APPENDIX C

RECYCLED RESIN BLENDS
APPENDIX C – RECYCLED RESIN BLENDS

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.1</td>
<td>Introduction</td>
<td>C-4</td>
</tr>
<tr>
<td>C.2</td>
<td>Resins Used for Blending</td>
<td>C-4</td>
</tr>
<tr>
<td>C.3</td>
<td>Blends Made with Mixed Color PCR</td>
<td>C-6</td>
</tr>
<tr>
<td>C.4</td>
<td>Blends Made with Natural PCR</td>
<td>C-13</td>
</tr>
<tr>
<td>C.5</td>
<td>Blends Made with PIR-HD</td>
<td>C-18</td>
</tr>
<tr>
<td>C.6</td>
<td>The BAM Stress Crack Test Results</td>
<td>C-20</td>
</tr>
<tr>
<td>C.7</td>
<td>Resin Formulations for Pipe Trials</td>
<td>C-21</td>
</tr>
<tr>
<td>C.8</td>
<td>Conclusions</td>
<td>C-24</td>
</tr>
<tr>
<td>C.9</td>
<td>Summary Tables, Graphs, and Test Reports for Blends Made with Mixed-Color, Post-Consumer, Recycled HDPE</td>
<td>C-25</td>
</tr>
<tr>
<td>C.10</td>
<td>Summary Tables, Graphs, and Test Reports for Blends Made with Natural, Post-Consumer, Recycled HDPE</td>
<td>C-93</td>
</tr>
<tr>
<td>C.11</td>
<td>Summary Tables, Graphs, and Test Reports for Blends Made with Post-Industrial, Recycled HDPE</td>
<td>C-154</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

C-1 The Effect of Recycled Content on Yield Strength on Blends of Virgin Pipe Resins and Mixed Color PCR-HDPE ................................................................. C-7
C-2 The Effect of Recycled Content on Break Strain on Blends of Virgin Pipe Resins and Mixed Color PCR-HDPE ................................................................. C-8
C-3 The Effect of Recycled Content on the 15% NCTL on Blends of Virgin Pipe Resins and Mixed Color PCR-HDPE ................................................................. C-9
C-4 The Effect of Recycled Content on the Yield Strength of Blends of Virgin Pipe Resins and Natural PCR-HDPE ................................................................. C-13
C-5 The Effect of Recycled Content on the Breaking Strain of Blends of Virgin Pipe Resins and Natural PCR-HDPE ................................................................. C-15
C-6 The Effect of Recycled Content on the 15% NCTL of Blends of Virgin Pipe Resins and Natural PCR-HDPE ................................................................. C-16

LIST OF TABLES

C-1 Component Resins for Blend Preparation .................................................... C-4
C-2 Component Resins for Blending Properties ................................................ C-5
C-3 Correlation Coefficients (R²) from Blend Plots found in Section C.8 .......... C-11
C-4 Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A ................................................................. C-12
C-5 Correlation Coefficients (R²) from Blend Plots found in Section C.9 ........ C-17
C-6 Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A ................................................................. C-18
C-7 Correlation Coefficients (R²) from Blend Plots found in Section C.10 .... C-20
C-8 Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A ................................................................. C-20
C-9 BAM Test Results Under 580 psi at 80°C in Deionized Water .................. C-22
C-10 Resins for Pipe Formulations ................................................................. C-23
C-11 Proposed Formulations for Pipe ............................................................. C-24
C-12 Predicted Properties of Pipe Formulations ............................................. C-24
C.1 INTRODUCTION

The results from Phase I of the project (Recycled Polyethylene Resins) showed that recycled HDPE had properties that were below the established limits of AASHTO approved pipe. Therefore, the percentage of recycled that can be blended with pipe resin will be limited by the properties. Efforts were undertaken to determine what those limits were and to also enhance the properties of recycled HDPE by blending it with non-pipe virgin resins such as LLDPE and LMDPE. A secondary, but important objective was to determine the relationships between the percentage component in a blend and the resulting blend’s properties.

C.2 RESINS USED FOR BLENDING

The identities and a brief description of all the resins used during the blending study are given in Table C-1.

Table C-1 - Component Resins for Blend Preparation

<table>
<thead>
<tr>
<th>Resin</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin Resin 1</td>
<td>VR1</td>
<td>PPI certified AASHTO HDPE pipe resin.</td>
</tr>
<tr>
<td>Virgin Resin 2</td>
<td>VR2</td>
<td>PPI certified AASHTO HDPE pipe resin.</td>
</tr>
<tr>
<td>Virgin Resin 3</td>
<td>VR3</td>
<td>PPI certified AASHTO HDPE pipe resin.</td>
</tr>
<tr>
<td>Virgin LLDPE</td>
<td>LLDPE</td>
<td>Commercial linear low density polyethylene resin from a supplier that makes AASHTO pipe resin.</td>
</tr>
<tr>
<td>Virgin LMDPE</td>
<td>MDPE</td>
<td>Commercial linear medium density polyethylene resin from a supplier that makes AASHTO pipe resin.</td>
</tr>
<tr>
<td>Mixed Color PCR 1</td>
<td>MCR1</td>
<td>Mixed-color post-consumer reprocessed HDPE pellets composed of colored and natural bottles.</td>
</tr>
<tr>
<td>Mixed Color PCR 2</td>
<td>MCRG</td>
<td>Mixed-color post-consumer regrind HDPE chips composed of colored and natural bottle.</td>
</tr>
<tr>
<td>Natural PCR</td>
<td>NAT</td>
<td>Post consumer reprocessed HDPE pellets made from milk, juice, and water bottles.</td>
</tr>
<tr>
<td>Natural PCR + 10% LLDPE</td>
<td>N10LL</td>
<td>Blend of NAT with 10% LLDPE to enhance the properties of the NAT.</td>
</tr>
<tr>
<td>Natural PCR + 35% LLDPE</td>
<td>N35LL</td>
<td>Blend of NAT with 35% LLDPE to enhance the properties of the NAT.</td>
</tr>
<tr>
<td>PIR Low Density</td>
<td>PIR-LD</td>
<td>Post industrial low density polyethylene reprocessed pellets believed to contain mostly film and bags.</td>
</tr>
<tr>
<td>PIR Medium Density</td>
<td>PIR-MD</td>
<td>Post industrial linear medium density polyethylene regrind chips from the sheet market.</td>
</tr>
<tr>
<td>PIR High Density</td>
<td>PIR-HD</td>
<td>Blend of PCR high density bottles with PIR polyethylene.</td>
</tr>
</tbody>
</table>
A few selected properties of these resins are shown in Table C-2. The average values will be used in the next chapter for blend optimization for pipe.

Table C-2 - Component Resins for Blending Properties

<table>
<thead>
<tr>
<th>Resin</th>
<th>Date Tested</th>
<th>Density (g/cm³)</th>
<th>Yield Stress (psi)</th>
<th>Break Strain (%)</th>
<th>15% NCTL (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-2-07</td>
<td>0.947</td>
<td>3627 ± 85</td>
<td>468 ± 28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-25-07</td>
<td>0.955</td>
<td>3882 ± 60</td>
<td>483 ± 86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-19-07</td>
<td>0.949</td>
<td>3555 ± 28</td>
<td>484 ± 22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.950</strong></td>
<td><strong>3688 ± 58</strong></td>
<td><strong>478 ± 45</strong></td>
<td><strong>45.8 ± 2.5</strong></td>
</tr>
<tr>
<td>VR2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-2-07</td>
<td>0.949</td>
<td>3805 ± 54</td>
<td>624 ± 58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-11-07</td>
<td>0.956</td>
<td>3936 ± 51</td>
<td>694 ± 53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-25-07</td>
<td>0.956</td>
<td>4026 ± 35</td>
<td>606 ± 108</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-28-07</td>
<td>0.952</td>
<td>4021 ± 57</td>
<td>675 ± 164</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-5-07</td>
<td>0.952</td>
<td>3834 ± 95</td>
<td>595 ± 109</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.953</strong></td>
<td><strong>3924 ± 58</strong></td>
<td><strong>639 ± 98</strong></td>
<td><strong>38.5 ± 3</strong></td>
</tr>
<tr>
<td>VR3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-2-07</td>
<td>0.950</td>
<td>3640 ± 72</td>
<td>634 ± 81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-25-07</td>
<td>0.949</td>
<td>3804 ± 49</td>
<td>667 ± 96</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-10-07</td>
<td>0.949</td>
<td>3849 ± 35</td>
<td>641 ± 72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.949</strong></td>
<td><strong>3764 ± 52</strong></td>
<td><strong>647 ± 83</strong></td>
<td><strong>36.2 ± 2.5</strong></td>
</tr>
<tr>
<td>LLDPE</td>
<td>2-07-08</td>
<td><strong>0.919</strong></td>
<td><strong>1616 ± 19</strong></td>
<td><strong>771 ± 94</strong></td>
<td></td>
</tr>
<tr>
<td>MDPE</td>
<td>2-07-08</td>
<td><strong>0.934</strong></td>
<td><strong>2732 ± 24</strong></td>
<td><strong>645 ± 49</strong></td>
<td></td>
</tr>
<tr>
<td>MCR1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-9-07</td>
<td>0.960</td>
<td>3685 ± 49</td>
<td>46 ± 24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-11-07</td>
<td>0.960</td>
<td>3556 ± 124</td>
<td>79 ± 30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.960</strong></td>
<td><strong>3620 ± 86</strong></td>
<td><strong>62.5 ± 27</strong></td>
<td><strong>7.6 ± 1</strong></td>
</tr>
<tr>
<td>MCRG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3-19-07</td>
<td>0.960</td>
<td>3441 ± 47</td>
<td>158 ± 35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-16-07</td>
<td>0.960</td>
<td>3613 ± 69</td>
<td>171 ± 26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.960</strong></td>
<td><strong>3527 ± 58</strong></td>
<td><strong>164 ± 30</strong></td>
<td><strong>7.6 ± 1</strong></td>
</tr>
<tr>
<td>NAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-13-07</td>
<td>0.960</td>
<td>4489 ± 50</td>
<td>229 ± 78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-21-07</td>
<td>0.959</td>
<td>4564 ± 62</td>
<td>313 ± 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-22-07</td>
<td>0.960</td>
<td>4523 ± 14</td>
<td>365 ± 206</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AVG</td>
<td><strong>0.960</strong></td>
<td><strong>4525 ± 42</strong></td>
<td><strong>302 ± 115</strong></td>
<td><strong>2.3 ± 0</strong></td>
</tr>
</tbody>
</table>
C.3 BLENDS MADE WITH MIXED COLOR PCR

A total of 29 blends were prepared with the use of Mixed Color PCR bottle resin. They included:

VR1 + MCR1 @ 20, 40, 60 and 80%,
VR1 + MCRG @ 20, 40, 60 and 80%,
VR2 + MCR1 @ 20, 40, 60 and 80%,
VR3 + MCR1 @ 20, 40, 60 and 80%,
MCRG + MDPE @ 25, 50 and 75%,
MCR1 + MDPE @ 25, 50 and 75%,
MCRG + PIR-MD @ 25, 50 and 75%,
75% MCR1 + 25% PIR-HD, and
50% VR3 + 25% MDPE + 25% MCR1.

The effect of recycled content on the yield strength for four blends of virgin pipe resins with mixed-colored PCR are shown in Figure C-1.
It is fairly clear from these graphs that the yield strength is a linear function with respect to recycled content. That means that a simple mixing equation can be used to approximate the yield strength of a blend. This information will allow one to blend different resins to make sure that the resulting blend always stays within the specified yield strength requirements. The correlations are not always good, but this is likely caused by the combination of the two blend components not being too far apart in strength and the higher scatter found with recycled materials.

Similar plots are shown for the breaking strain in Figure C-2. Notice that these are even farther away from the theoretical line, and the scatter in the results is quite high. This is a reflection of the contaminants found in PCR resins and demonstrates the need to control contamination.
Figure C-2 - The Effect of Recycled Content on Break Strain on Blends of Virgin Pipe Resins and Mixed Color PCR-HDPE

Plots of the NCTL stress crack resistance determined at 15% of the yield strength are shown in Figure C-3. In this case, the curves are obviously exponential in nature and the match between theoretical and actual is much better.

Section C.8 contains summary tables for all the blends made with PCR-MCR, plots of properties versus % recycled, and individual property reports for the 29 blends. Examination of the results reveals that the all the properties change in either a linear or an exponential manner. More specifically, all the property changes are linear except for the melt index (both loads) and the stress crack resistance. This is powerful information because the properties of blends can be predicted based on these relationships. On the other hand, some of the inherent scatter found in certain properties makes such predictions unreliable. However, it is believed that the relationships can be used as a guide for preparing blends with the understanding that actual blend testing will still be required.
Figure C-3 - The Effect of Recycled Content on the 15% NCTL on Blends of Virgin Pipe Resins and Mixed Color PCR-HDPE

There is a great deal of information in Section C.8. One way to summarize it is through an examination of the best-fit lines or curves, which are shown on each plot. The correlation coefficient ($R^2$) shows how well the data fit the line or exponential curve, and the Y-intercept is the predicted value for the first component in a two component blend. So, how far $R^2$ is from unity and how close the predicted value is to a measured value show both the quality of the fit, and how accurate the line or curve is.

Tables C-3 and C-4 are summaries of the $R^2$ values and how close the y-intercepts are to the measured values for the blends in Section C.8.

The shaded values are those values that are below 0.80. The low correlations in the Density and Melt Index seem to be outliers since all the other correlations are excellent. The low values seen in the Yield Stress and Break Strain occur more often and are believed to be representative of the samples tested. It’s clear from these data that the break strain shows the poorest correlation. This is most likely caused by the presence of contamination in the recycled resins. Any inhomogeneity can cause an early break in a tensile test, and would also tend to flatten the slope and increase the scatter in a series of samples.

Table C-4 shows the inaccuracies of the relationships described by the lines or curves.

NCHRP 04-32  C-9
Table C-3 - Correlation Coefficients ($R^2$) from Blend Plots found in Section C.8

<table>
<thead>
<tr>
<th>Blend</th>
<th>Density</th>
<th>Melt Index</th>
<th>Ash</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR1 + MCR1</td>
<td>0.963</td>
<td>0.994</td>
<td>0.972</td>
<td>0.844</td>
<td>0.700</td>
<td>0.994</td>
</tr>
<tr>
<td>VR1 + MCRG</td>
<td>0.882</td>
<td>0.995</td>
<td>0.999</td>
<td></td>
<td>0.608</td>
<td>0.979</td>
</tr>
<tr>
<td>VR2 + MCR1</td>
<td>0.953</td>
<td>0.985</td>
<td>0.997</td>
<td>0.956</td>
<td>0.985</td>
<td>0.965</td>
</tr>
<tr>
<td>VR3 + MCR1</td>
<td>0.085</td>
<td>0.990</td>
<td>0.999</td>
<td></td>
<td>0.605</td>
<td>0.954</td>
</tr>
<tr>
<td>MCRG + MDPE</td>
<td>0.973</td>
<td>0.987</td>
<td>0.996</td>
<td>0.933</td>
<td>0.992</td>
<td>0.962</td>
</tr>
<tr>
<td>MCR1 + MDPE</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.982</td>
<td>0.838</td>
<td>0.999</td>
</tr>
<tr>
<td>MCRG + PIRMD</td>
<td>0.987</td>
<td>0.250</td>
<td>0.986</td>
<td>0.984</td>
<td>0.897</td>
<td>0.999</td>
</tr>
</tbody>
</table>
Table C-4 - Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A

<table>
<thead>
<tr>
<th>Blend</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y-Inter</td>
<td>Measured</td>
<td>% Diff</td>
</tr>
<tr>
<td>VR1 + MCR1</td>
<td>3934</td>
<td>3688</td>
<td>+6.7</td>
</tr>
<tr>
<td>VR1 + MCRG</td>
<td>3564</td>
<td>3688</td>
<td>-3.4</td>
</tr>
<tr>
<td>VR2 + MCR1</td>
<td>3886</td>
<td>3924</td>
<td>-1.0</td>
</tr>
<tr>
<td>VR3 + MCR1</td>
<td>3779</td>
<td>3764</td>
<td>&lt;1</td>
</tr>
<tr>
<td>MCRG + MDPE</td>
<td>3619</td>
<td>3527</td>
<td>+2.6</td>
</tr>
<tr>
<td>MCR1 + MDPE</td>
<td>3695</td>
<td>3620</td>
<td>+2.1</td>
</tr>
<tr>
<td>MCRG + PIRMD</td>
<td>3720</td>
<td>3527</td>
<td>+5.5</td>
</tr>
</tbody>
</table>
These results also show that the break strain values are not going to be accurate when contaminants are involved. One must be aware that the contaminants are going to reduce the expected elongation at break. The NCTL values are very different than predicted for three sets of results. The first one actually predicts a better resistance that the measured values. There is no obvious explanation for this except perhaps testing errors. The NCTL test is complicated and there are a variety of small errors that can lead to larger values. That is why the tests’ interlaboratory scatter can be higher than 40%.

The other two large inaccuracies involve samples with MDPE in them. MDPE has a 15% NCTL time of thousands of hours, so it should not be surprising that it’s difficult to accurately predict down to 8 hours time. In spite of some alarming scatter and prediction inaccuracies, overall the results show that trends do occur in predictable manners.

The results of the blending and testing with mixed color PCR HDPE have produced the following findings.

1. The maximum amount of mixed color PCR that can be blended with one of the pipe resins and meet 24 hours of stress crack resistance is about 20%. And, since the 15% NCTL is less aggressive than the NCLS test, a conservative number is closer to 15%.

2. At 15% added MCR, all the AASHTO requirements of pipe would be met.

3. The two different batches of mixed color PCR (MCR1, MCRG) behaved dramatically different. The latter produced much better correlation to theory and had a much higher break strain, suggesting that there were fewer contaminants in the sample.

4. The difference between the predicted and actual values of % strain-at-break might be used to evaluate the level of contamination in the recycled material.

5. Much greater stress crack resistance may be required to offset the deleterious effects of contamination.

6. The stress crack resistance can be dramatically improved by the addition MDPE to the mixed color PCR. A 50:50 blend would produce a resin with about 200 hours in the 15% NCTL test. The yield stress would be reduced to about 3250 psi, so this must be kept in balance to maintain adequate pipe stiffness.

7. The PIR-MD evaluated also improved the resistance to cracking, but not as much as the virgin MD.
C.4 BLENDs Made with Natural PCR

There were 27 blends made with natural PCR HDPE. They included:

VR2 + NAT @ 20, 40, 60 and 80%,
NAT + LLDPE @ 20, 40, 60 and 80%,
NAT + MDPE @ 20, 40, 60 and 80%,
VR1 + N10LL @ 20, 40, 60 and 80%,
VR2 + N10LL @ 20, 40, 60 and 80%,
VR1 + N35LL @ 20, 40, 60 and 80%,
50% NAT + 50% MDPE,
65% NAT + 35% PIR-LD, and
50% VR3 + 25% MDPE + 25% NAT.

The effect of recycled content on the yield strength for four blends of virgin pipe resins with natural PCR are shown in Figure C-4.
The N10LL and N35LL are natural PCR with added LLDPE at 10 and 35% by weight. The correlation coefficients for the lines and the agreement between the actual and theoretical are poor.

Similar plots for the breaking strain and the 15% NCTL stress crack resistance are shown in Figures C-5 and C-6.

Figure C-5 - The Effect of Recycled Content on the Breaking Strain of Blends of Virgin Pipe Resins and Natural PCR-HDPE
Figure C-6 - The Effect of Recycled Content on the 15% NCTL of Blends of Virgin Pipe Resins and Natural PCR-HDPE

Section C.9 contains summary tables for the blend series, plots of properties versus % recycled, and individual property reports for the 27 blends. Identical tables to Tables C-3 and C-4 are shown for these materials in Tables C-5 and C-6.

The poor correlation in the break strain for the NAT + LLDPE series is easily explained by contaminants. The NAT itself has a coefficient of variation of 38%, which is carried over into the blends with low amounts of LLDPE. The COVs for 5, 10 and 20% LLDPE were 33, 38, and 25% respectively. Interestingly, the series of NAT with MDPE also have high scatter, but the averages happen to fall in line so it doesn’t present as dramatically as the NAT + LL results. The COVs for 20 and 40% MDPE were 36 and 28%.
Table C-5 - Correlation Coefficients ($R^2$) from Blend Plots found in Section C.9

<table>
<thead>
<tr>
<th>Blend</th>
<th>Density</th>
<th>Melt Index</th>
<th>Flow Ratio</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR2 + NAT</td>
<td>0.896</td>
<td>0.980</td>
<td>0.977</td>
<td>0.913</td>
<td>0.866</td>
<td>0.983</td>
</tr>
<tr>
<td>NAT + LLDPE</td>
<td>0.980</td>
<td>0.938</td>
<td>0.999</td>
<td>0.999</td>
<td>0.704</td>
<td>0.977</td>
</tr>
<tr>
<td>NAT + MDPE</td>
<td>0.924</td>
<td>0.995</td>
<td>0.999</td>
<td>0.998</td>
<td>0.963</td>
<td>0.989</td>
</tr>
<tr>
<td>VR1 + N10LL</td>
<td>0.968</td>
<td>0.989</td>
<td>0.994</td>
<td>0.215</td>
<td>0.861</td>
<td>0.651</td>
</tr>
<tr>
<td>VR2 + N10LL</td>
<td>0.600</td>
<td>0.955</td>
<td>0.980</td>
<td>0.015</td>
<td>0.025</td>
<td>0.971</td>
</tr>
<tr>
<td>VR1 + N35LL</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.976</td>
<td>0.452</td>
<td>0.930</td>
</tr>
</tbody>
</table>
Table C-6 - Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A

<table>
<thead>
<tr>
<th>Blend</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y-Inter</td>
<td>Measured</td>
<td>% Diff</td>
</tr>
<tr>
<td>VR2 + NAT</td>
<td>4116</td>
<td>3924</td>
<td>+4.9</td>
</tr>
<tr>
<td>NAT + LLDPE</td>
<td>4318</td>
<td>4525</td>
<td>-4.6</td>
</tr>
<tr>
<td>NAT + MDPE</td>
<td>4355</td>
<td>4525</td>
<td>-3.7</td>
</tr>
<tr>
<td>VR1 + N10LL</td>
<td>3905</td>
<td>3688</td>
<td>+5.9</td>
</tr>
<tr>
<td>VR2 + N10LL</td>
<td>4062</td>
<td>3924</td>
<td>+3.5</td>
</tr>
<tr>
<td>VR1 + N35LL</td>
<td>3800</td>
<td>3688</td>
<td>+3.0</td>
</tr>
</tbody>
</table>
The results of the blending and testing with natural PCR HDPE have produced the following findings.

1. Only about 10% of natural PCR HDPE can be added to virgin pipe resins and meet a 15% NCTL time of 24 hrs. However, the yield will be over 4000 psi, so the NCLS test will be less severe for this blend. That means that the limit might be closer to 15%.

2. Dramatic improvements in stress crack resistance can be obtained by blending the NAT with either LLDPE or MDPE. A failure time of 50 hrs in the 15% NCTL test can be obtained with around 45% of added LL and 55% of added MD.

3. Blends between NAT and MDPE are preferred because the yield stress remains higher for the MD blends. For example, the yield stress for 45% LL is around 2900 psi, while the yield stress for 55% MD is around 3400 psi. The AASHTO minimum density requirement for pipe resins is 0.948 g/cm³, which correlates to a yield stress of around 3500 psi.

4. The addition of only 10% LLDPE does very little to improve the properties of resulting blends.

5. A blend of 50% VR3, 25% NAT and 25% MDPE has properties very close to a PPI certified pipe resin.

### C.5 BLENDS MADE WITH PIR-HD

A total of 12 blends were prepared with post-industrial HDPE. Section C.9 contains summary tables for the blend series, plots of properties versus % recycled, and individual property reports for the 12 blends. Tables containing correlation coefficients and predicted versus measured properties are found in Tables C-7 and C-8.

The Blends were:

VR1 + PIR-HD @ 20, 40, 60 AND 80%,
VR2 + PIR-HD @ 20, 40, 60 AND 80%,
VR3 + PIR-HD @ 20, 40, 60 AND 80%. 
Table C-7 - Correlation Coefficients ($R^2$) from Blend Plots found in Section C.10

<table>
<thead>
<tr>
<th>Blend</th>
<th>Density</th>
<th>Melt Index</th>
<th>Color +Ash</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR1 + PIR-HD</td>
<td>0.890</td>
<td>0.996</td>
<td>0.999</td>
<td>0.931</td>
<td>0.933</td>
<td>0.918</td>
</tr>
<tr>
<td>VR2 + PIR-HD</td>
<td>0.966</td>
<td>0.164</td>
<td>0.999</td>
<td>0.994</td>
<td>0.101</td>
<td>0.888</td>
</tr>
<tr>
<td>VR3 + PIR-HD</td>
<td>0.985</td>
<td>0.880</td>
<td>0.999</td>
<td>0.897</td>
<td>0.592</td>
<td>0.841</td>
</tr>
</tbody>
</table>

Table C-8 - Percentage Difference Between Y-Intercepts from Blend Plots and Measured Values for Component A

<table>
<thead>
<tr>
<th>Blend</th>
<th>Yield Stress</th>
<th>Break Strain</th>
<th>15% NCLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y-Inter</td>
<td>Measured</td>
<td>% Diff</td>
</tr>
<tr>
<td>VR1 + PIR-HD</td>
<td>3821</td>
<td>3688</td>
<td>+3.6</td>
</tr>
<tr>
<td>VR2 + PIR-HD</td>
<td>3907</td>
<td>3924</td>
<td>&lt;1</td>
</tr>
<tr>
<td>VR3 + PIR-HD</td>
<td>3690</td>
<td>3764</td>
<td>-2.0</td>
</tr>
</tbody>
</table>
This series behaved more predictably. The PIR-HD had 3.9% color + ash but also a high break strain of 720%. The average yield stress of 3157 psi suggests its true density is around 0.943 g/cm³ and its 15% NCTL time is around 98 hours. This is a very good resin for blending because it seems to lack the type of contamination that produced the high scatter in the other blends. The low R² values in the table were due to the closes in the values of c the VR2 and PIR-HD. The melt indices were 0.33 and 0.30 g/10 min and the break strains were 595 and 612%.

The results of blending and testing with PIR-HD have led to the following findings.

1. This PIR resin is apparently void of the contaminants found in PCR bottles that create high scatter in some properties, particularly break strain.

2. A resin with a base density of around 0.943 g/cm³ is an excellent resin for blending because it has a yield stress of around 3150 psi and stress crack resistance around 100 hrs.

3. These test results served to validate the relationships found in the other blends.

4. Blends of virgin resins containing up to 40% PIR-HD had yield stresses around 3500 psi, break strains above 550% and 15% NCTL times greater than 40 hrs. This blend would meet the resin properties found in AASHTO M294 for pipe.

C.6 THE BAM STRESS CRACK TEST RESULTS

The BAM test is a stress crack test that is run at 80°C on samples that are 0.5 in wide, by 6 in long, and is performed without a notch. The test is similar to the hydrostatic burst test for pipe. There is no flaw in either test and the test specimen fails at a location of the largest defect. The BAM test is complimentary to the NCLS or NCTL tests. Polyethylene resins have an inherent resistance to cracking. The notched tests basically measure the crack growth rate when a crack is initiated at a controlled flaw. The BAM test creates a situation where the specimen fails at the most significant flaw. Previous work by the PI showed that as the NCTL times grew longer, materials were better able to accommodate flaws. So, both the notched value and the BAM results are important for long-term durability. A more complete description of the BAM test is found in Appendix A, Section A.3.2. The results generated for the blends containing recycled were generated under an applied stress of 580 psi, at 80°C in deionized water.

The results on the blends that were tested are found in Table C-9 along with there break strain.
Table C-9 - BAM Test Results Under 580 psi At 80°C in Deionized Water

<table>
<thead>
<tr>
<th>Sample</th>
<th>BAM Failure Time (hrs)</th>
<th>% Strain-at-Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR1</td>
<td>&gt;268 ± 38</td>
<td>465 ± 88</td>
</tr>
<tr>
<td>VR2</td>
<td>&gt;300 ± 97</td>
<td>625 ± 118</td>
</tr>
<tr>
<td>VR3</td>
<td>&gt;267 ± 47</td>
<td>575 ± 144</td>
</tr>
<tr>
<td>VR3 + 20% MCR1</td>
<td>87 ± 33</td>
<td>461 ± 65</td>
</tr>
<tr>
<td>VR2 + 20% NAT</td>
<td>93 ± 32</td>
<td>534 ± 120</td>
</tr>
<tr>
<td>50% VR3 + 25% MD + 25% MCRG1</td>
<td>&gt;300</td>
<td>601 ± 107</td>
</tr>
<tr>
<td>50% VR3 + 25% MD + 25% NAT</td>
<td>&gt;206 ± 89</td>
<td>631 ± 188</td>
</tr>
<tr>
<td>VR3 + 40% PIR-HD</td>
<td>&gt;242 ± 100</td>
<td>643 ± 97</td>
</tr>
<tr>
<td>50% VR3 + 25% MD + 25% MCRG2</td>
<td>40 ± 26</td>
<td>331 ± 145</td>
</tr>
</tbody>
</table>

1 - Some specimens exceeded 300 hrs
2 - 10 replicates

Notice that the virgin resins and several of the blends exceeded 200 hours in the test. This is very encouraging since this test should be a good model for potential cracks in the field. Secondly, notice that the binary blends with 20% MCR1 and NAT had times close to 100 hours. These will help establish the minimum times when pipe is made. And finally, notice the last sample tested had MCRG2 in it. This was a recent batch of regrind that was obtained and apparently had more silicone rubber than had been seen before. This became obvious by examining the edges of the BAM test specimens that had been shaved. One could see rubber particles present along the edge. Not surprisingly, the BAM stress crack resistance was poor. The break strain was also tested to see if there was a correlation with the BAM results. There may not be enough data here to say for sure, but it appears as if there is a relationship. Regardless, anything one can do to reduce the presence of contaminants should improve the results of both the stress crack resistance and the breaking strain.

C.7 RESIN FORMULATIONS FOR PIPE TRIALS

The last task in this phase of the project is to evaluate all the data generated and to select up to 10 blends for making trial corrugated pipe in at least 2 different pipe manufacturing plants. In an
effort to simplify the process, the focus will be on one virgin resin, and only PCR natural and mixed color resins. It is recognized that there are some differences between virgin resins, and that there are excellent PIR resins available. The main issue with the PIR is that it is difficult to find consistent supplies. It should also be mentioned again that this study has been limited by trying to add recycled to a virgin pipe resin with limited stress crack resistance. Better resins and resin blends are available with more than 100 hrs of stress crack resistance, as measured by the NCLS time. The use of these materials could produce much better formulations of equivalent formulations with more recycled HDPE in them.

The formulations presented were finalized after many hours of data analysis, and discussions with project personnel and consultants. It was decided that it is feasible to make blends that will meet AASHTO short-term requirements and contain significant amounts of recycled HDPE. The long-term properties of the pipe will be evaluated, and that information will allow for proper requirements to be placed on pipe resins containing recycled HDPE.

The two virgin resins, VR1 and MDPE, are consistent in their properties. The properties for the recycled resins will be an estimate, since there is some variability in these products.

Since there are two pipe plants available for manufacturing, it would be beneficial if they both made pipe from VR1 alone and 1 other formulation. So, there is a need for 7 formulations.

<table>
<thead>
<tr>
<th>Resin</th>
<th>Yield Stress (psi)</th>
<th>Break Strain (%)</th>
<th>15% NCTL (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR1</td>
<td>3688</td>
<td>478</td>
<td>45.8</td>
</tr>
<tr>
<td>MDPE</td>
<td>2732</td>
<td>771</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>PCR – MCR</td>
<td>3620</td>
<td>62.5</td>
<td>7.6</td>
</tr>
<tr>
<td>PCR – NAT</td>
<td>4525</td>
<td>302</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Two obvious choices are simple 2-component blends with VR1 and 15% of PCR-MCR and PCR-NAT. With the use of the relationships obtained from the blend study, the resulting properties can be estimated:

The yield stress and break strain are linear functions:

$$\text{Blend Yield Stress} = (0.85 \times 3688) + (0.15 \times 3620) = 3678 \text{ psi for MCR},$$
Break Strain = (0.85 x 478) + (0.15 x 62.5) = 416 %,

The 15% NCTL is an exponential relationship:

15% NCTL = 45.8 e\(^{-0.018 \times 15}\) = 35.0 hrs.

The values calculated in the same way for PCR-NAT are:

Yield Stress = 3814 psi,
Break Strain = 452 %
15% NCTL = 29.2 hrs

With the use of these equations, blends have been chosen that have a minimum yield stress of 3400 psi, a minimum break strain of 400% and a minimum 15% NCTL time of 29 hrs. Additionally, the blends have a recycled content from 15 to 60 percent.

The blends selected are shown in Table C-11 and their properties in Table C-12.

### Table C-11 - Proposed Formulations for Pipe

<table>
<thead>
<tr>
<th>Formulation #</th>
<th>VR1</th>
<th>Virgin MDPE</th>
<th>PCR-MCR</th>
<th>PCR-NAT</th>
<th>% Recycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>85</td>
<td>15</td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>85</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>20</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>40</td>
<td>24</td>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td></td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>40</td>
<td>36</td>
<td>24</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

### Table C-12 - Predicted Properties of Pipe Formulations

<table>
<thead>
<tr>
<th>Formulation #</th>
<th>Yield Stress (psi)</th>
<th>% Break Strain</th>
<th>15% NCTL (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3688</td>
<td>478</td>
<td>45.8</td>
</tr>
<tr>
<td>2</td>
<td>3678</td>
<td>416</td>
<td>35.0</td>
</tr>
<tr>
<td>3</td>
<td>3818</td>
<td>452</td>
<td>29.2</td>
</tr>
<tr>
<td>4</td>
<td>3443</td>
<td>412</td>
<td>&gt;49.5</td>
</tr>
<tr>
<td>5</td>
<td>3653</td>
<td>513</td>
<td>&gt;47.1</td>
</tr>
<tr>
<td>6</td>
<td>3423</td>
<td>468</td>
<td>&gt;63.3</td>
</tr>
<tr>
<td>7</td>
<td>3629</td>
<td>537</td>
<td>&gt;48</td>
</tr>
<tr>
<td>8</td>
<td>3482</td>
<td>403</td>
<td>&gt;40.1</td>
</tr>
</tbody>
</table>
The proposed formulations for making the trial pipe have a host of positive features. They include:

1. The minimum yield stress is 3420 psi, which is close to the yield stress of a 0.948 g/cm³ resin, which is the minimum for AASHTO.
2. The 15% NCTL failure times are above 29 hrs, which is close to the minimum NCLS time of 24 hrs.
3. The break strains are above 400%, which should correspond to favorable BAM test results.
4. There is a wide range of percentage recycled represented (15-60%).
5. Both PCR mixed color and natural resins are represented in case the contaminants in the mixed color compromise the long-term properties of the blends.

The plan is to make 100 feet of 12” diameter pipe from each formulation. This will allow enough for testing under this project and retained pipe samples for future evaluations.

**C.8 CONCLUSIONS**

A total of 66 blends were prepared and tested to find out how much recycled resin could be used in three PPI certified resins where the final product would still meet the AASHTO M294 resin requirements for corrugated pipe. It was determined that for simple, two component blends, the maximum amount of PCR HDPE is around 15%, while a specific PIR-HD obtained could be used in amounts up to 40%.

More importantly, it was found that through the relationships discovered during this task, other 2 and 3 component blends could be designed and optimized for the specific purpose of maximizing the amount of recycled HDPE used. This information will be invaluable to those developing new blends for improved short and long term properties of corrugated pipe resins. Contaminants like particles and silicone rubber seemed to affect the relationships in a negative way so the relationships are probably most useful as guidelines; some actual testing will still be required.

It also should be stated that much better recycled blends can be made than the ones described in this report. The results herein we limited by the fact that the recycled resins were blended with PPI certified pipe resins. The virgin resins only had around 50 hrs of NCLS time to begin with. Starting with similar resins with 100 or 150 hrs of NCLS time would allow for much more recycled to be used.
C.9 SUMMARY TABLES, GRAPHS, AND TEST REPORTS FOR BLENDS MADE WITH MIXED-COLOR, POST-CONSUMER, RECYCLED HDPE
## Virgin Resin 1 + Mixed Color Reprocessed

<table>
<thead>
<tr>
<th>Property</th>
<th>0% Recycle</th>
<th>20% Recycle</th>
<th>40% Recycle</th>
<th>60% Recycle</th>
<th>80% Recycle</th>
<th>100% Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density g/cm³</td>
<td>0.954</td>
<td>0.957</td>
<td>0.958</td>
<td>0.960</td>
<td>0.960</td>
<td></td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.18</td>
<td>0.22</td>
<td>0.30</td>
<td>0.39</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>27.7</td>
<td>31.9</td>
<td>37.2</td>
<td>43.1</td>
<td>45.2</td>
<td></td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>154</td>
<td>145</td>
<td>124</td>
<td>111</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>% Color + Ash</td>
<td>0.40</td>
<td>0.75</td>
<td>1.06</td>
<td>1.68</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td>1.5</td>
<td>2.1</td>
<td>3.6</td>
<td>4.4</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3840</td>
<td>3796</td>
<td>3771</td>
<td>3607</td>
<td>3685</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>199</td>
<td>219</td>
<td>127</td>
<td>124</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>24.8</td>
<td>15.1</td>
<td>9.5</td>
<td>6.7</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>OIT (min)</td>
<td>17.6</td>
<td>17.3</td>
<td>15.5</td>
<td>13.0</td>
<td>12.2</td>
<td></td>
</tr>
</tbody>
</table>
Virgin Resin 1 + Mixed Color Reprocessed

Density (g/cc)

\[ y = 9 \times 10^{-5}x + 0.9525 \]
\[ R^2 = 0.9627 \]

% Recycled

\% Color+Ash

\[ y = 0.0208x - 0.065 \]
\[ R^2 = 0.9725 \]

% Recycled
Virgin Resin 1 + Mixed Color Reprocessed

\[ y = 0.1352e^{0.0131x} \]
\[ R^2 = 0.9937 \]

\[ y = 23.831e^{0.0074x} \]
\[ R^2 = 0.9998 \]
Virgin Resin 1 + Mixed Color Reprocessed

**Yield Strength (psi)**

- \( y = -3.62x + 3934.5 \)
  - \( R^2 = 0.8439 \)

- \( y = -0.68x + 3688 \)

**Break Strain (%)**

- \( y = -4.155x + 478 \)
- \( y = -1.585x + 246.5 \)
  - \( R^2 = 0.7001 \)
Virgin Resin 1 + Mixed Color Reprocessed

\[ y = 37.231e^{-0.0219x} \]
\[ R^2 = 0.9941 \]

\[ y = 45.8e^{-0.018x} \]
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 1 + Post Consumer Mixed Color Reprocessed**  
**80% + 20%**

**Material:** Plaque from blended resin (MB 3X @ 100 Mesh)  
**Date:** 9-Feb-07  
**Sample:** VR1 + 20% MCR1  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.954</td>
<td></td>
<td></td>
<td>0.954</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.17</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>27.7</td>
<td>27.7</td>
<td></td>
<td></td>
<td></td>
<td>27.7</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>154</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.41</td>
<td>0.40</td>
<td>0.40</td>
<td></td>
<td></td>
<td>0.40</td>
<td>0.005</td>
</tr>
<tr>
<td>% PP</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3805</td>
<td>3779</td>
<td>3885</td>
<td>3867</td>
<td>3863</td>
<td>3840</td>
<td>41</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>200</td>
<td>182</td>
<td>161</td>
<td>232</td>
<td>218</td>
<td>199</td>
<td>25</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>21.3</td>
<td>25.9</td>
<td>27.3</td>
<td>21.5</td>
<td>28.1</td>
<td>24.8</td>
<td>3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>17.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.6</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS
### Recycled HDPE Blend
**Virgin Resin 1 + Post Consumer Mixed Color Reprocessed**
*60% + 40%*

**Material:** Plaque from blended resin (MB 3X @ 100 Mesh)  
**Sample:** VR1 + 40% MCR1  
**Date:** 9-Feb-07  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
* (ASTM D 1505)                              |     |     |     |     |     |      |      |
| Density (g/cm³)                               | 0.957 | 0.957 | 0.957 |     |     | 0.957 | 0.000 |
| **Melt Flow Index**  
* (ASTM D 1238)                               |     |     |     |     |     |      |      |
| 2.16 kg (g/10min)                             | 0.22 | 0.22 |     |     |     | 0.22  |      |
| 21.6 kg (g/10 min)                            | 31.6 | 32.1 |     |     |     | 31.9  |      |
| Ratio                                         |     |     |     |     |     | 145   |      |
| **Composition**                               |     |     |     |     |     |      |      |
| % Color/Ash                                   | 0.76 | 0.76 | 0.74 |     |     | 0.75  | 0     |
| % PP                                          | 2.1  |     |     |     |     | 2.1   |      |
| **Tensile Properties**                        |     |     |     |     |     |      |      |
| Yield Strength (psi)                          | 3704 | 3773 | 3800 | 3859 | 3842 | 3796  | 55   |
| Break Strain (%)                              | 174  | 212  | 269  | 259  | 182  | 219   | 39   |
| **Environmental Stress Crack Resistance**     |     |     |     |     |     |      |      |
| (ASTM D5397 @ 15% of Yield)                   |     |     |     |     |     |      |      |
| Failure Time (hours)                          | 14.8 | 15.4 | 15.4 | 14.7 | 15.4 | 15.1  | 0    |
| **Oxidative Stability**                       |     |     |     |     |     |      |      |
| (ASTM D 3895)                                 |     |     |     |     |     |      |      |
| Induction Time (min)                          | 17.3 |     |     |     |     | 17.3  |      |
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + Post Consumer Mixed Color Reprocessed**

40% + 60%

| Material: Plaque from blended resin (MB 3X @ 100 Mesh) | Date: 9-Feb-07 |
| Sample: VR1 + 60% MCR1 | TRI Log #: F7601 |

### TEST RESULTS

#### Recycled HDPE Blend

**Virgin Resin 1 + Post Consumer Mixed Color Reprocessed**

**40% + 60%**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.958</td>
<td></td>
<td></td>
<td>0.958</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.31</td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>37.0</td>
<td>37.4</td>
<td></td>
<td></td>
<td></td>
<td>37.2</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.06</td>
<td>1.08</td>
<td>1.05</td>
<td></td>
<td></td>
<td>1.06</td>
<td>0.012</td>
</tr>
<tr>
<td>% PP</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3719</td>
<td>3732</td>
<td>3843</td>
<td>3831</td>
<td>3732</td>
<td>3771</td>
<td>54</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>157</td>
<td>100</td>
<td>154</td>
<td>106</td>
<td>119</td>
<td>127</td>
<td>24</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>11.2</td>
<td>10.1</td>
<td>10.2</td>
<td>8.3</td>
<td>7.7</td>
<td>9.5</td>
<td>1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>15.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

#### Virgin Resin 1 + Post Consumer Mixed Color Reprocessed 
20% + 80%

| Material: Plaque from blended resin (MB 3X @ 100 Mesh) | Date: 9-Feb-07 |
| Sample: VR1 + 80% MCR1 | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td>1 2 3 4 5</td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.960 0.96 0.96</td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td>1 2</td>
<td>0.39 0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.39 0.38</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>43.8 42.4</td>
<td>43.1</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.62 1.68 1.73</td>
<td>1.68</td>
<td>0.045</td>
</tr>
<tr>
<td>% PP</td>
<td>4.4</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3685 3594 3657 3600 3500</td>
<td>3607</td>
<td>64</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>194 120 108 95 102</td>
<td>124</td>
<td>36</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>7.6 7.6 6.4 6.2 5.7</td>
<td>6.7</td>
<td>1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>13.0</td>
<td>13.0</td>
<td></td>
</tr>
</tbody>
</table>

NCHRP 04-32 C-34
### TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Mixed Color Reprocessed**  
**100%**

<table>
<thead>
<tr>
<th>Material: Plaque from blended resin (MB 3X)</th>
<th>Date: 9-Feb-07</th>
<th>TRI Log #: F7601</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample: 100% MCR1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.960</td>
<td>0.960</td>
<td>0.960</td>
<td>0.960</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.53</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>46.9</td>
<td>43.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.61</td>
<td>1.67</td>
<td>1.39</td>
<td></td>
<td></td>
<td>1.56</td>
<td>0.120</td>
</tr>
<tr>
<td>% PP</td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3591</td>
<td>3708</td>
<td>3724</td>
<td>3718</td>
<td>3684</td>
<td>3685</td>
<td>49</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>80</td>
<td>31</td>
<td>33</td>
<td>18</td>
<td>68</td>
<td>46</td>
<td>24</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>10.9</td>
<td>10.4</td>
<td>7.8</td>
<td>7.0</td>
<td>8.1</td>
<td>8.8</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>12.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.2</td>
<td></td>
</tr>
</tbody>
</table>
### Virgin Resin 1 + Mixed Color Regrind

<table>
<thead>
<tr>
<th>Property</th>
<th>0% Recycle</th>
<th>20% Recycle</th>
<th>40% Recycle</th>
<th>60% Recycle</th>
<th>80% Recycle</th>
<th>100% Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density g/cm³</td>
<td>0.953</td>
<td>0.956</td>
<td>0.956</td>
<td>0.958</td>
<td>0.960</td>
<td></td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.17</td>
<td>0.21</td>
<td>0.27</td>
<td>0.36</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>28.8</td>
<td>31.3</td>
<td>34.9</td>
<td>41.1</td>
<td>39.6</td>
<td></td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>169</td>
<td>152</td>
<td>129</td>
<td>114</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>% Color + Ash</td>
<td>0.37</td>
<td>0.68</td>
<td>0.98</td>
<td>1.26</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td>0.8</td>
<td>1.2</td>
<td>2.1</td>
<td>3.1</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3574</td>
<td>3515</td>
<td>3499</td>
<td>3535</td>
<td>3441</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>487</td>
<td>359</td>
<td>445</td>
<td>230</td>
<td>158</td>
<td></td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>32.4</td>
<td>19.1</td>
<td>15.2</td>
<td>9.1</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>OIT (min)</td>
<td>16.3</td>
<td>13.7</td>
<td>13.3</td>
<td>11.8</td>
<td>12.6</td>
<td></td>
</tr>
</tbody>
</table>
Virgin Resin 1 + Mixed Color Regrind

\[ y = 8 \times 10^{-5}x + 0.952 \]
\[ R^2 = 0.8824 \]

\[ y = 0.0149x + 0.08 \]
\[ R^2 = 0.9995 \]
Virgin Resin 1 + Mixed Color Regrind

\[ y = 0.1298e^{0.0125x} \]
\[ R^2 = 0.9954 \]

\[ y = 25.133e^{0.0059x} \]
\[ R^2 = 0.9766 \]
Virgin Resin 1 + Mixed Color Regrind

- Yield Strength (psi)
  - $y = -0.68x + 3688$
  - $R^2 = 0.2812$

- Break Strain (%)
  - $y = -3.425x + 551.5$
  - $R^2 = 0.6076$
  - $y = -4.155x + 478$
Virgin Resin 1 + Mixed Color Regrind

\[ y = 46.94e^{-0.0202x} \]

\[ R^2 = 0.9794 \]

\[ y = 45.8e^{-0.018x} \]
## TEST RESULTS

Recycled HDPE Blend  
Virgin Resin 1 + Post Consumer Mixed Color Regrind  
80% + 20%

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: VR1 + 20% MCRG  
Date: 19-Mar-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.952</td>
<td>0.953</td>
<td>0.954</td>
<td></td>
<td></td>
<td>0.953</td>
<td>0.001</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.17</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10min)</td>
<td>28.8</td>
<td>28.8</td>
<td></td>
<td></td>
<td></td>
<td>28.8</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.38</td>
<td>0.39</td>
<td>0.35</td>
<td></td>
<td></td>
<td>0.37</td>
<td>0.017</td>
</tr>
<tr>
<td>% PP</td>
<td>0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3653</td>
<td>3643</td>
<td>3586</td>
<td>3500</td>
<td>3486</td>
<td>3574</td>
<td>70</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>483</td>
<td>487</td>
<td>475</td>
<td>491</td>
<td>498</td>
<td>487</td>
<td>8</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>36.1</td>
<td>28.5</td>
<td>31.9</td>
<td>35.9</td>
<td>29.7</td>
<td>32.4</td>
<td>3</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>16.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.3</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + Post Consumer Mixed Color Regrind**

**60% + 40%**

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Density (g/cm³)</td>
<td>1 0.956 2 0.956 3 0.956 4 0.956 5</td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td>2.16 kg (g/10min)</td>
<td>1 0.21 2 0.20</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>21.6 kg (g/10 min)</td>
<td>1 31.3 2 31.2</td>
<td>31.3</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>152</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>% Color/Ash</td>
<td>1 0.70 2 0.67 3 0.68</td>
<td>0.68</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>% PP</td>
<td>1 1.2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties</td>
<td>Yield Strength (psi)</td>
<td>1 3635 2 3465 3 3535 4 3500 5 3438</td>
<td>3515</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Break Strain (%)</td>
<td>1 166 2 446 3 431 4 453 5 298</td>
<td>359</td>
<td>112</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance</td>
<td>Failure Time (hours)</td>
<td>1 18.4 2 21.2 3 22.2 4 18.5 5 15.0</td>
<td>19.1</td>
<td>3</td>
</tr>
<tr>
<td>Oxidative Stability</td>
<td>Induction Time (min)</td>
<td>1 13.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: VR1 + 40% MCRG  
Date: 19-Mar-07  
TRI Log #: F7601  

NCHRP 04-32  
C-42
**TEST RESULTS**

**Recycled HDPE Blend**

**Virgin Resin 1 + Post Consumer Mixed Color Regrind**

40% + 60%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.956</td>
<td>0.956</td>
<td>0.956</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.27</td>
<td>0.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>34.7</td>
<td>35.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>129</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.01</td>
<td>0.99</td>
<td>0.95</td>
<td></td>
<td></td>
<td>0.98</td>
<td>0.025</td>
</tr>
<tr>
<td>% PP</td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3548</td>
<td>3513</td>
<td>3545</td>
<td>3494</td>
<td>3397</td>
<td>3499</td>
<td>55</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>462</td>
<td>453</td>
<td>449</td>
<td>428</td>
<td>434</td>
<td>445</td>
<td>12</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>15.5</td>
<td>16.3</td>
<td>13.4</td>
<td>15.8</td>
<td>15.1</td>
<td>15.2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>13.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>(ASTM D3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS
### Recycled HDPE Blend
**Virgin Resin 1 + Post Consumer Mixed Color Regrind**

20% + 80%  

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: VR1 + 80% MCRG  
Date: 19-Mar-07  
TRI Log #: F7601

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.959</td>
<td></td>
<td></td>
<td>0.958</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.35</td>
<td>0.37</td>
<td></td>
<td></td>
<td></td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>41.5</td>
<td>40.7</td>
<td></td>
<td></td>
<td></td>
<td>41.1</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.27</td>
<td>1.23</td>
<td>1.27</td>
<td></td>
<td></td>
<td>1.26</td>
<td>0.019</td>
</tr>
<tr>
<td>% PP</td>
<td>3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3653</td>
<td>3533</td>
<td>3563</td>
<td>3514</td>
<td>3414</td>
<td>3535</td>
<td>77</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>233</td>
<td>153</td>
<td>171</td>
<td>156</td>
<td>435</td>
<td>230</td>
<td>107</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>9.4</td>
<td>9.9</td>
<td>8.8</td>
<td>9.3</td>
<td>8.3</td>
<td>9.1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>11.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.8</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Mixed Color Regrind**  
**100%**

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: 100% MCRG  
Date: 19-Mar-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.960</td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.47</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>39.3</td>
<td>39.6</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>83</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.58</td>
<td>1.57</td>
<td>0.014</td>
</tr>
<tr>
<td>% PP</td>
<td>3.2</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3486</td>
<td>3441</td>
<td>47</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>128</td>
<td>158</td>
<td>35</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>7.8</td>
<td>8.0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>12.6</td>
<td>12.6</td>
<td></td>
</tr>
</tbody>
</table>
### Virgin Resin 2 + Mixed Color Reprocessed PCR

<table>
<thead>
<tr>
<th>Property</th>
<th>Supplier/Resin Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density ( g/cm^3 )</td>
<td>0.956</td>
</tr>
<tr>
<td>Melt Index ( g/10 \text{ min} )</td>
<td>0.29</td>
</tr>
<tr>
<td>Flow Rate ( g/10 \text{ min} )</td>
<td>26.7</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>93</td>
</tr>
<tr>
<td>% Ash</td>
<td>0.05</td>
</tr>
<tr>
<td>% PP</td>
<td>0</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3936</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>694</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>39.2</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>86</td>
</tr>
</tbody>
</table>
Virgin Resin 2 + Mixed Color Reprocessed PCR

Density (g/cc)

\[ y = 6 \times 10^{-5} x + 0.9535 \]

\[ R^2 = 0.8 \]

% Recycled

% Color+Ash

\[ y = 0.0175x + 0.01 \]

\[ R^2 = 0.9973 \]
Virgin Resin 2 + Mixed Color Reprocessed PCR

\[ y = 0.2733e^{0.0069x} \]
\[ R^2 = 0.9854 \]

\[ y = 24.285e^{0.0078x} \]
\[ R^2 = 0.9898 \]
Virgin Resin 2 + Mixed Color Reprocessed PCR

\[
y = -3.945x + 3886 \quad \text{R}^2 = 0.9563
\]

\[
y = -3.04x + 3924
\]

\[
y = -3.945x + 3886 \quad \text{R}^2 = 0.9563
\]

\[
y = -5.765x + 639 \quad \text{R}^2 = 0.9852
\]
Virgin Resin 2 + Mixed Color Reprocessed PCR

\[ y = 55.392e^{-0.0211x} \]
\[ R^2 = 0.9647 \]

\[ y = 38.5e^{-0.0162x} \]
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 2**

**100%**

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Date: 11-May-07  
Sample: 100% Virgin Resin 2  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.956</td>
<td>0.956</td>
<td>0.956</td>
<td></td>
<td></td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.28</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>26.9</td>
<td>26.5</td>
<td></td>
<td></td>
<td></td>
<td>26.7</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>93</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.04</td>
<td>0.04</td>
<td>0.07</td>
<td></td>
<td></td>
<td>0.05</td>
<td>0.014</td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3932</td>
<td>3987</td>
<td>3961</td>
<td>3961</td>
<td>3840</td>
<td>3936</td>
<td>51</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>708</td>
<td>731</td>
<td>596</td>
<td>687</td>
<td>749</td>
<td>694</td>
<td>53</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>39.5</td>
<td>39.1</td>
<td>34.8</td>
<td>45.8</td>
<td>36.8</td>
<td>39.2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>86.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86.2</td>
<td></td>
</tr>
<tr>
<td>TEST RESULTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled HDPE Blend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virgin Resin 2 + Post Consumer Mixed Color Reprocessed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80% + 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 80% VR2 + 20% MCR1  
Date: 11-May-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.954</td>
<td></td>
<td></td>
<td>0.954</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.31</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>28.9</td>
<td>28.9</td>
<td></td>
<td></td>
<td></td>
<td>28.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.35</td>
<td>0.37</td>
<td>0.37</td>
<td></td>
<td></td>
<td>0.36</td>
<td>0.009</td>
</tr>
<tr>
<td>% PP</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3843</td>
<td>3817</td>
<td>3851</td>
<td>3813</td>
<td>3803</td>
<td>3825</td>
<td>18</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>236</td>
<td>217</td>
<td>488</td>
<td>476</td>
<td>496</td>
<td>383</td>
<td>128</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>34.1</td>
<td>38.1</td>
<td>33.2</td>
<td>34.1</td>
<td>35.6</td>
<td>35.0</td>
<td>2</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>55.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>55.7</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 2 + Post Consumer Mixed Color Reprocessed**

60% + 40%

<table>
<thead>
<tr>
<th>Material: Plaque from blended resin (MB 3X)</th>
<th>Date: 11-May-07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample: 60% VR2 + 40% MCR1</td>
<td>TRI Log #: F7601</td>
</tr>
</tbody>
</table>

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.956</td>
<td>0.957</td>
<td>0.957</td>
<td></td>
<td></td>
<td>0.957</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.35</td>
<td>0.35</td>
<td></td>
<td></td>
<td></td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>31.9</td>
<td>32.5</td>
<td></td>
<td></td>
<td></td>
<td>32.2</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.70</td>
<td>0.69</td>
<td>0.68</td>
<td></td>
<td></td>
<td>0.69</td>
<td>0.008</td>
</tr>
<tr>
<td>% PP</td>
<td>3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3792</td>
<td>3704</td>
<td>3716</td>
<td>3730</td>
<td>3620</td>
<td>3712</td>
<td>55</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>491</td>
<td>172</td>
<td>462</td>
<td>326</td>
<td>143</td>
<td>319</td>
<td>143</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>25.5</td>
<td>24.6</td>
<td>27.2</td>
<td>31.3</td>
<td>25.4</td>
<td>26.8</td>
<td>2</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>35.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35.2</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 2 + Post Consumer Mixed Color Reprocessed**

40% + 60%

---

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)

**Sample:** 40% VR2 + 60% MCR1

**Date:** 11-May-07

**TRI Log #:** F7601

---

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> <em>(ASTM D 1505)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.957</td>
<td>0.957</td>
<td>0.957</td>
<td></td>
<td></td>
<td>0.957</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> <em>(ASTM D 1238)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.41</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>38.7</td>
<td>38.6</td>
<td></td>
<td></td>
<td></td>
<td>38.7</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.09</td>
<td>1.11</td>
<td>1.06</td>
<td></td>
<td></td>
<td>1.09</td>
<td>0.021</td>
</tr>
<tr>
<td>% PP</td>
<td>4.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> <em>(ASTM D 638)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3507</td>
<td>3648</td>
<td>3704</td>
<td>3690</td>
<td>3592</td>
<td>3628</td>
<td>72</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>264</td>
<td>226</td>
<td>153</td>
<td>145</td>
<td>318</td>
<td>221</td>
<td>66</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> <em>(ASTM D5397 @ 15% of Yield)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>12.3</td>
<td>15.6</td>
<td>10.1</td>
<td>15.3</td>
<td>15.9</td>
<td>13.8</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> <em>(ASTM D 3895)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>(ASTM D3895)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

NCHRP 04-32
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 2 + Post Consumer Mixed Color Reprocessed**

**20% + 80%**

---

**Material:** Plaque from blended resin (MB 3X)

**Sample:** 20% VR2 + 80% MCR1

**Date:** 11-May-07

**TRI Log #:** F7601

---

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.958</td>
<td></td>
<td></td>
<td>0.958</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.49</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>44.9</td>
<td>46.3</td>
<td></td>
<td></td>
<td></td>
<td>45.6</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.30</td>
<td>1.45</td>
<td>1.41</td>
<td></td>
<td></td>
<td>1.39</td>
<td>0.063</td>
</tr>
<tr>
<td>% PP</td>
<td>6.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3609</td>
<td>3594</td>
<td>3632</td>
<td>3623</td>
<td>3493</td>
<td>3590</td>
<td>50</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>120</td>
<td>192</td>
<td>260</td>
<td>64</td>
<td>222</td>
<td>172</td>
<td>71</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>7.6</td>
<td>12.0</td>
<td>12.0</td>
<td>10.9</td>
<td>10.9</td>
<td>10.7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>22.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.0</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

Recycled HDPE Blend
Post Consumer Mixed Color Reprocessed
100%

Material: Plaque from blended resin (MB 3X @ 100 Mesh)
Sample: 100% MCR1

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.960</td>
<td>0.96</td>
<td>0.96</td>
<td></td>
<td></td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10 min)</td>
<td>0.55</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>52.9</td>
<td>53.9</td>
<td></td>
<td></td>
<td></td>
<td>53.4</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>95</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.72</td>
<td>1.75</td>
<td>1.61</td>
<td></td>
<td></td>
<td>1.69</td>
<td>0.060</td>
</tr>
<tr>
<td>% PP</td>
<td>8.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3708</td>
<td>3647</td>
<td>3514</td>
<td>3565</td>
<td>3347</td>
<td>3556</td>
<td>124</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>70</td>
<td>114</td>
<td>55</td>
<td>115</td>
<td>42</td>
<td>79</td>
<td>30</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>5.4</td>
<td>6.6</td>
<td>7.1</td>
<td>7.0</td>
<td>5.7</td>
<td>6.4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>16.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.5</td>
<td></td>
</tr>
</tbody>
</table>
## Virgin Resin 3 + Mixed Color Reprocessed PCR-HD

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycle Content</th>
<th>0% Recycle</th>
<th>20% Recycle</th>
<th>40% Recycle</th>
<th>60% Recycle</th>
<th>80% Recycle</th>
<th>100% Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density g/cm³</td>
<td></td>
<td>0.949</td>
<td>0.950</td>
<td>0.955</td>
<td>0.954</td>
<td>0.952</td>
<td></td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td></td>
<td>0.28</td>
<td>0.29</td>
<td>0.33</td>
<td>0.40</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td></td>
<td>23.2</td>
<td>25.3</td>
<td>28.3</td>
<td>35.2</td>
<td>43.8</td>
<td></td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td></td>
<td>83</td>
<td>88</td>
<td>86</td>
<td>87</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td>0.04</td>
<td>0.37</td>
<td>0.72</td>
<td>1.11</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td>0</td>
<td>1.8</td>
<td>3.1</td>
<td>3.6</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td></td>
<td>3804</td>
<td>3778</td>
<td>3726</td>
<td>3758</td>
<td>3724</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td></td>
<td>667</td>
<td>320</td>
<td>441</td>
<td>237</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td></td>
<td>44</td>
<td>17.6</td>
<td>15.3</td>
<td>9.5</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>OIT (min)</td>
<td></td>
<td>33.8</td>
<td>33.6</td>
<td>28.2</td>
<td>23.1</td>
<td>18.4</td>
<td></td>
</tr>
</tbody>
</table>
Virgin Resin 3 + Mixed Color Reprocessed PCR-HDPE

\[ y = 2 \times 10^{-5} x + 0.9515 \]
\[ R^2 = 0.0847 \]

\[ y = 0.0183x - 9 \times 10^{-16} \]
\[ R^2 = 0.9995 \]
Virgin Resin 3 + Mixed Color Reprocessed PCR-HDPE

**Equation:**

- MFI (g/10 min): $y = 0.238e^{0.0088x}$
- HLMFI (g/10 min): $y = 20.337e^{0.0093x}$

**R²:**
- MFI: 0.9905
- HLMFI: 0.9808
Virgin Resin 3 + Mixed Color Reprocessed PCR-HDPE

**Yield Strength (psi)**

- $y = -0.65x + 3779$
- $R^2 = 0.412$
- $y = -1.44x + 3764$

**Break Strain (%)**

- $y = -5.845x + 647$
- $R^2 = 0.6047$
- $y = -4.305x + 490$
- $R^2 = 0.6047$
Virgin Resin 3 + Mixed Color Reprocessed PCR-HDPE

\[ y = 36.2e^{-0.0156x} \]

\[ y = 28.342e^{-0.0188x} \]

\[ R^2 = 0.9541 \]
# TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 3**  
**100%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.948</td>
<td>0.949</td>
<td>0.949</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>22.6</td>
<td>23.7</td>
<td>23.2</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.08</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3875</td>
<td>3827</td>
<td>3767</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>731</td>
<td>479</td>
<td>733</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>39.1</td>
<td>48.0</td>
<td>45.3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>33.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 3 + Post Consumer Mixed Color Reprocessed**  
**80% + 20%**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 25-May-07 |
| Sample: 80% VR3 + 20% MCR1 | TRI Log #: F761 |

### Density

<table>
<thead>
<tr>
<th>Density (g/cm³)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.950</td>
<td>0.950</td>
<td>0.950</td>
<td></td>
<td></td>
<td>0.950</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Melt Flow Index

<table>
<thead>
<tr>
<th>Melt Flow Index (kg/g/10min)</th>
<th>2.16 kg</th>
<th>2.16 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.28</td>
<td>0.29</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.1</td>
<td>25.4</td>
</tr>
<tr>
<td>Ratio</td>
<td>88</td>
<td></td>
</tr>
</tbody>
</table>

### Composition

<table>
<thead>
<tr>
<th>% Color/Ash</th>
<th>% PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.38</td>
<td>1.8</td>
</tr>
<tr>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td></td>
</tr>
</tbody>
</table>

### Tensile Properties

<table>
<thead>
<tr>
<th>Yield Strength (psi)</th>
<th>3799</th>
<th>3797</th>
<th>3736</th>
<th>3760</th>
<th>3808</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break Strain (%)</td>
<td>480</td>
<td>248</td>
<td>246</td>
<td>148</td>
<td>476</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Environmental Stress Crack Resistance

<table>
<thead>
<tr>
<th>Environmental Stress Crack Resistance (kg/g/10min) @ 15% of Yield</th>
<th>Failure Time (hours)</th>
<th>15.2</th>
<th>19.0</th>
<th>17.3</th>
<th>19.5</th>
<th>17.2</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.8</td>
<td>2</td>
</tr>
</tbody>
</table>

### Oxidative Stability

<table>
<thead>
<tr>
<th>Oxidative Stability (kg/g/10min)</th>
<th>Induction Time (min)</th>
<th>33.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ASTM D3895)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

NCHRP 04-32
c-63
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.955</td>
<td>0.955</td>
<td>0.955</td>
<td></td>
<td></td>
<td>0.955</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.33</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>28.1</td>
<td>28.5</td>
<td></td>
<td></td>
<td></td>
<td>28.3</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.73</td>
<td>0.73</td>
<td>0.69</td>
<td></td>
<td></td>
<td>0.72</td>
<td>0.019</td>
</tr>
<tr>
<td>% PP</td>
<td>3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3767</td>
<td>3747</td>
<td>3750</td>
<td>3711</td>
<td>3653</td>
<td>3726</td>
<td>41</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>466</td>
<td>467</td>
<td>475</td>
<td>332</td>
<td>463</td>
<td>441</td>
<td>54</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>14.4</td>
<td>17.2</td>
<td>13.5</td>
<td>18.6</td>
<td>12.7</td>
<td>15.3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>28.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.2</td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin
Sample: 60% VR3 + 40% MCR1
Test Replicate Number: Virgin Resin 3 + Post Consumer Mixed Color Reprocessed
60% + 40%
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 3 + Post Consumer Mixed Color Reprocessed**  
**40% + 60%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(APST D 1505) | Density (g/cm³) | 0.953 | 0.954 | 0.954 |   | 0.954 | 0.000 |
| **Melt Flow Index**  
(APST D 1238) | 2.16 kg (g/10min) | 0.40 | 0.40 |   |   | 0.40 |     |
| | 21.6 kg (g/10 min) | 34.9 | 35.4 |   |   | 35.2 |     |
| **Ratio** | 87 |   |   |   |   |     |     |
| **Composition** | % Color/Ash | 1.13 | 1.09 | 1.12 |   | 1.11 | 0.017 |
| | % PP | 3.6 |   |   |   | 3.1 |     |
| **Tensile Properties**  
(APST D 638) | Yield Strength (psi) | 3770 | 3764 | 3736 | 3763 | 3757 | 3758 | 12 |
| | Break Strain (%) | 176 | 208 | 207 | 341 | 251 | 237 | 57 |
| **Environmental Stress Crack Resistance**  
(APST D5397 @ 15% of Yield) | Failure Time (hours) | 9.9 | 8.8 | 9.9 | 8.9 | 9.8 | 9.5 | 1 |
| **Oxidative Stability**  
(APST D 3895) | Induction Time (min) | 23.1 |   |   |   |   | 23.1 |     |
**TEST RESULTS**  
Recycled HDPE Blend  
Virgin Resin 3 + Post Consumer Mixed Color Reprocessed  
20% + 80%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Date: 25-May-07  
Sample: 20% VR3 + 80% MCR1  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.952</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.952</td>
<td>0.952</td>
<td>0.952</td>
<td></td>
<td></td>
<td>0.952</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.49</td>
<td>0.49</td>
<td></td>
<td></td>
<td></td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>43.9</td>
<td>43.6</td>
<td></td>
<td></td>
<td></td>
<td>43.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>89</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.46</td>
<td>0.029</td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.42</td>
<td>1.47</td>
<td>1.49</td>
<td></td>
<td></td>
<td>1.46</td>
<td>0.029</td>
</tr>
<tr>
<td>% PP</td>
<td>7.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3724</td>
<td>59</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3614</td>
<td>3764</td>
<td>3783</td>
<td>3726</td>
<td>3732</td>
<td>3724</td>
<td>59</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>152</td>
<td>48</td>
<td>91</td>
<td>88</td>
<td>124</td>
<td>101</td>
<td>35</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.9</td>
<td>1</td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>6.1</td>
<td>5.9</td>
<td>5.9</td>
<td>5.0</td>
<td>6.6</td>
<td>5.9</td>
<td>1</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.4</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>18.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.4</td>
<td></td>
</tr>
</tbody>
</table>
## Mixed Color Regrind + Virgin MDPE

<table>
<thead>
<tr>
<th>Property</th>
<th>Virgin MDPE Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% MDPE</td>
</tr>
<tr>
<td>Density $\text{g/cm}^3$</td>
<td>0.960</td>
</tr>
<tr>
<td>Melt Index $\text{g/10 min}$</td>
<td>0.52</td>
</tr>
<tr>
<td>Flow Rate $\text{g/10 min}$</td>
<td>50.8</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>97</td>
</tr>
<tr>
<td>Ash</td>
<td>1.46</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3613</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>171</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>7.1</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>12.1</td>
</tr>
</tbody>
</table>
Mixed Color Regrind + Virgin MDPE

\[ y = -0.0003x + 0.964 \]
\[ R^2 = 0.9727 \]

\[ y = -0.0172x + 1.56 \]
\[ R^2 = 0.9958 \]
Mixed Color Regrind + Virgin MDPE

\[ y = 0.5237e^{-0.0101x} \]
\[ R^2 = 0.9868 \]

\[ y = 46.44e^{-0.0099x} \]
\[ R^2 = 0.9933 \]
Mixed Color Regrind + Virgin MDPE

![Graph 1: Yield Strength vs. % LMDPE](image)

- \( y = -9.555x + 3619 \)
- \( R^2 = 0.933 \)

![Graph 2: Break Strain vs. % LMDPE](image)

- \( y = 6.705x + 199 \)
- \( R^2 = 0.9223 \)
Mixed Color Regrind + Virgin MDPE

\[ y = 2.8846e^{0.0852x} \]

\[ R^2 = 0.9616 \]
## TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Mixed Color Regrind + Virgin LMDPE**

**100% + 0%**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>Plaque from blended resin (MB 3X @ 150 Mesh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAMPLE</td>
<td>100% Mixed Color Regrind</td>
</tr>
<tr>
<td>DATE</td>
<td>16-Oct-07</td>
</tr>
<tr>
<td>TRI Log #:</td>
<td>F7601</td>
</tr>
</tbody>
</table>

### TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Mixed Color Regrind + Virgin LMDPE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Replicate 1</th>
<th>Replicate 2</th>
<th>Replicate 3</th>
<th>Replicate 4</th>
<th>Replicate 5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td>0.960</td>
<td>0.960</td>
<td>0.960</td>
<td>0.960</td>
<td>0.000</td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td>2.16 kg (g/10 min)</td>
<td>0.55</td>
<td>0.49</td>
<td>0.52</td>
<td>50.3</td>
<td>50.8</td>
<td>97</td>
</tr>
<tr>
<td>% Ash</td>
<td>1.45</td>
<td>1.46</td>
<td>1.46</td>
<td></td>
<td>1.46</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3708</td>
<td>3613</td>
<td>3623</td>
<td>3626</td>
<td>3493</td>
<td>3613</td>
<td>69</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>158</td>
<td>183</td>
<td>215</td>
<td>158</td>
<td>142</td>
<td>171</td>
<td>26</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td>Failure Time (hours)</td>
<td>7.1</td>
<td>7.9</td>
<td>7.1</td>
<td>7.1</td>
<td>6.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td>Induction Time (min)</td>
<td>12.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.1</td>
</tr>
</tbody>
</table>
## TEST RESULTS
### Recycled HDPE Blend
#### Post Consumer Mixed Color Regrind + Virgin LMDPE
80% + 20%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material</strong></td>
<td>Plaque from blended resin (MB 3X @ 150 Mesh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sample</strong></td>
<td>Mixed Color Regrind + 20% LMDPE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>16-Oct-07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TRI Log #:</strong></td>
<td>F7601</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PARAMETER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.957</td>
<td>0.957</td>
<td>0.957</td>
<td></td>
<td></td>
<td>0.957</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.44</td>
<td>0.43</td>
<td></td>
<td></td>
<td></td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>38.2</td>
<td>39.3</td>
<td></td>
<td></td>
<td></td>
<td>38.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>89</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>1.15</td>
<td>1.24</td>
<td></td>
<td></td>
<td></td>
<td>1.20</td>
<td>0.045</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3425</td>
<td>3410</td>
<td>3475</td>
<td>3437</td>
<td>3412</td>
<td>3432</td>
<td>24</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>164</td>
<td>403</td>
<td>312</td>
<td>427</td>
<td>156</td>
<td>292</td>
<td>115</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>21.2</td>
<td>22.0</td>
<td>18.5</td>
<td>18.1</td>
<td>16.9</td>
<td>19.3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>38.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38.7</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Mixed Color Regrind + Virgin LMDPE**  
**60% + 40%**

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)  
**Sample:** Mixed Color Regrind + 40% LMDPE  
**Date:** 16-Oct-07  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
<td></td>
<td></td>
<td>0.95</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.33</td>
<td>0.34</td>
<td></td>
<td></td>
<td></td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>30.9</td>
<td>30.6</td>
<td></td>
<td></td>
<td></td>
<td>30.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>91</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.94</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td>0.91</td>
<td>0.035</td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3333</td>
<td>3244</td>
<td>3274</td>
<td>3285</td>
<td>3253</td>
<td>3278</td>
<td>31</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>453</td>
<td>550</td>
<td>420</td>
<td>604</td>
<td>491</td>
<td>504</td>
<td>66</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>62.2</td>
<td>58.7</td>
<td>57.8</td>
<td>57.5</td>
<td>57.6</td>
<td>58.8</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>77.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>77.9</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
Post Consumer Mixed Color Regrind + Virgin LMDPE  
40% + 60%

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 16-Oct-07 |
| Sample: Mixed Color Regrind + 60% LMDPE | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.946</td>
<td>0.946</td>
<td>0.946</td>
<td></td>
<td></td>
<td>0.946</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.28</td>
<td>0.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.2</td>
<td>25.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.48</td>
<td>0.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>2993</td>
<td>2906</td>
<td>3031</td>
<td>2966</td>
<td>2861</td>
<td>2951</td>
<td>61</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>703</td>
<td>446</td>
<td>687</td>
<td>712</td>
<td>705</td>
<td>651</td>
<td>103</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>503</td>
<td>823</td>
<td>626</td>
<td>619</td>
<td>342</td>
<td>583</td>
<td>158</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>117</td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Mixed Color Regrind + Virgin LMDPE**

20% + 80%

---

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)

**Date:** 16-Oct-07

**Sample:** Mixed Color Regrind + 80% LMDPE

**TRI Log #:** F7601

## TEST RESULTS

### Recycled HDPE Blend

20% + 80%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.936</td>
<td>0.936</td>
<td>0.937</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.25</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>21.4</td>
<td>21.6</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.15</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>2980</td>
<td>2853</td>
<td>2908</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>672</td>
<td>726</td>
<td>705</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>&gt;1000</td>
<td>&gt;1000</td>
<td>&gt;1000</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>168</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Mixed Color Regrind + Virgin MDPE (Repeat)

<table>
<thead>
<tr>
<th>Property</th>
<th>Virgin MDPE Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% MDPE</td>
</tr>
<tr>
<td>Density $g/cm^3$</td>
<td></td>
</tr>
<tr>
<td>Melt Index $g/10$ min</td>
<td></td>
</tr>
<tr>
<td>Flow Rate $g/10$ min</td>
<td></td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td></td>
</tr>
<tr>
<td>% Color</td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3420</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>226</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>24.8</td>
</tr>
<tr>
<td>OIT (min)</td>
<td></td>
</tr>
</tbody>
</table>
Mixed Color Regrind + Virgin MDPE (Repeat)

\[ y = -10.2x + 3694.7 \]
\[ R^2 = 0.9825 \]

\[ y = 8.74x + 63 \]
\[ R^2 = 0.8378 \]
Mixed Color Regrind + Virgin MDPE (Repeat)

\[ y = 4.195e^{0.0707x} \]

\[ R^2 = 0.9999 \]
## TEST RESULTS
### Recycled HDPE Blend
### Post Consumer Mixed Color Regrind + Virgin LMDPE
75% + 25%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)
Sample: Mixed Color Regrind + 25% LMDPE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)&lt;br&gt;2.16 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)&lt;br&gt;21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)&lt;br&gt;Yield Strength (psi)</td>
<td>3389</td>
<td>3391</td>
<td>3419</td>
<td>3500</td>
<td>3403</td>
<td>3420</td>
<td>41</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)&lt;br&gt;Break Strain (%)</td>
<td>257</td>
<td>245</td>
<td>283</td>
<td>172</td>
<td>174</td>
<td>226</td>
<td>45</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)&lt;br&gt;Failure Time (hours)</td>
<td>25.8</td>
<td>24.3</td>
<td>25.3</td>
<td>25.3</td>
<td>23.4</td>
<td>24.8</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)&lt;br&gt;Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Mixed Color Regrind + Virgin LMDPE**

50% + 50%

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>

#### Density

**ASTM D 1505**

|Density (g/cm3) |  |  |  |  |  |  |  |

#### Melt Flow Index

**ASTM D 1238**

| Composition |  |  |  |  |  |  |  |

#### Composition

| % Ash |  |  |  |  |  |  |  |

#### Tensile Properties

**ASTM D 638**

<table>
<thead>
<tr>
<th>Test Replicate Number</th>
<th>Yield Strength (psi)</th>
<th>Break Strain (%)</th>
<th>Environmental Stress Crack Resistance</th>
<th>Oxidative Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Consumer Mixed Color Regrind + Virgin LMDPE</td>
<td>3286</td>
<td>3159</td>
<td>3254</td>
<td>3214</td>
</tr>
<tr>
<td>50% + 50%</td>
<td>697</td>
<td>475</td>
<td>641</td>
<td>605</td>
</tr>
</tbody>
</table>

#### Environmental Stress Crack Resistance

**ASTM D5397 @ 15% of Yield**

| Failure Time (hours) | 131 | 145 | 125 | 151 | 155 | 141 | 12 |

#### Oxidative Stability

**ASTM D 3895**

| Induction Time (min) |  |  |  |  |  |  |  |

---

Date: 20-Aug-07  
TRI Log #: F7601

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: Mixed Color Regrind + 50% LMDPE
## TEST RESULTS
### Recycled HDPE Blend
### Post Consumer Mixed Color Regrind + Virgin LMDPE
### 25% + 75%

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)  
**Date:** 20-Aug-07  
**Sample:** Mixed Color Regrind + 75% LMDPE  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) |   |   |   |   |   |      |     |
| Density (g/cm3) |   |   |   |   |   |      |     |
| **Melt Flow Index**  
(ASTM D 1238) |   |   |   |   |   |      |     |
| 2.16 kg (g/10min) |   |   |   |   |   |      |     |
| 21.6 kg (g/10 min) |   |   |   |   |   |      |     |
| Ratio |   |   |   |   |   |      |     |
| **Composition** |   |   |   |   |   |      |     |
| % Ash |   |   |   |   |   |      |     |
| **Tensile Properties**  
(ASTM D 638) |   |   |   |   |   |      |     |
| Yield Strength (psi) | 2959 | 2827 | 2875 | 2945 | 2943 | 2910 | 51 |
| Break Strain (%) | 666 | 677 | 673 | 648 | 652 | 663 | 11 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) |   |   |   |   |   |      |     |
| Failure Time (hours) | >850 | >850 | >850 | >850 | >850 | >850 |     |
| **Oxidative Stability**  
(ASTM D 3895) |   |   |   |   |   |      |     |
| Induction Time (min) |   |   |   |   |   |      |     |
## Mixed Color Regrind + PIR-MDPE

<table>
<thead>
<tr>
<th>Property</th>
<th>Virgin MDPE Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% PIR-MD</td>
</tr>
<tr>
<td><strong>Density</strong> g/cm³</td>
<td>0.954</td>
</tr>
<tr>
<td><strong>Melt Index</strong> g/10 min</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>Flow Rate</strong> g/10 min</td>
<td>41.2</td>
</tr>
<tr>
<td><strong>MFR</strong> (21.6/2.16kg)</td>
<td>75</td>
</tr>
<tr>
<td><strong>% Color</strong></td>
<td>1.62</td>
</tr>
<tr>
<td><strong>% Ash</strong></td>
<td>1.17</td>
</tr>
<tr>
<td><strong>Yield Strength</strong> (psi)</td>
<td>3490</td>
</tr>
<tr>
<td><strong>Break Strain (%)</strong></td>
<td>363</td>
</tr>
<tr>
<td><strong>NCTL-15%</strong> (hrs)</td>
<td>15.9</td>
</tr>
<tr>
<td><strong>OIT</strong> (min)</td>
<td>23.3</td>
</tr>
</tbody>
</table>
Mixed Color Regrind + PIR-MDPE

Density (g/cc)

\[ y = -0.0001x + 0.9563 \]
\[ R^2 = 0.9868 \]

% MCRG

% Ash

\[ y = -0.0166x + 1.5567 \]
\[ R^2 = 0.9862 \]

% MCRG
Mixed Color Regrind + PIR-MDPE

$y = 0.0004x + 0.55$
$R^2 = 0.25$

$y = -0.188x + 45.7$
$R^2 = 0.9946$
Mixed Color Regrind + PIR-MDPE

- Equation 1: $y = -9.92x + 3719.7$
  - $R^2 = 0.9839$

- Equation 2: $y = -8.64x + 3527$
Mixed Color Regrind + PIR-MDPE

$y = 5.6977e^{0.0411x}$
$R^2 = 1$

$y = 6.98x + 222.67$
$R^2 = 0.8969$

$y = 5.28x + 164$
## TEST RESULTS

### Recycled HDPE Blend

**PCR Mixed Color Regrind + PIR Regrind MD**

**75% + 25%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (<strong>ASTM D 1505</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.954</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (<strong>ASTM D 1238</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.54</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>41</td>
<td>41.5</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color</td>
<td>1.58</td>
<td>1.66</td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>1.16</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (<strong>ASTM D 638</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3478</td>
<td>3486</td>
<td>3514</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>463</td>
<td>357</td>
<td>243</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (<strong>ASTM D5397 @ 15% of Yield</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>17.8</td>
<td>16.2</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (<strong>ASTM D 3895</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)

**Sample:** 75% MCRG + 25% PIR-MD

**Date:** 16-Aug-07

**TRI Log #:** F7601
## TEST RESULTS

**Recycled HDPE Blend**

**PCR Mixed Color Regrind + PIR Regrind MD**

50% + 50%

---

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)

**Sample:** 50% MCRG + 50% PIR-MD

**Date:** 16-Aug-07

**TRI Log #:** F7601

---

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.951</td>
<td>0.951</td>
<td>0.951</td>
<td></td>
<td></td>
<td>0.95</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.60</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>35.8</td>
<td>35.9</td>
<td></td>
<td></td>
<td></td>
<td>35.85</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color</td>
<td>1.67</td>
<td>1.71</td>
<td></td>
<td></td>
<td></td>
<td>1.69</td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.63</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3135</td>
<td>3183</td>
<td>3197</td>
<td>3225</td>
<td>3197</td>
<td>3187</td>
<td>17</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>667</td>
<td>667</td>
<td>667</td>
<td>640</td>
<td>557</td>
<td>640</td>
<td>13</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>35.2</td>
<td>49.3</td>
<td>47.6</td>
<td>49.8</td>
<td>40.8</td>
<td>44.5</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35.3</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**

**PCR Mixed Color Regrind + PIR Regrind MD**

**25% + 75%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.949</td>
<td>0.95</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>32</td>
<td>31.80</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color</td>
<td>1.79</td>
<td>1.76</td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.36</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>2985</td>
<td>2994</td>
<td>41</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>734</td>
<td>712</td>
<td>13</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>108</td>
<td>124</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td>47.6</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**  
**PCR Mixed Color Reprocessed + PIR Reprocessed HD**  
**75% + 25%**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 24-May-07 |
| Sample: 75% MCR1 + 25% PIR-HD | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.961</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.960</td>
<td>0.961</td>
<td>0.961</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.51</td>
<td>0.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>46.4</td>
<td>45.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color</td>
<td>2.28</td>
<td>2.3</td>
<td>2.17</td>
<td></td>
<td></td>
<td>2.25</td>
<td>0.057</td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3614</td>
<td>3554</td>
<td>3586</td>
<td>3649</td>
<td>3521</td>
<td>3585</td>
<td>39</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>140</td>
<td>81</td>
<td>125</td>
<td>91</td>
<td>104</td>
<td>108</td>
<td>19</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>7.9</td>
<td>8.9</td>
<td>7.9</td>
<td>10.0</td>
<td>8.0</td>
<td>8.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>18.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NCHRP 04-32
**TEST RESULTS**

Recycled HDPE Blend  
Virgin Resin 3 + PCR Mixed Color Reprocessed + Virgin MDPE  
50% + 25% + 25%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: VR3 + 25% MCR1 + 25% MDPE  
Date: 20-Jun-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.941</td>
<td>0.942</td>
<td>0.942</td>
<td></td>
<td></td>
<td>0.942</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>24.4</td>
<td>23.9</td>
<td></td>
<td></td>
<td></td>
<td>24.2</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.42</td>
<td>0.42</td>
<td>0.42</td>
<td></td>
<td></td>
<td>0.42</td>
<td>0.000</td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3507</td>
<td>3575</td>
<td>3563</td>
<td>3649</td>
<td>3575</td>
<td>3574</td>
<td>45</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>604</td>
<td>510</td>
<td>459</td>
<td>526</td>
<td>583</td>
<td>536</td>
<td>52</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>39.3</td>
<td>50.3</td>
<td>38.3</td>
<td>32.1</td>
<td>42.6</td>
<td>40.5</td>
<td>6</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>63.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63.4</td>
<td></td>
</tr>
</tbody>
</table>
C.9 SUMMARY TABLES, GRAPHS, AND TEST REPORTS FOR BLENDS MADE WITH NATURAL, POST-CONSUMER, RECYCLED HDPE
**Virgin Resin 2 + Natural Reprocessed PCR**

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycled Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>0.950</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.36</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>30.9</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>86</td>
</tr>
<tr>
<td>% Ash</td>
<td>0.00</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4195</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>479</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>19.5</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>65.7</td>
</tr>
</tbody>
</table>
Virgin Resin 2 + Natural Reprocessed PCR

y = 0.0001x + 0.948
\( R^2 = 0.8963 \)

\( y = 0.0005x - 0.005 \)
\( R^2 = 0.8333 \)
Virgin Resin 2 + Natural Reprocessed PCR

\[ y = 0.3001e^{0.0081x} \]
\[ R^2 = 0.9796 \]

\[ y = 0.278x + 24.35 \]
\[ R^2 = 0.977 \]
Virgin Resin 2 + Natural Reprocessed PCR

Yield Strength (psi)

\[ y = 3.975x + 4116 \]
\[ R^2 = 0.9135 \]

\[ y = 7.62x + 3764 \]

% Recycled

Break Strain (%)

\[ y = -3.76x + 647 \]

\[ y = -2.555x + 553 \]
\[ R^2 = 0.8663 \]
Virgin Resin 2 + Natural Reprocessed PCR

\[ y = 31.843e^{-0.027x} \]

\[ R^2 = 0.983 \]

\[ y = 36.2e^{-0.0271x} \]

% Recycled

NCTL Failure Time (hrs)
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 2 + Post Consumer Natural Reprocessed**  
**80% + 20%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.950</td>
<td>0.950</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td>0.36</td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.36</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>31</td>
<td>30.8</td>
<td>86</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4297</td>
<td>4195</td>
<td>79</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>450</td>
<td>479</td>
<td>70</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>11.9</td>
<td>19.5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>65.7</td>
<td>65.7</td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 80% Virgin Resin 2 + 20% Nat PCR  
TRI Log #: F7601  
Date: 17-May-07
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 2 + Post Consumer Natural Reprocessed**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: | 17-May-07 |
| Sample: 60% Virgin Resin 2 + 40% Nat. PCR | TRI Log #: | F7601 |

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.952</td>
<td>0.952</td>
<td>0.953</td>
<td></td>
<td></td>
<td><strong>0.952</strong></td>
<td><strong>0.000</strong></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.40</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
<td><strong>0.41</strong></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>34.7</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td><strong>34.4</strong></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>85</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td></td>
<td></td>
<td><strong>0.02</strong></td>
<td><strong>0.000</strong></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4297</td>
<td>4315</td>
<td>4300</td>
<td>4319</td>
<td>4261</td>
<td><strong>4298</strong></td>
<td><strong>21</strong></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>333</td>
<td>521</td>
<td>549</td>
<td>516</td>
<td>522</td>
<td><strong>488</strong></td>
<td><strong>78</strong></td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>9.4</td>
<td>9.4</td>
<td>9.4</td>
<td>10.4</td>
<td>9.4</td>
<td><strong>9.6</strong></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D3895)</td>
<td>47.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 2 + Post Consumer Natural Reprocessed**

40% + 60%

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 17-May-07 |
| Sample: 40% Virgin Resin 2 + 60% Nat. PCR | TRI Log #: F7601 |

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> <em>(ASTM D 1505)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.955</td>
<td>0.956</td>
<td>0.956</td>
<td></td>
<td></td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> <em>(ASTM D 1238)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.47</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
<td>0.47</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>40</td>
<td>40.3</td>
<td></td>
<td></td>
<td></td>
<td>40.2</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>85</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
<td>0.008</td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.04</td>
<td>0.02</td>
<td>0.03</td>
<td></td>
<td></td>
<td>0.03</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> <em>(ASTM D 638)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4310</td>
<td>16</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4301</td>
<td>4333</td>
<td>4315</td>
<td>4315</td>
<td>4286</td>
<td>4310</td>
<td>16</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>422</td>
<td>277</td>
<td>538</td>
<td>202</td>
<td>529</td>
<td>394</td>
<td>134</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> <em>(ASTM D5397 @ 15% of Yield)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.9</td>
<td>0</td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>6.4</td>
<td>6.9</td>
<td>7.1</td>
<td>6.7</td>
<td>7.3</td>
<td>6.9</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> <em>(ASTM D 3895)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.5</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>36.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.5</td>
<td></td>
</tr>
</tbody>
</table>

NCHRP 04-32

C-101
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 2 + Post Consumer Natural Reprocessed 20% + 80%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.956</td>
<td>0.956</td>
<td>0.957</td>
<td></td>
<td></td>
<td>0.956</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.60</td>
<td>0.58</td>
<td></td>
<td></td>
<td></td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>47.7</td>
<td>47.3</td>
<td></td>
<td></td>
<td></td>
<td>47.5</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.04</td>
<td>0.04</td>
<td>0.02</td>
<td></td>
<td></td>
<td>0.03</td>
<td>0.009</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4442</td>
<td>4397</td>
<td>4520</td>
<td>4446</td>
<td>4474</td>
<td>4456</td>
<td>40</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>605</td>
<td>143</td>
<td>381</td>
<td>326</td>
<td>247</td>
<td>340</td>
<td>155</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>3.4</td>
<td>3.8</td>
<td>3.4</td>
<td>4.1</td>
<td>3.2</td>
<td>3.6</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>23.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23.6</td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 20% Virgin Resin 2 + 80% Nat. PCR  
Date: 17-May-07  
TRI Log #: F7601
## TEST RESULTS

**Recycled HDPE Blend**

**Reprocessed Post Consumer Natural HD 100%**

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 100% Nat PCR  
Date: 17-May-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) |   |   |   |   |   |      |     |
| Density (g/cm³) | 0.960 | 0.959 | 0.959 |   |   | 0.959 | 0.000 |
| **Melt Flow Index**  
(ASTM D 1238) |   |   |   |   |   |      |     |
| 2.16 kg (g/10min) | 0.76 | 0.77 |   |   |   | 0.77 |     |
| 21.6 kg (g/10 min) | 58.6 | 57.7 |   |   |   | 58.2 |     |
| Ratio |   |   |   |   |   | 76   |     |
| **Composition** |   |   |   |   |   |      |     |
| % Color/Ash | 0.06 | 0.04 | 0.00 |   |   | 0.03 | 0.025 |
| **Tensile Properties**  
(ASTM D 638) |   |   |   |   |   |      |     |
| Yield Strength (psi) | 4575 | 4644 | 4549 | 4597 | 4457 | 4564 | 62 |
| Break Strain (%) | 323 | 214 | 334 | 295 | 397 | 313 | 60 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) |   |   |   |   |   |      |     |
| Failure Time (hours) | 3.3 | 3.2 | 3.2 | 3.0 | 2.4 | 3.0 | 0 |
| **Oxidative Stability**  
(ASTM D 3895) |   |   |   |   |   |      |     |
| Induction Time (min) | 15.7 |   |   |   |   | 15.7 |     |
### Natural Reprocessed + LLDPE

<table>
<thead>
<tr>
<th>Property</th>
<th>LLDPE Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% LL</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>0.960</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.79</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>56.0</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>71</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4523</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>365</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>2.0</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>15.6</td>
</tr>
</tbody>
</table>
Natural Reprocessed + LLDPE

Density (g/cc) vs. % Recycled

\[ y = -0.0004x + 0.961 \]
\[ R^2 = 0.9805 \]

NCTL Failure Time (hrs) vs. % LLDPE

\[ y = 1.3205e^{0.0779x} \]
\[ R^2 = 0.9773 \]
Natural Reprocessed + LLDPE

For MFI (g/10 min):

\[ y = 0.7031e^{-0.0072x} \]

\[ R^2 = 0.9378 \]

For HLMFI (g/10 min):

\[ y = -0.5557x + 54.343 \]

\[ R^2 = 0.9988 \]
Natural Reprocessed + LLDPE

Yield Strength (psi)

\[ y = -32.268x + 4318.5 \]
\[ R^2 = 0.9992 \]

Break Strain (%)

\[ y = 3.8035x + 483.43 \]
\[ R^2 = 0.7039 \]
# TEST RESULTS

**Recycled HDPE Classification**

**PCR Natural Reprocessed**

**Prepared by TRI**

---

**Material:** Plaque from blended resin (MB 2X @ 100 Mesh)  
**Sample:** 100% Natural Repro  
**Date:** 13-Feb-07  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.960</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.71</td>
<td>0.87</td>
<td>0.79</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>52.7</td>
<td>59.3</td>
<td>56.0</td>
</tr>
<tr>
<td>Ratio</td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td>0.08</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.06</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4543</td>
<td>4507</td>
<td>4515</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>70</td>
<td>194</td>
<td>496</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**

**Natural Reprocessed + LLDPE 95% + 5%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> <em>(ASTM D 1505)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.958</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> <em>(ASTM D 1238)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10 min)</td>
<td>0.70</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>52.8</td>
<td>50.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> <em>(ASTM D 638)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4217</td>
<td>4132</td>
<td>4162</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>255</td>
<td>601</td>
<td>629</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> <em>(ASTM D5397 @ 15% of Yield)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>2.8</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> <em>(ASTM D 3895)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin
Sample: 95% Natural Repro + 5% LLDPE

Date: 23-Feb-07
TRI Log #: F7601
### TEST RESULTS

**Recycled HDPE Blend**  
**Natural Reprocessed + LLDPE**  
**90% + 10%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.958</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10 min)</td>
<td>0.63</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>49.1</td>
<td>48.6</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.02</td>
<td>1.01</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4127</td>
<td>3986</td>
<td>3960</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>379</td>
<td>728</td>
<td>599</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>2.7</td>
<td>2.7</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**

**Natural Reprocessed + LLDPE**

80% + 20%

---

<table>
<thead>
<tr>
<th>Material: Plaque from blended resin</th>
<th>Date: 23-Feb-07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample: 80% Natural Repro + 20% LLDPE</td>
<td>TRI Log #: F7601</td>
</tr>
</tbody>
</table>

### PARAMETER

<table>
<thead>
<tr>
<th>Density</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>0.951</td>
<td>0.952</td>
<td>0.952</td>
<td></td>
<td></td>
<td>0.952</td>
<td>0.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Melt Flow Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ASTM D 1238)</td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
</tr>
<tr>
<td>Ratio</td>
</tr>
</tbody>
</table>

### Composition

| % Volatiles |      |
| % Color/Ash | 1.00 | 1.02 | 1.02 |     |     | 1.01  | 0.009 |

### Tensile Properties

<table>
<thead>
<tr>
<th>Yield Strength (psi)</th>
<th>3792</th>
<th>3608</th>
<th>3697</th>
<th>3658</th>
<th>3632</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break Strain (%)</td>
<td>665</td>
<td>349</td>
<td>754</td>
<td>755</td>
<td>561</td>
<td>617</td>
<td>152</td>
</tr>
</tbody>
</table>

### Environmental Stress Crack Resistance

(ASTM D5397 @ 15% of Yield)

<table>
<thead>
<tr>
<th>Failure Time (hours)</th>
<th>4.3</th>
<th>5.4</th>
<th>5.2</th>
<th>4.7</th>
<th>4.9</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>

### Oxidative Stability

(ASTM D 3895)

<table>
<thead>
<tr>
<th>Induction Time (min)</th>
<th></th>
</tr>
</thead>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Natural Reprocessed + LLDPE**

**60% + 40%**

---

**Material:** Plaque from blended resin  
**Sample:** 60% Natural Repro + 40% LLDPE  
**Date:** 23-Feb-07  
**TRI Log #:** F7601

### PARAMETER

<table>
<thead>
<tr>
<th>Test Replicate Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.944</td>
<td>0.944</td>
<td>0.945</td>
<td></td>
<td></td>
<td>0.944</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.52</td>
<td>0.53</td>
<td></td>
<td></td>
<td></td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>32.4</td>
<td>32.3</td>
<td></td>
<td></td>
<td></td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>61</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Volatiles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3098</td>
<td>3029</td>
<td>3029</td>
<td>3043</td>
<td>2944</td>
<td>3029</td>
<td>49</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>596</td>
<td>665</td>
<td>636</td>
<td>571</td>
<td>608</td>
<td>615</td>
<td>33</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>31.1</td>
<td>31.8</td>
<td>34.5</td>
<td>39.4</td>
<td>29.5</td>
<td>33.3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
## Natural Reprocessed + Virgin MDPE

<table>
<thead>
<tr>
<th>Property</th>
<th>Virgin MDPE Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% MDPE</td>
</tr>
<tr>
<td>Density ( \text{g/cm}^3 )</td>
<td>0.960</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.81</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>61.9</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>76</td>
</tr>
<tr>
<td>Ash</td>
<td>0.05</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4489</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>229</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>1.8</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>9.0</td>
</tr>
</tbody>
</table>
Natural Reprocessed + Virgin MDPE

Density (g/cc)

\[ y = -0.0003x + 0.959 \]
\[ R^2 = 0.924 \]

% LMDPE

% Ash

\[ y = -0.0008x + 0.085 \]
\[ R^2 = 0.1969 \]

% LMDPE
Natural Reprocessed + Virgin MDPE

\[ y = 0.7117e^{-0.0129x} \]
\[ R^2 = 0.9948 \]

\[ y = 57.453e^{-0.012x} \]
\[ R^2 = 0.9988 \]
Natural Reprocessed + Virgin MDPE

Yield Strength (psi)

\[ y = -17.295x + 4355 \]
\[ R^2 = 0.9982 \]

Break Strain (%)

\[ y = 5.055x + 291.5 \]
\[ R^2 = 0.9633 \]
Natural Reprocessed + Virgin MDPE

$y = 1.0447e^{0.0699x}$

$R^2 = 0.9889$
## TEST RESULTS

**Recycled HDPE Blend**  
Post Consumer Natural Reprocessed + Virgin LMDPE  
100% + 0%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: Nat Repro  
Date: 22-Oct-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.960</td>
<td>0.96</td>
<td>0.96</td>
<td></td>
<td></td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.80</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>62.5</td>
<td>61.2</td>
<td></td>
<td></td>
<td></td>
<td>61.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>76</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.02</td>
<td>0.03</td>
<td>0.10</td>
<td></td>
<td></td>
<td>0.05</td>
<td>0.036</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4396</td>
<td>4539</td>
<td>4495</td>
<td>4492</td>
<td>4522</td>
<td>4489</td>
<td>50</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>169</td>
<td>127</td>
<td>245</td>
<td>354</td>
<td>249</td>
<td>229</td>
<td>78</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Natural Reprocessed + Virgin LMDPE**  
80% + 20%

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)  
**Sample:** Nat Repro + 20% LMDPE  
**Date:** 22-Oct-07  
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.954</td>
<td></td>
<td></td>
<td>0.954</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.56</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>45.3</td>
<td>45.8</td>
<td></td>
<td></td>
<td></td>
<td>45.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.07</td>
<td>0.09</td>
<td></td>
<td></td>
<td></td>
<td>0.08</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3927</td>
<td>4027</td>
<td>4070</td>
<td>4053</td>
<td>3997</td>
<td>4015</td>
<td>50</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>228</td>
<td>559</td>
<td>269</td>
<td>505</td>
<td>309</td>
<td>374</td>
<td>133</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>4.7</td>
<td>4.5</td>
<td>4.6</td>
<td>4.8</td>
<td>4.5</td>
<td>4.6</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>33.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>33.8</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Natural Reprocessed + Virgin LMDPE**  
*60% + 40%*

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Date: 22-Oct-07  
Sample: Nat Repro + 40% LMDPE  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm(^3))</td>
<td>0.950</td>
<td>0.950</td>
<td>0.950</td>
<td></td>
<td></td>
<td>0.950</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.43</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
<td>0.42</td>
<td>0.004</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>35.2</td>
<td>35.5</td>
<td></td>
<td></td>
<td></td>
<td>35.4</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>83</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3683</td>
<td>3655</td>
<td>3650</td>
<td>3695</td>
<td>3655</td>
<td>3668</td>
<td>18</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>242</td>
<td>658</td>
<td>515</td>
<td>574</td>
<td>547</td>
<td>507</td>
<td>141</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>14.2</td>
<td>14.6</td>
<td>14.2</td>
<td>14.3</td>
<td>14.8</td>
<td>14.4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>72.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

Post Consumer Natural Reprocessed + Virgin LMDPE

40% + 60%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: Nat Repro + 60% LMDPE  
Date: 22-Oct-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td>1</td>
<td>0.941</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>2</td>
<td>0.941</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.941</td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>4</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>5</td>
<td>27.7</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>1</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3</td>
<td>3373</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3364</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3273</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>1</td>
<td>60.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>40.9</td>
<td></td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>1</td>
<td>125.0</td>
<td></td>
</tr>
<tr>
<td>(ASTM D3895)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
**Post Consumer Natural Reprocessed + Virgin LMDPE**  
**20% + 80%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) |         |         |         |         |         |      |     |
| Density (g/cm³) | 0.940   | 0.940   | 0.940   |         |         | 0.940 | 0.00 |
| **Melt Flow Index**  
(ASTM D 1238) |         |         |         |         |         |      |     |
| 2.16 kg (g/10min) | 0.25    | 0.27    |         |         |         | 0.26  |     |
| 21.6 kg (g/10 min) | 22.2    | 22.3    |         |         |         | 22.3  |     |
| Ratio     | 85      |         |         |         |         |      |     |
| **Composition** |         |         |         |         |         |      |     |
| % Ash     | 0.00    | 0.00    |         |         |         | 0.00  | 0.00 |
| **Tensile Properties**  
(ASTM D 638) |         |         |         |         |         |      |     |
| Yield Strength (psi) | 2945    | 2954    | 3018    | 3057    | 2968    | 2988  | 43  |
| Break Strain (%) | 688     | 704     | 705     | 677     | 586     | 672   | 44  |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) |         |         |         |         |         |      |     |
| Failure Time (hours) | >750    | >750    | >750    | >750    | >750    | >750  |     |
| **Oxidative Stability**  
(ASTM D 3895) |         |         |         |         |         |      |     |
| Induction Time (min) (ASTM D3895) | 176.0   |         |         |         |         | 176.0 |     |
**Virgin Resin 1 + (Natural Reprocessed PCR + 10% Virgin LLDPE)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Property Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>0.951</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.192</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>29.7</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>155</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3896</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>278</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>10.5</td>
</tr>
<tr>
<td>OIT (min)</td>
<td></td>
</tr>
</tbody>
</table>
Virgin Resin 1 + (Natural Reprocessed + 10% LLDPE)

Density (g/cc)

\[ y = 0.0001x + 0.949 \]
\[ R^2 = 0.968 \]

NCTL Failure Time (hrs)

\[ y = 20.592e^{-0.0178x} \]
\[ R^2 = 0.6512 \]
\[ y = 45.8e^{-0.0273x} \]
Virgin Resin 1 + (Natural Reprocessed + 10% LLDPE)

\[ y = 0.1388e^{0.0148x} \]
\[ R^2 = 0.9895 \]

\[ y = 26.025e^{0.0059x} \]
\[ R^2 = 0.9945 \]
Virgin Resin 1 + (Natural Reprocessed + 10% LLDPE)

**Yield Strength (psi)**

- Linear equation: \( y = 0.415x + 3905.5 \)
- \( R^2 = 0.2146 \)

**Break Strain (%)**

- Linear equation: \( y = -0.67x + 478 \)
- \( R^2 = 0.8614 \)
<table>
<thead>
<tr>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.951</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>29.7</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>155</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3959</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>499</td>
<td></td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)**

**60% + 40%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.24</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10min)</td>
<td>32.9</td>
<td>32.6</td>
<td></td>
</tr>
<tr>
<td><strong>Ratio</strong></td>
<td></td>
<td></td>
<td>133</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3986</td>
<td>3907</td>
<td>3934</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>498</td>
<td>539</td>
<td>550</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>14.6</td>
<td>13.9</td>
<td>17.2</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 100 Mesh)
Sample: VR1 + 40% (Nat + 10% LL)
TRI Log #: F7601
# TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)**

**40% + 60%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.955</td>
<td>0.955</td>
<td>0.955</td>
<td>0.955</td>
<td>0.955</td>
<td>0.955</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.31</td>
<td>0.33</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>36.7</td>
<td>37.0</td>
<td>36.9</td>
<td>36.9</td>
<td>36.9</td>
<td>36.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4014</td>
<td>3958</td>
<td>3986</td>
<td>3913</td>
<td>3870</td>
<td>3948</td>
<td>51</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>535</td>
<td>550</td>
<td>211</td>
<td>538</td>
<td>450</td>
<td>457</td>
<td>128</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>8.0</td>
<td>7.9</td>
<td>8.5</td>
<td>7.7</td>
<td>9.2</td>
<td>8.3</td>
<td>1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 100 Mesh)
Sample: VR1 + 60% (Nat + 10% LL)
Date: 5-Mar-07
TRI Log #: F7601
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 1 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)**

20% + 80%

---

**Material:** Plaque from blended resin (MB 3X @ 100 Mesh)

**Sample:** VR1 + 80% (Nat + 10% LL)

**Date:** 5-Mar-07

**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.958</td>
<td>0.958</td>
<td>0.958</td>
<td></td>
<td></td>
<td><strong>0.958</strong></td>
<td><strong>0.000</strong></td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.46</td>
<td>0.48</td>
<td></td>
<td></td>
<td></td>
<td><strong>0.47</strong></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>42.1</td>
<td>42.5</td>
<td></td>
<td></td>
<td></td>
<td><strong>42.3</strong></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>90</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4041</td>
<td>3930</td>
<td>3956</td>
<td>3867</td>
<td>3812</td>
<td><strong>3921</strong></td>
<td>78</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>573</td>
<td>569</td>
<td>532</td>
<td>146</td>
<td>464</td>
<td><strong>457</strong></td>
<td>160</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>3.4</td>
<td>4.2</td>
<td>3.8</td>
<td>3.8</td>
<td>4.2</td>
<td><strong>3.9</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Natural Reprocessed + 10% Virgin LLDPE**

100%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material:</strong> Plaque from blended resin (MB 3X @ 100 Mesh)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sample:</strong> 100% (Nat + 10% LL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Date:</strong> 5-Mar-07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TRI Log #:</strong> F7601</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Density (ASTM D 1505):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.958</td>
<td>0.957</td>
<td>0.958</td>
<td></td>
<td></td>
<td>0.958</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.63</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>48.6</td>
<td>49.1</td>
<td></td>
<td></td>
<td></td>
<td>48.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>77</td>
<td></td>
</tr>
<tr>
<td><strong>Composition:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.06</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4127</td>
<td>3986</td>
<td>3960</td>
<td>3935</td>
<td>3870</td>
<td>3976</td>
<td>85</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>379</td>
<td>728</td>
<td>599</td>
<td>581</td>
<td>191</td>
<td>496</td>
<td>189</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>3.1</td>
<td>3.5</td>
<td>3.2</td>
<td>3.3</td>
<td>3.1</td>
<td>3.2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NCHRP 04-32 C-131
### Virgin Resin 2 + (Natural Reprocessed PCR + 10% Virgin LLDPE)

<table>
<thead>
<tr>
<th>Property</th>
<th>0% Recycle</th>
<th>18% Recycle</th>
<th>36% Recycle</th>
<th>54% Recycle</th>
<th>72% Recycle</th>
<th>100% Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density g/cm³</td>
<td>0.952</td>
<td>0.946</td>
<td>0.946</td>
<td>0.946</td>
<td>0.945</td>
<td>0.956</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.33</td>
<td>0.35</td>
<td>0.39</td>
<td>0.43</td>
<td>0.54</td>
<td>0.66</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>28.3</td>
<td>29.9</td>
<td>32.4</td>
<td>36.6</td>
<td>42.8</td>
<td>46.7</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>87</td>
<td>81</td>
<td>84</td>
<td>86</td>
<td>80</td>
<td>71</td>
</tr>
<tr>
<td>% Ash</td>
<td>0.04</td>
<td>0.06</td>
<td>0.07</td>
<td>0.07</td>
<td>0.09</td>
<td>0.12</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4021</td>
<td>3986</td>
<td>4094</td>
<td>4138</td>
<td>3942</td>
<td>4099</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>675</td>
<td>517</td>
<td>417</td>
<td>542</td>
<td>452</td>
<td>327</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>42.4</td>
<td>19.6</td>
<td>11.0</td>
<td>6.0</td>
<td>4.7</td>
<td>2.7</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>83.0</td>
<td>55.4</td>
<td>44.3</td>
<td>37.5</td>
<td>31.3</td>
<td>24.2</td>
</tr>
</tbody>
</table>
Virgin Resin 2 + (Natural Reprocessed PCR + 10% Virgin LLDPE)

Density (g/cc) vs. % Recycled

\[ y = -2 \times 10^{-5}x + 0.9465 \]

\[ R^2 = 0.6 \]

% Ash vs. % Recycled

\[ y = 0.0004x + 0.05 \]

\[ R^2 = 0.8526 \]
Virgin Resin 2 + (Natural Reprocessed PCR + 10% Virgin LLDPE)

- **MFI (g/10 min)**
  - Equation: $y = 0.2974e^{0.007x}$
  - $R^2 = 0.9554$

- **HLMFI (g/10 min)**
  - Equation: $y = 26.015e^{0.006x}$
  - $R^2 = 0.9801$
Virgin Resin 2 + (Natural Reprocessed PCR + 10% Virgin LLDPE)

Yield Strength (psi)

\[ y = -0.44x + 4062 \]
\[ R^2 = 0.0155 \]
\[ y = 1.13x + 3924 \]

Break Strain (%)

\[ y = -2.28x + 639 \]
\[ R^2 = 0.0246 \]
\[ y = -0.35x + 499.5 \]
\[ R^2 = 0.0246 \]
Virgin Resin 2 + (Natural Reprocessed PCR + 10% Virgin LLDPE)
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.952</td>
<td>0.952</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.33</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>28.3</td>
<td>28.3</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>87</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.03</td>
<td>0.04</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3986</td>
<td>3932</td>
<td>4021</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>741</td>
<td>825</td>
<td>675</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>45.8</td>
<td>37.4</td>
<td>42.4</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>83.0</td>
<td></td>
<td>83.0</td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 2 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)**

80% + 20%

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 28-Jun-07 |
| Sample: 80% Virgin Resin 2 + 20% (Nat. PCR + 10% LL) | TRI Log #: F7601 |

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td>1</td>
<td>0.946</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>2</td>
<td>0.946</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.946</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.946</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.946</td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td>1</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>2</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>4</td>
<td>29.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>27.5</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>5</td>
<td>28.7</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>1</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>2</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.019</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td>1</td>
<td>3986</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>2</td>
<td>4043</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3985</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3917</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>3986</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STD</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>1</td>
<td>541</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>541</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>514</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>525</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>464</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>517</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STD</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td><strong>Environment Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td>1</td>
<td>18.7</td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>2</td>
<td>21.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>19.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>19.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>19.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>STD</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td>1</td>
<td>55.4</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>2</td>
<td>55.4</td>
<td></td>
</tr>
</tbody>
</table>

---

NCHRP 04-32
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Test Replicate Number</th>
<th></th>
<th></th>
<th></th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>1</td>
<td>0.946</td>
<td>0.946</td>
<td>0.946</td>
<td>0.946</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td>2</td>
<td>0.38</td>
<td>0.39</td>
<td></td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>32.5</td>
<td>32.3</td>
<td></td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>% Color/Ash</td>
<td>0.06</td>
<td>0.09</td>
<td>0.07</td>
<td>0.07</td>
<td>0.012</td>
</tr>
<tr>
<td>Tensile Properties</td>
<td>Yield Strength (psi)</td>
<td>4129</td>
<td>4100</td>
<td>4069</td>
<td>4116</td>
<td>4057</td>
</tr>
<tr>
<td></td>
<td>Break Strain (%)</td>
<td>503</td>
<td>270</td>
<td>400</td>
<td>380</td>
<td>533</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance</td>
<td>Failure Time (hours)</td>
<td>10.7</td>
<td>12.0</td>
<td>10.8</td>
<td>10.7</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>Oxidative Stability</td>
<td>Induction Time (min)</td>
<td>44.3</td>
<td></td>
<td></td>
<td>44.3</td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 2 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)**  
**40% + 60%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(Density (g/cm³)) | 1 | 2 | 3 | 4 | 5 | 0.946 | 0.000 |
| **Melt Flow Index**  
(Melt Flow Index (ASTM D 1238)) | 2.16 kg (g/10min) | 0.42 | 0.44 | 0.43 | 0.43 | 0.43 | 0.000 |
| | 21.6 kg (g/10 min) | 36.5 | 36.6 | 36.6 | 36.6 | 36.6 | 0.000 |
| **Composition** | % Color/Ash | 0.08 | 0.07 | 0.06 | 0.07 | 0.008 |
| **Tensile Properties**  
(Yield Strength (psi)) | 4133 | 3960 | 4173 | 4208 | 4216 | 4138 | 94 |
| | Break Strain (%) | 564 | 542 | 541 | 512 | 550 | 542 | 17 |
| **Environmental Stress Crack Resistance**  
(Failure Time (hours)) | 6.2 | 5.9 | 5.9 | 5.9 | 5.9 | 6.0 | 0 |
| **Oxidative Stability**  
(Induction Time (min)) | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 37.5 | 0.000 |

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 40% Virgin Resin 2 + 60% (Nat. PCR + 10% LL)  
Date: 28-Jun-07  
TRI Log #: F7601
## TEST RESULTS

**Recycled HDPE Blend**

Virgin Resin 2 + (Post Consumer Natural Reprocessed + 10% Virgin LLDPE)

20% + 80%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.945</td>
<td>0.945</td>
<td>0.945</td>
<td></td>
<td></td>
<td>0.945</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.52</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>43.3</td>
<td>42.3</td>
<td></td>
<td></td>
<td></td>
<td>42.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.10</td>
<td>0.09</td>
<td>0.08</td>
<td></td>
<td></td>
<td>0.09</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>4014</td>
<td>3928</td>
<td>3958</td>
<td>3914</td>
<td>3897</td>
<td>3942</td>
<td>41</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>535</td>
<td>478</td>
<td>185</td>
<td>503</td>
<td>561</td>
<td>452</td>
<td>137</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>4.7</td>
<td>5.2</td>
<td>4.5</td>
<td>4.6</td>
<td>4.7</td>
<td>4.7</td>
<td>0</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>31.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.3</td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X)
Sample: 20% Virgin Resin 2 + 80% (Nat. PCR + 10% LL)
Date: 28-Jun-07
TRI Log #: F7601
## TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Natural Reprocessed + 10% Virgin LLDPE**

**100%**

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: 100% (Nat. PCR + 10% LL)  
Date: 28-Jun-07  
TRI Log #: F7601

### TEST RESULTS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**
ASTM D 1505                                     |       |       |       |       |       |      |     |
| Density (g/cm3)                                 | 0.956 | 0.956 | 0.956 |       |       | 0.956| 0.000|
| **Melt Flow Index**
ASTM D 1238                                      |       |       |       |       |       |      |     |
| 2.16 kg (g/10min)                               | 0.65  | 0.67  |       |       |       | 0.66 |     |
| 21.6 kg (g/10 min)                              | 45.8  | 47.6  |       |       |       | 46.7 |     |
| Ratio                                           |       |       |       |       |       | 71   |     |
| **Composition**                                 |       |       |       |       |       |      |     |
| % Color/Ash                                      | 0.10  | 0.16  | 0.11  |       |       | 0.12 | 0.026|
| **Tensile Properties**
ASTM D 638                                       |       |       |       |       |       |      |     |
| Yield Strength (psi)                            | 4104  | 4042  | 4125  | 4145  | 4081  | 4099 | 36  |
| Break Strain (%)                                | 208   | 100   | 547   | 568   | 210   | 327  | 193 |
| **Environmental Stress Crack Resistance**
ASTM D5397 @ 15% of Yield                        |       |       |       |       |       |      |     |
| Failure Time (hours)                            | 2.6   | 2.7   | 2.7   | 2.6   | 2.7   | 2.7  | 0   |
| **Oxidative Stability**
ASTM D 3895                                      |       |       |       |       |       |      |     |
| Induction Time (min)
ASTM D3895                                      | 24.2  |       |       |       |       | 24.2 |     |
## Virgin Resin 1 + (Natural Reprocessed PCR + 35% LLDPE)

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycle Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td></td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td></td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td></td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td></td>
</tr>
<tr>
<td>% Color + Ash</td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3697</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>501</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>36.7</td>
</tr>
<tr>
<td>OIT (min)</td>
<td></td>
</tr>
</tbody>
</table>
Virgin Resin 1 + (Natural Reprocessed PCR + 35% LLDPE)

Yield Strength (psi)

\[ y = -4.835x + 3800 \quad R^2 = 0.9761 \]

\[ y = -4.85x + 3688 \]

% Recycled

Break Strain (%)

\[ y = 2.165x + 516 \quad R^2 = 0.4525 \]

\[ y = 1.77x + 478 \]

% Recycled
Virgin Resin 1 + (Natural Reprocessed PCR + 35% LLDPE)

\[ y = 43.269e^{-0.0093x} \]
\[ R^2 = 0.9297 \]

\[ y = 45.8e^{-0.0085x} \]

% Recycled

NCTL Failure Time (hrs)
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + (PCR Natural + 35% LLDPE)**

**80% + 20%**

Material: Plaque from blended resin (MB 3X @ 100 Mesh)  
Sample: VR1 + 20% N35LL  
Date: 24-Aug-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong> (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong> (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties</strong> (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3685</td>
<td>3618</td>
<td>3693</td>
<td>3781</td>
<td>3708</td>
<td>3697</td>
<td>52</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>458</td>
<td>553</td>
<td>518</td>
<td>475</td>
<td>501</td>
<td>501</td>
<td>37</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong> (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>34.6</td>
<td>34.7</td>
<td>36.5</td>
<td>41.1</td>
<td>36.6</td>
<td>36.7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong> (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + (PCR Natural + 35% LLDPE)**

**60% + 40%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3678</td>
<td>3620</td>
<td>3630</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>685</td>
<td>662</td>
<td>699</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>27.4</td>
<td>31.2</td>
<td>26.5</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 1 + (PCR Natural + 35% LLDPE)**  
**40% + 60%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3597 3575 3438 3315 3507</td>
<td>3486</td>
<td>102</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>667 716 712 629 616</td>
<td>668</td>
<td>41</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>26.5 26.5 24.6 26.3 30.4</td>
<td>26.9</td>
<td>2</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 1 + (PCR Natural + 35% LLDPE)**

**20% + 80%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% PP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3458</td>
<td>3408</td>
<td>3366</td>
<td>3507</td>
<td>3371</td>
<td>3422</td>
<td>54</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>713</td>
<td>630</td>
<td>577</td>
<td>675</td>
<td>649</td>
<td>649</td>
<td>45</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>18.9</td>
<td>21.9</td>
<td>20.4</td>
<td>20.4</td>
<td>18.5</td>
<td>20.0</td>
<td>1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>(ASTM D3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

**PCR Natural + 35% LLDPE**

**Material:** Plaque from blended resin (MB 3X @ 100 Mesh)

**Sample:** 100% N35LL (65% Recycled)

**Date:** 24-Aug-07

**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**
  (ASTM D 1505)                                 |     |     |     |     |     |      |     |
| Density (g/cm³)                                 |     |     |     |     |     |      |     |
| **Melt Flow Index**
  (ASTM D 1238)                                  |     |     |     |     |     |      |     |
| 2.16 kg (g/10min)                               |     |     |     |     |     |      |     |
| 21.6 kg (g/10 min)                              |     |     |     |     |     |      |     |
| **Ratio**                                       |     |     |     |     |     |      |     |
| **Composition**                                 |     |     |     |     |     |      |     |
| % Color/Ash                                     |     |     |     |     |     |      |     |
| % PP                                           |     |     |     |     |     |      |     |
| **Tensile Properties**
  (ASTM D 638)                                   |     |     |     |     |     |      |     |
| Yield Strength (psi)                            | 3233| 3111| 3176| 3268| 3226| 3203 | 54  |
| Break Strain (%)                                | 607 | 678 | 632 | 660 | 696 | 655  | 32  |
| **Environmental Stress Crack Resistance**
  (ASTM D5397 @ 15% of Yield)                     |     |     |     |     |     |      |     |
| Failure Time (hours)                            | 15.4| 23.7| 17.5| 20.5| 20.5| 19.5  | 3   |
| **Oxidative Stability**
  (ASTM D 3895)                                  |     |     |     |     |     |      |     |
| Induction Time (min)                            |     |     |     |     |     |      |     |
# TEST RESULTS

**Recycled HDPE Blend**

**Post Consumer Natural Reprocessed + Virgin LMDPE**

**50% + 50%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong>&lt;br&gt;(ASTM D 1505)</td>
<td>1 0.947 2 0.947 3 0.947</td>
<td>0.947</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong>&lt;br&gt;(ASTM D 1238)</td>
<td>1 0.36 2 0.35</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)&lt;br&gt;21.6 kg (g/10 min)</td>
<td>1 30.9 2 31.0</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td><strong>Ratio</strong></td>
<td></td>
<td>88</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>1 0.05 2 0.07 3 0.10</td>
<td>0.07</td>
<td>0.021</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong>&lt;br&gt;(ASTM D 638)</td>
<td>1 3429 2 3480 3 3443 4 3368 5 3386</td>
<td>3421</td>
<td>40</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>1 733 2 224 3 643 4 661 5 464</td>
<td>545</td>
<td>183</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>1 322 2 269 3 360 4 315 5 300</td>
<td>322</td>
<td>4</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong>&lt;br&gt;(ASTM D5397 @ 15% of Yield)</td>
<td>1 36.7 2 26.9 3 36.0 4 31.5 5 30.0</td>
<td>32.2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong>&lt;br&gt;(ASTM D 3895)</td>
<td>1 113</td>
<td>113</td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 150 Mesh)
Sample: Nat Repro + 50% MDPE
Date: 13-Feb-07
TRI Log #: F7601
## TEST RESULTS

### Recycled HDPE Blend

**PCR Natural Reprocessed + PIR Reprocessed LD**

**65% + 35%**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date:       | 24-May-07 |
| Sample: 65% PCR Nat + 35% PIR-LD                     | TRI Log #:  | F7601     |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) | Density (g/cm3) | 0.956 | 0.957 | 0.957 | Mean | 0.957 | 0.000 |
| **Melt Flow Index**  
(ASTM D 1238) | 2.16 kg (g/10min) | 0.74 | 0.74 | | Mean | 0.74 | 0.000 |
| | 21.6 kg (g/10 min) | 42.2 | 41.7 | | Mean | 42.0 | 0.000 |
| **Ratio** | | | | | | | 57 |
| **Composition** |% Volatiles | | | | | | 1.46 |
| |% Color | 1.46 | 1.46 | 2.11 | Mean | 1.68 | 0.306 |
| |% Ash | | | | | | #DIV/0! |
| **Tensile Properties**  
(ASTM D 638) | Yield Strength (psi) | 3410 | 3400 | 3329 | 3486 | 3423 | 3410 | 64 |
| | Break Strain (%) | 548 | 639 | 587 | 668 | | 611 | 34 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) | Failure Time (hours) | 7.6 | 9.2 | 8.2 | 6.9 | 7.0 | 7.8 | 0.9 |
| **Oxidative Stability**  
(ASTM D 3895) | Induction Time (min) | 12.1 | | | | | 12.1 | 0.0 |

NCHRP 04-32

C-152
### TEST RESULTS

**Recycled HDPE Blend**  
Virgin Resin 3 + Post Consumer Natural Reprocessed + Virgin MD  
50% + 25% + 25%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.942  0.942  0.942</td>
<td>0.942</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.33  0.31</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>26.6  26.3</td>
<td>26.5</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>83</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Ash</td>
<td>0.08  0.04  0.06</td>
<td>0.06</td>
<td>0.016</td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3507  3535  3430  3455 3366</td>
<td>3459</td>
<td>59</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>661  483  653  669  665</td>
<td>626</td>
<td>72</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>33.7  36.7  38.0  34.0 35.6</td>
<td>35.6</td>
<td>2</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>65.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 50% VR3 + 25% Nat Repro + 25% MDPE  
Date: 25-May-07  
TRI Log #: F7601
C.10 SUMMARY TABLES, GRAPHS, AND TEST REPORTS FOR BLENDS MADE WITH POST-INDUSTRIAL RECYCLED HDPE
## Virgin Resin 1 + Post Industrial HD

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycle Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density g/cm$^3$</td>
<td>0.949</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.15</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>25.9</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>179</td>
</tr>
<tr>
<td>% Color + Ash</td>
<td>0.06</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3555</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>484</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>47.6</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>21.0</td>
</tr>
</tbody>
</table>
Virgin Resin 1 + Post Industrial HD

\[ y = 0.0001x + 0.9515 \]
\[ R^2 = 0.8895 \]

\[ y = 0.0399x + 0.1 \]
\[ R^2 = 0.9999 \]
Virgin Resin 1 + Post Industrial HD

- MFI (g/10 min)
  - $y = 0.1248e^{0.009x}$
  - $R^2 = 0.9962$

- HLMI (g/10 min)
  - $y = -0.009x + 25.4$
  - $R^2 = 0.1006$
Virgin Resin 1 + Post Industrial HD

Yield Strength (psi)

$y = -5.96x + 3820.5$
$R^2 = 0.9309$

$y = -5.31x + 3688$

% Recycled

Break Strain (%)

$y = 2.055x + 449.5$
$R^2 = 0.9334$

$y = 2.06x + 478$
Virgin Resin 1 + Post Industrial HD

\[ y = 39.423e^{0.0081x} \]

\[ R^2 = 0.9108 \]
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 1**  
**100%**

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 100% VR1  
Date: 19-Jun-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.949</td>
<td>0.949</td>
<td>0.949</td>
<td></td>
<td></td>
<td>0.949</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.15</td>
<td></td>
<td>0.15</td>
<td></td>
<td></td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.9</td>
<td>25.9</td>
<td></td>
<td></td>
<td></td>
<td>25.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>179</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.05</td>
<td>0.03</td>
<td>0.09</td>
<td></td>
<td></td>
<td>0.06</td>
<td>0.025</td>
</tr>
<tr>
<td>% PP</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3592</td>
<td>3535</td>
<td>3586</td>
<td>3535</td>
<td>3528</td>
<td>3555</td>
<td>28</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>513</td>
<td>491</td>
<td>479</td>
<td>445</td>
<td>493</td>
<td>484</td>
<td>22</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>49.3</td>
<td>50.1</td>
<td>45.8</td>
<td>42.2</td>
<td>50.4</td>
<td>47.8</td>
<td>3</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min) (ASTM D3895)</td>
<td>21.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.0</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 1 + Post Industrial Reprocessed HD)**

80% + 20%

---

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)

**Sample:** VR1 + 20% PIR-HD

**Date:** 19-Jun-07

**TRI Log #:** F7601

---

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>Test Replicate Number</th>
<th></th>
<th></th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td>0.954</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.954</td>
<td>0.954</td>
<td>0.954</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.9</td>
<td>25.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.92</td>
<td>0.88</td>
<td>0.87</td>
<td></td>
<td>0.022</td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td>3723</td>
<td>69</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3625</td>
<td>3693</td>
<td>3681</td>
<td>3865</td>
<td>3750</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>449</td>
<td>471</td>
<td>633</td>
<td>498</td>
<td>449</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td>43.8</td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>39.1</td>
<td>39.4</td>
<td>42.5</td>
<td>47.0</td>
<td>50.1</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td></td>
<td></td>
<td>18.2</td>
<td></td>
</tr>
</tbody>
</table>
**TEST RESULTS**  
Recycled HDPE Blend  
Virgin Resin 1 + Post Industrial Reprocessed HD  
60% + 40%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: VR1 + 40% PIR-HD  
Date: 19-Jun-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) |   |   |   |   |  |      |     |
| Density (g/cm³) | 0.955 | 0.956 | 0.956 |   | 0.956 | 0.000 |
| **Melt Flow Index**  
(ASTM D 1238) |   |   |   |   |  |      |     |
| 2.16 kg (g/10min) | 0.18 | 0.18 |   |   | 0.18 |      |
| 21.6 kg (g/10 min) | 24.6 | 24.3 |   |   | 24.5 |      |
| Ratio |   |   |   |   |   | 137 |     |
| **Composition** |   |   |   |   |  |      |     |
| % Color/Ash | 1.71 | 1.71 | 1.71 |   | 1.71 | 0.000 |
| **Tensile Properties**  
(ASTM D 638) |   |   |   |   |  |      |     |
| Yield Strength (psi) | 3535 | 3527 | 3597 | 3627 | 3603 | 3578 | 40 |
| Break Strain (%) | 450 | 601 | 514 | 481 | 512 | 512 | 50 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) |   |   |   |   |  |      |     |
| Failure Time (hours) | 55.6 | 53.1 | 70.9 | 64.4 | 53.9 | 59.8 | 7 |
| **Oxidative Stability**  
(ASTM D 3895) |   |   |   |   |  |      |     |
| Induction Time (min) | 20.0 |   |   |   |   | 20.0 |     |
**TEST RESULTS**

Recycled HDPE Blend
Virgin Resin 1 + Post Industrial Reprocessed HD
40% + 60%

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 19-Jun-07 |
| Sample: VR1 + 60% PIR-HD | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.961</td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.961</td>
<td>0.961</td>
<td>0.961</td>
<td>0.961</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.21</td>
<td>0.22</td>
<td>0.21</td>
<td>0.21</td>
<td>0.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>24.3</td>
<td>24.0</td>
<td>24.2</td>
<td>24.2</td>
<td>24.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>114</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>2.44</td>
<td>2.51</td>
<td>2.51</td>
<td>2.49</td>
<td>2.49</td>
<td>0.033</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3514</td>
<td>3361</td>
<td>3438</td>
<td>3397</td>
<td>3320</td>
<td>3406</td>
<td>67</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>613</td>
<td>414</td>
<td>561</td>
<td>689</td>
<td>641</td>
<td>584</td>
<td>94</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>68.0</td>
<td>70.1</td>
<td>73.4</td>
<td>56.8</td>
<td>54.5</td>
<td>64.8</td>
<td>8</td>
</tr>
<tr>
<td>Oxidative Stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>21.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.1</td>
<td></td>
</tr>
</tbody>
</table>

Recycled HDPE Blend
Virgin Resin 1 + Post Industrial Reprocessed HD
40% + 60%

NCHRP 04-32  C-163
### TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 1 + Post Industrial Reprocessed HD**  
**20% + 80%**

- **Material:** Plaque from blended resin (MB 3X @ 150 Mesh)  
- **Sample:** VR1 + 80% PIR-HD  
- **Date:** 19-Jun-07  
- **TRI Log #:** F7601

#### Test Results Table

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>0.961</td>
<td>0.961</td>
<td>0.961</td>
<td></td>
<td></td>
<td>0.961</td>
<td>0.000</td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index</td>
<td>0.26</td>
<td>0.26</td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>25.1</td>
<td>25.4</td>
<td></td>
<td></td>
<td></td>
<td>25.3</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>3.18</td>
<td>3.35</td>
<td>3.33</td>
<td></td>
<td></td>
<td>3.29</td>
<td>0.076</td>
</tr>
<tr>
<td>Tensile Properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3507</td>
<td>3382</td>
<td>3466</td>
<td>3324</td>
<td>3236</td>
<td>3383</td>
<td>97</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>608</td>
<td>611</td>
<td>719</td>
<td>649</td>
<td>477</td>
<td>613</td>
<td>79</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td>64.6</td>
<td>73.5</td>
<td>77.7</td>
<td>73.3</td>
<td>75.2</td>
<td>72.9</td>
<td>4</td>
</tr>
<tr>
<td>Oxidative Stability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td>16.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.9</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

## Recycled HDPE Blend

### Post Industrial Reprocessed HD

100%

<table>
<thead>
<tr>
<th>Material:</th>
<th>Plaque from blended resin (MB 3X @ 150 Mesh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample:</td>
<td>100% PIR-HD</td>
</tr>
<tr>
<td>Date:</td>
<td>19-Jun-07</td>
</tr>
<tr>
<td>TRI Log #:</td>
<td>F7601</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Replicate Number</th>
<th>Parameter</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Density (ASTM D 1505)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Density (g/cm³)</td>
<td>0.965, 0.965, 0.965</td>
</tr>
<tr>
<td></td>
<td>Melt Flow Index (ASTM D 1238)</td>
<td>2.16 kg (g/10 min)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21.6 kg (g/10 min)</td>
</tr>
<tr>
<td></td>
<td>Ratio (%)</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Composition</td>
<td>% Color/Ash</td>
</tr>
<tr>
<td></td>
<td>Tensile Properties (ASTM D 638)</td>
<td>Yield Strength (psi)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Break Strain (%)</td>
</tr>
<tr>
<td></td>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td>Failure Time (hours)</td>
</tr>
<tr>
<td></td>
<td>Oxidative Stability (ASTM D 3895)</td>
<td>Induction Time (min)</td>
</tr>
</tbody>
</table>
### Virgin Resin 2 + Reprocessed Post Industrial HD

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycled Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td><strong>Density g/cm³</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.952</td>
</tr>
<tr>
<td><strong>Melt Index g/10 min</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td><strong>Flow Rate g/10 min</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27.8</td>
</tr>
<tr>
<td><strong>MFR (21.6/2.16kg)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>84.2</td>
</tr>
<tr>
<td><strong>% Black</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Yield Strength (psi)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3834</td>
</tr>
<tr>
<td><strong>Break Strain (%)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>595</td>
</tr>
<tr>
<td><strong>NCTL-15% (hrs)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>34.6</td>
</tr>
<tr>
<td><strong>OIT (min)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>
Virgin Resin 2 + Reprocessed Post Industrial HD

\[
y = 0.0002x + 0.9525 \\
R^2 = 0.9657
\]

\[
y = 0.0389x + 0.08 \\
R^2 = 0.9991
\]
Virgin Resin 2 + Reprocessed Post Industrial HD

\[ y = 0.0002x + 0.31 \]
\[ R^2 = 0.1636 \]

\[ y = -0.0045x + 26.9 \]
\[ R^2 = 0.2418 \]
Virgin Resin 2 + Reprocessed Post Industrial HD

Yield Strength (psi)

\[ y = -7.67x + 3924 \]
\[ R^2 = 0.9941 \]

Break Strain (%)

\[ y = 0.45x + 639 \]
\[ y = -0.705x + 634.5 \]
\[ R^2 = 0.1008 \]
Virgin Resin 2 + Reprocessed Post Industrial HD
## TEST RESULTS
### Recycled HDPE Blend
#### Virgin Resin 2
##### 100%

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)
**Sample:** 100% Virgin Resin 2
**Date:** 5-Jul-07
**TRI Log #:** F7601

<table>
<thead>
<tr>
<th>TEST RESULTS</th>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td>0.952</td>
<td>0.952</td>
<td>0.952</td>
<td></td>
<td>0.952</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td></td>
<td>0.33</td>
<td>0.33</td>
<td></td>
<td></td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td></td>
<td>27.8</td>
<td>27.9</td>
<td></td>
<td></td>
<td>27.9</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>84</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>% Color/Ash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td></td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td></td>
<td>0.02</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td>(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td></td>
<td>3959</td>
<td>3800</td>
<td>3908</td>
<td>3818</td>
<td>3684</td>
<td>3834</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td></td>
<td>693</td>
<td>714</td>
<td>485</td>
<td>489</td>
<td>595</td>
<td>109</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td></td>
<td>34.9</td>
<td>34.4</td>
<td>32.8</td>
<td>35.5</td>
<td>35.5</td>
<td>34.8</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td>(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td></td>
<td>80.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 2 + Post Industrial Reprocessed HD**  
**80% + 20%**

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 80% VR2 + 20% PIR-HD  
Date: 5-Jul-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.957</td>
<td>0.957</td>
<td>0.957</td>
<td></td>
<td></td>
<td>0.957</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.32</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>36.9</td>
<td>27.2</td>
<td></td>
<td></td>
<td></td>
<td>32.1</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>101</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>0.89</td>
<td>0.80</td>
<td>0.82</td>
<td></td>
<td></td>
<td>0.84</td>
<td>0.039</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3817</td>
<td>3712</td>
<td>3773</td>
<td>3718</td>
<td>3662</td>
<td>3736</td>
<td>53</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>465</td>
<td>696</td>
<td>695</td>
<td>454</td>
<td>536</td>
<td>569</td>
<td>107</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>44.7</td>
<td>40.8</td>
<td>46.3</td>
<td>39.1</td>
<td>39.8</td>
<td>42.1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>65.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65.7</td>
<td></td>
</tr>
</tbody>
</table>

NCHRP 04-32  
C-172
## TEST RESULTS

### Recycled HDPE Blend

**Virgin Resin 2 + Post Industrial Reprocessed HD**

**60% + 40%**

<table>
<thead>
<tr>
<th>Material:</th>
<th>Plaque from blended resin (MB 3X @ 150 Mesh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample:</td>
<td>60% VR2 + 40% PIRHD</td>
</tr>
<tr>
<td>TRI Log #:</td>
<td>F7601</td>
</tr>
<tr>
<td>Date:</td>
<td>5-Jul-07</td>
</tr>
</tbody>
</table>

### Test Replicate Number

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>0.960</td>
<td>0.960</td>
<td>0.960</td>
<td></td>
<td></td>
<td>0.960</td>
<td>0.000</td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.31</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>26.8</td>
<td>26.3</td>
<td></td>
<td></td>
<td></td>
<td>26.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.64</td>
<td>0.080</td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1.56</td>
<td>1.75</td>
<td>1.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3643</td>
<td>3614</td>
<td>3592</td>
<td>3611</td>
<td>3500</td>
<td>3592</td>
<td>49</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>720</td>
<td>747</td>
<td>657</td>
<td>478</td>
<td>786</td>
<td>678</td>
<td>108</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>51.8</td>
<td>47.5</td>
<td>50.7</td>
<td>53.9</td>
<td>56.3</td>
<td>52.0</td>
<td>3</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>46.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46.2</td>
<td></td>
</tr>
</tbody>
</table>
### TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 2 + Post Industrial Reprocessed HD**

**40% + 60%**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material:</strong></td>
<td>Plaque from blended resin (MB 3X @ 150 Mesh)</td>
</tr>
<tr>
<td><strong>Sample:</strong></td>
<td>40% VR2 + 60% PIR-HD</td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td>5-Jul-07</td>
</tr>
<tr>
<td><strong>TRI Log #:</strong></td>
<td>F7601</td>
</tr>
<tr>
<td><strong>PARAMETER</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1505)</td>
<td></td>
</tr>
<tr>
<td>Density (g/cm3)</td>
<td>0.963</td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 1238)</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.31</td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>26.4</td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>2.38</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 638)</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3487</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>572</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>67.2</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td></td>
</tr>
<tr>
<td>(ASTM D 3895)</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>34.3</td>
</tr>
<tr>
<td>(ASTM D3895)</td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**  
*Virgin Resin 2 + Post Industrial Reprocessed HD*  
*20% + 80%*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
**(ASTM D 1505)** | | | | | | 0.968 | 0.000 |
| Density (g/cm³) | 0.968 | 0.968 | 0.968 | | | | |
| **Melt Flow Index**  
**(ASTM D 1238)** | | | | | | 0.33 | |
| 2.16 kg (g/10min) | 0.34 | 0.33 | | | | | |
| 21.6 kg (g/10 min) | 26.6 | 26.8 | | | | | |
| Ratio | | | | | | 80 | |
| **Composition** | | | | | | 3.16 | 0.022 |
| % Color/Ash | 3.19 | 3.14 | 3.15 | | | | |
| **Tensile Properties**  
**(ASTM D 638)** | | | | | | 3249 | 56 |
| Yield Strength (psi) | 3338 | 3222 | 3230 | 3280 | 3174 | | |
| Break Strain (%) | 632 | 466 | 471 | 480 | 685 | | |
| **Environmental Stress Crack Resistance**  
**(ASTM D5397 @ 15% of Yield)** | | | | | | 64.5 | 6 |
| Failure Time (hours) | 67.4 | 72.1 | 53.7 | 67.0 | 62.4 | | |
| **Oxidative Stability**  
**(ASTM D 3895)** | | | | | | 22.1 | |
| Induction Time (min) | 22.1 | | | | | | |

**Material:** Plaque from blended resin (MB 3X @ 150 Mesh)  
**Sample:** 20% VR2 + 80% PIR-HD  
**Date:** 5-Jul-07  
**TRI Log #:** F7601
## TEST RESULTS

### Recycled HDPE Blend
### Post Industrial Reprocessed HD
### 100%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: 100% PIR-HD  
Date: 5-Jul-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.970</td>
<td>0.970</td>
<td>0.970</td>
<td></td>
<td></td>
<td>0.970</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.30</td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>26.5</td>
<td>27.0</td>
<td></td>
<td></td>
<td></td>
<td>26.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>88</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>3.89</td>
<td>3.83</td>
<td>3.79</td>
<td></td>
<td></td>
<td>3.84</td>
<td>0.041</td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3303</td>
<td>3233</td>
<td>3312</td>
<td>3333</td>
<td>3300</td>
<td>3296</td>
<td>34</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>588</td>
<td>684</td>
<td>424</td>
<td>697</td>
<td>669</td>
<td>612</td>
<td>102</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>108.0</td>
<td>110.0</td>
<td>127.0</td>
<td>108.0</td>
<td>120.0</td>
<td>114.8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>18.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.8</td>
<td></td>
</tr>
</tbody>
</table>
### Virgin Resin 3 + Post Industrial Reprocessed HDPE

<table>
<thead>
<tr>
<th>Property</th>
<th>Recycle Content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% Recycle</td>
</tr>
<tr>
<td>Density g/cm³</td>
<td>0.949</td>
</tr>
<tr>
<td>Melt Index g/10 min</td>
<td>0.27</td>
</tr>
<tr>
<td>Flow Rate g/10 min</td>
<td>23.0</td>
</tr>
<tr>
<td>MFR (21.6/2.16kg)</td>
<td>84</td>
</tr>
<tr>
<td>% Black</td>
<td>0.05</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3849</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>641</td>
</tr>
<tr>
<td>NCTL-15% (hrs)</td>
<td>28</td>
</tr>
<tr>
<td>OIT (min)</td>
<td>43.0</td>
</tr>
</tbody>
</table>
Virgin Resin 3 + Post Industrial Reprocessed HDPE

\[ y = 0.0002x + 0.9485 \]
\[ R^2 = 0.9854 \]

\[ y = 0.0405x + 0.01 \]
\[ R^2 = 0.9996 \]
Virgin Resin 3 + Post Industrial Reprocessed HDPE

**MFI (g/10 min)**

\[ y = 0.2619e^{0.0025x} \]

\[ R^2 = 0.8796 \]

**HLMFI (g/10 min)**

\[ y = 22.575e^{0.0014x} \]

\[ R^2 = 0.9055 \]
Virgin Resin 3 + Post Industrial Reprocessed HDPE

Yield Strength (psi)

Break Strain (%)

% Recycled

% Recycled

\[ y = -4.85x + 3689.5 \]

\[ R^2 = 0.8965 \]

\[ y = -6.07x + 3764 \]

\[ y = 1.26x + 678.6 \]

\[ R^2 = 0.5924 \]

\[ y = 0.37x + 647 \]
Virgin Resin 3 + Post Industrial Reprocessed HDPE

$y = 34.61e^{0.0075x}$

$y = 36.2e^{0.0099x}$

$R^2 = 0.841$
## TEST RESULTS

### Recycled HDPE Blend

### Virgin Resin 3

100%

<table>
<thead>
<tr>
<th>Material:</th>
<th>Plaque from blended resin (MB 3X @ 150 Mesh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td>10-Jul-07</td>
</tr>
<tr>
<td>Sample:</td>
<td>100% VR3</td>
</tr>
<tr>
<td>TRI Log #:</td>
<td>F7601</td>
</tr>
</tbody>
</table>

### Test Results Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td>0.949</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>1</td>
<td>0.948</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.949</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.949</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.949</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.949</td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>1</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>1</td>
<td>23.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>22.8</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td>0.05</td>
<td>0.019</td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td>3849</td>
<td>35</td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>1</td>
<td>3810</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3853</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3904</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3865</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3814</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>1</td>
<td>740</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>690</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>659</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>571</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>547</td>
<td></td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td>28.0</td>
<td>2</td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>1</td>
<td>28.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>28.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>24.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>28.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>31.5</td>
<td></td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td>43.0</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>1</td>
<td>43.0</td>
<td></td>
</tr>
</tbody>
</table>
## TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 3 + Post Industrial Reprocessed HD**  
**80% + 20%**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 10-Jul-07 |
| Sample: VR3 + 20% PIR-HD | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) | | | | | | | |
| Density (g/cm³) | 0.953 | 0.954 | 0.954 | | | 0.954 | 0.000 |
| **Melt Flow Index**  
(ASTM D 1238) | | | | | | | |
| 2.16 kg (g/10min) | 0.28 | 0.29 | | | | 0.28 | |
| 21.6 kg (g/10 min) | 22.9 | 22.9 | | | | 22.9 | |
| Ratio | | | | | | 80 | |
| **Composition** | | | | | | | |
| % Color/Ash | 0.79 | 0.81 | 0.80 | | | 0.80 | 0.008 |
| **Tensile Properties**  
(ASTM D 638) | | | | | | | |
| Yield Strength (psi) | 3592 | 3526 | 3597 | 3544 | 3505 | 3553 | 36 |
| Break Strain (%) | 806 | 527 | 777 | 786 | 767 | 733 | 104 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) | | | | | | | |
| Failure Time (hours) | 40.9 | 38.0 | 41.8 | 40.8 | 54.8 | 43.3 | 6 |
| **Oxidative Stability**  
(ASTM D 3895) | | | | | | | |
| Induction Time (min) | 38.1 | | | | | 38.1 |

NCHRP 04-32  
C-183
## TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 3 + Post Industrial Reprocessed HD**

**60% + 40%**

| Material: Plaque from blended resin (MB 3X @ 150 Mesh) | Date: 10-Jul-07 |
| Sample: VR3 + 40% PIR-HD | TRI Log #: F7601 |

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
</table>
| **Density**  
(ASTM D 1505) |   |   |   |   |   |      |     |
| Density (g/cm³) | 0.958 | 0.958 | 0.958 |   |   | 0.958 | 0.000 |
| **Melt Flow Index**  
(ASTM D 1238) |   |   |   |   |   |      |     |
| 2.16 kg (g/10min) | 0.28 | 0.29 |   |   |   | 0.28 |     |
| 21.6 kg (g/10 min) | 23.5 | 23.5 |   |   |   | 23.5 |     |
| Ratio |   |   |   |   |   | 83 |     |
| **Composition** | | | | | | | |
| % Color/Ash | 1.63 | 1.68 | 1.66 |   |   | 1.66 | 0.021 |
| **Tensile Properties**  
(ASTM D 638) |   |   |   |   |   |      |     |
| Yield Strength (psi) | 3487 | 3535 | 3521 | 3584 | 3584 | 3542 | 38 |
| Break Strain (%) | 758 | 791 | 776 | 766 | 754 | 769 | 13 |
| **Environmental Stress Crack Resistance**  
(ASTM D5397 @ 15% of Yield) | | | | | | | |
| Failure Time (hours) | 42.7 | 42.7 | 39.5 | 39.2 | 43.1 | 41.4 | 2 |
| **Oxidative Stability**  
(ASTM D 3895) | | | | | | | |
| Induction Time (min) | 32.5 | | | | | 32.5 |     |
## TEST RESULTS

**Recycled HDPE Blend**  
**Virgin Resin 3 + Post Industrial Reprocessed HD**  
40% + 60%

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: VR3 + 60% PIR-HD  
Date: 10-Jul-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Replicate Number</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (ASTM D 1505)</strong></td>
<td>1</td>
<td>0.961</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>2</td>
<td>0.961</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.961</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.961</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.961</td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index (ASTM D 1238)</strong></td>
<td>1</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>2</td>
<td>24.2</td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>3</td>
<td>24.3</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>4</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>5</td>
<td>2.44</td>
<td>0.025</td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>1</td>
<td>2.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.41</td>
<td></td>
</tr>
<tr>
<td><strong>Tensile Properties (ASTM D 638)</strong></td>
<td>1</td>
<td>3429</td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>2</td>
<td>3453</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3423</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3479</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>3338</td>
<td></td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>1</td>
<td>779</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>776</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>722</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>656</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td>1</td>
<td>57.6</td>
<td></td>
</tr>
<tr>
<td>(ASTM D5397 @ 15% of Yield)</td>
<td>2</td>
<td>66.2</td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>3</td>
<td>52.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>52.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>49.6</td>
<td></td>
</tr>
<tr>
<td><strong>Oxidative Stability (ASTM D 3895)</strong></td>
<td>1</td>
<td>31.8</td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>2</td>
<td>31.8</td>
<td></td>
</tr>
<tr>
<td>(ASTM D3895)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# TEST RESULTS

**Recycled HDPE Blend**

**Virgin Resin 3 + Post Industrial Reprocessed HD**

**20% + 80%**

Material: Plaque from blended resin (MB 3X @ 150 Mesh)  
Sample: VR3 + 80% PIR-HD  
Date: 10-Jul-07  
TRI Log #: F7601

<table>
<thead>
<tr>
<th>Test Replicate Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.967</td>
<td>0.000</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.967</td>
<td>0.967</td>
<td>0.967</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melt Flow Index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.32</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.8</td>
<td>25.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>3.24</td>
<td>3.31</td>
<td>3.16</td>
<td></td>
<td></td>
<td>3.24</td>
<td>0.061</td>
</tr>
<tr>
<td><strong>Tensile Properties</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3371</td>
<td>3286</td>
<td>3243</td>
<td>3222</td>
<td>3225</td>
<td>3269</td>
<td>56</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>786</td>
<td>800</td>
<td>752</td>
<td>724</td>
<td>763</td>
<td>765</td>
<td>27</td>
</tr>
<tr>
<td><strong>Environmental Stress Crack Resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>64.0</td>
<td>62.7</td>
<td>69.8</td>
<td>62.7</td>
<td>64.8</td>
<td>64.8</td>
<td>3</td>
</tr>
<tr>
<td><strong>Oxidative Stability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>19.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Test Replicate Number</td>
<td>Mean</td>
<td>STD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------</td>
<td>------</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (ASTM D 1505)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td>0.970</td>
<td>0.970</td>
<td>0.970</td>
<td>0.970</td>
<td>0.970</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Melt Flow Index (ASTM D 1238)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 kg (g/10min)</td>
<td>0.29</td>
<td>0.32</td>
<td></td>
<td>0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.6 kg (g/10 min)</td>
<td>25.9</td>
<td>25.7</td>
<td></td>
<td>25.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Color/Ash</td>
<td>3.83</td>
<td>4.08</td>
<td>4.38</td>
<td></td>
<td>4.10</td>
<td>0.225</td>
<td></td>
</tr>
<tr>
<td>Tensile Properties (ASTM D 638)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield Strength (psi)</td>
<td>3132</td>
<td>3099</td>
<td>3097</td>
<td>3042</td>
<td>3068</td>
<td>3088</td>
<td>31</td>
</tr>
<tr>
<td>Break Strain (%)</td>
<td>720</td>
<td>736</td>
<td>717</td>
<td>712</td>
<td>714</td>
<td>720</td>
<td>9</td>
</tr>
<tr>
<td>Environmental Stress Crack Resistance (ASTM D5397 @ 15% of Yield)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure Time (hours)</td>
<td>88.8</td>
<td>95.7</td>
<td>93.1</td>
<td>69.5</td>
<td>85.6</td>
<td>86.5</td>
<td>9</td>
</tr>
<tr>
<td>Oxidative Stability (ASTM D 3895)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction Time (min)</td>
<td>18.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.7</td>
<td></td>
</tr>
</tbody>
</table>