ELASTOMERIC ACRYLIC ROOF COATINGS FOR EPDM ROOFING

By Joseph M. Rokowski and Thomas Ennis

Introduction

EPDM presently holds about 30 to 35% of the 3.6 billion-ft^2 low-slope roofing market and is growing rapidly at the expense of other conventional roofing systems. Black EPDM membranes are the predominant choice for new low-slope roof construction today.

The Environmental Protection Agency (EPA) has become a major influence in the roofing market. The EPA ENERGYSTAR® program promotes manufacturing and marketing of energy-efficient products, thereby potentially reducing combustion-related gases, including air pollution (greenhouse gases and NOx) from electrical power generation. The ENERGYSTAR® program has issued requirements for reflectivity for low slope roofs, both as new installations and after three years. They require that the membrane must have 65% initial reflectivity and 50% reflectivity after three years' exposure. Black EPDM membranes do not meet these requirements. However, a properly formulated, white-coated, black EPDM membrane roof will meet the ENERGYSTAR® requirements.

Uncoated EPDM membranes, because they are black, absorb significant solar heat energy. The high heat energy influences the chemistry of EPDM and leads to accelerated weathering of the membrane. Applying a white elastomeric roof coating to the black EPDM also reduces the heat load on the EPDM and increases its service life.

Rohm and Haas Company has been working cooperatively with EPDM and coating manufactures to develop new technology to allow the acrylic elastomeric roof coating to have excellent bonding to the black EPDM membrane. This will allow the EPDM to meet ENERGYSTAR® requirements and enhance the service life of an already durable membrane.

New EPDM Membrane Chemistry

New EPDM membranes contain additives that improve processing and field performance. Release agents ensure that the membrane will not adhere to itself during vulcanization. These required additives sometimes interfere with the adhesion of an elastomeric roof coating. Elemental surface analyses done on a commercial EPDM membrane showed the following inorganic elements and organic moieties on the surface of the EPDM membrane.

Substance	% of Surface
C-C	50.56
COR	3.76
COOR	1.80
O	18.03
N	1.13
Zn	15.71
Na	0.00
Ca	0.00
S	7.12
Sil	.89
Al	0.00

Table 1

Figure 1: No Pretreatment.

Figure 2: Pretreated.

On the surface of the EPDM membrane, there are two inorganic elements which interfere with adhesion of an acrylic roof coating. These are: zinc (Zn) and silicon (Si).

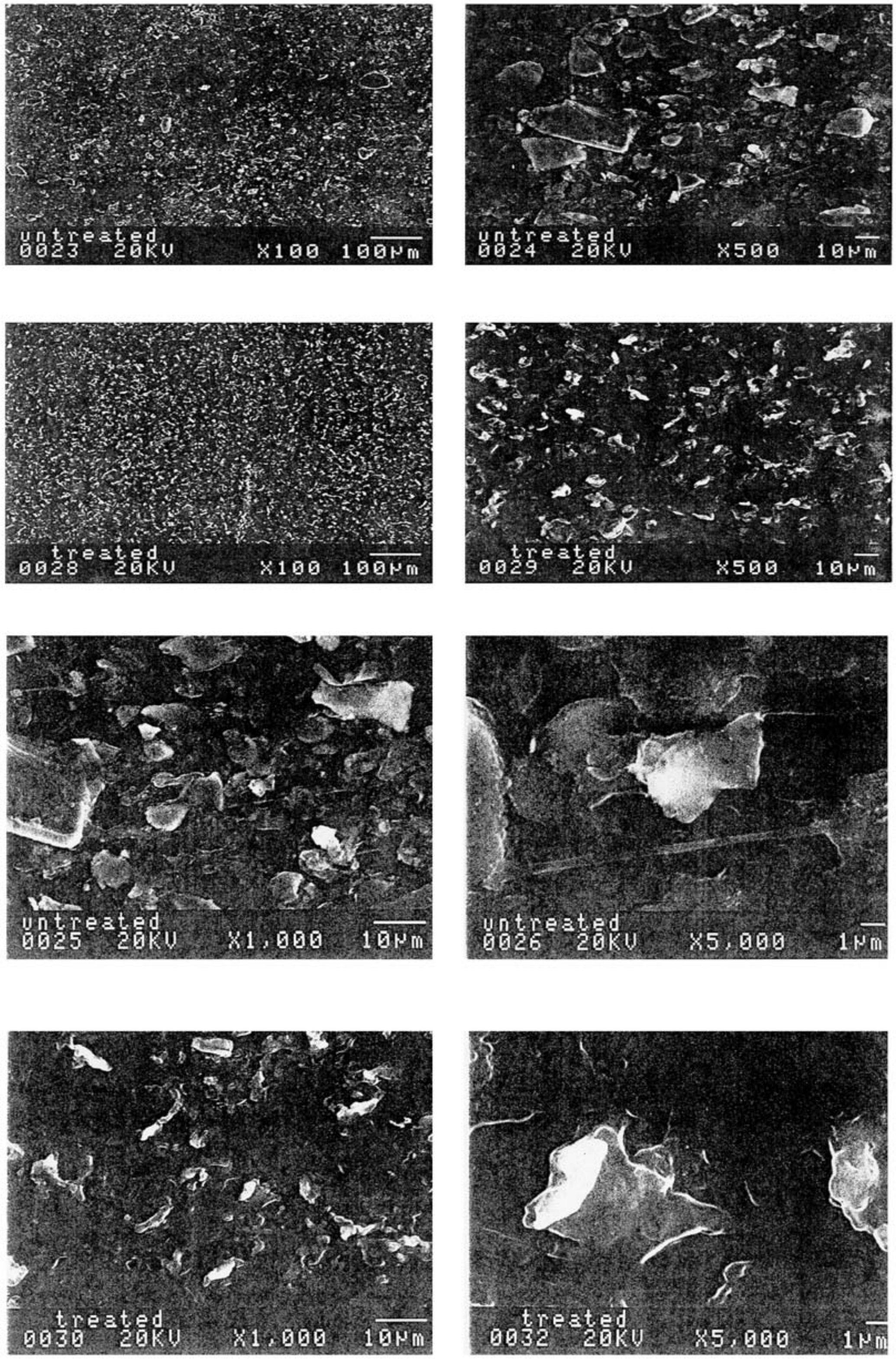
The surface of the new EPDM can be treated with the new technology from Rohm and Haas Company. After treatment, the EPDM surface is more easily bonded to the roof coating because a large portion of the zinc- and silicon-containing components are significantly lowered as shown in this table:

Substance	% of Surface
C-C	64.50
COR	5.22
COOR	2.89
O	14.92
N	0.00
Zn	3.14
Na	1.37
Ca	6.02
S	1.94
Sil	0.00
Al	0.00

Table 2

Coating Adhesion Testing

Since EPDM membranes are chemically very inert, it is very difficult for them to get adequate adhesion. New technology can allow an elastomeric acrylic roof coating to have excellent adhesion to the membrane, even in areas where there is water ponding. A nylon mesh was imbedded in the membrane during application. *Figures 1* and *2* illustrate a 10-year-old EPDM membrane coated with an elastomeric acrylic roof coating and a nylon mesh imbedded in the membrane during application, being pulled off after one year of weathering.



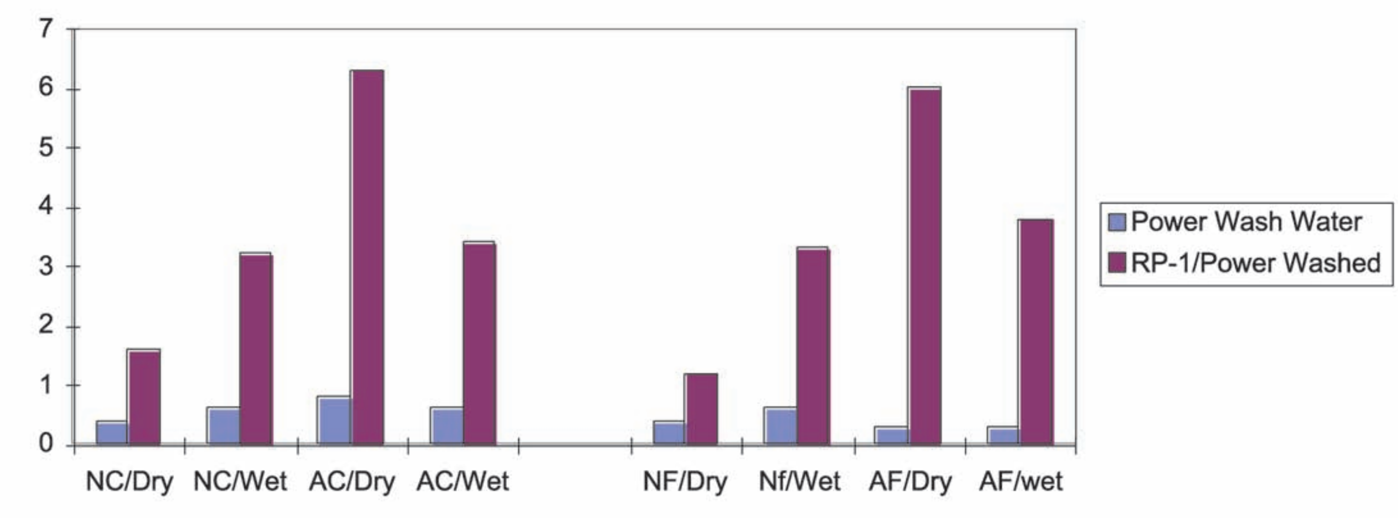
Figures 3 and 4: Microphotographs of treated and untreated new EPDM membranes.

Microphotographs of Treated and Untreated New EPDM Membrane

The microphotographs (*Figures 3* and *4*) clearly show the difference in crystalline surface changes of the untreated and treated EPDM membrane.

Adhesion of Acrylic Roof Coatings to EPDM

Adhesion of the elastomeric acrylic roof coating to the EPDM membrane will eliminate blistering in areas where there is ponding water. The graph shown in *Figure 5* illustrates the improvement in adhesion of both a new and aged EPDM membrane that was cleaned with a new technology product.



IDENTIFICATION

NC = New Manufacturer A EPDM AC = Aged Manufacturer A EPDM (10 year)

NF = New Manufacturer B EPDM AF = Aged Manufacturer B EPDM (10 year)

Figure 5: Peel adhesion of Manufacturers A and B EPDM with and without treatment graph. Scale is in pounds per inch width.

Improving EPDM Solar Reflectance Using Coatings

EPA's ENERGYSTAR® program is having a major influence in the roofing market. Legislation in certain states – i.e., California, Georgia, Texas, and even in Illinois – and some local building codes are making it mandatory that low-slope roofs have an initial and aged solar reflectance that meets the criteria for ENERGYSTAR®. The initial solar reflectance for a new roof must have a solar reflectance minimum of 65%. A black EPDM membrane must have a solar reflectance of ~10%, which is below the requirements of ENERGYSTAR®. Applying a white elastomeric acrylic roof coating will have an initial solar reflectance of 80% reflectance or higher, which is well above the criteria for initial reflectance as required by EPA. The table below illustrates some reflectivity measurements taken on several reflective coated projects throughout the country.

Weathering Properties of EPDM and the Effects of Coatings

Weathering of EPDM can cause changes in tensile strength and elongation properties of the rubber membrane. Generally, as the processing oils leach out, the membrane becomes less elastic, but stronger. This leaching phenomenon is evidenced by loss of membrane thickness and dimensional shrinkage. The elongation increases tensile strength, generally make the EPDM less flexible. Puncture resistance and tear resistance will be reduced as the EPDM membrane loses its elasticity. *Figure 6* shows a 15-year EPDM membrane with a severe tear caused by shrinkage over time.

Ballasted EPDM membranes will also lose elongation even though the direct UV rays from the sun are somewhat screened. The radiant heat IR portion of the sun will still heat the membrane to temperatures in excess of 150 degree Fahrenheit. The high membrane temperatures "bake" the processing oils out, and the membrane loses some of its initial elasticity. A paper was presented at the 11th Conference on Roofing Technology by Paroli, Delgado, Dutt, Smith, and Simmons on "Shrinkage of EPDM Roof Membranes: Phenomenon, Causes, Prevention, and Remediation." In this paper, studies on elongation properties showed that test samples taken from the top layers of the membrane had significant loss in elongation properties compared to the bottom sample of the same membrane.

The elastomeric acrylic is a UV-resistant, water-tight monolithic coating. In essence, it is a membrane fully adhered to another membrane. The coating reflects the UV rays and will keep the rubber membrane temperature at approximately 10 degrees higher than the ambient temperature as opposed to greater than 150 degrees Fahrenheit if left uncoated. At these lower temperatures, the oils in the EPDM will remain intact, the modulus of the rubber will not increase, the tensile strength of the membrane will not increase as much, and the membrane will remain more flexible. All this will result in longer life and lower life cycle cost for the EPDM roof.

REFLECTIVITY MEASUREMENTS ON REFLECTIVE COATED PROJECTS

Energy Star Specification	Performance Specification	Roof A 3 years	Roof B 4 years	Roof C 5 years
Initial Solar Reflectance	> 65%	83.4%	83.0%	77.0%
Maintenance of Solar Reflectance	> 50%	69.2%	66.9%	57.8%

Table 3

Conclusion

Elastomeric acrylic roof coatings have been used commercially on EPDM roofs since the mid 1980s. Recent improvements in adhesion technology and the need for enhanced solar reflectance have created an even greater opportunity for the combination of these two highly durable construction materials in low-slope roofing. ■

Figure 6: A 15-year-old EPDM with a severe tear caused by shrinkage over time.

REFERENCES

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ABOUT THE AUTHORS

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Joseph Rokowski of Rohm and Haas Company, Springhouse, PA, has been involved with coatings for 20 years. He specializes in adhesion issues, exterior durability matters, and roofing substrate analysis.

Thomas J. Ennis retired from Rohm and Haas Company in 2003 after 30 years of service. He was awarded the Rohm and Haas Otto Haas Award, Architectural Coating Award, and Vice Presidents Award for discovery of the patented technology of the Rinseable Primer RP-1, EPDM surface cleaner. Since leaving Rohm and Haas, Ennis has become technical director of Insulating Coating Corporation and Hi-R Insulating Roof Designs, LLC, where he has sole responsibility for all technical issues dealing with the performance of ASTEC and Hi-R elastomeric roof coatings for the metal and flat deck roofing industry. Ennis developed one of the highest (91%) solar reflective white elastomeric roof coatings currently sold by both ICC and Hi-R.

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