ROGERS CORPORATION

Exploring the Material Science Behind the Top 5 Types of Underfoot Cushioning

Kelly Nelson

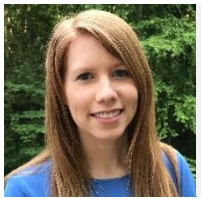
Eric Beaudry

poron COMFORT

Meet the Team

Eric Beaudry

Global Technical Service Manager



Kelly Nelson

Lead Technologist for Footwear

Jennifer Velasco

Technical Sales and Design Support

Agenda

What we will cover:

- Rogers Corp – Brief Overview
- Creating Comfort in the Footwear System
- Underfoot Cushioning Options and Performance Indicators
- Enabling Footwear Innovation
- Questions/Discussion

Rogers Corporation – At a Glance

Heritage

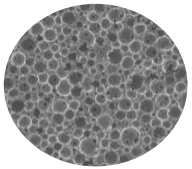
- Proud history of serving footwear applications for 60 years
- One of oldest public companies in U.S., started 1832

Global Presence

- 13 manufacturing facilities in 6 countries
- Worldwide product availability
- Local technical support from Rogers engineers

Culture of Responsibility

- Commitment to sustainable practices in environment, quality, ethics and safety
- Well-established reputation across industries



Innovation

- PORON® is not a single product but a technology platform
- Rogers R&D engineers polymer systems to achieve performance differentiation

Global leaders in engineered materials.
Helping power, protect, connect our world.®

Continuous Innovation

Rogers has a rich legacy of innovation and collaborative problem-solving with our customers

- Focused on customer-centric collaboration
- Partnering with global public and private industry, leading research universities and institutions
- R&D investment to create next-generation solutions

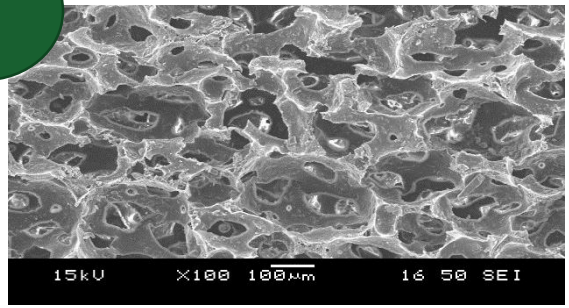
- Rogers Corporation Global Innovation Centers
  - Burlington, MA (Northeastern University)
  - Suzhou, China
  - Eschenbach, Germany

Rogers Innovation Center at Northeastern University in Burlington, MA

http://www.rogerscorp.com/about/innovation-center.aspx

Guess the Material Type!

1



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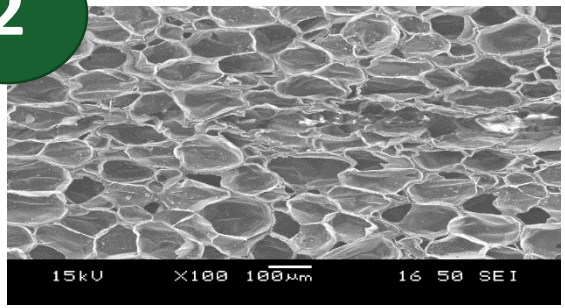

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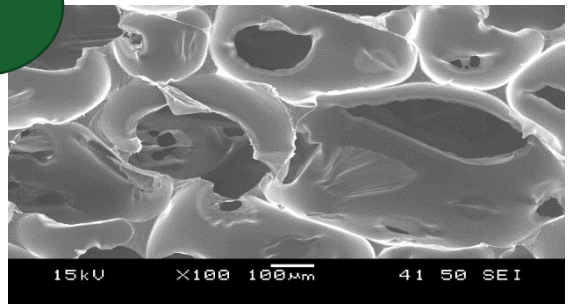

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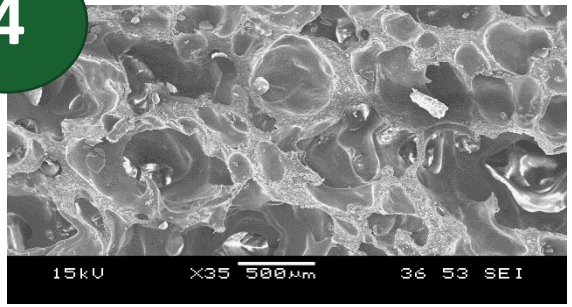

Footwear System

Footwear System

Upper

- Secures foot to shoe; attaches to lower components
- Protection from environment (resistance to abrasion, impact, etc.)
- Airflow for breathability
- Aesthetics and style

Footbed

- Direct contact with foot
- Step-in and long-term comfort to the foot
- Enhances consumer's perceived comfort
- Supplements the midsole functionality and benefits

Midsole

- Reduction of shock to the body (reduced leg fatigue)
- Visible comfort technology opportunity

Outsole

- Purpose and material depend on style and function of shoe
- Protection from environment (resistance to slipping, chemical, etc.)

Considerations for Underfoot Cushioning

Footbed:
Inside part of the shoe that runs under the bottom of the foot . . .
It may have many layers of construction and structural elements for better fit and comfort
https://www.liveabout.com/what-is-the-footbed-of-a-shoe-2987680

Footbed

Types:

- Removable
  - Insole or sockliner
- Permanent
  - Adhered to midsole or board
  - Strobel stitched to upper

Components:

- Top Cover
  - Leather
  - Fabric
- Adhesive
  - Type and placement that promotes flexibility and breathability
- Cushioning material

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Footbed

Cushioning Material

- Wide array of choices in varying levels of quality and performance
- Ideally, compliment and enhance the overall design
  - Maintain performance, shape and fit over the product lifetime
  - Retain neutral alignment and cushioning for long-term, “as-designed” comfort
- Select materials based on goals for your design
  - Trends (Comfort, Multi-Functional Use, etc.)
  - Category and style
  - Expected product life
  - Price point

Enduring the Footwear Environment

Underfoot cushioning material is under a variety of stresses during use

Walking

- At average walking pace (3 mph), one step every 0.6 seconds
- Feet experience 1.5 to 2 times the pressure of standing

Running

- Longer stride length and increased pace, one step every 0.3 seconds
- Feet experience 2 to 3 times body weight

Perspiration and Elevated Temperature

- 250,000 sweat glands on the average pair of feet produce ¼ liter of sweat per day
- Foot temperature rises during activity as blood flow and core body temperature increases

Performance Indicators: Extending Product Life

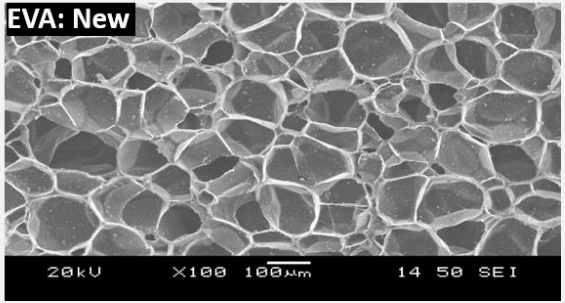
Indicators of performance that extend the comfortable life of footwear:

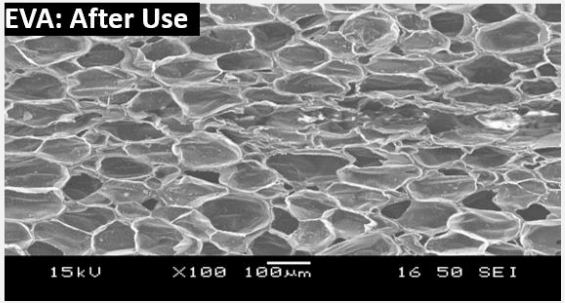
Compression Set Resistance	• Maintains fit, shape and cushioning without breaking down
Compression Force Deflection (CFD)	• Reduces discomfort at key pressure points by providing support and load-bearing ability
Hydrolysis Resistance	• Moves moisture vapor while maintaining performance without breaking down to keep feet cool, dry and comfortable

Ethylene Vinyl Acetate

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
EVA															

Maintaining Fit, Shape and Cushioning

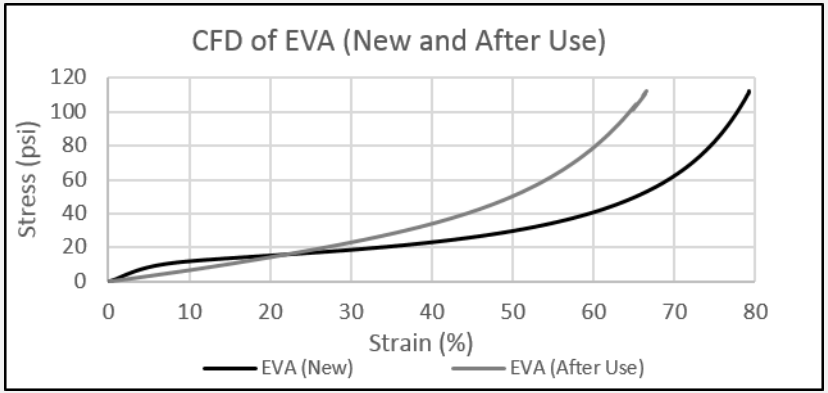




Cell Type: *Closed*

- Permanently molds and conforms to the foot after a period of wear

Load Bearing Support



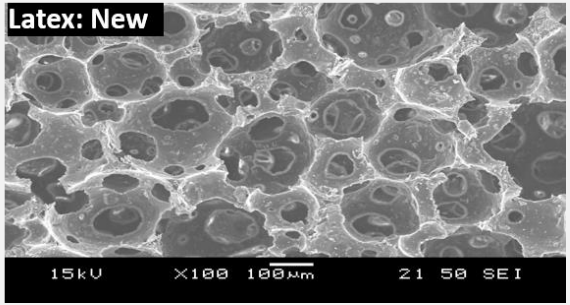
- EVA will have a firmer but less supportive feel after a short period of use
- Wearer will notice the change in cushioning experience and a different level of comfort

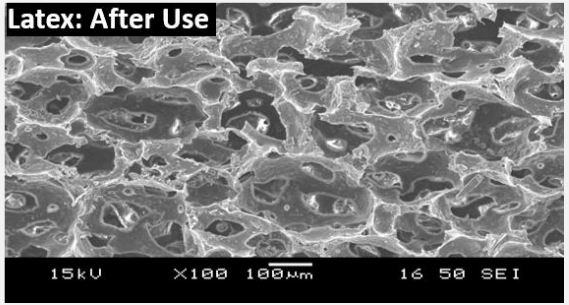
*After Use results are following accelerated aging to simulate one month of use

Synthetic Latex Foam

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Synthetic Latex															

Maintaining Fit, Shape and Cushioning

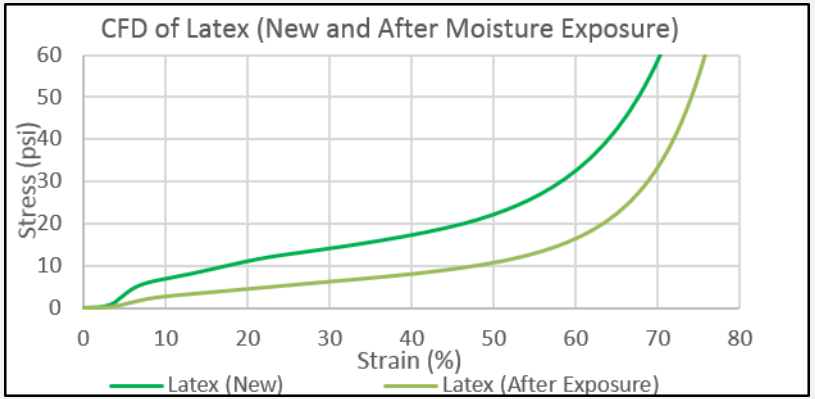




Cell Type: *Open*

- Cells distort permanently under stresses and result in altered cushioning response

Load Bearing Support



After a simulation of the humid footwear environment:

- High moisture absorption
- Remains wet after 24 hour drying cycle
- Lower load bearing capability after moisture exposure

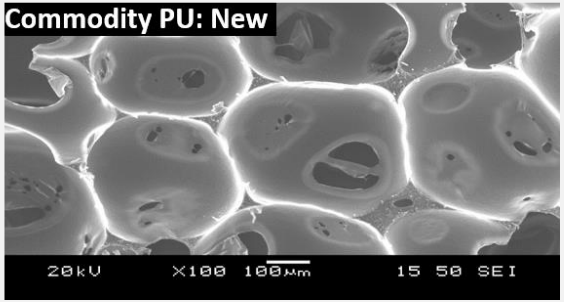
*After Use results are following accelerated aging to simulate one month of use

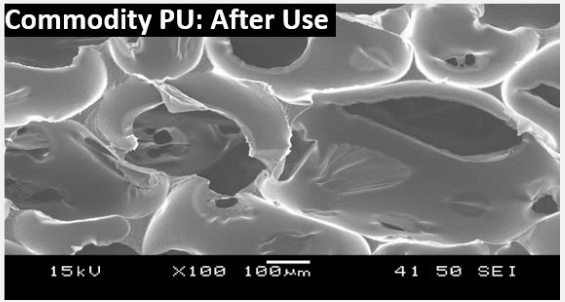
Polyurethane

Differences in Fit, Shape and Cushioning

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Polyurethane															

Commodity Polyurethane

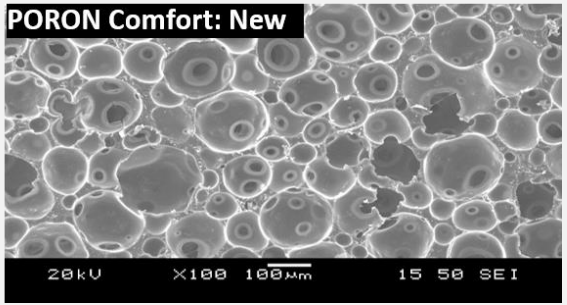


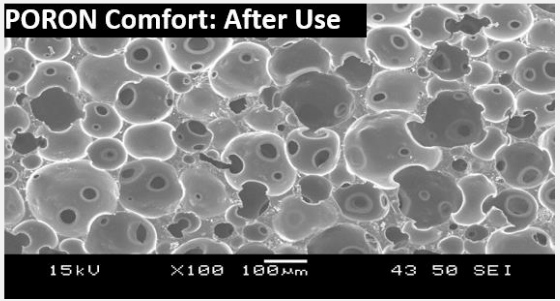


Cell Type: *Open*

- Cell integrity changes, weakened support structure and cushioning capability

PORON® Comfort Polyurethane Technology





Cell Type: *Engineered, Open Microcellular*

- Stable properties over product lifetime and after use for consistent performance

*After Use results are following accelerated aging to simulate one month of use

Polyurethane

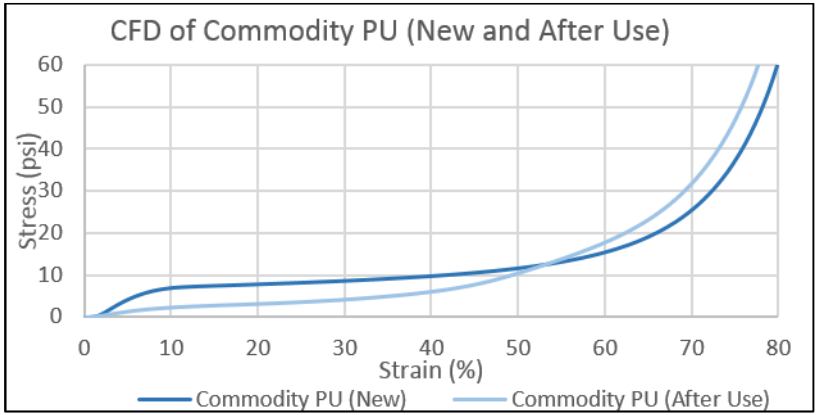
Differences in Load Bearing Support

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Polyurethane															

Commodity PU

Following one month of simulated use

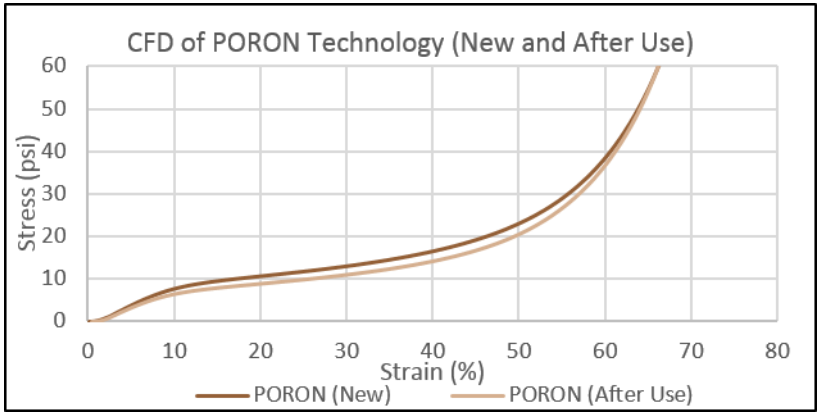
- Reduction in load bearing support
- Change in comfort and potential for higher rates of fatigue to wearer



PORON® Comfort Polyurethane Technology

PORON Technology has the same load bearing and cushioning capability over time

- The wearer will have same experience after one month as when the shoe was worn for the first time
- Indicates long-term cushioning performance



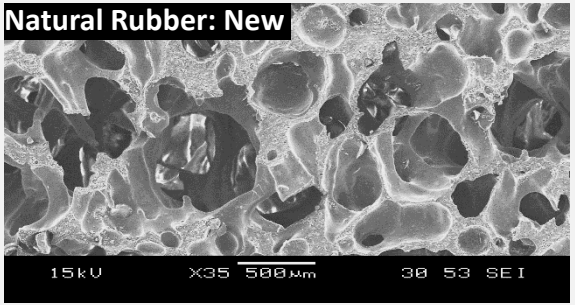
*After Use results are following accelerated aging to simulate one month of use

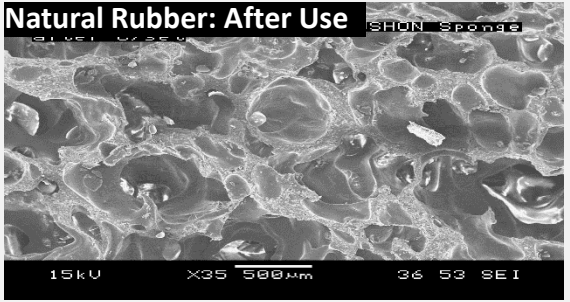
Natural Rubber

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Natural Rubber															

- Sustainable alternative to petroleum based polymers
- Produced from sap of approximately 200 different plants
- Vulcanization creates the finished rubber product
- Elasticity, high tensile and tear strength
- Durable with resistance to fatigue

Maintaining Fit, Shape and Cushioning





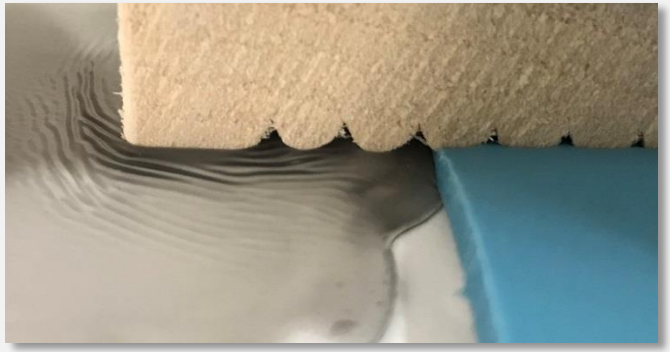
Cell Type: *Open*

- Cell size variability due to natural source but durable even after use

*After Use results are following accelerated aging to simulate one month of use

Gel

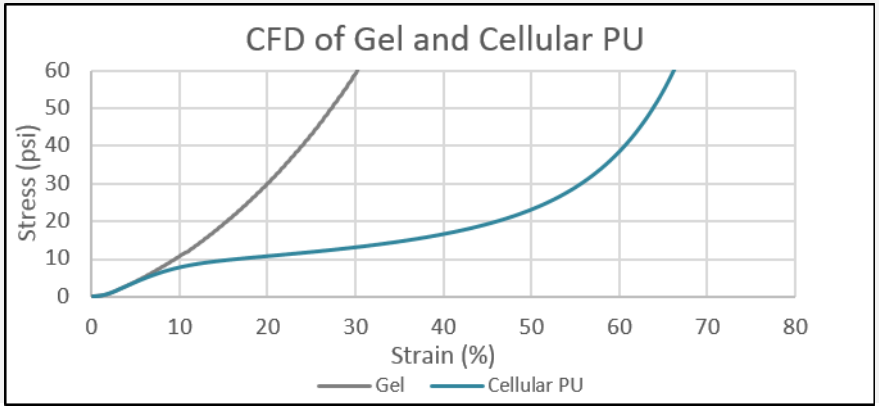
Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gel															



Gel and Cellular PU under compression

- Fine particles dispersed in a continuous medium contained within an outer skin
- Highly viscous and behaves similar to a solid
- Shape is maintained even under compression
- Limited conformability produces firm cushioning experience

Load Bearing Support



- Gel has high firmness and is incompressible
- Conformability and pressure distribution capability difference compared to cellular materials

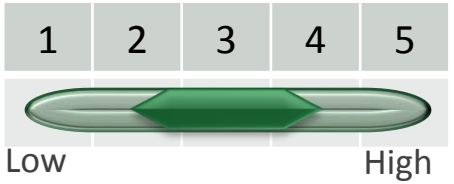
*After Use results are following accelerated aging to simulate one month of use

Underfoot Cushioning Options - Scorecard

Material Type	*Short Term* Performance					Long Term Performance					Price				
Rating Scale	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
EVA															
Gel															
Synthetic Latex															
Natural Rubber															
Polyurethane															

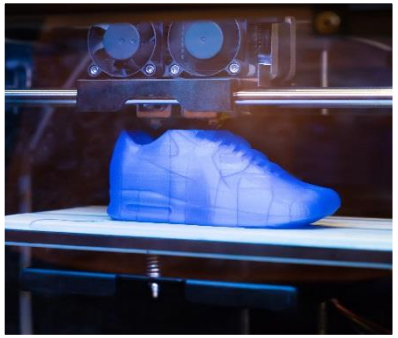
- A range of performance exists within each material category
- Other important criteria to consider:
  - Compliance
  - Innovation capability
  - Global supply chain support

Rating Scale Key:



Enabling Footwear Innovation

Shoe Construction

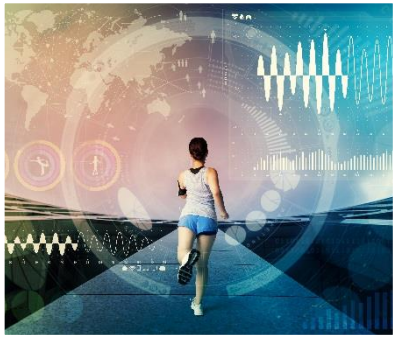


- Evolution of design to address consumer challenges
- 3D Printing

Multi-Functional Use

- One-style-fits-all-activities footwear
- Next-generation materials that combine benefits
- Durability and long-lasting quality

Wearable Technology



- Sensing capabilities
- Protecting sensitive electronics

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Thank you!