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Weathering Testing from Three Climate Zones
Supplemental Technical Reasoning

A quick analysis of aged ratings from the CRRC database yields the following:

Climate Zone Compared to the Average Aged Solar Reflectance	% <AVG	% < AVG & other Climates	Avg Degradation*	Max Degradation
Hot/Humid	63%	46%	0.039	0.314
Cold/Temperate	62%	45%	0.014	0.158
Hot/Dry	11%	4%	0.001	0.036

**Note this value is highly dependent on the product type population in the CRRC database.*

In other words, roughly 60% of the time the hot/humid climate zone and the cold/temperate climate zone will yield solar reflectance values lower than the average of all three climate zones, and 11% of the time the hot/dry climate zone will yield a lower value. Therefore, selection of one of these locations over another may yield a significantly different degradation in solar reflectance.

While the hot/humid climate will typically yield a lower solar reflectance value than the other two climates, this only occurs about 46% of the time. Therefore, the single climate selection of just Florida, or any other location, may not provide ENERGY STAR the most accurate, or conservative, aged solar reflectance value. Many different factors play into whether a roofing product will degrade more severely at the hot/humid versus hot/dry versus cold/temperate climate.

The following Lawrence Berkeley National Laboratory graph (from *Soiling of building envelope surfaces and its effect on solar reflectance, Part 1*) displays the difference between each climate and the average aged solar reflectance, broken out by product type.

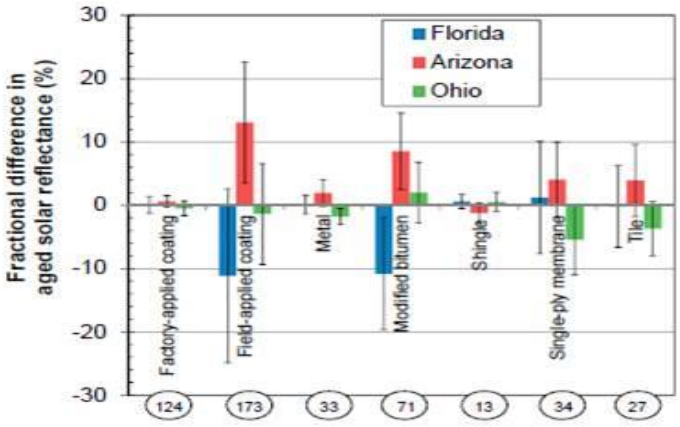

Figure 5. Fractional difference δ between site-specific aged solar reflectance, $\rho_{s,3}$ and three-site average solar reflectance, ρ_s, by product type in the CRRC2 database. Error bars mark one standard deviation; circled values are product counts.

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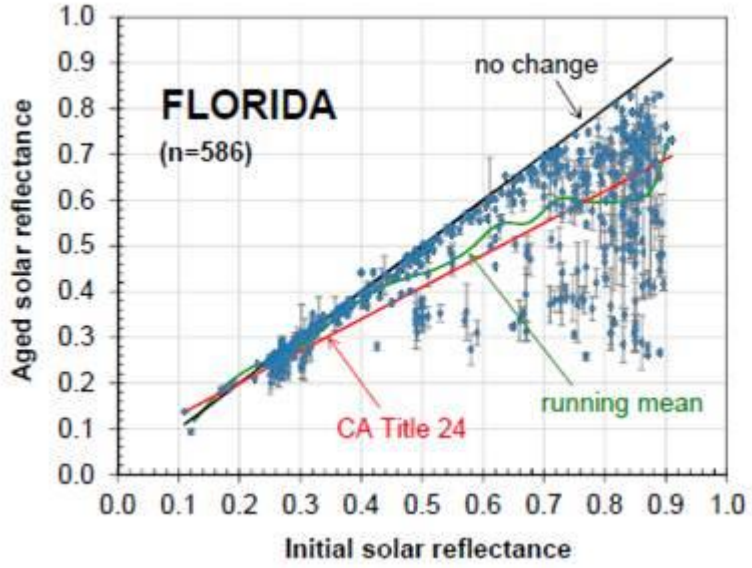
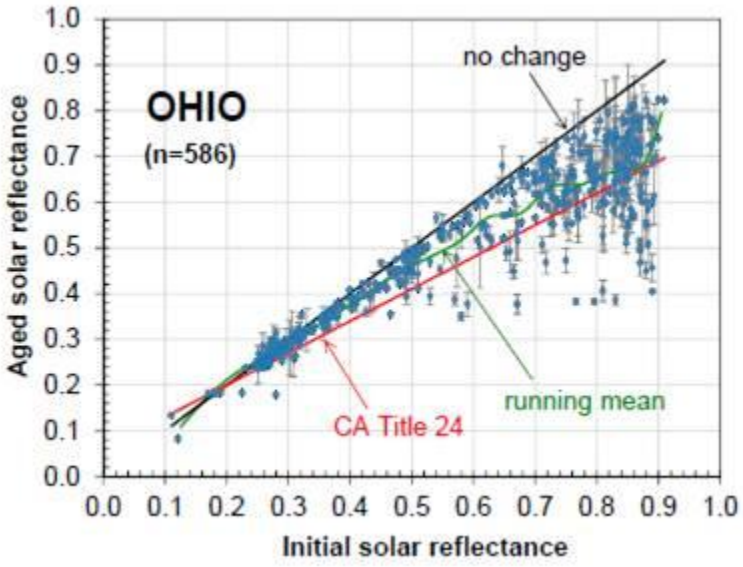
Since certain product types degrade more in certain climate zones, a balanced approach of averaging the three sites results in an equitable method to determine the aged solar reflectance for all roofing products. Use of all three climate zones is the most objective “one size fits all” protocol that results in an accurate representation of roofing product aging.

The below LBNL graphs visually demonstrate the impact that the aging location has on roofing products in terms of weathering degradation.





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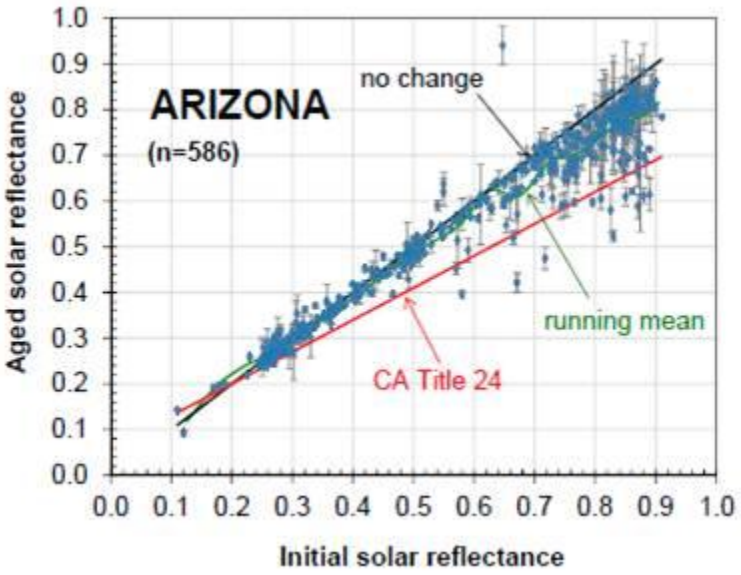

The aged reflectance in each of these three locations provides unique weathering input, as each climate zone tests a different characteristic of the roofing system. Limiting the test site selection to a single site limits the ability to test the roof surface's capability to withstand key aging influences.

- Florida's high heat and moisture captures a products resistance to biological growth, but not to non-biological soiling like soot and dust.
- Ohio captures resistance to non-biological soiling, but not to biological growth, and it also captures the impact of cold winter (freeze-thaw) weather.
- Arizona's high, but dry, heat and solar radiation captures resistance to fading from pigment breakdown and dust deposition, but not to biological growth or deposition of soot.

The CRRC has consulted with Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory to draft up the above supplemental technical analysis, in support of the use of three climate zones for roofing product aging.