

# PARABOLIC SOLAR CONCENTRATORS FOR COOKING, FOOD PROCESSING AND OTHER APPLICATIONS

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## ABSTRACT

On our return to India from Germany, we have worked on the development of parabolic solar concentrators with input and collaboration of German and Austrian inventors.

We have gradually improved the solar technologies to include food processing based on inputs and feedback from users to fulfil their specific requirements.

We will discuss the acceptability and commercialisation of various systems that we have successfully developed, their implications and their benefit.

These success stories can work as multipliers.

These concentrators can have various other applications.

The Global Treaty Kyoto Protocol's CDM (Clean Development Mechanism) can result in a win-win situation for both developing and developed nations and the world environment at large - whereby developed nations get carbon credits by supporting renewable energy projects in developing nations.

North-South dialogue and South-South dialogue can effectively foster global co-operation meaningfully, to benefit people and environments ensuring sustainable development and protection of our planet Earth, our only HOME !!!

**Keywords:** Solar Concentrators, cooking, food processing, other applications, CDM

## 1. INTRODUCTION

The last few years have seen emergence and success of solar concentrators in India, especially for cooking applications, and work is in progress to use these technologies for other applications, too. These include incineration, increasing the rate of evaporation of waste water, in food processing for processes like chips making, making of jaggary, etc., producing drinking water from brackish and sea water, producing water above 80 degree centigrade (which was not possible with conventional available technology and widely accepted flat plate solar collectors), hot water generating systems, and steam generation in process applications in textile, dairy, pharmaceutical, chemical, food, paper and other industries.

Besides producing heat for various applications mentioned above, now work is also in progress in using solar generated steam in Vapour Absorption Machines (VAM) for cooling to be used in air-conditioning and chilling applications.

In this paper attempt is being made to trace the path how solar concentrators evolved, some case studies documenting its success to date and to present the vision as to where the use of these Solar Concentrators could lead.

## 2. BACKGROUND

On our return to India from Germany, we have worked on the development of solar concentrators with input and collaboration of German and Austrian inventors.

The SK-14 Concentrator is the development of Dr. Dieter Seifert of Germany. It is a parabolic dish with diameter of 1.4 meter. Within the focus of the dish there is an arrangement to place a blackened cooking vessel. The solar rays are concentrated at the focus, generating high temperatures and cooking the food in the vessel. The temperature generated is above 400°C and thus cooks the food faster.

Solar box cookers require 2-3 hrs to cook rice/dal/vegetables for 4-5 persons, whereas the SK14 requires ¾ to one hour to cook similar food for 10 – 15 persons.

Besides faster cooking, Sk-14 allows frying and making chapatis, etc., which is not possible in solar box cookers.

The output of the SK14 is 600 W and it is one of the most cost effective solar cookers considering its price : output ratio.

SK-14 cookers are ideal for cooking for large families and small communities, but it has its limitations when solar cooking is required for large communities. Besides its limitation in size, the cook needs to go out in the sun with the cooking vessels to place it in the focus of the dish, and the cook also needs align the dish manually according to the movement of the sun. This is called tracking. Since the quantity of food can be as much as 30 kgs, this can be quite inconvenient for the cook. Thus a community solar cooker was identified, which reflects the light into the kitchen allowing cooking within the comforts of the kitchen itself.

Through Dr. Seifert we came to know of Mr. Wolfgang Scheffler of Austria who provided us with technology for community solar cooking.

The flexible-curvature parabolic dish developed by Wolfgang Scheffler also had an automatic tracking mechanism (counter weight driven clockwork) and due to the dish having flexible curvature gave fixed focus and thus offered a solution to both cooking in comforts in shadow of the kitchen and also being automatic with no need to be tracked manually. It needs to be started and focused only once in the early morning.

We have named the dish Scheffler Concentrator after its developer Wolfgang Scheffler and it has become a brand name due to its success.



Picture 1: Scheffler cooker

There are more than 100 institutes in India where the food for the community (mostly students) is being cooked with Scheffler Concentrators. With one Scheffler dish it is possible to cook for 50-60 persons and the system is modular. When the number of meals to be prepared is more, than number of dishes can be increased. There are cases where there are three Scheffler dishes at an institute for cooking food and producing hot water.

Brahma Kumari's, a spiritual organization in Mt Abu, had installed 2 Scheffler Cookers supplied by St. Xaviers. They thus were happy when they heard that Eco Center ICNEER and Gadhia Solar were working on Scheffler dishes. They approached us with the request to supply them a system to cook for 1200 person. Various ideas and possibilities were evaluated, discussed and considered. Opiniond were sought from many experts including Wolfgang Scheffler, Christof Sutter (a Swiss Student who had done evaluation on use of Scheffler Cookers), HTT GmbH (a Company in Germany with whom Deepak Gadhia had worked). Finally it was decided to design a solar steam cooking system based on the Scheffler Concentrator with HTT GmbH agreeing to give technical expertise for thermal engineering, design of receivers, controls and a back-up boiler. It was a team effort with Wolfgang Scheffler, a team of Brahma Kumari's under leadership of Golo Pilz (a German BK disciple based in India), a team of Eco Center ICNEER and Gadhia Solar under the leadership of Deepak Gadhia, and the German Company HTT GmbH Under the leadership of Mr. Guenther Schmitt.

Brahma Kumari's were fortunate to get funding from a German government funding organization, GATE (German Appropriate Technology Exchange), under their Small Project Pilot Plant development. Thus in 1997 the then-world's-largest solar steam cooking system came

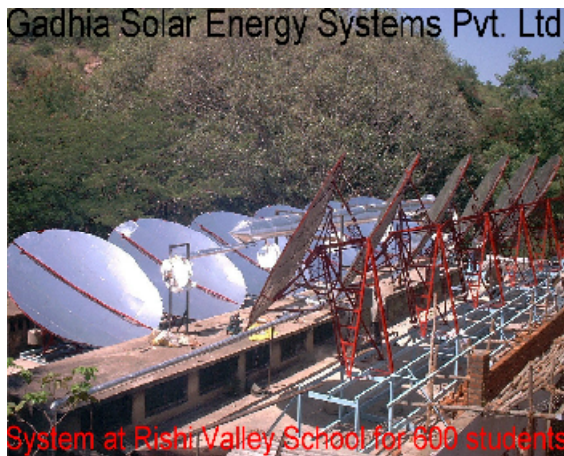
into operation at Gyan Saravor Complex of Brahma Kumaris in Mt. Abu, and it cooks for 1200 persons.

The System was a 2 loop system where the 12 receivers placed in the primary loop received concentrated solar rays from 24 Scheffler concentrators of 7 m<sup>2</sup> each. The pressurized hot water thus generated was sent to an external heat exchanger where steam was generated. The steam was sent to the kitchen and used for cooking. The system was hooked with the existing solar cooking system where previously the steam was generated in fuel fired boilers.

### 3. THIS PROJECT

Since then Gadhia Solar Energy Systems Pvt Ltd. of Valsad has supplied solar steam cooking systems on a turn-key basis for the following institutions :

- Shri Saibaba Sansthan Shirdi, Maharashtra to cook for 3,000 devotees
- Rishi Valley School, Madanappaly, Andhra Pradesh for 500 students



Picture 2: system at Rishi Valley School for 600 students

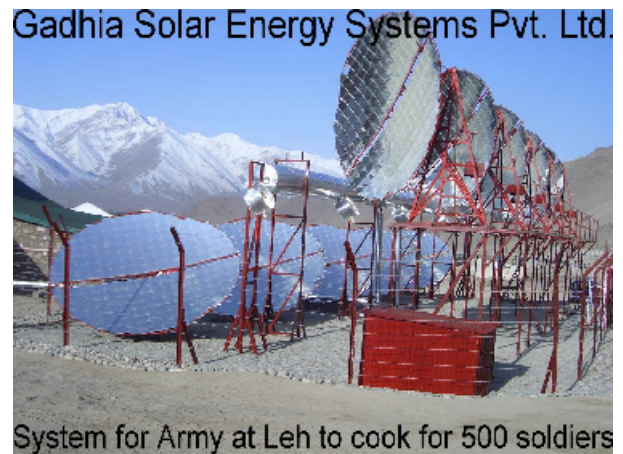
- Tirumala Tirupati Devasthanam, TTD, Andhra Pradesh for 15,000 devotees

- Sanghi Group of Hyderabad, A.P. for their Industrial Canteen for 500 people



Picture 3: System at Sanghi Textiles for 600 workers

- Sidhi Samdhi Yoga for their Ashram near Bangalore, Karnataka for 500 students
- The Indian Army at Ladakh in the Himalayas for 500 personnel



Picture 4: System for Army at Leh to cook for 500 soldiers

For the year 2005-2006 MNES has sanctioned further solar steam-cooking systems.

#### **Other applications :**

Now work is under progress at Gadhia Solar and Eco Center ICNEER for developing applications like

- a) Solar distillation with concentrators
- b) Smaller sized Scheffler Solar Concentrators of 2.7 m<sup>2</sup> for domestic cooking and for small dhabas / roadside teastalls and restaurants
- c) Development of 12 m<sup>2</sup> Scheffler Concentrator for use in food processing industries like potato chips making, jaggary making etc
- d) Waste incineration

- e) Solar Crematorium: Mr. Wolfgang Scheffler is working on a 50 m<sup>2</sup> solar crematorium and the initial results are very encouraging
- f) To increase rate of evaporation of waste water
- g) For use in textile and other process industries by generating water above 80°C and low pressure steam
- h) For bakeries to make bread, biscuits, cakes, etc.
- i) For drying applications where temperatures above 100°C are required.

#### 4. CONCLUSION

We would like to share our success on how the Global Treaty Kyoto Protocol's CDM (Clean Development Mechanism) can result in a win-win situation for the world environment at large - whereby developed nations get carbon credits by supporting renewable energy projects in developing nations.

Carbon credits from our solar steam cooking projects were purchased by the German Government to make the Renewable 2004 Conference in Bonn carbon neutral.

This clearly shows how North-South Dialogue and South-South dialogue can effectively foster global co-operation meaningfully, and benefit people and environments ensuring sustainable development and protection of our planet Earth, our only HOME !!!