In many countries like Nicaragua, outside major cities people are often organised in small communities. The milk supplying is done on a daily milking basis, mainly performed by hand. Due to this process of milking, the consumption is not generally subject to any treatment that would eliminate potential pathogenic microorganisms that the milk contains. As a result, there are public gastric health problems that regularly occur. Another aspect is that milk distribution, both in terms of space and time, is really difficult due to the high perishability of the milk.

Through a cooperative project funded by the Spanish University of Lleida, a system for milk pasteurization has been developed by getting the necessary heat power from a few solar thermal collectors. Pasteurizing milk in the early stages of handling avoids a large number of possible diseases such as salmonellosis or diphtheria.

The process of pasteurization basically has two possible procedures, which are HTST (high temperature, short time) and LTH (low temperature holding). The HTST process keeps the milk at a temperature of 72 to 75 °C for at least 15 seconds. The LTH works at a somewhat lower temperature of 62 to 65 °C, but over a time period of 30 minutes. Taking into account the range of temperatures, the duration of the treatment, and the requirements of the area, it has been decided to implement the high-temperature pasteurization.

One very important aspect has been to give priority to making a reliable and durable design of the pasteurizer, considering the economic and technological resources of the area, as well as materials and available knowledge. Inhabitants should be able to build it, to make replicas, to easily run it and to carry out maintenance.

The aim of the project was intended to cover three aspects: to prevent possible health problems, to prolong the shelf life period of milk and to increase the use of renewable energies.

Building the system

The milk production in the area of deployment is approximately 240 litres of milk per day. Assuming a treatment process time of 6 hours (40 litres per hour) and the requirement to heat the milk up to 75 °C, the system dimensions have been calculated at 6 m² of thermal collectors. The collector surface is divided into 3 interconnected panels, which were manufactured like the rest of the components, namely by hand.

Basically the process involves the heating of a properly insulated 250 litre water tank to a temperature of around 100 °C by the solar panels. A stainless steel spiral heat exchanger has been incorporated inside the water tank, which circulates the milk and...
heats it up to the required 75 °C. The outlet of the heat exchanger has been connected to a concentric tube recuperator system which preheats the inflowing milk before it enters the water tank. The tank in which milk is poured is placed on the water container, and the whole heat exchange system is positioned with height relevance. In this way, using static pressure, it is unnecessary to connect a pumping system. To ensure that the milk flows constantly through the heat exchanger, a Mariotte’s bottle has been added to the milk tank.

The dynamic behaviour of the system has been analysed using the programme TRNSYS 16 and meteorological data from Managua’s airport. As a requirement, the simulation considered a lower temperature limit of 72 °C, from which the range of HTST pasteurization starts. The results showed that in 85 % of days throughout the year the installation fulfils the HTST conditions.

The project showed that the construction of a solar system for pasteurizing the daily milk production in isolated or rural areas is a suitable and feasible solution, both from a technological and social point of view. The system implementation improved the hygienic/sanitary conditions for a product as basic as milk. The project may now act as a showpiece for other communities.

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