Coating vs. Non-Coating

With Sharp NT-175U1

Pacific Research & Development

October 31, 2013

Coating vs. Non-Coating

Purpose

We have tested Sharp 175w modules with the nano coating applied (Ionyx Hydrophobic Glass Treatment) vs a non-coated module. The nano-coating acts as a layer of protection to a module applied. This nano-coating bonds with the top layer of the module and this would allow the surface to be seemingly impenetrable to common substances such as bird droppings, markers, graffiti, etc. Theoretically if applied to large-scale projects/jobs, this would bring maintenance labor down and power efficiency should rise. The question is how effective this nano-coating is in bonding with the surface of a module? And how would this affect power output for a module when applied? The series of trials that follow are an attempt to address the latter question. By comparing two identical models with similar power output we should be able to see either a drop in power, a rise in power, or a static change in power for the module applied with the nano-coating.

Procedure

We began testing for power output on panels that were the most comparable. We ended up using panels labeled "Panel 3" and "Panel 1". The first two trials from each panel were used to compare how they differ in performance. We used these measurements for the best panels suited for comparison. After 12:25 p.m. I began recording the data onto the software and built some data from that. So anything before then the software doesn't have any data in form of an excel file. We used trials 3-7 from the tables to compare performance factor and power generated. I will show a third table comparing these values as such with calculations to show if the coated panel had an advantage/disadvantage in terms of power generated and a fourth table showing the same calculations with trials without the nano-coating. From the software Solmetric, I found two different sets of data that we could use for analysis. One set of data that was used, came from the predicted I-V model that the software provided by inputting the model type of the module and the second set of data came from the wireless sensors for irradiance

and temperature. The second set of data brought up different values for predicted measurements and Performance Factor (PF). This means that we could potentially use these predicted measurements and PF values as another means of checking performance of nano-coated vs non-coated. In which the last two tables illustrated. Either way of checking performance, both should indicate a trend if there is any, from the data that I extracted from Project Sharp NT-175U1.

Data

Panel 1 Trial Runs

Trial	Time	Power (W)
1	12:21:25	146.2
2	12:23:27	146.9
3	13:19:34	162.7
4	13:35:20	148.4
5	13:35:53	148.3
6	13:46:47	132.2
7	13:48:02	96.4

Panel 3 Trial Runs

Trial	Time	Power (W)
1	12:20:12	150.9
2	12:25:41	148.7
3	13:20:30	160.9
4	13:34:07	148.1
5	13:37:27	146.6
6	13:45:48	130.3
7	13:48:54	95.5

Analysis

Trial 2 difference (panel 3-1)- $148.7W - 146.9W = 1.8W$

Total- $148.7 + 146.9 = 295.6W$

Average- $\bar{x} = \frac{295.6W}{2} = 147.8W$

% Difference- $\frac{1.8W}{(147.8W)} \times 100\% = 1.2\%$

This percentage of 1.2% of Panel 3(P3) over Panel 1(P1) shows an acceptable percent difference in which we could help in discerning the results in the tests that include the coating. I'd like to note that this is a conservative estimate. In tables 3 and 4, I have done the same calculations in the same order of steps from the example shown above.

Coating vs. Non-Coating

Trial	3	4	5	6	7
Panel 1 W/ coating	162.7	148.4	148.3	132.2	96.4
Panel 3	160.9	148.1	146.6	130.3	95.5
Difference	1.8	0.3	1.7	1.9	0.9
Total	323.6	296.5	294.9	262.5	191.9
$\overline{x}$	161.8	148.3	147.5	131.3	95.95
% Difference	+1.1%, P1	+0.2%, P1	+1.2%, P1	+1.5%, P1	+0.9%, P1

Non-Coated Panels

Trial	1	2
Panel 1	146.2	146.9
Panel 3	150.9	148.7
Difference	4.7	1.8
Total	297.1	295.6
$\overline{x}$	148.9	147.8
% Difference	+3.2%, P3	+1.2%, P3

I calculated the average % difference from both tables 3 and 4. I then compared both averages to check how much the coating affected P1. P1 not only caught up to P3 (which demonstrated to initially perform better) but also surpassed it in terms of performance of power output and we could clearly see that by looking at the performance factor from each trial.

Average % Difference for Non-Coated Trials-

$$\bar{y} = \frac{3.2\% + 1.2\%}{2} = +2.2\%, P3$$

Average % Difference for Coated vs. Non-Coated Trials-

$$\bar{u} = \frac{(1.1\% + 0.2\% + 1.2\% + 1.5\% + 0.9\%)}{5} = +0.98\%, P1$$

Method 2- I used a second method including PF measurements from the wireless sensors and PF measurements from the model assigned on the software. This helps checking and verifying the resulted trend.

Panel 3- Performance Factor					
Trial	7	6	5	4	3
Wireless Sensor PF	104.1%	101.4%	99.4%	100.1%	N/A
Model PF	96.8%	96.7%	96.1%	96.2%	N/A
Difference	7.3%	4.7%	3.3%	3.9%	N/A

<u>Average P3 PF</u>

$$\frac{(7.3\% + 4.7\% + 3.3\% + 3.9\%)}{4} = 4.80\%$$

Panel 1 With Coating- Performance Factor					
Trial	7	6	5	4	3
Wireless Sensor PF	104.7%	101.9%	99.4%	N/A	97.8%
Model PF	95.5%	95.7%	95.1%	N/A	95.4%
Difference	9.2%	6.2%	4.3%	N/A	2.4%

Average P1 with Coating PF

$$\frac{(9.2\% + 6.2\% + 4.3\% + 2.4\%)}{4} = 5.53\%$$

Conclusion

We find that there indeed is a trend that exists with that of the nano-coated module. My analysis showed that there is an average of 3.2% better overall performance for the Coated P1 than P3 based on the number of trials and Solmetric software measurements taken on a sunny day with an open sky on October 31, 2013. Method 2 with PF also verifies this trend showing P1 performing 0.73% better than P3. Method 2 also helps in explaining this positive trend for P1. The software automatically calculates the exact predicted measurements based on the environment from each individual trial. Environment includes wireless sensor readings for temperature and irradiance. This shows us more accurate measurements than those provided by the model. By comparing these two types of data we are able to see how much P1 performs better than expected. In conclusion, we have indicative evidence that the nano-coating application helped P1 perform better by 3.2% and exceed P3 by 0.98%.

Method 1 with power output-

$$2.2\% + 0.98\% = 3.18\% \approx 3.2\%$$

Method 2 with PF from wireless sensors and I-V predicted Model-

$$5.53\% - 4.80\% = 0.73\%$$