



ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Stephen Wiel, Head
Energy Analysis Department
Environmental Energy Technologies Division

MS 90R4000
1 Cyclotron Road
Berkeley, CA 94720-8136

Tel: 510-486-5396
Fax: 510-486-6996
e-mail: Swiel@lbl.gov

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To: Chris Scruton (CEC)
From: Steve Wiel
Subject: **Cool Roof Colored Materials**: Monthly Progress Report for July 2003
CC: Hashem Akbari, Paul Berdahl, Andre Desjarlais, Bill Miller, Ronnen Levinson

A summary of the status of Tasks and Deliverables as of July 31, 2003 is presented in Attachment 1.

HIGHLIGHTS

- Painted metal and clay tile roof samples as well as the exposure rack systems have arrived at the Materials Testing at California Weathering Farms at Custom-Bilt, Steelscape, BASF, MCA, ELK, McArthur Farms and the California Irrigation Management Information System (CIMIS).
- We have characterized paint films prepared from 15 Shepherd "cool" pigments received in the form of pre-dispersed concentrates. This brings the number of single-pigment paints characterized to date to over 80.
- We have prepared and measured 1:4 and 1:9 tints (mixtures with white) of nearly all the acrylic-based paints received to date.

Tasks

- 1.1 Attend Kick-Off Meeting
This Task is completed.
- 1.2 Describe Synergistic Projects
This Task is completed.
- 2.1 Establish the Project Advisory Committee (PAC)
This Task is completed.
- 2.2 Software Standardization
(No activity.)
- 2.3 PAC Meetings
Planning for September 11, 2003 PAC meeting is started.
- 2.4 Development of Cool Colored Coatings

2.4.1 Identify and Characterize Pigments with High Solar Reflectance

We have completed (for purposes of our single-pigment-paint characterizations) the model used to compute Kubelka-Munk absorption and scattering coefficients K and S from measurements of film transmittance and film reflectances over various backgrounds. Two papers are in preparation. In the first the now-complete mathematical model is described that permits the extraction of K and S from spectrometer measurements. In the second, extensive plots of K and S are used to display the properties of a wide variety of pigments, with discussion on their applicability to cool roofing materials.

We have characterized paint films prepared from 15 Shepherd "cool" pigments received in the form of pre-dispersed concentrates (courtesy Shepherd Corporation). This brings the number of single-pigment paints characterized to date to over 80.

We have prepared and measured 1:4 and 1:9 tints (mixtures with white) of nearly all the acrylic-based paints received to date. We expect to complete tint preparation and measurement next month, at which point we will proceed to mixtures of non-white paints.

2.4.2 Develop a Computer Program for Optimal Design of Cool Coatings

See Task 2.4.1. No major activity in June.

2.4.3 Develop a Database of Cool-Colored Pigments

We started this task on July 1, 2003. We are starting by developing a format for the database, which we have prepared in draft form and will soon be soliciting industry input.

2.5 Development of Prototype Cool-Colored Roofing Materials

2.5.1 Review of Roofing Materials Manufacturing Methods

We modified the draft report based on some input comments. This report will be posted on the web.

2.5.2 Design Innovative Methods for Application of Cool Coatings to Roofing Materials (No activity.)

2.5.3 Accelerated Weathering Testing x (No activity.)

2.6 Field-Testing and Product Useful Life Testing

FERRO and Shepherd both sent representatives in July, 03 to support the Roof Tile Institute with the manufacture of cool concrete tiles. Both FERRO and Shepherd had difficulty producing the CRCM tile. ORNL personnel will visit each fence-post test site August 9 through 14 and will visit Mike Evans to discuss setup of instrumentation for the demonstration homes.

2.6.1 Building Energy-Use Measurements at California Demonstration Sites

FERRO worked with Hanson Roof Tile at the Fontana, CA plant to formulate concrete tiles with CRCMs for the demonstration houses being built in Sacramento. Applying the CRCM in a slurry coat while the tile mixture was still wet yielded significant improvement in the tile's surface reflectance. The reflectance of a standard black tile was only 5.4%, and was increased to 28% by applying a CRCM slurry coat while the concrete was still in an uncured condition. Adding the CRCM to the sand, cement, and water mixture during the manufacturing process was not as successful as anticipated. Hanson is shipping to FERRO concrete mixtures for FERRO to use in formulating a slurry coat

application that will yield reflectance boosts similar to that demonstrated at Hanson's lab. FERRO will request Hanson to use the technique for making the CRCM tiles that will be field tested on the demonstration homes.

The instrumented roof deck panels made of 5/8-in oriented strand board were shipped to Mike Evans Construction. The panels are equipped with additional thermometry for measuring surface, air gap, deck and the underside deck temperatures in the demonstration homes. Calibration of the heat flux transducers showed a slight but linear drop in sensitivity as the temperature of the OSB was increased from 40° to 120°F (i.e., temperatures typically observed by Parker in roof decks field tested at Ft. Myers, FL).

The calibration of the HFT corrects for shunting of heat flow caused by the difference in thermal conductivity of the HFT as compared to the OSB. ORNL personnel will meet with Evans on Monday, August 11 to review the placement of the panels in the demonstration homes. Placement of data acquisition equipment will follow once the homes are framed and in the dry.

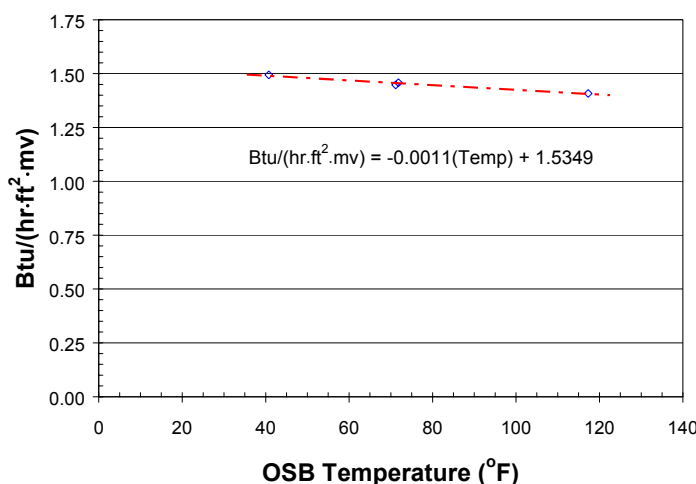


Fig. 1. Calibration of a HFT embedded in 5/8-in OSB.

2.6.2 Materials Testing at Weathering Farms in California

Shepherd Color Company sent a chemist from their technical service lab to Monierlife Tile's Rialto, CA plant to help expedite manufacture of the concrete tile samples. The results were not as successful as anticipated because the variegated colors were very difficult to match in the production process. Monierlife has shipped materials to Shepherd, and Shepherd plans to make all the samples at their facility. The Shepherd Color Company will rematch based on solid color standards that Monierlife Tile shall supply to produce the tiles.

Custom-Bilt, Steelscape, BASF, MCA, ELK, McArthur Farms and the California Irrigation Management Information System (CIMIS) sites located in Shasta and Imperial counties have received the painted metal and clay tile roof samples as well as the exposure rack systems. ORNL personnel will visit each site August 9 through 14 to check the setup of the exposure rack sets and to also install the sets at the CIMIS sites.

2.6.3 Steep-slope Assembly Testing at ORNL (No activity)

2.6.4 Product Useful Life Testing (No activity.)

2.7 Technology transfer and market plan

2.7.1 Technology Transfer
(No activity.)

2.7.2 Market Plan
(No activity.)

2.7.3 Title 24 Code Revisions
Levinson, Akbari, CEC, PG&E, Ely and Associates had many e-mail exchanges discussing and fine-tuning the details of proposed Title 24 code language for application of reflective low-sloped on non-residential buildings.

Management Issues

- None.

Attachment 1

Project Tasks and Schedules (Approved on May 16, 2002)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 07/31/2003
1	Preliminary Activities					
1.1	Attend Kick Off Meeting <i>Deliverables:</i> <ul style="list-style-type: none"> Written documentation of meeting agreements and all pertinent information (Completed) Initial schedule for the Project Advisory Committee meetings (Completed) Initial schedule for the Critical Project Reviews (Completed) 	5/16/02	5/16/02	6/1/02	6/10/02	100%
1.2	Describe Synergistic Projects <i>Deliverables:</i> <ul style="list-style-type: none"> A list of relevant on-going projects at LBNL and ORNL (Completed) 	5/1/02	2/1/02	5/1/02	5/1/02	100%
1.3	Identify Required Permits	N/A		N/A		
1.4	Obtain Required Permits	N/A		N/A		
1.5	Prepare Production Readiness Plan	N/A		N/A		
2	Technical Tasks					
2.1	Establish the project advisory committee <i>Deliverables:</i> <ul style="list-style-type: none"> Proposed Initial PAC Organization Membership List (Completed) Final Initial PAC Organization Membership List PAC Meeting Schedule (Completed) Letters of Acceptance 	6/1/02	5/17/02	9/1/02		100%
2.2	Software standardization <i>Deliverables:</i> <ul style="list-style-type: none"> When applicable, all reports will include additional file formats that will be necessary to transfer deliverables to the CEC When applicable, all reports will include lists of the computer platforms, operating systems and software required to review upcoming software deliverables 	N/A		N/A		

Project Tasks and Schedules (contd.)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 07/31/2003
2.3	PAC meetings <i>Deliverables:</i> <ul style="list-style-type: none"> Draft PAC meeting agenda(s) with back-up materials for agenda items Final PAC meeting agenda(s) with back-up materials for agenda items Schedule of Critical Project Reviews Draft PAC Meeting Summaries Final PAC Meeting Summaries 	9/1/02	6/1/02	6/1/05		33% (2/6)
2.4	Development of cool colored coatings					
2.4.1	Identify and Characterize Pigments with High Solar Reflectance <i>Deliverables:</i> <ul style="list-style-type: none"> Pigment Characterization Data Report 	6/1/02	6/1/02	12/1/04		~45%
2.4.2	Develop a Computer Program for Optimal Design of Cool Coatings <i>Deliverables:</i> <ul style="list-style-type: none"> Computer Program 	11/1/03		12/1/04		
2.4.3	Develop a Database of Cool-Colored Pigments <i>Deliverables:</i> <ul style="list-style-type: none"> Electronic-format Pigment Database 	6/1/03	7/1/03	6/1/05		< 1%
2.5	Development of prototype cool-colored roofing materials					
2.5.1	Review of Roofing Materials Manufacturing Methods <i>Deliverables:</i> <ul style="list-style-type: none"> Methods of Fabrication and Coloring Report 	6/1/02	6/1/02	6/1/03		~95%
2.5.2	Design Innovative Methods for Application of Cool Coatings to Roofing Materials <i>Deliverables:</i> <ul style="list-style-type: none"> Summary Coating Report Prototype Performance Report 	6/1/02	6/1/02	12/1/04		< 7%
2.5.3	Accelerated Weathering Testing <i>Deliverables:</i> <ul style="list-style-type: none"> Accelerated Weathering Testing Report 	11/1/02	10/1/02	6/1/05		< 5%

Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 07/31/2003
2.6	Field-testing and product useful life testing					
2.6.1	Building Energy-Use Measurements at California Demonstration Sites <i>Deliverables:</i> <ul style="list-style-type: none"> • Demonstration Site Test Plan • Test Site Report 	6/1/02	9/1/02	10/1/05		10%
2.6.2	Materials Testing at Weathering Farms in California <i>Deliverables:</i> <ul style="list-style-type: none"> • Weathering Studies Report 	6/1/02	10/1/02	10/1/05		22%
2.6.3	Step-slope Assembly Testing at ORNL <i>Deliverables:</i> <ul style="list-style-type: none"> • Whole-Building Energy Model Validation Presentation at the Pacific Coast Builders Conference • Steep Slope Assembly Test Report 	6/1/02	10/1/02	10/1/05		14%
2.6.4	Product Useful Life Testing <i>Deliverables:</i> <ul style="list-style-type: none"> • Solar Reflectance Test Report 	5/1/04		6/1/05		
2.7	Technology transfer and market plan					
2.7.1	Technology Transfer <i>Deliverables:</i> <ul style="list-style-type: none"> • Publication of results in industry magazines and refereed journal articles • Participation in buildings products exhibition, such as the PCBC Brochure summarizing research results and characterizing the benefits of cool colored roofing materials 	6/1/03	6/1/02	6/1/05		~5%
2.7.2	Market Plan <i>Deliverables:</i> <ul style="list-style-type: none"> • Market Plan(s) 	5/1/05		6/1/05		
2.7.3	Title 24 Code Revisions <i>Deliverables:</i> <ul style="list-style-type: none"> • Document coordination with Cool Roofs Rating Council in monthly progress reports • Title 24 Database 	6/1/02	5/16/02	6/1/05		~5%

Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of 07/31/2003
VII	Critical Project Review(s) <i>Deliverables:</i> <ul style="list-style-type: none"> Minutes of the CPR meeting 					
XII (C)	Monthly Progress Reports <i>Deliverables:</i> <ul style="list-style-type: none"> Monthly Progress Reports 	6/1/02	6/1/02	6/1/05		39% (14/36)
XII (D)	Final Report <i>Deliverables:</i> <ul style="list-style-type: none"> Final Report Outline Final Report 	3/1/05		10/1/05		
	Final Meeting <i>Deliverables:</i> <ul style="list-style-type: none"> Minutes of the CPR meeting 	10/15/05		10/31/05		

