3M Cool Roofing Granules

California Energy Committee

PAC Meeting

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Cool Roofing Granules

3M, LBNL, and ORNL have been collaborating in the area of Cool Roofing since 1995

Why granules?

Shingle Market

- Most widespread residential roofing choice
- High consumer awareness and acceptance
- Shingle roofing costs are lower than most other alternatives

Cool Roofing Granules

- Roofing Granules
  - Weight
  - UV-Protection
  - Aesthetics
- Roofing granules comprise the vast majority of visible surface area on a shingle
- To achieve shingle reflectance values, granules must be reflective

Project Objectives

- Ultimate goal is to produce reflective granules that allow shingle manufacturers to produce reflective shingles
- The ideal way to accomplish this is to make the granules/shingles as white as possible
- For consumers, bright white shingles are not desirable aesthetically
- CEC/LBNL Program to develop cool colored roofing materials
  - Infrared reflecting pigments – absorb energy in the visible portion of the solar spectrum

Developmental Approach

- Have evaluated the following issues:

  - Pigments (loadings, IRR) – expensive!
    LBNL Pigment database
  - Coating(s)

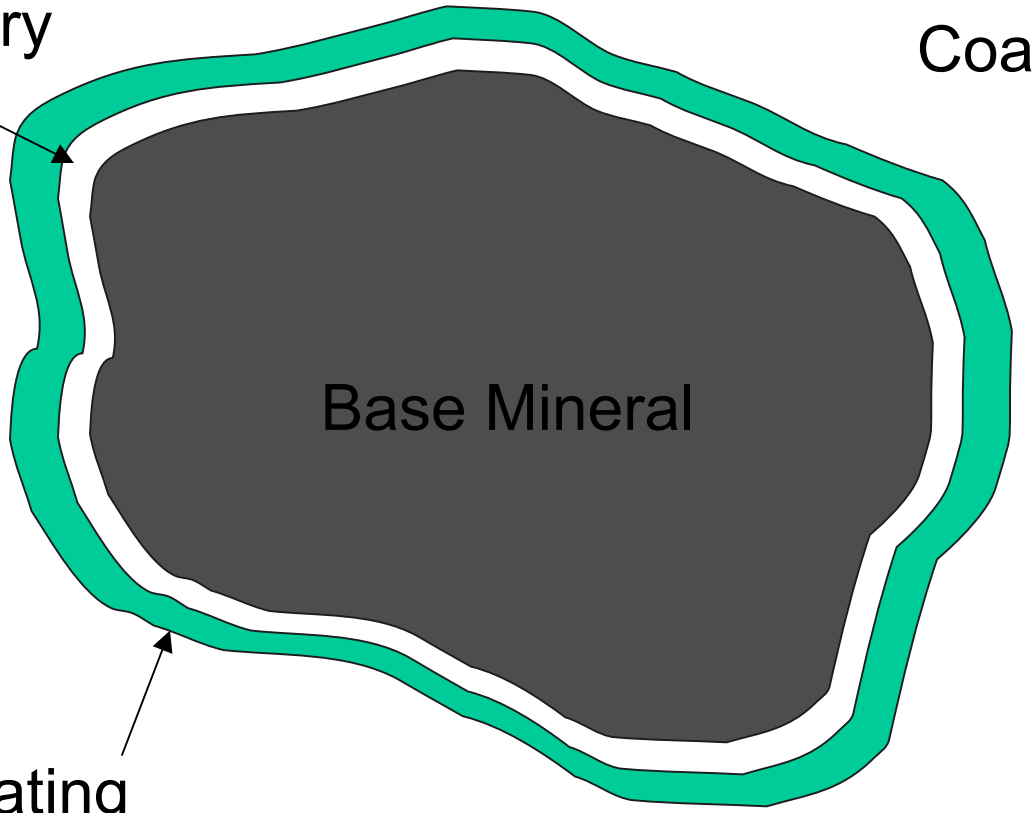
  - Asphalt Effects (~2-3% ↓)

  - Granule Grade Effects

  - Coverage Effects

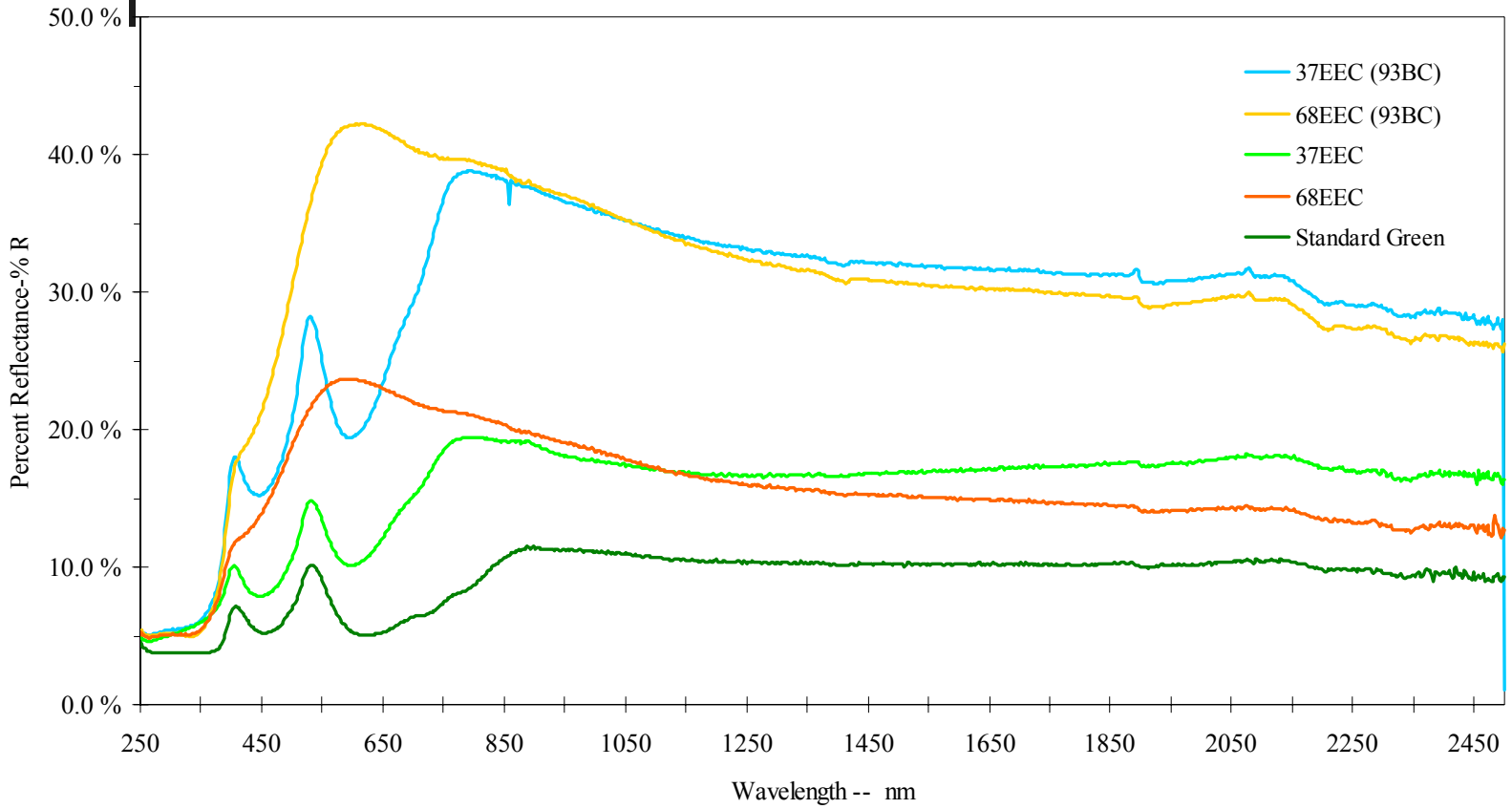
  - Post-treatment

Developmental Approach



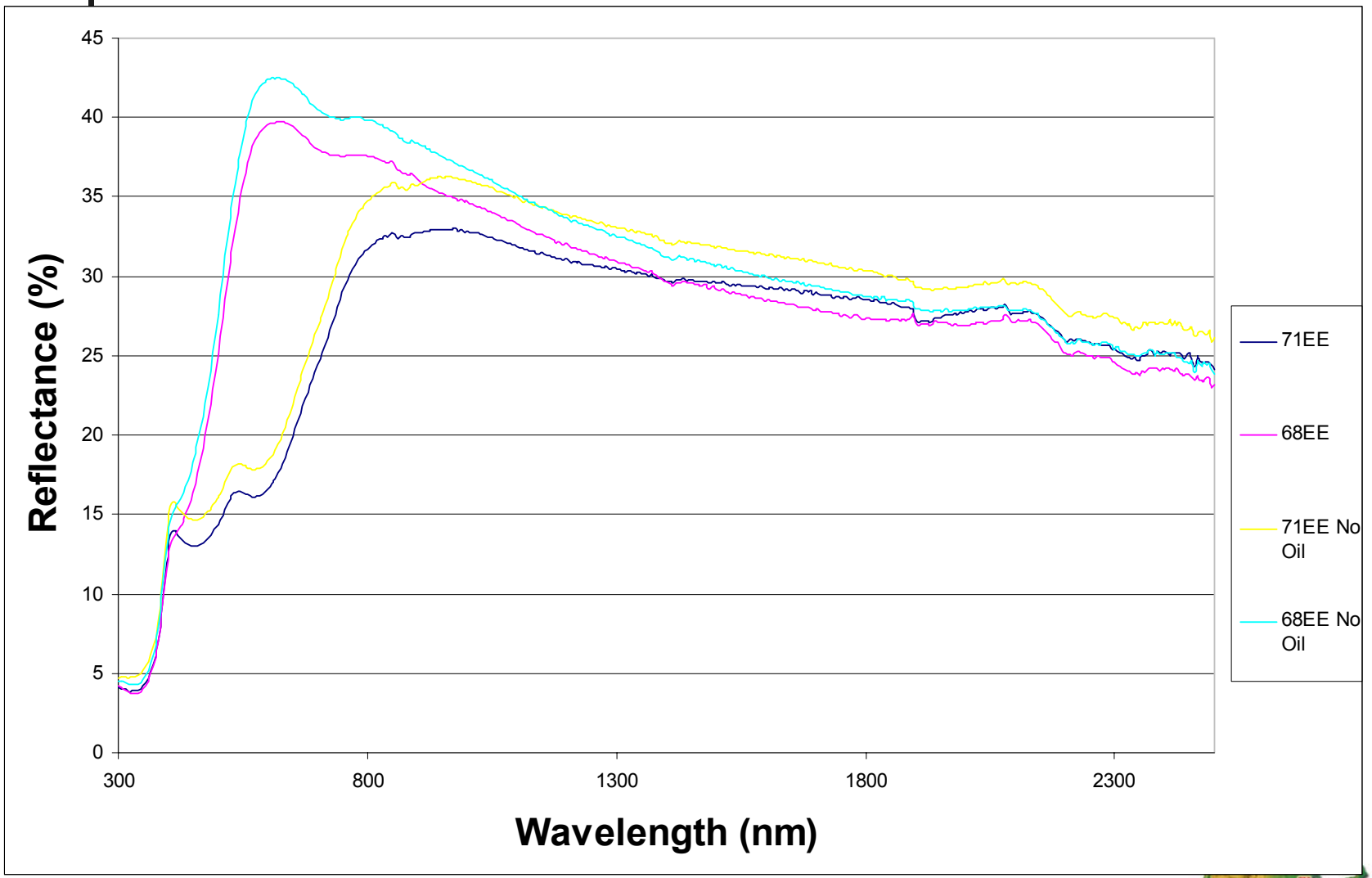
Can be manufactured w/ existing infrastructure

Reflectance Comparison



Air Mass 1.5 Hemispherical 37 Deg. Solar Reflectivities				
37EEC (White Basecoat)	37EEC (No Basecoat)	Standard Green	68 EEC 1 (White Basecoat)	68 EEC (No Basecoat)
27.92	14.48	8.17	33.84	18.54
Air Mass 1.5 Direct Normal 37 Deg Solar Reflectivities				
37EEC (White Basecoat)	37EEC (No Basecoat)	Standard Green	68 EEC 1 (White Basecoat)	68 EEC (No Basecoat)
28.98	14.98	8.45	34.44	18.66

Post-Treatment Effects



Post-Treatment Effects

Weatherometer Testing - 600 Hours

- Xenon Arc => 102 min. @ 63°C, 18min.
  light plus water spray
- QUV (Fluorescent) => 5 Hrs at 37°C, 1 Hr
  dark with condensation

Difference in Averages								
	Xenon 3-1				QUV			
Sample #	1	2	3	4	5	6	7	8
	top	top	top	top	top	top	top	top
	0.009	0.015	0.000	0.009	0.004	0.010	0.007	0.003
	bottom	bottom	bottom	bottom	bottom	bottom	bottom	bottom
	0.009	0.007	0.010	0.010	0.006	0.005	0.004	0.005
	Xenon 3-1				QUV			
Sample #	9	10	11	12	13	14	15	16
	0.007	0.007	0.005	0.008	0.006	0.008	0.009	0.008

Cool Granule Products

5 Cool Granule Colors – Solar Reflectance

Cool Tan – 32%
Cool Brown – 25%
Cool Blue Grey – 27%
Cool Grey – 27%
WA9300 White – 29%

Conclusions

- Dark mineral color and granule roughness (multiple scattering events) detracts from reflectance potential
- Multipass coatings and infrared-reflecting pigments can improve relative granule reflectances
  - Resultant granule colors not as rich as standard granules
  - Process/pigments adds significantly to the cost
- Higher reflectance values can be achieved
  - Additional cost is added
  - Aesthetics further degraded
- Continuing research to generate further advances
  - Current approach provides best balance of competing factors

Future Plans

- Future Directions
  - Optimize coating technology
  - Accelerate Agency (CRRC, Energy Star) qualifications
  - Develop relationship between granule reflectance values and ultimate shingle reflectances – coating analogy
  - Collaborate to quantify savings potentials of reflective granule/shingle products