TPE 101

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Jonas Angus, TPE Industry Expert

For more than 25 years, Jonas Angus, Founder of TPE Solutions, Inc., has been a leader in innovative Thermoplastic Elastomer (TPE) solutions. Now you can put his expertise to work for your company. TPE Solutions, Inc. is a private, consulting and procurement firm dedicated to helping clients select or formulate the most affordable TPE solution that meets the performance requirements of their application.

Why TPE

TPEs provide the similar advanced performance properties to thermoset rubber,
but can be processed with the speed and economy of thermoplastics. With unlimited end-use characteristics for the hottest consumer products (protection, color, feel, grip, softness, a feeling of quality and substance) TPEs can be found in a wide array of consumer and industrial applications. If you are currently manufacturing or designing a new rubber part, and want to capitalize on the economy of thermoplastic processing, then TPEs could be a viable option.

Bottom Line: TPEs offer a cost effective alternative to traditional rubbers.

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TPEs ?

Broad range of Terms

What is a TPE?

- TPE is an elastomer that is processed into final articles with equipment used for thermoplastics, such as injection molding, blow molding, extrusion, compression molding, thermoforming.
- TPE generally has two phases, soft and hard. The transition temperatures of these phases determine the service temperature range of TPE.
- TPE processing characteristics depend upon softening, or melting, of the rigid thermoplastic phase.
- TPE products are typically very shear sensitive during processing.
- TPE products are recyclable and colorable.

Classes of TPEs

Five Major Classes

1) Thermoplastic Polyurethane (TPUs)
2) Styrenic Block CoPolymers (SBCs)
3) Thermoplastic Vulcanizate (TPVs)
4) Thermoplastic Olefins (TPOs)
5) Engineered TPEs (COPEs, COPAs, MPR, ETPV, TPVs)

History of TPEs

1) TPUs
   - Discovery Period: 1937 to 1958
   - Commercialization: 1959
   - Pioneers: Otto Buyr, C.S. Schollenberger
   - Key N/A Suppliers: a) Noveon (B.F. Goodrich) – Estane
     b) Bayer – Texin
     c) Dow (Upjohn) – Pellethane
     d) BASF – Elastollan
     e) Merquinsa – Pearlthane
     f) SK Chemical - Skythane

2) Styrenic Black Copolymers (SBCs)

Discovery Period: 1950s

Pioneers: Shell Chemical

Current N/A Suppliers:

a) Kraton Polymers – Kraton

b) Repsol/Dynasol – Calprene

c) Kuraray – Septon

3) Thermoplastic Vulcanizates

Discovery Period: Early 1970s

Commercialization (Partially Vulcanized) 1971 – UniRoyal

Commercialization (Fully Vulcanized) 1981 – Monsanto

Key N/A Suppliers a) **Exxon (Advance Elastomer Systems – Santoprene**

b) DSM (Polysar) – Sarlink

c) Solvay (TRS) – NexPrene

Super TPV – Kraton – Kraton ?

Kuraray – Septon V

4) Thermoplastic Olefin (TPOs)

Discovery Period: 1971

Pioneers: RPI/Dexter Corp. – Solvay Engineered Polymers

Key N/A Suppliers:
- Solvay Engineered Polymers
- Basell – Profax
- Taknor Apex – Telcar
- DSM – Keltan
- Exxon
- A. Schulman
- Washington Penn

5) Engineered TPEs

Discovery Period: COPE – 1950s
COPA –
MPR –

Commercialization: COPE – 1972 – Hytrel
COPA
MPR
TPVs

Key N/A Suppliers: Dupont – Hytrel
APA – Alcryn
DSM – Anitel
Total – Rebax
Nylon Corp of America – COPA
Zeon – TPVs
Dupont - ETPV

Performance Matrix for TPE

	Olefin TPV	COPE	COPA	TPU (ester)	TPU (ether)
Clarity				X	X
Tensile Strength: 23C				X	X
Tensile Strength: High Temp.			X	X	X
Elasticity				X	X
Tear Strength				X	X
Cut Growth Resistance	X	X			
Abrasion Resistance				X	X
Compression Set Resistance (23C)				X	X
Compression Set Resistance (70 to 100C)	X				
Low Temperature Flexibility		X	X		
Elevated Temperature Modulus				X	X
Dart Impact Resistance (-40C)	X	X	X	X	X
High Resilience		X	X		
Hot Air Resistance	X			X	
Hot Water Resistance	X				X
Weatherability (strength)	X		X	X	X
Weatherability (color)	X	X	X		

Performance Matrix for Thermoplastic Elastomers

X = Highly Suitable for applications requiring this attribute

TPE SELECTION CHART

MATERIAL TYPE					
TEST PROPERTY	**TPVs**	**SEBS**	**MPR**	**TPU**	**COPE**
Hardness	20A to 50D	0A to 50D	40A to 90A	65A to 75D	80A to 80D
Wear Resistance	Poor	Poor	Fair	Excellent	Good
Chemical Resistance *Polar Solvents* *Non-polar oils*	 Good Fair	 Poor/Fair Poor	 Fair Good	 Poor/Fair Good	 Poor/Fair Good
U.V. Resistance	Good	Good	Good	Poor	Good/Fair
Tactile Feel	Fair	Excellent	Fair	Poor	Poor/Fair
Compression Set *70C* *100C*	 Good Good	 Good Poor/Fair	 Good Poor/Fair	 Good Poor	 Good Poor/Fair
Resilience	Poor	Fair/Good	Fair/Good	Good	Good
Oil Resistance	Fair	Poor	Good	Good	Good

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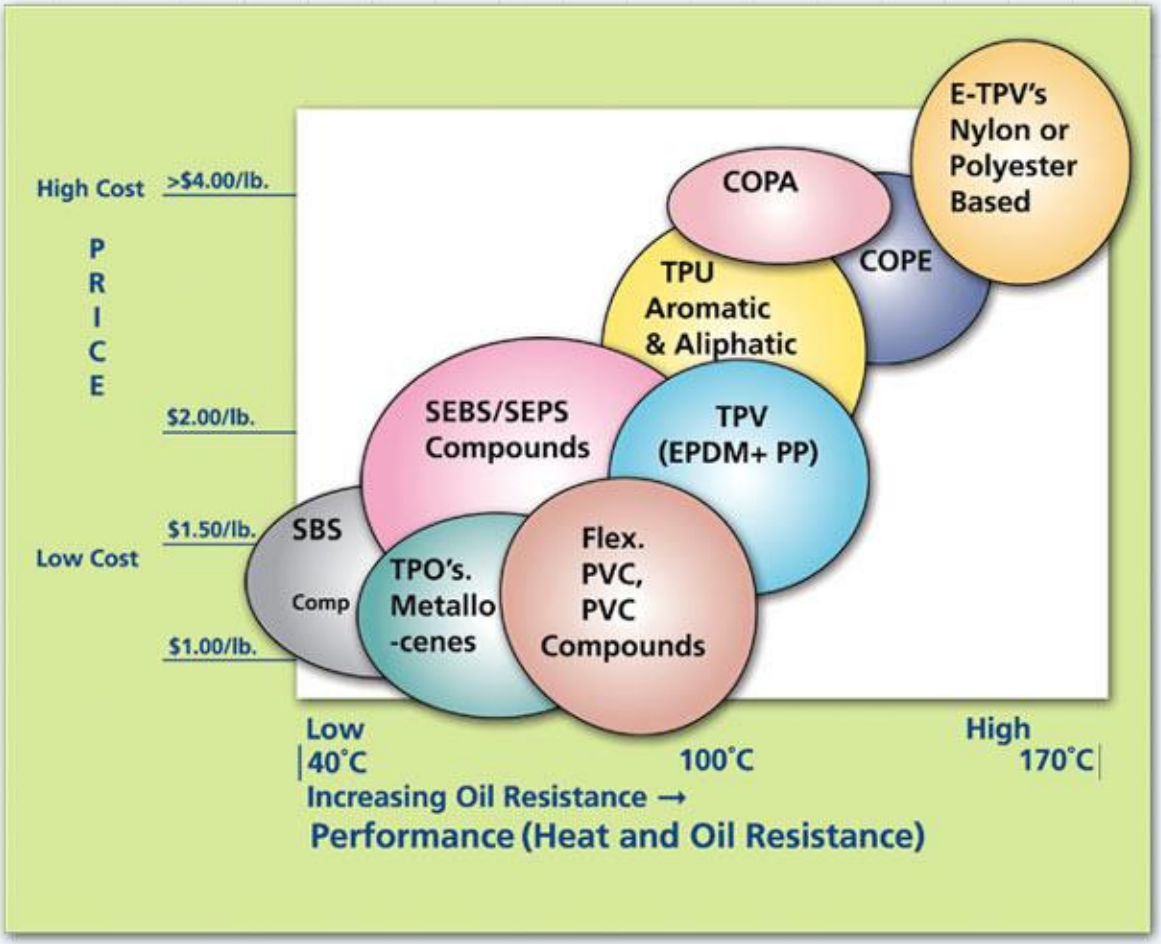

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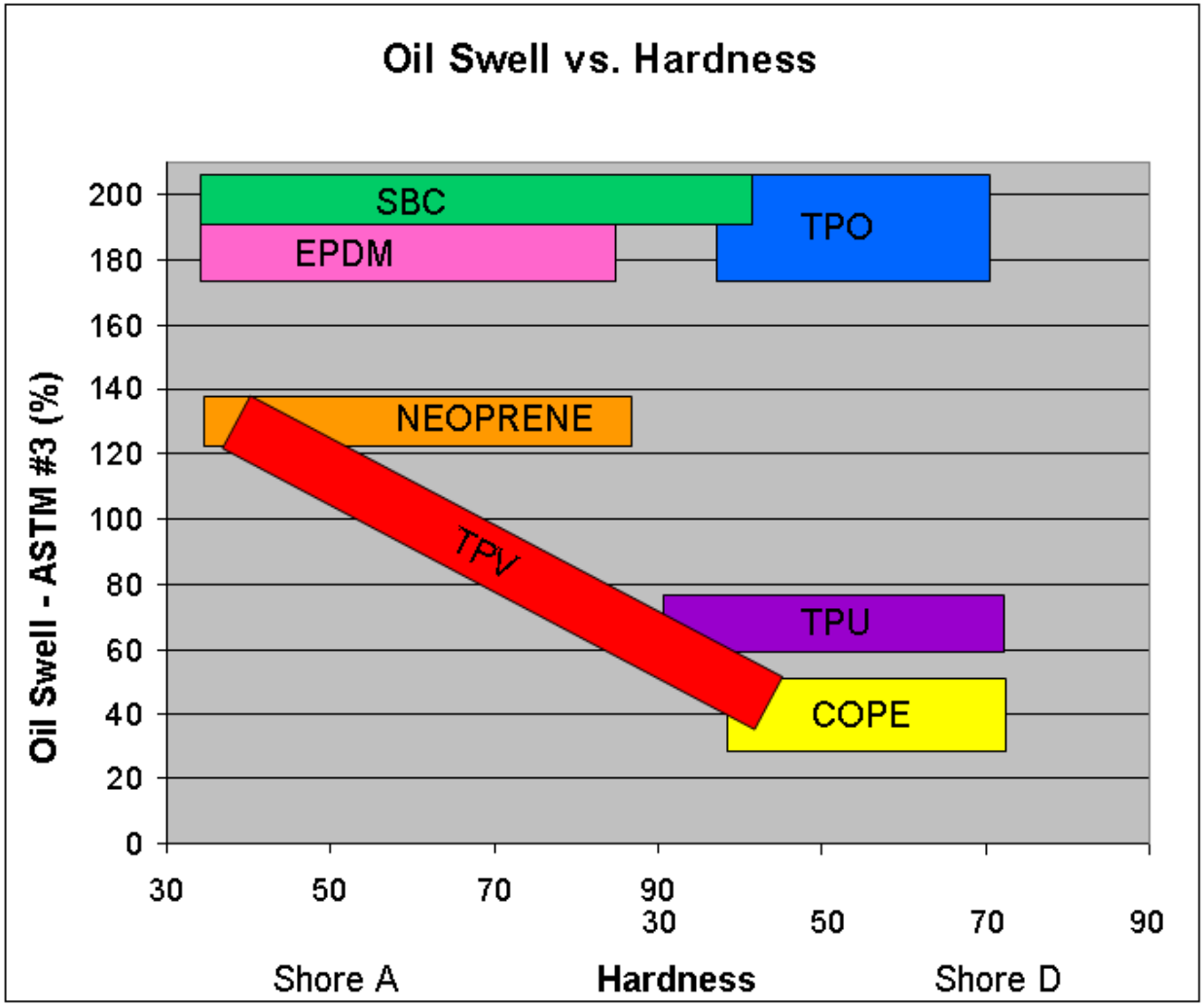
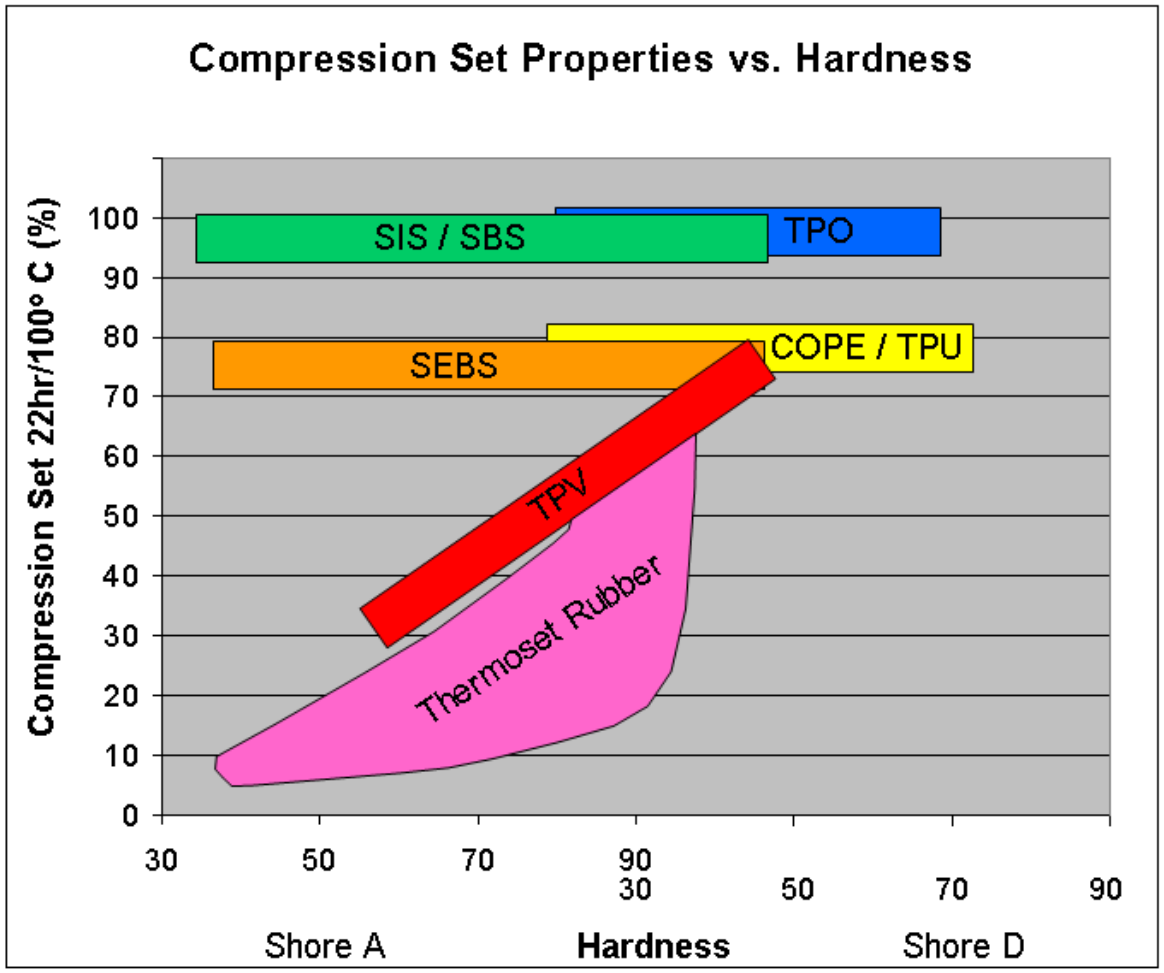
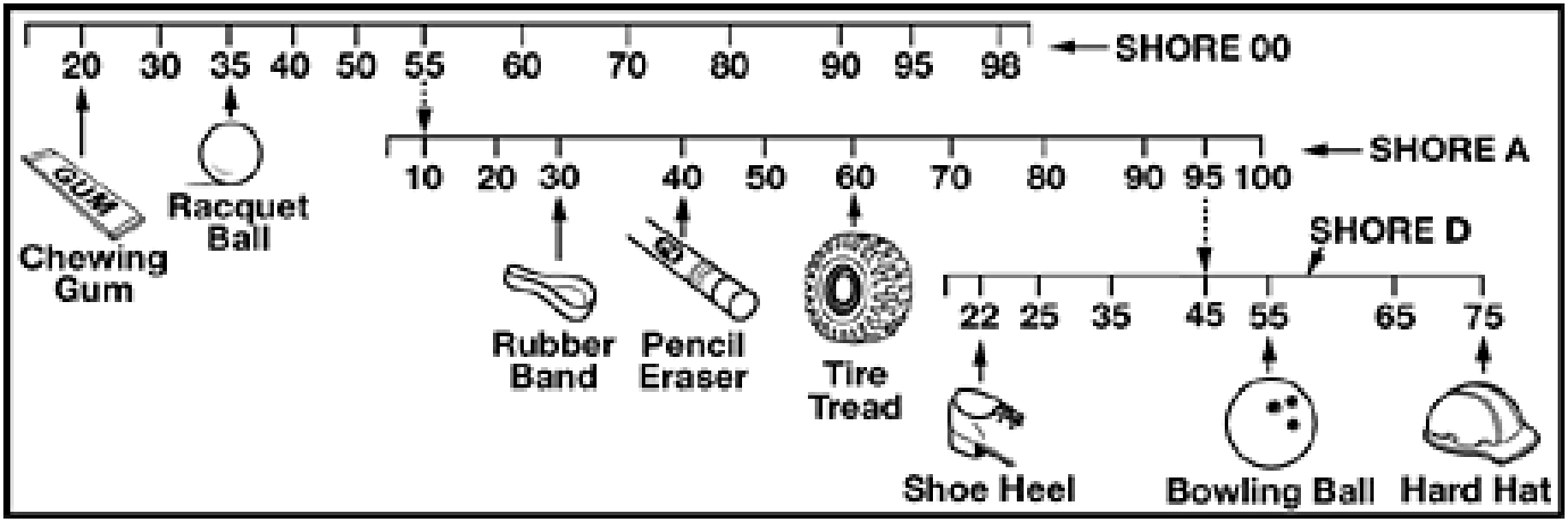
Oil Swell Properties of TPEs



Compression Set Properties of TPEs




20 30 35 40 50 55 60 70 80 90 95 98
SHORE 00
10 20 30 40 50 60 70 80 90 95 100
SHORE A
22 25 35 45 55 65 75
SHORE D
GUM
Chewing Gum
Racquet Ball
Rubber Band
Pencil Eraser
Tire Tread
Shoe Heel
Bowling Ball
Hard Hat