



EXTENSION OF SHELF LIFE OF FRUITS AND VEGETABLES BY SOLAR THERMAL DRYING WITH HIGH SOLAR FRACTION IN TEMPERATE CLIMATES

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The project described in this abstract shows a prime example of how sustainability in food processing can be achieved. The trade „Sonnenobst“ (sun fruit) sets high standards for the sustainable preservation of food by drying. Fruits and vegetables are purchased and harvested at regional ecological farms and gardens. The drying process is driven by solar energy. Finally, the sale of the products is run by regional marketing networks.

The raw materials i.e. fruits and vegetables are purchased from exclusively ecologically working partners from the “Kaiserstuhl” region near Freiburg, Germany. The effect of processing regional products is, that they can be used in further ways in addition to being sold as fresh fruit and vegetable. On the long run, this strengthens the fairly insecure financial situation of ecological farming. In addition to purchasing raw products from farms, the staff of “Sonnenobst” harvests from orchard meadows with standard height trees and seasonally also cares for these important wild life habitats.

In a second step, the fruits and vegetables are dried to extend their shelf life by using an innovative food drying system powered by solar energy. The system consists of the following components:

Evacuated tube air collector (24m²; ~16.8 kW, company Kollektorfabrik)
Hot air stone storage tank (1,5 tons, company phoma)
Food drying chamber (75 kg per batch, company CONA)

The measurement and control system is designed in such a way that in combination with the heat storage tank the use of solar energy is prolonged. Excess heat produced during peak sunshine hours can be used during times without sun. The control strategy allows an accurate temperature setting inside the drying chamber depending on the type of product being dried.

The way this renewable energy powered system is used gives an example for a strategy which could open up a much larger potential for the integration of renewables in the industrial sector. The „Energiewende“ in Europe is often rated by the market share of renewables within the electricity energy market only. Heat accounts for 70 % of the energy consumption within the industry. The market penetration of renewables within the process heat sector is below 1%

[1]. This means a huge and neglected problem within the public perception on the way to a sustainable society. Keeping the world's 1,5...2 °C target in mind and holding on to the commitment agreed upon by 195 nations during the last COP [2], substantial measurements need to be taken in the industrial sector. This would mean that industrial energy consumption and CO₂ emissions would have to be strictly regulated and deprived of governmental incentives. Another barrier to a rapid decrease in energy consumption and further deployment of renewables in the industry is the latter's continuous demand for energy. Production processes are mostly designed as „batch processes“ or „just in time“. Especially in large companies the continuous energy demand is contradictuous to the irregular availability of renewable energy. In contrast, agriculture, for instance, is a large sector where production times largely depend on environmental conditions. In farming, there is a season for sowing and a season for harvesting. „Sonnenobst“ gives a practical example of a food production process free of fossil energies through a solar-only¹ powered system. This is achieved by synchronization of production with solar energy availability. The products remain eatable for a year and more. Drying technologies in contrast to prolonging shelf life by cooling make it possible to save a substantial amount of energy. The product is of course not the same anymore. However, the addition of preservatives such as sulfur is avoided.

Conclusion:

The trade „Sonnenobst“ aims to pursue the following positive effects on nature conservation and climate protection:

- Regional drying of raw products saves energy expended for transportation. This is due to:
 - Products are preserved which are otherwise seasonal. They do not need to be imported during off season.
 - The decentral concept means small and nearby. As small amounts of fruits per batch are processed, advanced bicycle² transport can be used throughout all steps of the product's life cycle.
- Within the production of the trade „Sonnenobst“ it is favoured to process fruits which are not fit for the market because of size or looks. This can make regional organic farming more profitable as fruit and vegetables are used which might otherwise be thrown away (e.g. ~20 % of apples are defined as slight second). Organic farms play an important role in saving the environment through preserving habitats for animals by extensive farming, avoiding pesticides, less soil compaction etc.

¹ „Solar-only“ refers to the termic energy. The energy for the fan is electricity from the grid, <2% of the energy used for the drying process.

² Large e-motor supported bicycle trailer with a capacity of 200 kg are used (Carla Cargo, <http://www.carlacargo.de/>)

- Direct use and care for orchard meadows with standard tree heights. These are important to be preserved as wildlife habitats.
- Non fossil fuel fired food processing saves energy and reduces green house gas emissions.

For some of the above mentioned topics, information is given on the packaging. This is for advertisement purposes on the one hand, but also in order to give an example and raise awareness of the possibilities for sustainable food processing. It furthermore gives a signal to the food processing sector which uses up a high fraction of total industrial energy consumption. It needs to be admitted that regional fruit processing by solar drying and regional marketing of the same can not solve the problems our society faces. Pepper, for example, can not be grown in temperate climates in an adequate way. It shows only a niche with easy applicable ecological processes. Nevertheless, it is a step forward and a successful lighthouse project on the way to a sustainable society. Working with a solar only system with only regional processes and marketing makes the brand „Sonnenobst“ independent from energy and transport prices.

The company phoma GbR has two more projects in the pipeline to be installed in 2016. At the same time the topic “solar fruit dryer” is being pushed within the company by taking part in the “Econauten 2015”-program by Grünhof, Freiburg, Germany. It aims to support ecological business concepts.

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[1] Mauthner F, Weiss W, Solar Heat Worldwide. IEA, Solar Heating and Cooling Programme, 2011, edition 2013, Gleisdorf, Österreich.

[2] United Nations Framework Convention on Climate Change (FCCC) , Conference of the Parties, 12. Dec. 2015