CREATING A SNAPSHOT of PCR QUALITY

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WELCOME

UNDERSTAND

As more interest piques public awareness with updated government regulations worldwide concerning the use of PCR, PTI wants to foster an environment of understanding to help make our industry as successful as possible.

It is our responsibility as plastic engineers to help the industry produce the best preforms and bottles to maximize quality as well as addressing environmental concerns.

WHO WE ARE

PTI – Plastic Packaging from Concept to Commercialization

Optimizing packaging design and sustainability to ensure we have a safe, clean, and healthy future.

With 39 years of experience, PTI is a global leader in plastic sustainable packaging design & development and process technologies for packaging. Working with leading brands, converters, and material suppliers to deliver packaging solutions that are optimized to perform in today's marketplace.

NOT ALL PCR IS CREATED EQUAL

WHAT DOES THIS MEAN FOR ADDING PCR CONTENT TO YOUR PACKAGE?

- How do different PCR grades vary from one another?

- There is a high demand for incorporating increased amounts of PCR in packaging. Is the industry prepared to manage these expectations and this change?

- What does that mean for future package production?

BUT WE DID TEST THEM EQUALLY

TESTING

WHAT WAS TESTED

Six (6) varieties of rPET resin pellets – produced from both curbside or deposit feedstocks – and molded the pellets into plaques. The plaques were compared to one another and to virgin PET.

This was developed further into a preform and to a bottle to analyze the same data to determine how rPET and design impact bottle performance.

01 IV

02 Resin Color & Haze

03 Plaque Color/Haze

04 IR Transmission

05 IR Heating

06 Preform Color & Haze

07 Pre-Temp Data

08 Process Data

09 Bottle Color & Haze

STUDY RECAP

rPET PELLETS

Control – Virgin Resin
L* 80.4, b* -3.03

rPET Variable A1
L* 71.5, b* 0.5

rPET Variable B1
L* 69.1, b* 0.98

rPET Variable C1
L* 71.9, b* 0.65

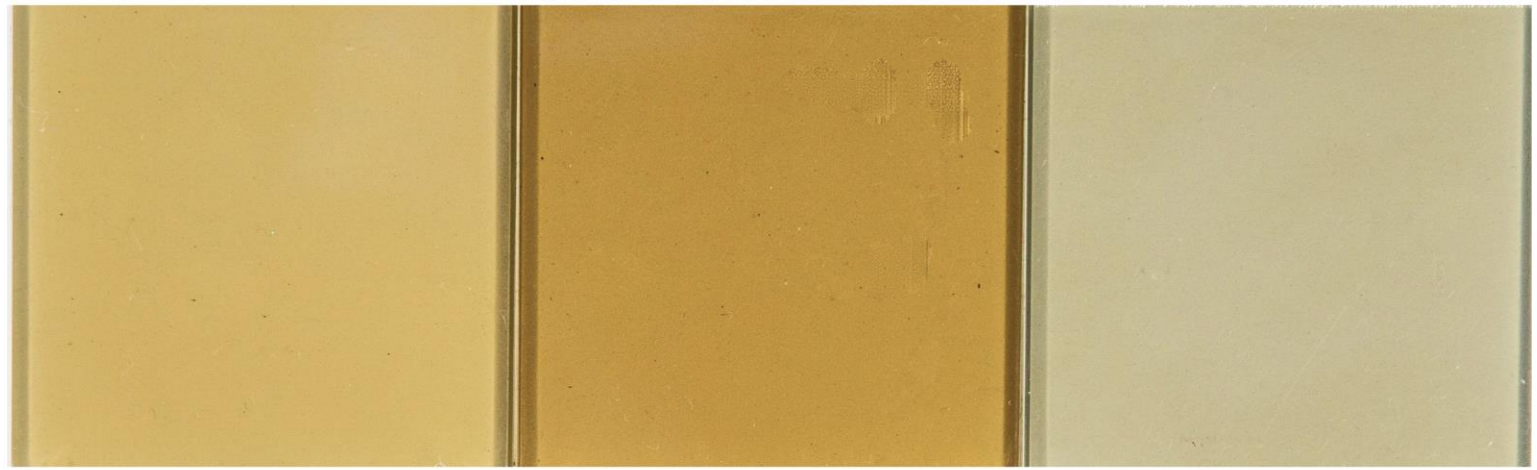
rPET Variable D1
L* 71.2, b* 2.97

rPET Variable E1
L* 69.2, b* -0.16

rPET Variable F1
L* 78.9, b* -1.68

rPET PLAQUE

Control – Virgin
L* 90.0, b* 1.3



rPET Variable A1
L* 71.5, b* 15.4

rPET Variable B1
L* 68.4, b* 25.9

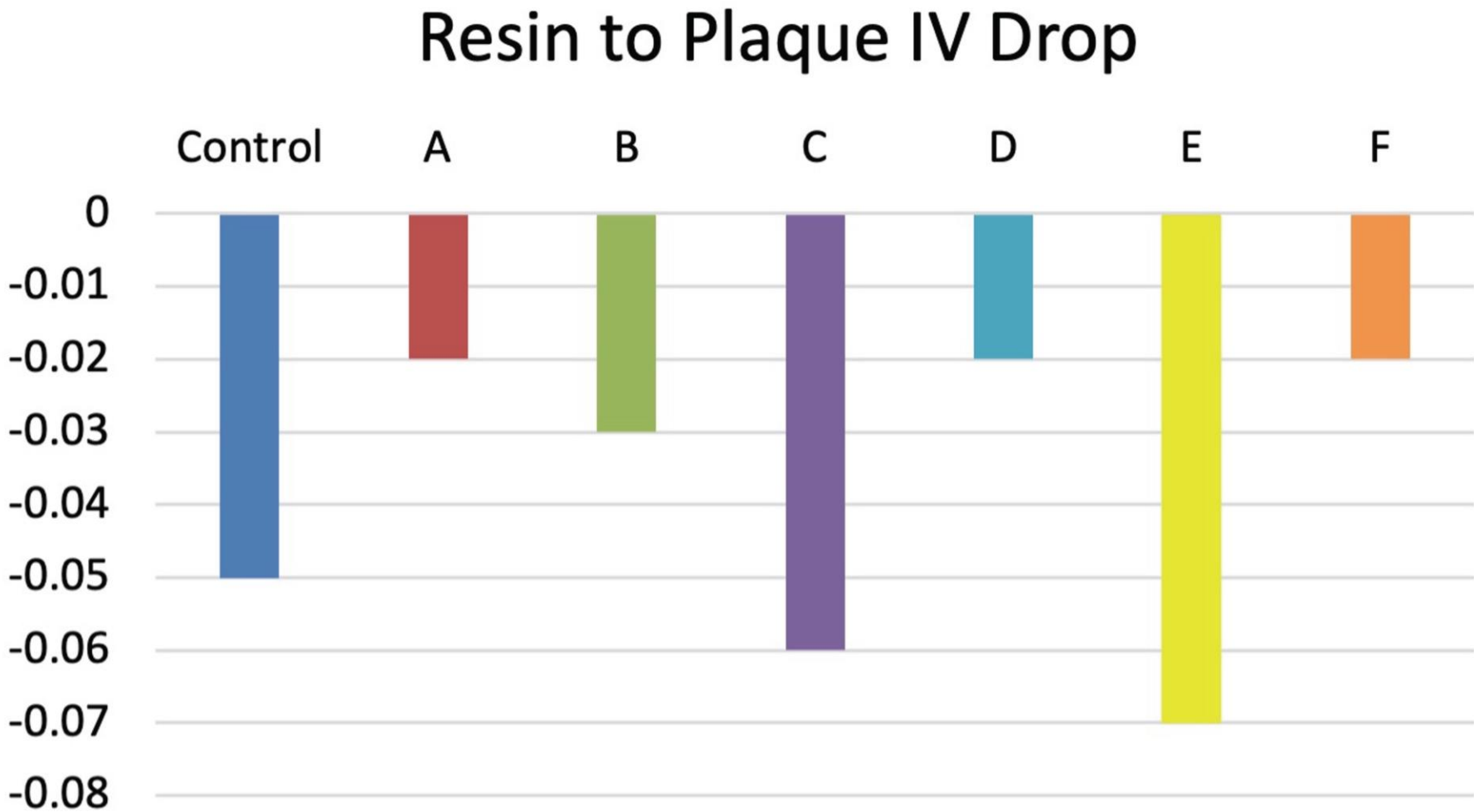
rPET Variable C1
L* 73.5, b* 14.6

rPET Variable D1
L* 80.1, b* 15.0

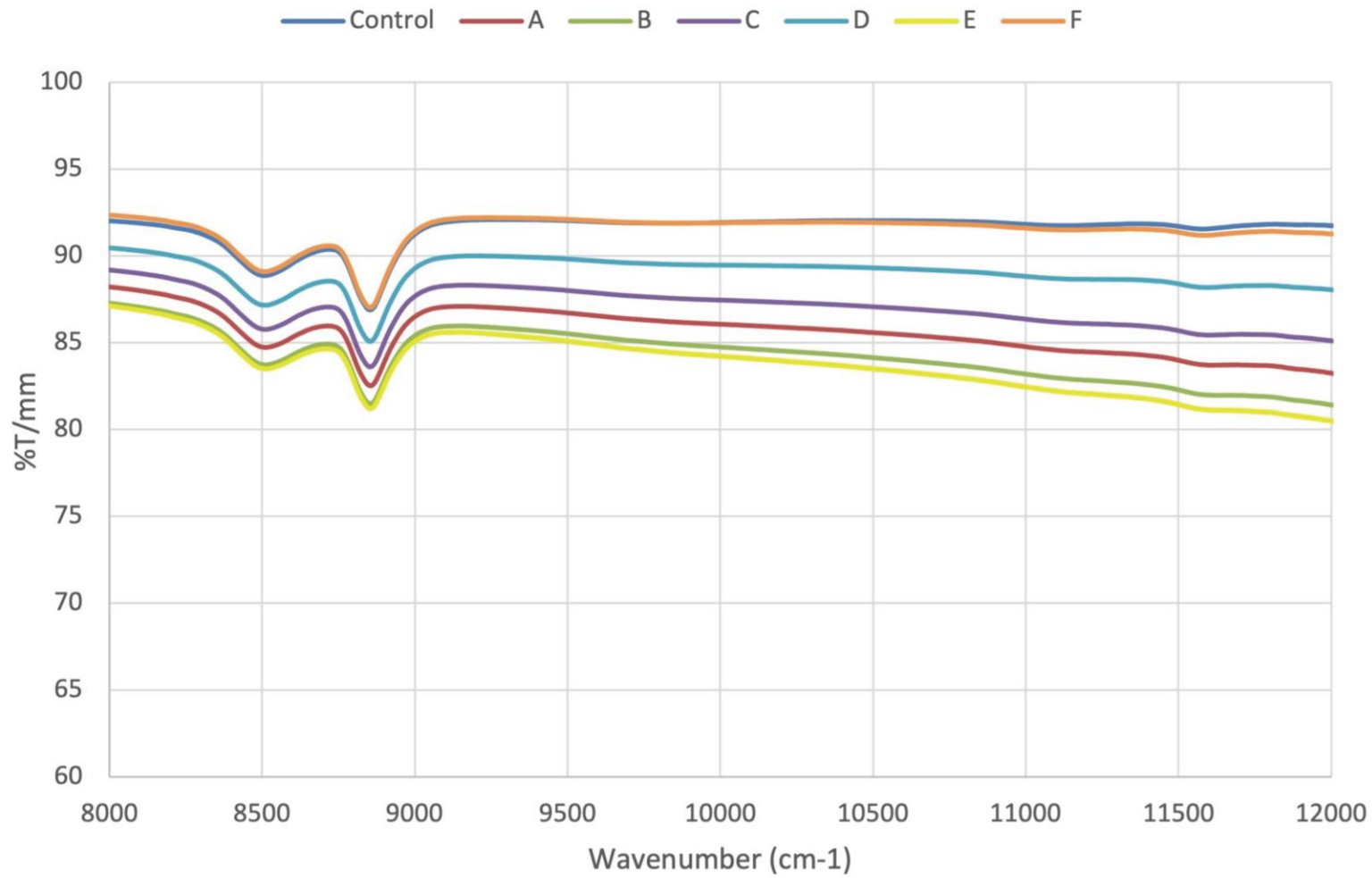
rPET Variable E1
L* 70.1, b* 13.9

rPET Variable F1
L* 87.1, b* 4.1

RESIN TO PLAQUE IV

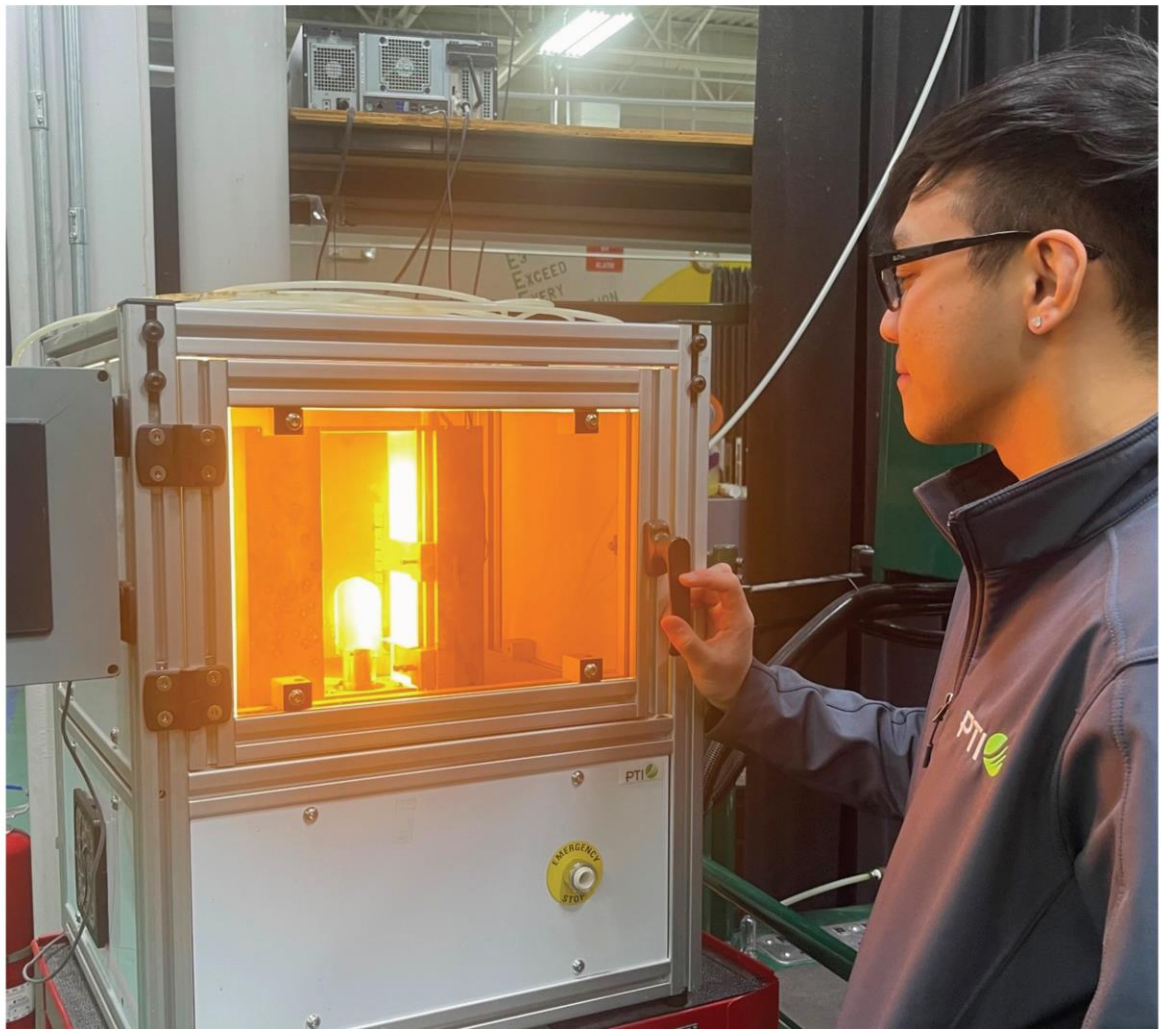


IR TRANSMISSION



Why is this important? Differences in IR transmission = differences in energy absorbed by the preform. Bottle quality is directly impacted by preform temperature.

IR REHEAT TEST

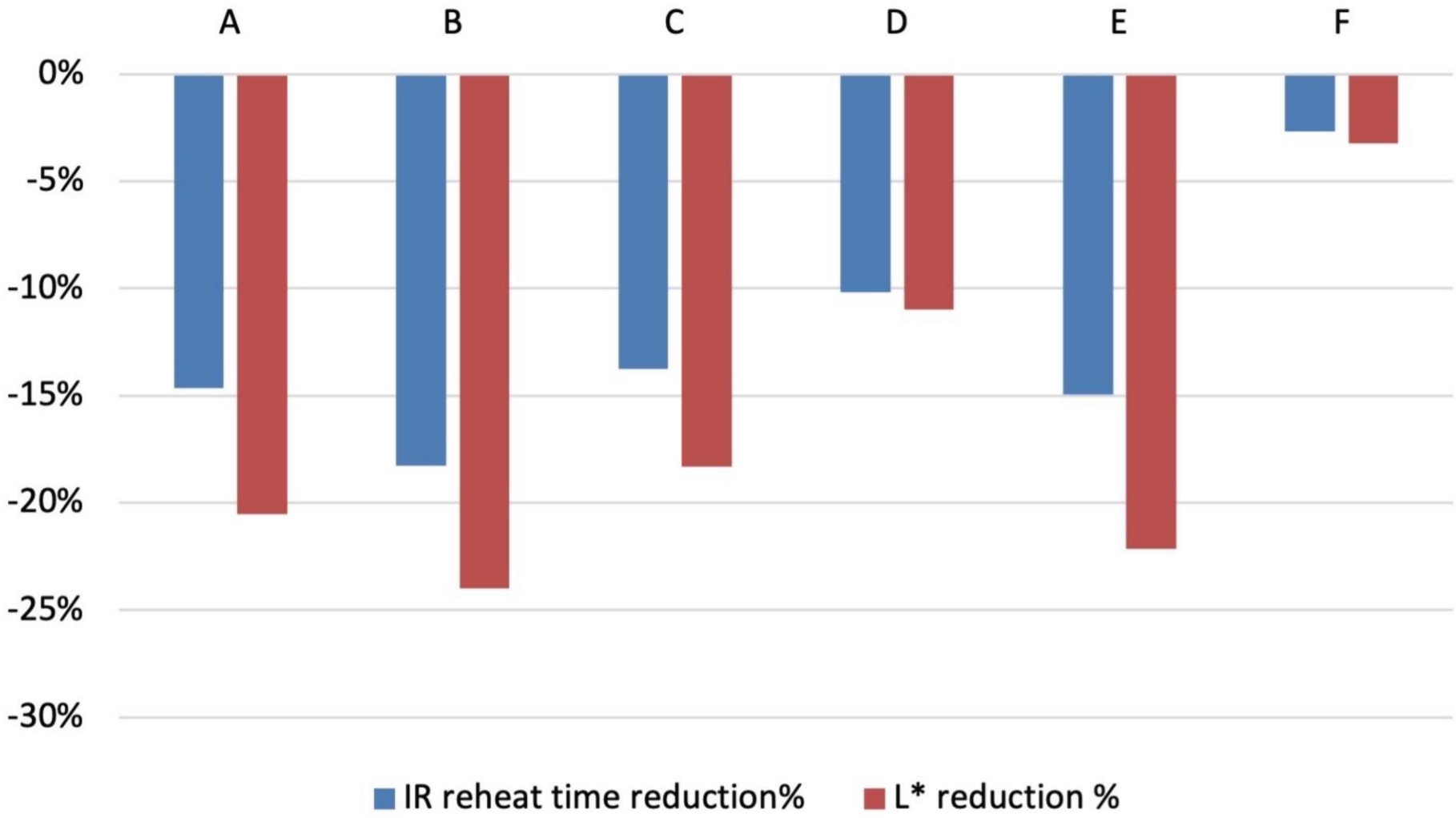


The plaque was heated in an IR oven at constant energy setting. The time needed for the plaque to be heated from room temperature to 110°C was recorded.

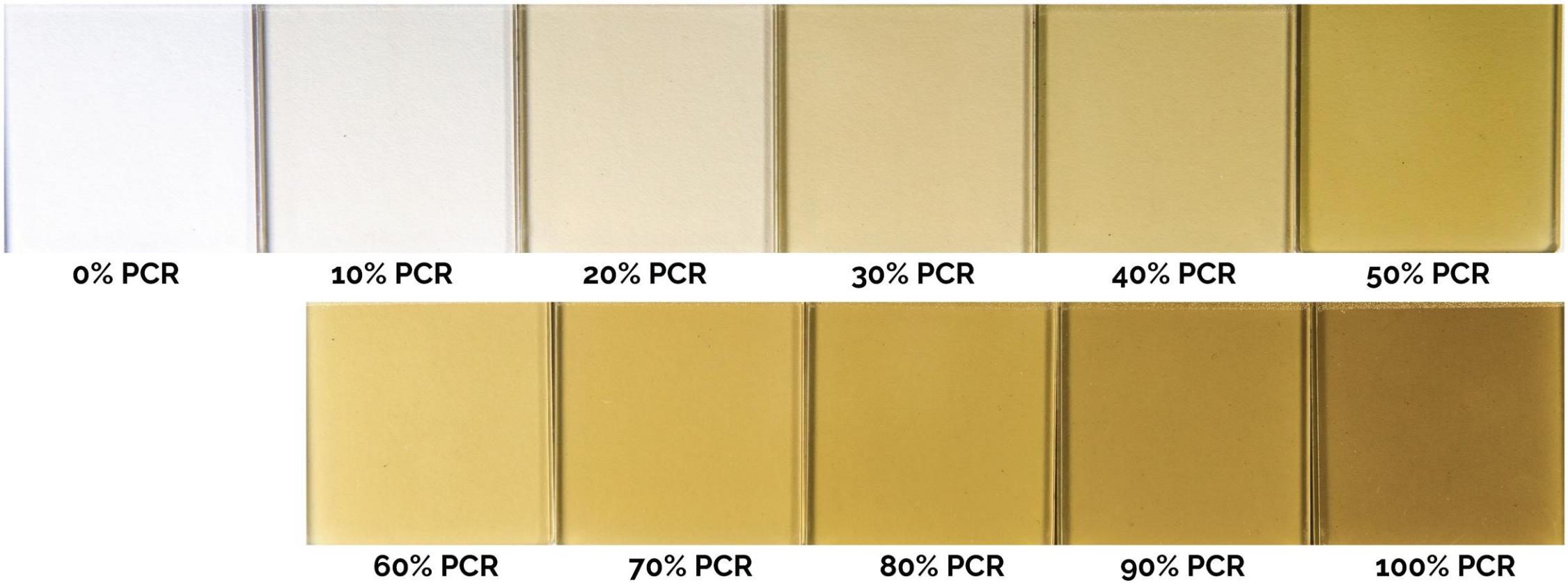
	Heat up time to reach 110°C (s)
Control	**33.4 ± 1.4**
Variable A1	**28.5 ± 0.8**
Variable B1	**27.3 ± 1.1**
Variable C1	**28.8 ± 0.7**
Variable D1	**30.0 ± 1.0**
Variable E1	**28.4 ± 1.1**
Variable F1	**32.5 ± 1.0**

STUDY RECAP

IR COMBINED WITH L* OF PLAQUE



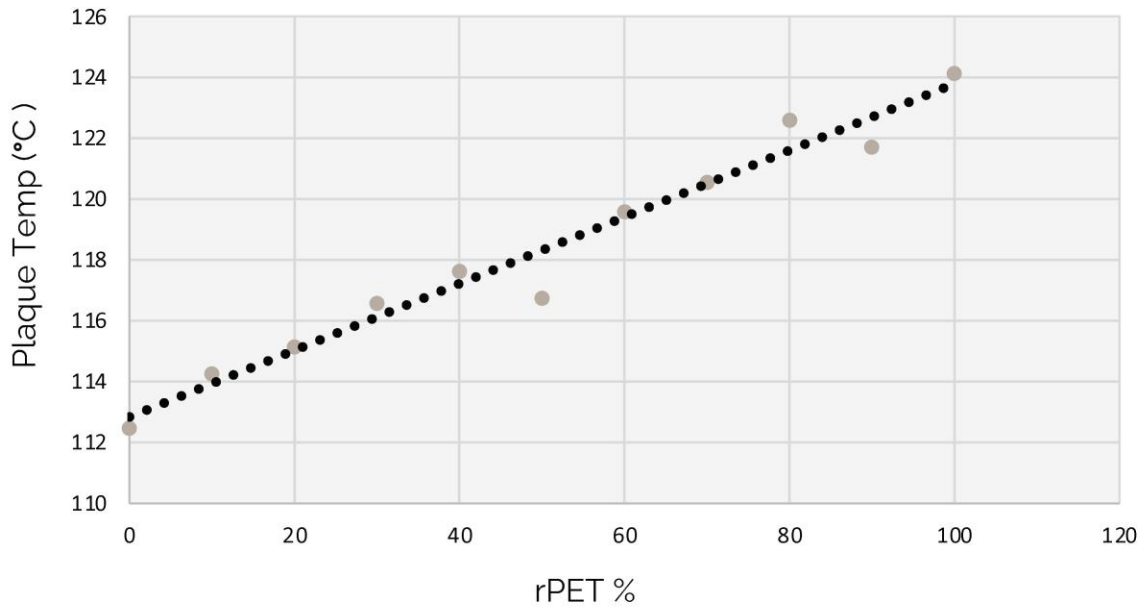
VIRGIN BLEND WITH PCR AT INCREASING LDR%



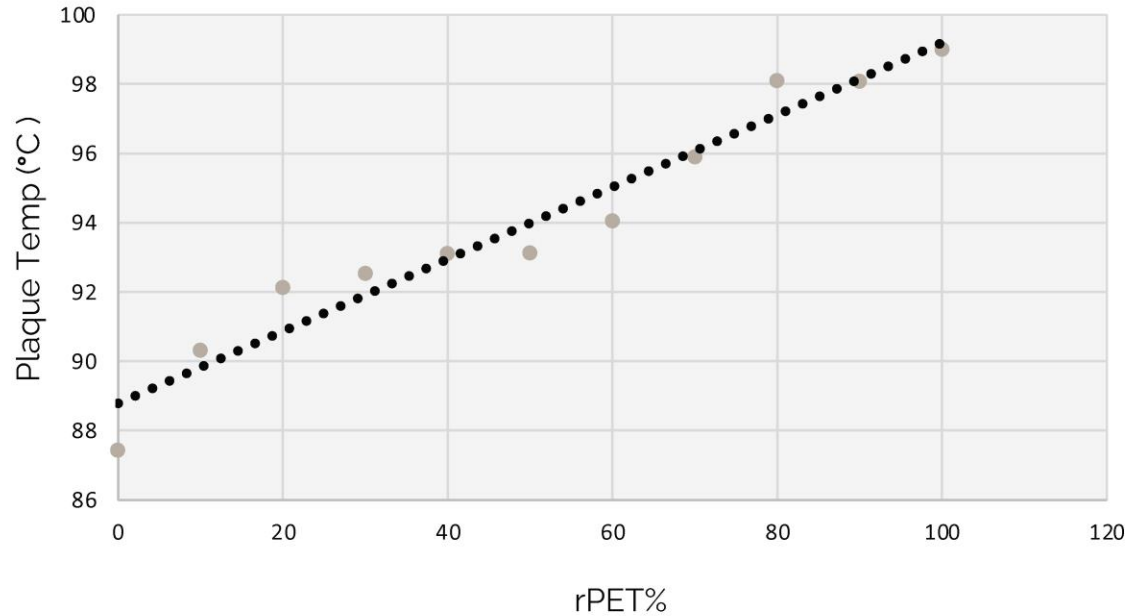
Looking at how things reheat, what happens as rPET content is increased by 10% - and the visual difference is astounding.

% PCR: IR REHEAT TIME STUDY

SAME SIDE TEMP AFTER HEATED FOR 25S



OPPOSITE SIDE TEMP AFTER HEATED FOR 25S



NEXT STEPS

OUR INITIAL CONCLUSION:

WHAT'S NEXT?

- Must test beyond the pellets

- While the plaque is an important step in predicting color and performance – is it enough?

- Comparing reheat processes of preforms to see how the bottle performance varied with the process window based on rPET content

TEST OBJECTIVE

PREFORMS TO BOTTLES

In the second round of this study, the variables changed, and focus was on three unique PCR sources, while still considering the various collection resources: curb-side or deposit feedstocks.

These resins were taken and used to produce preforms and bottles to test color and appearance.

DESIGN OPTIMIZATION

GOOD PREFORM TO PERFORM

DESIGN OPTIMIZATION

Since a preform is application specific, an optimized design was created to best test the rPET variables. It was necessary to keep the focus on material contributions to bottle performance.

The discovery - a GREAT preform design lends the most optimal start to determine the amount of effort needed to create a useable package.

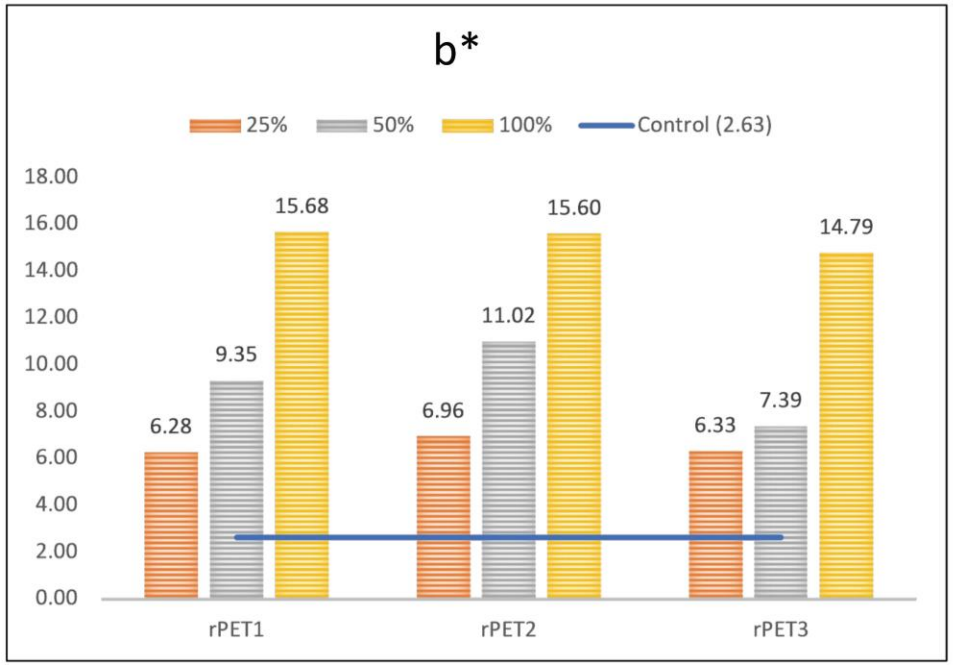
PREFORM VARIABLES

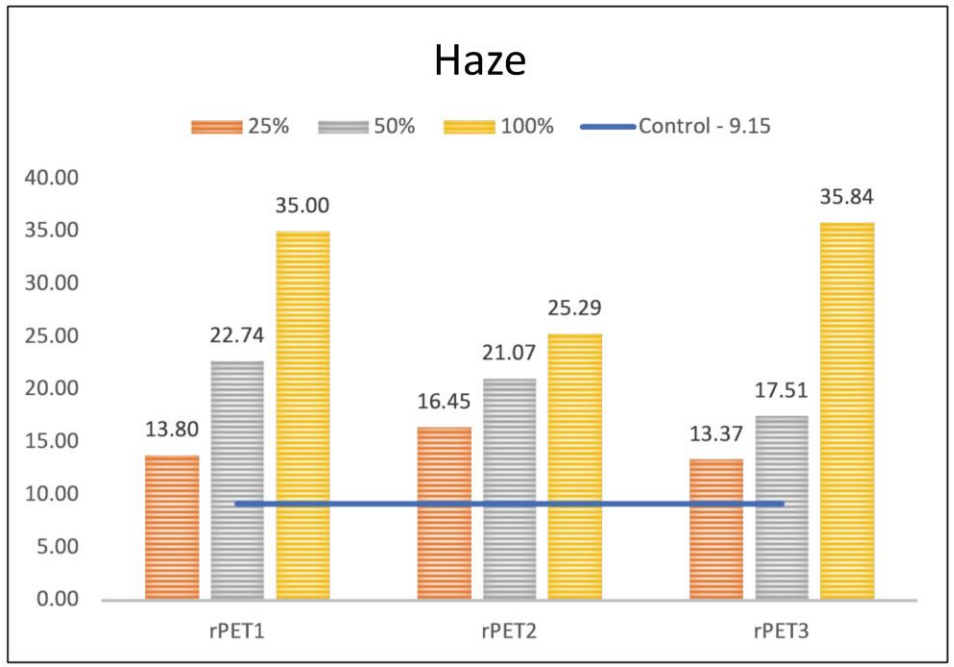
CONTROL **PCR1** 25%/50%/100% **PCR2** 25%/50%/100% **PCR3** 25%/50%/100%

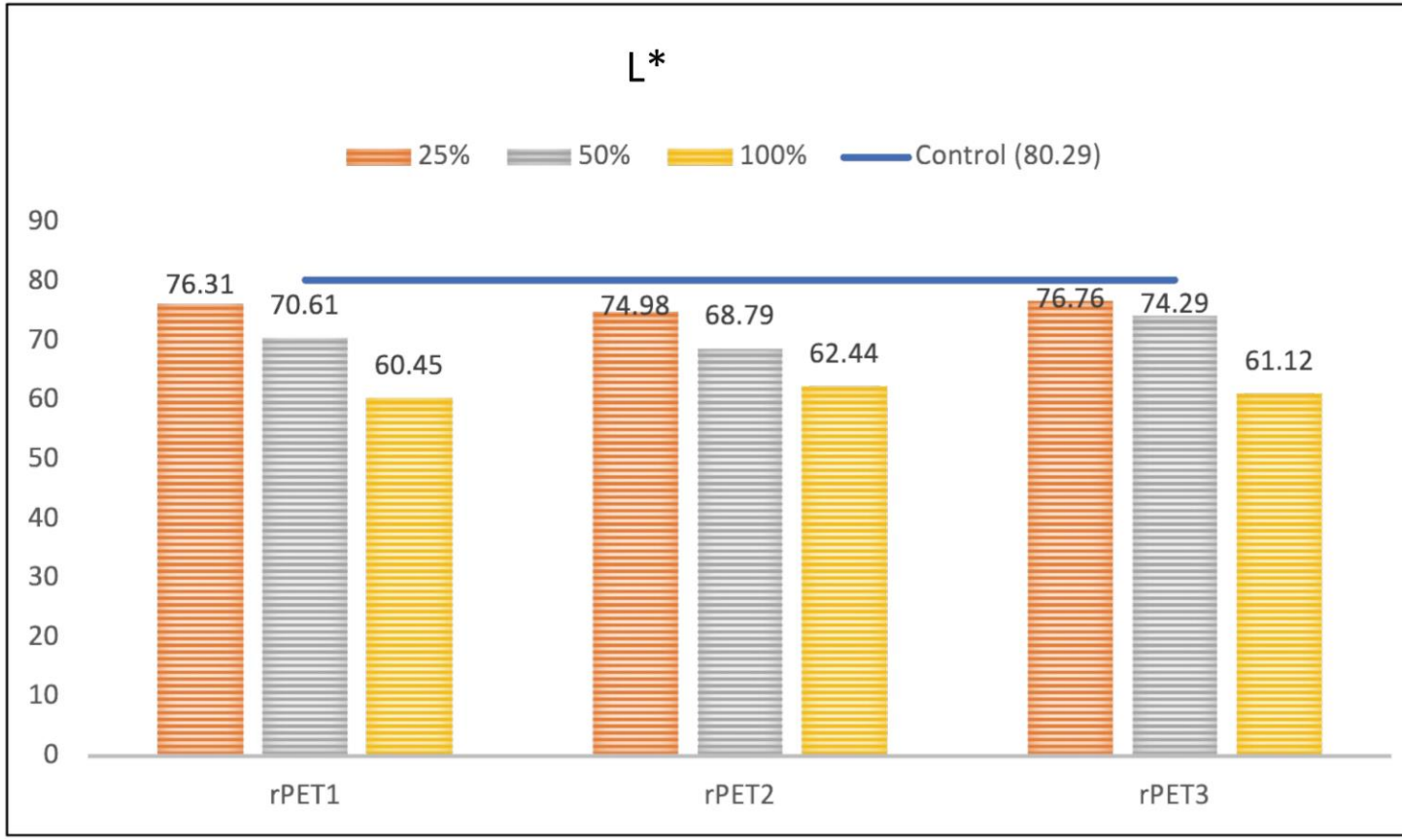
PREFORM VARIABLES

OVERVIEW OF PREFORM COLOR DATA

These graphs represent three blends of three different PCRs at 25%, 50%, and 100% which shows the comparison with the control variable, represented by the blue line.





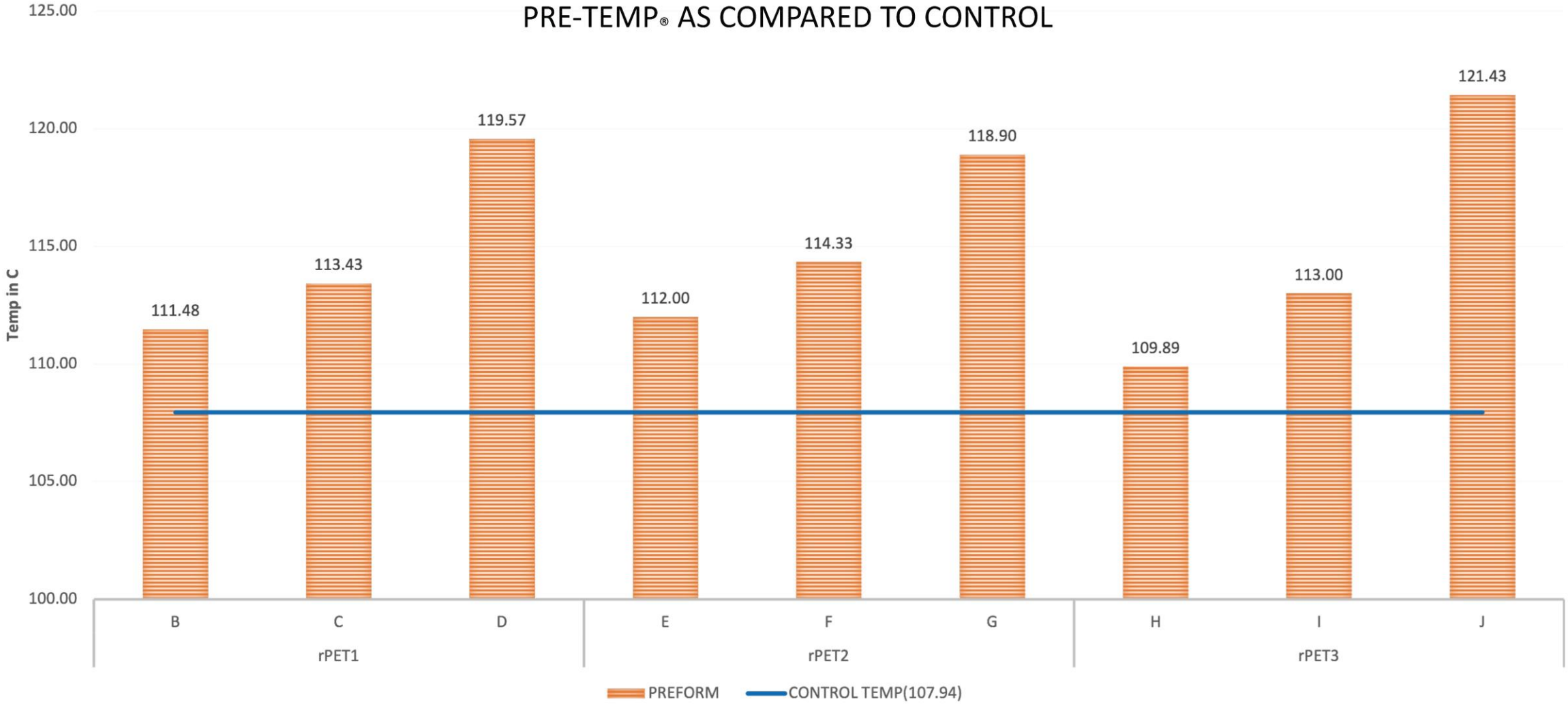


PRE-TEMP® MEASUREMENT

Pre-Temp® is used to measure the temperature inside and outside of the preform

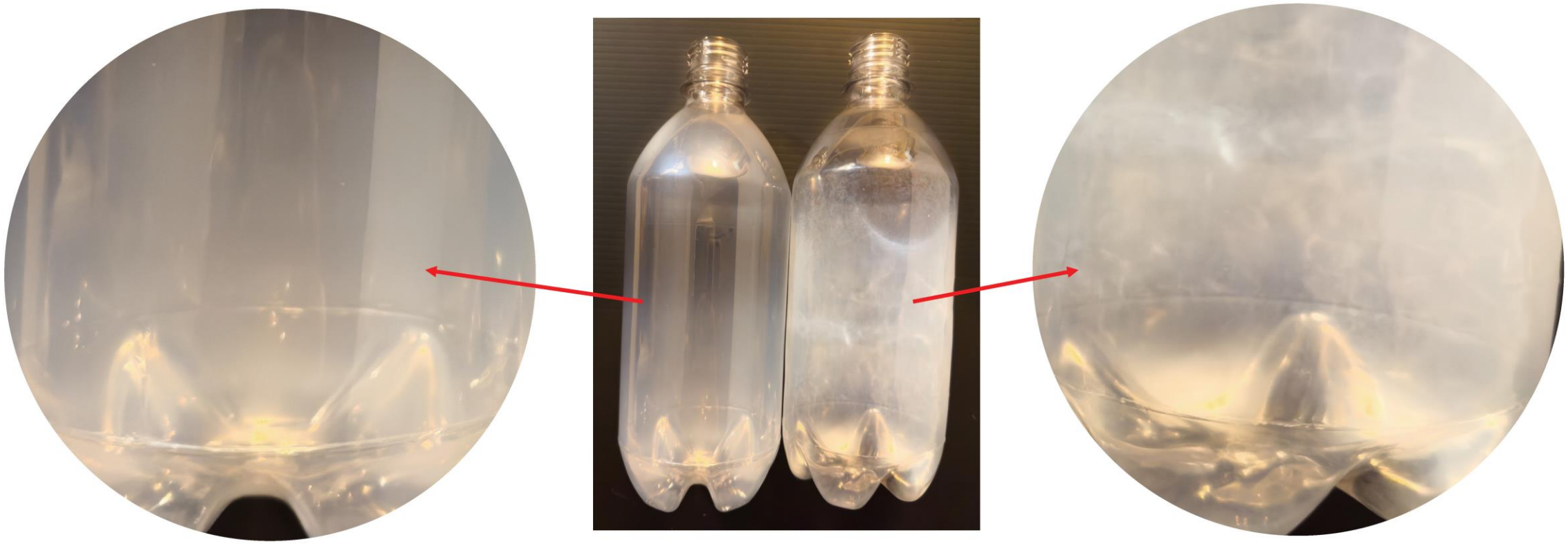
PREFORM VARIABLES

PRE-TEMP® AS COMPARED TO CONTROL



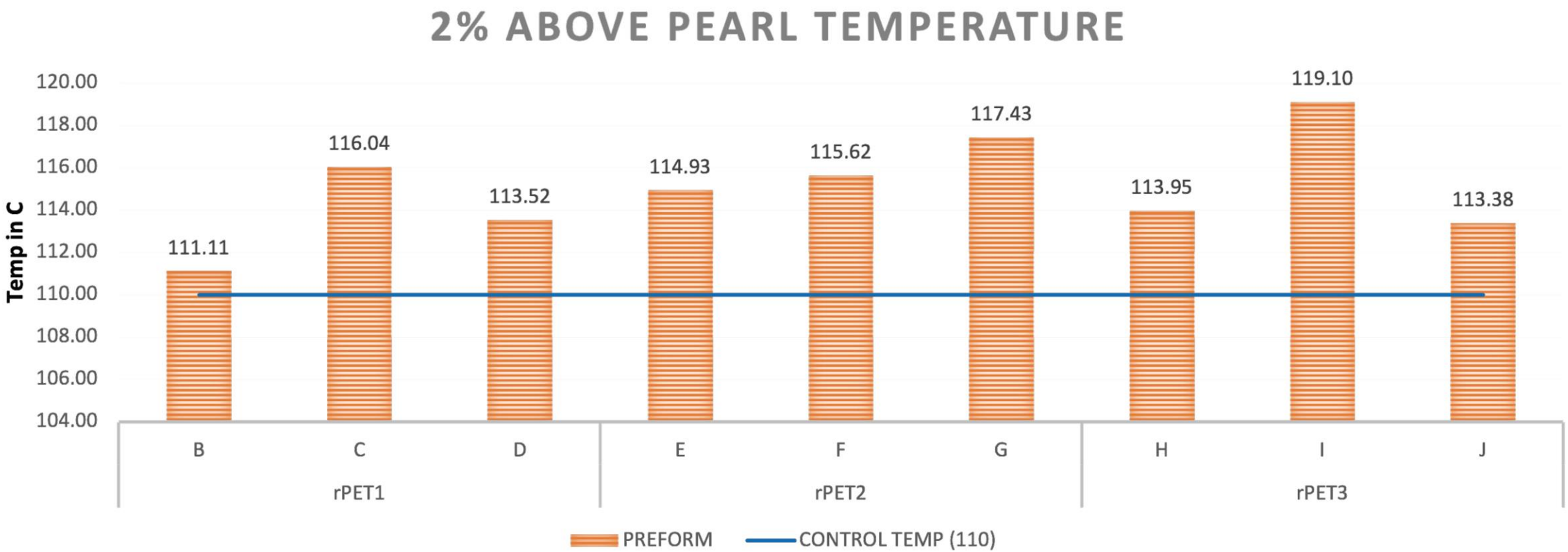
After establishing a formal process with the control variable, comparing the different PCR blends processed at the same conditions – measuring inside surface temperature of the preform. Why is this important? Easy, the more PCR added to the preform the more energy (IR) is absorbed.

STRESS WHITENING (PEARLESCENCE) AND THERMALLY INDUCED CRYSTALLINITY (HAZE) EXAMPLES



Used to establish the process window.

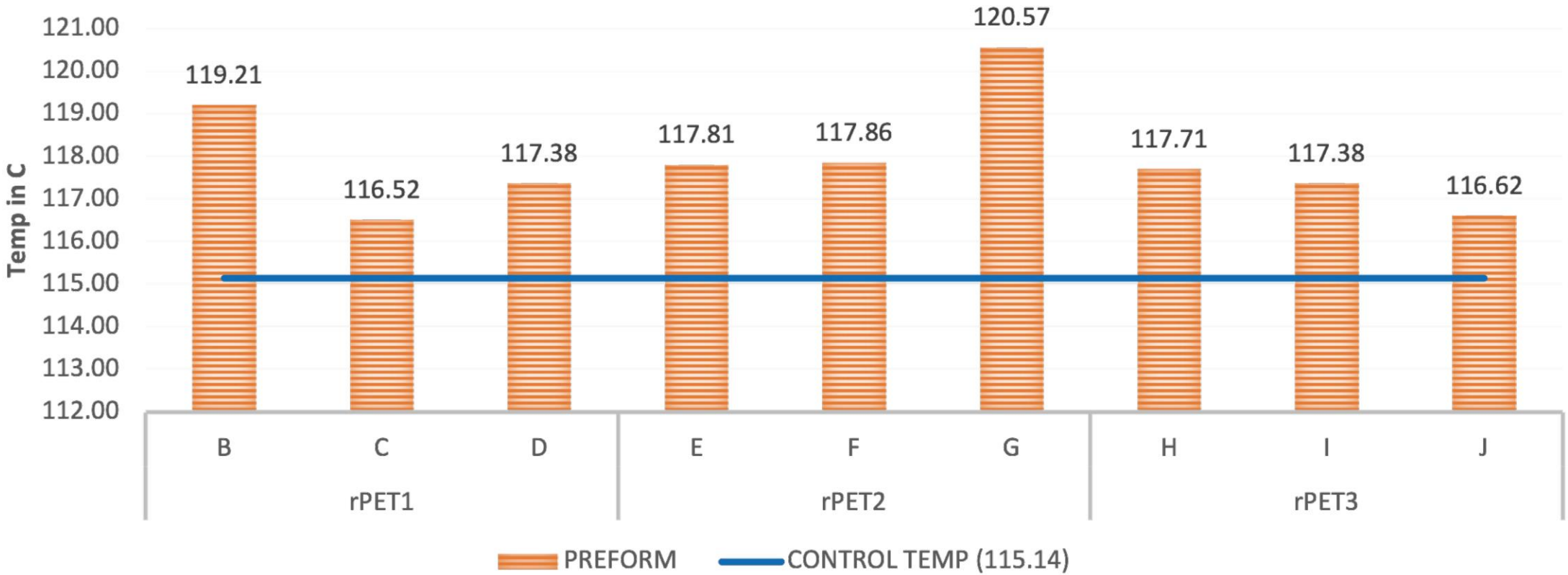
BOTTLE VARIABLES



This graph reflects 2% pearl temperature compared to control.

BOTTLE VARIABLES

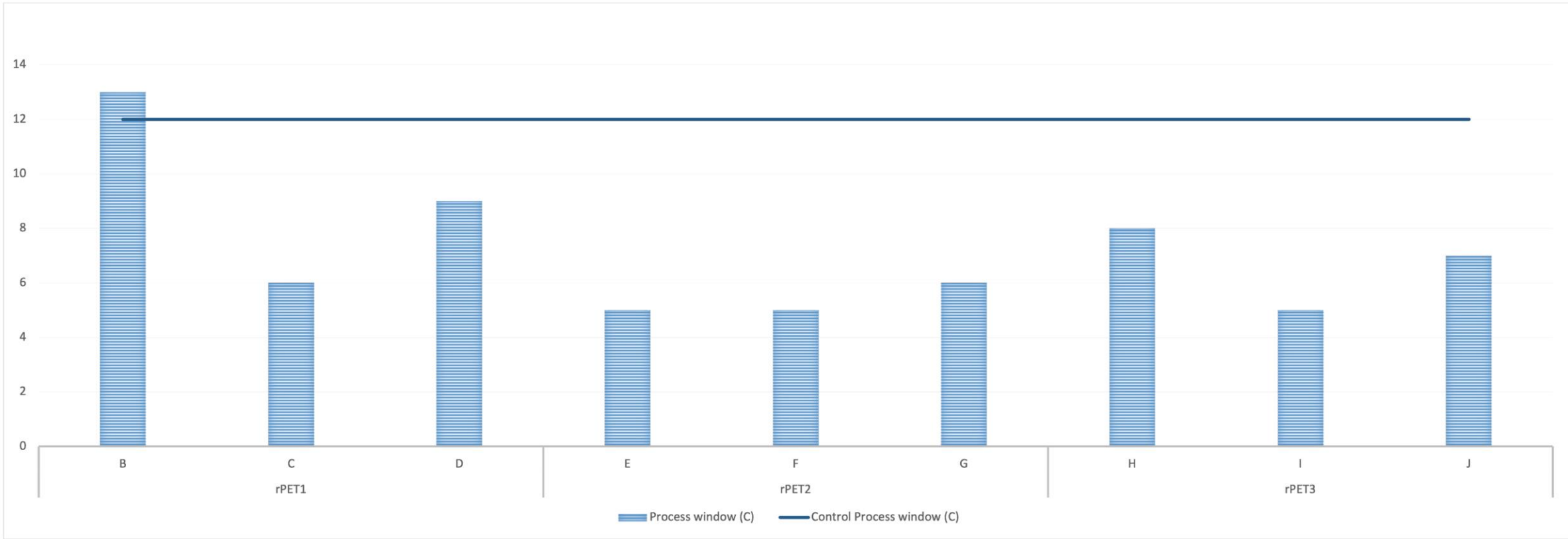
2% BELOW HAZE TEMPERATURES



This graph reflects 2% haze temperature compared to control.

BOTTLE VARIABLES

PROCESS WINDOW



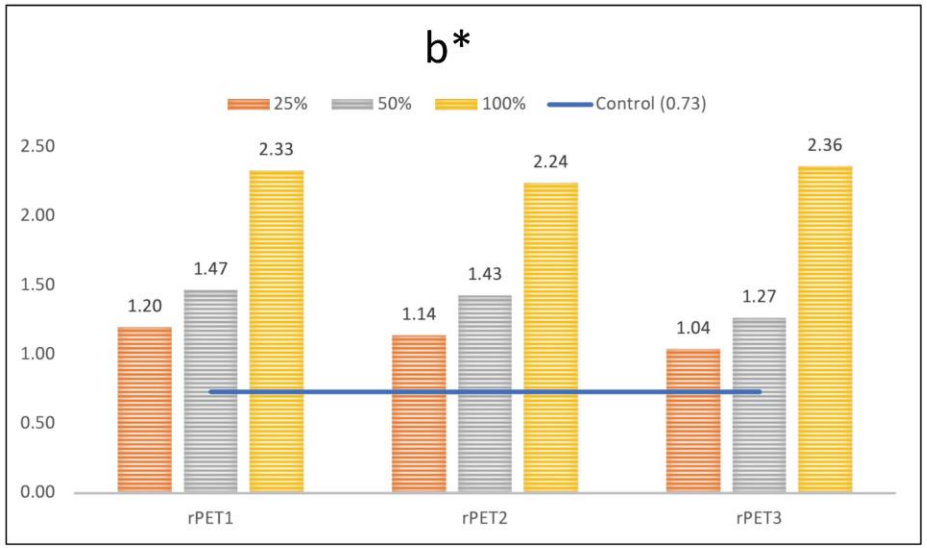
This graph shows how the operating process may be limited based on PCR content and source. This is why it is imperative that PCR suppliers are validated. Working with quality rPET resin allows maintenance of line performance. This is why process & design optimization is the first and foremost.

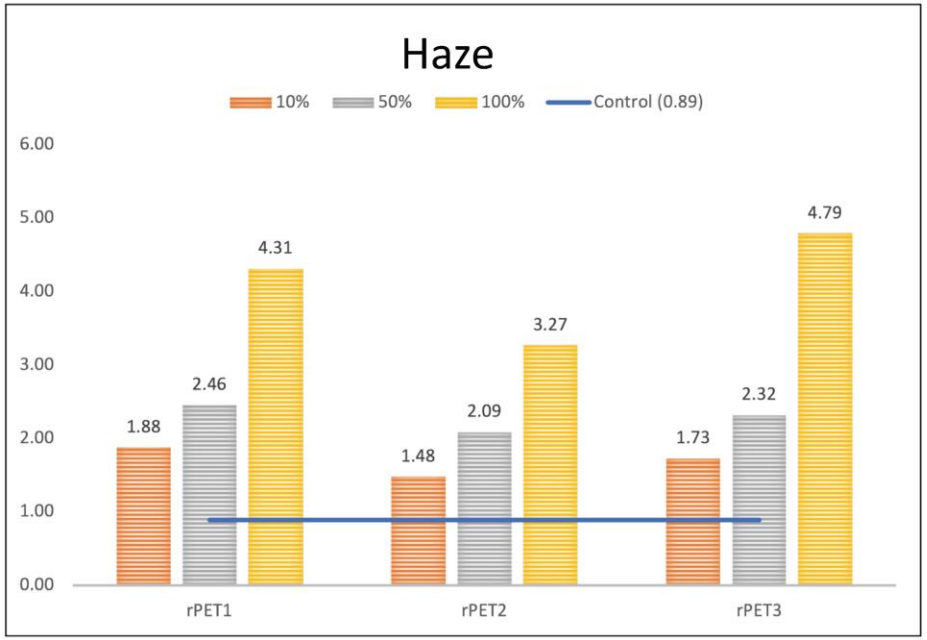
BOTTLE VARIABLES

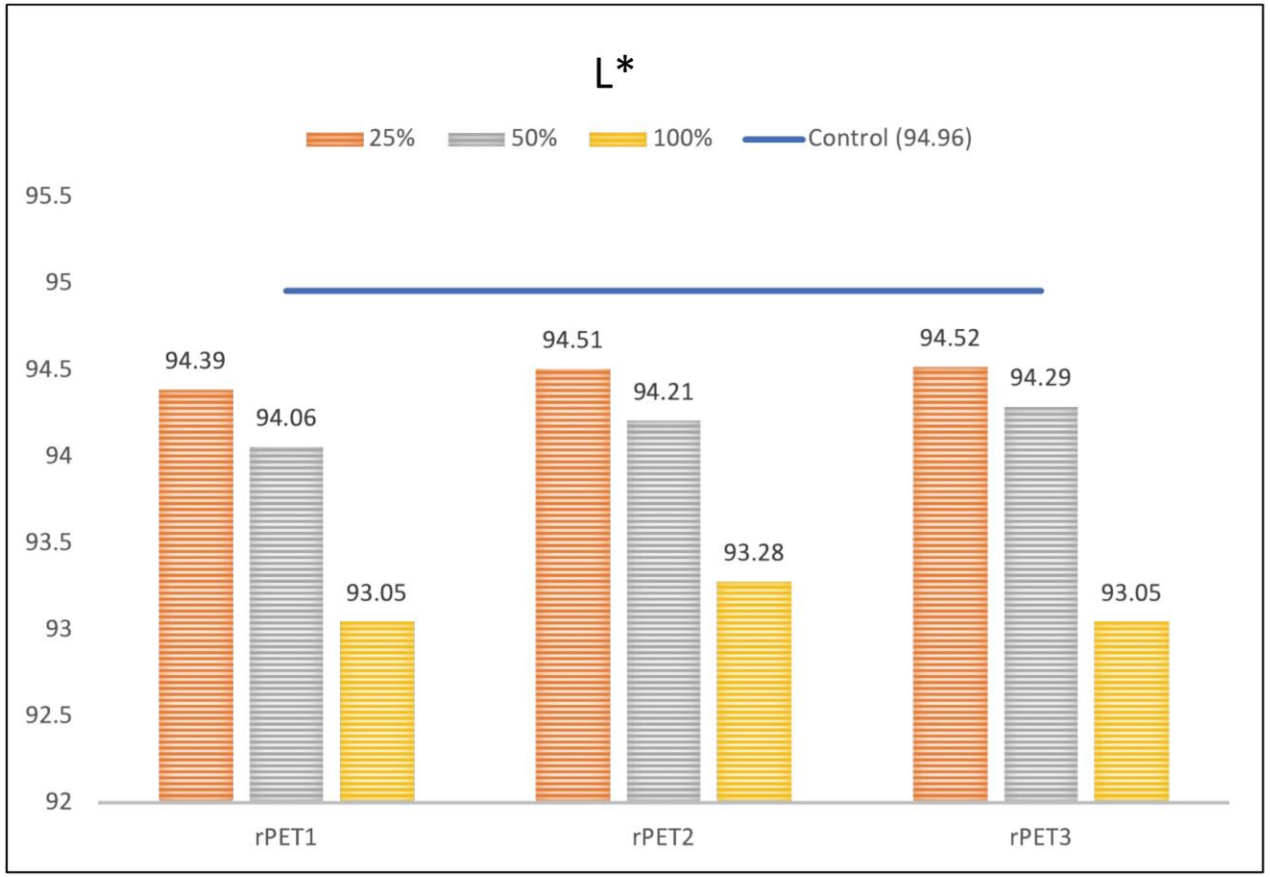
CONTROL **PCR1** 25%/50%/100% **PCR2** 25%/50%/100% **PCR3** 25%/50%/100%

OVERVIEW OF BOTTLE COLOR DATA

Comparing the preform data and bottle data - that the L*, b*, and haze follow the same trend.







BOTTLE PERFORMANCE SNEAK PEEK

WHAT'S NEXT?

How does this impact the brand and converter's experience?

EMPTY VENTED TOP LOAD

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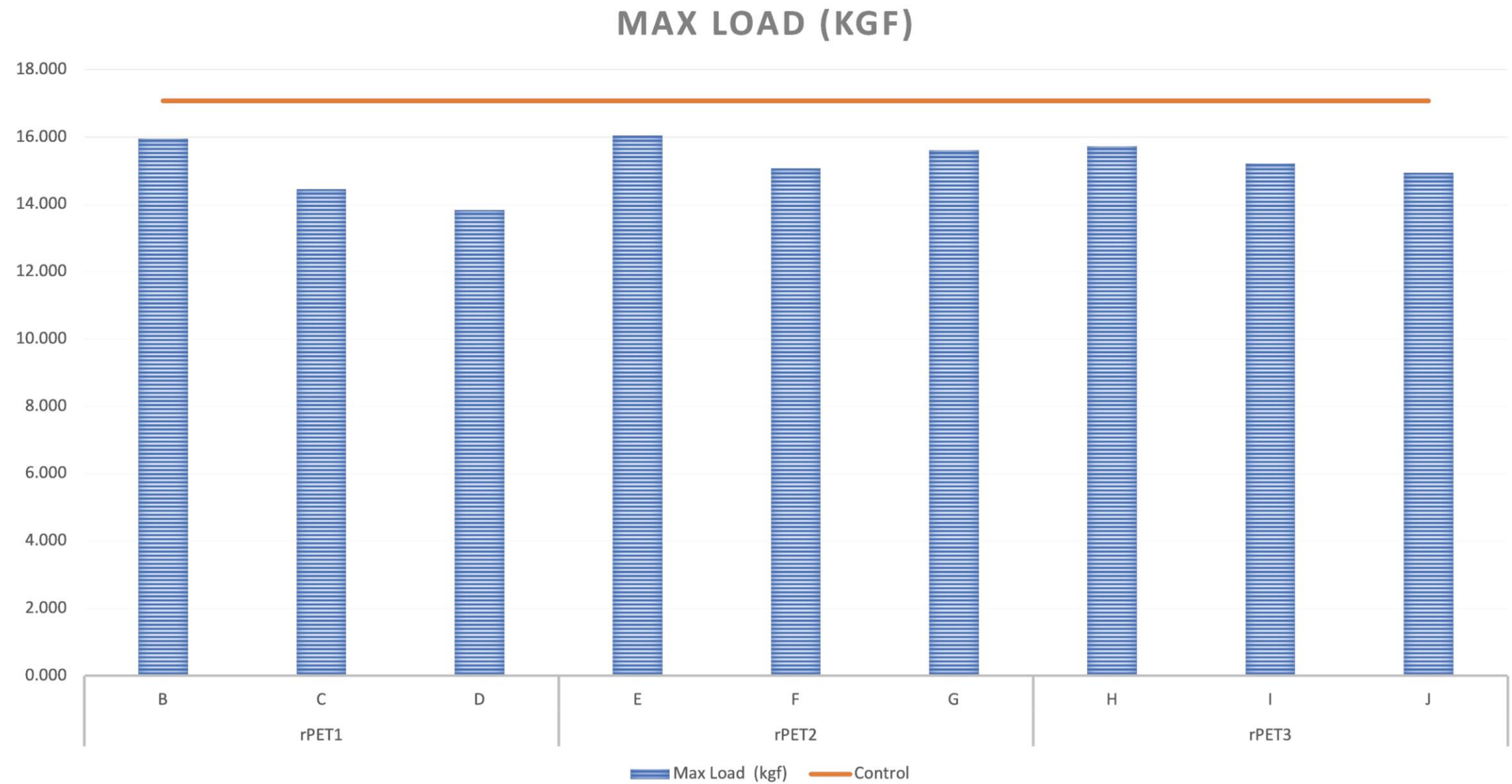
PCR SNAPSHOT

BOTTLE PERFORMANCE



BURST TEST

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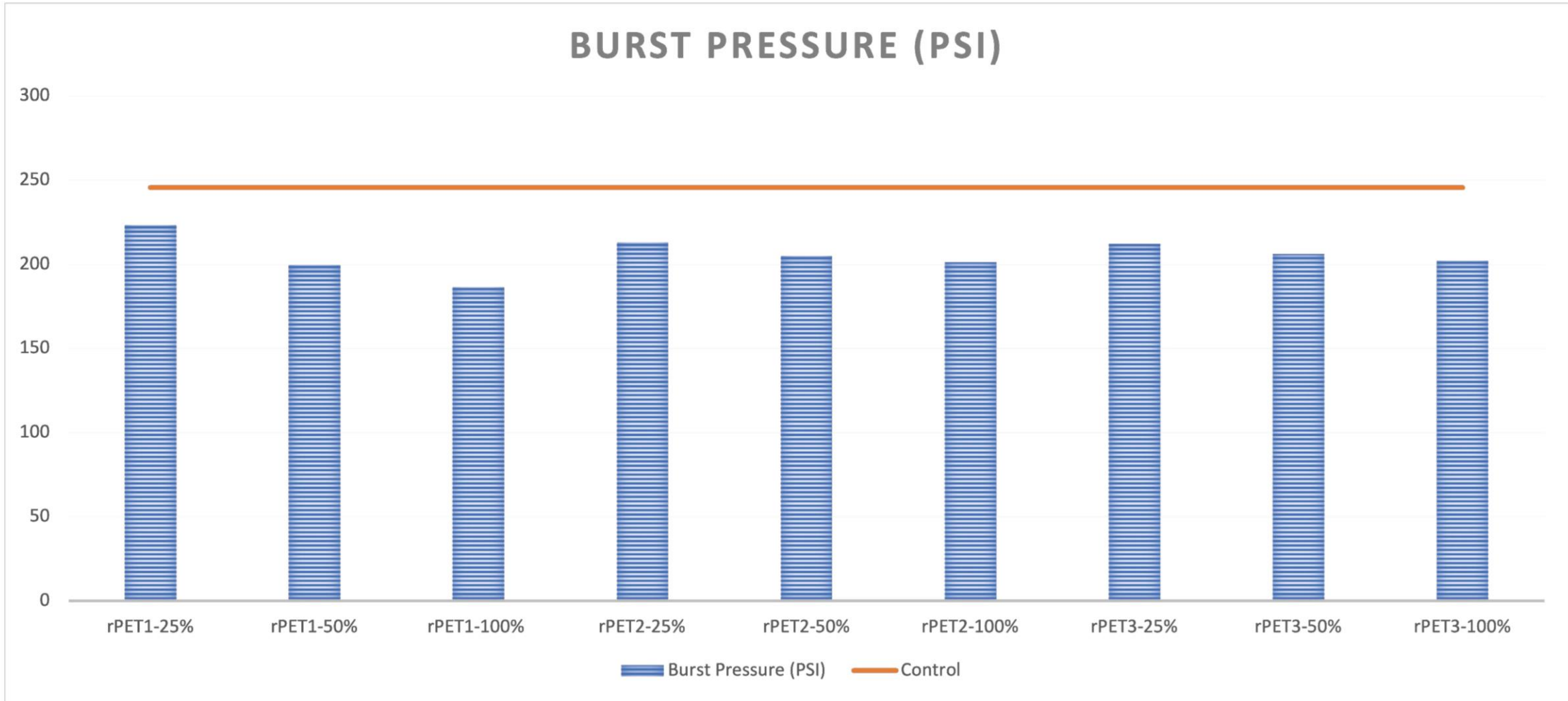
PCR SNAPSHOT

BOTTLE PERFORMANCE



DROP TEST

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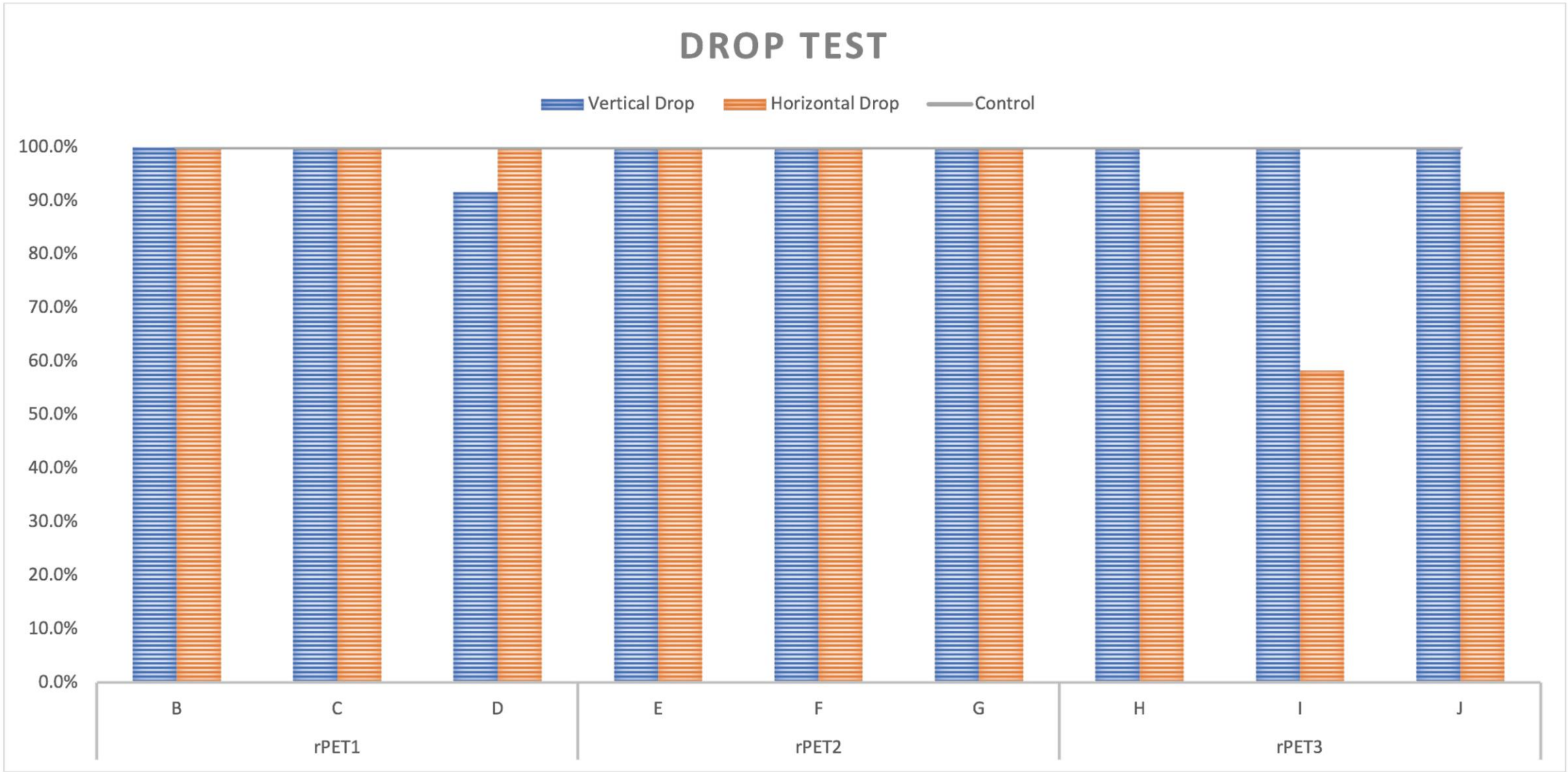
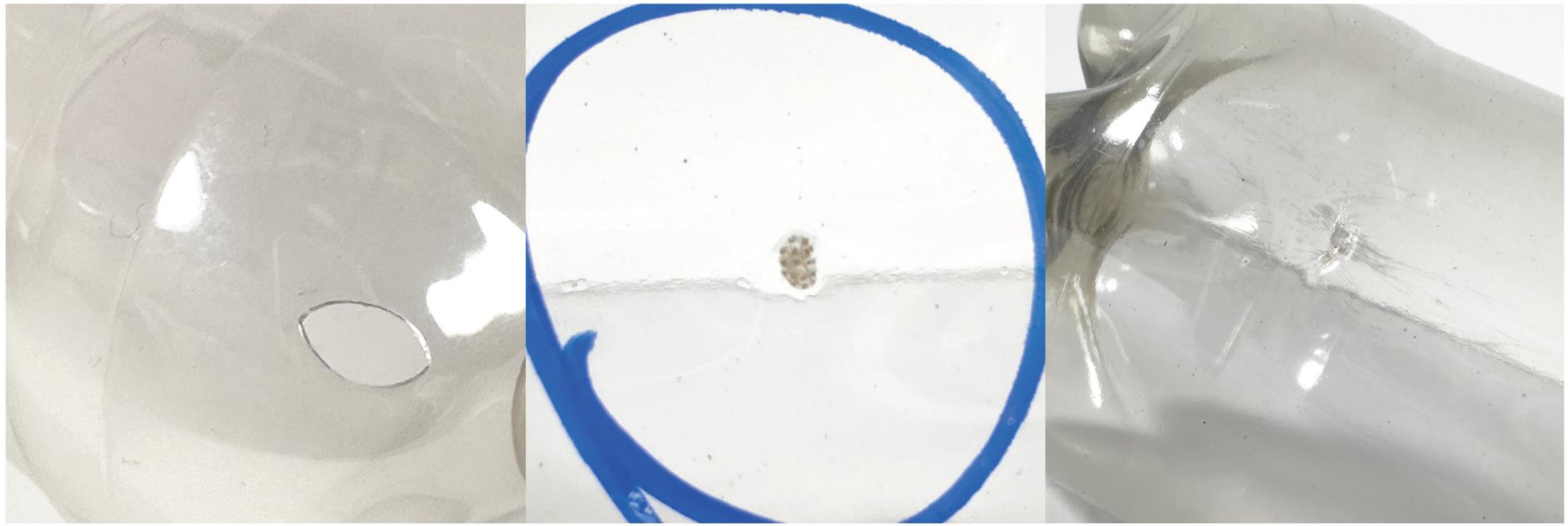
PCR SNAPSHOT

BOTTLE PERFORMANCE





Bad Bottles – and to be clear, even with the most optimized designs and carefully dialed in processing windows – bad bottles can still happen, though few and far between.

Understanding the PCR resin and process optimization will help make these bad bottles less common.

CONCLUSION

WHAT WE SEE

PCR CONTENT WHILE GOOD – NEEDS CONSIDERATION

In the past, many brands have tried to accelerate too quickly into recycled content without verifying that the desired combination of virgin and PCR has an optimal process for production.

100% PCR may not be the best place to start – nor will it always be achievable in all applications.

Adding PCR to your package is not the scariest process to move into if done with proper planning and verification.

PLASTIC TECHNOLOGIES INC.

THANK YOU

FOR YOUR TIME & ATTENTION

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