

Effect of Post-Consumer Recycled Content on Blow Molded High-Density Polyethylene Bottles

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Outline

- Introduction
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Introduction

- Incorporating recycled materials into plastic products is crucial for reducing the carbon footprint generated by the plastics industry
- Using recycled materials reduces the number of parts in landfills, emissions, and use of raw materials
- Due to the rising demand for PCR in plastics processes, extensive research has been done on the effects of PCR on part quality
- Problems with PCR content in plastic parts:
 - Noticeable odors that can linger from PCR cleaning
 - Varying PCR quality resulting in inconsistent processes
 - Increased brittleness from successive rounds of PCR processing
 - Impurities that are introduced by PCR

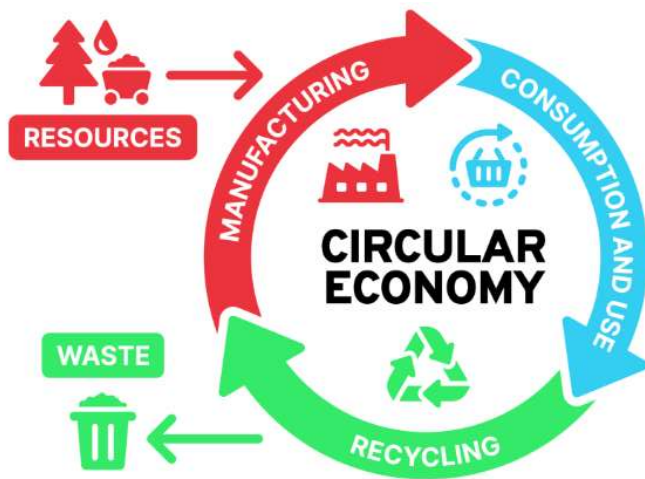


Introduction (continued)

- PCR research does show promise
 - Past studies were able to incorporate ratios as low as 30% and as high as 70%
 - Depending on PCR quality, some ratios have better properties than virgin materials
- It should be noted that PCR ratios were dependent on the design of the part
- Extensive testing is necessary to find optimal PCR ratios
- In our study, we molded one-quart cylindrical bottles for heavy duty motor oil



Introduction (continued)



- Our focus is to identify how incorporating PCR will affect processing and properties of finished blow molded parts
- This research provides a deeper understanding of:
 1. How recycled content affects blow-molded bottle production
 2. Contributes to more sustainable plastic manufacturing practices in the future

Objectives



Objectives

- 1) Characterize the influence of PCR material on HDPE bottle processing parameters across different let down ratios (LDRs):
 - Melt temperature
 - Pressure
 - Cycle time



Objectives

2) Evaluate mechanical and physical properties of HDPE blends with varying PCR levels.

- Tensile strength
- Impact resistance (drop testing)
- Compression resistance (top load testing)
- Melt index and density (melt flow indexing)
- Color (spectrophotometry)

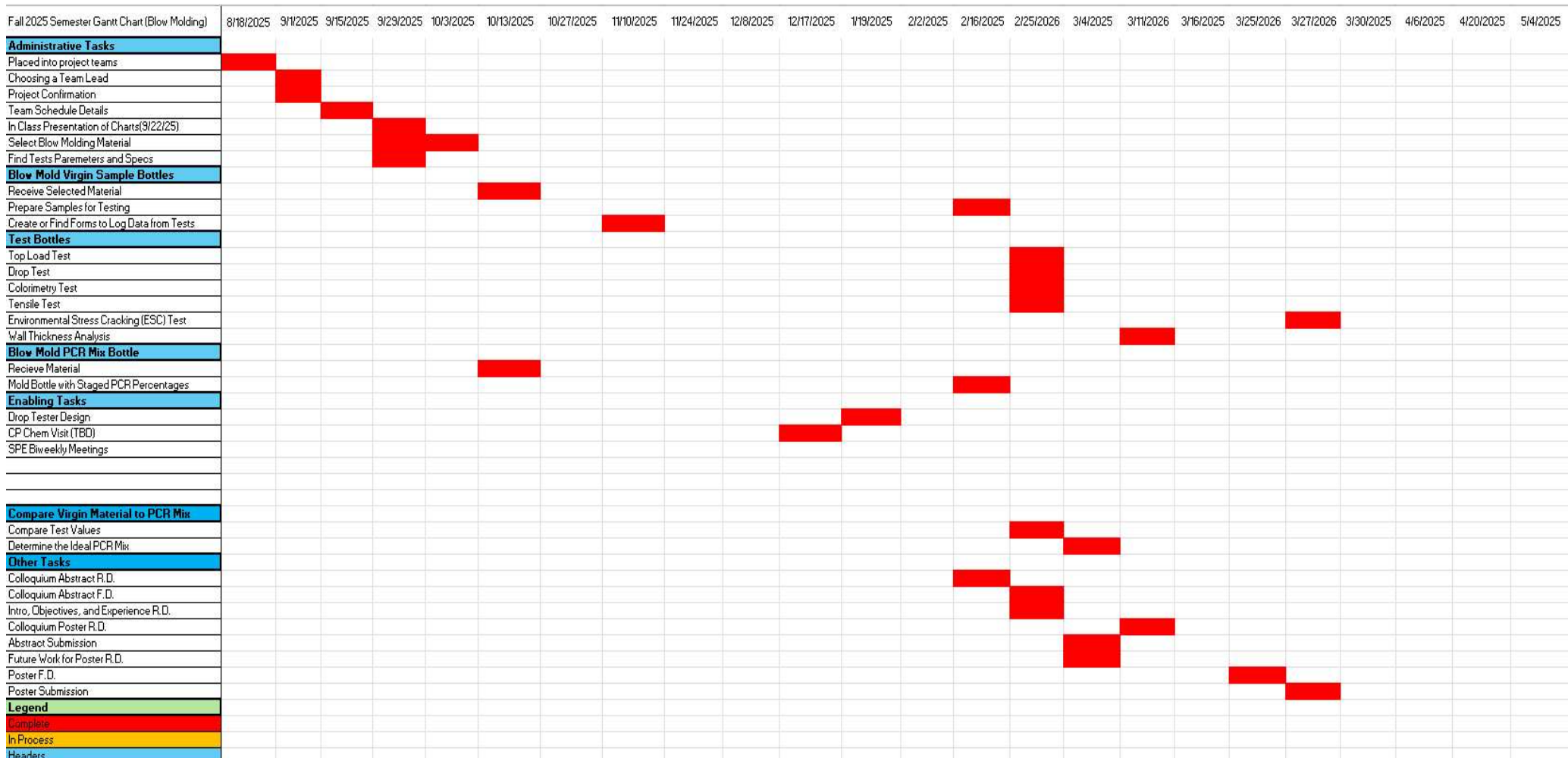


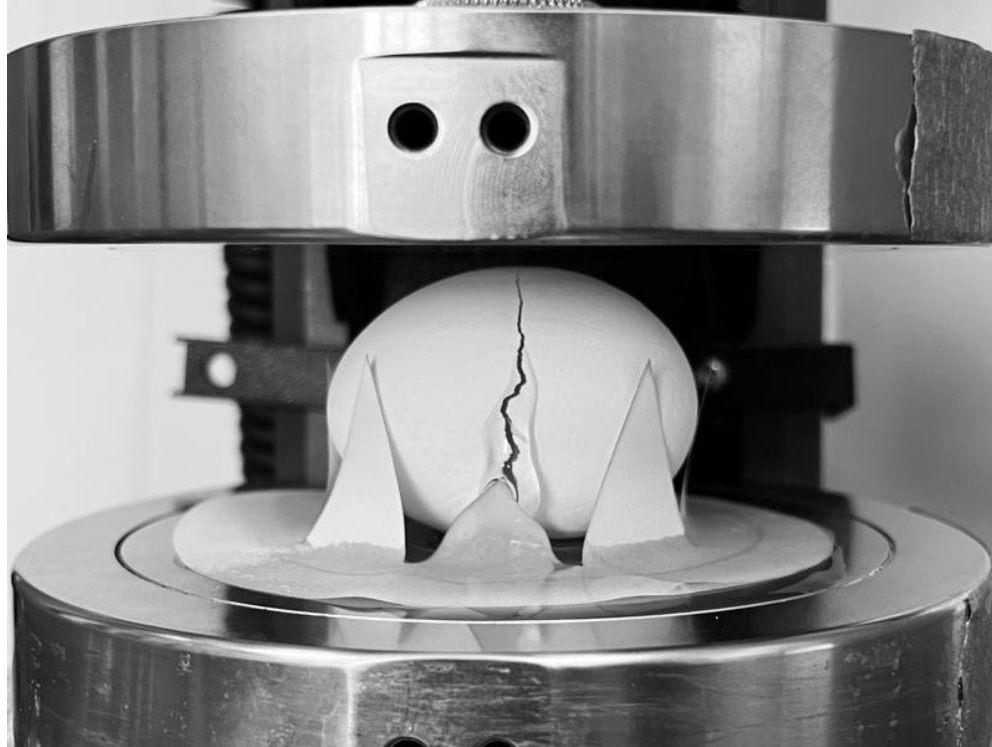
Objectives



- 3) Identify optimal LDR ranges that balance sustainability goals with acceptable performance and processing efficiency
- 4) Compare virgin HDPE and PCR-modified HDPE to quantify performance trade-offs and potential benefits
- 5) Provide recommendations for applications where PCR integration is feasible without compromising product quality or production efficiency

Gantt Chart





Experimental

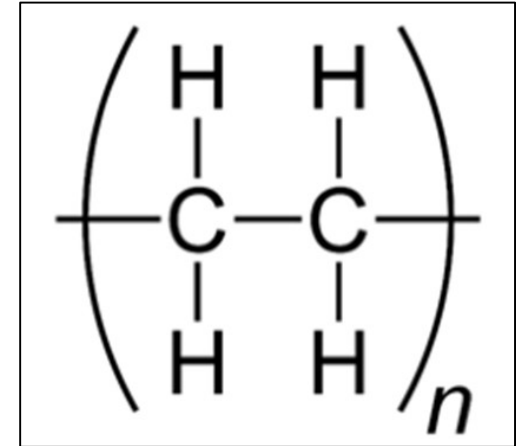
Experimental: Materials

Provided by Chevron Phillips Chemical:

- Marlex[®] 9512H HDPE
- Marlex[®] HHM 5202BN HDPE

Provided by Arch Plastics Packaging

- KWR 101-150, Provided by Arch Plastics



Experimental: Materials Analysis

Melt Flow Indexing

- Machine: INSTRON Ceast MF20 Melt Flow Indexer
- Method: ASTM D 1238
 - Temperature: 190 °C
 - Weight: 2.16 kg
 - Sample: 5 g
 - MFI was recorded as an average of three analyses



Thermal Analysis

Thermogravimetric Analysis

- Instrument: TA Instruments TGA 550
- Sample Program:
 - Sample Weights between 3-7 mg
 - Ramp 10 °C/min to 600 °C
 - Temperature at 10% weight loss, Temperature at 50% weight loss, and percent residue were reported

Differential Scanning Calorimetry

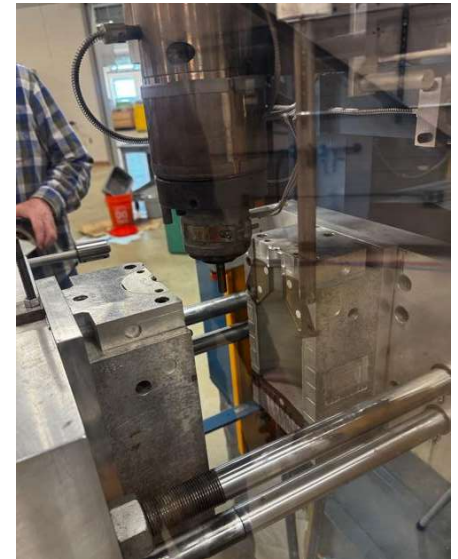
- Instrument: TA Instruments DSC 2500 with the Refrigerated Cooling System 90
- Sample Program:
 - Sample Weights between 3-7 mg
 - Ramp 10 °C/min to 250 °C
 - Ramp 10 °C/min to -80 °C
 - Ramp 10 °C/min to 250 °C
 - Crystallization and melt temperature were reported
 - Percent crystallinity was calculated from T_m and T_c ¹

Experimental: Process Parameters



Rocheleau R-4 blow-molding machine

- Plunger Forward Speed: 15 in/sec
- Die Gap: 30 %
- Range Setting: 5 %
- Current Program Point Readout: 16



Experimental: Process Parameters

Zone	Percent				
1-5	45	65	80	80	80
6-10	80	70	70	70	70
11-15	70	60	60	60	60

Location	Temperature (°F)
Rear	350
Front	365
Shutoff	365
Head 1	365
Nozzle 1	365
Melt Temp	369

Parameter	Seconds
Pre Blow Delay	0.0
Blow Delay	1.5
Blow PSI 1	3.0
Blow PSI 2	15.0
Air Exhaust	2.0
Eject	0.8
Screw Safety	60.0
Mold Safety	3.0
T9	0.0
T10	0.0
T11	0.0
T12	0.0
T13	0.0

Screw Set Up	
Screw Shot Size (%)	45
Screw Fill Speed (%)	70
Screw Forward Speed (%)	0
Screw RPM Readout	0
Blow Set Up	
Pre Blow (PSI)	0
Blow 1 (PSI)	40
Blow 2 (PSI)	80
Clamp Set Up (%)	
Clamp Close Speed 1	80
Clamp Close Speed 2	40
Clamp Open Speed	80

Experimental: Analysis

Weight Measurements

- Each bottle was weighed on a digital scale
- Each bottle was weighed and numbered after removal from the blow molder

Thickness Measurements

- Magna-Mike 8600 with WinXL Software
- $\frac{1}{4}$ in. ball
- Seven circumference locations
- Four locations per circumference



Experimental: Analysis

Compression (Top Load) Testing

- Testing Machines Inc. (17-76/77 Series Compression Tester)
- Method: ASTM D 2659
- Capped bottles filled were filled with water
- Crosshead Speed: 1 inch/min
- Deflection: 0.25 inches
- Compressive Force was recorded



Experimental: Analysis

Tensile Testing

- Instron Universal Tester in tensile mode
- Method: ASTM D638
- Two sets of ten samples were cut from bottles
- Size: 3.5" x 0.75"
- Set one was in the machine direction
- Set two was in the transverse direction



Experimental: Analysis

Drop Testing

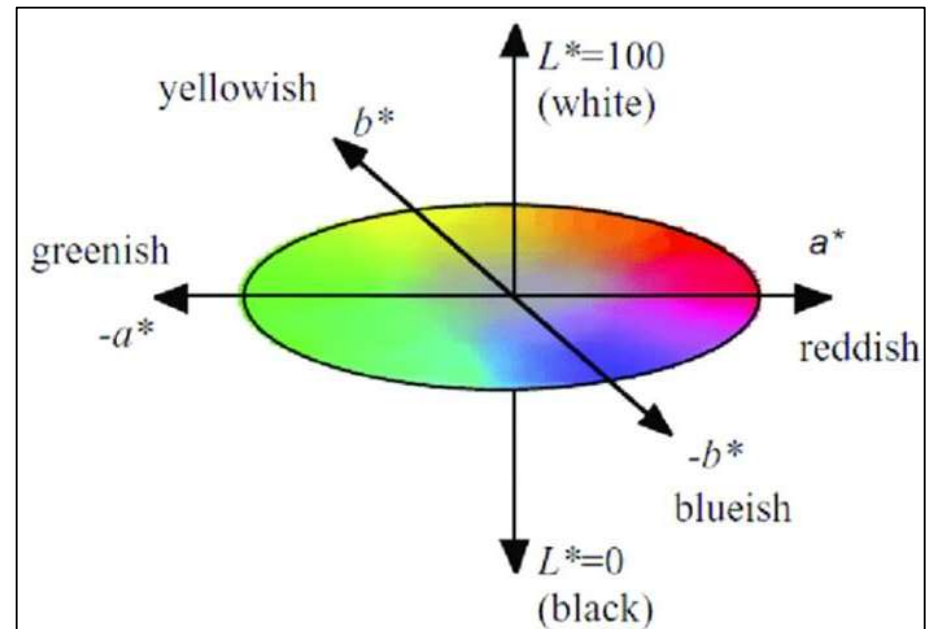
- Method: ASTM D 2463, Procedure B
- Containers filled with water
- Bruceton Staircase Method followed for testing
- Pass/Fails recorded



Experimental: Analysis

Color Determination

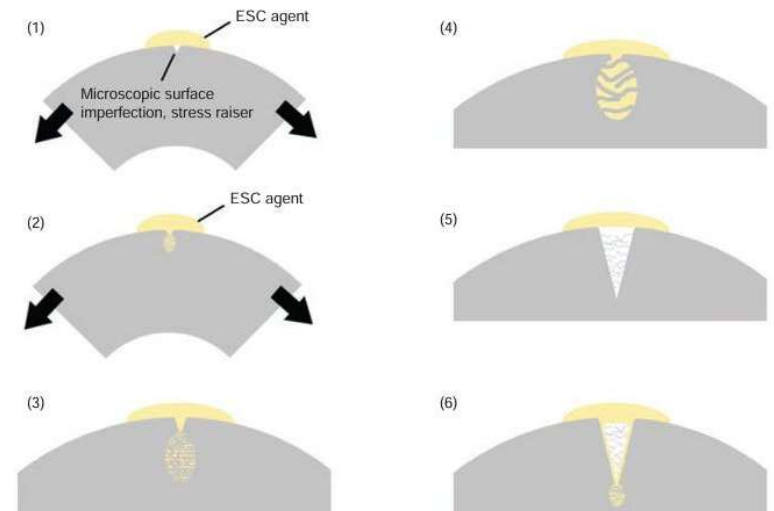
- BYK spectro2guide
- Quick Check mode
- Three trials for each sample
- $L^*a^*b^*$ values recorded for each trial

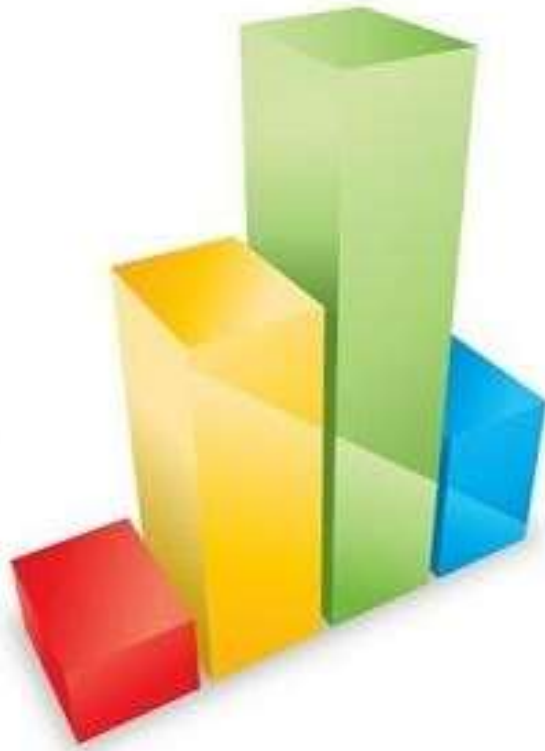


Experimental: Analysis

Environmental Stress Crack Resistance

- 15 Samples tested of each LDR
- Samples were filled 1/3 of the way up with Joy dish soap
- Bottles were capped and further sealed with Teflon tape
- Samples were placed in an oven bag to prevent spills into the oven
- Placed in an oven at 140 °F
- Checked hourly for the first eight hours
- After the first eight hours, they are checked every 24 hours
- Test can run up to 15 days





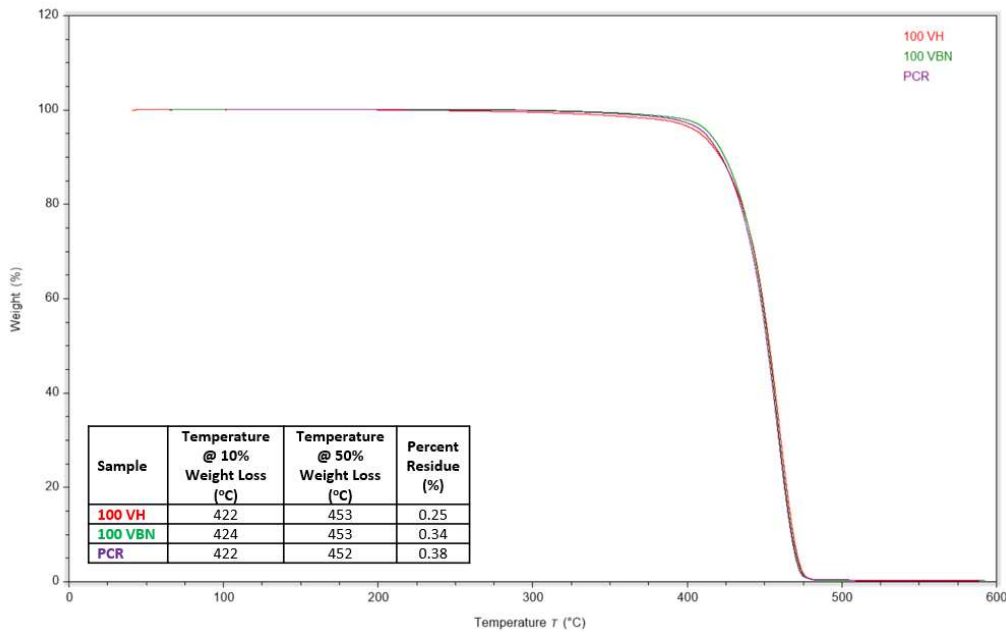
Results

Results: Melt Flow

Sample	Experimental MFI (g/10 min)	Reported MFI (g/10 min)
Virgin Marlex® 9512H	0.306 (± 0.006)	0.35
Virgin Marlex® HHM 5202BN	0.245 (± 0.016)	0.35
KWR101-150 PCR	0.501 (± 0.007)	0.60

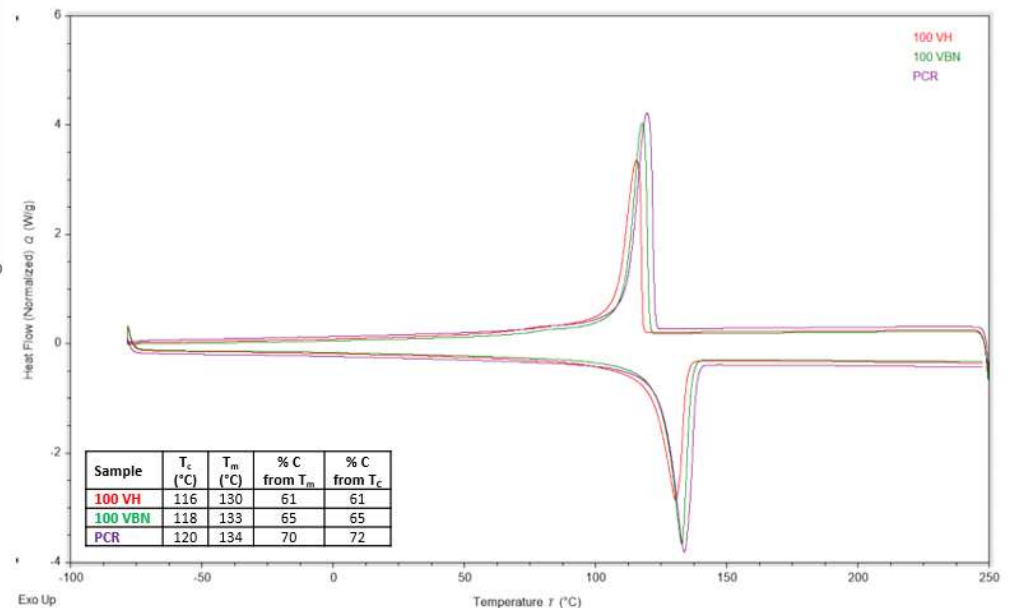
- Experimentally-determined melt flow results were lower than reported melt flow from material data sheets
- All materials used in this project demonstrated this phenomenon

Results: TGA and DSC

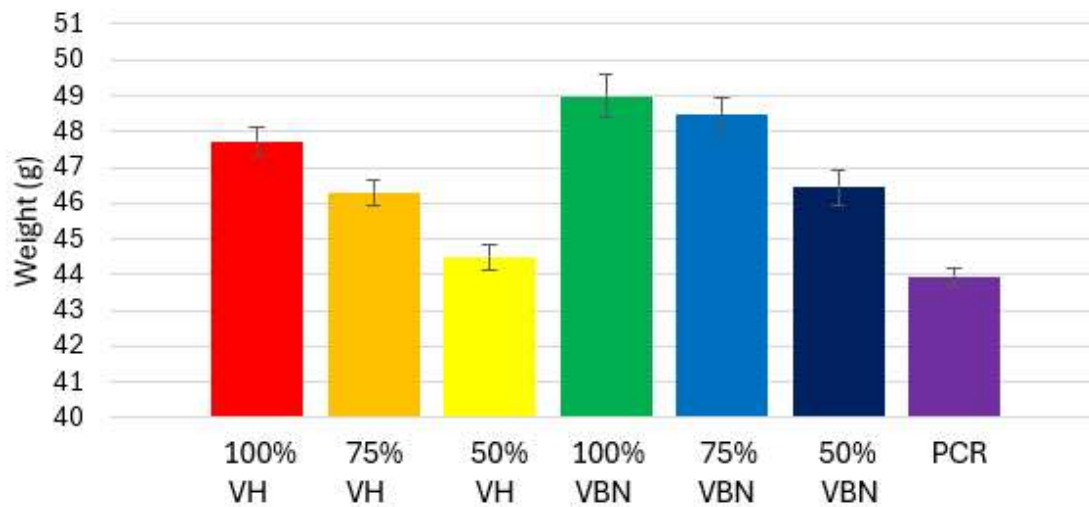


- All types of HDPE had similar transition temperatures in DSC
- Crystallinity varied: PCR>VBN>VH

- All types HDPE tested demonstrated similar degradation behavior in the TGA



Results: Bottle Weight

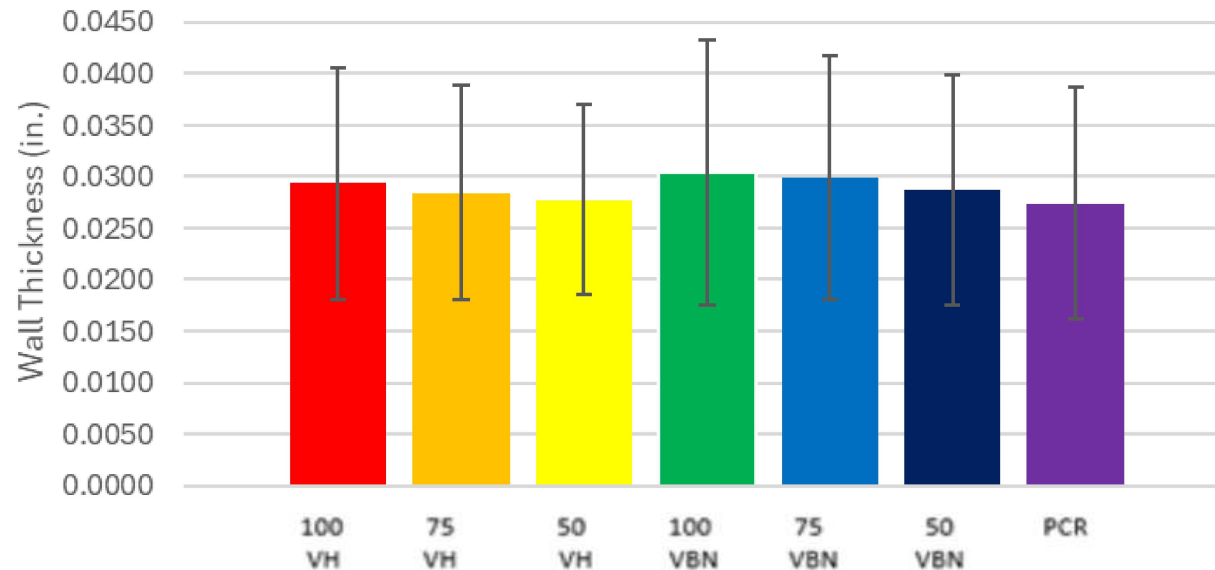


Sample	Average Bottle Weight (g)
100 VH	47.72 (±0.40)
75 VH	46.29 (±0.37)
50 VH	44.49 (±0.37)
100 VBN	48.99 (±0.59)
75 VBN	48.47 (±0.46)
50 VBN	46.43 (±0.51)
PCR	43.94 (±0.25)

Trend between VBN and VH when PCR was added to the bottles

- As more PCR was added the bottle weight dropped
- The drop in weight was more dramatic for both VH and VBN between 75% and 50% virgin material
- The 75% and 50% virgin bottles had a similar amount in weight lost as more PCR was added to the bottles
- 50% VH bottles weighed almost the same as PCR while 50% VBN bottles don't

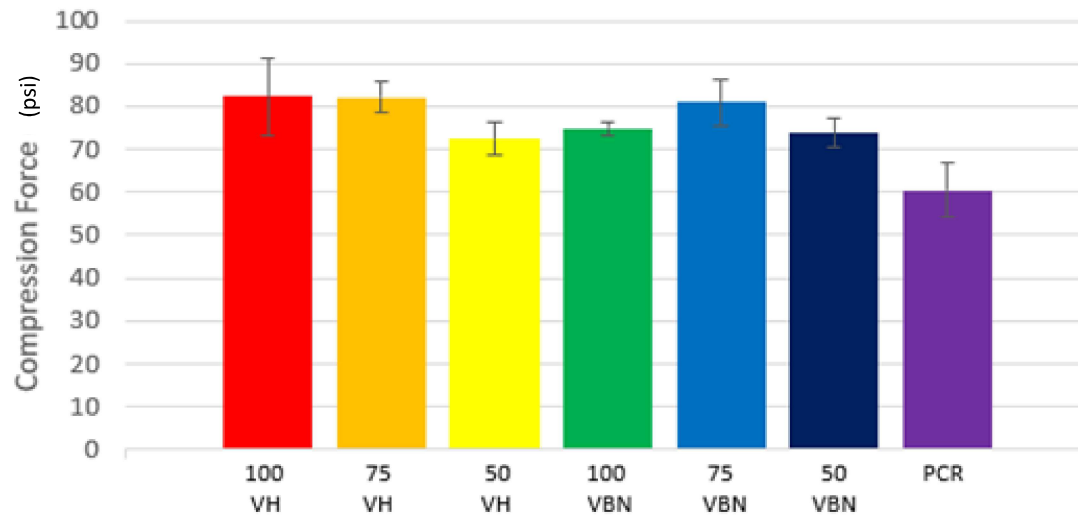
Results: Bottle Thickness



Sample	Average Wall Thickness (inches)
100 VH	0.0294 (±0.0112)
75 VH	0.0285 (±0.0104)
50 VH	0.0278 (±0.0093)
100 VBN	0.0304 (±0.0128)
75 VBN	0.0299 (±0.0119)
50 VBN	0.0287 (±0.0112)
PCR	0.0274 (±0.0113)

- A slight decrease in average part thickness as PCR content increased
 - Difference of 0.0016 inches from thickest to thinnest for VH (5.59%)
 - Difference of 0.0017 inches from thickest to thinnest for VBN (5.75%)
- Large standard deviation due to large variance in part thickness throughout circumference

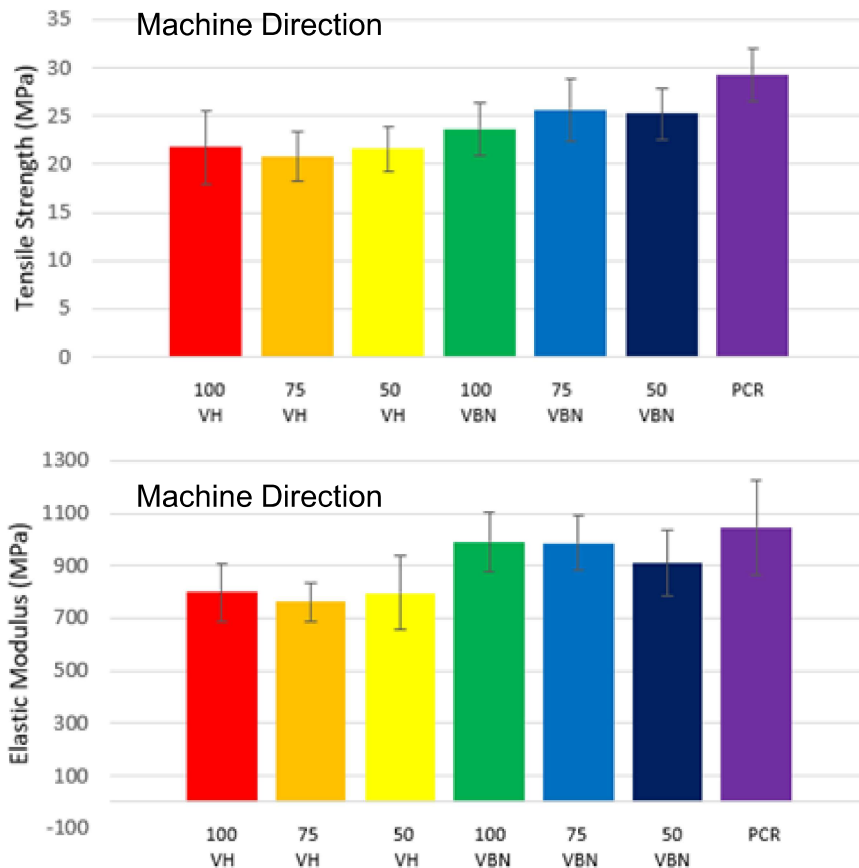
Results: Top Load Testing



Sample	Average Compression Force (psi)
100 VH	82.29 (± 8.92)
75 VH	82.10 (± 3.60)
50 VH	72.53 (± 3.85)
100 VBN	74.84 (± 1.70)
75 VBN	80.93 (± 5.40)
50 VBN	73.88 (± 3.46)
PCR	60.44 (± 6.26)

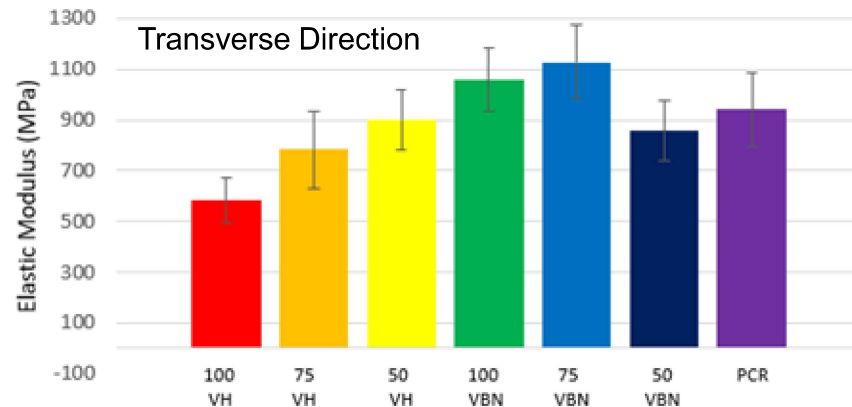
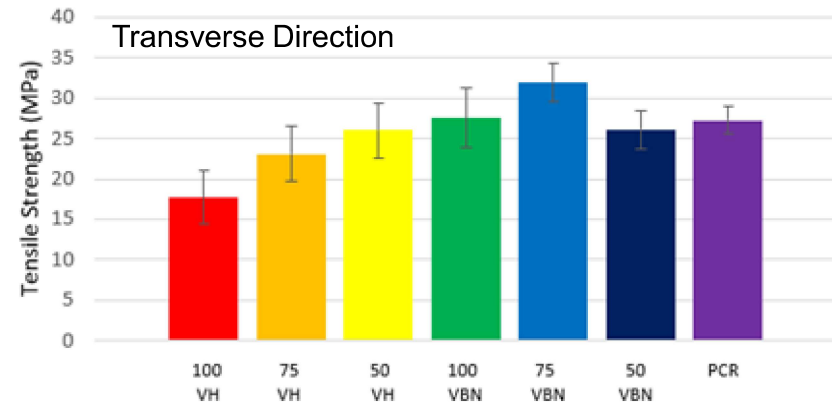
- The bottles that have the best compression strength were 100% VH, 75% VH, and 75% VBN.
 - 100% VH had an average compression force of 82.29 psi
 - 75% VH has an average compression force of 82.1 psi
 - 75% VBN has an average compression force of 82.1 psi

Tensile Testing – Machine Direction



Machine Direction		
Sample	Yield Strength (MPa)	Modulus (MPa)
100 VH	21.7 (±3.8)	798.2 (±108.0)
75 VH	20.8 (±2.6)	761.9 (±3.9)
50 VH	21.6 (±2.3)	797.2 (±139.0)
100 VBN	23.6 (±2.8)	990.8 (±113.7)
75 VBN	25.6 (±3.3)	987.0 (±105.7)
50 VBN	25.2 (±2.7)	910.3 (±123.6)
PCR	29.3 (±2.7)	1047.0 (±178.9)

Tensile Testing – Transverse Direction



Transverse Direction		
Sample	Yield Strength (MPa)	Modulus (MPa)
100 VH	17.7 (±3.3)	583.7 (±88.2)
75 VH	23.1 (±3.4)	783.0 (±153.6)
50 VH	26.0 (±3.4)	900.0 (±117.6)
100 VBN	27.6 (±3.6)	1057.9 (±125.4)
75 VBN	31.9 (±2.4)	1127.8 (±147.7)
50 VBN	26.1 (±2.4)	857.6 (±116.3)
PCR	27.3 (±1.7)	940.5 (±148.1)

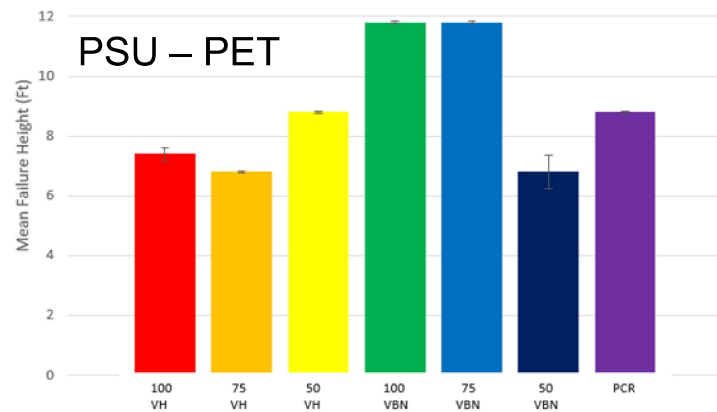
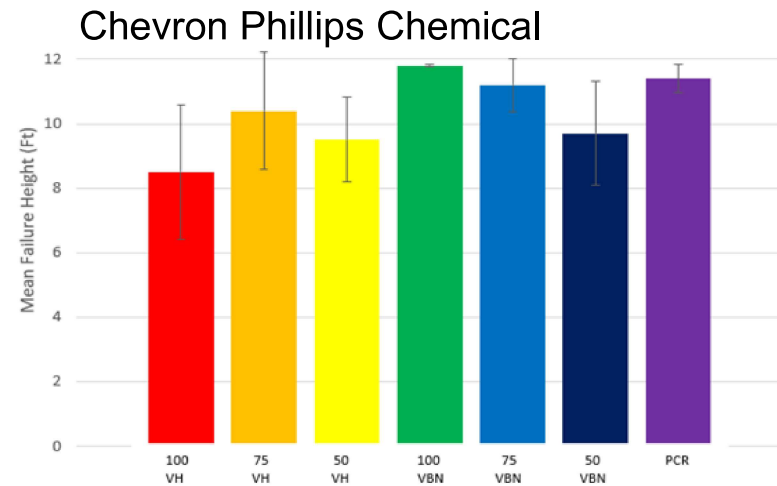
Results: Tensile Testing



- The reported values are the averages of the tensile modulus and strength for each virgin/PCR let down ratio
- We tested ten samples of each type of bottle in both the machine direction of flow and the transverse direction of flow
- PCR had the highest strength at yield (stress) and modulus (stiffness) in the machine direction, followed by 75 VBN and 50 VBN
- 75 VBN has the highest strength at yield (stress) and modulus (stiffness) in the transverse direction, followed closely by 100 VBN



Results: Chevron Phillips Chemical and PSU Drop Testing



Sample	Chevron Phillips Chemical Mean Failure Height (ft)	Pittsburg State University Mean Failure Height (ft)
100 VH	8.5 (±2.1)	7.4 (±0.2)
75 VH	10.4 (±1.8)	6.8 (±0.03)
50 VH	9.5 (±1.3)	8.8 (±0.03)
100 VBN	11.8 (±0.03)	11.8 (±0.03)
75 VBN	11.2 (±0.8)	11.8 (±0.03)
50 VBN	9.7 (±1.6)	6.8 (±0.6)
PCR	11.4 (±0.4)	8.8 (±0.03)

Results: Drop Testing

Chevron Phillips Chemical Drop Testing

- The bottle that survived the highest impact was 100% Virgin VBN (11.8 ft)
- VBN had an overall better impact strength
 - The 100% virgin bottle broke 3.3 Ft higher than 100% VH and 0.4 Ft higher than 100% PCR
 - 75% VBN broke 0.8 Ft higher than 75% VH
 - 50% VBN broke 0.2 Ft higher then 50% VH

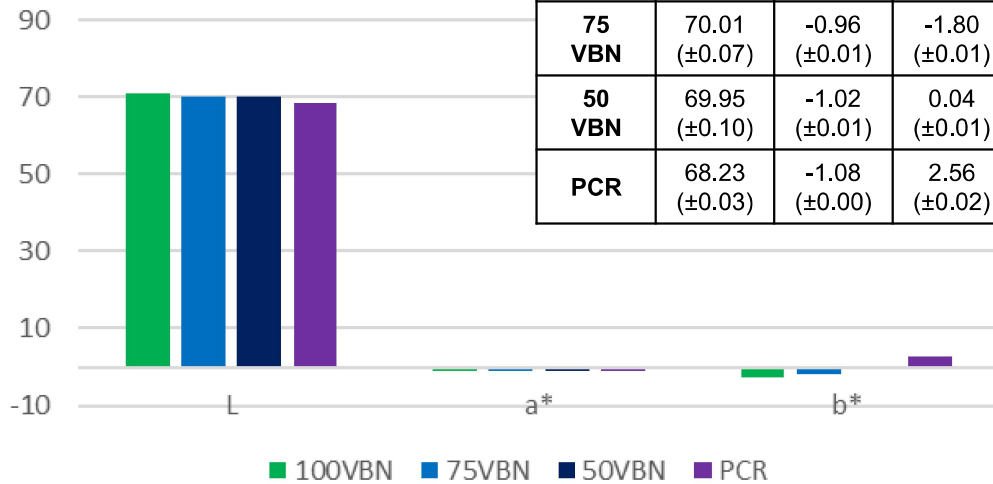
PSU Drop Testing

- The strongest bottles were 100% and 75% VBN (11.8 ft)
- VBN has the strongest bottles at 100% and 75% but not 50%
 - The 100% virgin bottle broke 4.4 Ft higher than 100% VH
 - The 100% virgin bottle broke 3 Ft higher than 100% PCR
 - 75% VBN broke 3.8 Ft higher than 75% VH
 - 50% VBN broke 1.2 Ft lower then 50% VH

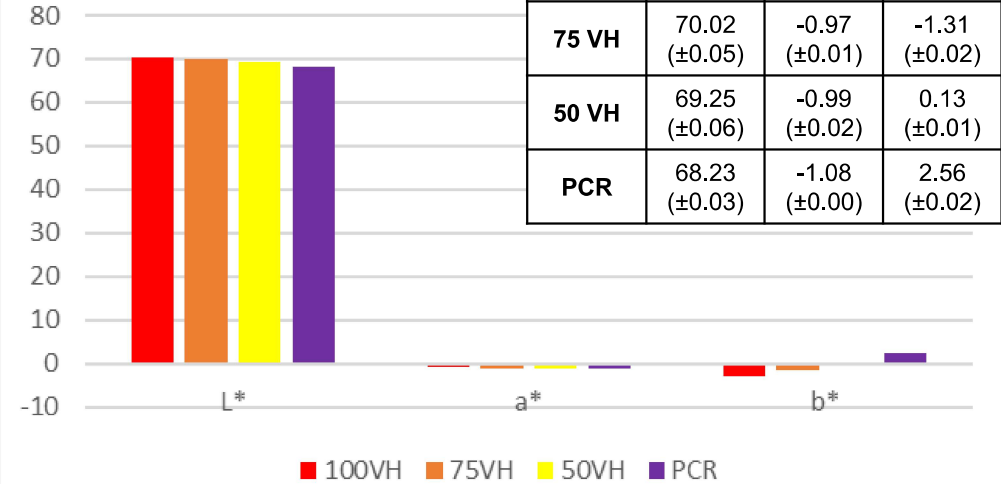


Results: Colorimetry

Sample	L*	a*	b*
100 VBN	70.94 (±0.11)	-0.99 (±0.01)	-2.88 (±0.06)
75 VBN	70.01 (±0.07)	-0.96 (±0.01)	-1.80 (±0.01)
50 VBN	69.95 (±0.10)	-1.02 (±0.01)	0.04 (±0.01)
PCR	68.23 (±0.03)	-1.08 (±0.00)	2.56 (±0.02)



Sample	L*	a*	b*
100 VH	70.27 (±0.01)	-0.88 (±0.01)	-2.77 (±0.02)
75 VH	70.02 (±0.05)	-0.97 (±0.01)	-1.31 (±0.02)
50 VH	69.25 (±0.06)	-0.99 (±0.02)	0.13 (±0.01)
PCR	68.23 (±0.03)	-1.08 (±0.00)	2.56 (±0.02)



- L* (+ white/- black), a* (+ red/- green), and b* (+ yellow/- blue)
- A decrease in the L* values show that bottles become darker as PCR content is added
- a* values decreased (bottles become greener) as PCR content increased
- b* values show the bottles become more yellow as PCR content is increased

Results: Environmental Stress Cracking Resistance

100 VBN		
Sample	Days	Hours
27	0	0
19	0	0
22	15	360
16	15	360
7	15	360
44	15	360
12	15	360
42	15	360
28	15	360
3	15	360
11	0	0
4	15	360
38	15	360
37	0	0
34	15	360

75 VBN		
Sample	Days	Hours
44	15	360
29	15	360
37	15	360
5	15	360
7	0	0
39	0	0
32	0	0
38	15	360
47	15	360
43	15	360
3	0	0
1	15	360
52	15	360
36	15	360
13	0	0

50 VBN		
Sample	Days	Hours
45	15	360
21	15	360
43	0	0
14	15	360
9	15	360
7	15	360
54	0	0
46	15	360
13	15	360
19	15	360
41	0	0
48	15	360
17	15	360
24	15	360
4	15	360

Legend
Failed Sealing**
Failed At Unknown Time
Pass
Fail

Failure Percentage (100 VH)**
0% (seal only)

Failure Percentage (75 VH)**
0% (seal only)

Failure Percentage (50 VBN)
20%

Results: Environmental Stress Cracking Resistance

100 VH		
Sample	Days	Hours
29	15	360
31	15	360
27	15	360
41	15	360
45	15	360
37	15	360
15	15	360
49	15	360
46	15	360
17	15	360
52	15	360
25	15	360
21	15	360
24	15	360
35	15	360

75 VH		
Sample	Days	Hours
33	15	360
16	15	360
53	15	360
36	15	360
23	15	360
47	15	360
24	15	360
43	15	360
15	15	360
19	15	360
31	15	360
28	15	360
45	15	360
48	15	360
37	15	360

50 VH		
Sample	Days	Hours
46	15	360
9	15	360
52	15	360
36	15	360
41	15	360
29	15	360
48	15	360
26	15	360
12	15	360
4	15	360
13	15	360
27	15	360
32	15	360
7	15	360
39	15	360

100% PCR		
Sample	Days	Hours
43	15	360
27	15	360
51	14.97	359.22
15	14.97	359.22
25	12.97	311.22
38	14.97	359.22
9	13.96	335.13
17	14.97	359.22
56	13.96	335.13
14	14.97	359.22
32	15	360
39	12.97	311.22
19	14.97	359.22
34	14.97	359.22
21	14.97	359.22

Legend
Failed Sealing
Failed At Unknown Time
Pass
Fail

Failure Percentage (100 VH)
0%

Failure Percentage (75 VH)
0%

Failure Percentage (50 VH)
0%

Failure Percentage (PCR)
80%

Environmental Stress Cracking Resistance

- Most bottles did not fail after 15 days
- Failure occurred at the seal
 - Cap failure issue
 - Inadequate sealing
- PCR had the most samples fail (80%)
- 50 VBN had the second highest failure (20%)
- There were no failures in the VH samples



Economic Study Parameters

- Material Cost

- Marlex 9512H: \$0.98/lb
- HHM 5202BN HDPE: \$1.05/lb
- KWR 101-150
 - \$2.00/lb
 - Assumed due to lack of information found online

- Process/Equipment

- Scope requested estimate for 2,000,000 parts annually
- Two blow molding machines are needed due to slow cycle times



- Packer

- Assumed packer hourly pay of \$15.00/hr

- Packaging

- 12 bottles/box
- \$1/box

- Electrical

- Energy cost per kW \$0.15

Economic Study – Results: Marlex® 9512H HDPE

100 VH (100% Virgin Resin)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.10	\$206,243.00
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$0.95	\$1,909,638.11

75 VH (75% Virgin/25% PCR)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.13	\$252,119.74
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$0.98	\$1,955,514.85

50 VH (50% Virgin/50% PCR)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.15	\$292,348.84
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$1.00	\$1,995,743.95

Economic Study – Results: Marlex® HHM 5202BN HDPE

100 VBN (100% Virgin Resin)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.11	\$226,855.57
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$0.97	\$1,930,250.68

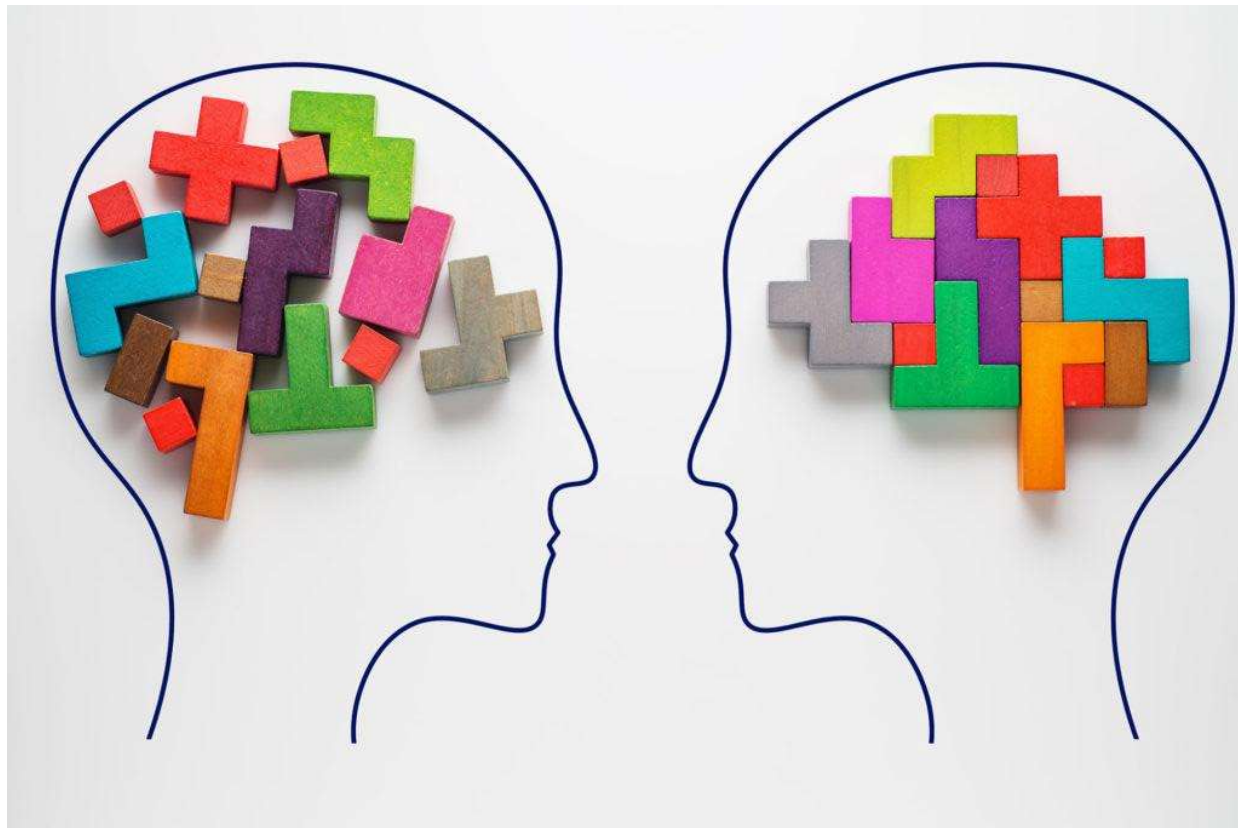
75 VH (75% Virgin/25% PCR)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.14	\$275,215.55
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$0.99	\$1,978,610.66

50 VH (50% Virgin/50% PCR)		
Price Summary	Per Part	Per Year
Material Cost per Part	\$0.16	\$312,263.51
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$1.01	\$2,015,658.62

Economic Study – Results: KWR 101-150 HDPE

Price Summary	Per Part	Per Year
Material Cost per Part	\$0.19	\$387,563.40
Machine, Labor, OH/Part	\$0.64	\$1,277,777.78
Other operations per Part	\$0.10	\$191,666.67
Packaging Cost per Part	\$0.08	\$166,666.67
Electrical Cost	\$0.03	\$67,284.00
Total Cost per Part	\$1.05	\$2,090,958.51

Conclusions



Conclusions



- We successfully molded 420 HDPE bottles with varied PCR content
- All experimental MFI values were lower than the data sheets reported values
- Thermal analysis showed similar degradation behavior in TGA
- Crystallinity as determined by DSC varied thusly: PCR>VBN>VH
- As PCR incorporation increased, bottle weight and thickness decreased
- A decrease in compression force was observed as PCR content increased
 - Marlex[®] HHM 5202BN was the exception
 - Compression force increased with increased % PCR content

Conclusions (continued)

- Tensile properties increased as PCR content increased
 - Yield strength and modulus in the transverse direction increased in all LDRs except for 50% PCR with Marlex[®] HHM 5202BN
 - In the machine direction, properties were comparable and no clear trend was observed
- A decrease in drop testing height was observed as PCR content increased
 - Marlex[®] 9512H with 25% PCR content was the exception
- Bottle color changed with PCR incorporation
 - Decreases in the L* values showing that bottles become darker as PCR content was added
 - Slight decrease in the a* values (greener) as PCR content increased
 - Slight increase in the b* (yellow) as PCR content increased
- ESCR testing
 - 100 VBN and 75 VBN showed failure at the seal
 - Failure in 20% of 50% VBN samples at an unknown time
 - VH samples had no failures
 - PCR had an 80% failure rate
- Marlex[®] HHM 5202BN performed better than Marlex[®] 9512H
- To meet the required 2 million parts per year, we would have to add another machine
 - Price per part ranges from \$0.95 to \$1.05 (100 VH – 100 PCR)
 - Based on assumed prices of resin

Summary of Results

Best Performing Bottles			
Properties	Marlex® 9512H	Marlex® HHM 5202BN	Overall
Compression Resistance	100%	75%	100%VH
Yield Strength (Machine)	100%	75%	75%VBN
Modulus (Machine)	100%	100%	100%VBN
Yield Strength (Transverse)	50%	75%	75%VBN
Modulus (Transverse)	50%	75%	75%VBN
Impact Resistance (Chevron Philips Chemical)	75%	100%	100%VBN
Impact Resistance (Pittsburg State University)	50%	100/75%	100/75%VBN
Environmental Stress Cracking Resistance	100%/75%/50%	100%	Any VH

Acknowledgements

- We gratefully acknowledge the following people and organizations for their support:
 - SPE Blow Molding Division, Board of Directors, and Executive Committee (Mike Misco, Chair)



- Justin Lumbley (Chevron Phillips Chemical)



- Chaitu Gogula (Arch Plastics Packaging)



Future Work with PET Students



Problem Statement:

- Determine the minimum possible weight achievable while balancing physical properties
 - Bottle to perform a minimum of a 5ft drop test
 - Bottle to achieve higher than target top load test
 - Bottle to exhibit similar ESCR properties of the original container weight
 - Projected annual volume: 10 million
- Current bottle cost structure vs the final lightweight bottle including:
 - Material (Marlex® HHM 5502BN Polyethylene)
 - Energy
 - Machinery
 - Labor
 - Packaging

Key Objectives:

- Establish a baseline bottle/process with a straight parison profile and test bottle performance
- Evaluate material grade selection effect on bottle performance
- Optimize material distribution using parison programming to determine the effect on top load
- Determine minimum required bottle weight to achieve a satisfactory bottle
- Analyze anticipated cost savings that result from producing a lighter weight bottle

General Blow Molding Updates at PSU:

Sport Bottle Production Service Project – July 2026

- Students & faculty produced 1,200 custom Sport Bottles for schools in Topeka, KS as part of a “Back to School Backpacks” project
- Bottles & Caps molded, silk-screened, assembled, and delivered
- Resins were supplied by Chevron Phillips Chemical



General Blow Molding Updates at PSU:

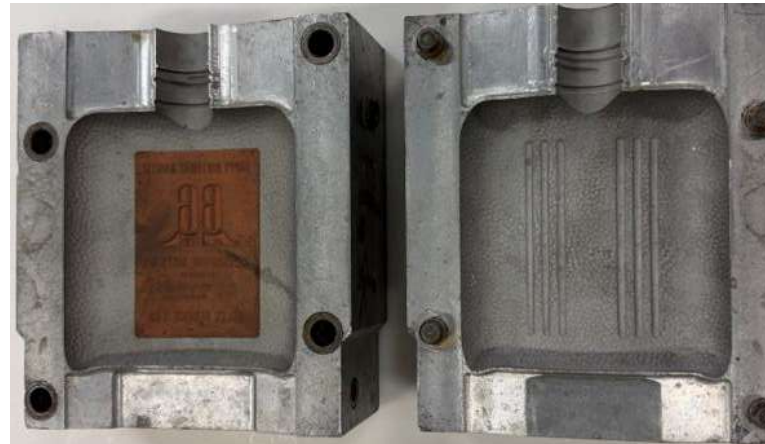
Design and Prove-out of Blow Molded Bottles with Inserts

Project Goals

- Successfully design a customizable insert for the current bottle mold
 - Insert design must be easily customizable
- Manufacture the designed insert and install in the mold
- Successfully mold bottles with the new insert
 - Use the Rocheleau R-4 blow-molder
 - Setting the tool
 - Changing out head tooling
 - Setting up a process

Project Benefits to Students

- Experience reverse engineering using and existing tooling
- Gain experience using design intent to design tooling that can be easily revised
- Gain experience using the blow molder



General Blow Molding Updates at PSU: Sidel SBO1 Lab – Reheat/Stretch/Blow Molder

- Machine donated by Pretium Packaging
- High-pressure air system installed
- Machine calibration and startup in September 2026
- Assistance provided by ProTech, LLC
- Production of 1.75 liter bottle achieved!
- Improvement tasks identified are being addressed

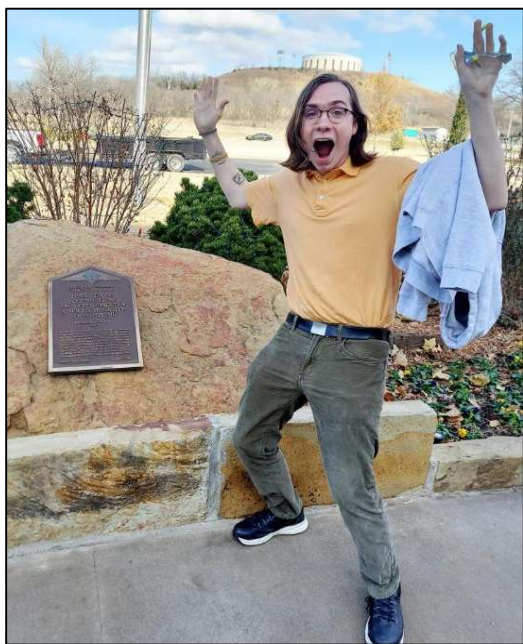


General Blow Molding Updates at PSU: Sidel SBO1 Lab – Reheat/Stretch/Blow Molder

- Improvement tasks identified
 - Nozzle Cylinder Rebuild?
 - Revise low pressure air supply connections
 - Reviewing mold/preform options
- Creation of Learning Materials/Activities
 - Safety, Preparation, and Setup
 - Startup and Operating Instructions
 - Pre-blow check
 - Wall thickness distribution – marked preform analysis
 - Create new Lab Manual content
 - Revisions incorporated into Processing II course in Spring 2027



? ? ? ? ? ? ? QUESTIONS?



Tyler Glass is very excited about visiting Chevron Phillips Chemical.



Dr. Gus T. Gorilla thanks you for your kind attention and is happy to take any questions you may have.

Jacob Culross is very proud of the first bottle he ever blow molded.



References

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