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Operating Solar Thermal Plants for Industrial Applications: Updated Statistics

More than 80 operating solar thermal plants for industrial applications have been reported up to October 2006, with an installed capacity of about 24 MW_{th} (34,000 m^2).

The majority of the plants operate in the sectors of food industry (especially dairies), car washing facilities, metal treatment, textile and chemistry. If we look at the capacity installed, the textile sector accounts for the highest share (about 40%) while e.g. the percentage of the transport sector is 5% (about 1 MW_{th}) due to a smaller average plant size.

Solar heat is used at 20-90°C for washing, space heating of production halls and preheating of boiler feed-water. A quite important application, especially in Greece, is the dairy, where solar is used to produce hot water for washing of equipment and to preheat the boiler feed-water at temperature levels up to 80 °C. Space heating of production halls (9 plants) is the most common application in Austria. Other applications in Austria are in the metal industry and car washing facilities. Car, lorry and container washing facilities account for 11 plants in Austria, Germany and Spain. Wineries account for 4 of the 6 plants reported within the beverage sector, showing a large potential for future applications.

Selective Flat Plate Collectors (FPC) are the most common solar thermal collectors in all industrial sectors analysed (about 70%). Parabolic trough collectors (PTC) are also relevant in terms of capacity installed (3.5 MW_{th}). Those in operation produce solar heat in two laundries, a brewery, the pharmaceutics sector and the transport sector mainly for space cooling and washing (working temperature up to 250 °C). Commercially available parabolic trough collectors require a certain minimum plant size (100–200 kW_{th}) for economic reasons. 8 plants have been realised with evacuated tube collectors (ETC) and 2 with compound parabolic concentrators for space cooling with a working temperature up to 95 °C.

About 80% of the plants supply heat below 100 °C: the major part are FPC or ETC systems working at 60-100 °C. In the range 100-160 °C only ETC installations are in operation, while above 160 °C PTC are used mainly for steam production or cooling with double effect absorption chillers.

Solar thermal plant for a carpet production factory in Italy (Source: Costruzioni Solari)

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Monitoring Results of the CONTANK Solar Plant for Container Washing

In the 2005 issue of this newsletter, a 357 kW_{th} solar thermal system for container washing close to Barcelona (Spain) was presented. The plant was equipped with a detailed monitoring system, fully operating since July 2006. The obtained data gives the opportunity of checking the real system operation, in order to validate the TRNSYS simulation model.

For instance, the real global incident radiation on the collector surface was 6.4% higher than the value used in the simulations.

The actual consumption (4,800 m^3 of hot water), evaluated from January to March and from July to September 2006, is 55.7% lower than the estimated consumption.

The two main reasons for this mismatch between the real and the estimated consumption are that the nominal working conditions (80 - 100 m^3/day; 5.5 days/week) have never been achieved and the percentage of cold water in the cleaning process is higher than expected.

Despite these aspects, the plant has been working according to the performance that can be expected under these conditions, as new simulations have shown. The solar plant has supplied almost 1/3 of the overall energy demand.

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Design Guidelines for Space Heating of Factory Buildings

Heat consumption for space heating of factory buildings is a non-negligible part of the global industrial heat demand. Factory buildings differ from residential buildings since the ceiling heights are higher and the required air temperatures range between 15 and 18 °C. Low temperatures and simplified system concepts offer ideal conditions for the application of solar thermal (ST) systems.

The concrete floor (thickness of 20-50 cm) can be used as a storage medium in conjunction with an under-floor heating system and replaces a traditional water storage tank. A built example in Austria shows that 100% solar fraction can be reached.

A good solution is to install the ST collectors into the walls of the factory building, thus obtaining remarkable solar yields in winter when space heating is needed and preventing overheating in summer. In addition, the collectors provide a prestigious looking façade that exhibits the high-tech image and the environmental consciousness of a company.

In central European weather condition, solar fractions of 20-45% can be reached. Design guidelines for typical factory buildings are currently being developed within Task 33/IV.

Solar-heated factory building of the collector manufacturer SIKO in Austria

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The Energy of the Sun for Brewing Beer

Two Austrian breweries were scanned for energy efficiency potentials and possibilities to integrate solar energy. The two companies showed two completely different production schemes, as one brewery is of industrial scale whereas the other one is a small home brewery.

For the industrial scale, the heat recovery can be implemented for heating water at lower temperature levels (up to 60-70 °C). The heating demand also shows that there is a large quantity of energy needed for the short-time preheater between 70 and 73 °C and for heating the water for the bottle cleaning system up to 90 °C.

For this demand, no energy supply by other process streams is available. Therefore, these processes are very suitable for introducing solar energy.

However, it has to be kept in mind that a lot of energy can also be generated from the draff, which is separated from the wort in the 'Lauter Tun' process. It is already state of the art to recover process energy by using this biomass as energy source.

Although the mass and energy flows look quite similar, heat recovery for the small brewery similar to the industrial process does not achieve high recovery yields, as warm process water is usually only needed every other day. Therefore, a promising method for the implementation of solar heat into the process has been identified. In co-operation with the brew master, a concept for the constructions and the brew boiler has been developed. The resulting pilot plant (SUNBREW) brews about 40,000 litres annually.

The demonstration solar thermal plant has a capacity of 14 kW_{th} (20 m^2), a 1 m^3 storage tank and a brew boiler of 400 litres. Since the temperature needed is up to 95 °C, special double-glazed anti-reflective solar thermal collectors have been used.

The SUNBREW solar thermal plant

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The PSE Linear Fresnel Process Heat Collector

The PSE linear Fresnel process heat collector is designed for applications with a thermal power starting at about 50 kW and operating temperature of up to 200 °C. 11 individually tracked mirror rows concentrate the direct sunlight to a stationary vacuum tube receiver with secondary CPC reflector. The collector length is modular in steps of 4 m (22 m² of mirror area). Due to its low wind load and the high ground coverage, it is ideally suited for installations on flat roofs.

The first full-scale prototype was manufactured in late 2005 in Freiburg and was operated and evaluated during the summer of 2006. The second unit (132 m²) was installed in August 2006 in Bergamo (Italy) to power an NH_3/H_2O absorption chiller. Further demonstration projects for solar cooling applications are currently under development.

Prototypes in Freiburg (left) and Bergamo (right)

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Task 33/IV Industry Workshops in Italy and Portugal

In 2006, Task 33/IV experts organised two Industry Workshop to share the results and the outcomes of task activities with the main stakeholders.

The Italian Industry Workshop, "Solar Thermal for Heat Production in Industries", was held on March 31st at the University of Rome "La Sapienza". About 150 people attended the seminar, promoted by the Province of Rome, the Region Lazio and the Ministry of Industry. The speakers' panel included policy makers, Task 33/IV experts and also representatives from solar thermal industry and small and medium enterprises.

The Portuguese Industry Workshop, "Solar Heat for Industrial Processes", was held on October 13th at INETI, Lisbon and was attended by about 70 people. Speakers represented Task 33/IV participants, experts on eco-design and sustainable efficiency measures for industry from INETI and also a solar thermal industry representative of a Portuguese manufacturer of CPC type collectors.

The presentations of both workshops are available for download at ***www.iea-ship.org/3_1.htm***