

The Effects of Surface Treatment on Heat Seal and Hot Tack

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Objective - Improve Rim Seals

During high speed paperboard carton manufacturing, the seal at the top rim is under stress. Low seal initiation and good hot tack strength are needed to ensure a good seal

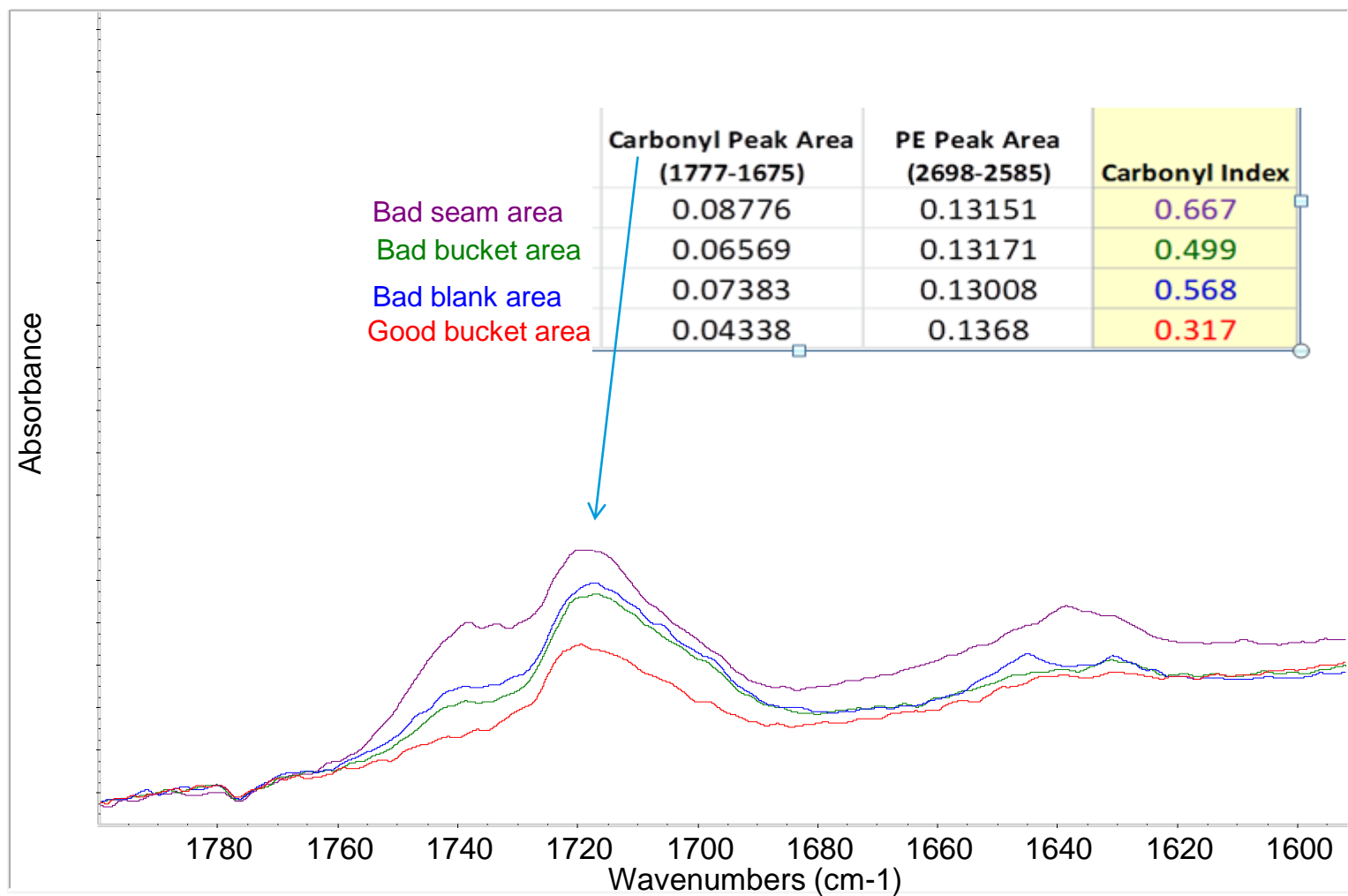
Rim Seal



Overview

- **This study looked at several aspects of surface treatment of LDPE coated paper**
 - Variables studied
 - Post Corona Treatment of the Coated Substrate
 - Time of the Coating Web in the Air Gap
 - Melt Temperature of the Coating Web
 - Performance compared
 - Hot Tack and Heat Seals
 - Attenuated Total Reflection (ATR) was used to look at oxidation levels of the LDPE coating expressed as the Carbonyl Index (C.I.)

Troubleshooting a Sealing Problem Using ATR

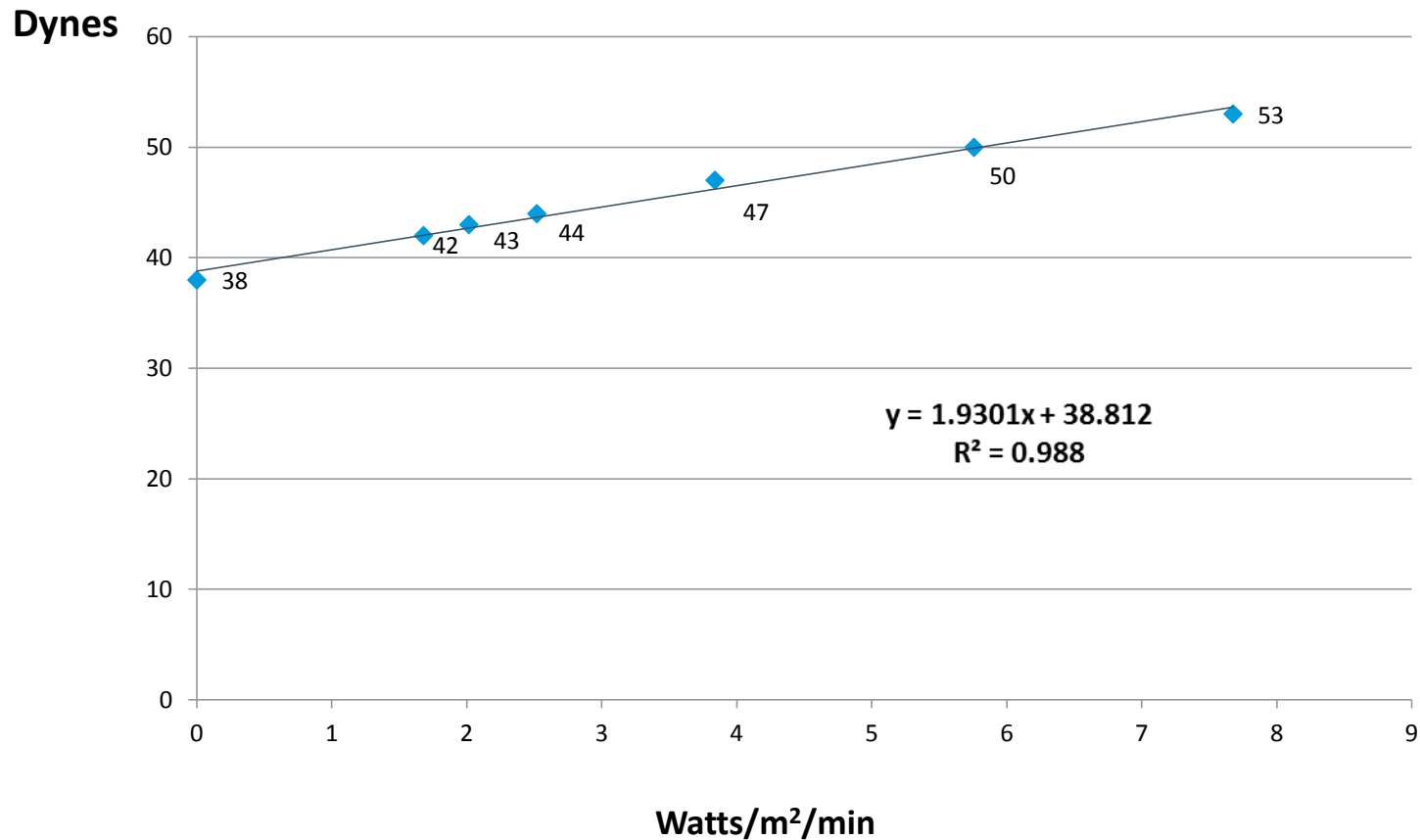


Post Corona Treatment of the Coated Substrate

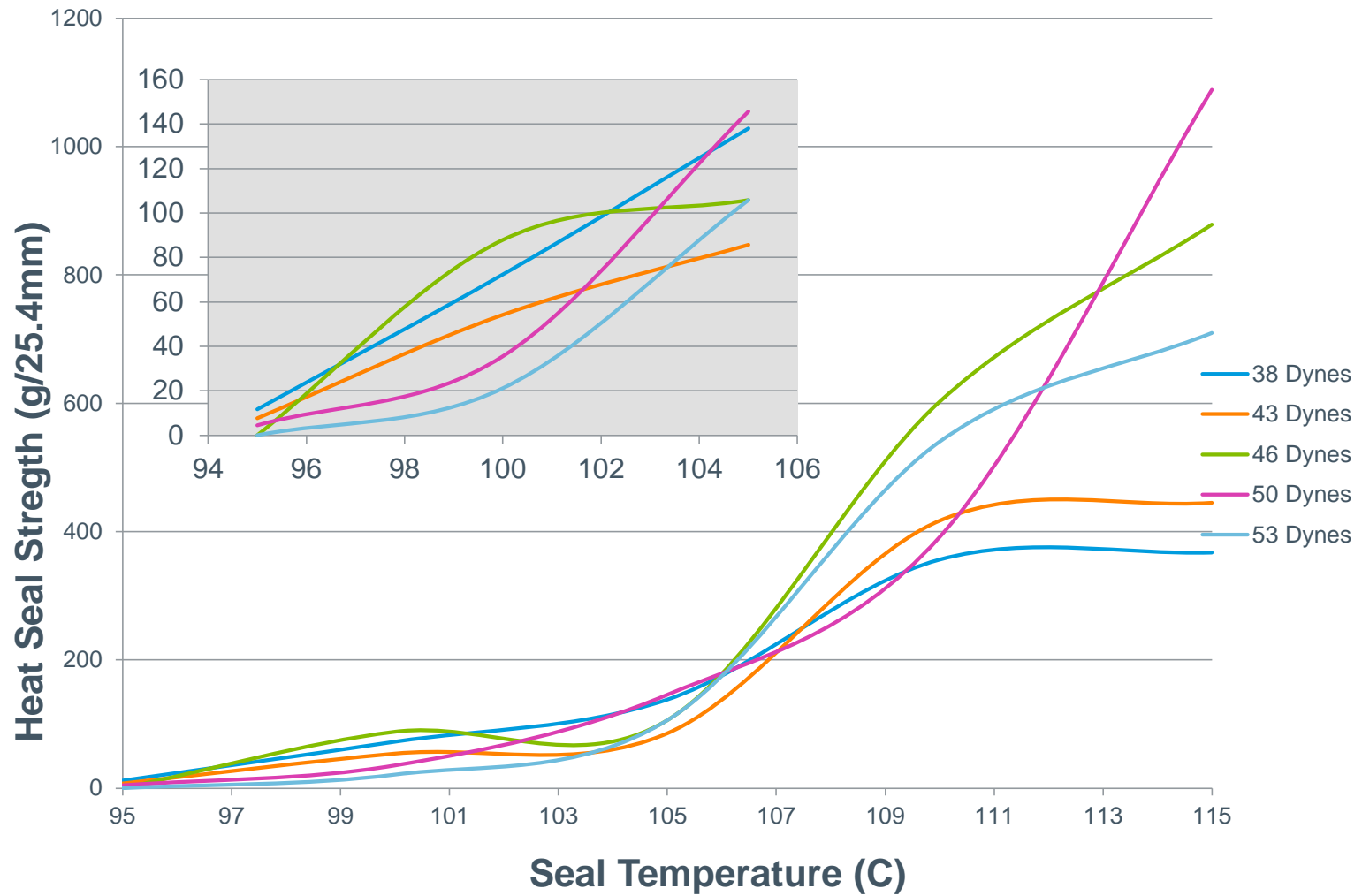
- **Investigate the effects on heat seals and hot tack by varying the level of post treatment**
 - Post treatment is often done to improve printability
- **LDPE was coated onto paper at 324°C (615°F) and an air gap of 17.8 cm (7 in) at a constant coat weight of 16.3 g/m² (10 lbs/ream)**
 - Power was adjusted on the corona treaters to alter the surface treatment

Dyne Level was Confirmed to be Linear with Watt Density (Treaters were Working Properly)

Dyne vs Watt Density



Heat Seal versus Corona Treatment Level



Higher Treatment Results in Higher Seal Strength and Higher Seal Initiation Temperature

Hot Tack Conditions

Hot Tack Test

File Tools Pressure Adjustment

Settings

Load from Saved Settings

New

Save

Start Temp

120.0 °C

Upper

Pressure

0.276 N/mm²

Dwell Time

0:50

Sec : 1/100 Sec

Length

25.4 mm

Width

19.1 mm

Peel Rate

33.0 mm/sec

120.0 °C

Lower

Jaw Pattern

Steel Upper/ Poly Low

Area

485.1 mm²

Cooling Time

0:00:10

Min : Sec : 1/100 Sec

Upper Heat ON

Lower Heat ON

Cycle Machine

Abort Test Run

Home

Exit

Test Results

Upper Temp

120.0 °C

Left Pressure

0.260 N/mm²

Right Pressure

0.335 N/mm²

Total Pressure

0.297 N/mm²

Selected Force

217 g/25.4mm

Lower Temp

120.0 °C

Operator

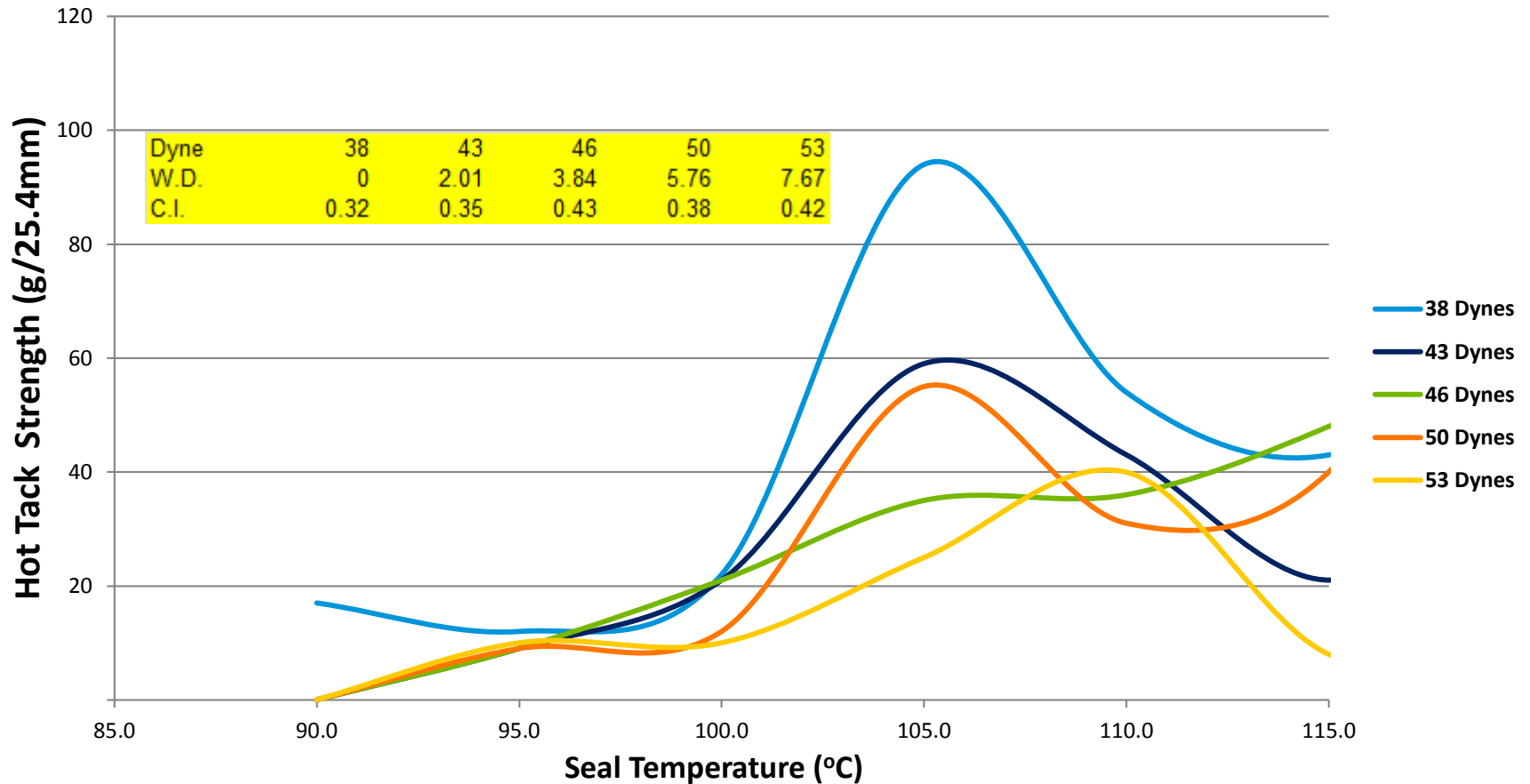
Material

View Graph

Press Cycle Machine

Test# 13

Hot Tack versus Corona Treatment Level



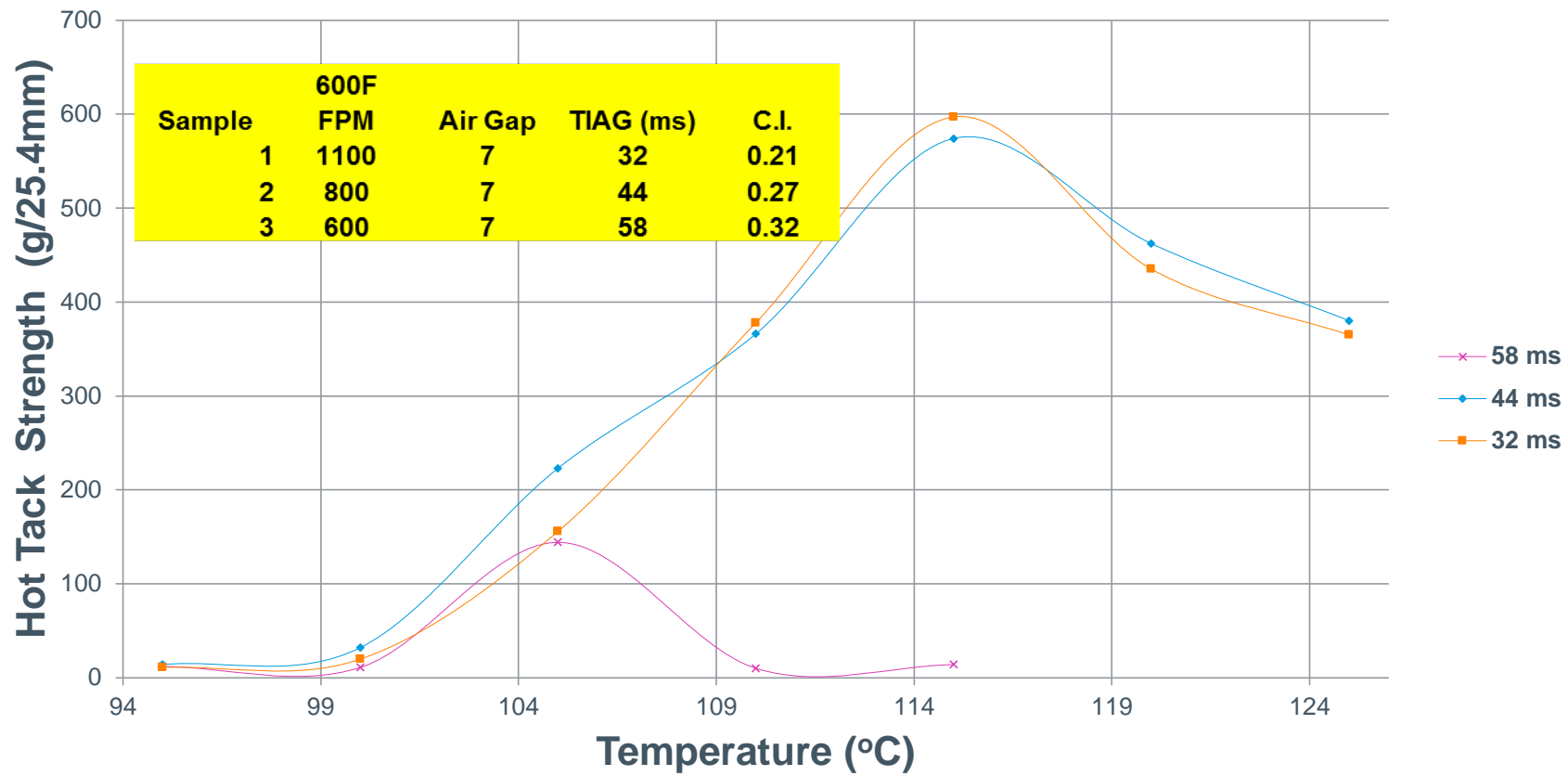
In General Higher Treatment is Detrimental

- At 38 Dyne (no corona) Hot Tack was 50% higher
- Increasing Treatment Resulted in Higher Oxidation as measured by the Carbonyl Index

Time of the Coating Web in the Air Gap

- **Investigate the effects on hot tack by varying the time in the air gap (TIAG)**
 - Air gap is often adjusted to maintain good bond strength
- **LDPE was coated onto paper at 316°C (600°C) with an air gap of 17.8 cm (7 in) at a constant coat weight of 16.3 g/m² (10 lbs/ream) Line speed was adjusted to change TIAG**
 - 32 ms
 - 44 ms
 - 58 ms

Hot Tack versus Seal Temp at Various TIAG's



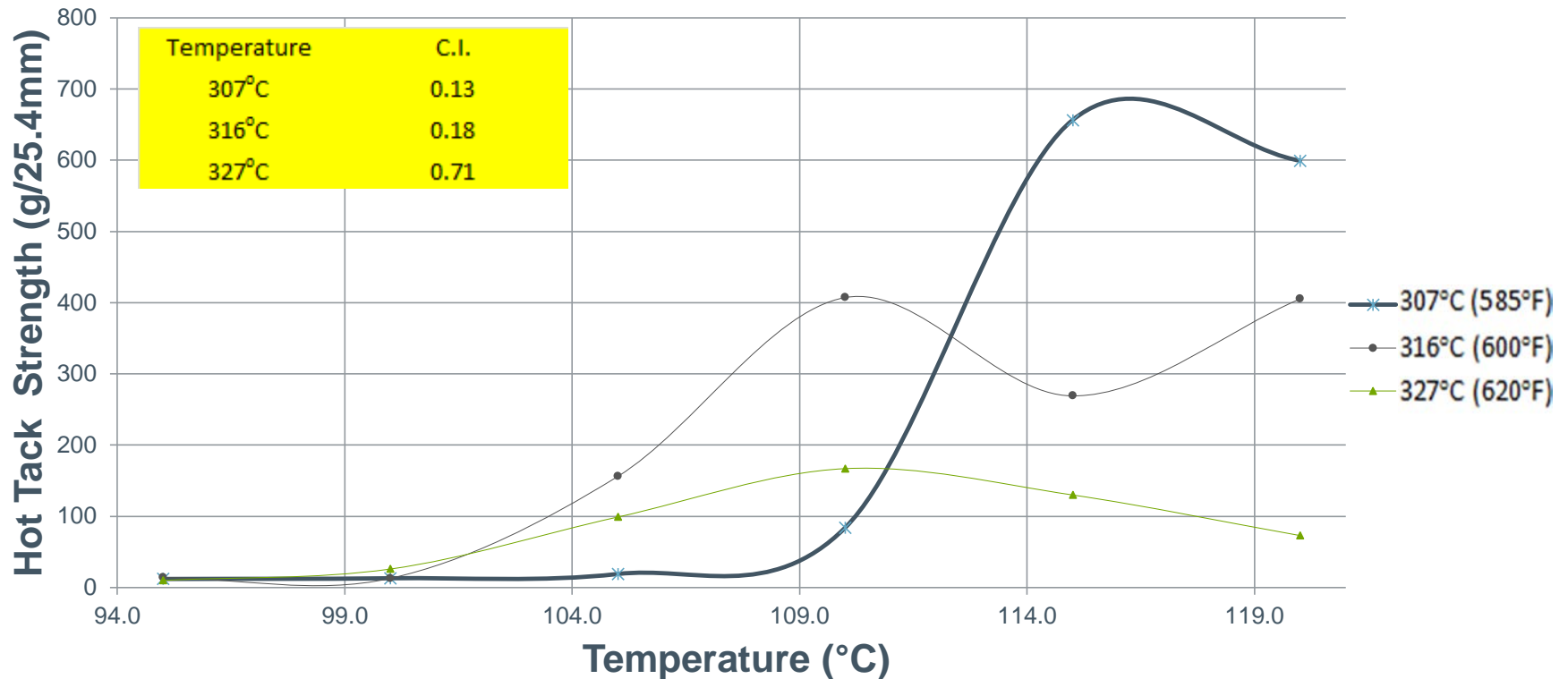
In General Longer TIAG is Detrimental

- Hot Tack was 4 times better at 32 ms versus 58 ms
- The More TIAG Results in a Higher Carbonyl Index

Melt Temperature of the Coating Web

- **Investigate the effects on Hot Tack by varying the melt temperature**
 - Melt temperature is often adjusted to maintain good bond strength
- **LDPE was coated onto paper at 307°C (585°F), 316°C (600°F), and 327°C (620°F) with an air gap of 17.8 cm (7 in) at a constant coat weight of 16.3 g/m² (10 lbs/ream)**

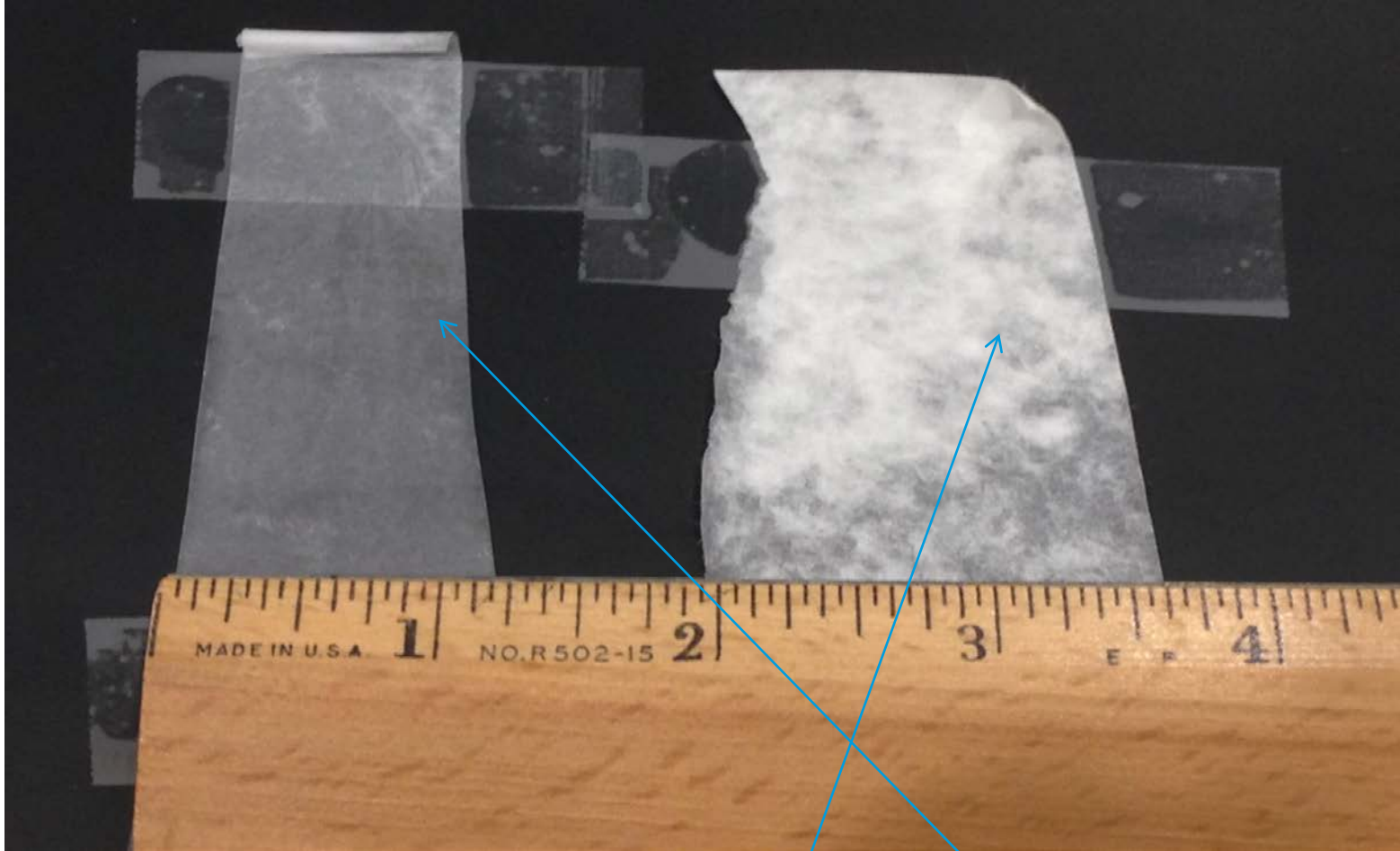
Hot Tack versus Seal Temp at Various Melt Temperatures



In General Higher Melt Temperature is Detrimental

- Hot Tack was Higher by 3x at 307°C and 2x at 316°C versus 327°C
- However, Bond Strength to the Paper is Diminished
 - What Then Do You Do???

How Ozone Treatment of the Coating Web that Contacts the Substrate Can Help (cup stock)



Fiber Tear at 307°C (585°F) Melt Temperature with and without Ozone (cup stock)

Solutions for Poor Seals (Faster Machines)

- **Minimize Post Treatment**
 - Set Minimum and Maximum values
 - Stay above minimum amount needed for printing
 - Stay below maximum allowable for good heat seals
- **Minimize the TIAG and/or Melt Temperature**
 - Set Minimum and Maximum values
 - Stay above minimum amount needed to insure good LDPE to paper bond
 - Stay below maximum allowable for good heat seals
- **Consider Using Ozone to Promote Bond of LDPE to Substrate**

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