OCTOBER 2023

SHEAR BULL

Palm Beach County Roofing & Sheet Metal Contractors Association

JOIN US SEPT 21
DINNER MEETING
Speaker will be Scott Hoffman,
"All Good Media"
Postponed from cancelled
June meeting.

601 Heritage Drive, Ste. 448,
Jupiter, FL 33458
tel 561-655-5393
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THE RELATIVE DURABILITY OF LOW-SLOPE ROOFING

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function of the reciprocal of the absolute temperature; it is given by:
log (i) = y+(VT) [8]
where y is the intercept, and r is the slope of the curve. The slope is an index of thermal sensitivity.

A thermal load, for the purposes of this work, was defined as the calculated absolute temperature (Kelvin) of a horizontal surface at a specific location. The author's previous work developed the method for modeling the thermal climate' and the method of calculating the thermal load at a particular location.' These methods were used for this paper.
The thermal load was calculated for a gray color at each respondent's location, and the response was placed in one of five groups that made up the full range of thermal loads in the United States (Appendices B, C, and D are maps with thermal load isobars for white, gray, and black surfaces).

This approach makes the following assumptions:
Each respondent s business is local. This is not necessarily true; some respondents are national, or even international, companies. Nevertheless, "local" is probably more often the case because of the mass of the materials and the economics involved.
The roof systems are gray. This is not always true, but more roofs most likely are in the mid-range of color than at the extremes of black or white. For example, the color of many PVC, CSPE, and PUF systems tend to be whiter, and EPDM systems tend to be blacker than gray. Even very white and dark black roofs tend to become the color of the ambient dirt; they tend to gray.

The durability data in each thermal load range was averaged, and regression analyses of these response averages were used to explore the fit of survey data to the Arrhenius equations.
These 0.90+ regression coefficients confirmed that the Arrhenius relationships apply to low-slope roof systems. Regression coefficients of -0.75 for metal panel, asphaltglass-pitch, and SBS polymer modified bitumen systems may suggest the presence of forces other than temperature that are important for these systems. For example, the metal panel data may reflect the performance of the coating on thepanel, rather than the performance of the panel itself.

The slope of the linear regression line illustrates the sensitivity of the roof system to changes in temperature. These data show that the mean durability declines very dramatically with changes in the temperature for some systems, such as PUF, PVC, and PIB, and declines very little for other systems, such as SBS-PMB. Despite the assumption that all the roofs are gray, changing their color to white or black changes only the intercept; it does not change the slope of the curve. One reviewer of this paper believed that the steep slope of the PUF system data (i.e., its thermal sensitivity) was an artifact not supported by field data. The author must rely on the data from the survey; it suggests the reviewer is biased.

Each roof system has its own activation energy (E) and test statistic (A).' The system thermal stability increases as the activation energy declines and the test statistic increases.

continued on page 4...

MESSAGE FROM THE PRESIDENT

As we are entering into fall, we will be entering an active time for the Association with a few events coming up that I would like to bring to your attention. We will be having our Annual Golf Tournament this October 11, 2023 at Winston Trails Golf Course located at 6101 Winston Trails Boulevard, Lake Worth, Florida 33463. We are looking to make this event bigger and better than last year; we are looking for Sponsors and Players for this event and the Association would appreciate all the support we can get, so please sign up and sponsor and I look forward to seeing everyone there!

The Board of Directors have also decided to hold a Christmas Party this year and "John Klingel" and "Richard Kasper" are working diligently on this event. There will be plenty of food, fun, dancing and they have even asked "Santa" to show up. With the help of our Association Members let's make this a great event and I look forward to seeing everyone there.

On a personal note, Joe and I are happy to announce that we are Grandparents again, our beautiful daughter "Jessica" has blessed us with a beautiful grandson, (Reilly Eastman Connolly), on August 31, 2023. We are so proud of her and are happy to see him join his cousins Madison and Wyatt, God has blessed our family with so much love!

Vicki D. Byrne
President, PBCRSMCA
Email Address: briroof81@gmail.com

UPCOMING EVENTS:

NO DINNER MEETING IN OCTOBER

ANNUAL GOLF TOURNAMENT WEDNESDAY, OCT 11, 2023
6101 Winston Trails Blvd., Lake Worth, FL 33463
For more info call Vicki Byrne 561-373-6510

CHRISTMAS DINNER - DECEMBER 2ND, 2023

COMMITTEE MEETING SCHEDULES:

- PBCRSM BOD 3rd Thursday each month
- PBCRSM Gen. Membership 4th Thursday each month
- BCAB 3rd Wednesday each month
- BOAF 3rd Thursday each month
- CILB 4th Monday each month
- CBAA 2nd Thursday each month

Of course, both the mean and the minimum durability change with the thermal loading. Therefore, the durability range for each system also changes. Figure 10 shows the percent surviving for EPDM membranes at 280K (45°F) through 310K (99°F) thermal loadings.
The durability range decreases significantly as the thermal loading increases. Similar charts can be drawn for each of the roof systems covered by the survey.

LIFE CYCLE COSTS

The life cycle cost of each membrane system was calculated by adding the mean installed and disposal cost responses, dividing the sum by the mean durability, and adding the mean annual maintenance cost response. The polyurethane foam system cost is the only one that includes the insulation; for this reason, care should be used in comparing the PUF numbers with the other numbers for this survey.
This calculation assumes that the inflation rate equals the discount rate for the present value of future dollars. Figure 11 shows these computed life cycle costs.
The percent coefficient of variation p was calculated using:
p=100 x s/ x n") [9]
It is good for these installed cost data, ranging from 3.5 to 7.1 percent. The disposal costs had a higher variability; p ranged from 6.7 to 14 percent of the mean, probably because of extremes in local costs. The maintenance costs showed the highest variability; p varied from 8.1 to 27 percent, in part because of variations in local costs and, to some extent, survey responses that quoted dollars per 100 square feet instead of the dollars per square foot requested.
These cost data cannot be used as absolute values, because of the variation in these data. They are perhaps best used as indices of perception, because all data were treated uniformly.

Membrane Type	R Regression Coefficient	Mean Durability, years				71 slope	E Activation Energy	A Test Statistic
		280 K	290 K	300 K	310 K			
PUF	0.99	31.8	13.9	6.5	3.2	2903	0.576	0.000000
PVC	0.95	26.8	16.4	10.3	6.7	1739	0.345	0.000016
PIB	0.95	14.8	10.9	8.2	6.3	1076	0.214	0.02118
EPDM	0.95	20.1	15.4	12.0	9.5	940	0.187	0.008789
APP-PMB	0.92	17.3	14.3	11.9	10.1	679	0.135	0.065139
CtGP-BUR	0.92	27.3	22.9	19.5	16.7	615	0.122	0.173
CSPE, CPE	0.99	16.4	11.9	11.9	10.2	611	0.121	0.1086
Metal	0.75	28.2	25.4	23.0	21.0	371	0.074	1.3343
AGP-BUR	0.75	20.7	18.7	17.0	15.6	359	0.071	1.0802
AOA-BUR	. 0.93	16.9	13.6	12.4	11.4	336	0.067	0.9557
EP, OT	0.93	14.0	12.8	11.8	10.2	314	0.062	1.0556
AGA-BUR	1.00	18.5	17.4	16.5	15.7	206	0.041	3.3915
CtOP-BUR	0.95	25.4	24.0	22.7	21.6	205	0.041	4.7269
SBS-PMB	0.74	16.3	15.9	15.5	15.2	92	0.018	7.7013

Figure 9. Mean durability at various thermal loads, regression coefficients, thermal sensitivity, activation energy and test statistic.

Service Life, years	Thermal Loading			
	280K (45°F)	290K (63°F)	300K (81°F)	310K (99°F)
3	100	100	100	99.9
6	100	99.8	99.0	95.4
9	99.6	97.4	87.5	59.5
12	97.3	84.9	50.0	11.5
15	88.7	54.8	12.5	0.6
18	69.2	21.5	1.0	0.0
21	41.7	4.5	0.0	
24	17.6	0.4		
27	5.1	0.0		
30	0.9			
33	0.1			
36	0.0			

Figure 10. EPDM, calculated percent surviving at various ages and thermal loading.

CONCLUSIONS

These survey data speak for themselves. As useful as mean time to failure data may be to the industry, this study illustrates that durability is not one value, but a range of durabilides for each system, and that durability perceived by the respondents is greatly influenced by the thermal climate to which the system is exposed.
The activation energy and test statistic constants for the Arrehenius equations, which were reported as empirical values, may be the basis for additional research into the durability of roofing materials.
These data demonstrate that the reaction to temperature differs by material. Perhaps these data may be used to help design roof systems that are more durable. In any event, these data show that comparing roof systems composed of different types of

continued on following page...

materials, by exposing them to a uniform

Membrane Type	Installed Cost $/ft^2	Disposal Cost $/ft2	Mean Durability Years	Maintenance Cost SAW x yr.)	Life Cycle Cost $/(ft^2 x yr.)
CtGP-BUR	3.23	1.12	21.9	0.10	0.30
AGA-BUR	2.28	0.81	16.7	0.12	0.31
AGP-BUR	2.87	1.07	17.7	0.09	0.31
CtOP-BUR	2.97	1.10	23.0	0.14	0.32
EPDM	2.21	0.98	14.2	0.10	0.33
AOA-BUR	2.27	0.86	14.7	0.12	0.33
SBS-PMB	2.70	0.93	15.9	0.11	0.34
APP-PMB	2.35	0.72	13.7	0.12	0.34
PVC	2.54	0.84	13.8	0.11	0.36
Metal	4.94	1.27	25.0	0.11	0.36
EP, OT	2.61	0.73	.12.7	0.11	0.37
CSPE, CPE	2.69	0.75	12.8	0.11	0.38
PIB	2.76	0.76	10.6	0.09	0.42
PUF*	2.57	1.27	12.1	0.15	0.47

Cash, C. G. "Estimating the Mean Temperature of Horizontal Surfaces for Predicting the Durability of Thermally Sensitive Materials (Arrhenius Relationship)," Dealing With Defects in Buildings, Varenna, Italy, 1994, 387-396.
These terms are defined previously after Equation 7.

heat aging program, may be invalid, because the response of each system to heat differs.

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Simpson Gumpertz & Heger Inc.
Siplast, Inc.

All of the people who took the time to respond to this survey, our co-op students who tabulated data, and supporters who declined to be mentioned.

ENDNOTES

Cash, C. G. "Durability of Bituminous Built-Up Roofing Membranes, Durability of Building Materials and Components, ASTM STP 691, P. J. Sereda and G. G. Litvan , Eds ASTM, 1980, 741-754. Experimental Statistics," Engineering Design. Handbook, AMCP 706-110, Headquarters, U.S. Army Material Command, 1969. Personal correspondence with R. Fricklas. Nelson, Wayne. Accelerated Testing, John Wiley & Sons, 1990. Cash, C. G. "Computer Modeling of Climates," Insulation Materials, Testing and Applications, STP 1030, D. L. McElroy and J. F. Kimpflen , Eds., ASTM, 1990, 599-611.

Appendix A

Simpson Gumpertz & Heger Inc.
1996 - Low Slope Roofing Questionnaire
Check if you wish a summary of the data.
Please check the box in front of the types of roof your organization manufactures, applies, or investigates. Return the questionnaire unmarked if you are not involved in any of these types.
For each roof type with which you are involved, please write your estimate in the appropriate box of:
the average life (the years that half of all of the roofs installed will perform satisfactorily, assuming proper design and installation),
the minimum life (the years of life typical of the worst 1 percent of the roofs installed),
the installed cost per square foot (materials, labor, profit and overhead, without insulation),
the maintenance cost per square foot per year, and
the tear off and disposal cost per square foot.
Proceedings of the Fourth International Symposium on Roofing Technology

Make or Use	Low-Slope Roof Membrane	Average Life	Minimum Life	Installed Cost	Maint. Cost	Disposal Cost
180	Asphalt-organic felt & asphalt BUR	14.7	7.3	2.27	0.12	0.86
155	Coal-tar organic felt & pitch BUR	23.0	12.2	2.97	0.14	1.10
283	Asphalt-glass felt & asphalt BUR	16.7	9.1	2.28	0.12	0.81
113	Asphalt-glass felt & pitch BUR	17.7	9.0	2.87	0.09	1.07
115	Coal-tar-glass felt & pitch BUR	21.9	11.2	3.23	0.10	1.12
225	APP multiply modified bitumen	13.7	7.1	2.35	0.12	0.72
274	SBS multiply modified bitumen	15.9	8.4	2.70	0.11	0.93
46	Polyisobutylene	10.6	4.8	2.76	0.09	0.76
252	EPDM (ethylene-propylene- diamine)	14.2	7.0	2.21	0.10	0.98
148	Reinforced polyvinyl chloride	13.8	6.5	2.54	0.11	0.84
145	Reinforced Hypalon , CPE	12.8	6.5	2,69	0.11	0.75
82	Other thermoplastic single plies	12.7	6.0	2.61	0.11	0.73
107	Foamed in place urethane	12.1	4.8	2.57	0.15	1.27
187	Prefabricated sheet metal	25.0	12.4	4.94	0.11	1.27

PHOTOS FROM OUR AUGUST DINNER MEETING!

OCTOBER 2023

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10 COLUMBUS DAY	11 ANNUAL GOLF TOURNAMENT	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31 HALLOWEEN				