
Green Elastomer Technology for Infrastructure
Elastomers in Infrastructure
18 June 2021
Rubber in Engineering
I·M3
artis
Birch Chemicals
ACE
RUBBER HEART
Endurica
ZEON

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Products & Consulting LLC
Physical Testing
Does your product comply with regulations and match consumer expectations? ACE's physical testing capabilities will assure that your final product meets the demands of government regulations, industry standards, and customer-specific protocols.
PHYSICAL TESTING
Analytical Testing
ACE's many analytical test capabilities include specialized equipment and an array of wet chemistry solutions. Looking to outshine competitors but there is no established ASTM standard? ACE offers custom test solutions by creating methods that meet customer-defined applications.
ANALYTICAL TESTING
Expert Consulting
A team of agile, highly trained professionals puts ACE in the vanguard of today's most solutions-oriented independent testing laboratories. Our broad scope for research makes ACE a great partner for preserving product integrity in increasingly competitive industries and markets.
CONSULTING

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ANAB

ANSI National Accreditation Board

ACCREDITED

ISO/IEC 17025

TESTING LABORATORY

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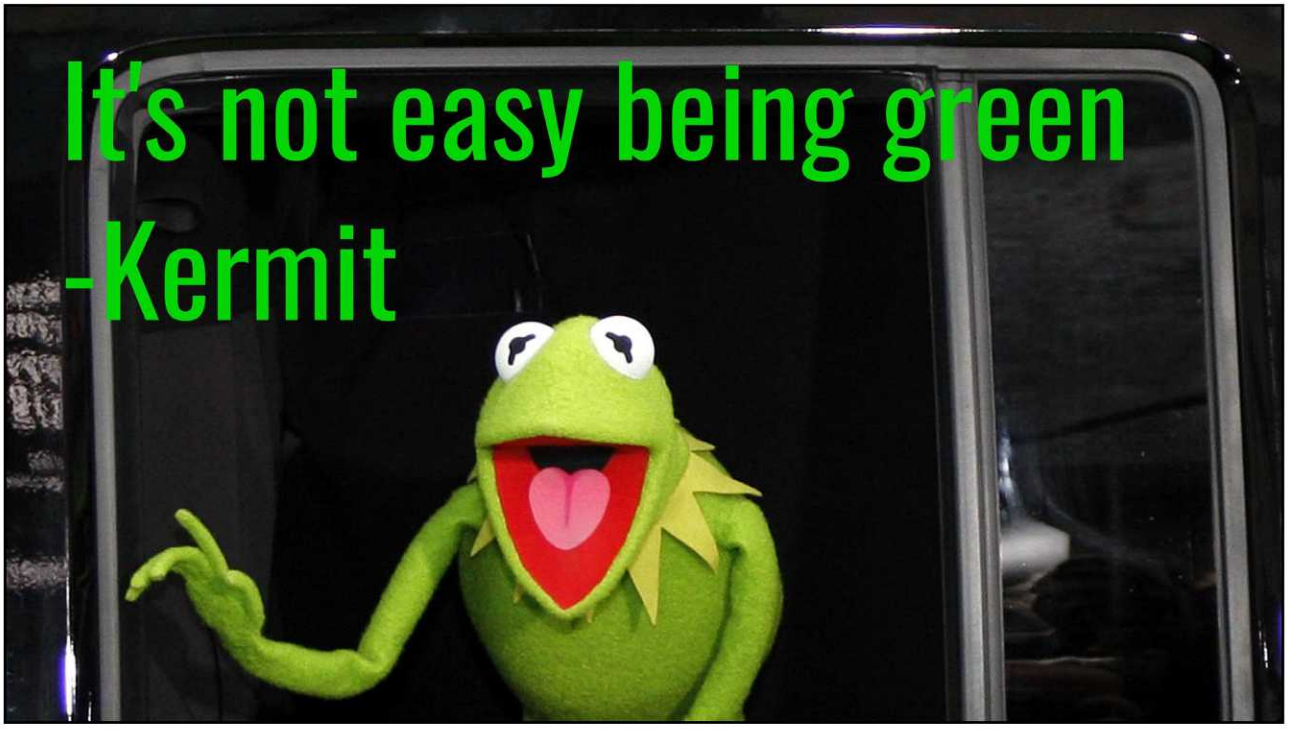

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What is Green

- Use of recycled materials
- Use of sustainable materials
- Reduction in energy to make product
- Energy savings by product performance
- Product end of life (disposal)

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Why Green?

Doing the right thing by saving the earth

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Why Green?

Because you were told to

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Why Green?

- Because you are incentivized to
  - Infrastructure spending
  - Green subsidies
  - Certifications (LEEDS)

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Green is going big in infrastructure

United States

- Proposed $2 Trillion infrastructure bill
  - At least 30% tied to green initiatives and incentives
- Carbon neutral by 2050

United Kingdom

- National Infrastructure Strategy
  - "Hundreds of Billions of GBP"
  - 1/3 of strategy is for delivering net zero

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Recycled Rubber

- Typically, compatible with rubber compounds being used in.
- Can solve end of life issue for same product or elastomer product.
- Can work as a partial substitution, resulting in cost savings

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Types of Recycled Rubber

Reclaim

- Vulcanized rubber that is recovered from scrap.
- Most commonly ground rubber scrap.
- Devulcanization is a form of reclaim.

Devulcanization

- Selective breakage of crosslinks
- Greater than 30% devulcanization

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% Devulcanization per ASTM D6814

- Crumb rubber extracted in hot acetone per ASTM D297
- Extract dried at 70°C for 16 hours
- Dried sample then swollen in solvent for 24 hours at RT
- Fresh solvent is cycled in three times during the 24 hours
- Specimen cleaned of surface solvent and weighed
- Solvent swollen specimen dried at 70°C for 16 hours
- Specimen cooled to RT in desiccator
- Density of specimen using methanol

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Flory-Rehner Equation

- Reference: ASTM D6814

9. Calculation of Crosslink Density (v_e)

9.1 The Flory-Rehner[3] equation is used for calculation of crosslinking density.

$$v_e = \frac{-[ln(1 - V_r) + V_r + \chi_1 V_r^2]}{[V_1(V_r^{1/3} - V_r)/2]} \quad (2)$$

where:

v_e = effective number of chains in a real network per unit volume,

V_r = volume fraction of polymer in a swollen network in equilibrium with pure solvent and is calculated as:

$$V_r = \frac{\text{Weight of dry rubber/density of dry rubber}}{\frac{\text{Weight of dry rubber}}{\text{Density of dry rubber}} + \frac{\text{Weight of solvent absorbed by sample}}{\text{Density of solvent}}}$$

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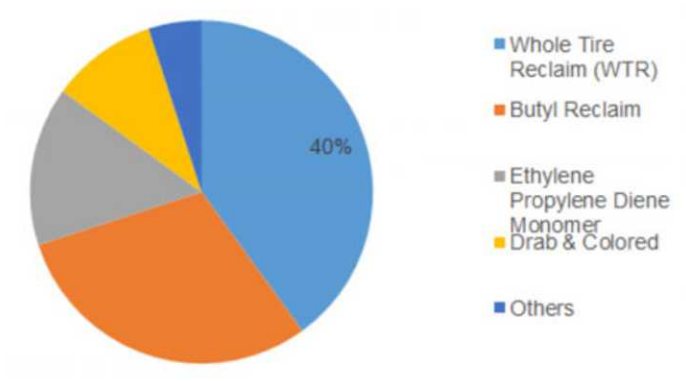
Material Sources – Feed Stock



- www.rueters.com

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Recycled Carbon Black

- Reclaimed from scrap rubber products or tires.

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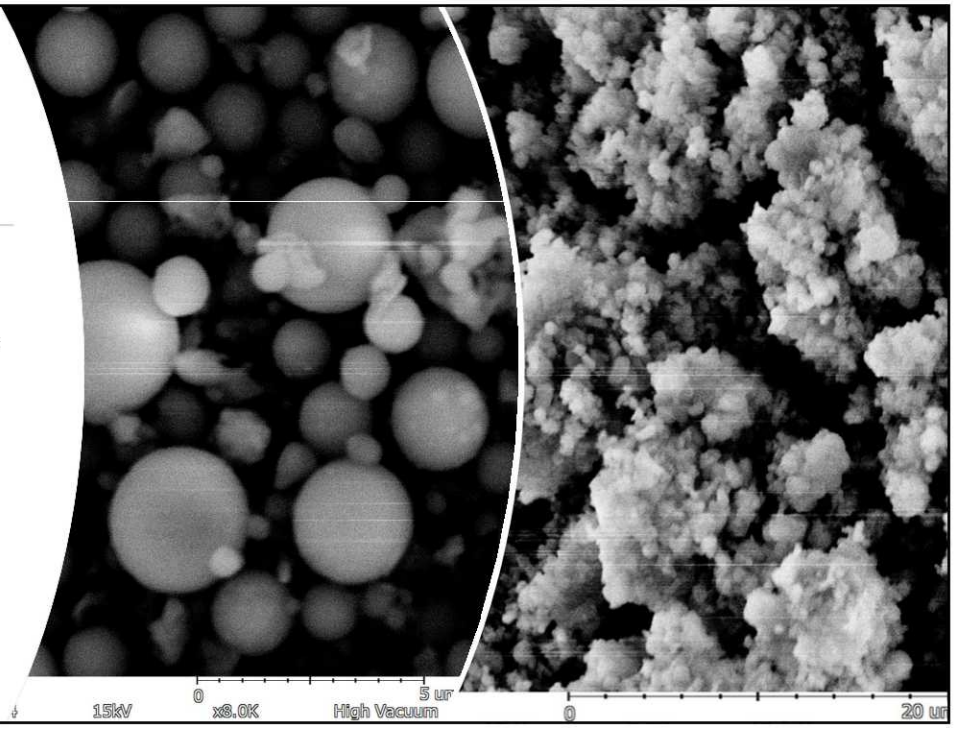
Recycled / Reclaimed Fillers

- Materials
  - Precipitated Silica
  - Ground silica
  - Ground calcium carbonate
  - Precipitated calcium carbonate
  - Aluminosilicate ceramic
- Sources
  - Steel Mill Dust
  - Coal Fly Ash



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Recycled Content Case Study

Case Study - EPDM Weatherstrip Gasket

Thomas Swan

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Case Study - EPDM Weatherstrip Gasket

Study for Thomas Swan

Material	Control	25% Crumb	50% Crumb	Crumb + rCB
EPDM Oil Extended	100	75	50	75
EPDM Medium ENB	50	37.5	25	37.5
Treated Crumb Rubber	0	97.75	195.5	97.75
N-550	90	67.5	45	67.5
N-762	90	67.5	45	0
Recycled Carbon Black	0	0	0	67.5
ZnO	5	3.75	2.5	3.75
Stearic Acid	1	0.75	0.5	0.75
AC-722	5	3.75	2.5	3.75
Sunpar 2280	50	37.5	25	37.5
MB PHR	391	391	391	391
Sulfur	1.5	1	1	1
TBBS	2.5	1.875	1.875	1.875
TMTD	1	0.75	0.75	0.75
ZDBC	1.5	1.125	1.125	1.125
Total PHR	397.5	395.75	395.75	395.75
% Renewable Content	0.0%	24.7%	49.4%	41.8%

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Case Study - EPDM Weatherstrip Gasket

	Control	25% Crumb	50% Crumb	Crumb + rCB
Cure Tc90 +5				
Shore A Duro	70.3	68	66.3	68.8
Tensile (Mpa)	12.78	11.56	10.89	11.16
Elongation (%)	339.29	338.7	342.01	355.16

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Use of Sustainable Materials

Renewable / sustainable sources with neutral carbon footprint

Expansion of NR to offset more synthetic polymers

- ENR
- DPNR

Sustainable plasticizers

- Soybean oil, rapeseed oil,

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Sustainable Materials - Logistics

Eliminating the geographical constraints on raw material production to reduce transit emissions

Natural rubber polymers

- Guayule
- Russian dandelion
- Sunflower

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Process Energy Savings

Reduction of carbon footprint to manufacture elastomer products by

- Reducing processing peak amps
  - Process aids / additives
  - Equipment innovations
- Reducing cycle times and processing times
- Reducing transport
- Manufacturing in an energy efficient facility / operation
  - Soft start drives on equipment
  - High efficiency lighting
  - Power generation / power capture

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Cycle time reduction case study

Aluminosilicate Ceramic Spheres in Silicone

Spherix Mineral Products

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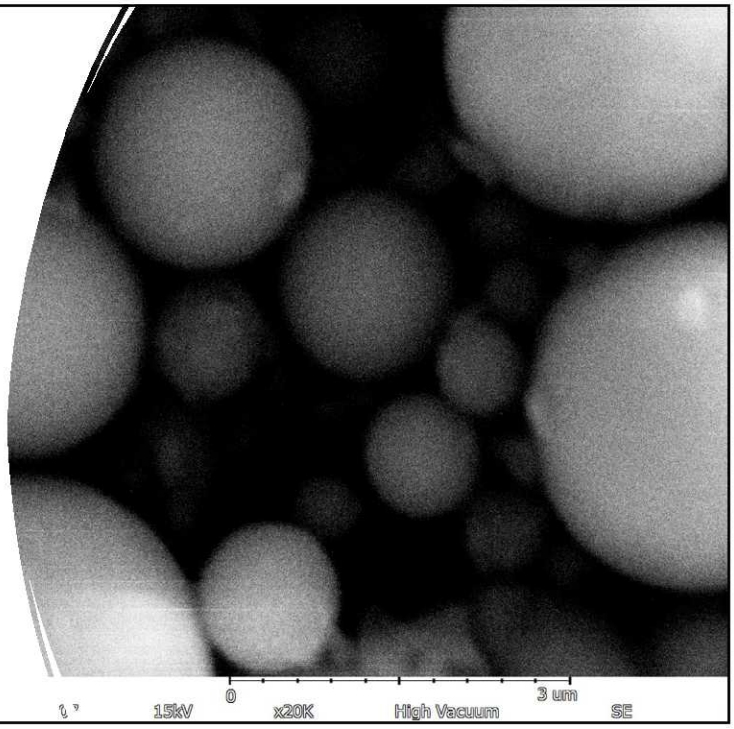
Cycle time reduction case study



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Cycle Time Reduction Case Study

Material	Control	Experiment
Silicone Base	100	100
Filler	60	60
Stabilizers	3	3
Peroxide	1.25	1.25
Aluminosilicate Ceramic Spheres	0	5

Study for Spherix Mineral Products

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Cycle Time Reduction Case Study

45% Reduction

Stage	Control	Experiment
Stage One (seconds)	445	292
Stage Two (seconds)	183	62
Stage Three (seconds)	152	75
Total Time (seconds)	780	429

Study for Spherix Mineral Products

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Energy Savings by Product Performance

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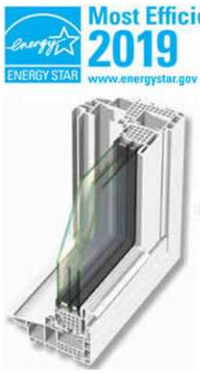
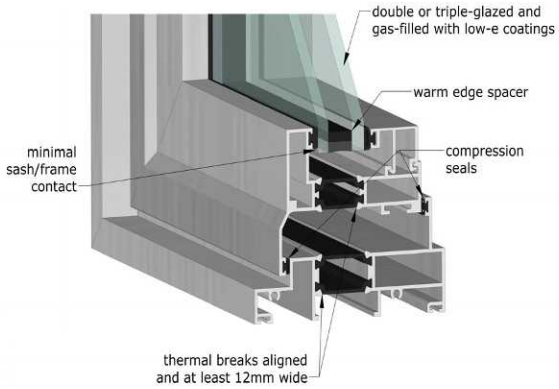
Energy Saving Product

- Thermal insulation values of elastomeric gaskets are used to improve energy efficiency in infrastructural glazing units.



EPA MOST EFFICIENT WINDOW

EnergyCore has been designated as one of the Most Efficient ENERGY STAR® qualified products in 2019



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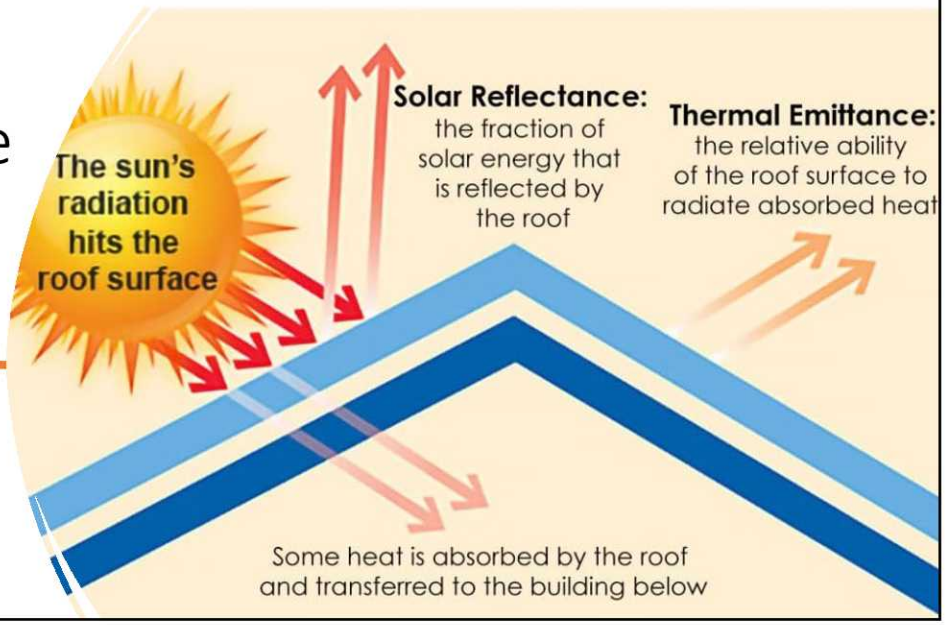
Energy Diffusive EPDM Roofing



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Disposal of product

- Does the final product have a sustainable waste stream for reuse?
- Is the final product biodegradable? (rubber = no)
- Is the product headed to a landfill?

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Send us your questions

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Rubber Nerds

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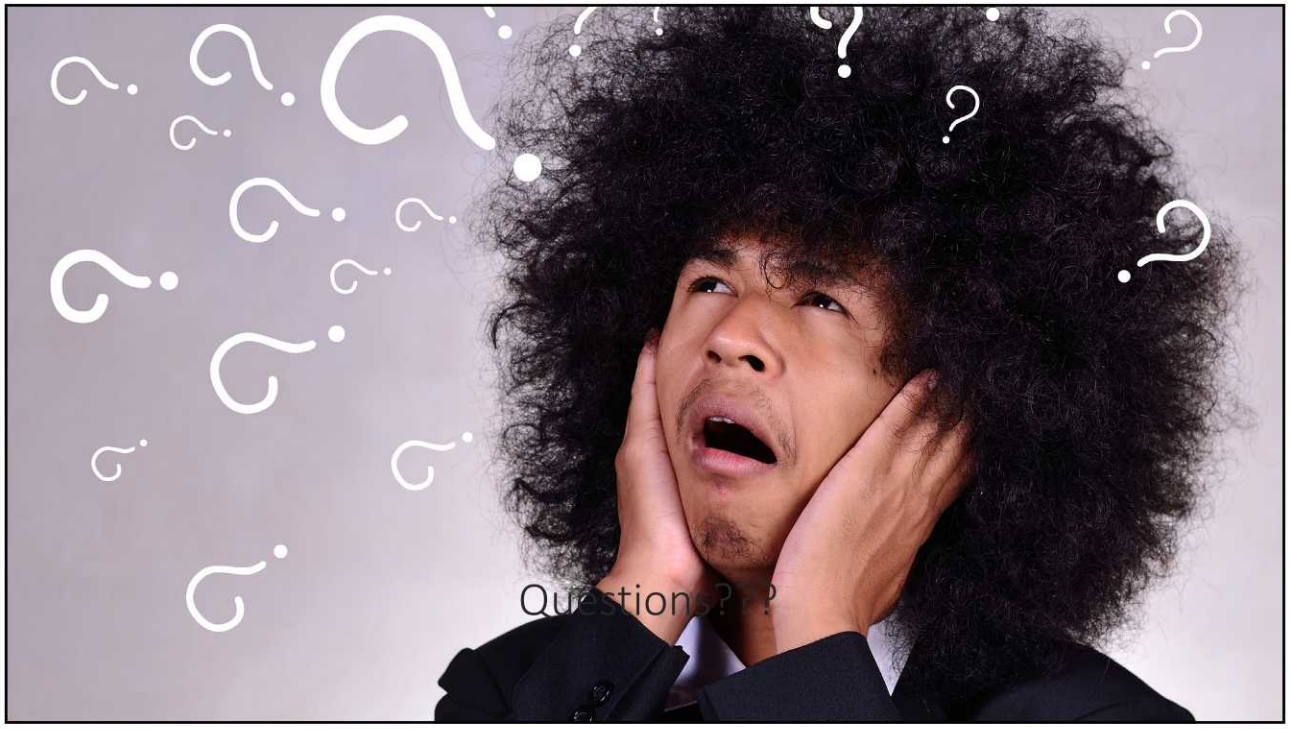

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