PROJECT CONTRACT Nº INCO-CT-2006-031880

TERMISOL

NEW LOW-EMISSIVITY AND LONG LASTING PAINTS FOR COST EFFECTIVE SOLAR COLLECTORS

Instrument: Specific Targeted Research Project – International Cooperation

Call title: Specific Targeted Research Projects (STREP) and Coordination Actions (CA) for Mediterranean Partner Countries (MPC)

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PUBLISHABLE FINAL ACTIVITY REPORT

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Project Coordinator: Dr. Javier García Jaca

Project Coordinator organisation:

CIDEMCO Technological Research Center

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1. PUBLISHABLE EXECUTIVE SUMMARY

1.1. Project objectives

The aim of this project is to set up an improved sort of selective paints, with high photo-thermal performance in solar energy conversion, for coating solar collectors. These paints are expected to be cost-effective and competitive with actual commercial technologies and with industrial advantages making application processes easier (in basic industrial workshops at lower final costs) becoming widespread.

Solar thermal devices converting solar radiation into heat (thermal conversion) are mainly flat plate collectors. Their most important and critical part is the absorber surface which is normally very expensive and the technological treatments are mainly based on the application of heavy metals.

The new paints that are going to be developed within this project will provide surfaces with structured surface morphology, at defined thickness ranges by control application methods and combining multilayer paint systems to adjust the performance of the whole system. The project considers the development of a low cost technology applicable everywhere but specially suited for their implementation in Mediterranean countries where there are optimal solar irradiation conditions and there is a growing demand of energy infrastructures and uses, taking into account the specific needs of remote places, rural areas, villages… and supply the basic necessities of water heating of general buildings such as hospitals or hotels.

- Regarding to standard solar black paints they will solve their main drawbacks:
    - high efficient energy outputs by optimising their photo-thermal properties;
    - high durability and service-life by adequate election of components and innovative formulations.
- Regarding to the conventional inorganic selective surfaces:
    - Use of easy application methods for widespread in small workshops;
    - Make the technology cost-effective reducing manufacturing costs, avoiding expensive methods only affordable with high investments;
    - No use of heavy metals;
    - Low energy cost manufacture and application process.

1.2. Partners

Partner role	Partner nº	Partner name	Partner short name	Country
CO	1	Cidemco, Centro Tecnológico	CIDEMCO	SPAIN
CR	2	Alexandria University	IGSR	EGYPT
CR	3	Centre des Techniques et de Matériaux de Construction	CETEMCO	MOROCCO
CR	4	Tunis Internat. Center for Environmental Technologies	CITET	TUNISIA
CR	5	Institute of chemistry and Technology on Polymers – National Research Council	ICTP	ITALY
CR	6	Isotest Engineering S.R.L.	ISOTEST	ITALY
CR	7	Pinturas Oropal	OROPAL	SPAIN
CR	8	Technichal Solar Systems SILVASOL	SILVASOL	SPAIN
CR	9	Solar Energy System	SES	TUNISIA
CR	10	Energy Systems and Environmental Research	TUBITAK-MRC-ESERI	TURKEY
CR	11	Société de peintures VALENTINE	CAP VALENTINE	TUNISIA
CR	12	Universidad de Cádiz	UCA	SPAIN

1.3. Coordinator contact details

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1.4. Work performed

The aim of the TERMISOL project is the preparation and characterization of a new class of cost effective and eco-friendly selective paint for coating solar collectors. The project addresses scientific and engineering expertise in sol-gel processes, analysis of polymeric materials and construction & study of performance of solar collectors.

During the 40 months of the project, several sol gel-based and silicone-based formulations have been developed and compared. Type and content of sol-gel precursors and pigments as well as final thickness of the coatings have been the most critical aspects of such development. Therefore, the formulation activities have been focused on the selection of adequate raw materials, the dispersion of the pigment and the search of application methods that allow low thickness of the coatings.

The different formulations have been characterized by means of optical characterization and physico-chemical characterization. For solar thermal applications there are two important radiation wavelengths that have been taken into account: solar absorptance (α) and infrared thermal emissivity (ε). These two parameters have been calculated from the measurement of other related parameter, the reflectance. Moreover, adhesion of the coatings is another key property that has been studied. The

results obtained allowed to discard some of the selected pigments and precursors and also demonstrate the influence of thickness on the optical and physical properties of the coatings.

One of the main objectives of the project is the development of coatings with improved durability compared to commercial selective silicone-based paints. Therefore, a second part of the work carried out in TERMISOL project has focused on the artificial ageing of the best coatings and the study of the durability of their optical, thermal and mechanical properties after such ageing that included, mainly, thermal weathering, weathering with UV lamps and weathering in condensation and corrosion conditions. The obtained results revealed the most important feature of the developed products: sol-gel coatings show an improved ageing resistance compared to commercial silicone-based paints. Although absorptance and adhesion properties are similar after ageing, thermal emissivity increases slightly in the case of sol-gel coatings and significantly in the case of commercial silicone-based paints. This increase of emissivity means a loss of efficiency of the solar collector which will be higher in the case of using silicone-based coatings.

Finally, a real scale sol-gel based prototype has been fabricated with the best sol-gel formulation. Special care has been taken in achieving the fixed conditions found as optimal such us thickness. Both the theoretical analysis and real performance of such prototype have been studied by means of efficiency tests that consider parameters such us the fluid energy inlet and outlet, the collector energy yield and the energy that can be obtained from the collector. Besides this, field tests are on going to validate the efficiency of the system.

Concerning the dissemination and management activities, press notes in printed journals can be highlighted (Infocidemco, Le Matin, The Parliament Magazine, Al-Akhbar) as well as press notes in internet web sites (Infomagazine, Ikerbasque) or TV interviews (Alexandria local TV). The website of the project has been updated during the project: http://www.cidemco.es/termisol/

Other dissemination activities include elaboration of posters and brochures for fairs (Fair of the Solar Energy, Green Ifiquiya, Salon international des énergies renouveables ENERGAÏA, 20th World Energy Congress & Exhibition, Batimat, Energaia, Genera, Innovation and Technology Transfer to the Egyptian Industry, , XI Congreso Nacional de Propiedades Mecánicas de Sólidos, Expoquimia, Congress on Renewable Energies, Conference on Biological Hydrogen and Renewable Energies, Medibat, Expoajjuntament, JITH, Construmat, Intersolar, Environtec, Eurocoat, Egética, RCREEE, Polychar, Hamburg, ClimExpo, Ecomed, Green Africa, SIEMAP…).

Two public workshops were organised about the applications of solar energy: the first one was organised after the 24 months meeting in the University of Alexandria (Egypt) and the second and lat one after the final meeting in the University of Cádiz (Spain). There lecturers coming from both inside and outside the Consortium gave conferences about the applications of the solar collectors and photovoltaic cells.

The management of the project has been carried out by strictly keeping in contact the partners with the coordinator. All the partners have been involved in the main strategic and executive decisions. The Kick-off meeting was organised on 15th November 2006 at CIDEMCO's facilities (Azpeitia, Spain); the 6 months meeting was held on 20th April 2007 at ICTP in Pozzuoli (Italy); the 12 months meeting of the project was organised on 18-19th October 2007 in Tunis (Tunisia) and hosted by CITET, CAP and SES; the 18 months meeting was hosted on 3rd-4th April 2008 by CETEMCO in Casablanca and Marrakech (Morocco); the 24 months meeting and workshop was held in the Alexandria University on 13-15th October 2008; the 30 months meeting was held on

12th March 2009 at TUBITAK facilities in Istanbul (Turkey); and the final meeting and public workshop was held on 27-28th January 2010 in the University of Cádiz (Spain).