



# PVC Roofing Materials

Performance, Construction & Functionality



**AIA**  
Florida

**Spring Series**

charlton • brack • associates

**Presented by Jeff Sommer**

[Jeff@thescarlettgroup.com](mailto:Jeff@thescarlettgroup.com)

813-415-6688

Provider # K031

Course # SDR116

# ***INTRO AND GOALS***

- **Jeff Sommer** – VP of Business Development at The Scarlett Group
  - 20+ years of experience in the residential and commercial building material industry
  - Member of FRSA, IIBEC and NAIOP

## **Goals** -

- To become your trusted resource for roofing related issues, concerns and/or recommendations. “Go To Guy”
- Provide help with spec. writing, FBC and to mitigate RFIs, change orders and substitution requests...
- **Earn a valued and long-lasting position within your roofing specification**





| the scarlette  
| group



**SPEED VIEW**  
FASTER · STRONGER · BETTER



Single-Ply Commercial  
Roofing: PVC, TPO, EPDM



Single-Ply Commercial Roofing



Roof and Wall Polyiso  
Insulation+Taper Designs



EPS Insulation



Waterproofing and Air Vapor Barriers



Duct Sealants and Adhesives



EPDM Roof Systems and Waterproofing



Metal Roof Systems



Polyurethane Roof Systems

## Poll Question #1

- Have you heard of or specified Versico Roofing Systems for your single-ply roofing membrane needs?
  - ☐ YES
  - ☐ NO

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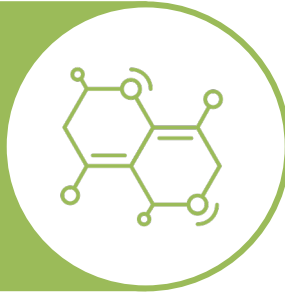
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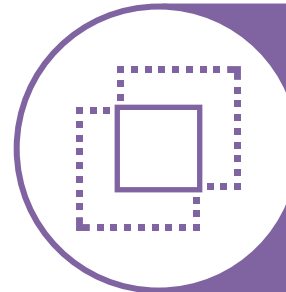
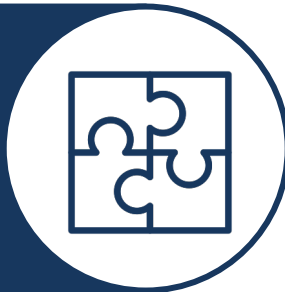
# Learning Objectives

Learn the basics of PVC chemistry, its environmental safety, and beneficial features.



Learn about the latest enhancement options for PVC membranes and how they offer a range of durability and performance features.

Understand the components of PVC membranes, such as the thickness, scrim choice, and formula and the impact on its longevity and performance.



Understand the various standards and types of PVC membranes.

# **PVC Roofing Materials**

## **Description**

In roofing systems, PVC membrane has been used as a waterproofing material for over 40-years. Over the years, PVC has been viewed by the industry from different perspectives. In addition, PVC membrane improvement of formulations and products offerings has increased. When considering PVC membrane and to insure that the correct membrane is specified for the correct building environment, it becomes important for the specifier who is choosing the material for a building owner understands the history, membrane options, and system assemblies.

## **Objectives**

1. Attendees will learn the history of PVC & learn how safe it is to the environment & building occupants.
2. How PVC roofing membranes fit within the building code, within industry energy programs, so the designer can discuss PVC options with the building owner.
3. Learn the major components, such as the thickness, scrim choice, and formula and how together they have impact on its longevity and performance.
4. The latest enhancement option for PVC membranes through the types of plasticizers and how they offer a range of durability and environmental influence.

# Thermosets and Thermoplastics

## Thermoset Membranes are:

- A material that will undergo or has undergone a chemical reaction by the action of heat, catalysts, ultraviolet light, etc. leading to a relatively infusible state (ASTM D 907)
- Examples – EPDM, butyl, polyepichlorohydrin

## Thermoplastic Membranes are:

- A plastic that repeatedly can be softened by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion (ASTM D 883)
- Examples – TPO, *PVC*, *PVC KEE*

# **Thermoplastic Roof Membranes**

**PVC                      Polyvinyl Chloride**

**TPO                      Thermoplastic Polyolefin**

**EPDM = Thermoset Membrane**  
**Ethylene Propylene Diene Monomer**

# Are These Two The Same?



# Are These Two The Same?

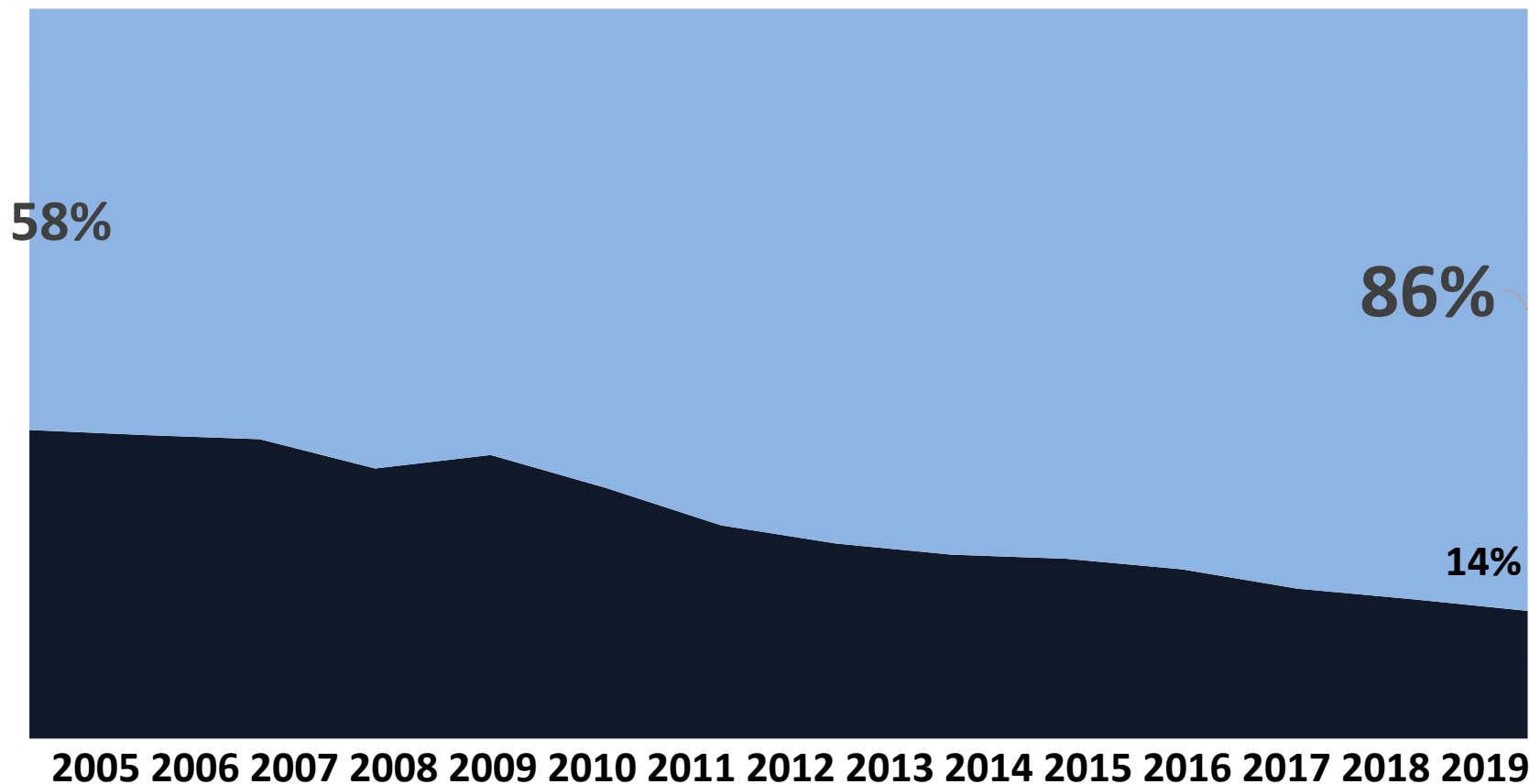




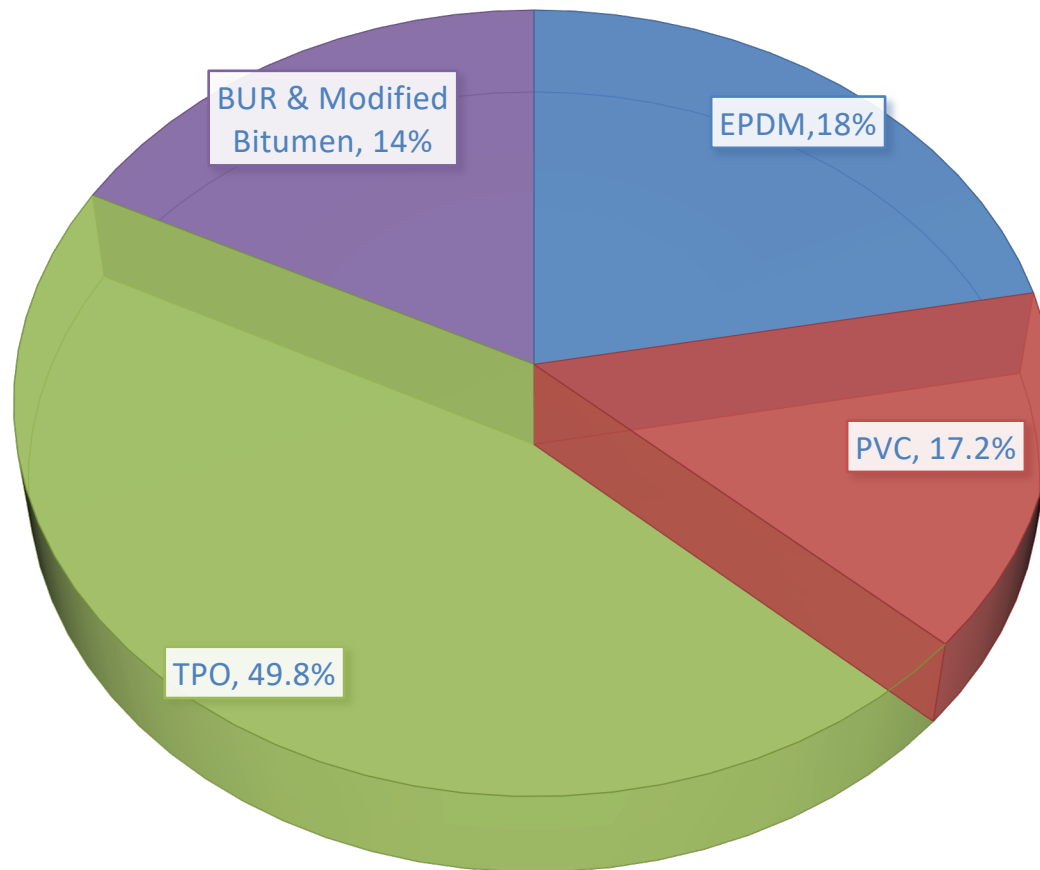
# **US Non-Residential Roofing Market**

# U.S. Non-Residential Roofing Market

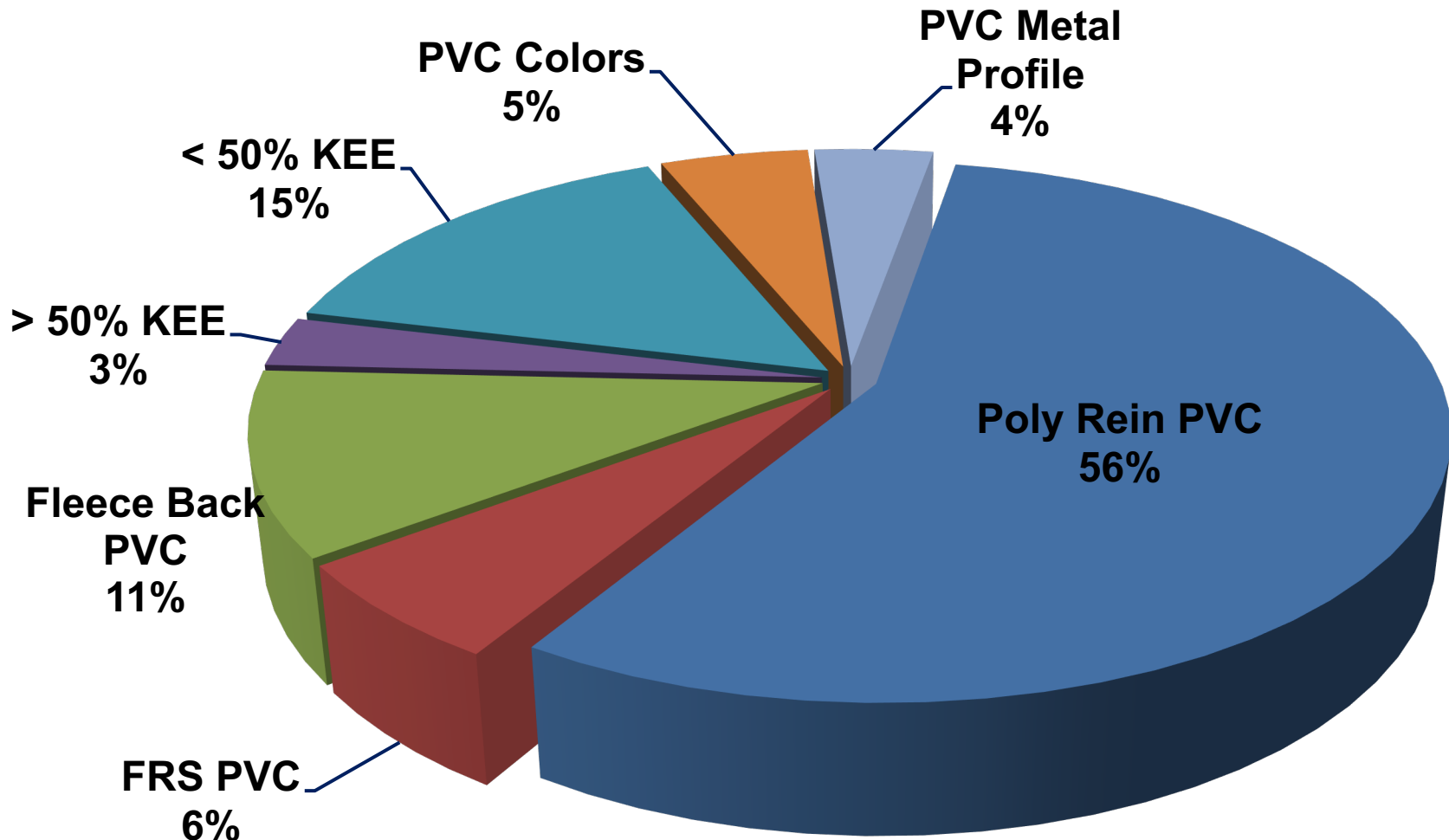
■ Asphaltic ■ Single-Ply



# National 2019 Industry Membrane Mix



# PVC Product Segments





# **History of PVC**

# PVC History



**Regnault  
Discovered**

**1838**

**White Powder  
In Bottle**

**1872**

**Plasticized**

**1926**

**Rebuilding  
Europe After  
WW II**

**Saran Wrap  
Raincoats, Etc.**

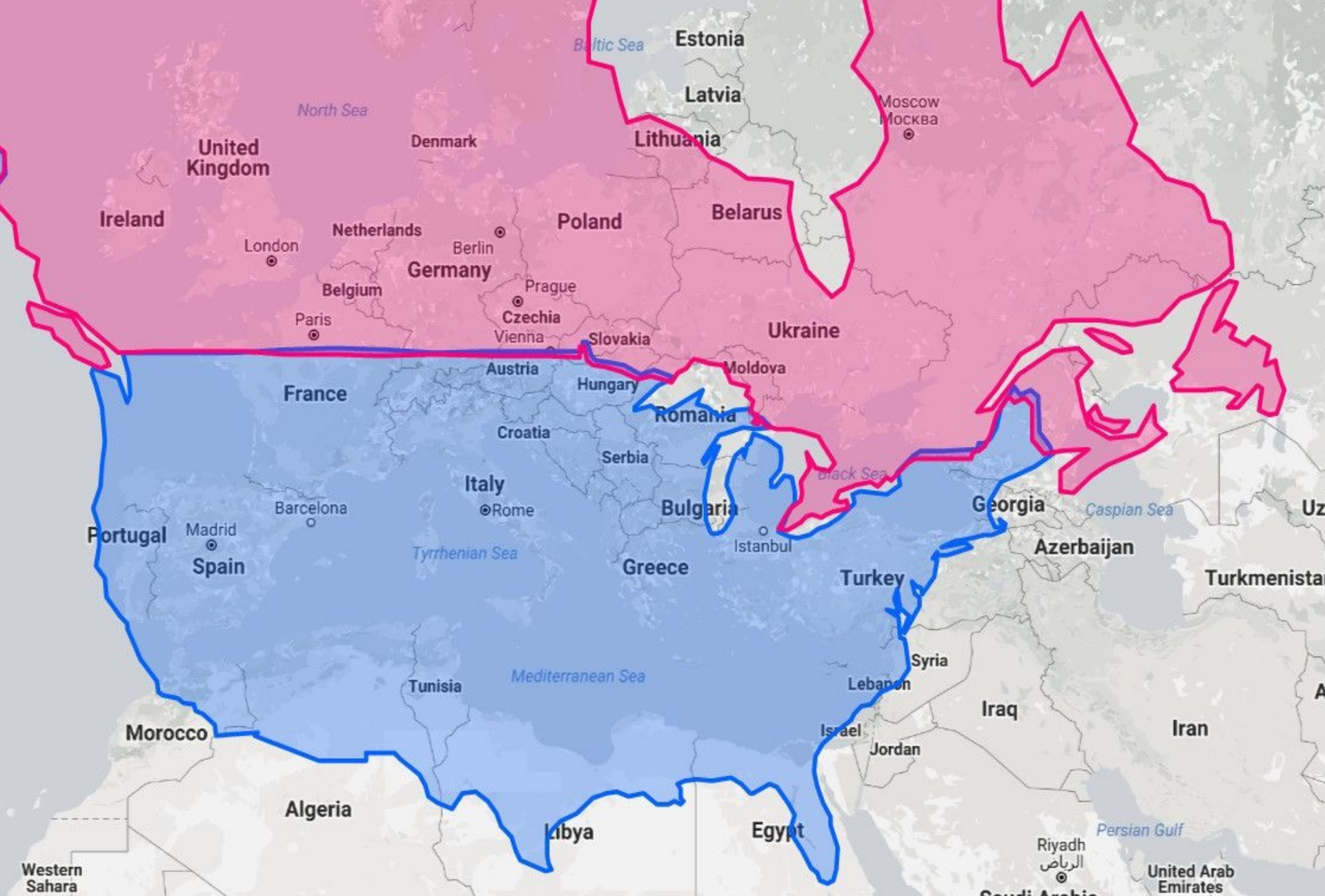
**1940's**

**First Used As  
Roofing in U.S.**

**1970's**

**Established**

**Today**





**What's PVC Made From?**

## *TWO NATURAL MATERIALS*



Natural  
Gas



Salt  
Water



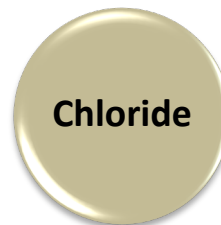
Natural Gas



Ethylene



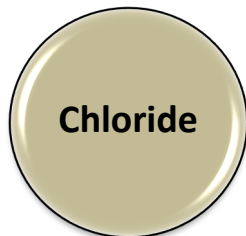
Salt Water



Chloride



Ethylene



Chloride



Vinyl Chloride Monomer

Gas



UV Light



PVC (vinyl) Resin  
(+ additives and modifiers)

# PVC ASTM Standards

American Society for Testing and Materials

## D-4434 PVC Standard

### Formulation:

- Polymer – at least 50% PVC

### Physicals:

- Min Thickness = .036
- Min Thickness/Scrim = .016



## D-6754 KEE Standard

### Formulation:

- Polymer – at least 50% KEE

### Physicals:

- Min Thickness = .031
- Min Thickness/Scrim = .006



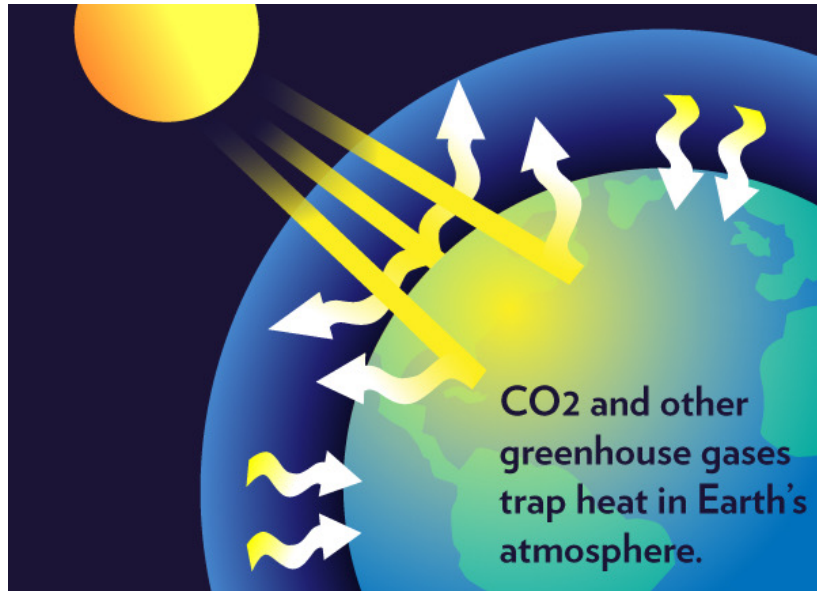
## Poll Question #2

- Have you specified PVC Roofing Membrane in the past?
  - ☐ YES
  - ☐ NO



# **Benefits of PVC**

# Green House Gases – Global Warming



PVC = 57% Salt

PVC = 43% Natural Gas

*The least contributing thermoplastic to the production of green house gases (fossil fuel < than 45%)*



Other Thermoplastics =  
Derive from almost  
100% Fossil Fuels

# Benefits of PVC

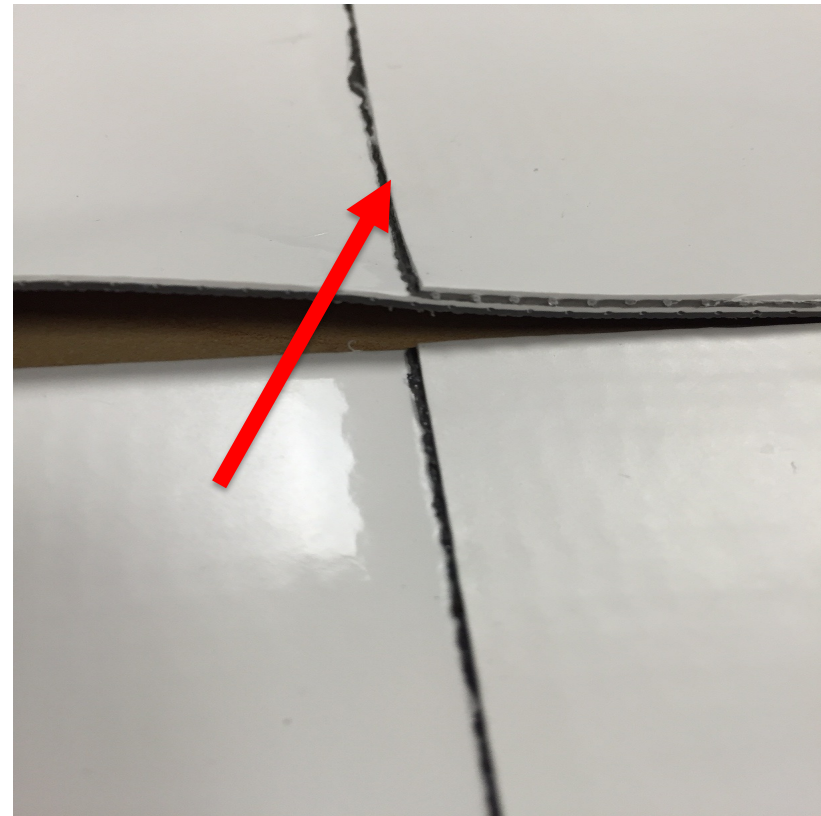
## Seam Integrity

**Heat-Weldable**



Approximately 1100\* at 8'-10' per minute

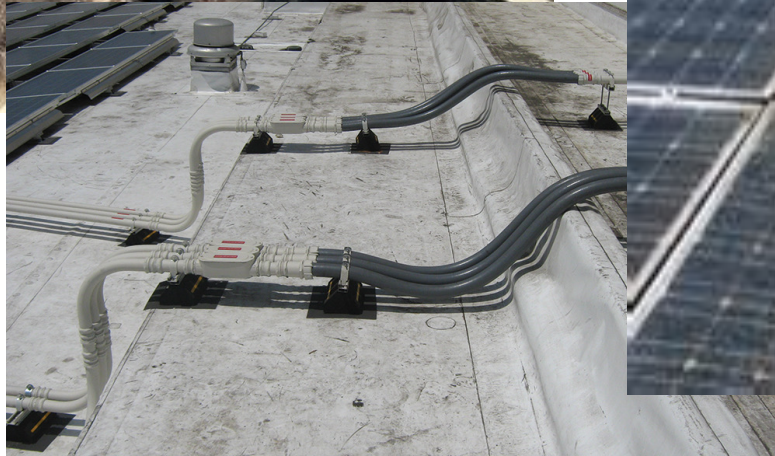
**Bleed out of Weld**



## High Value Content Buildings

# Benefits of PVC

## *Fire Resistance*



Buildings w/ Solar Panels

# Fire Resistance

- *PVC is the most fire-resistant membrane*
- *PVC is self-extinguishing*

**Burning Brand**



**Spread of Flame**



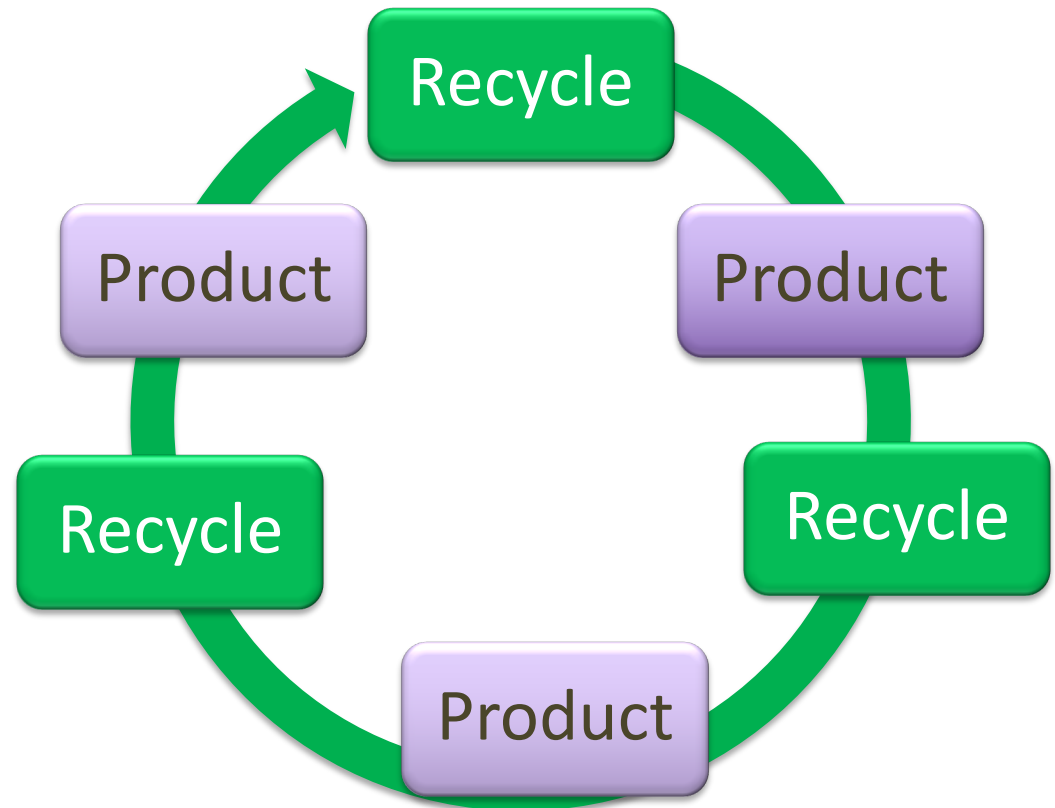
**High Density Areas**

# Recyclability of PVC



Photo: Rewindo Fenster-Recycling-Service GmbH

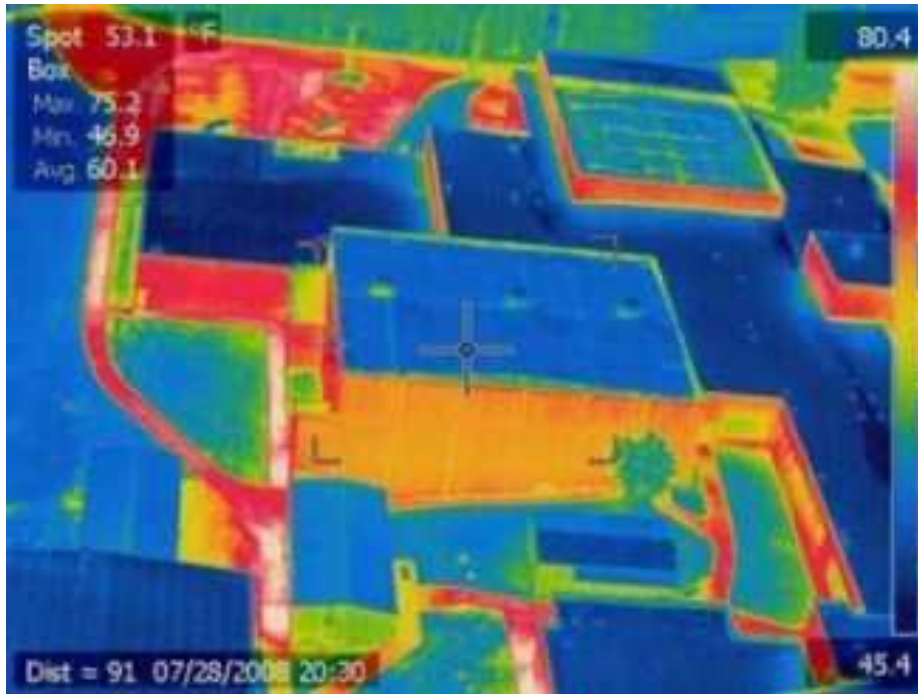
The collection and recycling of replaced PVC window systems is common practice today. At the end of the process, modern heat-insulating windows are manufactured which save energy and improve internal climate conditions.



*7 Times Without Losing Properties*

*LEED/Green Certified Buildings*

# Energy Savings of PVC



Membrane Color

Effects of UV  
LEED and  
Green Cert.

***SRI = 108***

Keep Buildings Cooler

# Chemical Resistance of PVC

PVC Chemical Resistance  
(Aged 28 Days at 140°F)



DIESEL  
FUEL



JET  
FUEL



PEANUT  
OIL

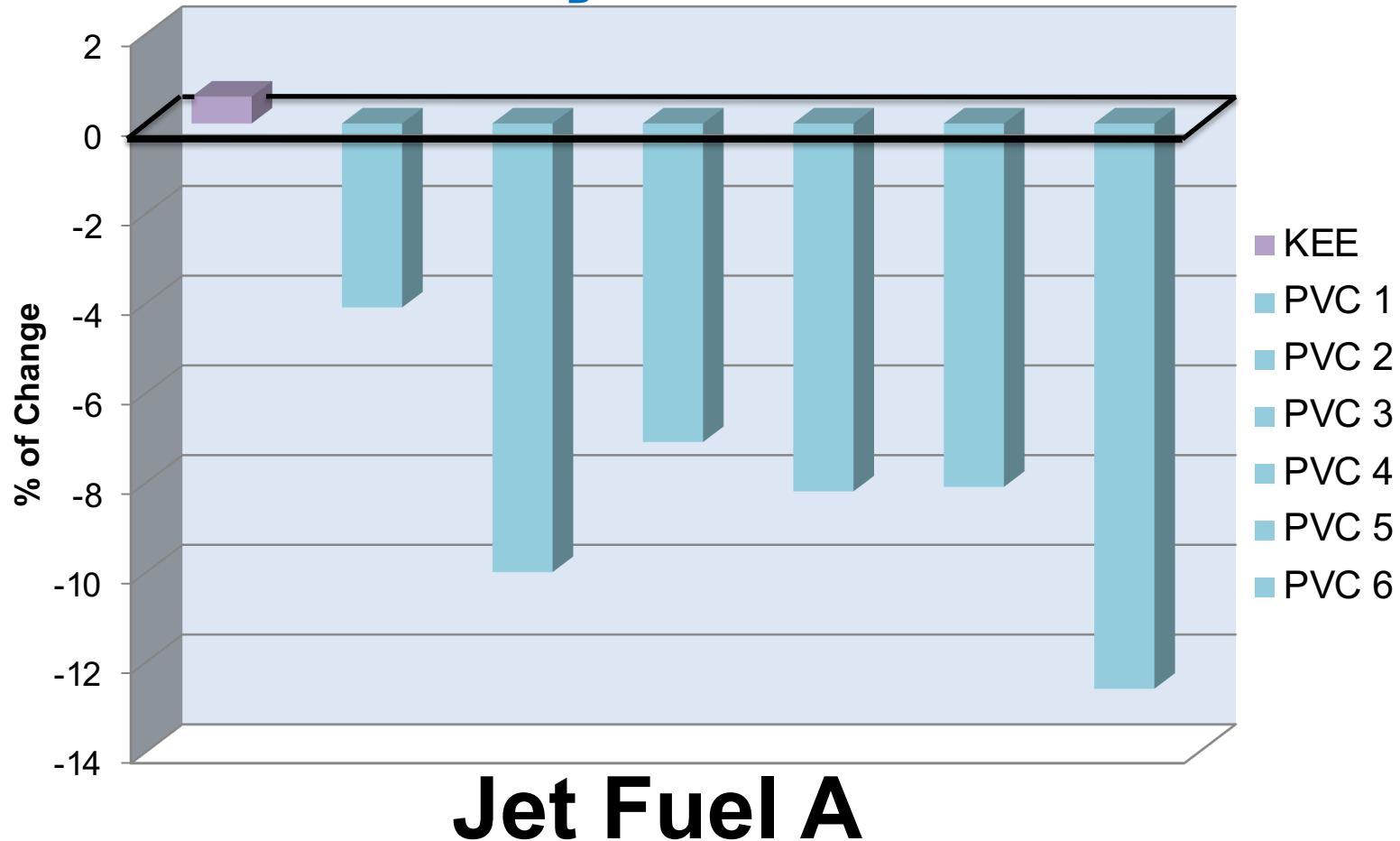


ANIMAL  
FATS

Restaurants, Airports, Gas Stations

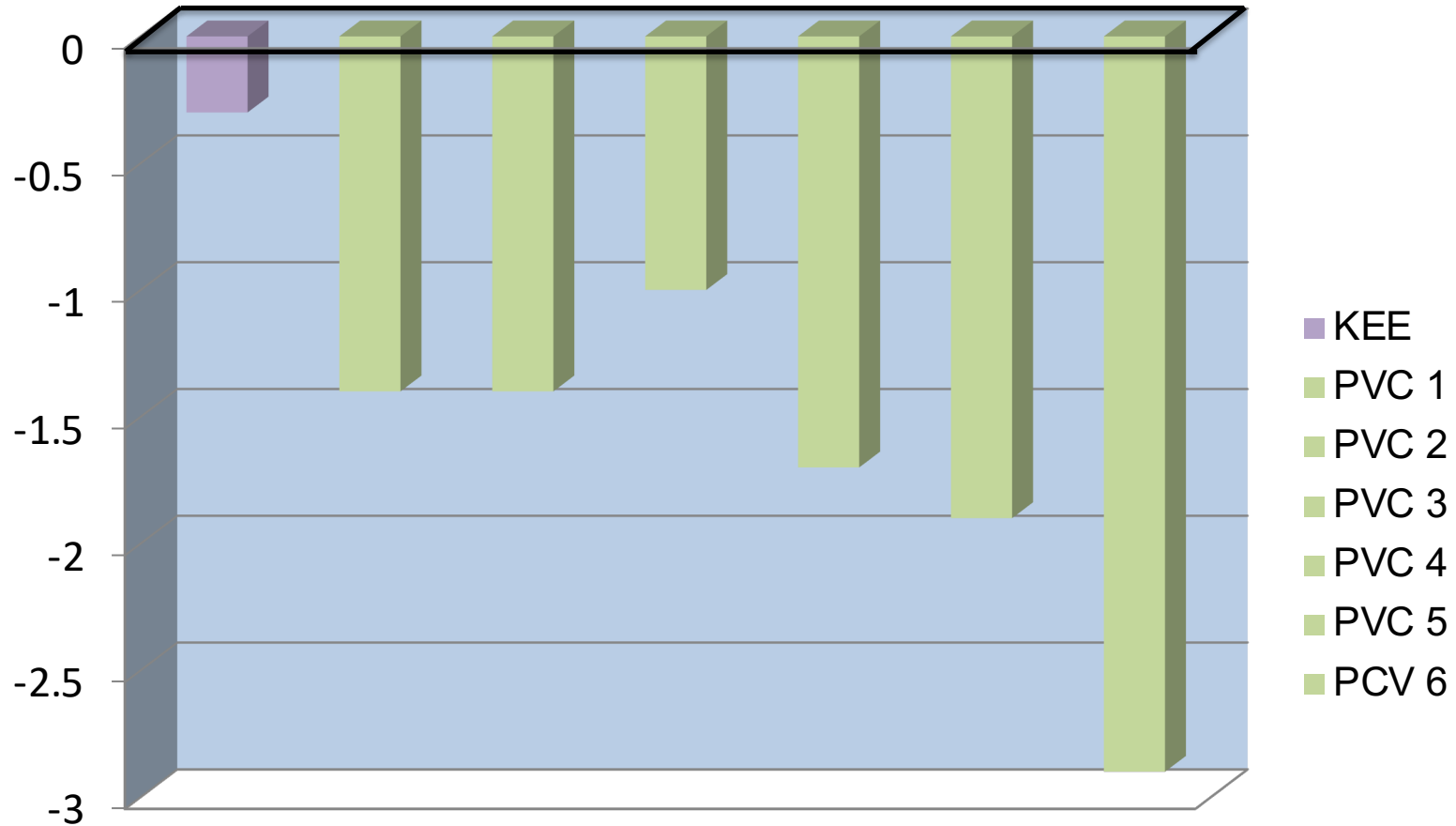
# Chemical Resistance

7 days Immersion



# Chemical Resistance

7 days Immersion



Animal Fats

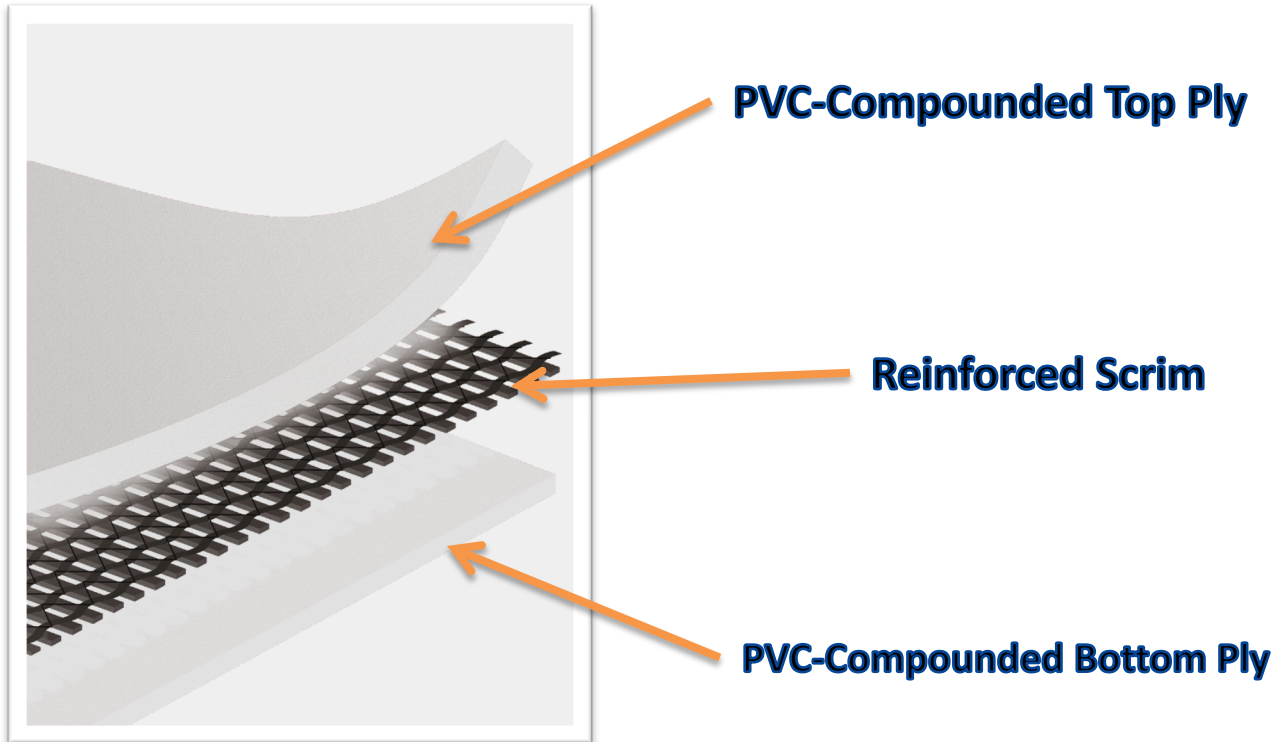
# **In What Other Applications Has PVC been used?**





# **Membrane Construction**

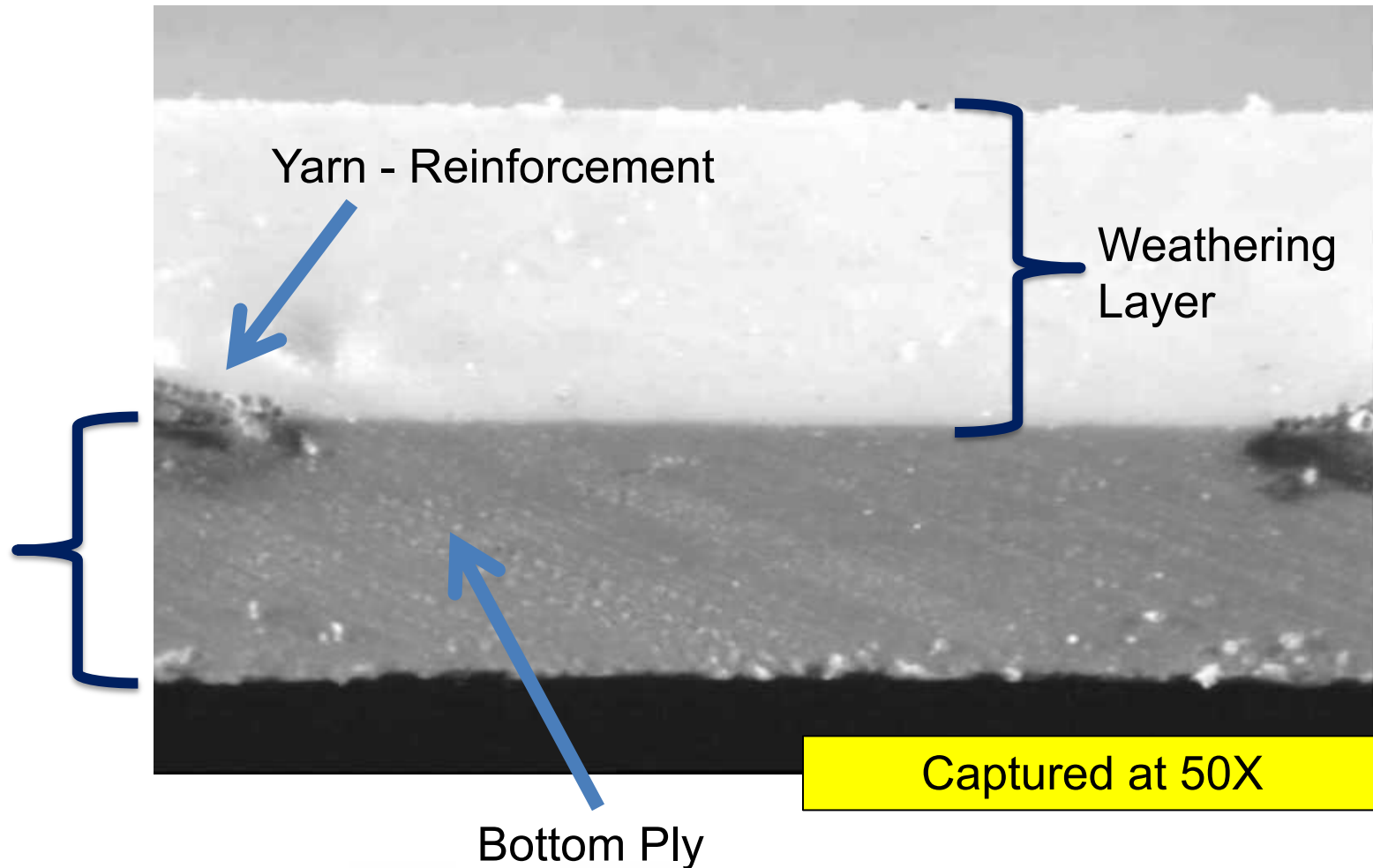
# Membrane Construction



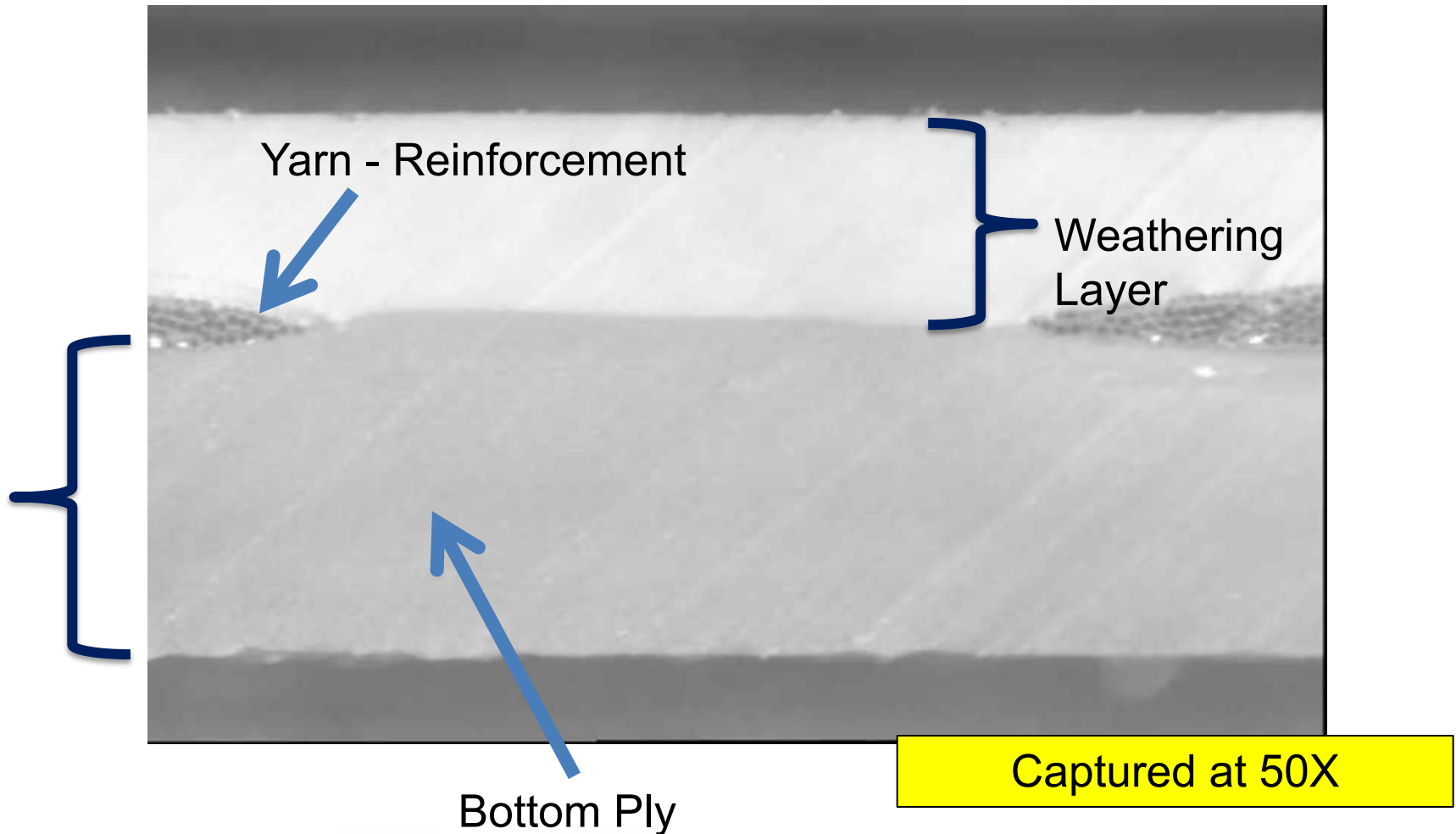
## Membrane is composed of three layers

- PVC-Compounded bottom ply
- Strong polyester or fiberglass-reinforced fabric center (scrim)
- Tough, thermoplastic PVC-compounded top ply

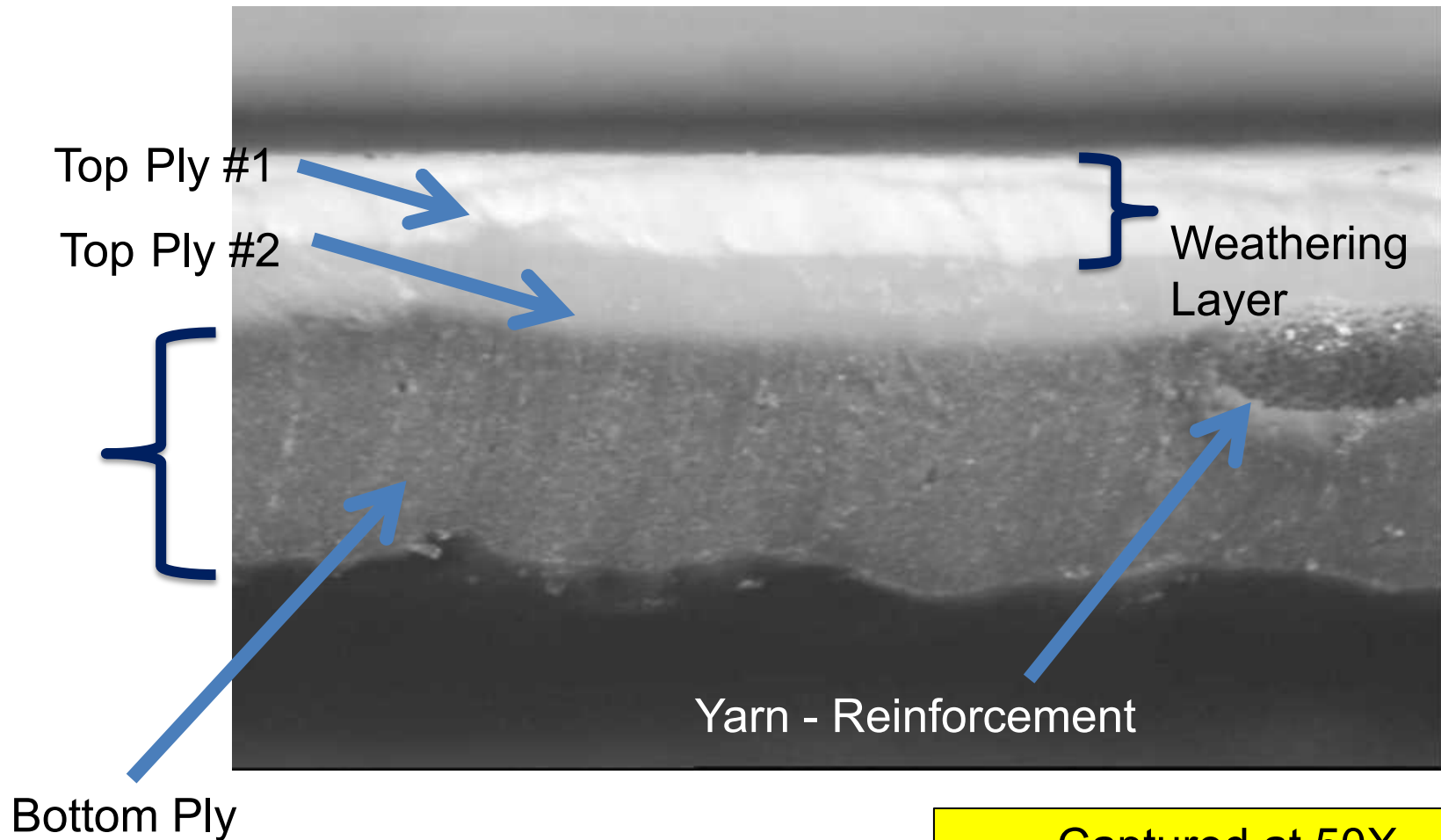
# 60-mil Polyester-Reinforced PVC Membrane



# 60-mil Polyester-Reinforced PVC Membrane

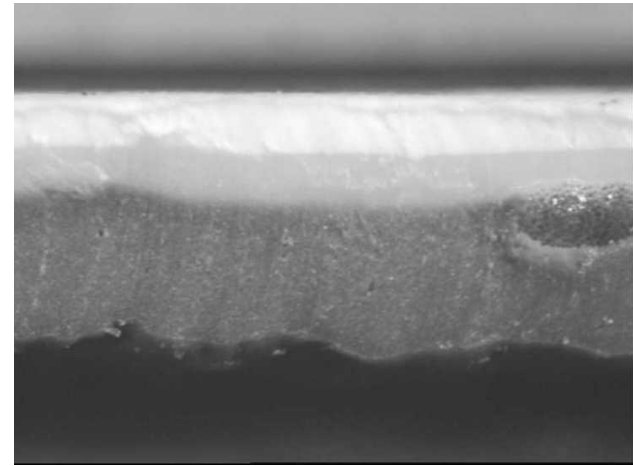
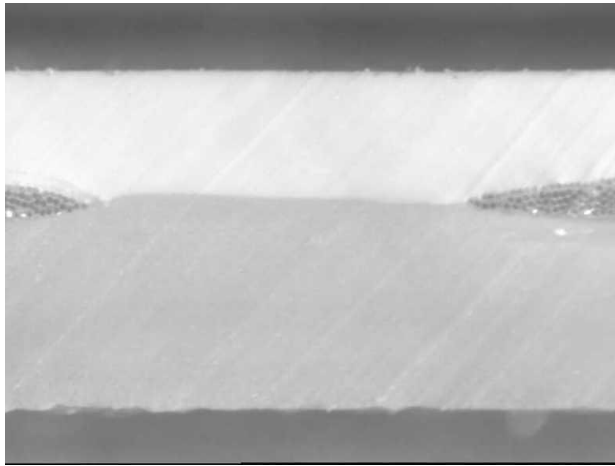
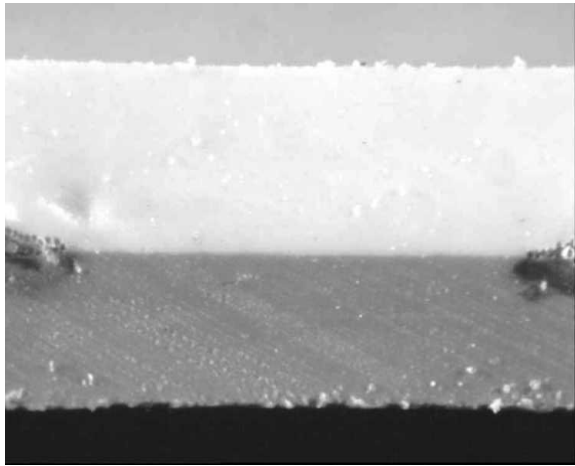


# 60-mil Polyester-Reinforced PVC Membrane



Captured at 50X

# ***Created Equal?***

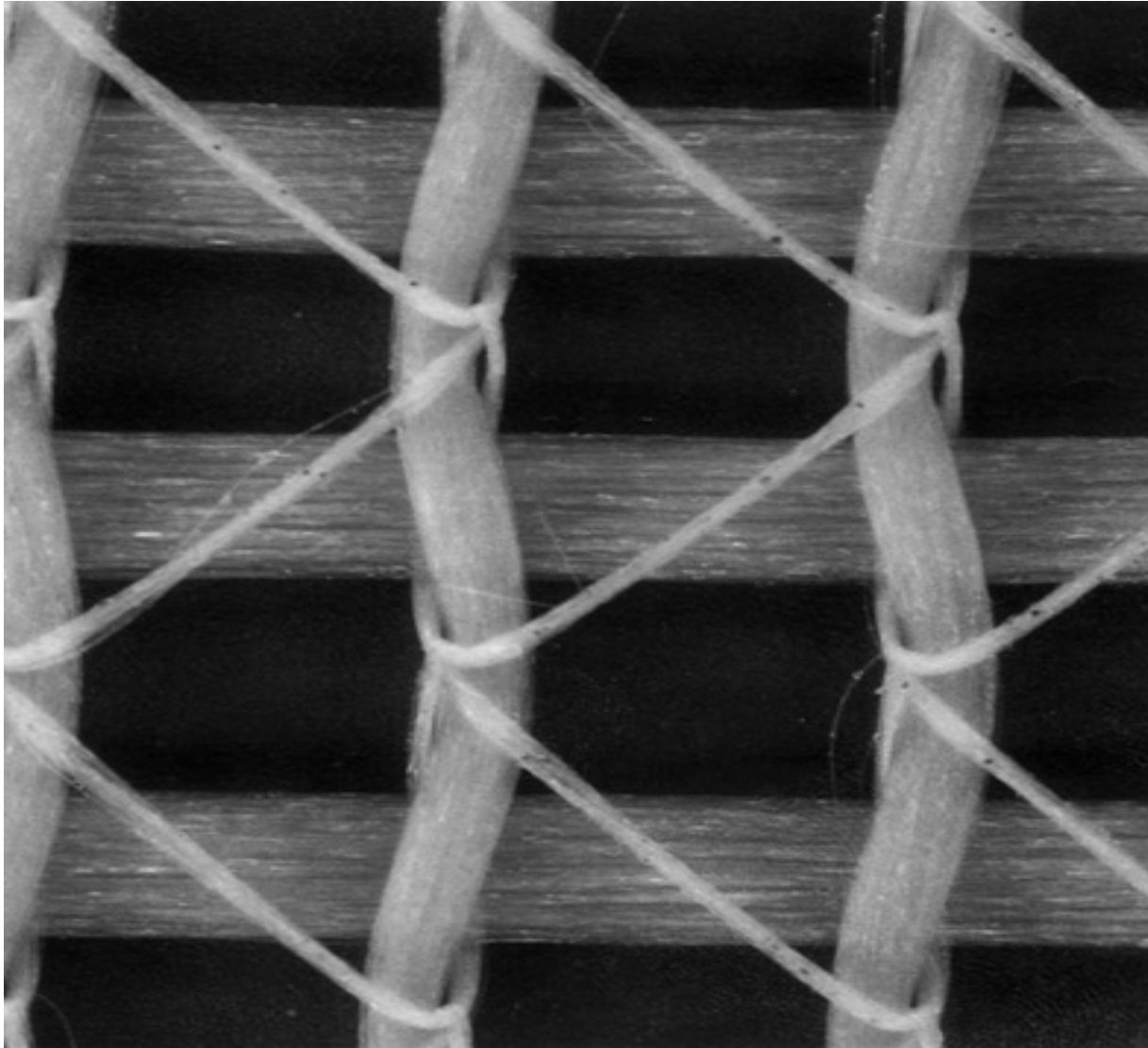


*Mil thickness over scrim AND overall top-  
ply thickness is very important:*  
*SHOULD BE CLOSE TO EQUAL*

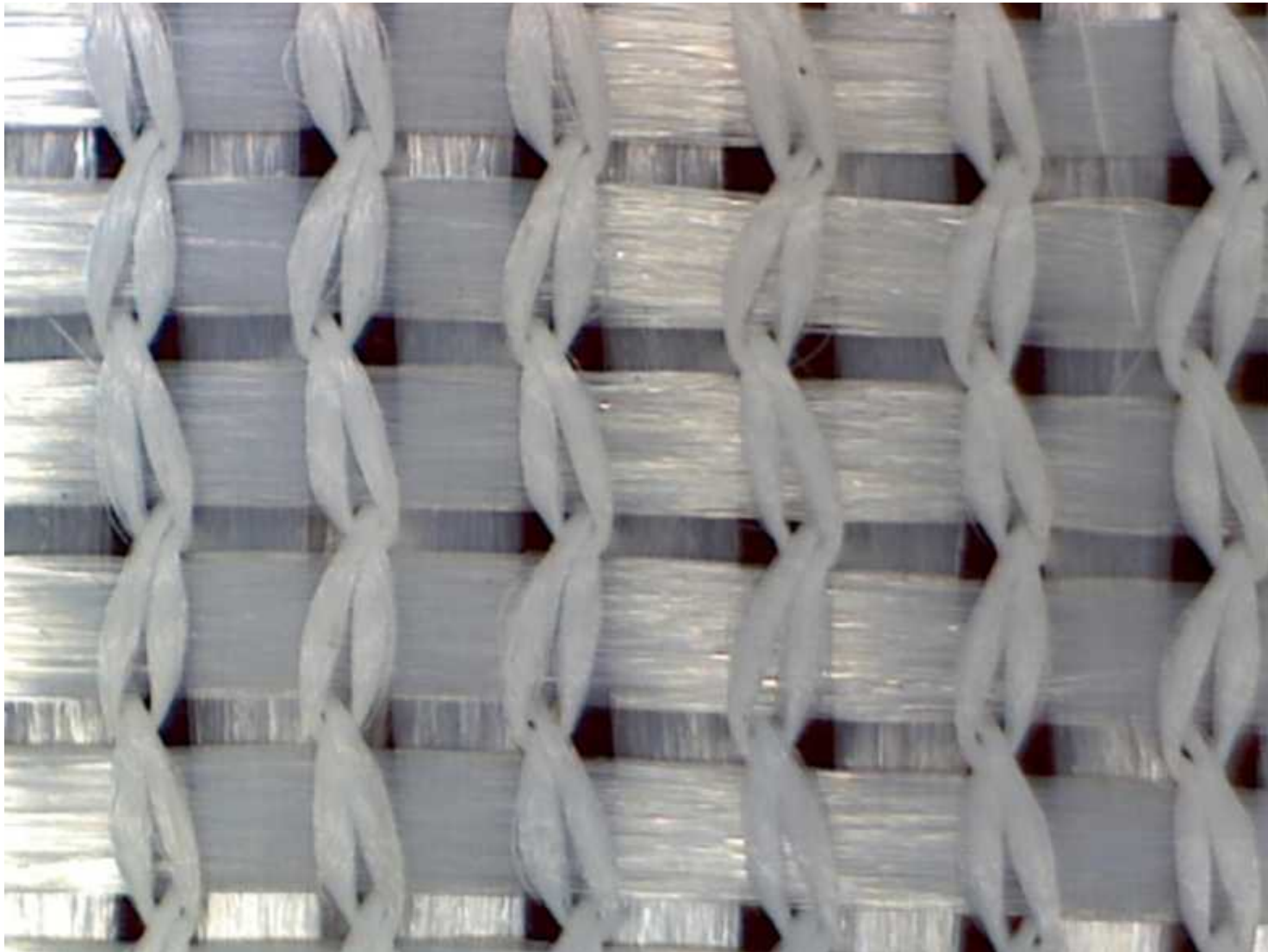


# **Types of Scrim Reinforcements? Polyester and Fiberglass**

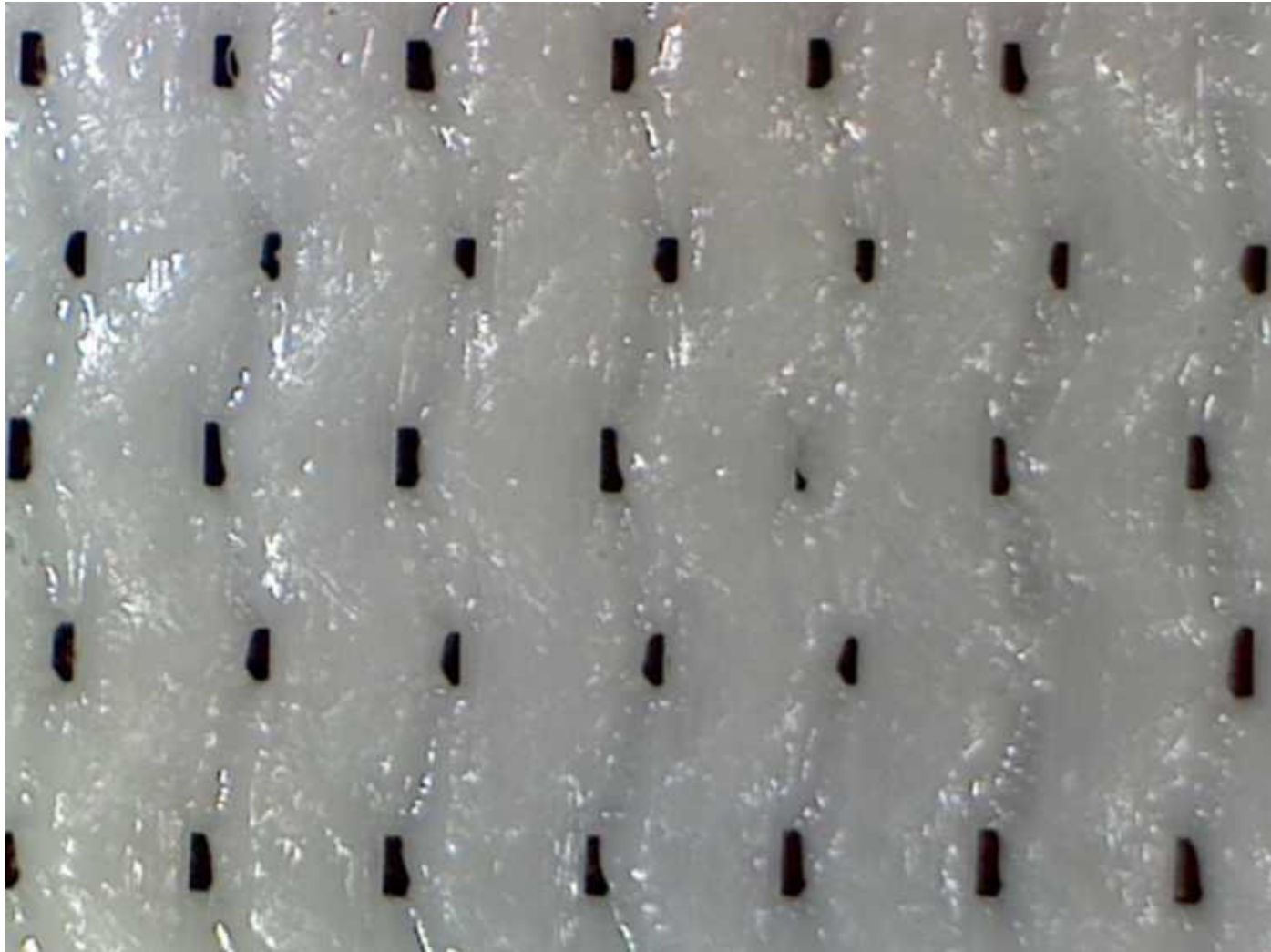
# **Weft Knit Polyester Tie Yarn**



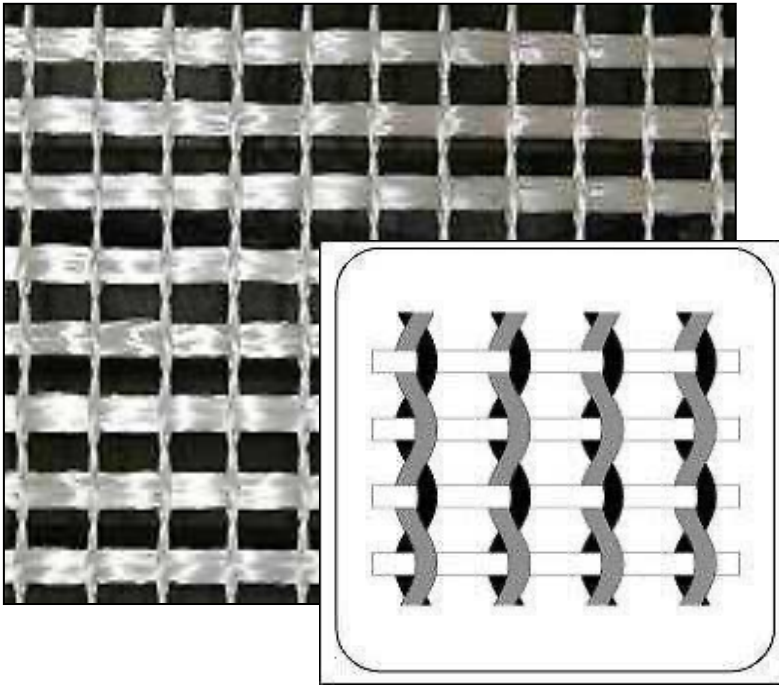
# 18 x 19 Weft Knit Polyester Fabric



# Adhesive Coating



# Fiberglass Fabric



**Leno Weave**



**Glass Mat**

**Fully Adhered Only – LOW Tear, Puncture and Breaking Strength**

# **So Which Reinforcement Is Better? Polyester or Fiberglass?**



# Linear Dimensional Change

Polyester

.4%

**.38%**  
DIFFERENCE  
( $\frac{1}{3}$  of 1%)

Fiberglass

.02%

**\*The only benefit of Fiberglass\***

## Polyester

70 lbf



Tearing Strength

**467%**  
INCREASE

320 lbf/in



Breaking Strength

**400%**  
INCREASE

20 Joules



Puncture Resistance

**100%**  
INCREASE

## Fiberglass

15 lbf

80 lbf/in

10 Joules



**PVC TYPES – II, III, AND IV**

# ASTM D4434 Standard for PVC

## Type II, Type III & Type IV

### 3. Classification

3.1 *Type II*—Reinforced sheet in which fibers are incorporated into a production process, for example as a carrier, without appreciably affecting such physical property characteristics of the finished product as tensile strength or ultimate elongation, but may provide other desirable characteristics, such as dimensional stability.

3.2 *Type III*—Sheet that is internally reinforced with fabric and which may also have a fabric backing.

3.3 *Type IV*—Sheet that is internally reinforced with fabric and which may also have a fabric backing with minimum thickness of 0.91 mm [0.036 in.].

# Type III vs. Type IV

	Type III	Type IV
Breaking Strength (lbf/in)	200	275
Elongation (min%)	15	25
Tearing Strength (lbf)	45	90



38%



66%



100%

ASTM D4434 Standard for PVC



# **PVC, KEE & KEE HP**

## **Understanding the Materials**

# KEE

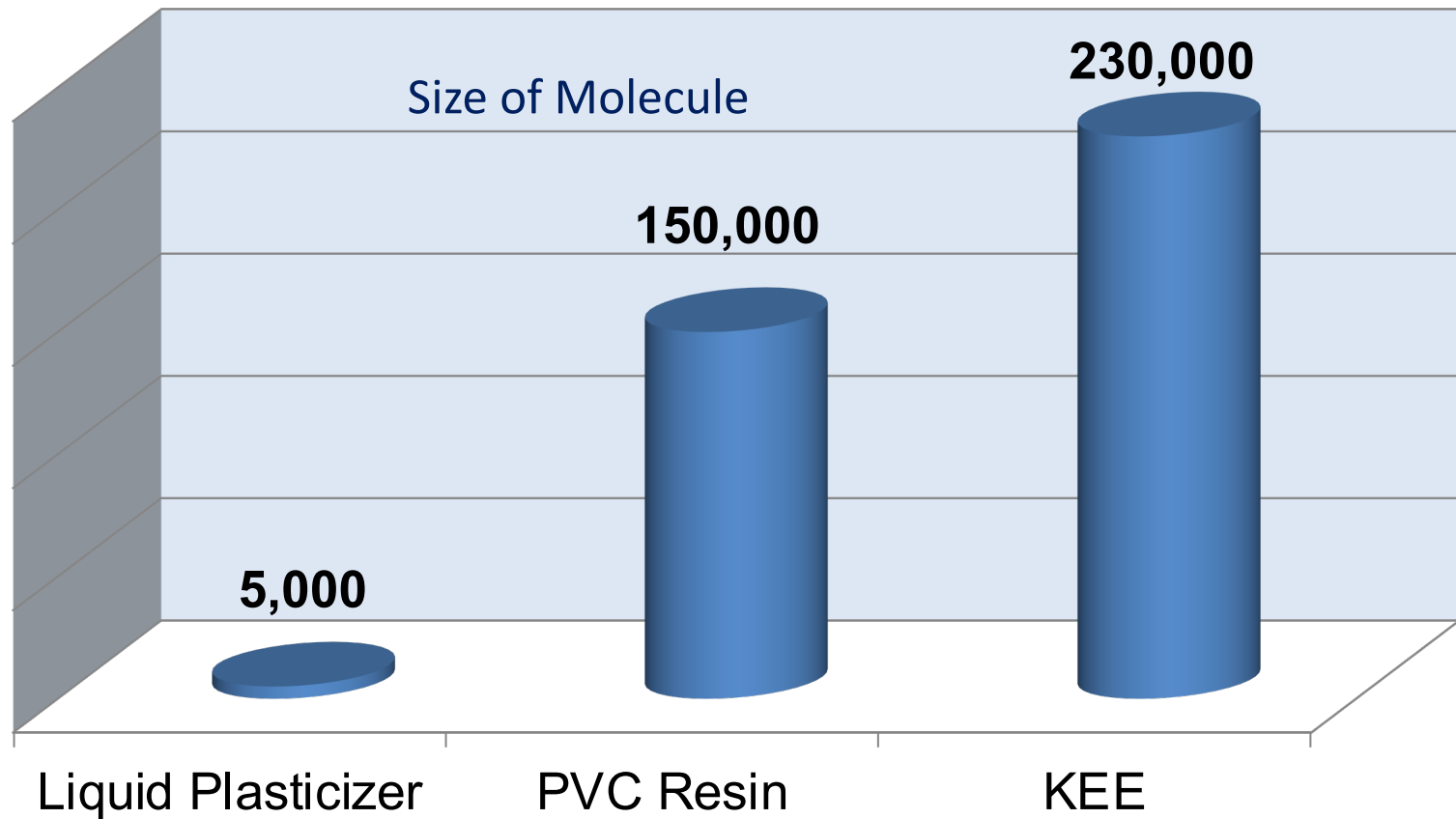
Chemical Name: *Ketone Ethylene Ester*

- Developed in 1973
- **Solid Plasticizers in Addition** to Liquid Plasticizers
- **Solid**, High Molecular Weight Polymer
- Does not migrate out...



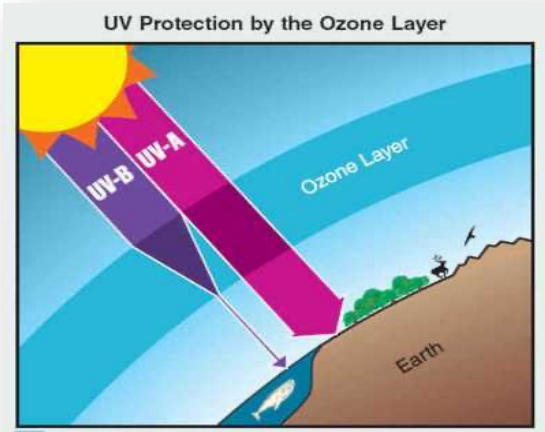
# Molecular Weight

**-M.W. is directly related to migration resistance-**



**...and DIRECTLY related to PERFORMANCE**

# “KEE” ADVANTAGES



- \*Enhanced UV Protection
- \*Reduced UV Degradation



- \*Increased Flexibility
- \*Longer Service Life
- \*Increased Resistance to Harsh Chemicals and Industrial Pollutants
- \*Stays whiter longer



# Reduced Dirt Pick-up



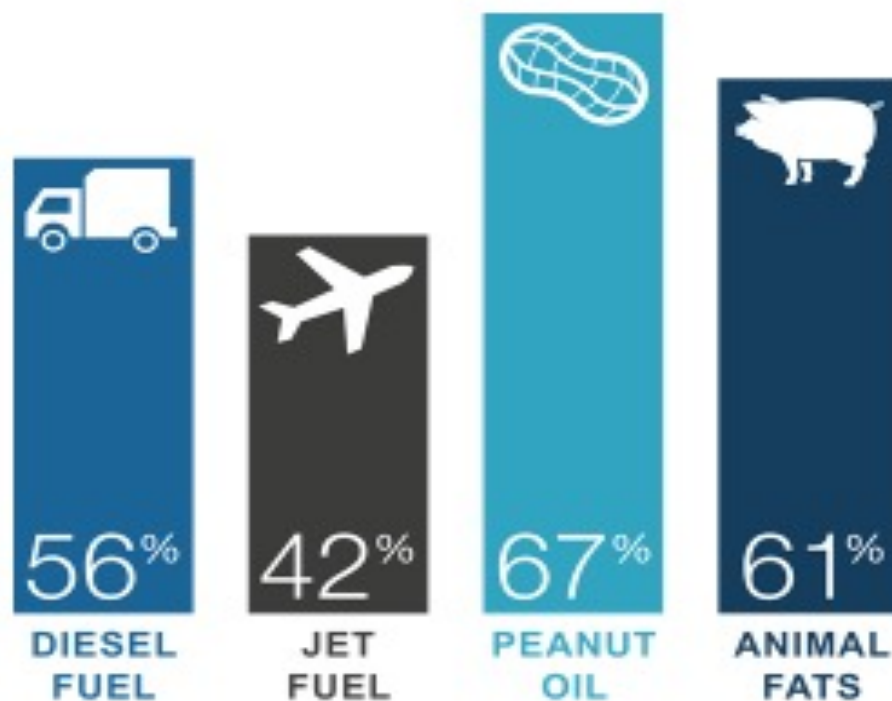
**Is not a liquid so it helps to prevent dirt pick-up –  
stays cleaner longer**

# Chemical Resistance

Resistance to Harsh Chemicals and Industrial Pollutants

PVC & KEE Chemical Resistance – Percent of Improvement

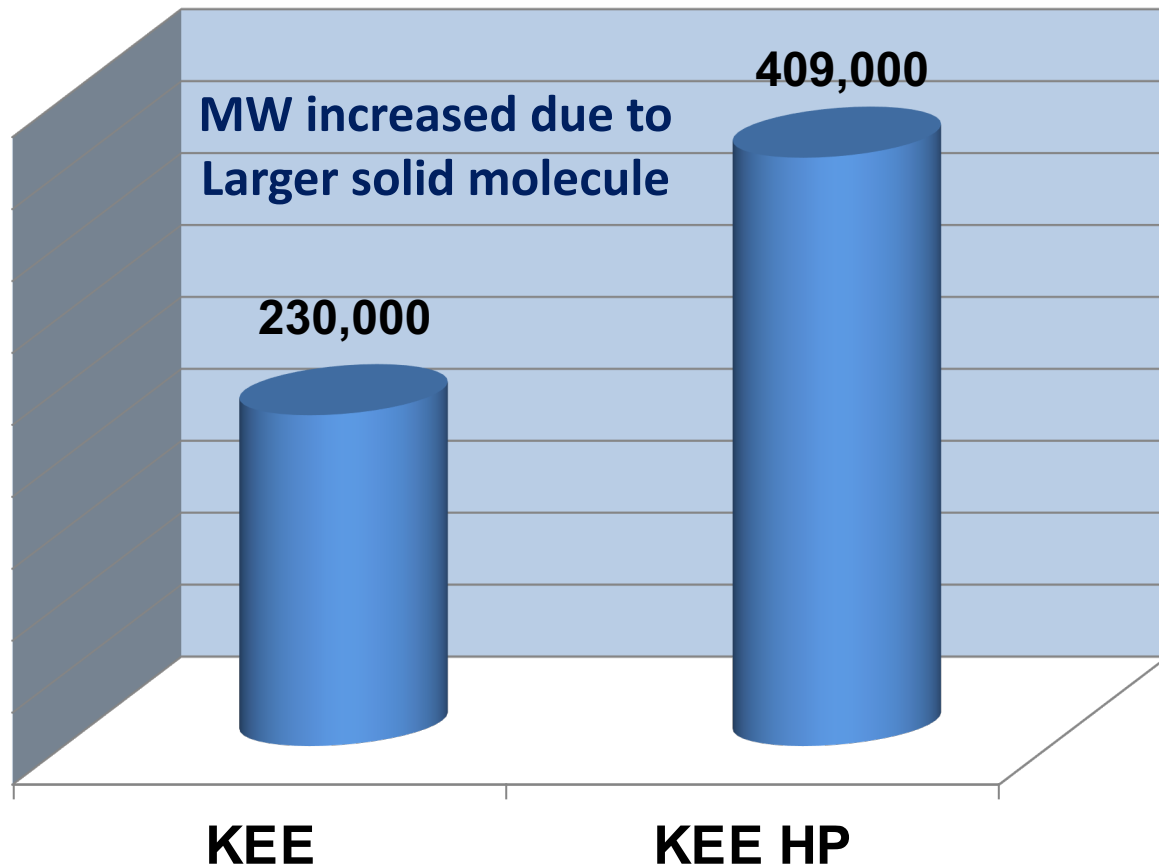
(Aged 28 Days at 140°F)



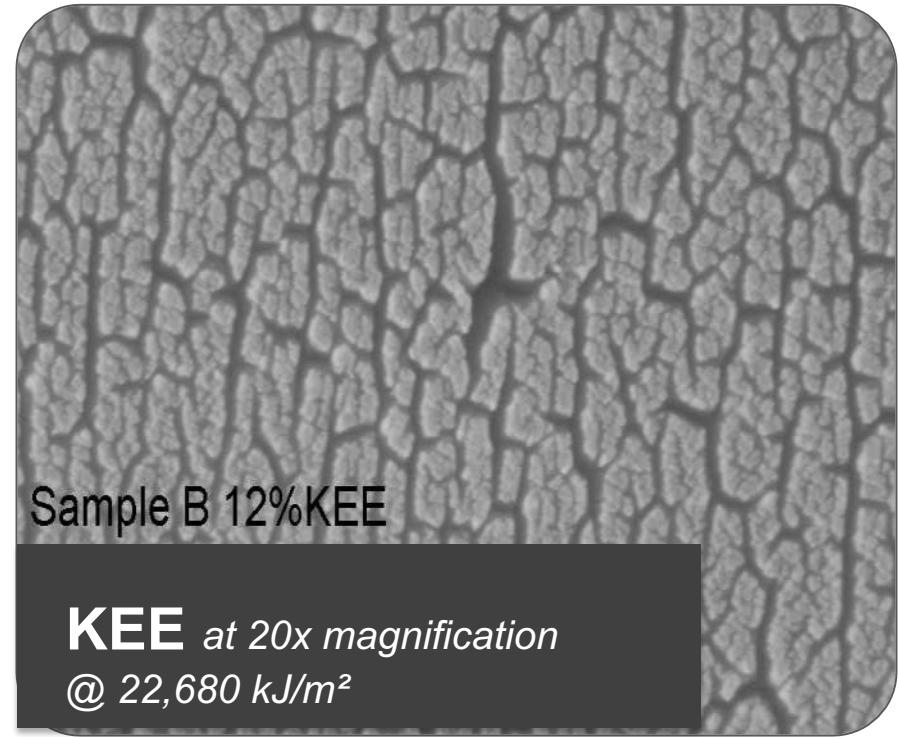
Percent of Improvement over Standard PVC

# Standard KEE vs. KEE HP

- **Higher** molecular weight
- Cold temperature flexibility
- Greater thermal stability
- Even less dirt pickup
- Easier melting compound



# Visual Results - Xenon Arc Testing

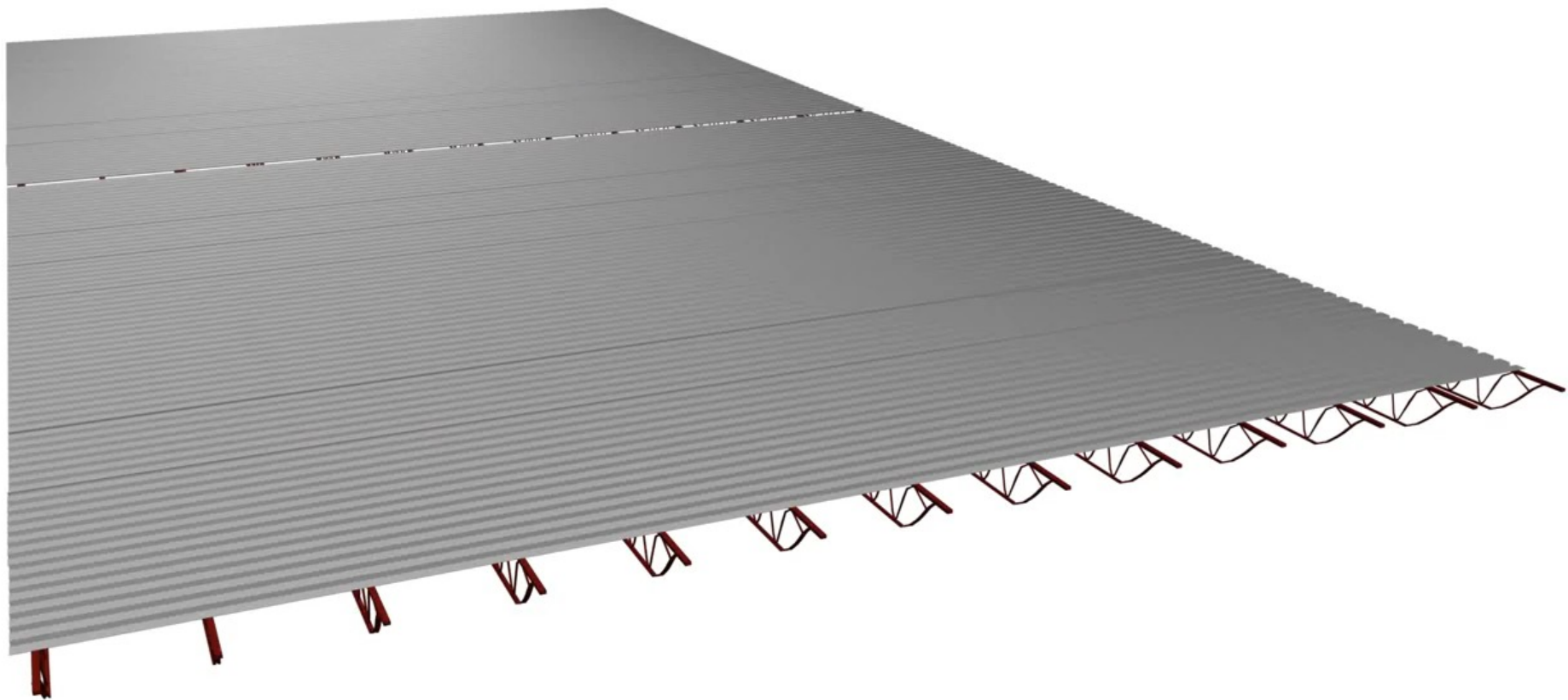


**Use KEE HP In Extreme Heat Applications**

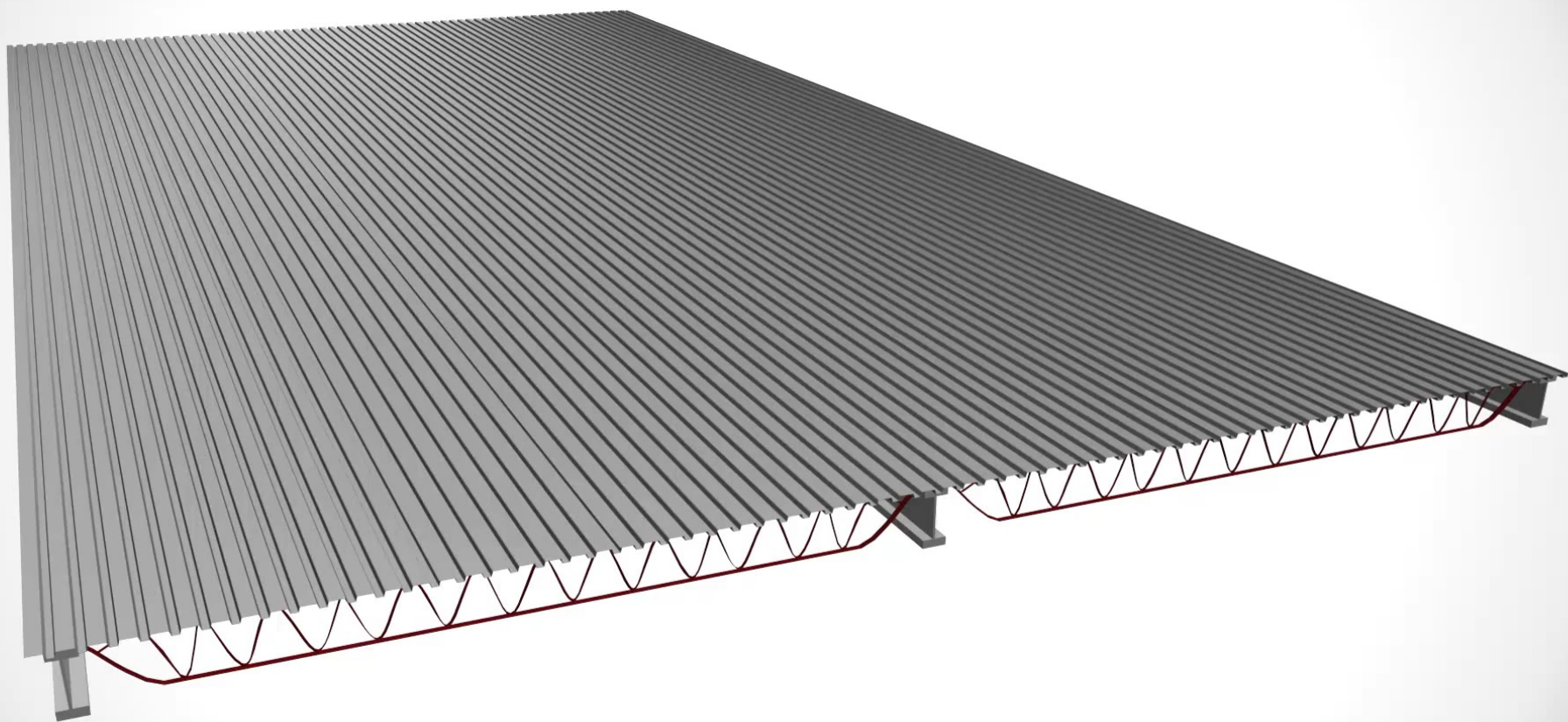
**\*\*1250 kJ/m<sup>2</sup> equates to 1 year in S. Fla at 90\* per day, everyday, for 1 full year\*\***

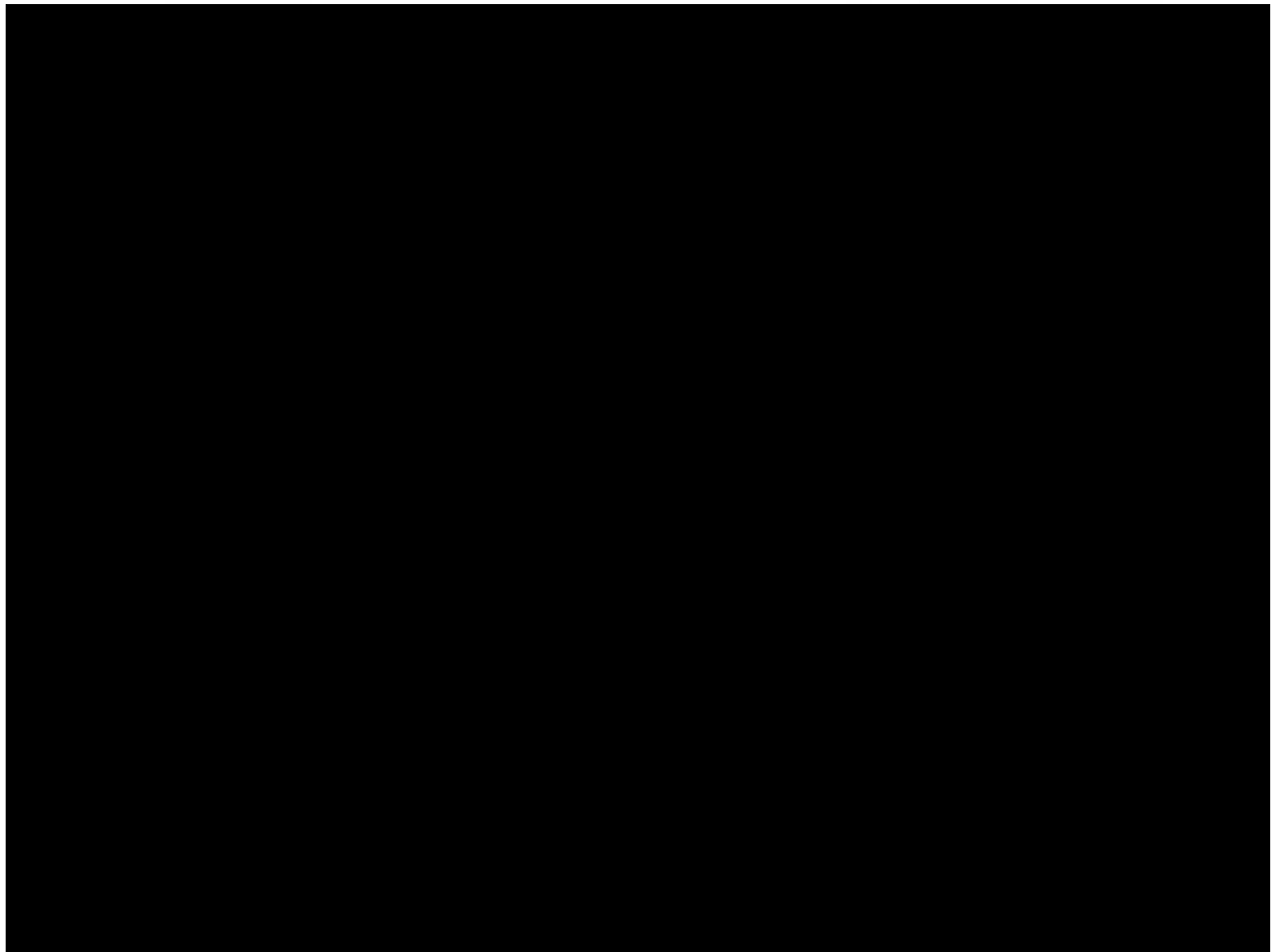


# **Installation Options**











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# PVC IN REVIEW

Remember your AIA member number  
it is needed for reporting purposes.

# On Which Buildings Do I Use PVC?

High Value  
Content Buildings

Owner Retention,  
Like Churches

Buildings w/ Solar  
Panels



# Why Choose PVC?

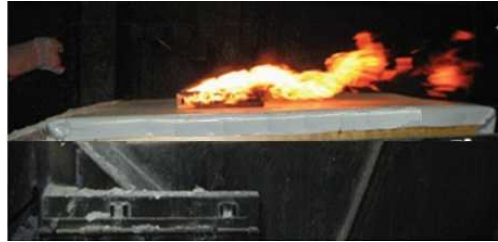
Seam Integrity

Long History

Fire Resistance

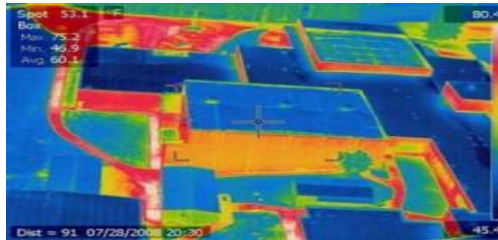
# On Which Buildings Do I Use PVC?

High Density Areas



Fire Resistance

Keep Buildings  
Cooler



White Reflective

Restaurants,  
Airports, Gas  
Stations

PVC Chemical Resistance  
(Aged 28 Days at 140°F)



DIESEL  
FUEL



JET  
FUEL



PEANUT  
OIL



ANIMAL  
FATS

Chemical Resistance



This concludes the American Institute of Architects  
Continuing Education Systems Course

**Thank you for  
attending!**

**Jeff Sommer**  
**813-415-6688**  
**[jeff@thescarlettegroup.com](mailto:jeff@thescarlettegroup.com)**



the scarlette  
group