ReflecTech Mirror Film

Scratching of Polymer Reflectors

If polymer reflectors are repeatedly abraded or scratched, specular reflectance can be reduced, impacting overall solar field performance. A drop in field performance is unacceptable, so surface scratching of reflective films is a common concern. In general, discussion of polymer reflector surface scratching sorts into either: **a) scratching during reflector cleaning**, or **b) abrasion from wind-borne particles**. Surface scratching of polymer films is evident as a result of direct contact cleaning, like brushing; however, there is no evidence that wind-borne particles have abraded polymer reflectors in operating solar collector systems.

The surface of polymer reflectors can be scratched if they are cleaned using contact methods such as brushing, a common technique for cleaning glass reflectors. Pressure washing with demineralized water (without contact brushing) does not cause surface scratching and is the recommended method for cleaning polymer reflectors. Even skeptics, after witnessing pressure washing of a polymer reflector, are generally convinced that this cleaning method will not scratch polymer reflectors.

To address the other concern, abrasion of polymer film reflectors by wind-borne sand, one can review the operational history [1) 2) 3) 4) and 5)] of parabolic concentrators placed into service beginning in the 1980s that used polymer reflective films. These systems were cleaned by pressure washing. A wide variety of operational issues (from major ones like improper tracking, to small ones like poorly insulated piping) were documented. Although issues and problems were listed with a great deal of detail, surface scratching of the polymers was not observed. We find no evidence that any trough systems using polymer reflectors have suffered wind-induced surface scratching. Anywhere.

An explanation of why wind-induced abrasion has not been observed is given in *Weathering of Polymers*, by Anthony Davis and David Sims [6)].

"The range of particle diameters of sand and dust together extends from about 0.1 to 2000 µm. Dust particles can remain suspended in the atmosphere by natural turbulence of the air for very long periods extending days, weeks, and even years. Particles greater than 150 µm diameter are unable to remain airborne unless continually subjected to strong natural winds, or man-made turbulence.

In general, the wind movement of sand is confined to the air layer within the first metre above the ground. Even within this layer, about half the sand grains (by weight) move within the first 10 mm above the surface whilst most of the remainder are within the first 100 mm. As a consequence of the low elevation at which most sand grains move, most abrasion damage caused by sand is at or near ground level."

Although it is not possible to conclude that extreme storms will never result in reflector surface abrasion, real-world experience shows that such events are so infrequent, they have never been reported. This is similar to the perspective that is commonly shared about weather events such as tornadoes or hail storms with large hailstones – they may occur but they are very rare. A fair assessment is that surface abrasion of polymer reflectors is more a theoretical worst-case concern than a practical concern. There is no evidence that wind-borne particles have abraded polymer reflectors in operating solar collector systems. Further, pressure washing with demineralized water (without contact brushing) does not cause surface scratching and is the recommended method for cleaning polymer reflectors.

References:

1) **D. L. Larson**, "*Coolidge Solar Power Plant Operation: Results and Experiences*", Proceedings of the ASME Solar Energy Division, Albuquerque, NM, page 371, April 1982.

2) **Mitchell Garber and David Allen**, "*The Dow Chemical Company Solar Steam Plant, 1000 m²*", Proceedings of the IEA Workshop on the Design and Performance of Large Solar Thermal Collector Arrays", San Diego, CA, page 260, June 1984.

3) **L.E. Wilson and D.R. McGuire**, "*A High-Temperature Process Steam System Application at the Southern Union Refining Company, Hobbs, New Mexico*", Proceedings of the IEA Workshop on the Design and Performance of Large Solar Thermal Collector Arrays", San Diego, CA, page 299, June 1984.

4) **E.J. Ney and J. Willard King**, "*Performance of 114 Dish Array at Shenandoah*", Proceedings of the IEA Workshop on the Design and Performance of Large Solar Thermal Collector Arrays", San Diego, CA, page 319, June 1984.

5) **R.C. Gee and E.K. May**, *A Seven Year Operation and Performance History of a Parabolic Trough Collector System*, 1994 ASME Solar Energy Conference Proceedings; Jacksonville, Florida, Feb. 28 - March 3, 1994.

6) **Anthony Davis and David Sims**, *Weathering of Polymers*, page 15, London: Applied Science, 1983.

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