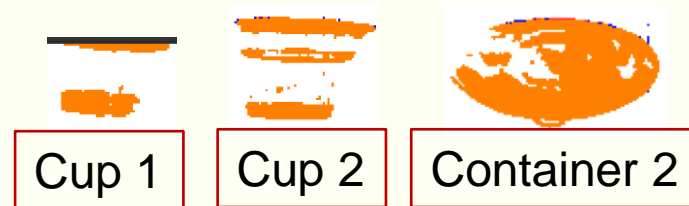
Not blown out



Blown out

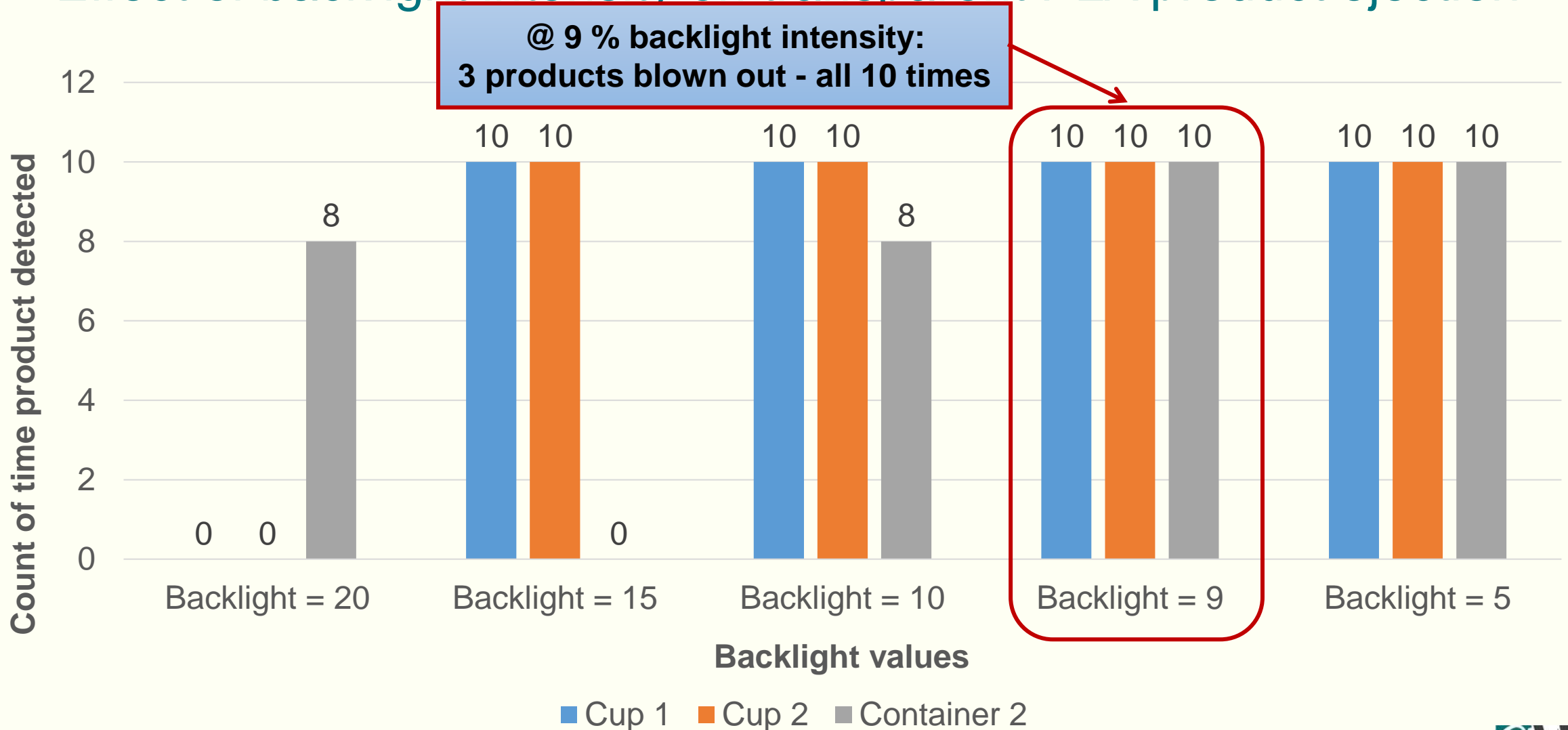


False colour images



# Experiment 3 – Results (5)

## Effect of backlight intensity on transparent PLA product ejection



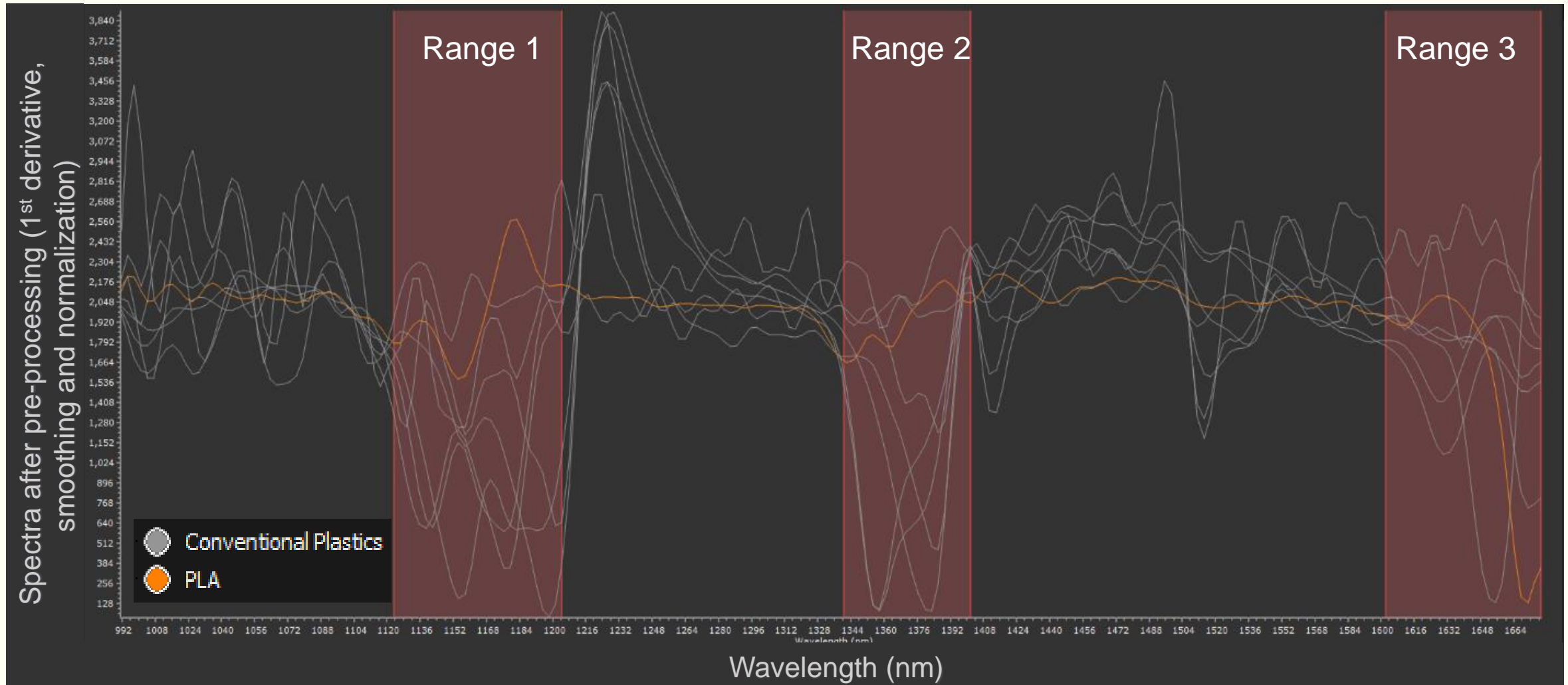
# Conclusion (1)

1. Does the PLA spectrum significantly differ from that of the seven conventional plastics considered?

**YES**

PLA has a distinct spectrum than HDPE, PET, LDPE, LLDPE, TPU, PP, and PVC.

# PLA has a distinct spectrum than HDPE, PET, LDPE, LLDPE, TPU, PP, and PVC





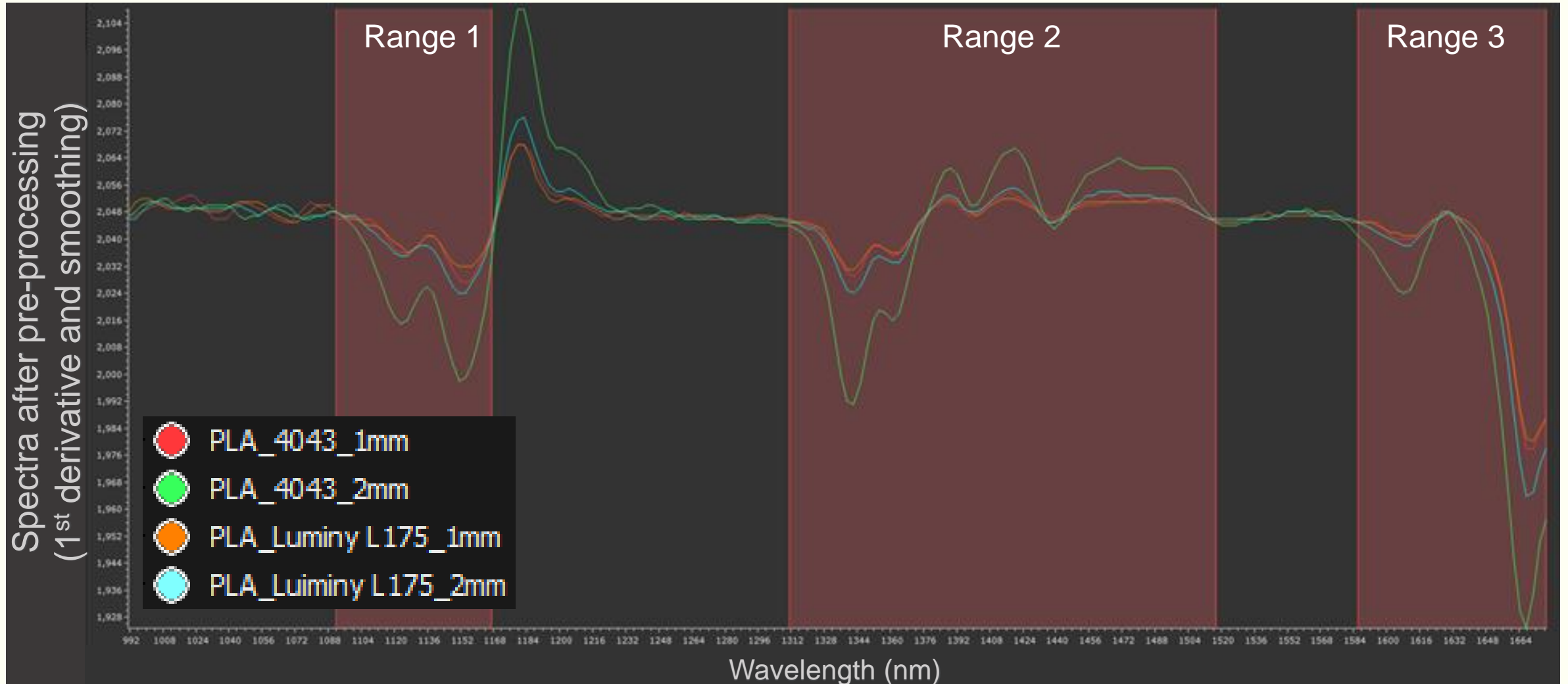
## Conclusion (3)

2. Does a change in grade and thickness affect the PLA spectrum?

**YES**

Varying intensities, no observed shift in the wavelengths.

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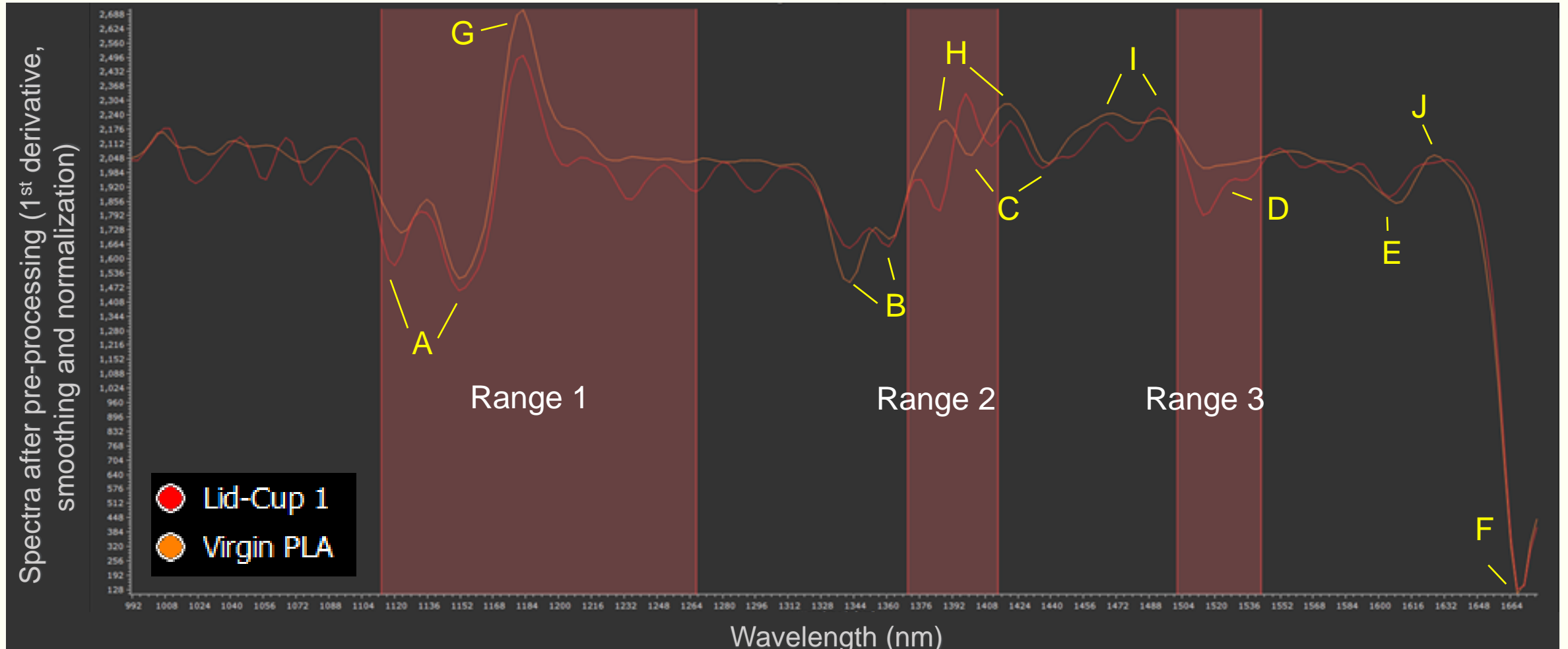
## Conclusion (3)

3. Can PLA products be detected using a recipe made from virgin PLA?

**YES**

- PLA products' spectra v/s virgin PLA spectra: shift in wavelength and a difference in the shape of spectra.
- PLA products were detected using the virgin PLA recipe.

# Comparing spectra of PLA products & virgin PLA



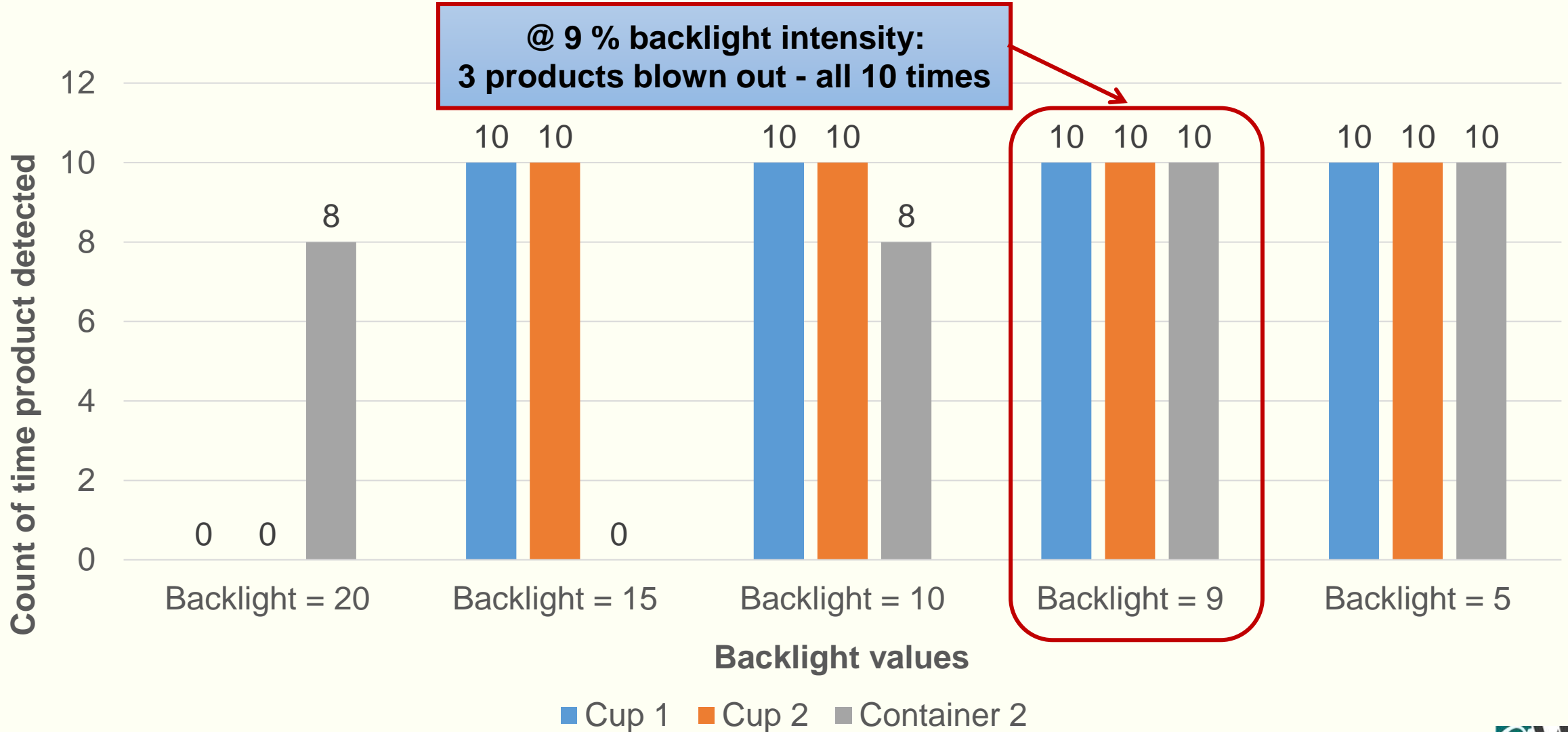
## Conclusion (4)

4. Any other factors affecting PLA detection/ejection?

**YES**

- Backlight settings affected the PLA product ejection.
- 20% to 9% reduction of backlight – all 3 products ejected.

# Any other factors affecting PLA detection/ejection?



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## Vielen Dank!



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