Scheffler Solar Workshop - Dhule, India, 21st to 27th January 2012
Report by Pat McArdle

This seven-day workshop, held at the SSVPS College of Engineering in Dhule, India, was sponsored by the College and by Prof. Ajay Chandak's PRINCE Foundation. The Government of India's Ministry of New & Renewable Energy also supported this workshop. Its primary purpose was to provide hands-on training for the installation, commissioning, testing, operation and maintenance of Scheffler solar cooking systems. Its secondary purpose was to expose renewable energy professionals and technicians to a variety of low and zero emissions cooking systems.

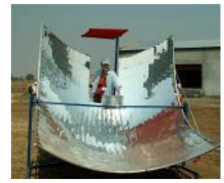
Although the workshop was initially designed to accommodate only thirty people, more than 110 applied and forty were accepted. Many of the applicants were Scheffler installers sent by their employers, but many others were Scheffler manufacturers, businessmen, young Indian entrepreneurs, investors and graduate students. Only three participants were from other countries: Celestino Ruivo of Portugal, an active promoter of small-scale solar cooking devices; Llewellyn Swift, an engineer from Capetown, who was interested in learning more about solar thermal technology; and me—the sole female in attendance.

Scheffler reflectors (80% of which are in India) are an established technology for large, rooftop steam generating systems, and on a smaller scale for direct indoor cooking systems. Close to 50% of Scheffler systems are currently not being used to full capacity due to a lack of properly trained installation and maintenance personnel—a deficit this workshop was intended to alleviate.

Participants learned the design principles of Scheffler reflectors in preparation for our first field assignment—taking measurements and calculating exact north-south alignments and latitude to correctly position the stand of the reflector. Scheffler reflectors require a permanent, shadow-free, year-round location and a kitchen or rooftop with an east-west orientation. Google Earth was the most precise tool for measuring, but manual calculations with a compass and hourly shadow markings were required to cross check the Google Earth coordinates. Scheffler reflectors apparently require seasonal adjustments every three to four days. (I had previously understood that these adjustments were made only three or four times per year). Currently most Indian manufacturers use thin glass mirrors for Scheffler reflectors.

Water boiling and kitchen performance tests were conducted on the Scheffler cooking system used at our workshop. Despite a light haze all day, a 15-liter pot of water was able to boil away two liters of water in one hour and cook 3.5 k of rice in 40 minutes. There is currently no formal testing protocol in India for certifying Scheffler reflectors. Professor Chandak is pressing the Ministry of New and Renewable Energy to establish such protocols.

A 16 square meter Scheffler reflector can save 5 kg of LPG per day. Similar fuel savings for smaller quantity community cooking can be achieved using institutional PRINCE parabolic reflectors, which were demonstrated during the workshop. They have wheels and can be moved to different locations. The PRINCE 40 and the PRINCE 65 (photo - rt), which holds a 35-liter pressure cooker (photo - left) and includes a shade canopy for the cook, can be



shipped in pieces and assembled on site. Both of the PRINCE models are less expensive to purchase, install and maintain than Scheffler reflectors. PRINCE institutional solar cookers would work well in regions where unskilled labor will be used for large-scale community cooking at schools and health centers. They could also be used for temporary kitchens in desert refugee camps, where they can be used most days of the year to cook with free solar energy—then disassembled and moved when needed to another location. On cloudy days, institutional biomass stoves like the rocket stove produced at Aprovecho or the institutional gasifier stove demonstrated at the workshop in Dhule could be used as back-up cooking systems.

I asked Prof. Chandak about the glare of parabolic solar cooker reflectors possibly causing eye damage. He said that although he provides sunglasses with all of his PRINCE parabolic solar cookers, it is his experience that training in the proper usage and positioning of a solar cooker is the most effective way to eliminate the risk of exposure to the reflected glare of the sun. Regarding the danger of fires, he noted that combustion temperature is only reached at the focal point of a solar cooker, which shifts constantly since the sun is moving through the sky with the earth's rotation. Although some Chinese and Indian solar cookers have a focal point outside the reflector, PRINCE parabolic solar cookers and the SK models have a focal point inside the reflector, which eliminates this danger. Schefflers have a fixed focus outside the reflector, but they are permanently aimed at a cooking or heating surface.

Watershed Organization Trust, an Indian NGO has installed twenty-three PRINCE 40 parabolic solar cookers in 22 village schools. Each PRINCE 40 is used to cook lunch for 40-50 students. These large solar cookers can be assembled in three hours. Professor Chandak emphasized the importance of using high quality reflective material in all parabolic solar cookers. He said that some Indian manufacturers were selling (and profiting from Indian government subsidies on) parabolic solar cookers with polished aluminum reflectors, which looked great at first but which oxidized and lost their reflectivity within six months. Chandak said that all reflectors should be made of polished, anodized, hard finish aluminum. Currently he buys the reflective material for his PRINCE solar parabolic cookers from German or U.S.-based companies.

Deepak Gadhia, who was the first person to begin large-scale use of Scheffler reflectors for solar steam cooking in India, attended the workshop for a day and spoke to our group about the history of solar cooking in India. He recalled that when he was an engineering student in Germany with his late wife Shirin in the early years of the Green Movement, a German woman told them that India didn't need high tech solutions for its problems. It needed 'appropriate' technology. Deepak and Shirin took this advice to heart when they returned to India after their studies and founded Gadhia Solar and ICNEER.

He lamented the fact that in just a few hundred years, humans will have extracted and burned up earth's entire supply of fossil fuels (which he reminded us took the planet hundreds of millions of years to create). He noted that the poorest countries in the world are among the sunniest and that fifty percent of the world's population still cooks over open fires. Deepak is promoting many renewable energy solutions including the development of solar crematoriums using Scheffler reflectors (with biogas back-up). He noted that there are 700 million Hindus in the world who will each someday require 200 kilos of wood for their cremations. Both Prof. Chandak and Deepak Gadhia reminded us that many energy efficient and renewable energy technologies were common in India a hundred years ago including floating biogas systems, retained heat cooking and gasifier stoves. They both said that the advent of cheap (and eventually subsidized) fossil fuels ended their use and slowed the further development of other renewable energy technologies.

Professor Chandak demonstrated a two-piece biogas digester made of heavy rigid black plastic (the same type of plastic used to make rooftop water storage tanks). These biogas makers come

in different sizes, can be nested for shipping and can be set up in just a few hours. The biogas they produce can be piped directly into a kitchen for cooking on a biogas burner (which works at a lower pressure than an LPG burner), providing an endless free supply of cooking gas from animal and plant waste. Participants visited a home with this set-up. Prof. Chandak's family uses only biogas and an SK-14 parabolic solar cooker. They have not used LPG for six years. He said that the average Indian family uses a 14 kg cylinder of LPG each month. The subsidized cost of a cylinder of cooking gas is 450 rupees ($9 US) (without the government subsidy it would cost around 1000 rupees—$20 US). The Indian Ministry of Renewable Energy is currently giving a 30% subsidy toward the purchase of biogas makers. Professor Chandak told workshop participants that he always offers a range of fuel-efficient cooking solutions to his clients. If they have access to a steady supply of animal and plant waste, he said that a biogas digester is all they need to meet their cooking needs, although he added that biogas digesters do not work well in cold climates. Large biogas makers can use the food waste from hotels and restaurants to generate power and help reduce the amount of garbage left to rot in the streets.

Chandak also fired up his PRINCE institutional wood gasifier stove, which has a fan powered by a ½ HP motor. He said the fan could be powered by direct current from a 2½ sq. meter photovoltaic panel. The PRINCE gasifier stove runs at 35-40% efficiency using wood or briquettes. Wood currently sells for 3.5 rupees/kilo. Briquettes (which can be made from agricultural waste) are 4.5 rupees/kilo. Chandak said that one kilo of LPG can be replaced in his stove by 2.5-5 kilos of wood depending upon the quality of the wood.

He demonstrated two small family-sized gasifiers. An Indian colleague of his, who designed and manufactured one of the stoves we were shown, was driven out of business after a patent infringement lawsuit from BP, which has developed a gasifier stove with a ceramic liner. All BP stoves require pellets made by a BP subsidiary. BP has sued for patent infringement other Indian manufacturers who try to market their own gasifier stoves. Some of these lawsuits might not have won in court, but because manufacturers have been intimidated, BP has managed to keep many gasifier stoves off the market in India. Chandak is confident that his new family-sized stove (photo), which he demonstrated during the workshop, is different enough from BP's stove that they won't bother to sue him.

Some gasifier stoves need to be turned upside down to dump out the used ashes, which can be dangerous and dirty. In Chandak's new gasifiers (the institutional and family sized models) ashes are emptied into a water-filled container under the stove. His target price for the family sized stove, with an adjustable flame is 1200 rupees.

Celestino Ruivo, who brought a roll of Mylar and several of his funnel solar cookers, prepared food for our group every day and amazed all of the workshop participants with the ability of his simple cardboard solar cookers to reach 150 c. (302F) and bake cakes, potatoes, fish, etc. He led several side workshops to teach participants how to build funnel solar cookers.

Chandak asked about future plans for the Solar Cooking World Network (formerly known as the Solar Cookers International Association). I told him that SCI's webmaster is culling inactive members, that SCI is recruiting new members, and that SCI is receiving updates from current members. I also told him that SCI is exchanging ideas on dissemination, testing, Gold Standard accreditation and carbon credits with a number of very active members of the SCWNet. He would like to be involved in this process.

On the final day of the workshop, Dr. R.P. Goswami, a senior administrator with the Indian Ministry of New and Renewable Energy spoke to our group about his government's plans for the spread of solar cookers and other renewable cooking devices in India. He noted that India receives 5,000 trillion kW hours of solar energy every year—most of which is still untapped. In some rural areas, the GOI is providing up to 90% in subsidies for solar cooking devices. He said that Ladakh, India's northernmost state, where temperatures drop to below zero, solar thermal cooking and heating devices are being installed with support from the state and national government.

When I spoke with Goswami at the workshop, I discovered that he was not aware of the Global Alliance for Clean Cookstoves. I also didn't know that the GACC director was planning to meet later in January with his boss, India's Minister for New and Renewable Energy. In mid-January, Dar Curtis gave the names of several Indian leaders in the global solar cooking movement including Prof. Chandak and Deepak Gadhia to the GACC for possible consultations with GACC officials. Dar and I also supplied their names (and those of other solar cooking experts around the world) to the GACC in January 2011 when GACC working groups were first being formed. Unfortunately none of these international solar and renewable energy experts have ever been contacted by the GACC. It's unfortunate that the GACC director was unable to meet with Deepak or Prof. Chandak during her visit to India. They are probably the most knowledgeable people in that country regarding the use of solar and other renewable energy technologies for cooking and food processing.

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