

End-of-Life Vehicle (ELV) Recycling

Thermoplastic Polyolefin (TPO) Test Results

April 2019



Results using ASTM Test Methods

Project Phase	Source	With or without paint	Shred or pelletized	Sample description	ASTM D638								ASTM D5630
					Tensile Yield (psi)	Tensile Strength (psi)	Yield Elongation (%)	Break Strength (KSI)	Elongation @ Break (%)	Tensile Modulus (KSI)	Tensile Modulus (psi)	Testing Speed (in./min.)	Ash content %
1	PCR	without paint	pelletized	ELV bumpers from Gary's U-Pull it processed by Geo-Tech									19.7
2	PCR	without paint	pelletized	Bales from Padnos processed by ACI		2,538			91				12.5 (Method B)
2	PCR	with paint	pelletized	Bumpers from Padnos processed by Ultra Poly		2,400							15.9
2	PCR	with paint	pelletized	TPEI processed bumpers from ISRI member and Noble evaluated	2,588		6		53.6		227,000		14.7
1	PIR	with paint	shred	MCC tests of Unmodified Shred TPO+Paint from Geo-Tech	2,435	2,437	5.29	1,934	27	195		2	21.5
1	PIR	with paint	shred	MCC tests of Modified Shred TPO+paint	1,766	1,920	17.26	1,919	352	128		2	
2	PIR	with paint	shred	Ultra-Poly evaluation of Geo-Tech material		2,600							17.1
2	PIR	without paint	pelletized	Ultra-Poly evaluation of Geo-Tech material		2,654							12.2



Phase	Source	With or without paint	Shred or pelletized	Sample description	ASTM D790				ASTM D256	ASTM D1238		ASTM D6980	ASTM D955
					Flex modulus (psi)	Flex modulus (KSI)	Flex Strength (psi)	Secant Modulus (%)	Izod impact (ft-lb/in)	Melt Flow Index (g/10 min)	Hardness (Shore D)	Moisture (%)	Shrink (%)
1	PCR	without paint	pelletized	ELV bumpers from Gary's U-Pull it processed by Geo-Tech	124,479				13.76	22.9		0.388	0.91503
2	PCR	without paint	pelletized	Bales from Padnos processed by ACI	214,890				8.8 (2 lb. hammer)	25.6			
2	PCR	with paint	pelletized	Bumpers from Padnos processed by Ultra Poly	265,000					26			
2	PCR	with paint	pelletized	TPEI processed bumpers from ISRI member and Noble evaluated	194,400				5.865	24.09			
1	PIR	with paint	shred	MCC tests of Unmodified Shred TPO+Paint from Geo-Tech		169	3,648	171	7.7	21.5	61		
1	PIR	with paint	shred	MCC tests of Modified Shred TPO+paint		94	2,167	97	8.8	13.4	52		
2	PIR	with paint	shred	Ultra-Poly evaluation of Geo-Tech material	259,275				8.1	23.4			
2	PIR	without paint	pelletized	Ultra-Poly evaluation of Geo-Tech material	204,969				10	17.4			



Phase	Source	With or without paint	Shred or pelletized	Sample description	ASTM D2240	ASTM D792	ASTM D5420	Melting Point ©
					Durometer/Hardness	Specific Gravity (method A)	Gardner(in-lbs)	
1	PCR	without paint	pelletized	ELV bumpers from Gary's U-Pull it processed by Geo-Tech	58			
2	PCR	without paint	pelletized	Bales from Padnos processed by ACI		0.99		
2	PCR	with paint	pelletized	Bumpers from Padnos processed by Ultra Poly		1.012		
2	PCR	with paint	pelletized	TPEI processed bumpers from ISRI member and Noble evaluated	59	1.0127	108	162.1
1	PIR	with paint	shred	MCC tests of Unmodified Shred TPO+Paint from Geo-Tech				
1	PIR	with paint	shred	MCC tests of Modified Shred TPO+paint				
2	PIR	with paint	shred	Ultra-Poly evaluation of Geo-Tech material		1.013		
2	PIR	without paint	pelletized	Ultra-Poly evaluation of Geo-Tech material		0.994		



Results using ISO Test Methods

Phase	Source	with or without paint	Shred or pelletized	Sample Description	ISO 1183	ISO3541	ISO527-1				ISO178	
					Specific Gravity, g/cc	Ash Content	Tensil modulus, Mpa	Tensil Break, Mpa	Ultiate Tensile Strenght, Mpa	Elongation @ Break %	Flexural Modulus, MPa	Flexural Strenght, MPa
1	PCR	without paint	pelletized	MCC analysis of Geo-Tech PCR Repro TPO	0.9975	13.7	1,365	14	14	50	1,495	25
1	PCR	without paint	pelletized	Toyota evaluation of Geo-Tech PCR repro	0.99	14.2	1,196		18.1	279.9	1,166	21
2		without paint	pelletized	Bales processed by ACI	1.01				18.4	127	1,616	
1	PCR	with paint	shred	MCC analysis of PCR Shred TPO+Paint from Post Plastics	1.01	16	1,640	18	18	23	1,537	26

Phase	Source	with or without paint	Shred or pelletized	Sample Description	ISO180		Method A (2 lb. hammer) kJ/m2	ISO1133	ACI L-23	
					Notched, Izod Impact, (kJ/m2)				Melt Flow Rate (230°C/2.16kg) g/10 Min.	VSPSI
					@23°C	@-30°C	spks/in ²	spks >0.4mm		
1	PCR	without paint	pelletized	MCC analysis of Geo-Tech PCR Repro TPO	33.75	8.75	25	25		
1	PCR	without paint	pelletized	Toyota evaluation of Geo-Tech PCR repro			28	28		
2		without paint	pelletized	Bales processed by ACI			24.8	24.8	4	0
1	PCR	with paint	shred	MCC analysis of PCR Shred TPO+Paint from Post Plastics	43.36	Not tested	13	13		



Phase	Source	with or without paint	Shred or pelletized	Sample Description	ISO 179		ISO 75-A		ISO 6603	
					Notched Charpy (23°C) kJ/m ²	Notched Charpy (-30°C) kJ/m ²	Tem of Deflection (1.80 Mpa) °C	Temp of Deflection (0.45 Mpa) °C	Dynatup (total energy 23°C) J	Dynatup (total energy -30°C) J
1	PCR	without paint	pelletized	MCC analysis of Geo-Tech PCR Repro TPO						
1	PCR	without paint	pelletized	Toyota evaluation of Geo-Tech PCR repro	50.6	4.4	46.7	79.7	28.1	26.7
2		without paint	pelletized	Bales processed by ACI						
1	PCR	with paint	shred	MCC analysis of PCR Shred TPO+Paint from Post Plastics						



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