

## **Solar Energy for Heating the Paraffin-Wax for Candle-making**

### **1 Short presentation of the project**

Paraffinwax is the basematerial for the candle-making process. The annual production in the Kerzenfabrik Root (Switzerland) is some 4 million candles. For this approximately 650 tons of liquid paraffin-wax is used. The minimum temperatures of this material for the casting-process this material has to be between 70 and 110°C. The rawmaterial is delivered in liquid form to the plant with special trucks. It is then discharged into two storage tanks, with capacities of 40 and 27 tons. This liquid in the tanks has to be maintained at temperatures higher than 65°C in order not to freeze. This is done with pipe-type heatexchangers in the tanks with thermooil as heat-transfermedium, which is heated electrically. For this process some 160'000 kWh of electric power are used.

The target of the project is to replace a considerable amount of the electric with solar energy. The temperatures needed for the process are unusually high in the context solar energy with collectors. During a considerable time of the year, the season with low insolation, this high temperature requirements can only be met for short periods. In this periods the energy produced must be diverted to other users in order to achieve the best output of this plant all the same. This is done by heating the domestic water and the water for the roomheating of the production-building and two flats.

#### **1.1 Technical Approach**

##### **1.1.1 Collectors**

Because of the high temperatures needed, it is inevitable to use vacuumtube type collectors with little loss at higher temperatures.

##### **1.1.2 Hydraulics**

On the attached schematic the hydraulic circuit is shown. The energy of the collectors is fed to the thermooil circuit with a external plate heatexchanger and via a second heatexchanger for the house heating plant. This energy is fed to two storage tanks. Off them energy for the roomheating and the heating of the domestic water is supplied.

##### **1.1.3 Process-Control**

The process is controlled with a commercially obtainable solar and differential temperature controller. Some settings of this controller need special adjustment ranges due to the higher temperatures, a topic, which is presently discussed with the supplier.

Basically the energy is distributed for the two main users in the priorities:

1: Energy for the manufacturing process

2: Energy at lower temperatures for domestic water / heating.

A special prioritymanagement tries to obtain the first priority periodically depending on the actual insolation.

The following topics will be a matter of fine tuning during the initial period:

#### **1.1.4 „Creating“ the High Temperatures**

For the main topic of this plant - to get energy for the parafin - temperatures of 80°C minimum at the inlet of the heatexchanger are required. As mentioned above this will be more difficult and rare in wintertime with the sun standing low. During this season, coinciding with the heatingperiod, the main part of the output of the collectors will go to the domestic purposes. Once the domestic needs are fed in winter and also in summertime, it will be necessary to get the high temperatures needed as soon as possible. This may be done by choosing a minimal collectortemperature, before the extraction of heat out of the collectors is started. Consequently it is pretty clear that there will be a summer and winter mode to run this plant. The exact details are now under investigation.

## **2 Yield of the Plant**

It was not easy to make a prognosis of the yield for the plant proposed. Firstly it was not possible to simulate this plant with the common simulation computerprograms. The temperatures of the mainstoragetank are beyond the limits of those programs. Next also the Tables of the yield (Bruttowärmeertragstabellen) of the published collectortests (SPF Info CD) showed results which are related to the aperture surface and top at 80°C only average temperature of the collectors. After several discussions a table of yields was created with the Polysun 3.3, in which it is possible to „define“ a collector with its technical data. In this table a likely share of the percentage for each particular yield-line of medium collector-temperature up to 120°C was estimated. In this way, a yearly yield of 656 kWh/m<sup>2</sup>,a was established. For the entire plant approximately 60'000 kWh/a.

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