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Compatibilization/Compounding Evaluation of Recovered Polymers

Joe Pomykala

Energy Systems Division

DOE Vehicle Technologies Program

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"This presentation does not contain any proprietary or confidential information"

Purpose of Work

- Evaluate the market opportunity for polymers recovered from shredder residue
- Identify limitations associated with the re-use of the materials as recovered and determine the need for post-processing technology to upgrade the recovered materials to meet the requirements of the market

Approach

- Specify standard protocols for material testing, content characterization, and performance properties
- Determine properties of recovered polymers
- Conduct blending and pelletizing trials of the recovered polymers
- Conduct mold trials using recovered polymers

Standard Protocols for Material Testing

- A test matrix and protocol for evaluating physical properties of plastics was developed by Midland Compounding
- A physical properties database has been compiled to provide comparison of the physical properties of the recovered polymers vis-à-vis various grades of similar virgin polymers

Determine Properties of Recovered Polymers --VW-SiCon

- Recovered polyolefin fraction

Parameter	Specification /condition	Unit	Value
Melt index	acc. to DIN ISO 1133 190 ° C / 2.16 kg 230 ° C / 2.16 kg	g/10 min	 2.00 +/- 0.50 4.50 +/- 0.50
Density	acc. to DIN ISO 55 990	g/cm³	0.93 to 0.96
Ignition residue	test temperature 60 ° C	%	1.70 +/- 0.40
Residual humidity	infrared-drying scale	%	< 0.5
Polymere composition (average)	HDPE PP	%	49 51

Source: mtm plastics GmbH

Determine Properties of Recovered Polymers --Salyp and MBA Polymers

- Salyp recovered a polyolefins fraction from European shredder residue whose properties were determined by Midland Compounding

- MBA polymers recovered plastic fractions from a polymer concentrate produced by the Salyp process:
  - Polyolefin A
  - Polyolefin B
  - Filled PP
  - HIPS
  - ABS

MBA Polymers Pelletized ABS Fraction

Determine Properties of Blended and Pelletized Materials --Argonne Recovered Polymers

- The polyolefins were blended 25/75 with industrial regrind polypropylene and pelletized using standard equipment

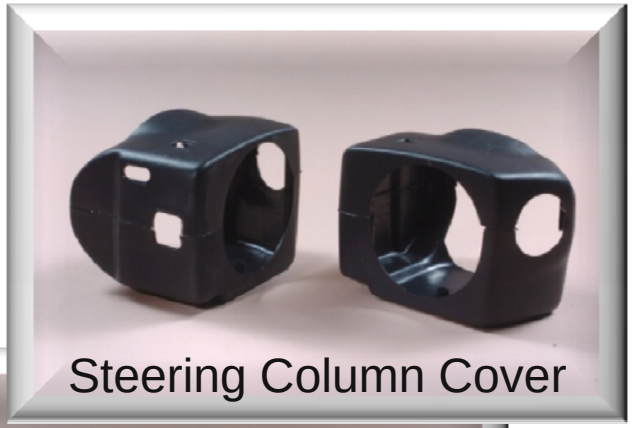
Standard Molding Machines used at MGV

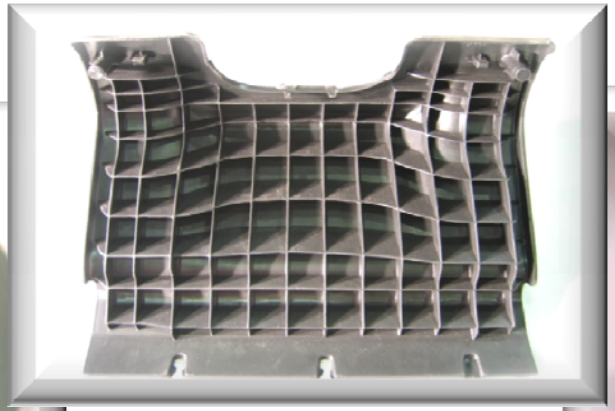
- A 70% filled ABS concentrate was recovered
  - Properties testing confirmed that the quality was sufficient for mixing with virgin ABS at a ratio of 10/90
  - Upgrading is necessary for higher blending ratios

Property	*Recovered F-ABS*	*Virgin ABS*	*90% V/ 10% R*	*75% V/ 25% R*
MFR	*3.9*	*6.5*	*7.6*	*6.4*
Izod Impact	*0.9*	*3.8*	*3.0*	*2.6*
Flex Mod	*324*	*296*	*299*	*302*
Tensile strength at yield, psi	*4982*	*5546*	*5392*	*5312*
Elongation at rupture, %	*2*	*56*	*9*	*6*
DTUL, 264 psi, ℉	*162*	*165*	*166*	*164*
Gardner Impact	*0*	*>320*	*32*	*8*
SG, g/cc	*1.08*	*1.05*	*1.05*	*1.06*

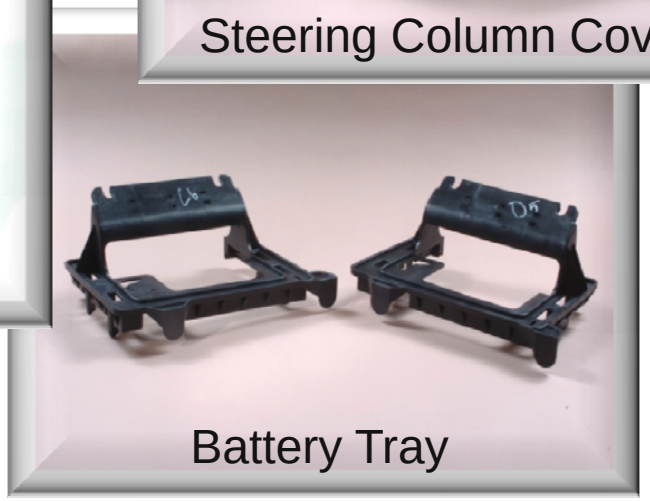
Mold Trials Confirm the Technical Feasibility of Re-use for Recovered Polyolefins ---Argonne Recovered Polyolefins

- Mold trials by MGV were successful for producing automotive parts from the polyolefins fraction at blend rates with regrind of 0%, 25%, 50%, and 75%


Steering Column Cover


Knee Bolster


Spare Tire Base Plate


Battery Tray

*Wheel well covers molded but not pictured

Plans for Next Fiscal Year

- Determine the properties of plastics after they are cleaned to remove the PCBs in order to determine the impact of the cleaning process on the properties of the recovered material

- Determine the properties of the plastics from the auto only trials
  - Big three late models (’02-’07)
  - Pre-2000 ELVs mix

Summary

- Mold trials confirmed the technical feasibility of re-use for lightweighting automotive plastics
- The polyolefins were blended 25/75 with industrial regrind polypropylene and pelletized using standard equipment
- The physical properties of the polyolefins are comparable to a general purpose polypropylene
- The properties of the recovered filled ABS when mixed in a ratio of 10/90 with virgin ABS are comparable to the virgin ABS