ULTRA-POLY CORPORATION

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End of Life Vehicle (ELV) Recycling – Bumper Fascia

SPE International Polyolefins Conference
Houston, TX February 24-27 2019

Ultra-Poly was founded in 1974 with only one production line and has since grown to be one of the largest, asset-based plastics recyclers in the country

Background:

- We produce specified, recycled plastic compounds made by grinding, blending, and pelletizing plastic scrap, suppling manufacturers making a wide variety of goods
- A technological leader in recycling, we specialize in supplying custom resins made by compounding plastic scraps with different physical characteristics
- More recently, the Company has focused on developing innovative separation processes in order to reclaim scrap streams that were previously un-recyclable, such as geomembrane, agricultural films, multi-layer packaging films

Facilities:

Over 275,000 square feet of manufacturing space in four plants house:

- 10 extrusion lines with a combined 230 million pounds of annual capacity
- Approximately 200 employees
- 4 grinding and elutriation lines,
- On-site laboratory facilities
- Fourteen large capacity blending silos

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The Opportunity

Approximately 11-12 million vehicles are scrapped in the US every year

- Scrap yards remove items that can be sold into the Aftermarket
  - Most durable functional/mechanical components, some body panels

- The remainder of the vehicle is generally sent to the shredder
  - Metals are extracted and recovered
  - Plastic components wind up in ASR (Automotive Shredder Residue) which is most frequently landfilled

*Bumper Fascia are most commonly **not** removed prior to shredding and represent a significant opportunity to be potentially removed and recycled. Fascia compounds are TPO based and are characterized by excellent physical and mechanical properties. Weight per vehicle ranges typically 15-25 lbs.*

The Challenge

- Can Post-Consumer bumper fascia be recovered into usable material?
  - How can the automotive paint on the fascia be dealt with?
  - Can the bumpers be supplied “clean” enough to be reprocessed?

- Is there enough value in the recovered material to justify recovery costs?
  - Enough value for scrap yards to remove, “clean”, and bale?
  - Enough value for recyclers to pre-process and pelletize?
  - Can a material with an attractive price/performance ratio to create markets for its reuse be produced?

The Approach

The PLASTICS Industry Association Recycling Committee commissioned a study to determine the feasibility of this recovery effort

Phase I Goals:

- Test technical and economic feasibility of recovery at auto salvage yards
- Understand properties of TPO and the necessity of secondary processes (ie: paint removal)

Phase II Goals:

- Continue to demonstrate a viable collection process at auto shredding operations
- Further understanding of TPO properties with and without secondary processes

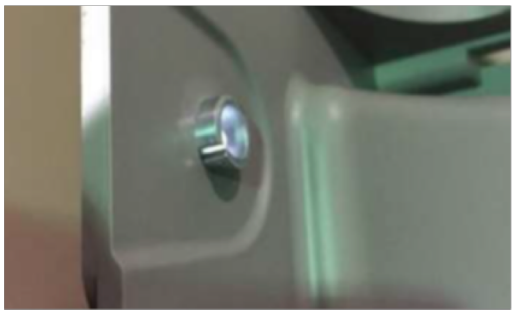
Phase III Goals:

- Seeks potential end-market users of the recycled TPO from ELVs
- Mold and test products utilizing the recycled TPO

Fascia Collection

Baled fascia were received from Padnos auto scrap processing facility in Michigan

4000 lbs. of bumpers were collected



Minimal manual sorting and separation was required to remove:

- PC headlamps
- Wiring harnesses
- Some of clips and fasteners

Bale Observations

- Bale was tightly packed and had good weight and density and included random colors and configurations
- A significant number of adhesive paper labels were affixed to the fascia and in some cases paper in sleeves attached to fascia with nylon zip ties
- Some bright plated ABS accent trim were affixed to some of the fascia which were NOT removed as it would not be practical to do so on a production basis
- A few wiring harnesses and small lamp housing that were picked out along with some side marker reflectors which could be easily removed by hand
- A lot of metal clips that could not easily be removed by hand - were captured by the magnets in our system after size reduction

Processing Summary

- Bale was broken and fed into a single shaft shredder with 1” screen, obvious non-plastic contamination removed by hand
- Shred passed under cross-belt magnets, blown to cyclone and passed over additional magnet plates on exiting cyclone
- Shred then fed to open-rotor grinder with 3/8” screen and elutriated to remove fines and paper contaminates
- Resulting regrind was melt processed using single screw extruder with 64 mesh Dutch weave screen filtration and underwater pelletization
- ASTM test specimens molded and mechanical and physical properties tested
- Starting bale weight was not recorded but yield to pelletized product is estimated to be >90%

Non-TPO Items Removed

Examples of contaminants removed by hand

Close-up of lamp housing

Metal Removal - Magnet Cleanouts

A significant amount of clips were removed via magnets. Shredding prior to finer grinding is key to leaving them largely intact and removing the vast majority and minimizing any metal contamination in the final product

Processed Material Appearance

1” Shred

3/8” Elutriated Regrind

Pelletized

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Properties and Appearance

			PCR w/Paint
Material	**Test Method**	**Units**	**UPC**
Melt Flow	ASTM D1238	gm/10min	26
Specific Gravity	ASTM D793		1.012
Ash Content	ASTM D5630	% wt.	15.9
Flexural Modulus	ASTM D790	psi	265,000
Tensile Strength	ASTM D638	psi	2,400
Notched Izod Impact	ASTM D256	ft-lb/in	7.33 (HB)

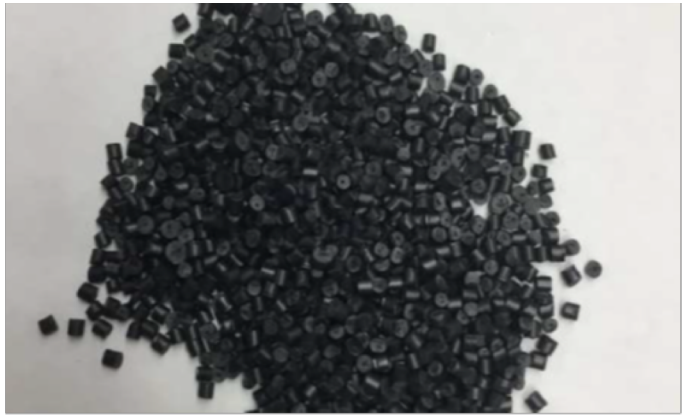
Mechanical properties are quite good and sample molding was very easy. Surface finish displays “pock” marks due to residual paint

Additional Approaches Tried

- Bumpers supplied by Gary's U-Pull It, Binghamton, NY were shredded at Geo-Tech and then put through their patented cleaning technology

Geo-Tech cleaning for:

- delamination
- de-metalize
- paint removal
- pigment removal



- Resulting pellet was uniform and free of visible impurities

Property Comparison - PCR

			PCR w/Paint	PCR – Paint Removed
Material	**Test Method**	**Units**	**UPC**	**Geo-Tech**
Melt Flow	ASTM D1238	gm/10min	26	17.4
Specific Gravity	ASTM D793		1.012	0.994
Ash Content	ASTM D5630	% wt.	15.9	12.2
Flexural Modulus	ASTM D790	psi	265,000	204,969
Tensile Strength	ASTM D638	psi	2,400	2,654
Notched Izod Impact	ASTM D256	ft-lb/in	7.33 (HB)	10

Compatibilized Paint Trial

ASTM Method	D638						
	Tensile Yield	Tensile Strength	Yield Elongation	Break Strength	Break Elongation	Tensile Modulus	Testing Speed
Sample	PSI	PSI	%	KSI	%	KSI	in./min.
Unmodified Shred TPO+paint	2,435	2,437	5.29	1,934	27	195	2
Modified Shred TPO+paint	1,766	1,920	17.26	1,919	352	128	2

Material tested by Midland Compounding with and without modifier for paint compatibilization

ASTM Method	D790			D256	D5630	D1238	
	Flex Modulus	Flex Strength	Secant Modulus	Notched IZOD	Ash Content	MFR	Hardness
Sample	KSI	PSI	%	ft.lbs/in.	%	g/10min.	Shore D
Unmodified Shred TPO+paint	169	3,648	171	7.7	16.1	21.5	61
Modified Shred TPO+paint	94	2,167	97	8.8	18.9	13.4	52
Notes: MFR Tested at 230°C/2.16 kg							

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Modification helped with elongation and impact, but reduced strength and modulus

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Conclusions – Processing Evaluations

PCR with Paint left on

- Bales can be fairly easily handled and processed
- Degree of contamination is not too high and is manageable
- Metal clips are addressable with good magnetic separation
- Material does require elutriation after size reduction to remove paper and fines
- Mechanical and physical properties appear to be good in spite of known contamination with low levels of ABS, nylon
- Appearance of molded parts is somewhat “pocked” due to residual paint

PCR with Paint Removed

- Ash content reduced and surface appearance improved
- Impact strength improved but flexural modulus is reduced
- Adds cost

PCR with Paint plus Compatibilizer

- Impact and elongation improved
- Modulus and strength reduced
- Adds Cost

Conclusions – Commercial Potential

- Material cannot be reclaimed for re-use in bumper fascia applications. No processes attempted yielded high enough property retention.
- Reclaiming Post Consumer Fascia is technically feasible and a processable material with good, reasonably consistent physical/mechanical properties can be produced.
- Material cannot be used in appearance-critical parts, unpainted or painted.
- Some additional processing steps such as paint removal or use of compatibilizers can improve some characteristics but also add cost.
- Material can also be used as a component in compounding other PP recycled compounds
- It is available in any color you want…..as long as it is black!

What's Next?

Application development is underway by several of the participants in this work.

- Non-appearance automotive and recreational vehicle components
- Dunnage, pallets, bins etc.
- Other proprietary developments

It is critical to establish technical success in multiple applications in order to determine the value of the material in the marketplace and justify the economic feasibility of collection and processing.

Infrastructure for disassembly, collection and transportation needs to be developed in order to establish on-going volumes of available material.

Continued collaborative development work through PLASTICS is key in leveraging multiple stakeholder participation which accelerates progress.


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