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Solar Thermal Components
A Bibliography with Abstracts
Quarterly Update, April-June 1979

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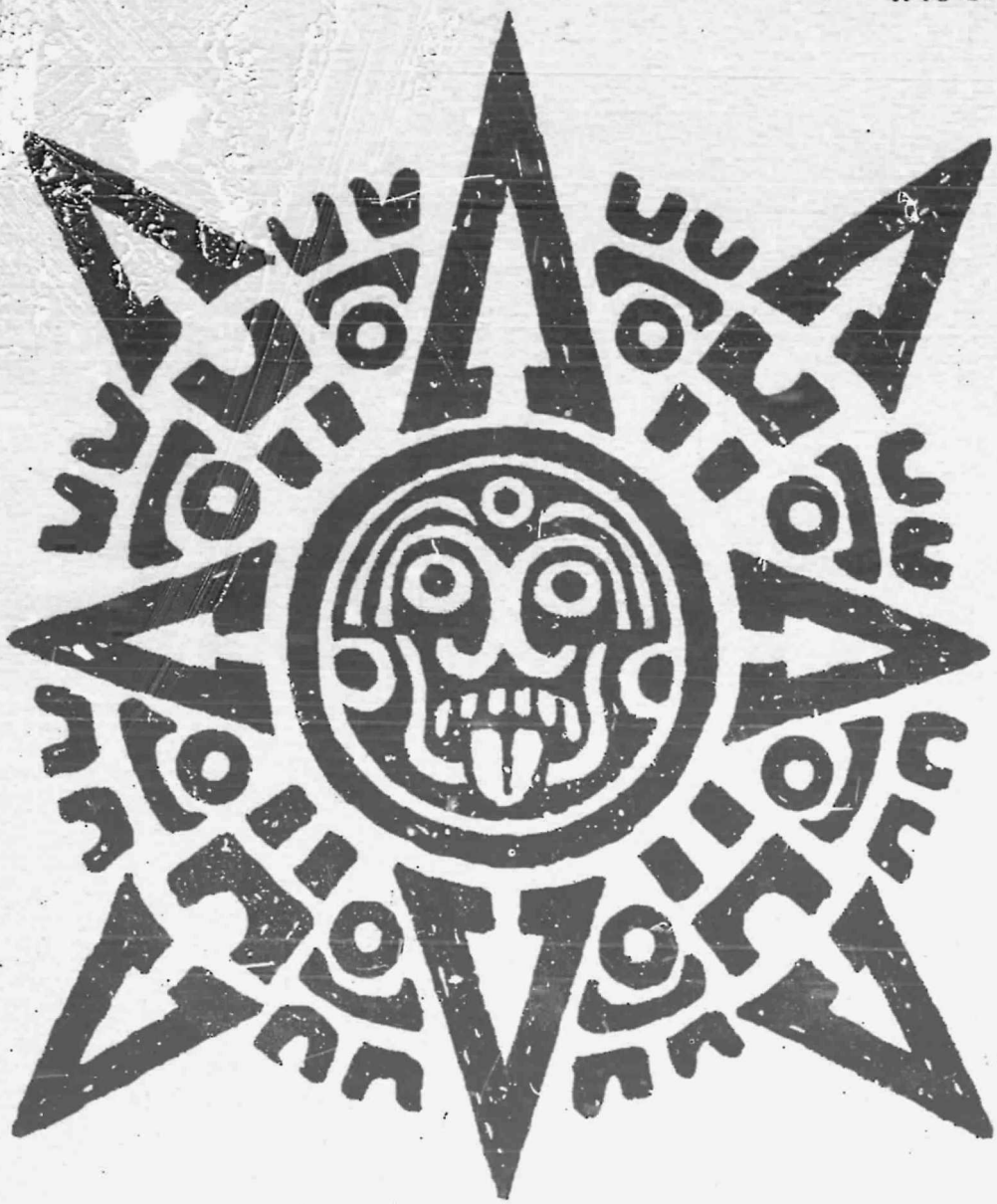

Solar Thermal Components

Quarterly Update April-June 1979

TECHNOLOGY APPLICATION CENTER
THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO 87131

NASA

SOLAR THERMAL COMPONENTS

A BIBLIOGRAPHY WITH ABSTRACTS

QUARTERLY UPDATE APRIL-JUNE 1979

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OF THE

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THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO

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INTRODUCTION

The Materials Properties section has some interesting citations on the optical properties of selective surfaces where two or more materials are deposited, sometimes in alternate layers. These materials are chosen on the basis of their optical indices and other optical properties in order to maximize the absorption and minimize emission (20028), (20039), (20042), (20046), (20047), (20052), (20053), (20054), (20064), (20068), (20069), (20072), (20075), (20078), (20079).

Industrial and agricultural uses of solar energy for drying products and for heating water and steam are continuing to increase. Large potential savings of oil and gas are possible by the use of these methods (28,000, Process Heat section).

William R. Bozman
Co-Editor

GUIDE TO USE OF THIS PUBLICATION

A number of features have been incorporated to help the reader use this document. They consist of:

-- A TABLE OF CONTENTS; listing general categories of subject content and indexes. More specific coverage by subject keyword and author is available through the appropriate index.

-- CITATION NUMBERS assigned to each reference. These numbers, with the prefix omitted, are used to identify references found in the indexes. They are used as TAC identifier numbers when dealing with document order, so please use the entire (prefix included) citation number when corresponding with TAC. An open ended numbering system allows for easy incorporation of subsequent updates in this system, and numbers assigned to new citations will follow directly the last assigned numbers in the previous issue. Citation number of the last reference on each page appears in the upper right-hand corner to facilitate quick location of a specific article.

-- A REFERENCE FORMAT; containing the TAC citation number, title of reference, author, corporate affiliation, reference source, and abstract. The reference source tells, to the best of our knowledge, where the reference came from. If from a periodical, the reference source contains its title, volume, page number and date.

-- An INDEX OF AUTHORS; alphabetized by author's last name, followed by the reference citation number. For multiple authors, each one is indexed.

-- An INDEX OF KEYWORDS affords access to each citation through an assigned set of descriptive terms. All words pertaining to a reference are permuted alphabetically and the corresponding citation numbers appear as many times as there are keywords. These permuted keywords run down the center of an index page, while the remaining keywords are clustered adjacently. A "#" indicates the end of a set of keywords, while a "/" indicates where a set has been cut off within the line due to overflow.

-- A LIST OF ABBREVIATIONS used in describing frequently occurring titles or corporate sources.

CONTENTS

20,000 MATERIAL PROPERTIES

ST79 20028 Chlorite Oxidized Copper: A Selective Absorber Surface for Solar Energy Collection

Uppsala Univ., Fysiska Inst., Uppsala, Sweden
Avail:NTIS, UPTEC-78-39-R p. 23 April 1978

The optical properties of chlorite-oxidized copper surfaces have been investigated. Values of the specular reflectance are reported in the wavelength interval 0.35 μm to 14 mum and of the angular hemispherical reflectance in the interval 0.35 μm to 1.1 μm. Scanning electron microscope pictures show that it is possible to relate changes in the reflectance to observable changes in the surface structure of differently treated samples. Powder x-ray diffraction shows that Cu_2O is the clearly dominating constituent of the surface layer. Values of the solar absorptance α and the thermal emittance ε are reported for samples treated at 55 C, 60 C, and 65 C. The results show that it should be possible to control the oxidation process to give α similarly ordered 0.90 and ε = 0.10 to 0.15. The results also give good reasons to believe that it is possible to further increase the capacity of this surface by a more detailed study of the growth process of the oxide crystals on different types of copper substrates.

ST79 20029 Colored Stainless Steel as Selective Absorber

Uppsala Univ., Fysiska Inst., Uppsala, Sweden
Avail:NTIS, UPTEC-78-38 p. 10 April 1978

Specular reflectances for four differently colored stainless steel samples are reported. The integrated solar absorptance and thermal emittance have been calculated. It is pointed out that the material shows a considerable selectivity. Further optimization of these surfaces might make them strong candidates for solar thermal converters.

ST79 20030 Covering Transparent to Light for Solar Energy Flat Collectors

German Patent no. 2,622,718/A
p. 11 Dec. 1, 1977 In German

A covering transparent to light for solar collectors is described, which fulfills the requirement for being weather resistant with the lowest possible weight, and further, offers the possibility of achieving a relatively optimal thermal slot effect of the solar collectors by matching to the existing weather conditions and operating conditions. The covering consists of a combination of a weather resistant outer covering with a relatively flexible and light inner covering which can be rolled up. The outer covering consists of a glass plate or plastic plate, but the inner covering consists of a thin plastic foil. The inner covering is preferably constructed like a sun roller blind which can be drawn out and wound up on its own.

ST79 20031 Doing It The Chemical Way

Chem. Weekly V 121 No. 14 p. 44-45,47 Oct. 1977

Chemical heat storage for residential heating and cooling systems is discussed in this article. Various companies are studying the different forms of chemical heat storage. Energy density is an important factor in the design of these storage mediums. Requirements included for the heat storage chemicals include: high heat density, high heat of fusion, low cost, low volatility, and low toxicity. GE researchers are using a drum-shaped device to deal with the problem of incongruent melting in hydrated salts. ERDA has given a grant to Dow Chemical to study the use of calcium chloride as a heat storage material. Metal hydrides are also being considered by Argonne National Laboratory Laboratories and Allied Chemical. Allied recently received a patent on its metal hydride storage work. Other reactions under study indicate Monsanto's Dayton, Ohio laboratory studying the decomposition of sodium pyrosulfate, University of California's study of sulfur trioxide, and at the University of Georgia, the conversion of the hydrocarbon nobornadine into an isomer.

ST79 20032 Final Report on MSFC Assessment of Owens-Illinois Sunpak Collector Problems

NASA, Marshall Space Flight Center, Huntsville, AL
Avail:NTIS, DOE/NASA/TM-78179 p. 62 July 1978

Marshall Space Flight Center (MSFC) conducted an in-depth assessment of problems encountered with the Owens-Illinois Sunpak liquid evacuated tube solar collector installed in several ERDA solar system demonstration sites. The assessment included analysis and independent tests of the collector in the MSFC solar simulator where the system failure conditions were duplicated. The assessment showed the basic design of the Sunpak collector to be sound; however, material limitations dictate that near-term applications constraints be recognized by system designers. Subsequent retrofit activity by Owens-Illinois appears to have been effective in demonstrating the integrity of the Sunpak collector.

ST79 20033 Hazardous Properties and Environmental Effects of Materials Used in Solar Heating and Cooling (SHAC) Technologies: Interim Handbook

Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-78-0842 p. 226 Aug. 1978

General background information related to SHAC systems, how a particular material was chosen for this handbook, and codes and standards are given. The following are included: classification scheme and general properties of materials used in SHAC systems; chemical composition, thermal degradation products, and thermoxidative products; toxic properties and other potential health effects of SHAC materials; fire hazard properties of SHAC materials; and environmental effects of and disposal methods for SHAC materials. Each chapter begins with a general discussion of the properties considered in that chapter, discusses the properties of specific categories of materials, and includes available data in tabular form with discussion of a specific category. Materials are categorized according to their functional use in SHAC systems as follows: heat transfer fluids and fluid treatment chemicals; insulation materials; seals and sealant materials; glazing materials; collector materials; and storage media.

ST79 20034 Heat Insulator

US Patent no. 4,084,574
Avail:Patent Office p. 4 June 30, 1975

A solar radiation absorber has absorbing means within a gas-filled housing and an overlying radiation transparent plate spaced therefrom. Ribbons of thin material are disposed between the absorbing means and the plate to restrict convective heat losses.

ST79 20035 Investigation of Reflective Solar Control Films for Windows, Special Report

Army Construction Engng. Res. Lab., Champaign, IL
Avail:NTIS, AD-A-056620, CERL-SR-M-240 p. 85 June 1978

This report presents the results of a study of flexible solar conttol film applied on windows to eliminate or reduce glare and solar heat, and to conserve energy. Four manufacturers' films were investigated by surveying users in 15 areas of the United States, visiting selected installations, and conducting a laboratory evaluation of film/glass samples. In addition, solar radiation heat balance profiles were developed to indicate the solar heat gain through clear glass with and without solar film. A computer heating and cooling load and systems simulation program was run on a typical 72-man barracks module. Annual heating and cooling loads and costs and the related life-cycle cost (LCC) for the barracks module were computed for several types of window glass, solar film on clear glass, and interior shading.

ST79 20036 Large Solar Domestic Hot Water Heating System Employs New Synthetic Heat Transfer Fluid

Bldg. Systems Des. V 75 No. 1 p. 13-16 1977

A residence for senior citizens in Washington, D.C. features a solar hot water system and a new synthetic fluid for heat transfer. The system is designed to furnish 65 percent of the energy used for water heating. Twenty-five hundred ft^2 of solar panels and a 3200-gallon water storage tank are located on the roof of the ten-story building. All the solar components are commercially available. The heat transfer fluid (Brayco no. 888) was selected because it can withstand temperature extremes, is nontoxic and noncorrosive, and is compatible with the other construction materials. Comparisons with other fluids are

summarized in a table. The Department of Housing and Urban Development and the general contractor, Forest City Dillon, Inc. of Cleveland, Ohio shared the design and construction costs of the solar system.

ST79 20037 Owens-Illinois Liquid Solar Collector Materials Assessment

NASA, Marshall Space Flight Center, Huntsville, AL
Avail:NTIS, DOE/NASA/TM-78163 p. 36 March 1978

The Marshall Space Flight Center (MSFC) was requested by the Energy Research and Development Agency (ERDA) to assess the general suitability of the design and materials and to investigate certain failure modes of the Owens-Illinois (O-I) Sunpak Solar Energy Collector System. The primary problem was the violent fracture of collector tubes, with attendant scattering of glass fragments, under boilout conditions. The data and information generated during the materials analysis segment of this effort are presented. These data were obtained during pressure testing of the individual tubes, performance testing of a complete array of tubes on the MSFC solar simulator apparatus, and in other investigations as noted. The information herein represents only the data directly associated with materials analysis and is not a comprehensive presentation of all the data compiled during the MSFC test program.

ST79 20038 Reusable Solar Control Film and Method of Making

Minnesota Mining and Mfg. Co.
US Patent no. 4,095,013
Avail:Patent Office p. 10 May 16, 1977

Solar control film is described which incorporates a "cling" adhesive layer so that it can be repeatedly applied to and removed from a window pane. The adhesive layer is obtained by coating a solvent-soluble vinyl chloride or vinylidene chloride copolymer containing a vinyl stabilizer, a tack-inhibiting polymeric modifier, and a plasticizer for vinyl resins.

ST79 20039 Selective Radiation Absorption Devices for Producing Heat Energy

Perkin-Elmer Corp.
US Patent no. 4,082, 413
Avail:Patent Office p. 6 Jan. 2, 1976

A device for absorption of selected radiation wavelengths, such as solar radiation, for producing heat energy consists essentially of a single film or layer of a mixture of metal particles and a dielectric material coated on a supporting substrate of either metal or glass. The metal and dielectric concentration varies in a gradual transition from a major portion up to 100 percent of metal at one boundary surface to a major portion up to 100 percent of dielectric at the opposite boundary surface. There are no interior boundaries in the film. Dielectric materials and metals adapted for solar radiation absorption over a broad band of wavelengths, on the order of from 0.35 to 1.5 micrometers are used to provide good mechanical and radiation stability at high temperatures, up to temperatures on the order of 450 C, in air or in a vacuum. Heat building up in the film as radiation is absorbed and withdrawn for use or storage by heat transfer.

ST79 20040 Solar Energy Absorber

Hercules, Inc.
US Patent no. 4,065,592
Avail:Patent Office p. 10 April 14, 1976

An improved solar energy absorber is provided in which the absorber surface is prepared from fibers having free ends which are tapered and coated with a low emissivity material. The fibers are straight, aligned in a parallel relationship and have diameters of from about 4 to 100 micrometers. The fibers are spaced together very tightly so that the distance between adjacent fibers is from about 1 to 10 micrometers. The fiber surface presents an improved solar trap for absorbing solar energy.

ST79 20041 Solar Energy Absorber and Method of Production

Sekisui Chemical Co., Ltd., Osaka, Japan
German (FRG) Patent no. 2,718,288/A p. 21 Nov. 3, 1977 In German

A solar energy absorber is described which consists of a metallic copper or copper alloy substrate with a black or dark brown copper oxide surface coating. The surface coating is obtained by treating the substrate surface with an aqueous alkaline solution which contains a peroxysulfuric acid or an inorganic peroxysulfate. The chemical process methodology is described.

ST79 20042 Some Experimental Results on Selective Absorbing Surfaces for Low-Temperature Solar Collectors

DOE, Washington, D.C., Office of NEPA Coordination
Avail:NTIS, N78014686, DLR-FB-77-23 p. 50 May 27, 1977

The efficiency of a flat-plate solar collector can be greatly enhanced by the use of a selectively absorbing layer, that is, a surface with high absorptance for the solar spectrum and low emittance for thermal radiation. From various methods known from the literature for realizing coatings with these properties, the process of electroplating selective black nickel coatings was chosen and studied in detail. One result of this investigation was that the effectiveness of these layers results from optical interference. With the production of black nickel two-layer coatings on a copper substrate, one obtains surfaces with an absorptance as high as 0.95, when weighted with the terrestrial solar spectrum. The simultaneous emittance is in the order of 0.05. The superiority of absorber plates with such values, in comparison with nonselective solar collectors, is outlined using the results of a numerical calculation.

ST79 20043 Status Report on the Direct Absorption Receiver

Sandia Labs., Livermore, CA
Avail:NTIS, SAND-78-8702 p. 17 July 1978

A novel receiver concept is described in which concentrated solar energy is absorbed directly in a black high-temperature heat transport fluid. Advantages and disadvantages of the method are reviewed, and a summary is presented of the results of investigations on materials stability and corrosion, fluid flow, absorption characteristics, wind effects, and various design studies. Also described are recent high solar flux tests in which levels exceeding 6 MW/m^2 were directly absorbed in the fluid.

ST79 20044 Sun Screen Structure

Bell Telephone Labs., Inc.
US Patent no. 4,089,594
Avail:Patent Office p. 6 June 13, 1977

A sunscreen structure is disclosed which consists of a covering for external building surfaces that reflect sunlight during summer months and admit it during winter months to help stabilize internal building temperatures. The covering consists of a planar array of short focal length optical lenses. A pattern of light-reflective and light-transmissive surfaces is located at the focal plane of each lens in the array. The lenses project the rays of the sun onto the reflective or transmissive surfaces, depending on the angle of elevation of the rays with respect to the horizon. The reflective surfaces are located so that the rays are reflected away from the building during the summer months. The transmissive surfaces are located so that the rays are transmitted towards the building interior during the winter months.

ST79 20045 Symposium on Films for Solar Energy, Yorkville Heights, New York

J. Vac. Sci. Tech. V 12 No. 5 p. 70-76 1975

The following topics were dealt with: photothermal and photovoltaic conversion systems; solar concentrators; optical coatings; Si and GaAs solar cells; fabrication techniques; and costs.

ST79 20046 The Solar Key Word is Often Coatings

Opt. Spectra V 12 No. 4 p. 36-39 April 1978

The desired characteristics of coatings that can be used in photothermal applications are reviewed. There is a certain amount of energy in sunlight. Solar collector systems can harvest a limited amount of energy from that sunlight. However, types of coatings applied to the solar collector systems can allow them to harvest increased amounts of that energy. Surface techniques and the chemicals used are briefly described so as to provide examples of spectral reflectance, transmission, and absorption. Formulae, graphs, and sketches illustrate the functional relationships of optical light wavelengths vs. absorptivity/emissivity or heat harvest/reflectivity factors. Though solar collectors at large are discussed, mirrors, particular metals, and certain coatings are given additional attention.

ST79 20047 Improvements in the Design of Solar Selective Thin Film Absorbers

Botten, L.C.; Ritchie, I.T.
Univ. of Tasmania, Hobart, Australia
Opt. Commun. V 23 No. 3 p. 421-426 Dec. 1977

Surface roughening and refractive index grading are shown to be capable of improving the solar absorptance of thin films. Both methods can eliminate undesirable interference features but do so by vastly dissimilar mechanisms. Improvements in the integrated absorptance in excess of 10 percent have been achieved.

ST79 20048 Silicone Sealants for Solar Energy Systems

Brady, S.A.
Dow Corning Corp., Midland, MI
Adhes. Age V 20 No. 11 p. 36-38 Nov. 1977

This article covers the use of silicone sealants in flat-plate solar energy collectors, passive solar architecture, solar concentrators, and photovoltaic solar arrays and discusses their flexibility and adhesion despite constant moisture, UV radiation, and thermal cycling.

ST79 20049 Studies Into Reduction of Radiative Heat Losses of Flat-Plate Solar Collectors

Brennecke, P.; Justi, E.
Technische Univ., Braunschweig, Germany
Comples-Rev. Int. Heliotech. p. 18-24 1976

A report is given on investigations into optimization of flat-plate solar collectors for production of warm water by minimizing the various heat losses, especially radiative ones. Selective covers have been measured as commercial silicate glass, methacrylic acid methylester polymerisate glass ("plexi-glass" or "lucite"), and organic ETFE (ethylene tetrafluor ethylene polymerisate, "hostaflon") foils, or combinations of them. The results of thermal measurements are discussed in terms of the carefully determined absorption spectra between 0.23 and 30 mum wavelength. Most attractive seems to be the transmission spectrum of acryl-glasses because it approaches best the ideal slope of the cutoff curve. However, this organic material is not useful in practice because it becomes soft at about 85 C already and because it loses its transparence by formation of fine hair cracks after about some weeks of thermalcycles. Nevertheless, plexi-glass is commercially available in the form of flat sheets with integral flow passages enabling thermostatic temperature control by circulation of fluids, especially pure water. In this way the theoretical expectation could be verified that the radiative heat loss of such covers by infrared dipole radiation may be reduced appreciably by cooling them down to ambient temperature, and that the maximum adiabatic temperature increase is improved by this method.

ST79 20050 Solar Absorber Plate Materials: Questions and Answers

Butt, S.H.; Popplewell, J.M.
Solar Age V 2 No. 5 p. 9-11 May 1977

Corrosion and mechanical failure problems typical for four metals used as solar absorbers are discussed in a question/answer format. Corrosion protection considerations for each metal for different solar collector conditions and choices of coolants are presented. Typical mechanical failure problems of absorber metals under collector stagnation conditions are briefly described. Some guidelines for solution of coolant fluids and anti-freeze additives are suggested.

ST79 20051 Solar Absorber Plate Materials: Aluminum

Byrne, S.C.
Solar Age V 2 No. 5 p. 19-21,30-31 May 1977

Advantages of use of aluminum as a solar absorber material for flat-plate collectors are briefly discussed, and an extensive review of guidelines for compatible application of aluminum in conjunction with water heat transfer solutions is presented. Corrosion and corrosion protection are emphasized. Preferred alloys are suggested. Effects of water solution pH, temperature, chloride content, dissolved metals and solids content, and flow velocity, and corrosion inhibitors on corrosion resistance of aluminum are discussed.

ST79 20052 Correlation Between Optical Properties and Chemical/Metallurgical Constitution of Cr_2O_3/Cr Thin Films

Chang, R.; Hall, W.F.
Rockwell Int. Corp., Thousand Oaks, CA
AIP (Am. Inst. Phys.) Conf. Proc. Electrical Transport and Opt. Properties of Inhom. Media
CONF-770925 p. 305-310 Sept. 7, 1977 No. 40 Columbus, OH

A theoretical model correlating the optical properties and chemical/metallurgical constitution of Cr_2O_3/Cr thin films for solar thermal applications is outlined. Preliminary results of comparison of calculated and experimental optical properties via the proposed approach are encouraging. It should be possible to synthesize in the computer dielectric/metal composite films of optimum thickness, composition, and composition gradient for the best selectivity in solar thermal applications and to confirm the theoretical prediction by means of directed experimental film processing and property evaluations.

ST79 20053 Optical Properties of Selectively Absorbing Metal Insulator Composite Films

Craighead, H.G.; Buhrman, R.A.
School of Applied and Engng. Phys. and Materials, Science Center, Cornell Univ., Ithaca, NY
J. Vac. Sci. Tech. V 15 No. 2 p. 269-271 March 1978

The optical properties of Ni/Al_2O_3, V/Al_2O_3, V/SiO_2, V/MgO, Fe/Al_2O_3, and Fe/MgO composite films have been studied with consideration given to their applicability as selective solar energy absorbers. Thin films were produced by coevaporation and the microstructure examined by electron microscopy. The optical properties of Ni/Al_2O_3 composites, measured over the range of the solar spectrum, are in good accord with the predictions of Maxwell-Garnett theory, provided the Ni volume fraction is $< \text{or} = 0.2$. The Ni/Al_2O_3 films have excellent spectral selectivity for the absorption of solar radiation with a solar absorptivity of 0.94 obtained for a film produced with a graded composition. Low-temperature emissivities of approximately 0.1 have been obtained for Ni/Al_2O_3 on a highly reflecting metal backing. The composite Ni/Al_2O_3 is stable at high temperatures in air. The V and Fe composite studies have optical properties different in character from the predictions of Maxwell-Garnett theory and are not as suitable for solar energy applications as Ni composites.

ST79 20054 Conformal Antireflective Coatings on a Textured Tungsten Surface

Distefano, T.H.; Pettit, G.D.; Woodall, J.M.; Cuomo, J.J.
IBM T. J. Watson Res. Center, Yorktown Heights, NY
Appl. Phys. Lett. V 32 No. 10 p. 676-678 May 15, 1978

A conformal antireflective coating of WO_3 on a textured tungsten surface is found to significantly increase the optical absorptance of the surface over a broad selected band of wavelengths. The coating enhances the selectivity of solar absorbing surfaces on dendritic tungsten and increases the solar absorptance of such surfaces. The average solar absorptance measured at air mass 2 was increased from 0.95 to 0.985 for large dendrite surfaces and from 0.76 to 0.90 for small dendrite surfaces. Emittance values for the anodized surfaces at 300 C range from 0.18 for the small dendrites to 0.5 for the larger dendrites. The WO_3 conformal coating, produced by anodization of the tungsten, forms an antireflective coating with a minimum at a wavelength between 0.43 and 0.8 μm for anodization voltages between 20 and 40 V, respectively. Total reflectances as low as 0.00025 have been measured.

ST79 20055 Use of Porcelain Enamels on Solar Heating and Cooling Equipment

Eppler, R.
Ceram. Inc., Chicago, IL V 108 No. 3 p.26-28 March 1977

Porcelain can be used as durable coatings for hot water collection and storage needs as well as the absorbing surafaces of the solar collector. For absorptive coatings, the porcelain enamels should have high absorbance, low emittance, and high durability. Black porcelain enamels are being considered because of their emissivity/absorptivity ratio. The black porcelain enamels have proven equivalent in performance to black paints and somewhat less than black chrome. Several porcelain weatherability tests were conducted by the Porcelain Enamel Institute Association at the National Bureau of Standards. With the exception of constant salt spray, black porcelain enamels showed barely noticeable color changes after 15 years. Coatings must be free of metal defects and pass the ASTM and PEI tests for continuity of coating.

ST79 20056 Anti-Loss Cellular Structure: Association With a Selective Surface

Gallet, P.; Ropke, A.; Papini, F.; Pasquetti, R.
Universite de Provence, Marseille, France
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 209-218 March 1, 1976 In French

To reduce thermal losses of a solar radiation absorber, hot selective surface or honeycomb structures can be used; the last device has the advantage of reducing both radiative and convective losses of the covered surface. Combination of honeycomb structures and selective surfaces are presented. First, results obtained for absorption and emission index are given, for a system comprising a metallic substrate covered with two thin layers, one being lead sulfide and the other zinc sulfide. Then, changes in these results are discussed when the system is covered with honeycomb structures. Until now the antiradiating properties of honeycomb structures were studied assuming that the walls were presenting, among others, the two following properties: (1)they were perfectly absorbing for radiation emitted by the flat-plate collector, and (2)they were transparent for the incoming radiation from the sun. These assumptions are no longer sufficient when the temperature of the plate has values relatively high (> 200 C). The cut off wavelength of the wall material spectral properties is to be considered.

ST79 20057 Anti-Loss Cellular Structure: Effect of the Cutoff Wavelength of the Material

Gallet, P.; Ropke, A.
Univ. de Provence, Marseille, France
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 219-222 March 1, 1976 In French

A method for calculating the reduction factor of radiative losses from honeycomb structures for solar absorbers is presented. The method takes into account the cutoff wavelength of the wall material spectral properties. The data are then applied to a special case.

ST79 20058 Weather-Testing of Solar Utilization Materials

Gilligan, J.E.; Brzuskiewicz, J.; Gaumer, S.J.
IIT Res. Inst., Chicago, IL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.15-5.31 Sept. 26, 1977

A program of research and experimental testing is described in which the optical and mechanical performance of materials for use in solar energy utilization devices is determined before and after exposure to outdoor weathering tests. Materials which are currently in use and others which are being considered or developed for these applications are being exposed to outdoor weathering in Phoenix, Arizona; Miami, Florida; and Chicago, Illinois. The results of these tests, primarily the effects of outdoor exposure on optical and physical properties, will ultimately be compiled in a handbook, along with cost, availability, and other pertinent information.

ST79 20059 Selective Absorption of Solar Energy in Granular Metals: The Role of Particle Shape

Granqvist, C.G.; Hunderi, O.
Physics Dept., Chalmers Univ. of Tech., Fack, S-402 20 Gothenburg, Sweden
Appl. Phys. Letters V 32 No. 12 p. 798-800 June 15, 1978

Coatings for efficient photothermal conversion of solar energy should have high absorption at wavelengths $\lambda < \lambda_c$ and low absorption at $\lambda > \lambda_c$, where λ_c is approximately 2 μm. For granular metals, we show by computation that λ_c depends strongly on the shape of the metal particles. Increasing eccentricity of ellipsoidal grains is seen to displace λ_c towards the infrared. A similar shift is found also for spherical metallic shells surrounding dielectric cores of increasing size. Some implications for practical absorber surfaces are pointed out.

ST79 20060 Ultrafine Chromium Particles for Photothermal Conversion of Solar Energy

Granqvist, C.G.; Nikl[illegible]son, G.A.
Physics Dept., Chalme[illegible] Univ. of Tech., Fack, S-402 20 Gothenburg, Sweden
J. Appl. Physics .. 49 No. 6 p. 3512-3520 June 1978

Individually isolated chromium particles were prepared by evaporation onto KBr plates in a mixture of argon and air. Such coatings were taken as a model substance simulating the properties of electrodeposited chromium black: a well-known material for efficient photothermal conversion of solar energy. Median diameters of the particles were 5 to 13 nm; their shapes were spherical or cubelike, optical transmittance at normal incidence was recorded by spectrophotometry in the interval 0.3 to 25 μm. Excellent spectral selectivity was documented with high absorptance over the wavelength range for solar radiation and high transmittance further out in the infrared. The optical data were interpreted within the Maxwell-Garnett theory, which was generalized so as to encompass dipole-dipole coupling among aggregated spheres, cubelike shapes, and oxide pellicles. Agreement between theory and experiments was achieved by considering aggregation of spherical particles into linear chains. The effects of having cubic particles, as well as oxide-coated spherical ones, were calculated and found to be rather unimportant for understanding the spectral selectivity.

ST79 20061 Performance Comparison of Flat-Plate Collector Absorber Coatings Utilizing NBS Standard 74-635: Collector Performance Methods

Ingley, H.A.; Reinhardt, R.E.
Univ. of Florida, Gainesville, FL
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 91 Dec. 5, 1977

No abstract available.

ST79 20062 Solar Collector of Glass

Keller, A.
Univ. Tecnica F. Santa Maria, Valparaiso, Chile
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 223-227 March 1, 1976

A cheap thermal solar collector of glass is presented. In a glass cylinder such as is used for fluorescent lamps, a flat hollow glass body ("absorbing body") made by molding a U-shaped tube and covered with a thin metal foil with a selective surface is soldered. Its width is about 80 percent of the diameter of the cylinder. Considering that a very high vacuum would raise the cost of a mass produced collector in a prohibitive way, the heat conduction losses are lowered by filling the space between cylinder and absorbing body with a gas of low thermal conductivity of a few torr. It is planned to pump water of 80 C through a field of such collectors, to heat it to 100 C, to evaporate Freon 11 in a heat exchanger and to drive a turbine. Heat losses as low as 1.85 W/m^2 K (as referred to the useful surface and the temperature difference between the absorbing body and the air) have been obtained for this case with cylinders 50 mm in diameter. An estimative economic calculus is presented.

ST79 20063 Solar Absorber Plate Materials: Steel

Kruger, P.
Solar Age V 2 No. 5 p. 16-18 May 1977

Performance and engineering data for design of steel flat-plate solar absorbers are briefly presented. Comparisons with copper and aluminum are included. Design parameters which affect thermal performance, producibility, and material costs, coating compatibility and application costs for several steel alloys are tabulated. An extensive table comparing absorber coating performance and cost for 15 steel alloys, copper, and aluminum is added. Solar absorptance, infrared emittance, and coating durability, as well as estimated mass production costs are included in the tabulation. Many different coatings can be applied to steel absorbers at relatively low cost.

ST79 20064 Selective Surfaces for Copper Solar Absorbers

Lindstrom, R.S.
Arthur D. Little, Inc., Cambridge, MA
Incra Res. Rept. No. 250 p. VP Dec. 1977

This program evaluated a wide range of treatments for copper to determine their utility as selective surfaces. These treatments include: oxide and sulfide-type chemical treatments; combinations of sulfide and oxide treatments; other chemical treatments; electrochemical treatments; and proprietary commercial copper darkening treatments, three of which are commercially available.

ST79 20065 Solar Absorber Plate Materials: Copper

Lyman, W.S.; Anderson, P.
Solar Age V 2 No. 5 p. 12-15 May 1977

An extensive discussion of the advantages of copper as a solar absorber material for solar collectors is presented. Corrosion resistance, thermal properties, and other physical properties of copper are discussed. Recommended methods of fabrication, joining, and surface finishing are described. Results of evaluation tests of selective absorber coatings compatible with copper are discussed. Guidelines for prevention of erosion-corrosion are briefly described.

ST79 20066 Use of Lexan and Kapton Honeycombs to Increase Solar Collector Efficiency

Marshall, K.N.; Wedel, R.K.
Lockheed Palo Alto Res. Lab., Palo Alto, CA
AIChE Symp. Ser. V 73 No. 164 p. 156-163 1977

A program at Lockheed Palo Alto Laboratory under ERDA evaluated various transparent plastic materials for honeycomb applications in solar collectors. Lexan and Kapton were used to fabricate the various honeycomb sections. Solar transmission of each honeycomb section was shown to be a function of aspect ratio and solar incident angles. The more transparent materials performed significantly better diurnally than the opaque honeycombs. The honeycomb collectors were designed to accept a wide range of L/D ratios from one to ten for simultaneous testing that could be performed on a number of differentj configurations. Instrumentation for continuous data collection was used to calculate collector efficiency. Results showed that collector efficiency increases as the honeycomb ratio gets larger. Increases in honeycomb collector efficiency were due to reduction in convection and to radiation heat losses as the L/D increases. Collectors equipped with Lexan honeycomb with L/D = 5 having either 0.477 or 0.953-cm cell diameters, have much better efficiency than double-glazed nonhoneycomb flat-plate collectors. All honeycomb collectors performed better than single-glazed nonhoneycomb collectors. Maximum efficiency for honeycomb collector was achieved by using only one transparent coverglass.

ST79 20067 Run For The Sun: Solar Heating Opens a Vast New Construction Market

Martino, R.
Mod. Plast. V 6 No. 5 p. 56-59 May 1976

Uses of plastic in domestic solar heating systems are described. Some solar heating components which can be manufactured of plastics are discussed: collector frames and housings, mirrors, lenses, absorbers, insulation, pipes and storage, and hot water tanks.

ST79 20068 Selective Surfaces for Solar Thermal Conversion

Masterson, K.
Univ. of Arizona, Optical Sciences Center
J. Solid State Chem. V 22 No. 1 p. 41-49 Sept. 1977

A selective surface is defined as one having a high absorbance over the wavelengths spanning the spectrum of solar flux and also a low emittance. The paper reviews the economics of using the selective absorber coating and the basic designs for implementation on flat-plate distributed collector and central receiver systems. Equations are used to indicate the relationship between performance and selectivity. Optical characteristics of various optical coatings are discussed. The author identifies five methods for obtaining surface selectivity: (1)single material; (2)bulk absorber-reflector tandem; (3) (3)interference films; (4)controlled surface morphology; (5)resonance absorption of small particles in the dielectric. Selective coatings run from less than $1/m^2 to several dollars per m^2.

ST79 20069 Gold Black and Gold Cermet Absorbing Surfaces

McKenzie, D.R.
Univ. of Sydney, Sydney, Australia
Gold Bull. V 11 No. 2 p. 49-53 April 1978

Gold black and gold cermet coatings have properties for radiation detection and solar energy conversion applications. The characteristics required for each specific application can be obtained by taking advantage of the critical dependence of the properties of such coatings upon the conditions used for their preparation.

ST79 20070 Reflective Materials for Solar Systems

Munoz, F.; Gonzalez, A.; Almanza, R.
Nat'l Univ. of Mexico, Mexico City, Mexico
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.1-5.4 Sept. 26, 1977

One important problem in Mexico is to get good reflective materials for solar energy applications. Different reflective materials have been developed at the Institute of Engineering in order to build good mirrors. These are the following: (1)second aluminized surface has been evaporated on acrylic, afterwards covered with paint in order to protect the aluminum; reflectance of 0.8 was measured in these mirrors. (2)Small aluminum sheet samples of very high purity (99.8 percent) have been electropolished using the following electropolishing solutions: fluoboric acid; sulfuric acid, orthophosphoric acid and chromic acid; perchloric acid and acetic anhydride; and sodium hydroxide and tribasic sodium phosphate. All these solutions contain a defined quantity of water. The reflectance of these samples was found to be of the order of 0.7. (3)Vacuum-evaporated aluminum into stainless steel sheets, afterwards covered with acrylic transparent paints or anodized films; produced around 0.7 reflectances. (4)Polished brass sheets are plated in chrome and nickel baths; 0.6 reflectances were obtained. Reflectances were measured with a laser ray and incidence was about 5° from the vertical.

ST79 20071 Structural Composition and its Influence on the Optical Properties of Gold Black

O'Neill, P.; Ignatiev, A.; Doland, C.
Univ. of Houston, Houston, TX
AIP (Am. Inst. Phys.) Conf. Proc.; Electr. Transport and Optical Properties of Inhomog. Media
CONF-770925 p. 288-293 No. 40 Sept. 7, 1977 Columbus, OH

A model is developed for the optical properties of gold black within the realm of effective medium theory. This model assumes that the strands of gold black can be approximated by spheroids for which the depolarization factor is well known from electrostatic theory. This model is applied to several gold blacks produced by inert gas evaporation. It is found that excellent agreement between experimental and theoretical transmittance can be achieved in the solar spectrum using a distribution of spheroids (gold black strands) that is closely approximated by a log-normal function. Experimental results for packing factor and sample thickness were used without modification. Experimental data for the electron collision frequency were modified to account for particle size effects.

ST79 20072 Black Chromium Plating for Solar Collectors

Robison, T.G.
Prod. Finish., Cincinnati, OH V 42 No. 4 p. 38-42 Jan. 1978

This article discusses the flat-plate collector coating, black chromium. Properly applied black chromium is considered one of the best selective coatings. It is also considered one of the most durable coatings in terms of resistance to high temperature and long life. The Olympic Plating Industries, Inc. is one of the companies that does such plating. In 1976 Olympic plated 100,000 ft^2 of collectors. The two basic kinds of collectors plated at Olympic are steel and copper. The plating process is explained in a step-by-step fashion. A slightly different process is used for the steel flat-plate collectors. Spectrophotometers are used at the end of the plating process to measure the emittance and absorptance values.

ST79 20073 Material Selection For Agricultural Solar Systems

Schlag, J.H.; Sheppard, A.P.; Wood, J.M.
Georgia Inst. of Tech., Atlanta, GA
Conf. on Solar Crop Drying Raleigh, NC
CONF-770686 p. 26-31 June 30, 1977

The attributes of common materials which can be used as glazings, absorbers, and insulation are compared. Water and rocks are also compared as storage mediums.

ST79 20074 Optical Properties and Composition of Electroplated Black Chrome

Sowell, R.R.; Mattox, D.M.
Sandia Lab., Albuquerque, NM
Plat. Surf. Finish. V 65 No. 1 p. 50-52 Jan. 1978

The use of electroplated black chrome as a selective solar photothermal absorber on 3.66 meter-long receiver pipes is described. Solar absorptance was > 95 and thermal emittance (at 300 C) was < 0.25 for 1800-angstrom coatings, which did not exhibit optical interference effects, due to a variable chromium-oxygen composition throughout the coating. The highest chromium-oxygen ratio in the coating was found near the interface with the electrodeposited sulfamate nickel interlayer. Metallic chromium was the only phase in the coating identifiable by using transmission and reflection electron diffraction.

ST79 20075 Selective Surfaces for High Temperature Solar Photothermal Conversion

Spitz, J.
Lab. D'Etudes Des Materiaux Minces, Centre D'Etudes Nucleaires de Grenoble, France
Thin Solid Films V 45 No. 1 p. 31-41 Aug. 15, 1977

The purpose of this paper is to show how performance of the collector at medium and high temperatures can be substantially improved by choosing optical properties of the surface absorber materials. A selective surface is defined as a material surface with an absorption or reflection coefficient that varies selectively with the wavelength. Four methods for obtaining a selective surface are given. The first method suggests the use of certain metallic compounds that possess a reflectance profile of the type required. Examples given are carbides and nitrides of the transition metals. The second method is the successive deposition of alternate films of two materials with different optical indices. Another similar method is the deposition of two materials with precise optical functions. Examples are given of the coupling of a reflector and absorber. The fourth method suggests the use of a surface texture material known for its optical properties. Criteria for choice of a selective surface include: (1)temperature coefficients that affect optical properties, (2)thermally stable materials, (3)corrosion resistant materials. In conclusion, the author states that it is necessary for the field of metallurgy to develop optically selective materials or pairs of materials.

ST79 20076 New Glazing Materials For Your Home, Greenhouse, or Solar Collector

Stone, G.
Pop. Sci. V 211 No. 3 p. 126,128-132, 134 Sept. 1977

Various new window materials for letting the sun in while keeping the heat from getting back out are described. New materials include: a double-walled, hollow-channeled polycarbonate sheet; an aluminum gridwork with fiberglass-reinforced panels; thermopane windows filled with a dry gas; and fiberglass layers with a layer of light-transmitting foam between them.

ST79 20077 Heat of Fusion Systems For Solar Heating and Cooling

Telkes, M.
Solar Engng. V 2 No. 9 p. 27-29 Sept. 1977

The use of salt-hydrates as latent heat storage materials in houses is discussed. Comparisons of several salt-hydrates, along with thickening agents, are included. Glauber's salt has been used in three test homes. Plastic containers are recommended as heat exchangers. Heat transfer and cost calculations are outlined. Consideration is being given to salt-hydrates for cooling also.

ST79 20078 Geometrical Spectral Selective Window

Van Wakeren, J.H.A.; Verhoeven, J.
Inst. for Atomic and Molecular Physics, Amsterdam, Netherlands
Int. Colloquium On Solar Electricity Toulouse, France
CONF-760374 p. 229-233 March 1, 1976

A spectral selective window with large transmission for solar radiation and high reflection for thermal infrared, based on a geometrical metal structure, is proposed. The structure consists of a metal foil with as many holes in it as possible. Each hole has a diameter of 1 micron; a hole of this size in metal acts as a waveguide for sunlight. A blackbody placed behind this waveguide structure is heated by solar radiation. The radiation loss of the blackbody is suppressed because the surface with its small holes acts as a mirror for the thermal infrared radiation. When aluminum foil is used as material for this spectral selective window. A transmittance over emittance ratio $\alpha/\varepsilon > 10$ and a maximum working temperature of 800 K are possible.

ST79 20079 Selective Absorbers for Flat-Plate Collectors

Winegarner, R.M.
Optical Coating Lab., Inc., Santa Rosa, CA
Sunworld No. 4 p. 12-14 May 1977

Methods for calculation of absorptance and emittance of selective absorbers for flat-plate solar collectors are explained. Properties of some selective absorber coatings are tabulated. The desirability of selective absorbers in solar space heating/cooling and water heating application is discussed. Formulas for determining the impact of use of selective absorbers on system operating economics are explained.

21,000 FLAT PLATE COLLECTORS

ST79 21059 Arrangement for a Tube System of a Solar Collector

German (FRG) Patent no. 2,550,018/A
Volkswagenwerk A.G., Wolfsburg, Germany, F.R. p. 12 May 18, 1977 In German

The invention concerns the arrangement for supply and removal of liquids for at least one tube system of a solar collector, in particular, one made of elastic material. Construction details of the arrangement are reported.

ST79 21060 Arrangement of the Pipe Systems of a Solar Collector

German (FRG) Patent no. 2,556,747/A
Volkswagenwerk A.G., Wolfsburg, Germany, F.R. p. 10 June 30, 1977 In German

This is a supplement to the main patent P2550018.9, where an arrangement for the supply of liquids to several parallel-operated tube systems of a solar collector, in particular, tubes made of elastic material is described. The present supplement intends to design the arrangement described in the main patent in such a manner that construction is simplified to the utmost. The constructional measures required to achieve this are described in detail.

ST79 21061 Collation of Quarterly Reports on Air Flat-Plate Collectors

Life Sciences Engng., Morrison, CO
Avail:NTIS, DOE/NASA/TM-150514 p. 110 Oct. 31, 1977

A collection of quarterly reports on the Solar II air flat-plate collectors is presented. The work covers the development and fabrication of a prototype air flat-plate collector subsystem containing 320 ft^2 of collector area. Three instrumented panels were completely assembled with glazing and insulation. Manufacture of the last seven prototype collectors was completed in October 1977.

ST79 21062 Design and Installation Package for the Sunmat Flat-Plate Solar Collector

Calmac Mfg. Corp., Englewood, NJ
Avail:NTIS, DOE/NASA/CR-150741 p. 61 March 1978

The information used in evaluating the design of the Sunmat liquid flat-plate solar collector developed by Calmac Manufacturing Company is presented. Included in this package are the subsystem performance specification, installation, operation, and maintenance manuals; collector sizing guides; and detailed drawings of the single-glazed collector.

ST79 21063 Development of a Cost-Effective and High-Efficiency Low-Temperature Nonconcentrating Black Liquid Collector, Interim Report

Battelle Columbus Labs., Columbus, OH
Avail:NTIS, TID-28680 p. 34 May 31, 1978

The primary objective of this project is to develop a cost-effective and high-efficiency low-temperature nonconcentrating black liquid type collector. A secondary objective is to determine if such a collector would have specific advantages when used as a thermal energy source for a heat pump. A third objective is to provide DOE and the solar energy community with some of the necessary technical and economic data to evaluate and compare a black liquid collector with conventional flat-plate collectors for other potential applications. Status and results are presented.

ST79 21064 Device for Collecting Solar Energy

Battelle Memorial Inst., Columbus, OH
US Patent no. 4,083,360
Avail:Patent Office p. 12 Feb. 28, 1975 Switzerland

A device for collecting solar energy, for incorporation in a dwelling, especially in a tiled roof, comprises a heat absorbing plate, ducting for a heat exchange fluid for extracting heat from the plate, and single or double glazing over the plate; the glazing consists of a plurality of radiation transmitting tiles each having a recessed rear face defining a cell, whereby convection between the glazing and the absorbing surface is reduced or eliminated.

ST79 21065 Device for Utilizing the Heat Energy of Solar Radiation

Volkswagenwerk A.G., F.R. Germany
US Patent no. 4,059,095
Avail:Patent Office p. 10 April 9, 1975

A device for producing usable heat from solar radiation consists of a carrier which is in heat conductive contact with a flowable heat carrier medium in a flexible conduit structure which has an inlet and an outlet and is on a surface of the carrier. The carrier is formed of a flexible material whereby the device including the conduit and the carrier is coilable into a roll.

ST79 21066 Engineering Analysis and Testing of Water-Trickle Solar Collector, Final Report, June 1975-November 1977

Univ. of Virginia, Dept. of Mech. and Aerospace Engng., Charlottesville, VA
Avail:NTIS, ORO-4927-78/1, UVA-527121/MAE78/107 p. 60 Nov. 1977

An outdoor solar collector testing facility was built at the University of Virginia for the purpose of conducting thermal performance evaluations of the Thomason "Solaris" water-trickle solar collector. A near linear relationship of steady state efficiency for the Thomason "Solaris" collector is displayed as a function of the difference between inlet water temperature and the ambient temperature, divided by the incident solar energy. The performance of the "Solaris" water-trickle collector is compared with published results for conventional single and double glazed flat-plate collectors. A theoretical model of the collector has also been used to examine the thermal performance of the collector. Experimental measurements and the model also were used to demonstrate how design changes such as glazing spacing, glazing material, double glazing, and condensate suppression influence the performance of the water-trickle collector. The test facility was expanded to evaluate the performance of an open fluid film (silicone oil) collector. Testing was done at various ambient conditions and a discussion of the results are presented.

ST79 21067 Flat Plate Solar Collector Design and Performance (Citations From the Engineering Index Data Base), Report for 1970-June 1978

NTIS, Springfield, VA
Avail:NTIS, NTIS/PS-78/0841 p. 150 Aug. 1978

Citations from worldwide literature on the design, thermal performance, and optimization of air and liquid-type flat-plate collectors are covered. Topic areas include heat loss and heat transfer, effect of orientation, corrosion protection, optical coatings, enhancement of performance through the use of planar reflectors, and the effect of honeycomb layers on collector performance. A few studies pertain to grooved, corrugate corrugated, or V-trough collectors. Abstracts dealing with methods of measuring the performance of flat-plate collectors and computer optimization studies are included.

ST79 21068 Flat-Plate Solar Collector Design and Performance (Citations From the NTIS Data Base), Report for 1976-June 1978

NTIS, Springfield, VA
Avail:NTIS, NTIS/PS-78/0840 p.104 Aug. 1978

Federally funded research on the design and thermal efficiency of air and liquid-type flat-plate collectors is discussed. Topic areas cover convection characteristics, methods to reduce heat loss, optical coatings, and corrosion control. Emphasis of the bibliography is on basic research studies.

ST79 21069 Indoor Test for Thermal Performance Evaluation of Lennox-Honeywell Solar Collector

Wyle Labs., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150510 p. 28 Nov. 1977

The test procedures used and the test results obtained from an evaluation test program conducted on a Lennox-Honeywell double-covered liquid solar collector under simulated conditions are presented. The Marshall Space Flight Center Solar Simulator was used in accordance with test requirements. The test article is a flat-plate solar collector using liquid as the heat transfer medium. The absorber plate is steel with the copper tubes bonded on the upper surface. The plate is coated with black chrome with an absorptivity factor of .95 and emissivity factor of .12. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector.

ST79 21070 Indoor Test for Thermal Performance Evaluation of Libbey-Owens-Ford Solar Collector

Wyle Labs., Huntsville, AL, Solar Energy Systems Div.
Avail:NTIS, DOE/NASA/CR-150508 p. 26 Nov. 1977

This test program was conducted to evaluate the thermal performance of a Libbey-Owens-Ford liquid collector under simulated conditions. The test conditions and the thermal performance data obtained during the tests conducted on the simulator are described. In addition, a time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector.

ST79 21071 Indoor Test For Thermal Performance Evaluation of Sunworks (Liquid) Solar Collector

Wyle Labs., Huntsville, AL, Solar Energy Systems Div.
Avail:NTIS, DOE/NASA/CR-150573 p. 35 Dec. 1977

This report presents the test procedures used and test results obtained from an evaluation test program conducted on a Sunworks (S/N L1158G) single-covered liquid solar collector under simulated conditions. The Marshall Space Flight Center Solar Simluator was used in accordance with test requirements. The test article is a flat-plate solar collector using water as the heat transfer medium. The absorber plate is copper with copper tubes bonded by soft solder. The plate is coated with enthone selective black with an absorptivity factor of 0.87 to 0.92 and an emissivity factor of 0.10 to 0.20. A time constant test and incident angle modifier test were conducted to determine the transient effect and the incident angle effect on the collector.

ST79 21072 Indoor Test For Thermal Performance Evaluation of the Life Science Engineering (Air) Solar Collector

Wyle Labs., Huntsville, AL, Solar Energy Systems Div.
Avail:NTIS, DOE/NASA/CR-150665 p. 36 Feb. 1978

The test procedure used and the results obtained from an evaluation test program, conducted to obtain thermal performance data on a life sciences double-glazed air solar collector under simulated conditions, are described. These tests were made using the Marshall Space Flight Center's solar simulator. A time constant test and incident angle test were also conducted to determine the transient effect and incident angle effect on the collector. These results and the results of the collector load test are also discussed. The life sciences collector, Model Solar II, is an air-type, double-glazed (Tedlar for outside glazing and tempered glass for inside glazing) flat plate. The gross collector area is 32 ft^2 (4' x 8') with an aperture area of 30.9 ft^2. The absorber plate is coated with 3M Nexel black.

ST79 21073 Indoor Thermal Performance Evaluation of Daystar Solar Collector

Wyle Labs., Huntsville, AL; Solar Energy Systems Div.
Avail:NTIS, DOE/NASA/CR-150511 p.49 Nov. 1977

The test procedures used and results obtained from a test program to obtain thermal performance data on a Daystar Model 21B, S/N 02210, Unit 2, liquid solar collector under simulated conditions are presented. The article is a flat-plate solar collector using liquid as a heat transfer medium. The absorber plate is copper and coated with black paint. Between the tempered low iron glass and absorber plate is a polycarbonate trap used to suppress convective heat loss. The collector incorporates a convector heat dump panel to limit temperature excursions during stagnation. The following tests were conducted: collector thermal efficiency, collector time constant, collector incident angle modifier, collector heat loss coefficient, and collector stagnation.

ST79 21074 Indoor Test for Thermal Performance Evaluation of the Solaron (Air) Solar Collector

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150572 p. 35 Jan. 1978

The test procedure used and the results obtained from an evaluation test program, conducted to obtain thermal performance data on a Solaron double-glazed air solar collector under simulated conditions, are described. These tests were made using the Marshall Space Flight Center Solar Simulator. A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector. The results and the results of the collector load test are also discussed. The Solaron collector absorber plate is made of 24-gage steel, the coating is baked-on black paint, the cover consists of two sheets of 1/8-inch low-iron tempered glass, and the insulation is one thickness of 3 5/8-inch fiberglass batting.

ST79 21075 Indoor Thermal Performance Evaluation of the Sepco Air Collector

Wyle Labs, Solar Energy Systems Div., Huntsville, AL
Avail:NITS, DOE/NASA/CR-150631 p. 36 Sept. 1977

This report contains the procedures used and the results obtained during the evaluation test program on the Solar Energy Products Company (SEPCO) Solaron Solar Air Collector, Model EF-212, under simulated conditions for comparison with data collected in outdoor tests on the same collector. The test article was a single-glazed collector with a nonsensitive absorber plate, aluminum box frame, and one-inch isocyanurate foam insulation. The Marshall Space Flight Center's solar simulator was used for these tests.

ST79 21076 Installation Package For Air Flat-Plate Collector

Life Sciences Engineering, Morrison, CO
Avail:NTIS, DOE/NASA/CR-150536 p. 25 Oct. 1977

Life Sciences Engineering developed the Solar II Air Flat-Plate Collector, Model SC4X8, under the direction of the National Aeronautics and Space Administration. The Solar II dimensions are 4' x 8' x 2½". The collector weighs 130 pounds and has an effective solar collector area (aperture) of > 29.5 ft^2. This area represents 95 percent of the total surface of the collector. The installation, operation, and maintenance manual, safety hazards analysis, special handling instructions, materials list, installation concept drawings, warranty and certification statement are included in the installation package.

ST79 21077 Lightweight Solar Heater Employing Tubes and Channels

Yu, Y.N.
Ying Mfg. Corp.
US Patent no. 4,084,579
Avail:Patent Office p. 4 June 14, 1976

A solar collector comprises: (1)a multiplicity of tubes to pass fluid and to receive heat, and (2) channel-shaped heat transfer members having flanges, the members having webs interconnecting the flanges and presented to receive solar radiation; (3)the tubes clamped between and in heat transfer contact with flanges on successive of said members to form a tube and member assembly, whereby the solar heated channel members transfer heat via the tube clamping flanges to the tubes.

ST79 21078 Liquid Flat Plate Collector and Pump for Solar Heating and Cooling Systems, A Collection of Quarterly Reports

Calmac Mfg. Corp., Englewood, NJ
Avail:NTIS, DOE/NASA/CR-150599 p. 29 Jan. 1978

This report is a collection of quarterly reports from Calmac Manufacturing Company covering the progress made during the period from October 15, 1976 to October 15, 1977 for the development, fabrication, and delivery of solar subsystems consisting of a solar operated pump, and solar collectors which can be used in solar heating and cooling or hot water, for single-family, multi-family, or commercial applications. These reports have been reformatted, retyped, the pages renumbered, and the cost information removed.

ST79 21079 Measurements on a Thermal Solar Energy Collector With a Francia-Type Cell Structure

Commission of the European Communities, Joint Nuclear Res. Center, Ispra, Italy
Avail:NTIS, EUR-5760-DE p. 31 1977 US Sales Only

A flat-plate collector with a Francia-type cell structure was tested in practical operation. In addition, laboratory measurements in which the effects of the cell structure on the internal heat transfer by raddidiation and by natural convection were determined separately, were carried out. The method used, the comparison of the cover glass temperatures arising under selected operating conditions, yields additional data on the effect on the attainable useful power of the absorption of solar radiation in the cover glass plate and in the cell structure. The dependence of the useful power on the angle of incidence as a result of the angular dependence of the absorption of solar radiation in the cell structure was explained.

ST79 21080 Medium Temperature Flat-Plate Solar Energy Collectors for Use in Florida

Florida Solar Energy Center, Cape Canaveral, FL
Avail:TIC, FSEC-TN-78-2 p. 2 Jan. 1978

Various types of flat-plate collectors are discussed briefly. The properties of different glazing materials and the difficulties of maintaining watertight housings are described. Corrosion and materials compatibility are discussed.

ST79 21081 Monthly Performance Report

Perl-Mack Enterprises, Inc., Denver, CO
Avail:NTIS, SOLAR/1015-78/03 p. 14 March 1978

Performance results are presented for a system to provide space heating and domestic hot water preheating. The site is a single-family dwelling in Denver with 470 ft^2 of flat-plate collectors with a water-glycol heat transfer medium. The energy is stored in a 945-gallon tank after passing through a liquid-to-liquid heat exchanger. The system is shown schematically and its five modes of operation are described. In March, solar energy supplied 61 percent of the combined heating and hot water demand of 3.61 million BTUs.

ST79 21082 Mother's Super Simple Solar Tracker

Mother Earth News No. 48 p. 110-112 1977

A do-it-yourself solar tracking system for a flat-plate collector is described. It operates on the basis of freon gravity balance between two cylinders varying in solar exposure in time. Cost is about $35.

ST79 21083 Operational Experience With Drain-Down Solar Systems

Ames Lab., Ames, IA
Solar Heating and Cooling Systems Operational Results Conf. Colorado Springs, CO
Avail:NTIS, IS-M-166, CONF-781102-3 p. 11 Nov. 29, 1978

Drain-down solar collector systems offer substantial economic advantage over antifreeze heat exchange systems. Drain-down systems are simpler, have lower piping and plumbing costs, and operate at higher collector and system efficiencies. Properly designed and installed drain-down systems intrinsically should require less maintenance. These advantages have not yet been demonstrated in actual operating experience. A substantial number of the solar heating and cooling demonstration projects under Ames Laboratory cognizance are of drain-down design. Most projects are located in freezing climates; some suffered damage from freezing last winter. Operating experiences for these projects are presented, together with some design criteria for drain-down systems that these operating experiences reveal.

ST79 21084 Pleated PC Film and Low Profile PUR Foam Slim Down a Solar Collector

Mod. Plastics V 55 No. 1 p. 26,28 Jan. 1978

The Daystar Corporation reports reduced bulk and increased efficiency with the use of pleated polycarbonate (replacing one layer of glass) and the use of isocyanurate foam in their collectors. Pleated PC film is critical to the design of the Daystar system. Two inches of the isocyanurate foam provide an R-value of 12.22 for the back panel and an R-value of 6.46 for the sides. Daystar now has 250 successful installations in the country. diagram of the collector is included in the article.

ST79 21085 Preliminary Design Review Package on Air Flat-Plate Collector for Solar Heating and Cooling System

Life Sciences Engng., Morrison, CO
Avail:NTIS, DOE/NASA/CR-150601 p. 58 Jan. 1977

This preliminary design review package as received from Life Sciences Engineering covers development and fabrication of a prototype air flat-plate collector subsystem containing 320 ft^2 (10 4' x 8' panels) of collector area. The package contains: verification plan; thermal analysis; safety hazard analysis; drawing list; special handling, installation, and maintenance tools; structural analysis; and selected drawings.

ST79 21086 Solar Collector

German (FRG) Patent no. 2,610,901/A p. 6 Sept. 29, 1977 In German
Buderus'sche Eisenwerke, Wetzlar, Germany, F.R.

The invention pertains to a solar collector consisting of a heat exchanger covered at some distance with transparent material. Apart from a high efficiency, the collector should also be of light weight and inexpensive to produce. According to the invention, the transparent cover material, the heat exchanger, and the spacers between them are embedded in a compact composite element made of plastic foam. This way, a tight and insulating border is obtained while avoiding an outer casing. The plastic foam is usually integral foam due to its close and tight outer skin.

ST79 21087 Solar Collector

German (FRG) Patent no. 2,615,584/A p. 13 Oct. 20, 1977 In German

The solar collector consists of an absorber element carried in a support, through which the medium to be heated flows, and a transparent cover. The absorber element consists of two plates connected with each other, which enclose a duct which runs over the plate surface in serpentines between its inlet and outlet. The absorber element consists of metal or plastics.

ST79 21088 Solar Collector

German (FRG) Patent no. 2,618,827/A p. 19 Nov. 17, 1977 In German

The solar collector described here consists of tubes arranged at some distance from each other, which are rigidly connected by profiled connecting pieces. The collector is thus made into a portable element in wave form. The connecting pieces consist of one or more ring segments and may be in parabolic arrangement.

ST79 21089 Solar Collector For 85 Cents a Square Foot

Pop. Science V 211 No. 3 p. 51 Sept. 1977

Foamglas, a rigid foam in which V-grooves have been cut, is used as solar absorber, heat transfer surface, and thermal insulation. Kal-Lite fiberglass is used for glazing the solar air heater.

ST79 21090 Solar Collector With a Covering of Evacuated Pipes

German (FRG) Patent no. 2,615,473/A p. 15 Oct. 13, 1977 In German
Philips Patentverwaltung GMBH, Hamburg, Germany, F.R.

The invention is based on the problem of creating a solar collector with a vacuum isolation consisting of several evacuated pipes, which is dust-tight and rainproof, and in which there is practically no air between the covering pipes and the heat exchanger. According to the stated construction, this is achieved by having the covering pipes in contact over a large area on their underside with the absorber and the heat exchanger.

ST79 21091 Solar Collector With Long Dewar Vessel (Vacuum Flask)

German (FRG) Patent no. 2,622,252/A
Philips Patentverwaltung GMBH, Hamburg, F.R. Germany
p. 12 Dec. 1, 1977 In German

The invention refers to a solar collector with a long, double-walled cylindrical vessel made of transparent material which encloses a hollow evacuated space whose inner tube is provided on the vacuum side over at least half its cylindrical cross-section with a layer absorbing the sun's light. The tube touches a liquid transport medium for transferring the heat produced by solar radiation. The transport medium is introduced by means of a feed device projecting into the inner tube, and flows back along the inside of the inner tube.

ST79 21092 Solar Energy Absorber and Method of Production

German (FRG) Patent no. 2,718,288/A
Sekisui Chemical Co., Ltd., Osaka, Japan
p. 21 Nov. 3, 1977 In German

A solar energy absorber is described which consists of a metallic copper or copper alloy substrate with a black or dark brown copper oxide surface coating. The surface coating is obtained by treating the substrate surface with an aqueous alkaline solution which contains a peroxysulfuric acid or an inorganic peroxysulfate. The chemical process methodology is described.

ST79 21093 Solar Energy Collector

US Patent no. 4,063,544
Raytheon Co.
Avail:Patent Office p. 4 Oct. 5, 1976

A solar energy collector includes an enclosure within which is located a solar energy absorbing panel disposed in space relation with an overlying glazing. The enclosure is a single sheet of metal fabricated with integral side and end walls, spacing ribs, glaze-holding lips, lock joints, and tie-down brackets.

ST79 21094 Solar Energy Collector

US Patent no. 4,100,914
Avail:Patent Office p. 4 June 13, 1977

A solar energy collector is disclosed having a horizontal housing section adapted for insertion into an opening in the wall of a building, and housing having an upper warm air duct and a lower cool air duct, a lower manifold, an air pumping means, a plurality of opaque corrugated metal tubes wherein air is heated by the action of the sun, an upper manifold for collecting and dispensing the heated air, a reflecting surface for heating the rear portions of the tubes, and a transparent enclosure surrounding the tubes. The solar energy collector is particularly characterized by its adaptation for insertion into a window frame, its light weight, ease of installation, mechanical simplicity, and low power requirements.

ST79 21095 Solar Energy Collector and Glazing System

US Patent no. 4,114,595
Avail:Patent Office p. 12 July 6, 1977

A direct air heating solar energy collection apparatus and glazing system therefore are described. Unique framing members are utilized to create modular collector assembly panels, to provide a glazing system for the collectors, and to contain reflective trapping members in a precision spaced array. The framing members are formed in cross-sectional shapes that admit of multiple uses in the overall frame structure of the apparatus, some of the members being utilized for a plurality of different mechanical functions within the framing system.

ST79 21096 Solar Heat Collector

US Patent no. 4,064,867
Avail:Patent Office p. 10 Aug. 2, 1976

A solar heat collector is described which has an enclosure, a first receptacle for a heated liquid medium, and a second receptacle for a cooled liquid medium. Heat transfer means within the enclosure provide transfer of heat either to or from a liquid medium. Additionally, the heating enclosure may include a closure member which is transparent to radiant energy from the sun. Means may be provided to move the closure member between an

opened and a closed position in response to the intensity of radiant energy which impinges on the closure member. Means may be provided to convey a liquid medium from the first receptacle through the heat transfer means and back to the first receptacle with the closure in a closed position. Second means may be provided to convey a liquid medium from the second receptacle through the heat transfer means and then back to the second receptacle with the closure member in an opened position. Thus, heat from radiant energy may be transferred to a liquid medium by the heat collector with the radiant energy passing through the closure in its closed position. The collector may function to transfer heat from a liquid medium with the heat being radiated to a darkened sky with the closure in its opened position.

ST79 21097 Solar Heater Unit

US Patent no. 4,084,575
Avail:Patent Office p. 4 Sept. 13, 1976

A solar heating unit employs plural cells each comprising sloping side walls with a first side wall having a sun facing relationship in the morning hours and a second side wall having a sun facing relationship in the afternoon hours. The first and second walls are inclined from the horizontal to a degree determined by the latitude of the unit.

ST79 21098 Solar Heater Units

US Patent no. 4,083,359
Avail:Patent Office p. 8 July 15, 1976

A shallow tank is described which is inclined when the unit is in operative position and having a relatively large surface to face in the direction of the sun, and a wide tube or a plurality of tubes extending over the large surface and communicating at one end directly with the interior of the tank near the lower end thereof and communicating at an opposite end directly with the interior of the tank spaced above its lower end, thermo thermosiphon circulation being maintained as liquid in the unit is heated by the sun when in the tube or tubes and flows therefrom into the tank, down through the tank and back into the tube or tubes. It is preferable to provide an insulation shield over the end of each tube which directs liquid into the tank.

ST79 21099 Solar Light Collector With a Device to Release Excess Heat to the Environment

German (FRG) Patent no. 2,607,188/A p. 6 Aug. 25, 1977 In German

The invention is to prevent overheating and damaging of the solar collector in the case of strong solar irradiation and simultaneous failure of the water pump. A mechanical device is designed for this purpose which at a certain temperature lifts the thermal covering on the back collector wall so that free convection results removing the heat from the collector floor.

ST79 21100 Some Experimental Results on Selective Absorbing Surfaces For Low Temperature Solar Collectors

DOE, Washington, D.C., Office of NEPA Coordination
Avail:NTIS, N78-14686 p. 50 May 27, 1977

The efficiency of a flat-plate solar collector can be greatly enhanced by the use of a selectively absorbing layer, that is, a surface with high absorptance for the solar spectrum and low emittance for thermal radiation. From various methods known from the literature for realizing coatings with these properties, the process of electroplating selective black nickel coatings was chosen and studied in detail. One result of this investigation was that the effectiveness of these layers results from optical interference. With the production of black nickel two-layer coatings on a copper substrate, one obtains surfaces with an absorptance as high as 0.95, when weighted with the terrestrial solar spectrum. The simultaneous emittance is in the order of 0.05. The superiority of absorber plates with such values in comparison with nonselective solar collectors is outlined using the results of a numerical calculation.

ST79 21101 Thermal Performance Evaluation of Solar Energy Products Company (SEPCO) "Solaron" Collector Tested Outdoors

Wyle Labs., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150509 p. 92 Nov. 1977

The test results obtained during the performance of a test program conducted to determine the performance of a Solaron solar collector. The test article is a single-glazed collector with a nonselective absorber plate using flowing air as the heat transfer medium. The absorber plate and box frame are aluminum and the insulation is one-inch isocyanurate foam board with thermal conductivity of 0.11 BTU/ft^2 hr ^{o}F. The tests included the following: time constant test, collector efficiency test, collector stagnation test, incident angle modifier test, load test, weathering test, and absorber plate optical properties test. The results of these tests are tabulated, graphed, or otherwise recorded.

ST79 21102 Thermal Performance Evaluation of the Solargenics Solar Collector at Outdoor Conditions

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150857 p. 33 Dec. 1978

Information contained within this report presents test procedures used during the performance of an evaluation program. The test program was conducted to obtain the following performance data and information on the solar collector: (1)thermal performance data under outdoor conditions; (2)structural behavior of collector under static conditions; and (3)effects of long-term exposure to material weathering elements. The Solargenics is a liquid, single-glazed, flat-plate collector. Approximate dimensions of each collector are 240 inches long, 36 inches wide, and 3.5 inches in depth.

ST79 21103 Thermal Performance of Honeywell Double-Covered Liquid Solar Collector

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150505 p. 19 Nov. 1977

The test procedures and results obtained during an evaluation test program to determine the outdoor performance characteristics of the Honeywell liquid solar collector are presented. The program was based on the thermal evaluation of a Honeywell double-covered liquid solar collector. Initial plans included the simultaneous testing of a single-covered Honeywell collector. During the initial testing, the single-covered collector failed due to leakage; thus, testing continued on the double-covered collector only (as per test requirements). To define better the operating characteristics of the collector, several additional data points were obtained beyond those requested.

ST79 21104 Thermal Performance of MSFC Hot Air Collectors Under Natural And Simulated Conditions

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150506 p. 39 Nov. 1977

The procedures used and the results obtained from an evaluation test program conducted to determine the thermal performance and structural characteristics of selected MSFC-designed hot air collectors under both real and simulated environmental conditions are presented. Five collectors, serial numbers 5, 6, 8, 10, and 11, were tested in the three-phased program. Phase one consisted of a series of outdoor tests to determine stagnation temperatures on a typical bright day and to determine each collector's ability to withstand these temperatures. Two of the collectors, S/N's 5 and 6, experienced structural deformation sufficient to eliminate them from the remainder of the test program. Of the three remaining collectors, S/N 10 was selected as the test article for the last two phases of the program. Phase two consisted of a series of outdoor tests to evaluate the thermal performance of collector S/N 10 under certain test conditions. The final phase of the program consisted of a series of indoor tests to evaluate the thermal performance of the collector under closely controlled simulated conditions.

ST79 21105 The Sun on Your Roof -- "Dollars in Your Pocket"

The Contractor V 24 No. 11 p. 14-17 1975

Technological and economic aspects of solar heating and cooling systems are reviewed. The basic principle of operation for such systems is the conversion of solar radiation to heat by means of an absorbing surface incorporated in a flat-plate collector assembly. The most common collector is a metal black-coated plate with a glass or plastic covering which transmits the sun's rays but does not permit the reflected radiant waves to pass back through. A heat transfer fluid, water, a water antifreeze mixture, or air is passed through channels in contact with the heat absorber surface. The fluid is circulated to a heat storage unit or to the heating and cooling service system. A solar heating system which includes a 5000-ft^2 collector array, a 15,000-gallon water storage tank, and a hot water heating system has been installed in one wing of a public school and has resulted in

a saving of 1200 gallons of fuel oil from March 1, 1974 to May 15, 1974. Solar energy conversion is most practical in the southwest, deep south, and midwest regions of the country, with the ratio of clear sunny days being of greater importance than temperature variation. Although solar collectors currently cost an estimated $6 per ft^2, the cost should be reduced to about $4 by 1980 and to about $2 by 1985. A solar system may increase the cost of a newly built home by $2000 or more; however, the solar system when perfected may last 20 years or more, thus offsetting the initial cost. It is estimated that solar heating and cooling can become competitive by 1985-1990.

ST79 21106 Verification Test of the MSFC Solar Simulator Using a Honeywell Double-Covered Liquid Solar Collector

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150507 p. 16 Nov. 1977

This test program was conducted to obtain additional verification data to support the utilization of the MSFC solar simulator for testing solar collectors. The Honeywell double-covered liquid solar collector no. 2 for which thermal performance data under natural outdoor conditions had been previously obtained was installed on the solar simulator and subjected to a series of eight tests under the conditions shown. Although these test conditions are not absolutely identical to those of the outdoor tests, they are considered to be sufficiently representative to provide a basis for an accurate comparative analysis of the data recorded for both test programs.

ST79 21107 Recent Significant Developments in Solar Technology

Barker, N.M.
Solar Energy 2nd Symp. in Pittsburgh: Demo. Programs and Plans
CONF-7706117 p. 136-157 June 1, 1977 Pittsburgh, PA

Recent technological developments in flat-plate collectors are reviewed including absorber coatings, insulation, and geometry. Also, several solar water heating projects in Pennsylvania are briefly discussed.

ST79 21108 Engineering Influences on the Thermal Performance of Open-Flow Liquid Solar Collectors

Beard, J.T.; Huckstep, F.L.; May, W.B.Jr.; Iachetta, F.A.; Dirhan, L.A.Jr.
Univ. of Virginia, Charlottesville, VA
Alt. Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 85-87 Dec. 5, 1977

No abstract available.

ST79 21109 Physical Fundamentals For the Calculation of Flat-Plate Collectors, Part 6, Parametric Variations of Collector Characteristic Values

Bossel, U.
Mitteilungsbl. Dtsch. Ges. Sonnenenergie V 2 No. 3 p. 18-21,24 May 1977
In German

The general collector equation which was presented in Part V is interpreted in Part VI (the last part in the series) with a view to application in practice. The main influencing parameters are varied in order to change the collector efficiency degree in dependence of other influencing factors. Calculations are made with the aid of a computer program. The following influencing factors were considered: absorber layer, solar radiation, ambient temperature, wind velocity, selectivity of absorbers, no-load temperature of collector.

ST79 21110 Silicone Sealants for Solar Energy Systems

Brady, S.A.
Dow Corning Corp.
Adhes. Age V 20 No. 11 p. 36-38 Nov. 1977

Of the different varieties of solar collectors on the market, the flat-plate collector is the most widely used today. The unit is explained in terms of its materials and its thermal capacity. The differential expansion and contraction of the collector creates a sealing problem. The sealing is responsible for avoiding heat loss, and

preventing condensation on the inside of the collector. Few sealants can withstand the kind of joint movement in an eight-foot long collector with an aluminum frame. Silicone RTV sealants and silicone rubber gasket are used in over 80 percent of the flat-plate collectors manufactured. The sealants display the same properties as silicon rubber. After 20 years, silicon rubber retains almost half of its original elongation and two-thirds of its original tensile strength. High-temperature exposure has less effect on the tensile strength of silicone rubber than other elastomers. In other solar energy devices used in passive heated houses, silicone RTV adhesive sealants have become the standard material for bonding and sealing.

ST79 21111 All-Glass Collectors in Solar Energy Utilization

Deminet, C.; Beverly, W.D.
Boeing Co., Seattle, WA
Am. Ceramic Soc. Bulletin V 56 No. 12 p. 1058-1059,1067 Dec. 1977

An all-glass flat-plate solar collector concept has been developed. It consists of a glass panel structure containing vacuum cells and liquid passageways and is manufactured by a continuous glass-forming process. Solar energy is directly absorbed, depending on the collector's applications, in a variety of working fluids.

ST79 21112 Air Heating Collectors, Simplified

Elwood, L.A.
Alternative Energy Sources No. 32 p. 21-23 June 1978

Simple solar air heaters suitable for do-it-yourself construction are reviewed. Innovative solar absorber materials are discussed and some reference papers are mentioned.

ST79 21113 Solar Simulators and Indoor Testing

Gillett, W.B.
Univ. College, Cardiff, Wales
Conf. on Testing of Solar Collectors, Systems London, England
CONF-770487 p. 31-48 April 1977

Thermal performance testing of collectors by indoor loss measurement and individual component property measurement is discussed with reference to the research programs being carried out by the International Energy Agency and the European Commission. A summary of the considerations involved in the design of a solar simulator is presented with special reference to the new facility under construction at Cardiff.

ST79 21114 Drain/Freeze Test Steps Developed for Manufacturers

Hager, S.F.; Tranel, L.J.
Olin Corp., East Alton, IL
Solar Engng. V 3 No. 1 p. 18-20 Jan. 1978

A simple drain/freeze test developed by McDonnell-Douglas to determine the integrity of flat-plate solar collectors using water without freeze protection in freezing climates is described and discussed. Test equipment, plumbing, and instrumentation are described. Test data for copper and aluminum roll-bond flat panels are presented for both free-draining and nondraining operation. Drain/freeze cycles used in the tests involve temperature excursions from ambient temperature to -20° F over a two-hour period. Instructions are given for duplicating the drain/freeze cycle test. Based on this testing, it is recommended that 10 drain/freeze cycles be run to assess a given collector design.

ST79 21115 Use of a Honeycomb As Solar Radiation Absorber and Heat Exchanger in an Air-Type Solar Collector

Hightower, R.F.; Pyrlinski, J.T.
Kansas State Univ., Manhattan, KS
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 93-97 Dec. 5, 1977

No abstract available.

ST79 21116 Theoretical Investigation on the Effect of Channel Spacing on the Efficiency of Aluminum Flat Collectors

Hoenisch, S.; Behm, E.
Hlh. Z. Heiz., Lueftung, Klim., Haustech. V 28 No. 7 p. 253-256 July 1977
In German

The channel spacing has hardly any effect on the efficiency of a collector, provided that static operating conditions are postulated. It is therefore more sensible to find a suitable channel spacing from the point of view of creating good flow conditions in the system. Above all, one should attempt to ensure that all channels are equally loaded. It is not always useful to use double-glazed collectors. For low operating temperatures, the absorption of the covering is greater than the loss due to heat radiation. In certain cases it may therefore be better to use collectors without any covering.

ST79 21117 Arrays of Fixed Flat-Plate Solar Energy Collectors: Performance Comparisons For Differing Individual Component Orientations

Janke, S.H.; Boehn, R.F.
AIChE Symp. Series V 73 No. 164 p. 171-180 1977

A determination is made regarding the energy density and flux available after passage of direct solar radiation through single and double glass covers, for panels inclined at various angles, and oriented with varying azimuths, several latitudes are also considered. Results of a computer program which for any latitude, date, time of day, and arbitrary panel orientation, allows for atmospheric attenuation and glass transmission are displayed in several graphical formats. Orientations other than south-facing are found to give greater availability of energy for a period of roughly 90 days centered about the summer solstice, and to give higher flux values early or late in the day for winter dates, but are inferior to south-facing panels in other respects.

ST79 21118 Some Aspects of Testing the Thermal Performance of Collectors

Justin, B.
Pilkington Bros, Ltd., Ormskirk, England
Conf. on Testing Solar Collectors, Systems London, England
CONF-770487 p. 1-13 April 1977

Some of the problems encountered when evaluating the thermal performance of a flat-plate collector and the method proposed by the American National Bureau of Standards for evaluation of collector performance are outlined. It may be, in the light of further experiences, that alternative procedures may be developed and/or additional tests need to be carried out. The proposed standard test presently being drafted by ASHRAE is based on the NBS but includes two additional tests, one to determine the collector's "time constant" and the other to determine the "incident angle modifier" which should enable the performance of a collector to be predicted under a wide range of conditions. Also, it may be possible to develop techniques for normalizing the test results produced by the NBS procedure to standardized conditions in order to eliminate possible variations between test centers. The NBS proposed standard forms an excellent starting point for any thinking in this area and should be taken into consideration in moving towards a British standard testing procedure, bearing in mind that the ultimate goal should be to enable comparisons of performance data to be carried out on an international basis.

ST79 21119 Various Methods for Freeze Protection of Solar Collectors are Compared

Koenigshofer, D.R.
Sunworld No. 3 p. 10-11 Feb. 1977

Five methods of freeze protection for water circulated in solar collectors are evaluated and compared. Energy and capital costs for each method are determined and tabulated. Capital costs are highest for the automatic draining method and lowest for the freeze cycle method. Of the methods considered, the freeze cycle system is concluded to be the most cost-effective.

ST79 21120 Window Solar Collector

La Rosa, R.
Alternative Energy Sources p. 20 April 1977

A blackened metal plate mounted between the shade and the window help absorb the sunlight usually lost. Window box solar collectors consist of a black metal absorber plate with plywood at the front and back to enclose the box. On a sunny day, a thermocouple mounted to the absorber plate reaches 150° F. Although the size of the collectors is small, the cost is minimal for the construction and the fuel savings during the daylight is considerable.

ST79 21121 How to Build Your Very Own Sun Sucker

Larson, E.
Alternative Energy Sources No. 32 p. 14-15 June 1978

Design, construction, operation, and costs are given for a 4' x 16' solar collector to mount on a vertical exterior wall next to a conventional double-hung window.

ST79 21122 Air-Cooled Collectors: Applications and Systems

Loope, R.
Solar Heating, Cooling p. 18-20 Dec. 1977

Applications of air-type solar collectors are very briefly reviewed. Solar drying of grains and lumber are mentioned. The underpass system design of air-type collectors is briefly explained. Advantages of air-type collectors for use in space heating buildings and houses are pointed out. The four modes of operation of this type collector are discussed.

ST79 21123 Experimental Evaluation of Natural Convection Solar Air Heaters

Macedo, I.C.; Altemani, C.A.C.
Univ. of Campinas, Sao Paulo, Brazil
Solar Energy V 20 No. 5 p. 367-369 1978

Four basic types of natural convection solar air heaters, in many geometries, were tested in a wide range of input solar energy values. Measured values of air flow rate, temperature increase and efficiency are reported. It is expected that the results and conclusions will be valuable in the design of equipment for drying, space heating, other purposes.

ST79 21124 Low-Cost Solar Collector

Miller, C.
Mech. Illustrated V 73 No. 595 p. 58,60-61 Dec. 1977

George Cvijanovich, a professor at Upsala College in New Jersey, has invented a solar collector that costs one-third the cost of most flat-plate collectors. A special dyed color enclosed in plastic absorbs the heat directly. The collector panel is made of plastic and has two walls connected by cross-sections that run the length of the sheet. The double-wall panel is backed by aluminum foil, styrofoam insulation, and plywood. The collector is reported to have an efficiency of 42 percent, with a 10° difference in ambient and output temperature. Cvijanovich estimates that one-third to one-fourth of the collector surface would be needed to space heat a home. The inventor estimates $1 to $1.60 per ft^2 for the cost of his system. Cvijanovich will not reveal the liquid dye being used in the system. He estimates the cost of the collector sufficient to heat a six-room house to be about $300, plus installation.

ST79 21125 · Onersol Collector and Its Performance

Moumouni, A.; Wright, A.
Office De L'Energie Solaire, Naimey, Nigeria
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 413-428 March 1, 1976 In French

Onersol has developed flat solar collectors whose yields are sufficiently high at average temperature (100 to 130 C) to make their use profitable as a heat source for a solar vapor engine. A battery of eight collectors of this type, coupled with a cylindrical parabolic concentrator, is capable of giving to a circulating fluid a heat flux of the order of 340 Kcal m^{-2} hr^{-1} at temperatures close to 170 C.

ST79 21126 Design and Performance of an Air Collector For Industrial Crop Dehydration

Niles, P.W.; Carnegie, E.J.; Pohl, J.G.; Cherne, J.M.
California Polytech. State Univ., San Luis Obispo, CA
Solar Energy V 20 No. 1 p. 19-23 1978

Test results are reported for the operation of unglazed and single-glazed solar collectors used to heat air to the 90 C range. The collectors were constructed of standard black-painted metal decking and were tested in various lengths so that pressure drops and convective heat transfer rates could be varied independent of collector operation temperature. It is shown that the experimental collector performance results with single-pass operation are in substantial agreement with standard collector analysis procedures. These results give a firm basis for collector and system optimization.

ST79 21127 Stability of Air in the Gap of Inclined Flat-Plate Solar Collectors: Effects Of Convective Boundary Conditions and Radiation

Oezisik, M.N.; Hassab., M.A.
North Carolina State Univ., Raleigh, NC
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 89-90 Dec. 5, 1977

No abstract available.

ST79 21128 Low Temperature "Ambient-Plus" Solar Collectors

Pemberton, E.V.; Remick, C.D.
Wilfred Laurier Univ., Waterloo, Ontario, Canada
ASHRAE J. V 20 No. 1 p. 57-59 Jan. 1978

The authors attempt to show that ambient-plus collectors can be very efficient, with low cost and least complexity of manufacture, and that these collectors should be considered as real contenders in the solar heating arena.

ST79 21129 Testing Collectors With Solar Simulator: Fitting to the Theoretical Model and Extrapolation

Ployart, R.; Devin, B.; Colomes, J.
Commissariat a L'Energie Atomique Cen-Saclay, Gif-Sur-Yvette, France
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 235-249 March 1, 1976 In French

In order to test flat-plate collectors, a process for experimentation, theoretical fitting, and extrapolation of data is given. This is possible with the help of an artificial lighting and theoretical model "Capsol." Global parameters are defined, which are collectors specific or environment specific. Those parameters can be used for the purpose of comparing a collector to another collector. Furthermore, these parameters are convenient for predicting collector performance and any given conditions by means of hand computations and standard tables.

ST79 21130 Two-Dimensional Analysis of a Flat-Plate Collector

Prabhakar, R.P.; Francis, J.E.; Love, T.
Univ. of Oklahoma
J. Energy V 1 No. 5 p. 324-328 Sept.-Oct. 1977

A two-dimensional steady-state analysis of a flat-plate collector was made. The theoretical studies were undertaken on a winter day at a latitude of 35° and longitude of 97° and at 1300 hours. The incident solar radiation was assumed to be 200 BTU/hour ft^2 with a collector tilt of the latitude plus 15° and an ambient temperature of 50° F. and a wind speed of five knots. The results show that, for flow rates in normal operating ranges, the axial fluid temperature variation is considered as linear. The model also shows that outlet temperatures increase with increasing tube spacing/tube diameter ratio. Also shown was that the outlet fluid temperature is relatively insensitive to either plate thickness or thermal conductivity within the range of parameters used. It was noted that there was an optimum tube spacing that results in maximum collector efficiency. Beyond a certain value of tube spacing, losses become greater and efficiencies are reduced. For a mass flow rate per unit area of about 10 lb/hr ft^2, the collector reaches its nearest maximum efficiency for that particular configuration. Further increases in the mass flow rate were not responsible for an increased efficiency. The computer model generated can be run using hourly values of atmospheric data making it suitable for simulation work.

ST79 21131 Optimal Material Selection for Flat-Plate Energy Collectors Utilizing Commercially Available Materials

Ratzel, A.C.; Bannerot, R.B.
Chem. Engng. Prog., Symp. Ser. V 73 No. 164 p. 186-203 1977

Flat-plate collectors are viewed as having two main problems; that of cost and performance, as well as the cheap cost of fossil fuels. Single-cover flat-plate collector designs are analyzed by computer simulations for cost, weight, performance, durability, and estimated life. Four major components of the flat-plate collector were analyzed: the cover panel, the absorber, the absorber plate, and the insulation material. Performance data was based on technical brochures from various companies and through various governmental and university authorities. It was considered that the cover was the most critical element since durability is the most important factor in the life of the panel. A general criteria function was established for the collector cost and weight, durability life, and an absorber efficiency of 30 to 50 percent. Eight aluminum and five copper panel systems and 59 single-cover aluminum panel systems were found applicable to solar cooling. Optimal systems were chosen from this grouping by using criteria function analysis. Two cover materials were considered for solar cooling applications; both were plastics. Plastic covers are considered superior to float glass because of the negligible differences in light transmission.

ST79 21132 Thermal Vacuum and Low-Pressure Flat Solar Energy Collectors

Reinhard, K.
Erno Raumfahrttechnik GMBH, Bremen, Germany, F.R., Bereich Waermetechnik
Klima Kaelte Ing. V 6 No. 4 p. 131-135 1978 In German

The author described low-pressure or vacuum collectors with the aim of reducing the heat losses from solar collectors due to radiation and to protect radiation-selective absorber layers from corrosion. The constructive measures for frames and covering plates necessary to absorb the atmospheric forces are outlined and their safety is illustrated by tests. A flexible metallic compound between glass and frame is described which maintains the low-pressure or vacuum over a long period. Finally, problems yet to be solved on idling resistance are indicated. Results of power measurements are given for a second part of the article.

ST79 21133 Parametric Studies of the Thermal Trap Flat-Plate Collector

Smith, P.R.; Cobble, M.H.; Lukens, L.L.
New Mexico State Univ., Las Cruces, NM
AIChE Symp. Ser. V 73 No. 164 p. 164-170 1977

The thermal trap solar collector differs from the traditional flat-plate collector in that it has a slab of transparent material placed on the absorbing side of the collector plate. The thermal trap effect occurs when the transporting media is exposed to radiation from a high-temperature source and the interior side becomes a higher temperature than the side facing the source. Trap material should have a high transmittance in the region of the arriving solar radiation and low transmittance in the long wavelength radiation. The trap material used in the study was methylmethacrylate, produced under the name of Plexiglass G. The purpose of the study was to determine the effects of the thickness of the trap material on the performance of the thermal trap solar collector. Four collectors were constructed, each with its own pump and storage tank. The thickness of the cover glass and the air gap thickness remained constant. All four collectors were monitored for flow rates, temperature of the transfer fluid, and the amount of energy arriving at the collector. Thermocouples and pyreheliometers were placed at various points on the collectors. The numerical model predicted that the thinner the trap material, the higher the efficiency. Warping, however, was found to be a major problem for thin sheets of trap material at higher temperatures.

ST79 21134 Solar Building Panel Concept for the Supply of Hot Water

Spedding, P.L.; Allen, M.L.; Brow, D.
Univ. of Auckland, New Zealand
N Z. Engng. V 32 No. 6 p. 126-131 June 15, 1977

A solar building panel concept is proposed which serves the dual function of acting as a solar collector as well as providing weather protection for a building. The panel is constructed from standard roofing material for incorporation in the roofing s ructure. Where the particular aspect of the building does not allow the incorporation of the solar building panel in the existing roof, the collector surface can be made up into a separate solar collector in the normal way. The straight solar building panel and the glazed solar

building panel both can achieve temperature rise rates and certain other operating characteristics which are substantially the same as that achieved by the conventional flat, copper, glazed collector. However, the straight solar building panel only can achieve temperature rises of up to 30° C, which is well below the maximum temperature rise of the conventional flat, copper, glazed collector. The solar building panel gave collection efficiencies close to 100 percent for low-temperature differences of about 10° C. This is substantially higher than for conventional units. The life of the solar building panel can be extended by suitable pretreatment and its cost is about \$10 to \$15/m^2 of collecting surface, which is about one-tenth of the cost of a conventional unit.

ST79 21135 Study of Solar Thermal Electric Power System (Effect of Selective Thin Barrier On Radiative Heat Transfer

Tanaka, T.; Horigome, T.; Tani, T.; Sawada, S.; Sakuta, K.
Electrical Engng. Japan, Engl. Transl. V 97 No. 2 p. 57-63 1977

A theoretical analysis of the effects of the cover plate on the thermal performance and heat transfer characteristics of a flat-plate collector is presented. Also, the thermal and optical characteristics of the absorber plate are studied, and the effect of its thermal capacity and convection loss on the quantity of heat transfer is examined.

ST79 21136 Solar Power for a Motorhome

Thoms, W.
Mech. Illustrated V 74 No. 599 p. 32 April 1978

Two 4' x 8' flat-plate collectors assembled from salvaged materials sit on the motorhome roof. The collectors, which contain parallel, copper-pipe radiators, recirculate the water by convection and hold about 1½ gallons each. Some 1000 feet of copper tubing throughout the motorhome's system circulates 150 gallons of water to heat the vehicle's interior. A pair of 30-gallon beer kegs store heated water. The motorhome is well-insulated. Its owner tours the country and gives solar demonstrations.

ST79 21137 Metal Roof as Solar Absorber, Promising Concept for Low-Temperature Heat/Price Per Square Meter From DM 68

Urbanek, A.
Mitteilungsbl. Dtsch. Ges. Sonnenenergie V 2 No. 6 p. 43-45 Nov. 1977
In German

A new concept for providing energy for supplying a house is described. Instead of the usual flat collectors, the whole roof is made of a metal sheet. The solar energy absorbed by the roof is conducted by a heat transfer medium and is either taken directly to underfloor heating or is taken to a ground store. The total system is coupled to a heat pump. The plant covers the complete heat demand of the house, which is 65,000 kWh/annum. The total annual power costs for the house with 410 m^2 of living space are DM 1,300.00.

ST79 21138 Measurement in Solar Collector Testing

Wozniak, S.J.
Bldg. Res. Est'ment, Garston, England
Conf. on Testing of Solar Collectors and Systems, London, England
CONF-770487 p. 15-30 April 1977

An outline is given of the types of equipment that could be used for determining the thermal performance of solar water heating collectors. Sources of possible error are highlighted and several procedures suitable for validating and calibrating measuring equipment are briefly described. It is concluded that considerable care is necessary in both selecting and using measuring equipment if accurate results are to be obtained.

22,000 CONCENTRATING COLLECTORS

ST79 22019 Cylindrical Radiant Energy Direction Device With Refractive Medium

US Patent Appl. no. 714,863
ERDA, DOE, Washington, D.C.
Avail:Patent Office p. 17 Aug. 16, 1976

A device is described for directing radiant energy and includes a refractive element and a reflective boundary. The reflective boundary is so contoured that incident energy directed by the refractive element is directed to the exit surface onto the surface of an energy absorber positioned at the exit surface.

ST79 22020 Development and Fabrication of a Concentrating Solar Collector Subsystem (Third and Fourth Quarterly Reports)

Northrup, Inc., Hutchins, TX
Avail:NTIS, DOE/NASA/CR-150713 p. 28 Oct. 1977

The third and fourth quarterly reports covering the period from April 1, 1977 through September 30, 1977 are presented. These reports cover the finalization of designs, fabrication of the new lens, receiver and tracking box, and a review of the contract status.

ST79 22021 Indoor Test for Thermal Performance Evaluation of the Northrup Concentrating Collector

Wyle Labs., Solar Energy Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150804 p. 28 July 1978

The test procedure used and the results obtained from an evaluation test program conducted to obtain thermal performance data on a Northrup concentrating solar collector under simulated conditions are described. These tests were made using the Marshall Space Flight Center's solar simulator. A time constant test and incident angle modifier test were also conducted to determine the transient effect and the incident angle effect on the collector. The Northrup concentrating solar collector is a water/glycol/working fluid type, dipped galvanized steel housing, transparent acrylic Fresnel lens cover, copper absorber tube, fiberglass insulation, and weighs approximately 98 pounds. The gross collector area is about 29.4 ft^2 per collector. A collector assembly includes four collector units within a tracking mount array.

ST79 22022 Installation Duct to Remove the Solar Energy Collected

German (FRG) Patent no. 2,617,495/A p. 11 Nov. 3, 1977 In German

The patent describes a system for the conversion of solar energy into thermal energy. The system consists of an installation duct with a circulating heat carrier medium which is covered by a transparent plate on the side facing the sun; the rear of the duct is designed so as to generate focal points in the region of the transparent plate. The plate is heated and transfers its thermal energy to the transport medium.

ST79 22023 Novel Solar Collector Using a Large Circular Fresnel Lens Concentrator, Final Report

McDonnell Douglas Astronautics Co., Huntington Beach, CA
Avail:NTIS, SAND-78-7023 p. 89 May 1978

The results of a preliminary design and commercial cost projections study for a large circular Fresnel lens solar collector are provided. The novel feature is the size of the proposed lens concentrator, approximately three meters in diameter. Lens development is a separate activity, not covered by this contract. The purpose of the contracted effort was the determination of the value of such a collector from the performance and cost standpoint.

ST79 22024 Pyramidal Optical Collector System Operates in Condominium Project

Solar Engng. V 2 No. 7 p. 30-32 July 1977

Two solar-assisted home heating systems incorporating pyramidal optical collectors are described. Back up systems are electrical resistance heat and a heat pump. The skylight mounted collector system allows a factor of four reduction in area over flat-plate collectors. Performance of the collectors in homes in Delaware and South Carolina is discussed. Cost and economics of the system are analyzed.

ST79 22025 Solar Age Nudged Forward

Mech. Engng. V 98 No. 6 p. 52 June 1976

The compound parabolic solar energy concentrator developed by R. Winston at the University of Chicago and Enrico Fermi is being licensed by University Patents to Steelcraft Corporation, which plans to market a solar concentrator later this year for manufacturing applications where hot water and steam will be produced at 160 to 600° F, and to M-7 International which will manufacture a dielectric compound parabolic concentrator which can be combined with solar cells to convert light directly to electricity. Meanwhile, about $1,000,000/year is being spent on further development, a large part of it at the Argonne Laboratories as well as the University of Chicago, with additional research and development work proceeding through the manufacturers licensed by University Patents, Inc.

ST79 22026 Solar Collector for the Generation of Mechanical Energy

German (FRG) Patent no. 2,617,6045/A p. 7 In German Nov. 3, 1977

A solar collector for the generation of mechanical energy is described. First, the incoming light is focused by collecting lenses. The spot with the highest light concentration is inside a tube filled with an easily vaporizable fluid which drives a turbine or a piston engine.

ST79 22027 Solar Concentrating Collectors

Georgia Inst. of Tech., College of Engng., Atlanta, GA
Concentrating Solar Collector Conf. Atlanta, GA
Avail:NTIS, CONF-770955 p. 689 Sept. 26, 1977

Separate abstracts were prepared for 63 of the 72 papers presented. Nine papers were previously abstracted and can be found in the report number index under Report Number CONF-770953.

ST79 22028 Solar Energy Collector

US Patent no. 4,059,093
Grumman Aerospace Corp.
Avail:Patent Office p. 6 Sept. 22, 1975

A solar energy collector is described for collecting, concentrating, and utilizing solar energy. It includes a target for transferring solar energy into another usable energy form and a reflector positioned to increase the amount of solar energy reaching the target and prevent solar energy from escaping around the target. The target includes a transparent envelope and a heat pipe containing a heat transfer fluid. The heat pipe has an evaporator portion disposed within the transparent envelope and an emergent condenser portion with a flange forming a dry thermal interface with a manifold for conducting heat energy directly from the heat pipe to the manifold.

ST79 22029 Solar Energy Collector Apparatus

US Patent no. 4,059,094
Avail:Patent Office p. 10 Dec. 4, 1975

Solar collector energy apparatus is described. It includes a parabolic reflective surface or parabolic mirror for receiving and focusing the radiation to a pipe disposed at a focal point of the mirror collector. The pipe is in direct contact with the parabolic mirror collector so as to receive reflection from the mirror. A heat chamber is included behind the parabolic mirror collector to trap heat behind the collector and provide an additional heat source for the pipe and for fluid in the pipe.

ST79 22030 Solar Heating System

US Patent no. 4,066,062
Avail:Patent Office p. 4 Oct. 28, 1975

An improved apparatus is described for utilizing heat from the sun's rays as a source of energy for heating a liquid which may be stored and/or circulated through a heating system for heating homes or other areas. A number of individually adjustable lenses are divided into groups. Each group is adapted to focus the sun's rays on a heat absorbing member at consecutive periods during the daylight hours as the sun changes its position.

ST79 22031 Solar Parabolic Trough Forming Process, Final Technical Report

Williams (O.G.) and Skaggs (R.L.), Las Vegas, NV
Avail:NTIS, ALO-4158-1 p. 58 May 31, 1978

Eight-foot and six-foot long solar parabolic shells were formed from thin aluminum sheet by using this entirely new forming process, exceeding 8:1 concentration. Expanding on work previously done, many variables were investigated. Using one-foot long trough samples, a high degree of slope accuracy was obtained. One laser beam scan sample showed a 75:1 concentration ratio based on receiver diameter, and a 24:1 concentration ratio based on receiver circumference. The forming process eliminated the need for ribs, boxes, or other devices now used to maintain the parabolic shape of a solar parabolic shell. The process, in brief, involves: (1)alloy aluminum; (2)moments; (3)temperature; (4)time; (5)thickness; (6)bearings; (7)flange angle bend; (8)hardness; (9)lengthwise sag; (10)material flatness; (11)aperture control. A large forming fixture was built; although it was sufficient to produce the shells needed, it should be modified and improved. The process allows for large manufacturing tolerances which were helpful with this fixture. The small sample-testing fixtures were satisfactory as is. Flanges add strength and provide a flat surface across which the end and receiver support is attached. This simplifies and reduces the cost of the end supports.

ST79 22032 Test and Analysis of a Northrup Collector Controller

NASA, Marshall Space Flight Center, Huntsville, AL
Avail:NTIS, DOE/NASA/CR-78153 p. 24 Jan. 1978

The collector controller is examined as a functioning control system that drives the Northrup collector from east to west to follow the sun then back to the east at sundown in readiness for the next sunrise. The major components are examined separately with particular emphasis placed on an analysis of the electronic drive circuit. The collector is a concentrating collector using a Fresnel lens. Results are presented from hardware testing and analysis with recommended changes to improve the system.

ST79 22033 Vacuum-Tight Solar Collector for Water Heating

German (FRG) PAtent no. 2,655,613/A p. 23 June 8, 1977 In German
Commission of the European Communities, Luxembourg, Belgium

The described solar collector consists of a cylindrical glass tube which is entirely leakproof. Two vacuum ducts take care of the entry and exit of the liquid to be heated. The heat transfer liquid, normally water, flows inside an opaque blackened tube of stainless steel. The incident light is concentrated on the absorber tube through a clear profiled mirror surface with apparently elliptic diameter, which is installed along the flow course. The absorber tube can be equipped with a selective surface coating. Alternatively the absorber tube can also consist of light permeable glass. In this case, a light-absorbing medium is used as heat transfer liquid.

ST79 22034 Concentrating Collector System to Supply Industrial Process Hot Water

Ameduri, G.; Rost, D.F.; Alexander, C.K.; Schuler, H.F.
Solar Energy Engng., Poland, OH
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.15-8.20 Sept. 26, 1977

Solar energy engineering has recently completed the engineering design, installation, and preliminary test results of a concentrating collector system integrated into an industrial process hot water application. A 408-m^2 (4400 ft^2) array of General Solar Systems Division of General Extrusions, Inc. own design and manufacture, limited tracking concentrator (3.67:1 concentration ratio) was built and stalled on General Extrusions' roof in Youngstown, Ohio. This array is integrated into a solar-direct and solar-assisted

heat pump system with storage to provide energy to a 77° C (170° F) 3656-gallon alkaline cleaning tank. Energy requirements for this application are 1.9 x 10^9 BTUs per year. The concentrating collector in this system is the General Solar Systems/Solar Energy Engineering Limited tracking concentrating solar collector. It features five cycles of a half parabola shape in a 3.0 m x 1.36 m lightweight module. It require no expensive tracking machanism and is easily realigned in seven positions to produce maximum performance throughout the year. The energy output of the 408-m^2 array will be transferred to the alkaline cleaning tank through heat exchangers and a specially designed Westinghouse Templifier industrial liquid-to-liquid heat pump. This system, as designed, is extremely flexible and can operate in a number of different modes and can produce output energy in the temperature range of 90 to 93° C (140 to 200° F). Because of the corrosiveness of the cleaning solution, the entire system is stainless steel and CPVC. This demonstrates the versatility of the system to handle a variety of industrial applications. The system is capable of producing over 500,000 BTUh (146 kW) at 88° C (190° F) during a sunny noontime.

ST79 22035 Radiation Cavity Solar Collector for High-Temperature Applications

Antoniak, Z.I.; Palmer, H.B.
Pennsylvania State Univ., University Park, PA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.79-2.84 Sept. 26, 1977

A 1.5-m long experimental model of a previously-proposed high-temperature solar concentrator collector in which argon is employed as a working fluid was studied. The effect of using a selective absorber in place of the graphite absorber reported on earlier was investigated. No measurable gain in efficiency was observed. A computer model of this system which takes into account most of the influential variables has been formulated. It yields temperature profiles that normally agree with the experimental data at all axial positions within ca. 10° C. This good agreement permits the formulation of a second computer model of the full-scale device with confidence. The effect of various parameters has been investigated in an optimization study of the full-scale collector.

ST79 22036 Novel Concentrating Solar Collector and Receiver System

Antrim, W.D.Jr.
Concentrating Solar Collector Conf. Atlanta, GA
Am. Science and Engng., Inc., Cambridge, MA
CONF-770953 p. 3.123-3.132 Sept. 26, 1977

A concentrating solar collector and receiver system new to the subject literature is described. The collector lens is a right circular cylinder comprised of a transparent tube filled with water. A row of such cylinders would face south, vertical or inclined to receive optimum sun for the latitude. Energy is concentrated onto focal lines which are a short distance aft of the cylinders. Thus, in this passive system the vertical focal position lines sweep from west to east behind the cylinders onto a pipe organ-like row of thermally separate receiver pipes which take a sequential focal position as the sun sweeps its path. The water in the collecting lenses will be the system entry and thus will receive preheating to moderate reflection and transmission losses. The plumbing system in the receiver pipes will employ automatic rationing to render inoperative all but the ones in the focal position. It is anticipated that the system lends itself to very economical production.

ST79 22037 Radiative Characteristics of Nontracking Moderately Concentrating Solar Energy Collectors

Bannerot, R.B.
Univ. of Houston, Houston, TX
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.71-3.85 Sept. 26, 1977

The ideal (geometric) and effective (actual) concentration ratios are used to compare the radiative performances of various booster mirror configurations and nontracking east-west aligned grooved collector designs. The groove designs are represented by various sidewall shapes, including a single straight facet (trapezoidal), a double facet, and a range of curved wall designs, including the compound parabolic concentrator or Winston collector. The results of the comparison indicate that a wide range of performance is possible. In particular, the higher the ideal concentration ratio, the smaller the acceptance angle of the collector. This, in turn, indicates the frequency of tilt adjustments and the usefulness of nondirect insolation. Designs with the highest effective concentration ratios are usually impractical due to the amount of reflector area required. Only a small performance degradation occurs when a significant amount of reflector is removed. In general, the single facet wall collector is limited to practical

concentration ratios up to about 2.0. The two facet designs extend this to about 2.7. Additional facets continually increase the concentration ratio (as the acceptance angle decreases) until the performance of the compound parabolic concentrator is attained. The maximum practical concentration ratio without tracking is around six.

ST79 22038 Concentrators Producing a Given Irradiation Field at the Receiver

Baum, I.V.
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 947-956 March 1, 1976 In French

Formulas are derived describing the surface form of a reflector producing a prescribed irradiation distribution on the surface of the receiver. The particular cases of the one-dimensional problem and the axially symmetric concentrator are examined separately.

ST79 22039 Novel Design of Evacuated Concentrating Spherical Collector

Bayazitoglu, Y.; Chapman, A.J.
Rice Univ., Houston, TX
Miami Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 83-84 Dec. 5, 1977

No abstract available.

ST79 22040 Production of Foam Plastic Concentrators and Their Characteristics

Bazarof, B.; Baum, V.
Inst. of Tech. Physics, Ashkhabad, USSR
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 957-960 March 1, 1976 In French

Solar concentrators were constructed of rigid polyurethane foam. The physical and mechanical properties were determined and the results tabulated. The properties and service life tests performed during a year indicated that pulverized rigid polyurethane foam can be successfully used for the fabrication of solar concentrators.

ST79 22041 Estimating Hourly Solar Radiation For One-Axis Tracking Focusing Collectors

Bingham, C.E.; Posner, D.; Bradley, J.O.
Midwest Res. Inst., Kansas City, MO
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 227-229 Dec. 5, 1977

No abstract available.

ST79 22042 Hexcel Parabolic Trough Concentrator

Branch, G.P.
Hexcel Corp., Dublin, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.11-2.14 Sept. 26, 1977

The solar tracking parabolic trough collector with honeycomb sandwich construction, manufactured by the Hexcel Corporation, is described.

ST79 22043 Pressure Stabilized Solar Collector (PSSC)

Brantley, L.W.Jr.
Marshall Space Flight Center, Huntsville, AL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 4.21-4.24 Sept. 26, 1977

Presented is a concentrating, two-axis, tracking, spheroidal collector designed to minimize the cost of the tracking system and the reflector. The cavity absorber has been designed to minimize the tracking and reflector surface accuracy requirements while maintaining high performance efficiency. Working fluid temperatures of 200 to 1000° F are achievable at efficiencies of 50 to 70 percent of the direct solar radiation at a cost of projected in mass production to be as low as $5/ft^2$ for units 25 to 50 feet in diameter.

ST79 22044 Selling Solar Energy As a Cash Crop

Brantley, L.W.
NASA, Marshall Space Flight Center, Huntsville, AL
Agric. Engng. V 59 No. 3 p. 12-16 March 1978

The author describes a concentrating two-axis, tracking, spheroidal collector which produces high-quality energy. Applications could include space heating and cooling for homes, industries, and commercial buildings; crop drying; process hot water; heat for specific farm and industrial routines. The collector is reported to offer advantages even when it's used for low-temperature applications. Low working fluid flow rates (smaller pipes) with lower pumping power can be used.

ST79 22045 Hybrid Concentrating Mechanical Tracking Collectors in Mainframes Typical of Flat-Plate Collectors: The Best of Several Technologies Aimed at Solar Cooling Reliability (An Ongoing Project Of)

Brent, C.R.
Univ. of Southern Mississippi, Hattiesburg, MS
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.85-2.91 Sept. 26, 1977

Random direct beam solar radiation measurements made over the past three years confirm the distinctly flatter power curve available to tracking collectors compared to direct beam radiation falling on a fixed collector. Knowing that an economic breakthrough in solar cooling would have to be made in order for maximum solar utilization to occur in the south, the author combined the protective and insulating properties of mainframes typical of flat-plate collectors with tracking ($\pm$ 4°) miniature concentrating troughs in an attempt to optimize a high-temperature solar collector capable of powering an absorption chiller at 99° C. Prototype testing provided an efficiency near 20 percent at this temperature. Upgrading of reflectors, glazing, and absorber surface should provide higher efficiencies. Collector costs are somewhat high at $178/m^2$ but capital recovery calculations show that a system cost of $9500 can be amortized against fuel savings of $600 per year in 1978 within a payback period of ten years.

ST79 22046 Fresnel Lens Concentrating Collector

Claxton, R.J.
Northrup, Inc., Hutchins, TX
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.57-2.60 Sept. 26, 1977

The Northrup concentrating collector is a polar axis collector with equatorial tracking capability. The collector consists of a steel trough housing with a black chrome-plated copper absorber tube and a curved Fresnel lens. Applications include heating heating, cooling, and domestic hot water, some of which are among the largest solar installations in the world. Recent engineering advancements have overcome some of the initial difficulties with the sun tracking system, and all installations are being upgraded with this new hardware. Meanwhile, research and development continue on the next generation collector. Major advances to be expected include a more efficient Fresnel lens and an advanced receiver assembly.

ST79 22047 Design Considerations for the Energy Receiver in a Fixed Mirror Distributed Focus (FMDF) Solar Energy System

Clements, L.D.
Texas Tech. Univ., Lubbock, TX
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 225-226 Dec. 5, 1977

No abstract available.

ST79 22048 Efficiency of Fresnel Lens Solar Collector

Cobble, M.H.; Smith, P.R.; Boyes, J.D.
New Mexico State Univ., Las Cruces, NM
23rd IES Annual Tech. Mtg. and Expo. Los Angeles, CA April 24, 1977
CONF-770415 p. 147-150 Inst. of Environ. Sciences, Mt. Prospect, IL

A theoretical analysis is made of a series of Fresnel lens collectors, in parallel connection, that track the sun to produce wet steam. Equations are developed for the boiler efficiency, the steam quality, and the fluid temperature distribution to be expected in the fluid. A series of experiments run at three mass flow rates and at three pressures verify the theoretical predictions.

ST79 22049 Slats Line Focus Solar Collector

Davison, J.H.; Wendt, A.J.
Suntec Systems, Inc., Lakeville, MN
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.29-2.39 Sept. 26, 1977

SLATS (solar linear array thermal system) is a high-concentration (40:1) solar collector with single-axis tracking. It is composed of planar modules containing 10 one-foot wide reflectors in which all reflectors are focused on a stationary, linear, overhead receiver. Each reflector concentrates reflected energy by a factor of 4:1 or more. These modules, depending on the quantity of heat required and the site, may be connected in series forming rows 200 feet and more in length. SLATS is controlled electronically by an automatic closed-loop Servo system. The electronic control will automatically start operation each morning and end operation each evening. It also provides for shut-down in the event of cloud cover, over-temperature, and power failure. SLATS can deliver thermal energy at high temperature with efficiencies exceeding 60 percent. This is obtained by use of high-quality mirrors, an insulated receiver or heat absorber, and controlled real-time sun tracking. One SLATS has been in operation for more than a year. Other modules have been assembled under ERDA contract for evaluation at intermediate-to-high temperatures. In addition, Suntec is currently installing a 2800-ft^2 collector field for the Sandia Laboratory, small-scale total energy system, and is under contract to deliver a 10,000-ft^2 collector field for the United States Fish and Wildlife Research Laboratory. Other orders are imminent in a variety of applications.

ST79 22050 Transmission Solar Focusing Collector

DeMichelis, F.; Russo, G.
Politecnico di Torino, Italy
Lett. Nuovo Cim. V 19 No.5 p. 145-151 June 4, 1977

In this letter is described a TIR-total internal reflection solar collector with a concentration ratio of about 40; output temperature required, 250°. The collector is made of methacrylate"roof" type (AMICI) prisms; the engineering of the collector is described and a proper suntracking system is identified.

ST79 22051 Focusing Collectors: Estimation of Yield; Effect of Imperfections of the Collector Surface

Desautel, J.; Peri, G.; Desautel, J.; Imbert, B.
Universite de Provence, Marseille, France
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 397-411 March 1, 1976 In French

Two problems in the field of solar radiation focusing collectors are discussed. The first one is concerned with a method to determine solar collector performance in view of the design and comparison of collectors. An equation characterizing the behavior of a collector is adopted, including some assumptions to simplify the use of various parameters (insolation, meteorological conditions, geometry, optical and thermal properties, utilization boundaries, etc). This equation includes the balance of energy at the level of concentrated radiation absorbing surface in which various transfer processes are considered (radiation, conduction, natural or forced convection), together with data obtained in previous experimental work. This approach leads to the analysis of various collectors that shows a compromise between the concentration on to the absorber and the "selectivity" of this absorber. This "selectivity" is realized by various devices such as: greenhouse effect without or with convection transfer, selective surfaces, anti-radiant and anti-convective devices. The second aspect takes into account significant parameters due to the manufacture of the reflecting surface such as defects of curvature, orientation, stiffness, and the pointing errors of the mounting. These defects are

simultaneously involved in the cost and efficiency of the system. An evaluation of geometrical concentration for various collectors of different types (paraboloid, cylindrical parabolic, conical, spherical) is presented. It is shown how the geometrical concentration is a function of the collector geometry and of the total angular error given by the mirror defects. The geometry which gives the maximum value for the concentration is determined for each type of collector. A comparison between the various types of collectors with perfect geometry is given to show the influence of mirror defects in the thermal efficiency expected.

ST79 22052 Inexpensive High-Temperature Solar Collector

Dorman, J.; Lansing, F.L.
Caltech/JPL
NASA Tech. Briefs V 2 No. 2 p. 213-214 Summer 1977

A high-temperature solar concentrator was devised at Caltech. It consists of a series of parallel cylindrical lenses made of glass or plastic. The curvature of the lenses would be designed to give the maximum concentration ratio and short focal length. Experiments show that the collector can heat a working fluid to around 200 C. The liquid lens concentrates the solar radiation by a factor of 100:1. The typical lens would be 10 cm wide and mounted to move along with the rest of the collector with a transitional tracking unit. Seasonal adjustments can be made to the tracking unit.

ST79 22053 General Model for Predicting the Performance Characteristics of Planar Concentrating Systems

Edgecombe, A.L.; Clausing, A.M.
Univ. of Illinois, Urbana, IL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.109-3.113 Sept. 26, 1977

The specular reflector enhancement of flat-plate solar collectors is analyzed in this study. A mathematical model is developed and two key geometrical parameters are introduced in the analysis of the spatially averaged energy flux over the collector surface. The model allows these parameters to be determined as a function of the collector size and tilt, the reflector size and tilt, and the position of the sun. The key parameters, when time averaged over a period of interest, yield a relative measure of the direct beam component and the specularly reflected component of the total energy flux during the given period. The relative values of these two flux components are used in optimizing the reflector-collector system. Data gathered by computer simulation is presented as an example of determining an optimum system with respect to one of the system variables.

ST79 22054 New Design for an Efficient Low Concentrating Solar Collector

Eldifrawi, A.A.
Irvin Industries, Inc., Lexington, KY
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.115-3.121 Sept. 26, 1977

A design of a concentrating collector has been developed. The design incorporates two reflectors, one mounted above and the other mounted in front of a flat-plate collector. This assembly is enclosed inside an air-supported transparent membrane structure. Besides the increase in solar insolation received by the collector absorber due to the reflectors, the temperature around the flat-plate collectors increases either due to the greenhouse effect or by utilizing the building exhaust air in supporting the structure. This results in a significant increase in the system's efficiency. The membrane inflated sqructure privides protection against weather conditions and the structural integrity of the system. It is possible, therefore, to use an inexpensive and thinner glazing material for the enclosed flat-plate collectors. The preliminary analysis indicated that the flat-plate collector's performance, when incorporated inside the structure, would increase over 100 percent under extreme cold weather. An output of 200° F, required for solar absorption air conditioning, is possible at a reasonable efficiency. The economic analysis of the utilization of this concentrator indicates that it would be cost effective.

ST79 22055 Fixed Concentrating Flat-Plate Collectors for Heating and Hot Water Applications

Espy, P.N.
Marshall Space Flight Center, Huntsville, AL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.55-3.60 Sept. 26, 1977

An alternative to simple flat-plate collector use for solar heating and hot water systems is a fixed concentrating collector utilizing low-cost flat-plate collectors. The argument against the use of low-efficiency collectors for winter collecting temperatures of about 70° C (158° F) is met from economical and technical considerations. It can be shown that the least expensive collectors augmented by single or double-faceted reflectors perform at high efficiency and at a low total collector array cost. Additionally, the system operating requirements for summer for domestic hot water at about 60° C (140° F) are are adequately met. The design proposed has a reflector oriented at a right angle to the collector. The results of this design approach is to provide a concentration ratio of about 1.5 during the winter season, and a concentration of 1.0 during the mid-summer period. Winter performance of an inexpensive and relatively inefficient collector may thus be elevated to more than twice the collected energy of conventional configurations; the summer efficiency need only be that which is required for meeting hot water heat loads. The overall system may thus be seen to better match the load requirement of heating and hot water applications.

ST79 22056 Concentrating Collector Testing at the Solar Engineering Test Module

French, R.L.; Mooney, L.G.; McDowell, J.H.; Uselton, R.B.
Am. Tech. Univ., Kileen, TX
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 6.19-6.30 Sept. 26, 1977

The Solar Engineering Test Module (SETM), a facility designed for testing concentrating collectors at intermediate heat-transfer fluid temperatures ($\leq$530° F) and pressures ($\leq$1050 psi), is operated by American Technology University (ATU) in support of the ATU/Fort Hood Solar Total Energy Military Large-Scale Experiment (LSE No. 1). Objectives include: (1)data for verification of modeling techniques for predicting the amount of solar energy that can be collected at Fort Hood, Texas; and (2)information on concentrating collector operation, control, reliability, and cleaning requirements. The SETM consists of an instrumented loop for circulating water through the receiver of a 400-ft^2 Suntec Systems, Inc. SLATS^{TM} collector module which is a linear focusing, segmented-reflector, fixed-receiver collector. Measurements at the SETM include normal incidence solar intensity, receiver inlet-outlet temperatures, and fluid flow rates and pressures. Data reduction and analysis includes consideration of solar intensities and the various optical, geometric, and thermodynamic factors which influence the collector performance. Preliminary results indicate a nominal efficiency of 40 percent for the SLATS collector with V-entrant receiver that is presently installed at the SETM.

ST79 22057 Design of Fixed Evacuated Concentrating Collectors For Operation at 80° and 200° C

Garrison, J.D.
San Diego State Univ., San Diego, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.45-3.54 Sept. 26, 1977

Space heat, hot water, air conditioning, and process steam utilize more than 40 percent of U.S. energy consumption. These uses provide the greatest opportunity for solar energy to contribute significantly to the U.S. and world energy needs. In order to compete economically with other energy sources for these uses and also achieve the higher operating temperatures required for air conditioning and process steam (up to approximately 200° C), a solar collector must have low energy loss and low cost. Low loss requires vacuum to eliminate conduction and convection losses, and concentration onto a selective absorber to minimize radiation loss. Optimum concentration or minimum ratio of absorbing surface area to collecting area requires Winston concentration. The apparent motion of the sun indicates the use of cylindrical concentration with axis east-west. A series of arguments leading to optimum performance at near minimum cost indicate the collector should be of all glass tubular construction. A mirror coating on side and bottom inside surfaces provides concentration onto an internal glass tube coated with selective absorber. The window is only slightly convex to withstand atmospheric pressure while keeping reflection losses low. Heat transfer calculations, which are used to minimize losses, help fix the collector length and width. Radiation collection calculations determine the acceptance angle and other parameters.

ST79 22058 Optimization of a Fixed Solar Thermal Collector

Garrison, J.D.
San Diego State Univ., San Diego, CA
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 77-79 Dec. 5, 1977

No abstract available.

ST79 22059 An Inflated Cylindrical Concentrator for Producing Industrial Process Heat

Gerich, J.W.
Lawrence Livermore Lab., Livermore, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.103-2.115 Sept. 26, 1977

The use of industrial process heat below 170° C accounts for 5 percent of this country's total energy consumption. A concentrating solar collector is being developed to produce hot water and steam in this temperature range. The collector structure consists mainly of an inflated thin film plastic cylinder which is clear on the upper portion and is an aluminized reflector on the lower portion. The reflector concentrates sunlight on a receiver tube which is jacketed with a heat transfer suppressing thin film plastic cylinder. Because of its simplicity, it is believed this collector will be cost effective relative to fossil fuels such as oil at $15/barrel. Computer codes were written to analyze the optical and thermal properties of this collector. Results indicate that weekly tilting of the collector provides over 90 percent of the energy available from continuous tracking. A selective surface on the receiver tube ($\alpha = 0.84$, $\varepsilon = 0.20$) increases the useful energy gain by over a factor of five at 170° C. The stagnation temperature at the outer receiver tube surface is calculated to be below 350° C. Combining calculated optical and thermal efficiencies gives an overall collector efficiency of 20 percent for 170° C operation. This is based on an aperture of the full diameter times the length and on-beam radiation. The first experimental collectors are being constructed to verify our computer code studies. These units have an outer diameter of one meter and are four meters long.

ST79 22060 Inflated Cylindrical Concentrator for Producing Industrial Process Heat

Gerich, J.
Mech. Engng. Dept., Res. Engng. Div. 1977 Activities Highlights Rept.
UCID-17804-77 p. 2-18 May 18, 1978

A concentrating solar collector is being developed that will produce hot water or steam up to a temperature of about 170° C. Such a system is of interest because approximately 25 percent of the energy consumed in the United States is in the form of industrial process heat with about 20 percent of this heat used at a temperature of 170° C or below. Such collectors could potentially supply 5 percent of this country's total energy needs in the form of industrial process heat. It is planned to achieve an extremely low cost by using inexpensive, weatherable plastics and by developing a design which does not require tracking of the sun. The use of plastics most likely means replacing these components at regular intervals. It is also believed that the life cycle costs can be kept low. Analysis of this design shows that it can likely compete with fossil fuels such as oil at $15 per barrel. The initial efforts were directed toward developing optical and heat transfer codes to model the concentrator performance. The heat transfer analysis began with the development of a model of the collector based on a thermal resistive network. Results of the codes are discussed.

ST79 22061 Seasonal Daily Thermal Energy Output of the ITEK Solar Collector

Goralnick, N.S.
ITEK Corp., Lexington, MA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.51-2.55 Sept. 26, 1977

Measurements of overall efficiency as a function of temperature have been made on a demonstration tracking segmented mirror collector system. The results are given based on local operation with peak solar insolation available. The approach to determine the seasonal daily thermal energy output of the ITEK solar collector utilizing insolation data from Sandia Laboratories is described. The technique used to arrive at the thermal energy output is first to determine the "effective width" of the collector as a function of elevation angle from the local latitude reference. The second step is to determine the "effective length" of the collector as a function of time of day, including end losses and cosine effects. Thirdly, the effective width (after converting to time of day for the four seasons) is combined with the effective length to yield "effective area." Next, the local solar insolation data times the collector aperture is used with the effective area curves to produce curves of daily solar seasonal power available for conversion to thermal power. Finally, these curves are integrated to establish the seasonal daily solar energy available for conversion to thermal energy. The solar energy values are multiplied by the efficiency, based on measurements made on ITEK's demonstration solar collector, to arrive at the seasonal daily thermal energy output (corresponding to a 200-m^2 collector aperture area).

ST79 22062 Development and Performance of the Del Concentrating Solar Energy Collectors

Goranson, G.G.; Riise, H.N.; Eldridge, B.G.
Del Mfg. Co., Monterey Park, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.15-2.27 Sept. 26, 1977

The Del parabolic trough concentrating collectors have been designed for high optical and thermodynamic performance and low cost in manufacturing, installation, operation, and maintenance. The evolution of the unique Del collector design is described relative to system considerations in space heating and cooling, industrial process heat, agriculture, and power generation.

ST79 22063 Concentrating Collector Applications in the DOE Agricultural and Industrial Process Heat Program

Greyerbiehl, J.M.
DOE, Washington, D.C.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 1.37-1.44 Sept. 26, 1977

Several demonstration projects of agricultural and industrial solar process heat are briefly described. Solar grain drying, solar process heat for textile drying and concrete block curing, and solar water heating for can washing at a Campbell Soup Company are discussed.

ST79 22064 Flood-Lamp Shaped Concentrating Collectors For Solar Thermal or Total Solar Applications

Grimmer, D.P.
Los Alamos Scientific Lab., Los Alamos, NM
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.121-5.128 Sept. 26, 1977

A flood lamp sized paraboloidal-shaped concentrating collector that is currently under study at LASL is described. These glass collectors are physical vapor deposited (PVD) aluminized on their inside reflecting surfaces just like a flood lamp. However, rather than a filament assembly at the focus, there is an absorber tube upon which the incoming solar radiation is concentrated.

ST79 22065 Development and Evaluation of a Medium Temperature Concentrating Collector

Gupta, B.P.
Honeywell, Inc., Minneapolis, MN
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.41-2.49 Sept. 26, 1977

A cylindrical parabolic solar collector was designed and fabricated and is undergoing tests to obtain performance data at operating temperatures up to 400° F. The concentrating collector is designed to track the apparent motion of the sun in one axis. The tracking axis can be aligned in any orientation, as the design allows for 270° of rotation during the day. The concentrator consists of half a parabola reflecting the sunlight onto a cylindrical absorber tube. The parabolic structure is of a honeycomb sandwich construction to combine high strength and stiffness with light weight. The selectively coated absorber tube is insulated within a metal housing with a high transmittance glass window forming the receiver aperture. The receiver and the concentrator are arranged such that the receiver does not block any part of the concentrator aperture. The modular construction in 20-foot lengths allows convenient collector row lengths up to 120 feet with a compatible motor/gearbox drive mounted in the middle of the row. The design allows stowage of the collector in a low profile and low drag position with the mirror facing down to enhance the life of the second surface aluminized acrylic reflective material. Simulation analysis results of the thermal loss from the receiver and the overall collector efficiencies are presented. The results of the experimental evaluation with pressurized water as the heat transfer fluid is also presented. The collector tests with Therminol 44 as the working fluid are in progress. This collection design will be used in different lengths for ERDA demonstrations in heating and cooling and process heat applications and also on the Honeywell general offices building HVAC system.

ST79 22066 Performance Characteristics of a 1.8m x 3.7m Fresnel Lens Solar Concentrator

Hastings, L.J.; Allums, S.L.
Marshall Space Flight Center, Huntsville, AL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.71-2.77 Sept. 26, 1977

Line-focusing acrylic Fresnel lenses with application potential in the 200 to 370° C range are being analytically and experimentally investigated. The measured solar concentration characteristics of a 1.8m x 3.7m lens and its utilization in a solar collection mode are summarized. A peak concentration ratio of 64 with 90 percent of the transmitted energy focused into a 5 cm width was achieved and demonstrated the feasibility of the Fresnel lens solar concentrator concept.

ST79 22067 Application of ASHRAE Standard 93-77 to Concentrating Collectors

Hill, J.E.; Jenkins, J.P.
NBS, Washington, D.C.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 6.1-6.8 Sept. 26, 1977

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) has recently adopted ASHRAE Standard 93-77 for testing and rating of solar collectors, based on thermal performance. Four separate tests are required to be conducted. The tests are explained and their adaptation for use with concentrating collectors is indicated.

ST79 22068 Results of Development of Linear Parabolic Trough

Hutchison, G.
Solar Kinetics, Inc., Dallas, TX
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.93-2.102 Sept. 26, 1977

After more than two years of development and testing, Solar Kinetics, Inc. has completed the T-500 solar collector. Initial design considerations included short focal length for reasonable mirror accuracy requirements, Monocoque construction for maximum strength per weight ratio and angular misalignment compensation for minimum maintenance and installation expense. Black chrome was chosen for the selective surface and the receiver is insulated with Pyrex glass, suspended on silicone "O" rings. Hydraulics are used for tracking due to the many benefits which include superior tracking accuracy. Finally, testing was reduced to various performance curves.

ST79 22069 Orientation Studies For Single-Axis Concentrating Collectors

Jeter, S.; Craig, J.I.; Grems, E.G.
Georgia Inst. of Tech., Atlanta, GA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 9.49-9.57 Sept. 26, 1977

The useful heat gain of a linear single-axis concentrating solar collector is significantly affected by the orientation of the collector. The temporal distribution of the heat output, both diurnally and annually, and the integrated energy output vary with the direction of the collector axis. For a typical insolation sequence, a north to south orientation yields greater annual heat gain while an east to west orientation gives a flatter annual distribution. Selection of the best collector orientation depends on this distribution, the thermal capacitance of the system, and the load profile. These factors are considered in the definition of an economic criterion function which is then used to identify the optimum distribution of collectors among all possible orientations. A minimum value indicates a collector array optimized with respect to the characteristics of the load and the overall solar energy system.

ST79 22070 Tubular Collector

Krock, W.
Pop. Science V 211 No. 6 p. 52,54 Dec. 1977

Ronald Krock has devised a solar water heating system that combines a concentrating collector design with a drain-down feature that eliminates the need for a heat exchanger. The concentrating collectors consist of four 20-foot long strips of 3/4-ft. copper tubes painted black. The tubes are centered inside 6-foot lengths of acrylic tubing. A timer and photocell permit circulation of the water only under optimum solar conditions. Krock has been collecting data on his system to support his efficiency claims. Krock admits that the system is experimental and he is making changes to eliminate problems.

ST79 22071 Parabolic Collector For Total Energy Systems Application

Levine, A.L.; Paradis, L.R.; Truesdale, K.L.
Raytheon Co., Bedford, MA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 4.33-4.36 Sept. 26, 1977

The Raytheon Company is participating in the ERDA/Sandia Laboratories Total Energy Systems Development Program by designing and fabrication a parabolic point concentrator solar collector. The point concentrator designed and under construction is a toric parabola 6.7 m in diameter, with an effective aperture of 35 m^2. Azimuth and elevation drive systems are computer controlled and provide maximum aperture utilization over the course of the year. Mirrors are curved glass, hand mounted on an aluminum substructure, concentrating the solar energy into a cavity absorber located on the collector optical axis.

ST79 22072 Point Concentrator for Total Energy Systems Applications

Levine, A.L.; Paradis, L.R.; Vallee, E.C.; Stadtlander, G.L.
Raytheon Co., Bedford, MA
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 237-239 Dec. 5, 1977

No abstract available.

ST79 22073 Design Considerations for Solar Radiation Concentrators

Mather, G.R.Jr.; Beekley, D.C.
Owens-Illinois, Inc., Toledo, OH
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.87-3.91 Sept. 26, 1977

The character of insolation as to beam and diffuse components must enter into the design considerations for proper evaluation of a concentrating surface. Various aspects of this problem are discussed in terms of tests and evaluation of concentrating surfaces. The surfaces are shown to provide various degrees of collector performance enhancement both for the beam and diffuse components of insolation. Modest concentration ratios are achieved by the use of these nonimaging optical surfaces but collector performance is increased regardless of the character of the insolation. Problems concerning the manufacture and durability of the surfaces are discussed.

ST79 22074 Concentrating Collectors Applied to the Industrial Process of Textile Drying

Mitchell, P.D.; Gupta, B.P.
Honeywell, Inc., Minneapolis, MN
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.29-8.34 Sept. 26, 1977

The first phase of this ERDA solar industrial process heat program has resulted in the detailed design of a solar energy collection system for providing process heat to a textile drying process. The solar collection subsystem uses 700 m^2 of parabolic trough, single-axis tracking, concentrating collectors to heat water in a high-temperature water (HTW) loop. At the system design point (clear day) the solar collectors nominally generate 198° C water with the HTW loop at 2 x 10^6 pa. A steam generator is fueled with the HTW and produces 490 kg/hr of process steam at the nominal design point conditions. The generated process steam is at 0.5 x 10^6 pa and 160° C. The solar system will provide 1.2 x 10^6 MJ/yr to the process. This is 41 percent of the direct insolation available to the collector field during the operational hours (300 days/yr) of the Fairfax Mill. The process being solarized is textile drying using cylindrical can dryers. The can dryers are part of a "slashing" operation in a West Point Pepperell Mill in Fairfax, Alabama. Over 50 percent of all woven goods are processed through slashers and dried on cylindrical can dryers. Furthermore, since can dryers are also used in other drying processes, this application of solar energy to process heat is one that shows high potential for having a significant impact on displacing conventional fuels.

ST79 22075 Acurex Cylindrical Parabolic Solar Collector

Muller, T.K.
Acurex Corp., Mountain View, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.1-2.10 Sept. 26, 1977

Acurex Corporation has designed and currently manufactures a parabolic trough, concentrating solar collector of the single-axis tracking type. This system has eight modules, each with a 6' x 10' aperture coupled torsionally to a common rotational axis. Each row of eight modules is positioned with the rotational axis oriented either east-west or north-south and tracking horizon-to-horizon. The collectors are designed to heat water, transfer oils, and other fluids to temperatures in the range of 140 to 600° F. Operation at these temperatures is required for the following applications: process hot water and steam, space heating, single and two-stage absorption cooling and refrigeration, drying operations, and solar thermal and photovoltaic power generation.

ST79 22076 Cast Acrylic Fresnel Lens Solar Concentrator

Nixon, G.
Swedlow, Inc., Gardan Grove, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.33-5.43 Sept. 26, 1977

A description of Fresnel lens solar concentrators prepared for solar thermal and photovoltaic applications is presented with arguments for this refracting method of concentration compared with that obtained by reflection. Acrylic material used in a casting process has been utilized successfully by Swedlow, Inc. in producing such Fresnel lenses, and arguments for both this selected material and the noted process are delineated. A status report of lens production and field experiences is made along with lens price projections. Design techniques, performance characteristics, and the next generation of Fresnel lens development are described.

ST79 22077 Selectivity/Concentration Compromise in Solar Energy Collection

Peri, G.; Papini, F.; Pasquetti, R.
Universite de Provence, Marseille, France
Int. Colloquium on Solar Electricity Toulouse, France
CONF-760374 p. 429-434 March 1, 1976

In the design of solar thermal collectors and converters, three principal parameters are to be considered: (1)working fluid temperature, (2)incoming energy or radiation concentration ratio, and (3)absorber selectivity. Taking into account that usable energy has to be as large as possible, these parameters are not independent. Namely, for a given working temperature, we can determine the values for the absorbing surface "selectivity" parameters as a function of the concentration ratio; higher than these values, the usable energy does not increase in a significant way. The results of a study that shows the compromise between "selectivity" and concentration when the concentration ratio is relatively low are given.

ST79 22078 Proposed Floating Solar Energy Station for Producing High Temperatures

Plankenhorn, W.F.
Miami Int. Conf. on Alternative Energy Sources Miami Beach, FL
CONF-771203 p. 631-632 Dec. 5, 1977

No abstract available.

ST79 22079 Overview of DOE R and D Program on Concentrating Collectors for Solar Thermal Power Applications

Rannels, J.E.
DOE, Washington, D.C.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 1.9-1.18 Sept. 26, 1977

Some of the DOE R and D projects on concentrating collectors are reviewed, including fixed mirror collectors, compound parabolic collector, SLATS fixed receiver collectors, parabolic trough collectors, and parabolic dish collectors.

ST79 22080 Crosbyton Solar Power Project: Fixed Spherical Mirror/Tracking Receiver

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Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.61-3.70 Sept. 26, 1977

The Crosbyton Solar Power Project at Texas Tech. University deals with the solar gridiron concept, often called the FMDF (fixed mirror distributed focus) concept. Basically, the concept involves the use of large spherical segment mirrors fixed in position with the symmetry axis declined about 15° south of vertical. The support for the mirror involves excavation near the south lip and space frame near the north rim. A conical receiver, typically operating with a water-steam cycle, is the tracking element. The tracking requirement is for the receiver cone symmetry axis to lie, at all times, on the line determined by the center of the sun and the center of curvature of the spherical segment. The project, funded by ERDA, has been underway for 12 months, and a conceptual design for a nominal 5-MWe solar thermal electric system has been developed and matched to the load and climatic conditions of Crosbyton, Texas. The solar gridiron concept offers reasonable high-temperature performance at relatively low cost and there is some indication that such systems may be cost effective in the near term market.

ST79 22081 Overview of ERDA R and D Program on Concentrating Collectors For Solar Heating, Cooling, and Industrial Applications

Sargent, S.L.
ERDA, Washington, D.C.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 1.19-1.23 Sept. 26, 1977

No abstract available.

ST79 22082 Nonimaging Concentrators Deliver Higher Temperatures for Industry

Schertz, W.W.
Argonne Nat'l Lab., Argonne, IL
Solar Engng. V 2 No 7 p. 28-29 July 1977

The design and advantages of compound parabolic solar concentrators for high-temperature industrial uses are explained. Concentration ratios required for several temperature ranges from 140 to 600° F are discussed. Performance advantages over flat-plate collectors are enumerated. Commercialization progress is related. Contact information concerning USERDA patents is included.

ST79 22083 Fixed Moderately Concentrating Collector With Reversible Asymmetric V-Trough and Vacuum Tube Receiver

Selcuk, M.K.
Jet Propulsion Lab., Pasadena, CA
Concentration Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.93-3.101 Sept. 26, 1977

A vacuum tube receiver combined with an asymmetrical V-trough is being developed as an efficient solar heat collector for a range of about 100 to 200° C. An improvement in the efficiency of the vacuum tube receiver and a reduction in collector cost result with the use of the V-trough reflector. A triangular sectioned, flat surfaced reflector whose axis is laid in the east-west direction is reversed 180° on the equinoxes. The collector is tilted an angle which equals the latitude. Thus, a concentration ratio of about two is obtained for eight hours daily and year-round operation. A vacuum tube receiver placed at the bottom of the V-trough collects solar heat most efficiently since convection is completely eliminated; radiation losses are reduced by use of selective coatings on the absorber, and conduction losses can be minimized with a well-insulated manifolding system. Steady state performance based on the absorber area as well as day-long efficiency data are presented. A test bed for experimental evaluation of a fixed solar collector which combines an evacuated glass tube solar receiver with a flat-plate/ black chrome plated copper absorber and an asymmetric V-trough concentrator was designed and constructed. Analytical predictions of thermal performance were compared with test data acquired for a bare vacuum tube receiver and receiver tubes with Alzak aluminum, aluminized FEP teflon film laminated sheet metal and second surface ordinary mirror reflectors. Test results and system economics are discussed.

ST79 22084 Design and Predicted Performance of Scientific Atlanta's Fixed Faceted Mirror Concentrator

Shelton, S.V.; Blackshaw, A.; Hutchins, S.F.
Scientific-Atlanta, Inc.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.9-3.16 Sept. 26, 1977

A high-volume manufacturing design has been developed by Scientific-Atlanta, Inc. for a linear east-west fixed faceted mirror solar concentrator. This concept utilizes fixed east-west flat mirror slats oriented around a circular arc such that the resulting focal line is an east-west linear band in front of the mirror slats which moves north-south or another circular arc. Both the arc on which the mirrors are located and the arc on which the focal band moves are on a common circle lying in a vertical plane. The maximum energy is generally collected annually if the normal to the aperture is tilted from the vertical toward the equator an amount equal to the latitude of its location. The developed design incorporates 28 rear silvered mirror slats each of which are 7.3 cm wide and spaced over 105° of a 127-cm radius arc. The total collector aperture width is two meters. The east-west aperture length can be any integral number of three meters. The moving receiver at the focal band incorporates a secondary trapezoidal concentrator (groove type) with a 2:1 concentration ratio. Its aperture is 12.7 cm wide concentrating onto a 6.4-cm wide flat absorber surface. The mechanical design utilizes die stamped and roll formed galvanized sheet metal parts for the mirror slat supporting structure. This insures low manufacturing costs with the necessary accuracy of mirror location. The mirror slats are held onto the sheet metal brackets by spring clips. The receiver is made up of a flat, single-glazed absorber consisting of multiple side-by-side tubes and coated with black chrome. The sides and back of the absorber are insulated.

ST79 22085 Analysis of a Cylindrical Parabolic Focusing Collector for Distributed Collector Power System

Tanaka, T.; Tani, T.; Sawata, S.; Sakuta, K.; Horigome, T.
Electrotech. Lab., Tokyo, Japan
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 217-219 Dec. 5, 1977

No abstract available.

ST79 22086 Thermal Efficiency Test Procedures and Results for a Cylindrical Concentrating Collector

Thomas, W.C.
Virginia Polytech. Inst. and State Univ., Blacksburg, VA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 6.9-6.14 Sept. 26, 1977

The applicability and limitations of established test standards for evaluating cylindrical concentrating (CC) collectors are examined. A CC collector manufactured by Martin Processing, Incorporated is described. Differences between test procedures for CC and other collector designs are considered. Existing standards make no distinction between the "hour" angle and "acceptance" angles as related to the incident angle. Since test results should provide information for determining day-long response, a new test procedure for the angular response tests is suggested. The efficiency of a CC collector is generally much more sensitive to the directional properties and magnitude of the scattered component of solar radiation. Results for the thermal efficiency and angular response under various environmental conditions are shown and compared with theory.

ST79 22087 Annual Performance Comparisons of Parabolic Trough and Flat-Plate Collectors Based on Measured Insolation

Treadwell, G.W.; Grandjean, N.
Sandia Labs., Albuquerque, NM
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 9.25-9.30 Sept. 26, 1977

Parabolic trough and flat-plate nontracking collectors in various orientations have been analytically compared for annual performance capabilities at two locations and at various delivery temperatures. These comparisons have been made using hourly measured direct and total horizontal insolation and weather data. The comparisons indicate the parabolic trough will outperform the flat-plate collector at delivery temperatures as low as 80° F. This results because the thermal losses are lower and the tracking of the sun more than compensates for the trough's inability to use the diffuse component of radiation. Current state-of-the-art designs have been used. It is likely that materials improvements can be made in both parabolic trough and flat-plate collectors, but not enough to significantly change the outcome. If anything, design and materials changes will increase the differences in performance. Performance data for other locations will be obtained as solar and weather data become available. Surveyed collector cost information will permit the cost of energy to be calculated.

ST79 22088 Optical Performance of the Compound Trapezoidal Collector (An Optimized Nonfocusing Concentrating Collector

Truong, H.V.; Villanueva, J.
Florida Atlanta Univ., Boca Raton, FL
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.103-3.108 Sept. 26, 1977

This paper is concerned with the theoretical evaluation of the operating characteristics of an optimized nonfocusing "compound trapezoidal collector." A "compound trapezoidal collector" consists of two successive trapezoidal grooves the dimensions of which are optimized to accept all the solar insolation impinging on it when the sun's rays are directed along the optical axis of the collector. Previous results on computer simulation of this collector indicate that theoretical concentration ratios as high as 5 can be achieved. However, a daily average concentration ratio of 3.5 can be obtained with this optimal geometry. The computer simulations presented include the optical performance of the CTC for various reflective wall reflectivities and receiver surface absorptivities. Only direct solar radiation has been considered in the theoretical estimation so far. A more complicated computer simulation that includes diffuse solar radiation collection is now underway, utilizing a Monte Carlo technique. Predicted results are verified by direct testing of a prototype collector which was constructed to receive an evacuated tube at the target.

ST79 22089 Survey of Generic Types of Focusing Collectors for Large-Scale Applications

Wachtler, W.J.; Price, J.H.; Henry, R.L.; Hale, B.L.
Am. Tech. Univ., Killeen, TX
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.35-8.45 Sept. 26, 1977

The pertinent features and characteristics of focusing collectors are described, and their large-scale applicability is compared and evaluated from a generatic standpoint. The information provides a basis for the selection of a generic type of high-temperature focusing collector operating in the temperature range of 280 to 650° F. The data and information were obtained from a survey of a number of collector manufacturers. Five generic types of focusing collectors were surveyed: the parabolic trough, parabolic dish, linear-segmented array, Fresnel lens, and fixed mirror. Generic types are discussed in terms of their optical and structural characteristics. The components considered include the concentrator, receiver, drive mechanism, pylons, and tracking device. Design considerations are given to the auxiliary components used, such as flexible hoses, couplings, insulation, and construction materials. The collectable energy is compared for both single-axis and two-axis tracking modes. Further, the collector field layout and orientation are discussed regarding annual performance and heat losses. Collector selection criteria are identified as well as methods for making predictions of both performance and cost. A summary of the significant findings is presented, which consists of the availability of each type of collector in terms of size, cost, production, and development.

ST79 22090 Honeywell General Offices Solar System

Waters, D.E.; Block, R.F.
Honeywell, Inc., Minneapolis, MN
Concentrating Solar Collector Conf. Atlanta GA
CONF-770953 p. 8.21-8.28 Sept. 26, 1977

A description of an advanced solar energy HVAC system presently under construction by Honeywell, Inc. is presented. The solar system will provide 82 percent of the cooling energy, 53 percent of the heating energy, and 100 percent of the domestic hot water energy for a 100,000 ft^2 office building in Minneapolis, Minnesota. The solar system components are described, including the parabolic trough collectors, the heating and cooling subsystems, and the solar system controls. The technical rationale for the selection of the collector, the Rankine cycle turbine, the heat transfer fluids, and the thermal storage system is discussed. Annual and peak load system performance predictions are also presented.

ST79 22091 Industry Warms Up to the Idea of Solar Heat

Weimer, G.A.
Iron Age V 220 No. 16 p. 32-33 Oct. 17, 1977

General Extrusions, Inc. of Youngstown, Ohio has 100 semi-parabolic collector panels supplying heat for the company's aluminum anodizing department's hot acid dipping process. The collectors are semi-parabolic panels with limited tracking. All parts of the plant's

solar panels are aluminum except for the insulation and acrylic glazing. An oil-based heat transfer fluid is used to eliminate corrosion and protect against freezing. General Extrusions is hoping to market its system as soon as it has collected enough performance data to provide evaluation of its efficiency.

ST79 22092 Pyramidal Optics Solar Concentrating System

Wormser, E.M.
Wormser Scientific Corp., Stamford, CT
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 3.133-3.143 Sept. 26, 1977

A low-gain concentrating system, the Pyramidal Optics Solar Concentrating System, is described. The system has been incorporated in a model home of 1400 ft^2 heated area near Rehoboth, Delaware. The performance of the system through the winter of 1976-1977 is briefly described.

ST79 22093 Design and the Testing of a Solar Receiver for a Stirling Engine

Wu, Y.C.; Moynihan, P.I.; Day, F.D.; Selcuk, M.K.
Jet Propulsion Lab., Pasadena, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.63-5.74 Sept. 26, 1977

A highly efficient solar receiver is a key component of a solar electric power generation system that uses a sun tracking paraboloidal collector, a solar receiver, and a Stirling engine-linear alternator combination. As one part of the efforts in the development of such a system, a solar Stirling receiver experiment program was undertaken, and the results are reported. The design, testing, and test results of an experimental receiver, suggestions of advanced receiver design concepts, and considerations of the integration of the receiver with the Stirling engine are presented. This experimental receiver was adapted to a 2.90 m (9.5 ft) nickel vapor-deposited paraboloidal solar collector located at the Caltech JPL Table Mountain Solar Test Facility. The receiver is a cavity composed of four essential parts: a heat exchanger section, a properly contoured ceramic receiver body, an aperture piece, and an insulation canister. The test results indicate that such an experimental receiver can achieve an efficiency of close to 90 percent with possible improvements by minor design modifications and is thus a feasible receiver concept for the type of application under consideration. For field operation, however, it requires the incorporation of some heat storage capability.

ST79 22094 Problem of Rationally Packing the Facets of Large Collectors

Zakhidov, R.A.; Dudko, Y.A.
Geliotekhnika No. 5 p. 82-84 1975 In Russian

A shape for flat facets is determined which would ensure dense and horizontally axial packing on a paraboloidal solar collector. All the peaks of the facets would lie on the paraboloid, thus ensuring strain shaping, where all the initially flat facets, as a result of strain, would be transformed into extra-axial cutouts of the corresponding paraboloid of revolution.

23,000 HEAT PUMPS

ST79 23030 Cost and Performance of Heat Pump TES and Solar TES Household Energy Systems

TRW, Inc., Energy Systems Planning Div., McLean, VA
Avail:NTIS, ANL/EES-TM-15 p. 106 March 1977

In order to understand the various possibilities and roles thermal energy storage (TES) can play in household energy systems, Argonne National Laboratory has studied the engineering performance and economics of such systems. This phase of the study concentrates on the use of TES in conjunction with solar augmented and heat pump residential energy systems that provide hot water, space heating, and space cooling. The overall effort is directed towards evaluating the interaction of these systems with electric utilities in terms of costs and benefits to both the utility and the consumer. This interaction depends on the system's overall design, performance, and cost characteristics. This evaluation covers the three basic household energy services that lend themselves to thermal energy storage: hot water, space heating, and space cooling. The systems are evaluated individually; however, it is more likely that final design could be integrated to achieve a more effective system. The exception to this is the heat pump, which is generally sized to handle the cooling load, although it also supplies heating capacity. The solar systems are augmented by an electric utility. The systems are designed to minimize their impact on the utilities load management problems by use of a TES subsystem. The study evaluates these systems for a single-family dwelling unit, although it is recognized that systems for multiple dwelling units are often technically and economically more viable. Detailed evaluations of hypothetical future systems for which there is little basis to perform an economic evaluation are not included in this report. They will be considered in an assessment of R and D alternatives in the final study report. A summary evaluation is made, however, of the characteristics of some advanced TES subsystems in order to illustrate how much improvement they would offer over the baseline systems.

ST79 23031 Grimm Heat Pump System

Elektrizitaetsverwertung V 50 No. 3 p.100-105 March 1975
Avail:British Library Lending Div., Bostor Spa, Wetherby, Yorkshire, United Kingdom

The water-to-air heat pump for space heating is briefly described. The system can extract heat from solar collectors, ground water, a polyethylene tube buried in the ground, surface water, or waste water.

ST79 23032 Heat Pump Development for a Solar Assisted Heat Pump Space Conditioning System

Brookhaven Nat'l Lab., Upton, NY
3rd Conf. on Heat Pump Tech. Stillwater, OK
Avail:NTIS, BNL-24353 p. 24 April 10, 1978

A program to develop a cost-effective solar assisted heat pump system for space conditioning applications is described. In this system, the heat pump is the energy distribution vehicle. The collectors are relieved of this function and can now operate effectively over a wide temperature range including the lower temperatures easily developed by simple collecting structures. Thus, inexpensive collectors unsuitable for other solar heating systems can be used. This provides salient hope for cost effectiveness. Existing heat pumps, designed for "stand-alone" application, are not readily adaptable to the solar assist function, and the thermodynamic potential of the series solar assist concept is destroyed by forcing this mismatch. The development and cost-effective production of properly engineered heat pumps are within the state of knowledge of the vapor compression science, and this development has been initiated by contracts. The necessary heat pump characteristics are noted, followed by a technical discussion of how these characteristics can be obtained. The ongoin work in this area is then briefly described.

ST79 23033 Heat Pumps

N.D. Rec. Magazine V 23 No. 4 p. 43-56 Oct. 1977

A brief review is given on heat pumps, particularly relating to their use in North Dakota rural areas. Topics discussed include: (1)heat pump operating principles; (2)selecting a heat pump; (3)supplemental heating; (4)solar assisted heat pumps; and (5)installation and operation.

ST79 23034 Pumping in the Sun's Heat

Domestic Heat. News V 15 No. 4 p. 12 April 1975

The Battelle Institute's Columbus laboratories, in a study for U.S. National Science Foundation are developing a combined heat pump/solar heating system for homes. The concept involves a solar heated working fluid to drive a low-friction heat pump instead of being circulated to radiators for direct heating; the heat pump could provide heating, or cooling if run in reverse.

ST79 23035 Solar Assisted Heat Pump System For Cost Effective Space Heating and Cooling

Brookhaven Nat'l Lab., Upton, NY
Avail:NTIS, BNL-50819 p. 138 March 1978

The use of heat pumps for the utilization of solar energy is studied. Two requirements for a cost effective system are identified: (1)a special heat pump whose coefficient of performance continues to rise with source temperature over the entire range appropriate for solar assist and (2)a low-cost collection and storage subsystem able to supply solar energy to the heat pump efficiently at low temperatures. Programs leading to the development of these components are discussed. A solar assisted heat pump system using these components is simulated via a computer and the results of the simulation are used as the basis for a cost comparison of the proposed system with other solar and conventional systems.

ST79 23036 Solar Plant With Heat Pump and Waste Heat Utilization

Baier, K.
Mitteilungsbl. Dtsch. Ges. Sonnenenergie V 2 No. 6 p. 40-41 Nov. 1977
In German

An energy supply plant for a workshop and residential building is described. The already existing heating system was extended by a solar plant with heat pump while at the same time making use of the process waste heat of the welding facilities. Apart from this, a waste oil combustion plant was included in the overall concept. The costs for the extension amounted to DM 200,000. During the first year of operation, more than 20,000 L fuel oil were saved.

ST79 23037 Solar Assisted Heat Pump System: A Parametric Study For Space Heating of a Characteristic House in Madison, Wisconsin

Bosio, R.C.; Suryanarayana, N.V.
Michigan Tech. Univ., Houghton, MI
Am. Soc. Mech. Engng. Paper no. 75-WA/SOL- p. VP 1975

In the northern parts of the United States, where the winters are severe and the solar insolation limited, a significant part of residential heating requirements can be met by a solar assisted heat pump system. The effect of varying three significant variables of such a system are analyzed. The heating load and system performance were determined by employing a transient analysis for a hypothetical characteristic house using detailed three hourly weather data (and hourly solar insolation) for one heating season (1969-1970) for Madison, Wisconsin. The effect of varying collector operating temperature, storage capacity, and collector area are presented in tabular and graphical form. Analysis of fossil fuel savings and cost estimates are also presented.

ST79 23038 Heat Pumps Could Inject Life Into Solar Energy

Butler, P.
Engineer, London, and V 245 No. 6329 p. 52, 54, 55 July 14, 1977

Prospects for economical use of solar energy for domestic water and space heating, as well as for public buildings and swimming pools in the United Kingdom are discussed. The potential impact of developments in solar technology in the United States on these prospects are highlighted. Problems in retrofitting and consumer opinions are mentioned. Solar-assisted heat pumps for homes and public swimming pools in the United Kingdom are concluded to be nearly attractive economically. The favorable prospects of wind powered solar assisted heat pumps are briefly pointed out. The potential benefits of amorphous semiconductor solar cell developments in the United States are also briefly reviewed. The bulk of solar technology that might be used in the future in the United Kingdom is expected to be imported from the United States.

ST79 23039 Computer Modeling of Heat Pumps and the Simulation of Solar Heat Pump Systems

Freeman, T.L.; Mitchell, J.W.; Beckman, W.A.; Duffie, J.A.
Univ. of Wisconsin, Madison, WI
ASME Paper no. 75-WA/SOL- p. VP 1975

A generalized digital computer model of a residential size heat pump is described. The modeling strategy is to "design" or "size" the four major components in the vapor components in the vapor compression cycle to yield any desired designed condition performance. Once the system has been defined, the program is able to compute a "performance map" of heat added and heat rejected at all possible combinations of inlet flow-stream conditions. The model is applied to the thermal performance simulation of several different solar heat pump heating and cooling systems using the modular simulation program, TRNSYS. Performance of "in-line" heat pump boosted solar systems which use solar energy storage as the heat source are compared to "parallel" systems where the heat pump acts only as an auxiliary and ambient air provides the source.

ST79 23040 Chemical Heat Pump (Hydrated Salt Heat Pump)

Greiner, L.
ERDA-Information Exchange Mtg. for Thermal Energy Storage Program Gatlinburg, TN
CONF-770955 p. 289-295 Sept. 29, 1977

A preliminary investigation of the chemical heat pump, based on vapor hydration of salts as means of day and night heating and cooling of residences with solar energy is described. Its purpose is to integrate design and analytical studies and experimental studies to provide the background technology needed for design and fabrication of a pre-prototype. The design and analytical task includes theoretical and engineering analyses to refine an initial design sketch of the chemical heat pump towards a viable prototype, including external apparatus, interface requirements, control systems, estimated operating capabilities, and preliminary economic assessment. The experimental task is largely performed in laboratory models, and determines rates of water desorption from the salt as function of various physical parameters, rates of water condensation in selected configurations, cycling effects, and examination of inexpensive materials of construction with respect to mechanical life and chemical attack. Preliminary attention is given to $MgCl_2 \cdot XH_2O$ as salt absorbant. Analytical and design studies have resulted in a simplified collector-absorber design that appears capable of collecting the desired solar energy input at the required temperatures for operating the chemical heat pump. The experimental studies have established requirements for achieving the necessary conditions for absorption and desorption of water vapor. They show a strong dependence on the mechanical features of the system. These requirements are met by the collector-absorber design. Chemical corrosion problems have hampered the studies, but successful solutions appear at hand. Cycling studies appear initially promising.

ST79 23041 Solar Heat Pump Systems: An Analysis

Hurley, J.P.
Solar Heating, Cooling V 3 No. 3 p. 21-25 June 1978

A brief review of the heat pump system is given. The use of a solar assisted heat pump and the use of a heat pump assisted solar heating system are discussed. Both systems employ the use of a swimming pool.

ST79 23042 Energy Savings Through Combining of Operation of Heat Pump and Air Conditioning System

Hrycak, P.
New Jersey Inst. of Tech., Newark, NJ
23rd IES Annual Tech. Mtg. and Expo. Los Angeles, CA
CONF-770415 p. 157-160 April 24, 1977 Inst. of Environ. Sci., Mt. Prospect, IL

Considerable savings of energy are possible through improvement of the original coefficients of performance of air conditioning and heat pump systems by storing the energy rejected during the cooling season in order to be picked up during the heating season. The storage facility considered is a foundation soil. It is shown that capacity of such heat reservoirs is very considerable, and can be made an integral part of combined air conditioning/heat pump systems for a year-round operation. Inclusion of a solar heat collector into the system will give it an additional degree of flexibility.

ST79 23043 Refrigerated Solar Heating

Jones, R.; Ottaviano, V.B.
Domestic Engng. V 230 No. 4 p. 48-51 Oct. 1977

The use of solar collectors is discussed in conjunction with a water-cooled heat pump. The cost of the installed system is around $1600. Fewer square feet of collector space are needed since the ambient temperature is utilized. Lower collector temperatures remove the need for glazing resulting in reduced reradiation losses. Systems were installed in Dallas and Denver. In Denver the solar system had a booster coil added bringing the total cost of the system up to $2200. This system was usable for commercial purposes where the water is heated to a temperature of 120° or less. Expected performance charts are include included for the Dallas and Denver locations. The total solar contributions for the two locales are also indicated in a chart.

ST79 23044 Use of Solar Energy and Environmental Heat for Space and Water Heating

Kalischer, P.
Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen, F.R. Germany
Abt. Anwendungstechnik
Elektrowaerme Int. Ed. A V 36 No. 2 p. 87-92 March 1978 In German

The author first outlines the availability of solar energy in West Germany in comparison with other regions. The possibilities to make direct use of solar energy are discussed along with the indirect use by recovering heat from the environment for which purpose heat pumps are employed. These withdraw heat from water, ground, or the atmosphere and can be operated as single or dual-source units. Energy balances and investment cost are given for both direct and indirect use of solar energy. The conclusion is that the recovery of heat by heat pump is superior to the use of solar energy in terms of investment cost and at least equal to it in terms of energy gain.

ST79 23045 Determination of Optimum Heat Storage Volumes and Conditions in Complex Heat Pump/Solar Systems

Khumtsariya, R.K.; Turkestanishvili, O.A.
Tr. Gruz. Nauchno-Issled. Inst. Energ. V 16 p. VP 1962 In Russian

No abstract available.

ST79 23046 Applying Cost-Effective Solar Assisted Heat Pump Systems Now

Meckler, M.
Energy Group, Inc., Los Angeles, CA
Conf. on Tech. for Energy Conservation Washington, D.C.
CONF-7706140 p. 184-192 1977 Information Transfer, Inc., Rockville, MD

The problem of integration of promising solar augmentation concepts with conventional building heating, ventilating, and air conditioning (HVAC) systems, employing unitary water source heat pumps, is discussed. Discussions on the following are included: chilled water storage vs. load management options, utility pricing impacts, and solar system costs and market projections.

ST79 23047 Cost-Effective Solar Augmented Heat Pump/Power Building Systems

Meckler, M.
Energy Group, Inc., Los Angeles, CA
23rd IES Annual Tech. Mtg. and Expo. Los Angeles, CA
CONF-770415 p. 118-133 April 24, 1977 Inst. of Environ. Sci., Mt. Prospect, IL

The problem of integration of some promising solar augmentation concepts with conventional building heating, ventilation, and air conditioning and power systems is discussed. The following topics are discussed: solar variability, thermodynamic availability, heat pumps, Rankine cycle engines, chemical dehumidification potentials, operating cycles, dynamic storage potentials, selecting solar collectors for power options, and solar system costs and market projections.

ST79 23048 Solar Energy and Large Building HVAC Systems: Are They Compatible?

Meckler, M.
Energy Group, Inc., Los Angeles, CA
ASHRAE J. V 19 No. 11 p. 43-50 Nov. 1977

An extensive discussion of engineering parameters affecting the economic feasibility of use of solar powered heat pumps for large building systems is presented. Optimization of the Rankine cycle for use of solar energy is discussed. Operating features of a proposed solar powered heat reclamation air conditioning system (SPHRACS) are described. A detailed engineering flow diagram of the SPHRACS system is presented. Factors which affect economic feasibility of the SPHRACS system in several building and system configurations are discussed. Choices between the dual duct terminal system, single duct reheat system, and ceiling induction terminal system alternatives are described. Factors affecting selection of the working fluid are discussed. In the cooling mode, energy savings of 60 to 70 percent over conventional HVAC systems are projected for use of a SPHRACS. In the heating mode, saving of three to four-fold are possible.

ST79 23049 Operating Experiences With a Solar Project in New Martinsville, West Virginia

Schaeffer, D.
2nd Energy Symp. on Demo. Programs and Plans: Solar Energy in Pittsburgh
CONF-770617 p. 204-217 June 1, 1977 Pittsburgh, PA

A solar assisted heat pump system using flat-plate collectors for heating the people's Federal Savings and Loan Association Branch Building in New Martinsville, West Virginia is described. The system uses a glycol-water mixture as heat transfer and storage fluid with 4000-gallon tank storage and flat-plate collectors.

ST79 23050 Economic Optimization of Heat Pump Assisted Solar Heating in Illinois

Shams, A.; Mass, E.A.
Center for Biology of Natural Systems, St. Louis, MO
4th UMR-DNR Conf. on Energy Rolla, MO
CONF-7710136 p. 258-269 Oct. 11, 1977

This study undertakes the task of determining the optimal mix of solar and heat pump forms of heating. By installing a solar heating system a homeowner is considered to be an energy producer, and thus, to apply the least-cost methods used by firms in the competitive market for any given level of fuel conservation. The study will examine the simulated performances of air and liquid circulating systems in conjunction with heat pumps, in parallel as well as combined fashion. Optimization is achieved by equating the present value of the cost of solar and heat pump heating systems at margin.

ST79 23051 Heat Pump and Solar Heating and Cooling of Dwellings (A Brief Review)

Shvaleva, O.L.; Zakhidov, R.A.; Avezov, R.R.
Geliotekhnika No. 1 p. 72-79 1975 In Russian

After reviewing the problem of searching for economic systems of space heating and air conditioning, the authors propose a variant of joint utilization of semiconductor heat pump and a solar energy plant of the "hot box" type. A brief review of the development of semiconductor heat pumps abroad and in the Soviet Union is given. It is shown that the proposed heating and cooling system is more economical than those presently in use.

24,000 COOLERS

ST79 24008 Analysis of an Improved Solar Powered Cooling System Utilizing Open-Cycle Absorbent Regeneration

Los Alamos Scientific Lab., Los Alamos, NM
Mtg. of Am. Sect. of ISES Denver, CO
CONF-780808-10 p. 6 Aug. 28, 1978 LA-UR-78-1663

A solar powered cooling system which promises high system COP's and low collector costs is analyzed. It consists of a desiccant and an absorption cooling system operating in series to both dry ard cool the air. A common solution of lithium chloride is used as the absorbant. The lithium chloride solution is regenerated by evaporating the excess water to the atmosphere in an "open" collector. This collector consists merely of a blackened flat surface. The weak solution of lithium chloride is introduced at the top of the collector and then flows by gravity over the entire collector surface where it is subsequently heated and dried. The daily performance of this combined system is compared by computer simulation to that of either an absorption or desiccant system alone using actual weather data for five typical U.S. cities. The performance improvement of the combined system ranged from 25 percent to 95 percent, the greatest improvement being for humid, windy conditions.

ST79 24009 Application of Solar Energy To Air Conditioning Systems

IBM Federal Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150532 p. 80 Nov. 1976

The results of a survey of solar energy system applications of air conditioning are summarized. Techniques discussed are both solar powered (absorption cycle and the heat engine/Rankine cycle) and solar related (heat pump). Brief descriptions of the physical implications of various air conditioning techniques. Discussions of status, proposed technological improvements, methods of utilization, and simulation models are presented along with an extensive bibliography of related literature.

ST79 24010 Comparison of Solar Absorption and Vapor Compression Residential Cooling Systems, Interim Report

Univ. of Texas, Arlington, TX
Avail:NTIS, EPRI-ER-843 p. 39 Aug. 1978

Texas Electric Service Company and the University of Texas at Arlington are performing testing for the direct comparison in the same facility of solar powered absorption cooling and solar assisted electric-powered heat pump cooling for a single-family residence. Solar hot water heating and space heating with electric resistance and heat pump heating as back-ups are also included. The facility is a 1550-ft^2 residence which has been constructed as a solar energy research facility on the campus of the University of Texas at Arlington. A complete description of the facility is presented with emphasis on the solar heating and cooling equipment and the associated instrumentation. Calculated heating and cooling loads are presented with design predictions as to the degree of solar participation. A review of start-up and operating difficulties which have occurred since the facility has been constructed is also included. The program is beginning the second year of a two-year test plan.

ST79 24011 Control of a Rankine Chiller and an Absorption Chiller in the National Security and Resources Study Center

Los Alamos Scientific Lab., Los Alamos, NM
Workshop on the Control of Solar Energy Hyannis, MA
Avail:NTIS, LA-UR-78-2228 CONF-7805126-2 p. 5 May 23, 1978

The National Security Resources Study Center (NSRSC) at Los Alamos, New Mexico has 60,000 ft^2 of air conditioned space, solar heated and cooled with an 8000-ft^2 array of flat-plate collectors. The collectors have a selective surface of black chrome and are single-glazed with water-white glass. A paraffinic oil is used as the collector coolant, transferring heat to water through a heat exchanger. In the cooling mode, hot water is stored in a 5000-gallon pressurized tank and chilled water is stored in a 10,000-gallon tank. Two water chillers are installed in the system: a York lithium-bromide absorption unit (ESIA2), derated to 85 tons with 185° F water; and a Rankine cycle unit designed and fabricated by Barber-Nichols, rated at 77 tons with 200° F water. The chillers are installed in series with the 10,000-gallon cold storage tank. The mean daily values of measured energies in the NSRSC for 1978 are given. The percent solar cooling measured for

the 1977 cooling season is August, 73 percent and September, 92 percent. Observations on the system indicate that very little auxiliary energy is now used due to optimum management of solar energy and cold storage.

ST79 24012 Site Dependent Factors Affecting The Economic Feasibility of Solar Powered Absorption Cooling

IBM Federal Systems Div., Huntsville, AL
Avail:NTIS, DOE/NASA/CR-150533 p. 37 Jan. 1978

A procedure has been developed to evaluate the cost effectiveness of combining an absorption cycle chiller with a solar energy system. A basic assumption of the procedure is that a solar energy system exists for meeting the heating load of the building, and that the building must be cooled. The decision to be made is to either cool the building with a conventional vapor compression cycle chiller or to use the existing solar energy system to provide a heat input to the absorption chiller. Two methods of meeting the cooling load not supplied by solar energy were considered. In the first method, heat is supplied to the absorption chiller by a boiler using fossil fuel. In the second method, the load not met by solar energy is met by a conventional vapor compression chiller. In addition, the procedure can consider waste heat as another form of auxiliary energy. Commercial applications of solar cooling with an absorption chiller were found to be more cost effective than the residential applications. In general, it was found that the larger the chiller, the more economically feasible it would be. Also, it was found that a conventional vapor compression chiller is a viable alternative for the auxiliary cooling source, especially for the larger chillers. The results of the analysis gives a relative rating of the sites considered as to their economic feasibility of solar cooling. Before a final judgment is made on the cost effectiveness of a particular site, the influence of all parameters must be determined.

ST79 24013 Solar Collector for Space Conditioning

Nat'l Engng. V 82 No. 1 p. 5 Jan. 1977

The system described derives energy from a solar collector, which is supplemented by natural gas, electricity, or propane during periods of low solar input. The paper shows how the MEC unit operates in the cooling mode. Room air is directed through a drying wheel, which contains a desiccant. The air is then cooled in the heat-exchange wheel. After humidification, the air is returned to the room. The drying wheel is continually regenerated by the outside air stream. This stream is first cooled by humidification and then removes the heat accumulated in the heat exchange wheel.

ST79 24014 Solar Cooling "Not Yet Commercial"

Refrig. Air Cond. V 80 No. 951 p. 52 June 1977

A brief review of some factors preventing commercialization of solar refrigeration equipment is presented. Methods of solar cooling based on the greenhouse effect, the absorption principle, and on the chimney effects are briefly mentioned.

ST79 24015 Solar Powered Ice Maker

Refrig. Air Cond. V 80 No. 951 p. 43 June 1977

A solar powered ice maker is described which can produce 80 lb/day of ice. The 4' x 4' total system employs a flat-plate collector and ammonia-water generator combined in one unit. Potential applications are in developing nations in tropical climates for food preservation. In those areas, solar refrigeration is considered economically feasible.

ST79 24016 Solar Air Conditioning Performance Using Stochastic Weather Models

Anand, D.K.; Allen, R.W.; Bazquez, E.O.
Univ. of Maryland, College Park, MD
J. Energy V 1 No. 5 p. 319-323 Sept.-Oct. 1977

The performance of a solar powered water cooled absorption air conditioning system is obtained using real and synthetic data. The synthetic data are derived using five years of weather history and represented by a joint probability density matrix and six constants. The system performance is defined as the useful capacity of the absorption air

conditioner divided by the total radiation incident on the collector. This performance is obtained as a function of dry-bulb temperature, wet-bulb temperature, and solar insolation. The coefficient of performance using real data and synthetic data is compared and the predictions based on synthetic data are quite good. It is concluded that synthetic data allow very inexpensive simulation and yield satisfactory results for design purposes.

ST79 24017 Dehumidification by Solar Energy

Arnas, O.A.
Louisiana State Univ., Baton Rouge, LA
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 433-435 Dec. 5, 1977

No abstract available.

ST79 24018 Ingenuity and Experiment are Needed to Advance Solar Cooling

Beckman, W.A.
Univ. of Wisconsin, Madison, WI
Sunworld No. 6 p. 2-6 Nov. 1977

The author examines various solar cooling systems and points out some of the operational problems that must be solved if solar cooling is to be used extensively. Absorption cooling systems, liquid desiccant systems, solid desiccant systems, and Rankine cycle powered cooling are discussed.

ST79 24019 Hydride Heat Pump System For Building Air Conditioning Using High-Temperature Solar Input

Gorman, R.; Akridge, W.L.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.75-5.104 Sept. 26, 1977

This paper presents the results of a performance and cost analysis of a metal hydride air conditioning (heat pump) system as compared to conventional absorption heat pumps and a projection of the capabilities and uses of the system for power generation. This system concept was developed by D.M. Gruen et al., Argonne National Laboratory. Due to the preliminary state of development of the hydride conversion and storage systems (HYSCOS) concept, a major part of the effort was to develop a baseline design for a commercially practical hydride air conditioner, driven by solar energy obtained by concentrating collectors. A 100-ton design capacity was arbitrarily chosen to coincide with the size of commercially available lithium-bromide absorption heat pumps. The resultant 100-ton baseline system was estimated to have a coefficient of performance (COP) of 0.46 at a total cost of $17,292. In the baseline systems, the cost of the hydride represents 51 percent of the total cost. The above test estimates may be compared to a 100-ton lithium-bromide absorption heat pump which exhibits a COP of 0.68 and is commercially priced at $20,000.

ST79 24020 Modeling of a Solar Operated Absorption Air Conditioner System With Refrigerant Storage

Grassie, S.L.; Sheridan, N.R.
Univ. of Queens, Brisbane, Australia
Solar Energy V 19 No. 6 p. 691-700 1977

A detailed dynamic model of a solar air conditioning system is reported. The model, including the solar collector and cooling tower, is described in terms of design parameters. Ambient wet and dry-bulb temperatures and solar radiation are the required inputs. System temperatures, energy flows, and coefficient of performance can be predicted. Careful attention is given to the evaporator model and the control of refrigerant flow. Typical performance results are discussed. Several recommendations for future investigations are made.

ST79 24021 Refined Model of Solar Space Cooling System

Jenks, R.L.; Kremheller, A.; Rogers, W.A.; Jones, R.W.
Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 423-424 Dec. 5, 1977

No abstract available.

ST79 24022 How One Engineer Uses Solar Energy in Different Ways

Meckler, G.
Sershon Meckler Assoc., Washington, D.C.
Spec. Engng. V 38 No. 3 p. 92-97 Sept. 1977

Developed as a method of reducing summer solar heat gains, the thermal louver has been used to reduce annual energy use in large glass-curtainwall office buildings. Solar heat gain in these buildings is typically 40 percent of the total air conditioning load. The goal of the louver's original design concept was removal of up to 85 percent of the solar gains, thus significantly reducing summer air conditioning costs. Also inherent in its design is the ability to take winter solar gains and distribute this heat to cooler parts of the building. So it is able to reduce summer gains and supplement winter heating, the louvers mount inside the building, adjacent to perimeter glass areas. The blades are made from extruded aluminum and have a hollow center core through which water is circulated. The blades are connected to concealed manifolds that, in turn, are connected to the water transfer system. Also described is a chemical dehumidification system which is unique in that it makes use of solar energy at temperatures much lower than that required for absorption refrigeration. It, therefore, can use solar augmentation for a higher percentage of the cooling season.

ST79 24023 Liquid Sorbent Solar Air Conditioner

Robison, H.
Univ. of South Carolina, Conway, SC
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 437 Dec. 5, 1977

No abstract available.

ST79 24024 Economic Comparison Between Solar and Conventional Residential Air Conditioning In Miami, Florida

Rotolante, B.H.
Univ. of Miami, Coral Gables, FL
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 273-275 Dec. 5, 1977

No abstract available.

ST79 24025 Solar Absorption System for Space Cooling, Heating

Shwarts, I.; Shitzer, A.
ASHRAE J. V 19 No. 11 p. 51-54 Nov. 1977

Solar winter heating and cooling are considered the most promising prospects of solar energy utilization in the near future. The paper presents the feasibility of solar cooling and heating using the solar absorption system. Two mixtures in wide use for absorption cooling systems are NH_3-H_2O and H_2O-LiBr. The difference between the two compounds is that the lithium bromide is nonvolatile. The absorption system is capable of providing space cooling and is usually operated on waste heat or low grade heat. There are two modes of operation for space heating with the absorption system. The first system operates with solar heat supplied to the evaporator and additional nonsolar heat supplied to the generator. The other system functions similarly to a mechanical evaporation heat pump system. Flat-plate collectors or concentrating collectors can provide the energy necessary for the system. A thermodynamic analysis was performed for different ranges of the operation factors chosen to suit typical Israeli climate conditions. The system analysis shows that using the absorption system for space heating may effect up to 70 percent savings in energy requirements.

25,000 HEAT EXCHANGERS

ST79 25013 Ceramic Heat Exchanger: Applications and Developments

Pietsch, A.; Styhr, K.
Proc. of 5th Army Materials Tech. Conf. Newport, RI
Avail:AIAA, A79-12826 p. 385-395 March 21-25, 1977
Brook Hill Publ'ing Co., Chestnut Hill, MA

The potential for using ceramic heat exchangers to recover waste heat in selected industrial processes and in the direct combustion of coal is discussed. The paper also describes results recently achieved on two experimental programs which are evaluating silicon carbide tubes in heat exchanger applications.

ST79 25014 Passive Thermosyphon Solar Heating and Cooling Module With Supplementary Heating

Sigma Res., Inc., Richland, WA
Avail:NTIS, N79-15402 58 p.

A collection of three quarterly reports from Sigma Research, Inc., covering progress and status from January through September, 1977 are presented. Three heat exchangers are developed for use in a solar heating and cooling system for installation into single-family dwellings. Each exchanger consists of one heating and cooling module and one submerged electric water heating element.

ST79 25015 Prototype Solar Heated Hot Water Systems and Double-Walled Heat Exchangers

Elcam, Inc., Santa Barbara, CA
Avail:NTIS, N79-13495 11 p.

Development progress made on two solar heated hot water systems and two heat exchangers is reported. The development, manufacture, installation, maintenance, problem resolution, and system evaluation are described.

ST79 25016 Solar Energy Heat Exchanger and Method for Making Same

US Patent no. 4,085,491
Avail:Patent Office p. 4 March 1, 1976

A fluted strip of heat conducting material is spirally wound edgewise about a length of pipe to define a heat exchanger for receiving solar energy. The lateral edges of the flutes forming the outer edge of the strip define an undulating line superimposed upon a helix. The lateral edges of the flutes forming the inner edge of the strip define an undulating line superimposed upon a sinusoidal curve which is superimposed upon a helix. The flutes become oriented normal to the rays of the sun to effect maximum heat transfer as the angle of incidence to the heat exchanger varies. A method for producing the heat exchanger is also described.

ST79 25017 System Design Package: Maxi-Therm S-101 Heating Module, Passive Heat Exchanger

Sigma Research, Inc., Richland, WA
Avail:NTIS, DOE/NASA/CR-150516 p. 36 Oct. 1977

This document is the specification which establishes the requirements for the design, installation, and performance of a passive heat exchanger module (Model S-101) with auxiliary heaters for use with solar heating systems. It designates the interim performance criteria applicable to the subsystem and defines any deviations. This document also includes the manufacturing instructions and required materials and parts for the Maxi-Therm S-101 heating module.

26,000 SOLAR PONDS

ST79 26005 Energy Production From Solar Ponds

US Patent no. 4,063,419
Avail:Patent Office p. 8 Nov. 12, 1976

A method for obtaining solar energy in a useful form by utilizing solar ponds is described. The method comprises direct or indirect contact of hot liquid from the pond with a low boiling point immiscible working fluid for transfer of the heat energy from the liquid to the working fluid. The heated working fluid is separated from the liquid and flash evaporated to provide hot high-pressure vapors which are led to a turbine or similar working device to produce electricity. The spent vapors are thereafter condensed and reused in the system. The solar ponds employ a covering agent to minimize evaporation of the liquid and thus provide for a maximum internal heat building. Additionally, light absorbing dyes may be added to the pond liquid to improve solar absorbing efficiency. The pond liquids may alternatively be used for a medium thermal requirement process or supplying heat source for a building structure.

ST79 26006 Solar Ponds: Citations From the NTIS Data Base, Report for 1976-June 1978

NTIS, Springfield, VA
Avail:NTIS, NTIS/PS-78/0836 p. 34 Aug. 1978

Federally funded research on the design, performance, and use of solar ponds is discussed. Topic areas cover the use of solar ponds in industrial process heat production, roof ponds for passive solar buildings, and solar pond use in the production of biomass for renewable fuels.

ST79 26007 Shallow Solar Pond Design Improvements

Casamajor, A.B.; Trautt, T.A.; Flowers, J.M.III
Univ. of California, Livermore, CA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 151-160 Sept. 19, 1977

Improvements in the design of shallow solar ponds are reported. Reshaping the pond's bed improves draining at the end of the day and improves daily efficiency by 4 percent at no additional cost. The glazing support structure has been redesigned to improve its ability to withstand wind and snow loads. A moisture related problem with foamed glass insulation is identified and a solution proposed.

ST79 26008 Solar Production of Industrial Process Hot Water Using Shallow Solar Ponds

Guinn, G.R.; Hall, B.R.
Teledyne Brown Engng., Huntsville, AL
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 161-170 Sept. 19, 1977

The object of this effort is to demonstrate the performance and economic feasibility of shallow solar ponds (SSPs) for the production of industrial process hot water. Eight SSPs, each measuring 11.5' x 180 ' x 4" average depth, will heat 41,000 gallons/day of process water for a poultry canning operation.

ST79 26009 Solar Lagoons With Density Stratification: Physical Elements, Previous Results, Research Project

Hyacinthe, J.L.
CNEXO, Brest, France
Comples-Rev. Int. Heliotech. p. 37-38 1976 In French

The principal problems and physical factors for a solar pond, developed on the basis of linear exchange models and justified for an immobile fluid, are briefly reviewed. An experimental installation, which is to be placed in a Polynesian lagoon, is designed to test the concepts developed.

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ST79 26010 Circular Cylindrical Reflector: Application to a Shallow Solar Pond Electricity Generating System

Koui, C.F.
Lockheed Res. Lab., Palo Alto, CA
Solar Energy V 20 No. 1 p. 69-73 1978

The circular cylindrical reflector is shown to be a means of effectively tilting a solar energy collecting plane. This is particularly useful for swimming pools and solar ponds with free water surfaces that cannot be tilted. Such reflectors are applied to an electricity generating system which is driven by shallow solar ponds at a 40° latitude. Thereby, the annual electrical energy production can be increased by 40 percent; to a large extent power production can be leveled on an annual basis, and the turbine inlet temperature can be maintained at a constant level through the year.

ST79 26011 Solar Ponds

Nelson, E.
Pop. Science V 211 No. 6 p. 80-81 Dec. 1977

A solar pond is supplying heat to an Ohio State University Office Building. The salt distribution in the pond is responsible for the circulation of the heat. Professor Nielson is responsible for devising the system. The 2100-ft^2 pond is specifically designed to collect and store solar energy to heat buildings. Varying concentrations of salt in the pond trap heat in the bottom layer which has the highest concentration of salt. Heat exchanger piping draws off heat from the bottom layer. Nielson feels that farmers will benefit the most from the solar pond technology.

ST79 26012 Engineering Feasibility of an Irrigation Pumping Plant Using Shallow Solar Ponds

Platt, E.
Mech. Engng. Dept., Res. Engng. Div. 1977 Activities Highlights Rept.
UCID-17804-77 p. 19-26 May 18, 1978

Energy from shallow solar ponds is evaluated as possible alternative to purchased power for irrigation on farms. The relatively low-temperature heat could be used to run a freon engine of the waste-heat-recovery type coupled to a generator or well pump or both.

ST79 26013 Solar Ponds for Space Heating

Rabil, A.; Nielson, C.
Solar Energy V 17 No. 1 p. 1-12 April 1975

Solar ponds are defined as shallow bodies of water in which artificially maintained salt concentration gradient prevents convection. They combine heat collection with long-term storage and can provide sufficient heat for the entire year. Their operation and effectivity are considered.

ST79 26014 Absorption of Solar Radiation in Ponds

Viskanta, R.; Toor, J.S.
Purdue Univ., School of Mech. Engng., West Lafayette, IN
Solar Energy V 21 No. 1 p. 17-25 1978

Analysis is presented to predict the local rate of solar energy absorption in a pond using the radiative transfer theory. The physical model considers absorption and scattering by the water and internal reflection of radiation from the air-water interface, as well as the bottom. A forward scattering approximation and a discrete-coordinate approximation of the radiative transfer equation are discussed. Numerical results for the local volumetric rate of solar energy absorption in the water are presented for a range of parameters of physical interest. The effects of the directional distribution of solar radiation incident on the water surface, the attenuation of solar radiation by the atmosphere during the diurnal cycle, and the modification of the spectral radiation characteristics of water by impurities and additives on the absorption and distribution of the absorbed energy in the pond are investigated.

ST79 26015 Heat Extraction From a Salt Gradient Solar Pond

Zangrando, F.; Bryant, H.C.
Univ. of New Mexico, Albuquerque, NM
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 891-893 Dec. 5, 1977

No abstract available.

27,000 DISTILLATION

ST79 27003 Solar Desalination of Saline Water

Hua Hseuh Tung Pao No. 6 p. 10,18 Nov. 23, 1976 In Chinese

The construction and performance of a newly developed solar energy saline water distiller to supply fresh drinking water from April to September in the five alpine, dry and salty ground water northwestern provinces in China are described. The distiller is 2 m^2 in dimension, south facing, consisted of glass cover, water pool, water collector, and pipes and is able to produce two kilograms of water per day in good weather. The concentrated saline water is discharged after three to five days of distillation.

ST79 27004 Solar Energy Prospects in Saudi Arabia

Abdel-Aal, H.K.; Al-Somait, F.
Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia
Energy Commun. V 4 No. 3 p. 271-291 1978

This paper cites and examines some of the potential applications and research developments in the field of solar energy for Saudi Arabia. Water desalination, among other possible projects, has been treated in some depth. The outline of a multipurpose water desalination plant is described in this work. Such a scheme which utilizes direct solar radiation would produce fresh water, a concentrated brine to be used as a feed stock for the chlor-alkali industry and some valuable salts, such as magnesium chloride. Other topics discussed are: heating and cooling for housing; deep water pumping; and the assessment of some meteorclogical data pertinent to Saudi Arabia.

ST79 27005 Chemical Investigation of Water Distilled by Film Solar Plants

Aghilov, B.M.; Norov, E.Z.; Kamaeva, G.B.
Phys.-Tech. Inst., Tashkent, USSR
Appl. Solar Energy, USSR English Transl. V 12 No. 4 p. 68-69 1976

The results of investigations of salt water distilled in solar plants made of various film materials are considered. The influence of these materials on the ion composition of the distillate obtained following treatment is examined. The qualitative and quantitative compositions are given for the initial water and the distillate.

ST79 27006 Coupled Solar Still, Solar Heater

Davison, R.R.; Harris, W.B.; Moor, D.H.
Texas A and M Univ., College Station, TX
Proc. of 5th Int. Symp. on Fresh Water From the Sea Alghero, Italy
CONF-760588-P2 p. 437-446 May 16, 1976

Computer simulation of combinations of solar stills and solar heaters indicates the probable economic advantage of such an arrangement in many locations if the size of the heater is optimized relative to that of the still. Experience with various low-cost solar heaters is discussed.

ST79 27007 Design Philosophy and Operating Experience For Australian Solar Stills

Cooper, P.; Read, W.
Solar Energy V 16 No. 1 p. 1-8 Aug. 1974

No abstract available.

ST79 27008 Application of Solar Evaporation to Waste Water Treatment in Galvanoplasty

Dind, P.; Schmid, H.
Inst. du Genie de L'Environ, Fed. Inst. of Tech., Lausanne, Switzerland
Solar Energy V 20 No. 3 p. 205-211 1978

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Two experimental solar stills have been developed. One of them showed excellent results. Data have been collected, allowing one to know the mean productivity to be expected in a region of Switzerland. A solar waste water treatment system is proposed for the plating industry, which leads to possible recycling of chemicals and water by using counter-current rinsing and solar evaporation. A method of dimensioning stills and storage volumes is proposed; investment cost was calculated. Calculation shows that the proposed system is quite competitive with reverse osmosis in the range of small plating installations.

ST79 27009 Solar Distillation With Evaporating Wick

Hirschmann, J.; Rheinlaender, J.
Universidad Tecnica Federico Santa Maria, Valparais, Chile
5th Int. Symp. on Fresh Water From the Sea Alghero, Italy
CONF-760588-P2 p. 447-456 May 16, 1976 In German

The experimental investigations on solar distillers with evaporating wick realized by the Solar Energy Laboratory of UTFSM at Valparaiso, Chile are reported. The Model USM-9 with only one wick facing towards the equator in a flat container of galvanized sheet showed the best efficiency up to now. But the sheet must be replaced by a corrosion-resistant material (i.e., plastics). In order to gain qualitative information about the thermal processes in such systems, theoretical computations have been realized using the analogy between heat and mass transfer. This procedure showed that the air circulation caused by the thermosiphon effect in the Model USM-9 is not always advantageous. Its suppression by avoiding the backward air volume forces a greater partition of the total incident energy to leave the wick as latent heat of evaporation. Wick-type distillers demonstrate efficiencies which are about 1.3 times higher than those of basin-type systems, but they require more accuracy of construction and maintenance.

ST79 27010 Water by Dehumidification of Air Saturated With Vapor Below 80° C

Ivekovic, H.
Univ. of Zagreb
5th Int. Symp. on Fresh Water From the Sea Alghero, Italy
CONF-760588-P2 p. 457-465 May 16, 1976

The humidification-dehumidification process of air saturated with vapor below 80° C was studied by a number of authors. This paper deals with investigations on three variants of the process on humidification-dehumidification of air saturated with vapor at temperatures between 50 and 80° C.

ST79 27011 Direct Use of Solar Energy for Water Desalination

Moustafa, S.M.; Brusewitz, G.H.; Farmer, D.M.
Western Illinois Univ., Macom, IL
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 445-447 Dec. 5, 1977

No abstract available.

ST79 27012 Distillation of Sea Water Using Desert as the Solar Energy Collector

Rajvanshi, A.K.; Oliver, C.C.
Dept. of Mech. Engng., Gainesville, FL
CONF-771203 p. 441-443 Dec. 5, 1977

No abstract available.

ST79 27013 Economical Investigation of Solar Water Distillation in Egypt

Sakr, I.A.; Khalil, M.A.
Nat'l Res. Center, Cairo, Egypt
5th Int. Symp. on Fresh Water From the Sea Alghero, Italy
CONF-760588-P2 p. 477-482 May 16, 1976

Many ways of solar water distillation have been suggested but most of them are either too expensive or only a practical solution to different processes under investigation. Solar heat distillation has a bright future because the greatest potential needs appear to be in those sections where the availability of solar energy is high and the availability

of potable water is low as in our Egyptian deserts where the solar intensity has a yearly mean value of about 6000 kcal/m^2-day. The solar distillation method has a number of economic characteristics which are different from other sea water conversion methods, including: the processing equipment is very simple and results in low equipment costs. No special skills are required for both erection and operation; it can be used with saline water of wide range of salt concentration. The still design is essentially modular and can be made to meet any desired capacity. Scale formation and corrosion are minor problems as compared with other methods. Power requirements are negligible; the cost of unit construction is not markedly influenced by the size of the still. The lack of quantitative and operative data of solar water distillation techniques with respect to their cost needs in investigation from the economical standpoint of view in Egypt. The subject of this work is to find the order of magnitude of the fresh water cost by solar distillation.

28,000 PROCESS HEAT

ST79 28042 Application of Solar Energy to the Supply of Industrial Hot Water, Volume II. Appendix to the Final Design Report

Jacobs Engng. Co., Pasadena, CA
Avail:NTIS, TID-28745 p. 475 Jan. 31, 1977 For: Am. Linen Supply, El Centro, CA

The appendices for the conceptual design of a solar system for integration into the process hot water and steam services for the laundry facility, American Linen Supply, located in El Centro, California are presented. Included are: solar collector information, specifications, and design drawings; energy reduction analyses data; tables of insolation data; 36 system design drawings, analysis of heat transfer fluids, analysis of thermal insulation, design of system components, design of control system, design of electrical systems, and maintenance and repair; diagrams of instrumentation system; structure drawings and specifications; project organization chart construct schedule; method and results of economic analysis for comparison of solar process heat systems; and information on personnel involved.

ST79 28043 CCMS Special Format Report: Solar Industrial Process Heating for Can Warming At Queanbeyan, New South Wales, Australia

Commonwealth Scientific and Industrial Res. Organization, Melbourne, Australia
Avail:NTIS, SES-10 p. 14 April 1978 ISBN 0 643 01955 3

The system was 94 m^2 of flat-plate collectors. The original array had 77 m^2 using standard window glass and a copper oxide selective surface. The added collectors use low iron glass and chrome black selective surface. The solar process heating system is shown schematically and various subsystems are discussed briefly.

ST79 28044 Inflated Cylindrical Solar Concentrator for Producing Industrial Process Heat

Univ. of California, Lawrence Livermore Lab., Livermore, CA
Avail:NTIS, UCID-17612(Rev. 1) p. 24 Dec. 19, 1977

The use of industrial process heat below 170° C accounts for five percent of this country's total energy consumption. A concentrating solar collector to produce hot water and steam in this temperature range is under development. The collector structure consists of an inflated thin-film plastic cylinder that is clear on the upper portion and is an aluminized reflector on the lower portion. The reflector concentrates sunlight on a receiver tube which is jacketed with a heat transfer suppressing, thin-film, plastic cylinder. Because of its simplicity, it is believed this collector will be cost-effective relative to fossil fuels, such as oil at $15/bbl. Computer codes were written to analyze the optical and thermal properties of this collector. Results indicate that weekly tilting of the collector provides over 90 percent of the energy available from continuous tracking. A selective surface on the receiver tube (α = 0.92, ε = 0.20) increases the useful energy gain by more than a factor of five at 170° C. The stagnation temperature at the outer receiver tube surface is calculated to be below 350° C. Combining calculated optical and thermal efficiencies gives an overall collector efficiency of 20 percent for 170° C operation. This figure is based on an aperture of the full diameter times the length, and on beam radiation. The first experimental collectors are being constructed to verify our computer code studies. These units are 4 m long with an outer diameter of 1 m.

ST79 28045 Performance and Economic Feasibility of Solar Grain Drying Systems, Agricultural Economic Report No. 396

Economics, Statistics, and Cooperatives Service, Washington, D.C.
Avail:Dept. of Agriculture, ESCS Publications, Washington, D.C. p. 37 NP-23567
Feb. 1978

The performance and costs of eight experimental on-farm solar collectors designed to dry corn were studied. Solar drying costs were compared with costs of owning and operating conventional grain dryers. The costs of the lowest cost collectors were found to be as low as or lower than those for some conventional dryers. Depreciation and fuel costs were the major cost items contributing to this favorable comparison. Fixed costs for the eight solar collectors ranged from 6.6 to 26.6 cents/bu; variable costs ranged from 1.5 to 8.4 cents. Further research, mass production, and increasing energy costs should enhance the economic feasibility of solar grain drying. However, its dependability on sunshine and the uncertainty of solar performance in times of inclement weather are factors which may limit its use to a "solar grain drying belt."

ST79 28046 Proceedings of the Solar Industrial Process Heat Symposium

Univ. of Maryland, Dept. of Mech. Engng., College Park, MD
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 228 Sept. 19, 1977

The purpose of the symposium was to review the progress of various solar energy systems currently under design for supplying industrial process heat. Formal presentations consisted of a review of solar energy applications in industrial process heat, as well as several on-going project reviews. An open forum was held to solicit the comments of the participants. The recommendations of this open forum are included in these proceedings. Eighteen papers were included. Separate abstracts were prepared for each paper.

ST79 28047 Solar Energy System Performance Evaluation: Aratex Services, Inc., Industrial Laundry, Fresno, California, November 1977-May 1978

IBM Corp., Huntsville, AL
Avail:NTIS, SOLAR/2008-78/14 p. 49 July 1978

An operational summary of how the solar energy system installed at Aratex Services, Inc., an industrial laundry located in Fresno, California, performed during the report period is provided. This analysis is made by evaluation of measured system performance and by comparison of measured climatic data with long-term average climatic conditions. Performance of major subsystems is also presented to illustrate their operation. Included are: a brief system description, review of actual system performance during the report period, analysis of performance based on evaluation of meteorological load and operational conditions, and an overall discussion of results. Monthly values of average daily insolation and average ambient temperature measured at the Aratex site are presented. Also presented are the long-term average monthly values for these climatic parameters. The Aratex system collected an average of 67 million BTUs of solar energy per month. The available solar radiation was 75 percent of the long-term average. The use of both a solar energy and heat recovery system at Aratex has combined to reduce the total load of a system without heat recovery by approximately 45 percent. The solar energy system alone contributed 16 percent of the total hot water load at the site. Damage to the Lexan covers on 14 of the total 140 collectors was reported. This damage is believed to have been caused by winds.

ST79 28048 Solar Industrial Process Heat: Economic and Other Barriers

Univ. of California, Lawrence Livermore Lab., Livermore, CA
Conf. on Analysis for Solar Heating and Cooling San Diego, CA
CONF-780639-7, UCRL-81348 p. 13 June 27, 1978

Experience with experimental industrial solar energy systems, along with field and laboratory research, has led to several design criteria and guidelines for solar industrial process heat systems. The current cost of solar energy systems must be reduced by at least half before such systems will be economical for industry. Outside of the southwestern United States, the lower amount of available solar energy dictates that solar energy systems cost even less to be economical. Lack of adequate space for collectors limits retrofit applications, but this problem will probably not be serious in new industrial plants. Water heating collectors are generally preferred over air heating. Lower collection temperatures mean a less expensive, probably more efficient system. Cogeneration and waste heat utilization, where applicable, will probably take precedence over the use of solar energy. The need for and cost of heat storage can often be eliminated by connecting the solar energy system in series, rather than in parallel, with the main process heating system.

ST79 28049 Thermal Performance of the Aratex Services, Inc. Solar Energy System

IBM Corp., Huntsville, AL
Avail:NTIS, SOLAR/2008-78/25 p. 10 July 1978

The International Business Machines Corporation is contributing to the national solar data program of the Department of Energy by monitoring, evaluating, and reporting the performance of designated solar energy systems. The Aratex Services, Inc. solar energy system for preheating process water in an industrial laundry in Fresno, California and its modes of operation are briefly described, and a performance evaluation of the system is presented. The evaluation is based on comparison of predictions of climatic, load, and operational conditions with those measured at the site. The technique for determining the thermal performance is also presented. Associated documentation is described, and seasonal as well as typical monthly data are presented. These data are then briefly analyzed to produce an evaluation of the system performance.

ST79 28050 Concentrating Collector System to Supply Industrial Process Hot Water

Ameduri, G.; Rost, D.F.; Alexander, C.K.; Schuler, H.F.
Solar Energy Engng., Poland, OH
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.15-8.20 Sept. 26, 1977

Solar energy engineering has recently completed the engineering design, installation, and preliminary test results of a concentrating collector system integrated into an industrial process hot water application. A 408-m^2 (4400 ft^2) array of General Solar Systems Division of General Extrusions, Inc. own, design, and manufacture limited-tracking concentrator (3.67:1 concentration ratio) was built and installed on General Extrusions' roof in Youngstown, Ohio. This array is integrated into a solar-direct and solar-assisted heat pump system with storage to provide energy to a 77° C (170° F) 3656-gallon alkaline cleaning tank. Energy requirements for this application are 1.9 x 10^9 BTUs/year. The concentrating collector in this system is the General Solar Systems/Solar Energy Engineering Limited tracking concentrating solar collector. It features five cycles of a half parabola shape in a 3.0 m x 1.36 m, lightweight module. It requires no expensive tracking mechanism and is easily realigned in seven positions to produce maximum performance throughout the year. The energy output of the 408-m^2 array will be transferred to the alkaline cleaning tank through heat exchangers and a specially designed Westinghouse templifier industrial liquid-to-liquid heat pump. This system, as designed, is extremely flexible and can operate in a number of different modes and can produce output energy in the temperature range of 60 to 93° C (140 to 200° F). Because of the corrosiveness of the cleaning solution, the entire system is stainless steel and CPVC. This demonstrates the versatility of the system to handle a variety of industrial applications. The system is capable of producing over 500,000 BTUh (146 kW) at 88° C (190° F) during a sunny noontime.

ST79 28051 Review of the Use of Solar Energy For Industrial Process Heat

Anand, D.K.
Univ. of Maryland, College Park, MD
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 1-22 Sept. 19, 1977

The results of two surveys of the use of solar energy in industrial process applications are reviewed, first separately, and then to try and find some common ground. The conclusions of the surveys are compared. The industries reviewed are listed and process heat requirements are summarized for some. Fuel cost projections and the potential for solar energy are included.

ST79 28052 Opportunities for Solar Energy in California Industry, Agriculture, and Commerce

Barbieri, R.H.; Pivirotto, D.S.
Jet Propulsion Lab., Pasadena, CA
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 257-259 Dec. 5, 1977

No abstract available.

ST79 28053 Application of Solar Energy to Industrial Food Dehydration

Carnegie, E.J.; Niles, P.W.
California Polytechnic State Univ., San Luis Obispo, CA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 83-97 Sept. 19, 1977

The application of solar energy to an industrial raisin dehydration plant in Fresno, California is discussed. Included is Phase I, The Design and System Analysis, and part of Phase II, The Construction. The estimated costs and the actual costs are compared.

ST79 28054 Economics and Market Projections for Solar Process Heat Delivery Systems

Curto, P.A.
Mitre Corp., McLean, VA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 179-187 Sept. 19, 1977

Engineering cost and performance estimates are presented for solar process heat delivery systems for the agricultural/industrial process heat market sector and some preliminary market projections for solar equipments.

ST79 28055 Need for Government Economic Incentives to Promote the Use of Solar Energy for Industrial Process Heat

Dickinson, W.C.
Univ. of California, Livermore, CA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 189-198 Sept. 19, 1977

The average installed costs of industrial solar systems now being constructed under ERDA funded projects are considerably too high to make them attractive to industry. Cost reductions of a factor of two to three can be projected but a factor of about ten is needed to provide industry with a reasonable rate of return. This gap can be closed if the government provides some effective "fuel-savings" incentives to industry. The effects of different possible incentives are illustrated.

ST79 28056 Optimization of a Solar Timber Drier Using an Adsorbent Energy Store

Duffie, N.A.; Close, D.J.
Div. of Mech. Engng., Highett, Victoria, Australia
Solar Energy V 20 No. 5 p. 405-411 1978

This paper is concerned with determining the optimized design of a solar timber drier equipped with an absorbent energy store. To perform the optimizations, use has been made of a complex search method, each point being generated using a simulation program describing the drier. For the cost data used, the adsorbent store gave lower total costs than did a gravel bed store, and the best solar plus auxiliary energy system was cheaper than a conventionally heated system when the energy used was electricity.

ST79 28057 An Inflated Cylindrical Concentrator for Producing Industrial Process Heat

Gerich, J.W.
Lawrence Livermore Lab., Livermore, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 2.103-2.115 Sept. 26,1977

The use of industrial process heat below 170° C accounts for 5 percent of this country's total energy consumption. A concentrating solar collector is being developed to produce hot water and steam in this temperature range. The collector structure consists mainly of an inflated thin film plastic cylinder which is clear on the upper portion and is an aluminized reflector on the lower portion. The reflector concentrates sunlight on a receiver tube which is jacketed with a heat transfer suppressing thin film plastic cylinder. Because of its simplicity, it is believed this collector will be cost effective relative to fossil fuels such as oil at $15/barrel. Computer codes were written to analyze the optical and thermal properties of this collector. Results indicate that weekly tilting of the collector provides over 90 percent of the energy available from continuous tracking. A selective surface on the receiver tube ($\alpha = 0.84$, $\varepsilon = 0.20$) increases the useful energy gain by over a factor of five at 170° C. The stagnation temperature at the outer receiver tube surface is calculated to be below 350° C. Combining calculated optical and thermal efficiencies gives an overall collector efficiency of 20 percent for 170° C operation. This is based on an aperture of the full diameter times the length and on-beam radiation. The first experimental collectors are being constructed to verify our computer code studies. These units have an outer diameter of one meter and are four meters long.

ST79 28058 Inflated Cylindrical Concentrator for Producing Industrial Process Heat

Gerich, J.
Mech. Engng. Dept., Res. Engng. Div. 1977 Activities Highlights Rept.
UCID-17804-77 p. 2-18 May 18, 1978

A concentrating solar collector is being developed that will produce hot water or steam up to a temperature of about 170° C. Such a system is of interest because approximately 25 percent of the energy consumed in the United States in in the form of industrial process heat with about 20 percent of this heat used at a temperature of 170° C or below. Such collectors could potentially supply 5 percent of this country's total energy needs in the form of industrial process heat. It is planned to achieve an extremely low cost by using inexpensive, weatherable plastics and by developing a design which does not require tracking of the sun. The use of plastics most likely means replacing these components at regular intervals. It is also believed that the life cycle costs can be kept low. Analysis of this design shows that it can likely compete with fossil fuels such as oil at $15/barrel. The initial efforts were directed toward developing optical and heat transfer codes to model the concentrator performance. The heat transfer analysis began with the development of a model of the collector based on a thermal resistive network. Results of the codes are discussed.

ST79 28059 Concentrating Collector Applications in the DOE Agricultural and Industrial Process Heat Program

Greyerbiehl, J.M.
DOE, Washington, D.C.
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 1.37-1.44 Sept. 26, 1977

Several demonstration projects of agricultural and industrial solar process heat are briefly described. Solar grain drying, solar process heat for textile dying and concrete block curing, and solar water heating for can washing at a Campbell Soup Company are discussed.

ST79 28060 Soybean Drying Using Heat From Solar Energy

Guinn, G.R.; Fisher, P.N.
Teledyne Brown Engng., Huntsville, AL
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 111-120 Sept. 19, 1977

The objective of this project is to provide for the analysis, design, fabrication, testing, and demonstration of a solar energy system for process drying of soybeans. An array of 672 air collectors will be used to temper the inlet air to the existing continuous-flow dryers at the Gold Kist Soy Facility at Decatur, Alabama.

ST79 28061 Potential for Process Heat Applications of Solar Thermal Systems

Harmer, C.
Intertechnol/Sol Corp., Warrenton, VA
J. Am. Leather Chem. Assoc. V 72 No. 12 p. 475-488 Dec. 1977

A computerized model for prediction of performance and life cycle costs associated with solar thermal energy systems is described. The model was used to predict the potential for meeting the process heat needs of the tanning industry throughout the United States. Approximately 64 percent of the total process heat needs can be met cost effectively with solar thermal systems by the year 2000. Prototype systems and cost factors are discussed.

ST79 28062 Performance and Cost of Solar Industrial Process Heat Systems Utilizing the Parabolic-Cylinder Collector

Ludwig, D.
Intertech./Solar Corp., Warrenton, VA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 9.31-9.38 Sept. 26, 1977

Intertechnology/Solar Corporation has evaluated the technical performance and life cycle cost of a solar thermal system to produce industrial process heat utilizing the parabolic cylinder. The work was conducted under contract with Energy Research and Development Administration with the aim of evaluating the potential and problems of solar-supplied industrial process heat. A comparison of the performance and cost factors for flat-plate, compound-parabolic, low-concentration Fresnel lens, parabolic cylinder, and solar pond collectors showed the parabolic-cylinder collector to be the most cost effective collector for solar supplied industrial process heat applications above 175° F. For applications below 175° F, a well-designed single-glazed, black-chrome-plated flat-plate collector is the most economical system, even though the usable energy produced is less than that produced by the parabolic cylinder. The system studies were performed at six locations representative of six constant-performance solar regions covering the United States. Performance and cost factors were computed for a wide range of solar fractions of load and process temperature requirements, ranging from 125° F through 500° F. For example, a system supplying 50 percent of a 400° F (from 60° F) process energy requirement, collector output ranged from 219,000 BTU/ft^2-year in Schenectady, New York, to 613,000 BTU/ft^2-year in El Paso, Texas. The marginal costs of solar energy produced for the two locations are \$8/10^6 BTU and \$2.40/10^6 BTU, respectively. These figures represent the current life cycle value of delivered conventional fuel cost required for the solar system to be cost competitive.

ST79 28063 Feasibility of Using Solar Energy in a Canning Plant and Meat Processing Plant

Lund, D.B.; Duffie, J.A.; Levonowich, P.; Heidemann, R.; Buelow, F.
Univ. of Wisconsin, Madison, WI
ASAE Tech. Paper no. 77-6518 p. 1-25 ASAE Winter Mtg., Chicago, IL Dec. 13, 1977

Load models for a canning plant and several meat processing and manufacturing plants are generated and used in a computer simulation program for assessing the compatibility of the demands with solar energy supply collection and storage. Results suggest that fuel costs must rise and collector costs must decrease substantially before retrofit with solar assist is economically feasible.

ST79 28064 Concentrating Collectors Applied to the Industrial Process of Textile Drying

Mitchell, P.D.; Gupta, B.P.
Honeywell, Inc., Minneapolis, MN
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.29-8.34 Sept. 26, 1977

The first phase of this ERDA Solar Industrial Process Heat Program has resulted in the detailed design of a solar energy collector system for providing process heat to a textile drying process. The solar collection subsystem uses 700 m^2 of parabolic trough, single-axis tracking, concentrating collectors to heat water in a high-temperature water (HTW) loop. At the system design point (clear day), the solar collectors nominally generate 198° C water with the HTW loop at 2 x 10^6 pa. A steam generator is fueled with the HTW and produces 490 kg/hr of process steam at the nominal design point conditions. The generated process steam is at 0.5 x 10^6 pa and 160° C. The solar system will provide 1.2 x 10^6 MJ/yr to the process. This is 41 percent of the direct insolation available to the collector field during the operational hours (300 days/yr) of the Fairfax Mill. The process being solarized is textile drying using cylindrical can dryers. The can dryers are part of a "slashing" operation in a West Point Pepperell Mill in Fairfax, Alabama. Over 50 percent of all woven goods are processed through slashers and dried on cylindrical can dryers. Furthermore, since can dryers are also used in other drying processes, this application of solar energy to process heat is one that shows high potential for having a significant impact on displacing conventional fuels.

ST79 28065 Textile Drying Using Solarized Cylindrical Can Dryers

Mitchell, P.D.; Gupta, B.P.
Honeywell, Inc., Minneapolis, MN
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 171-178 Sept. 19, 1977

A solar energy system is described for providing process heat to a textile drying process. The solar collection subsystem uses 700 m^2 of parabolic trough, single-axis tracking, concentrating collectors to heat water in a high-temperature water loop. A steam generator is fueled with the HTW to produce process steam. The process being solarized is textile drying using cylindrical can dryers. The can dryers are part of a "slashing" operation in a West Point Pepperell Mill in Fairfax, Alabama.

ST79 28066 Design and Performance of an Air Collector for Industrial Crop Dehydration

Niles, P.W.; Carnegie, E.J.; Pohl, J.G.; Cherne, J.M.
Solar Energy V 20 No. 1 p. 19-23 1978

Test results are reported for the operation of unglazed and single-glazed solar collectors used to heat air to the 90° C range. The collectors were constructed of standard black painted metal decking and were tested in various lengths so that pressure drops and convective heat transfer rates could be varied independently of collector operation temperature. It is shown that the experimental collector performance results with single-pass operation are in substantial agreement with standard collector analysis procedures. These results give a firm basis for collector and system optimization.

ST79 28067 Low-Cost Solar Collector Suitable for Use in Peanut Drying Applications

Schlag, J.H.; Sheppard, A.P.; Wood, J.M.
Georgia Inst. of Tech., Atlanta, GA
Conf. on Solar Crop Drying Raleigh, NC
CONF-770686 p. 18-25 June 30, 1977

Over the past two years, three types of low-cost solar collectors have been tested to determine their applicability as energy sources for peanut drying. They are a black film hot air collector, an integral rock storage and collection system, and a shallow solar pond collector. The results to date indicate that the first two systems are the most promising and that the most effective method of utilizing them is to combine them in a series installation which we refer to as the augmented integrated rock system or AIRS. Two overriding considerations dictated the design of the collectors discussed. One was that they must be constructed of inexpensive materials and the other was that a farmer should be able to construct them on-site from a set of simple plans. It is felt that a solar system will have to meet these criteria if it is to receive widespread acceptance in the agricultural community.

ST79 28068 Experimental Solar Energy System to Provide Process Hot Water for Textile Dyeing

Trice, J.B.; Haas, S.A.; Savitsky, E.J.; Duff, T.
GE Co., Philadelphia, PA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 57-81 Sept. 19, 1977

Phase I of a three-phase program to design, build, and evaluate an experimental solar energy process hot water system for textile dyeing is summarized. The artist's sketch shows the textile plant and the 6680 ft^2 solar collector field that will supply 190° F water to an 1100-gallon dyeing tank at Riegel Textile Corporations's LaFrance, South Carolina facility.

ST79 28069 Potential for Solar Energy in Dyeing and Finishing

Trice, J.B.; Spera, R.J.; Haas, S.A.; Koenig, A.A.; McCarthy, R.L.
GE Co., Philadelphia, PA
Am. Dyest. Rept. V 66 No. 5 p. 24,26,28,32-34 May 1977

This paper describes a conceptual design of a demonstration system to utilize solar energy in a process hot (190° F) water system for a dyeing vat (dye-beck) in a typical textile mill. Critical performance analyses have led to the selection of high-performance solar collectors for a 6000-ft^2 solar collector field. Also, a complete system description is presented of primary and retrofit heat exchangers, thermal energy storage tanks, and automatic controls and instrumentation that apportions the supply of hot water from the solar energy system and the fossil fuel system. Computer programs are reviewed that have been developed to couple solar insolation profile data to industrial process hot water requirements and to yield both quantitative system performance data and in-depth economic analyses.

ST79 28070 Europe's Largest Solar Plant Dries Fodder

Urbanek, A.
Mitteilungsbl. Dtsch. Ges. Sonnenenergie V 3 No. 1 p. 21-22 1978 In German

A report is given on a solar dryer. A thermal power of maximum 1 MW is obtained with a collector surface of 1500 m^2 and a reflector surface of about 2100 m^2. The collector efficiency is about 64 to 84 percent. Air is used as heat transport medium. About 180,000 liters heating oil is to be saved per year by this plant.

ST79 28071 Solar Energy for Industrial Process Hot Water

Vindum, J.O.
Acurex Corp., Mountain View, CA
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 23-37 Sept. 19, 1977

Acurex Corporation is designing, constructing, and will evaluate a solar energy system for supplying industrial process hot water. At the Campbell Soup plant in Sacramento, California, solar-heated water will be used to wash empty and full soup cans on one of 20 parallel can-washing lines. The solar collector field is made up of a combination of single-glazed, nonselective flat-plate and parabolic trough concentrating collectors.

ST79 28072 Preliminary Assessment of Nontechnical Issues Related to Industrial Application of Solar Thermal Energy Systems

Watkins, G.A.; Brown, M.L.; Maiden, B.; Moore, J.; Smail, H.; Solomon, S.
Battelle's Columbus Labs., Columbus, OH
23rd IES Annual Tech. Mtg. and Expo. Los Angeles, CA April 24, 1977
CONF-770415 p. 134-146 Inst. of Environ. Sci., Mt. Prospect, IL

A preliminary assessment of nontechnical issues related to industrial application of solar thermal energy systems (SES) was performed. The assessment was made through review of the literature and contacting 100 individuals in 33 industries, public agencies, and others throughout the United States. There were three substantive areas and 10 issues addressed in this preliminary assessment of nontechnical issues. First, economic issues assessed were as follows: (1)technical uncertainties of SES; (2)noncompatibility of heat requirements; (3)cost differentials; (4)present need for incentives; and (5)industry investment criteria. The institutional portion of this study assessed the "need for government incentives" to promote SES in industry by reducing private risk. It also assessed the "impact of regulatory action" relating to building codes, zoning restriction, and water resource allocation. Finally, environmental issues for which a preliminary assessment was conducted included "system land requirements," "ecological effects of glare," and "reduction in pollution from alternative process heat sources."

ST79 28073 Application of Solar Energy to the Supply of Hot Water to Manufacture Cement Blocks

Wilkening, H.A.Jr.
AAI Corp., Baltimore, MD
Solar Industrial Process Heat Symp. College Park, MD
CONF-770966 p. 39-55 Sept. 19, 1977

AAI Corporation is currently on Phase II of a contract to design and build a solar augmented hot water system for curing concrete blocks. The collector array includes 9216 ft^2 of AAI's 24:1 concentrating collector system. The collectors will be applied to a new block plant near Harrisburg, Pennsylvania owned by York Building Products Company.

29,000 IRRIGATION PUMPS

ST79 29012 Department of Energy/Sandia Laboratories Solar-Powered Irrigation Program

Sandia Labs., Albuquerque, NM
Turfgrass Sprinkler Irrigation Conf. Lake Arrowhead, CA
Avail:NTIS, SAND-78-0950C, CONF-7806102-1 p. 11 June 9, 1978

A program to determine the feasibility of solar-powered irrigation is described. Three solar irrigation experiments in New Mexico and Arizona are reviewed briefly.

ST79 29013 Design and Installation Package for A Solar-Powered Pump

Calmac Mfg. Corp., Englewood, NJ
Avail:NTIS, DOE/NASA/CR-150740 p. 34 July 1978

Information is presented to evaluate the design and installation procedures of a solar-powered pump developed by Calmac Manufacturing Company. Included is information about subsystem installation, operation, and maintenance requirements; subsystem performance specifications; and detailed design drawings.

ST79 29014 One-KW Solar Pump System

Almanza, R.; Diaz, A.; Gonzalez, A.; Lopez, S.
Nat'l Univ. of Mexico, Mexico City, Mexico
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.47-8.53 Sept. 26, 1977

One of the objectives of a group formed in 1975 at the Institute of Engineering deals with the development of photothermal-mechanical processes in regard to power systems. The first stage is a 1-kW system consisting of the following parts: (1)30 m^2 parabolic cylinder collectors covered with different kinds of reflective materials. The focus of the parabola is located at 50 cm having a rim angle of 90^o. (2)An absorber at the focal position made of copper pipe covered with a CuO and Cu_2O mixture as the selective surface, in order to minimize the radiation losses. (3)The absorber is located inside a 10^{-2}-torr evacuated Pyrex glass pipe, in order to reduce the convective losses. (4)A steam piston engine was chosen as the mechanical system with about 50 percent efficiency. Also, a 1-kW steam turbine was tried, unfortunately with very low efficiency (about 5 percent). The working fluid has been steam at 170^o C at 3 to 5 atms pressure. This system has been connected to a pump in a shallow-water well.

ST79 29015 Turbo-Gearboxes for Solar Rankine Engines

Barber, R.E.
Barber-Nichols Engng. Co., Arvada, CO
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 5.105-5.112 Sept. 26, 1977

Turbine expanders are used by Barber-Nichols in solar air conditioning and irrigation systems because they offer: (1)the highest cycle efficiency since R-113 can be used in the Rankine loop; (2)good performance with low prototype cost; and (3)low cost in production. Development work is being carried on in the area of seals, and low loss and cost gearboxes. Photographs are presented of 4-HP and 25 to 100-HP gearboxes as examples. Solar Rankine engines for air conditioning (with flat-plate collectors) are presented that have demonstrated COP's of 0.45 to 1.2. Photographs are presented of these air conditioners and of a 25-HP irrigation engine that operates with concentrating collectors and has a cycle efficiency of approximately 15 percent. Development is progressing on improved three-ton and 25-ton air conditioning units (for use with flat-plate collectors), a 100-ton water chiller, and a 4-HP pumping unit (for use with concentrating collectors).

ST79 29016 Solar Power and Irrigation

Childers, R.
Mont. Rural Electric News V 25 No. 8 p. 10 April 1978

The Northwestern Mutual Life Insurance Company (NML), Milwaukee, Wisconsin and Battelle Memorial Institute (BMI) have joined in a cooperative venture to accelerate the development of practical applications of solar energy. A solar-powered irrigation system was developed and installed at Northwestern Mutual's 76,000-acre Gila River ranch near

Phoenix, Arizona. The ranch represents an agricultural investment in one of the country's most arid regions where intensive irrigation is required. Crops grown on the 25,000 irrigated acres include cotton, wheat, barley, alfalfa, and safflower. Alternative off-season uses are being considered, such as grain drying and providing space heating for greenhouses, livestock shelters, poultry houses, and farm houses. A major portion of the program involved system analyses using computer modeling in the design of the components and in optimizing the system. The NML/BMI 50-HP solar irrigation pump is the largest of its kind operating in the world.

ST79 29017 Where the Sun Waters the Desert

Halacy, D.
Mech. Illustrated V 73 No. 595 p. 78,80 Dec. 1977

The world's largest solar-powered irrigation system pumping up to 10,000 gallons of water per minute near Gila Bend, Arizona is described. Nine banks of linear parabolic collectors, each made up of 9' x 80' aluminum and honeycomb mirrors, are aimed at the sun by photocells. Associated plumbing carries the heated water to the boiler and a 50-HP Rankine-cycle turbine operating on freon. The operation of this privately owned system is described briefly.

ST79 29018 Engineering Feasibility of an Irrigation Pumping Plant Using Shallow Solar Ponds

Platt, E.
Mech. Engng. Dept., Research Engng. Div. 1977 Activities Highlights Rept.
UCID-17804-77 p. 19-26 May 18, 1978

Energy from shallow solar ponds is evaluated as possible alternative to purchased power for irrigation on farms. The relatively low-temperature heat could be used to run a freon engine of the waste heat recovery type coupled to a generator or well pump, or both.

ST79 29019 Basic Technical and Economical Aspects of the Use of Solar Energy For Pumping Irrigation Water

Pytlinski, J.T.; Eckhoff, N.D.
Kansas State Univ., Manhattan, KS
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 461-469 Dec. 5, 1977

No abstract available.

ST79 29020 Historical Developments of the Use of Solar Energy for Pumping Irrigation Water

Pytlinski, J.T.
Kansas State Univ., Manhattan, KS
Alternative Energy Sources Symp. Miami Beach, FL
CONF-771203 p. 449-460 Dec. 5, 1977

No abstract available.

ST79 29021 25-KW Agricultural Field Test Preliminary System Performance

Romaine, W.R.
Massachusetts Inst. of Tech., Lexington, MA
SemiAnnual Review Mtg. on Silicon Tech. Williamsburg, VA
CONF-770865 p. 123-131 Aug. 23, 1977

No abstract available.

ST79 29022 Acurex Concentrates on Solar Energy

Rossiter, E.
Acurex Corp., Mountain View, CA
Concentrating Solar Collector Conf. Atlanta, GA
CONF-770953 p. 8.1-8.13 Sept. 26, 1977

Several thermal applications for solar systems are described, including irrigation pumping, process hot water, and process steam. The design and construction of the 25-HP solar irrigation system at Willard, New Mexico is discussed in some detail. Some aspects on the economics and costs for systems are presented.

ST79 29023 Solar-Powered Irrigation Systems

Varnado, S.G.; Vandevender, S.G.; Lukens, L.L.
Sandia Labs., Albuquerque, NM
Alternative Energy Sources Symp., Miami Beach, FL
CONF-771203 p. 471-473 Dec. 5, 1977

No abstract available.

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LIST OF ABBREVIATIONS

ACES: American Chemical Engineering Society

AIA: American Institute of Architecture

AIAA, Inc.: American Institute of Aeronautics and Astronautics

2nd AHPT Conf.: 2nd Annual Heat Pump Technology Conference

AIChE: American Institute of Chemical Engineers

AIEC Workshop: Aluminum Industry Energy Conservation Workshop

ANL: Argonne National Laboratory

ASAE: American Society of Automotive Engineers

ASERC: Arizona Solar Energy Research Commission

ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers

ATEOPPIMOFP: Assessing the Effects of Power-Plant-Induced Mortality on Fish Populations

BNL: Brookhaven National Laboratory

BPNL: Battelle Pacific Northwest Laboratories

CPMTFESHCS: Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems

CSIRO: Commonwealth Scientific and Industrial Research Organization

DAA, Inc.: Development Analysis Associates, Inc.

DOC: Department of Commerce

DOE: Department of Energy

EDA: Economic Development Administration

EPA: Environmental Protection Agency

EPRI WTCEUEE: EPRI Workshop on Technologies for Conservation and Efficient Utilization of Electric Energy

ERDA: Energy Research and Development Administration

FEA: Federal Energy Administration

FRG: Federal Republic of Germany

GPO: Government Printing Office

Dept. HUD: Department of Housing and Urban Development

3rd Mtg. on HWTS II· 3rd Meeting on Heating with the Sun II

ICSSM: International Congress on the Sun in the Service of Mankind

IEA: International Energy Agency

IEEE, Inc.: Institute of Electrical and Electronic Engineers, Inc.

ISES: International Solar Energy Society

12th IEEE PSC: 12th Institute of Electrical and Electronic Engineers Photovoltaic Specialists Conference

12th ISECE Conf.: 12th Intersociety Energy Conversion Engineering Conference

JPL: Jet Propulsion Laboratory

LASL: Los Alamos Scientific Laboratory

LLL: Lawrence Livermore Laboratory

NASA: National Aeronautics and Space Administration

NBS: National Bureau of Standards

NESEA: New England Solar Energy Association

NMEI: New Mexico Energy Institute

NMSEA: New Mexico Solar Energy Association

NMSU: New Mexico State University

NOAA: National Oceanic and Atmospheric Administration

NPAEF Royal Inst. Forum: Nuclear Power and the Energy Future Royal Institute Forum

NRPA: National Recreation and Park Association

NSF: National Science Foundation

NTIS: National Technical Information Service

ORNL: Oak Ridge National Laboratories

SCH Nat'l Forum: Solar Cooling and Heating National Forum

SHCDPCR: Solar Heating and Cooling Demonstration Program Contractors Review

SEHGGRC Conf.: Solar Energy for Heating Greenhouses and Greenhouse/ Residential Combinations Conference

SERI: Solar Energy Research Institute

SGD Conf.: Solar Grain Drying Conference

SWEES (1976): 1976 Summer Workshop on an Energy Extension Service

UNESCO: United National Education, Scientific, and Cultural Organization

WCAHE: Workshop on Ceramics for Advanced Heat Engines

WMO: World Meteorological Organization