Seal Your Way to Know Leaks

Presented by:
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Product / Applications Engineer

MOMENTIVE™
Learning Objectives

#1 – Sealant Types?

#2 – Durability of Silicone?

#3 – What is Silicone?

#4 – Installation of sealants and use of silicone tape in SPF roofing

#5 – Proper joint geometry and use of backer rods

#6 – Surface Preparation & Tooling
Sealant Types

- polysulfide
- silicone
- polyurethane
- acrylic (water-based)
- acrylic (solvent-based)
- asphaltic
- SPUR
- Butyl
- STPE
Available Sealant Types

- Silicone
- Hybrids (STPE & STPU)
- Polyurethane & Polysulfide
- Acrylics (water & solvent based)
- Butyls (mastics)

Inorganic

Organic
acrylic polymers emulsified in water (latex)

Silicone additives
- Silane adhesion promoters ~0.1%
- Silicone polymer plasticizer agents, 3% or less
  improves flexibility and durability, too
  much affects paintability

Acrylcs
Advantages
Paintable
Water Cleanup
Shrinkage, ~30% of Volume
Interior Joint, Acrylic product, loss of flexibility

Detroit Metro Airport
Acrylics are water-based
Durometer / Shore A

Installed reading: 50 (+/-5)

20 year reading: 93

~86% increase in hardness

Weatherability

Acrylic TerPolymer

Atlas South Florida Test Service
- Long Term Exposure Study -
UV Resistance & Weatherability

Cracking

Polyurethane Sealant
Washington DC
UV Resistance & Weatherability

Cracking

Polyurethane Sealant
Salt River Phoenix, AZ
Organic sealants (non-silicones) stiffen and lose flexibility at colder temperatures, placing added stress on the bondline(s) when building movement occurs.

Weatherability - Hardness

Shore A “Durometer”
0 - no resistance to penetration
100 - complete resistance to penetration

Urethane Hardening
Polyurethane Reversion
A long-term sealant exposure study was started in 1983. On the 20th year (January 2003), the samples were inspected & evaluated for condition.
# Annual Weathering Data Summary

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<th>Year</th>
<th>Total Solar Radiation direct, @ 45° (MJ/m²)</th>
<th>Ultraviolet Solar Radiation direct, @ 45° (MJ/m²)</th>
<th>Ambient Temperature Annual Average, (°F)</th>
<th>Black Metal Panel Temp. Annual Average, (°F)</th>
<th>Relative Humidity Annual Average (%)</th>
<th>Total Time of Wetness @ 45° (hours)</th>
<th>Total Rainfall (inches)</th>
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*: Data not available.
Rainfall for 2000 & 2001 indicates corrected data.

total hours in 20 years 175,200
% of total time 44.8%
22 year old silicone sealant, still pliable and adhering to panels after TWENTY years of exposure in Miami environment.

**Durometer / Shore A**
- Installed reading: 28 (+/- 5)
- 20 year reading: 30
Silicone Coating, 25 years old

Acrylic Coating, unknown age
Learning Objectives

#1 – Sealant Types?

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#3 – What is Silicone?

#4 – Installation of sealants and use of silicone tape in SPF roofing

#5 – Proper joint geometry and use of backer rods

#6 – Surface Preparation & Tooling
Silicone is derived from Element #14 *Silicon* (Si), which is the second most abundant element (after Oxygen) in the earth's crust. *Silicon* is found in glass and most rocks.
Silicon Metal (aka, Elemental Silicon) is pulverized, and .....(next) -
...is then chemically processed to make several fundamental forms of silicone-based materials, including....
Silicone Polymer

5 manufacturers globally

**North America (USA)**

**Momentive** (formerly GE)
Dow Corning

**Europe**

Blue Star (formerly Rhodia)
France

Wacker (now sold as Sika)
Germany

**Asia**

Shin-Etsu
(Japan)

- CLEAR
- ODORLESS
- STICKY
- SYRUP CONSISTENCY
Silicone Elastomeric Coatings

Silicone Sealants & Adhesives
Silicone Products
Useful for Construction Applications

1.) Sealant

2.) Rubber

3.) Coatings
RTV

• Room Temperature Vulcanization

The process that transforms a paste into rubber in the presence of moisture
**Acetoxy ?**
- developed in the 1960’s
- Vinegar odor, Acetic Acid
- corrosive to some items
- less broad adhesive characteristics
- proven in aquarium applications
  - hydrolytically stable

**or Neutral ?**
- Alkoxy - methanol
- Methoxy - methanol / ammonia
- Ketoxime - methylethylketoxime
- Aminoxy - diethylhydroxylamine
- Amide / Aminoxy - N-methylacetamide

**Silicone Paste**
Cure Time?
One-Component Silicone

• ATMOSPHERIC MOISTURE is required to initiate & facilitate the curing process.
• CURE METHOD is from the outside in (forms a skin), and the cure reaction works its way inward toward the center of the material.
• RATE OF CURE is dependent upon relative humidity as well as temperature.

MOISTURE VAPOR CURE CHEMISTRY
Silicones exhibit Very Low Shrinkage

Silicone products shrink less than 5% of volume
One-Component Silicone

- Atmospheric Moisture is required to initiate & facilitate the curing process.
- Cure Method is from the outside in (forms a skin), and the cure reaction works its way inward toward the center of the material.
- Rate of Cure is dependent upon relative humidity (RH) as well as temperature.
- Strength Properties reach 50% of full within 1 or 2 days.
- Full Cure & Maximum Physical Properties require 7 to 14 days.
Example of Cure Speed

(One-Component Silicone)

<table>
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<th>Temperature</th>
<th>Humidity</th>
<th>Tack Free Time</th>
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<td>90°F</td>
<td>95%RH</td>
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<td>50%RH</td>
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<td>30°F</td>
<td>10%RH</td>
<td>8 HOURS</td>
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Cure Rate – What to Expect

(single-component silicone)

temperature & relative humidity

Cure Depth @ 46 Hours
Hydrolytic Stability

Silicone is used to attach and seal aquarium walls.
Thermal Stability

Temperature (°F)

-200 -100 0 100 200 300 400 500

-175 -55

Silicone (Industrial)

Silicone (Construction)

Hybrid, STPE

Polyurethane

Polysulfide

Fortified Acrylic

Acrylic

Butyl

In-service temperatures

Temperatures (°F)

-200 0 100 200 300 400 500

-175

-55

-40

-30

-20

-15

-10

-5

0
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Spray Applied Silicone Roofing System
• Silicone has been used as a primary barrier in roofing systems for nearly 30 years in a system which utilizes two coats of silicone adhered to a base of polyurethane foam.

• The **Polyurethane Foam** is spray applied, after which it instantly expands to 30 times its original volume into a rigid insulating base, up to several inches thick with an R value of 6.67 per inch. The end product is a seamless, lightweight, waterproof, insulating layer of closed-cell foam which delivers great benefits in terms of energy savings.

• The **Base Coat** is spray-applied directly to the polyurethane and functions primarily to protect the foam from UV exposure which can erode the polyurethane.

• The **Top Coat** is applied in contrasting color to assure complete coverage and proper thickness as well as to provide for a final, completely weather-resistant barrier. **Granules** are cast into the top coat to provide abrasion resistance and a slip-free surface.
Seal your way to KNOW leaks
Seal your way to KNOW leaks - Fracture
Seal your way to KNOW leaks – V Groove cut out
Seal your way to KNOW leaks – 3 sided adhesion?
Seal your way to KNOW leaks – Roof Movement
Seal your way to KNOW leaks – improper installation
Three-Sided Adhesion

- Three-sided adhesion occurs when the sealant adheres to both the sides AND to the base of the joint. This condition restricts the ability of the sealant to flex, causes the buildup of concentrated stresses within the sealant during joint displacement, and should be avoided in any dynamic condition. In the example shown, adding a bond breaker material to the base of the joint will prevent three-sided adhesion from occurring. The bond breaker may be anything to which the sealant will not permanently adhere; wax, teflon, etc., and is commonly polyethylene tape in shallow joint designs.
Butt Joint Design

Good joint design
Silicone sealant
Backer rod
Ratio of A:B should be about 2:1

Poor joint design
Silicone sealant
Backer rod

Sealant in tension
Sealant bead

Sealant in compression
Sealant bead
Joint Proportioning

Backer Rod

1/4” MINIMUM adhesion contact

tooled concave

1/8” to 3/8” MAX over crown of backer rod
What is Backer Rod Used For?

To limit the amount of applied sealant.

Too little sealant won’t provide enough strength to absorb the movement. Nor will it have a sufficient area of adhesion to the substrate.

- Under stress, sealant will tear or separate from the substrate.
- Too much sealant will create a block that will not allow for enough movement. The sealant will separate from the substrate or the substrate will crack or break.
- Sealant is very expensive and use of more than necessary results in excessive costs.

To provide a form to assist the sealant in developing the appropriate shape factor for maximum adhesion and flexibility.

- A parabolic curve, $\frac{1}{x^2}$, gives the sealant strong adhesion to the substrate, while allowing for flexibility and movement of the substrate.

Acts as a bond breaker to prevent back-side adhesion

- If the sealant “sticks” to the bottom (back side) of a joint, or to the backer rod, it forms a solid block that will not allow for flexibility and movement, resulting in joint failure.
- Nomaco’s backer rod products are formulated so that approved, applied sealants will not stick to the backer rod.
What are the Types of Backer Rod?

- **Types of Backer Rod**
  - **SOF® Rod and Dual Rod®**
    - Per ASTM C 1330. Cylindrical flexible sealant backings composed of bi-cellular material as defined in Terminology ASTM C717
  - **HBR® and Green Rod®**
    - Per ASTM 1330. Cylindrical flexible sealant backings composed predominantly of closed cell material per ASTM C 1330, for use with cold applied sealants.
  - **HBR®-XL**
    - Round rods of various diameters intended for use with cold- and hot-applied joint sealants per ASTM D 5249.
  - **Foam Pak II™**
    - Cylindrical flexible sealant backings composed of predominantly open cell material per ASTM C 1330.
Seal your way to KNOW leaks – Typical V Groove
Seal your way to KNOW leaks – A properly sealed joint

Tooled Sealant

Backer Rod

Silicone/Polyurethane Foam Roofing System
Joint Proportioning

Backer Rod

1/4” MINIMUM adhesion contact

tooled concave

1/8” to 3/8” MAX over crown of backer rod
Seal your way to KNOW leaks – A properly sealed joint

Triangular Backer Rod
Backer Rod

Do not twist, double-up or otherwise misuse backer rod to compensate for improper or undersized backer material.
Effect of twisted backer rod on sealant cross section (backside of installed sealant joint shown after sealant removed from joint)
Seal your way to KNOW leaks – A properly sealed joint
Seal your way to KNOW leaks – A properly sealed joint
Seal your way to KNOW leaks – A properly sealed joint

Butter Silicone sealant on edges & tool
Seal your way to KNOW leaks – A properly sealed joint

Add silicone top coat & granules to match existing coating
Seal your way to KNOW leaks – A properly sealed joint

Repair done with minimal sealant & continued expansion allowed
apply sealant
place weatherstrip, masking tape & roller optional
tool squeeze out
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#6 – Surface Preparation & Tooling
Cleaning

Dirty Environment

Uncontrolled Work Conditions on Site
Cleaning – Air Blow
Tooling
Why Tool?

• Confirms that sealant is forced into intimate contact with joint surfaces
• Aides in minimizing internal voids
• Creates neat final appearance
• Dry tool only
Tooling
Tooling
Use 1/4” Minimum Contact

Not acceptable!
Batch Code

Marking
End of Program

Any Questions
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