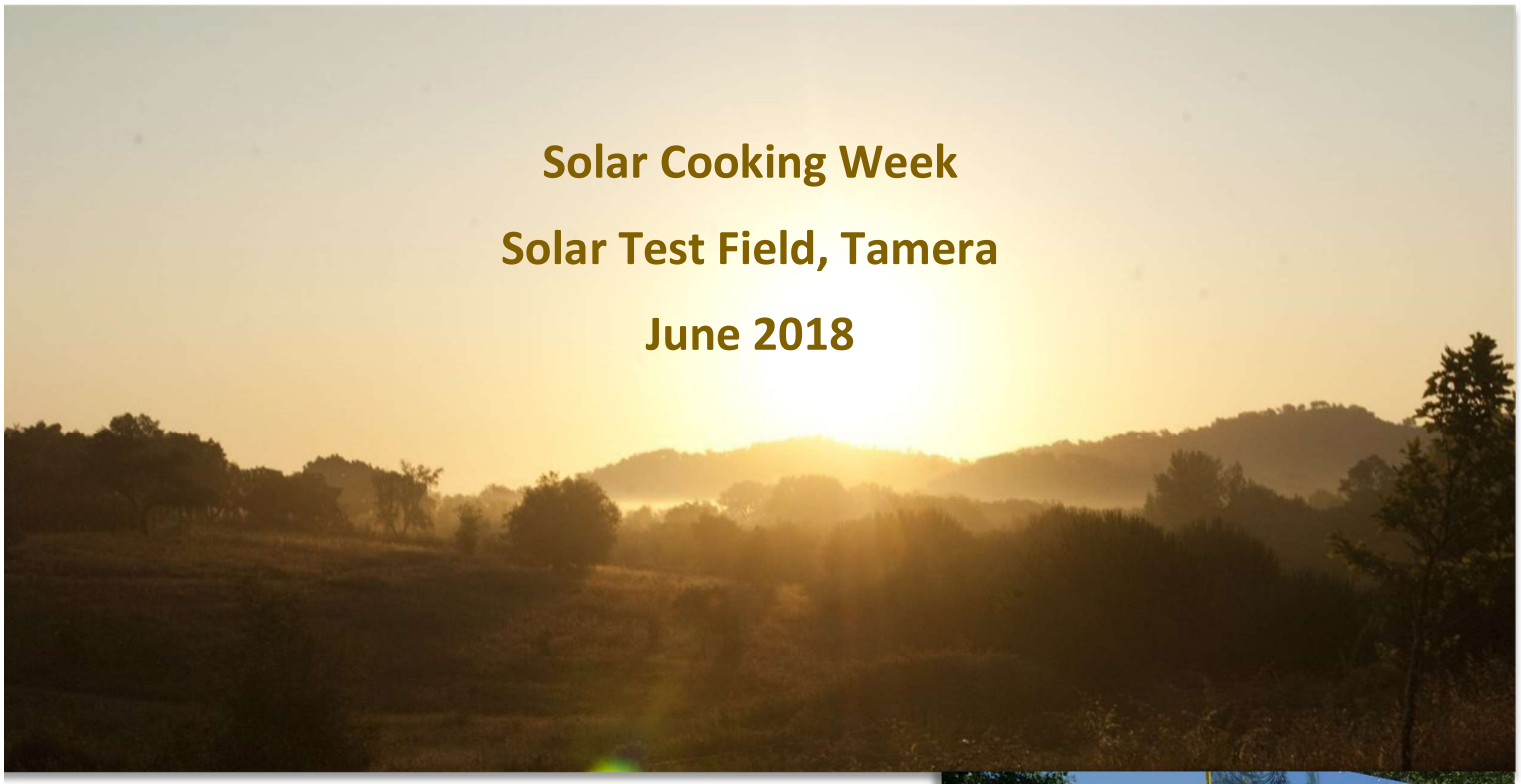

Solar Cooking Week

Solar Test Field, Tamera

June 2018

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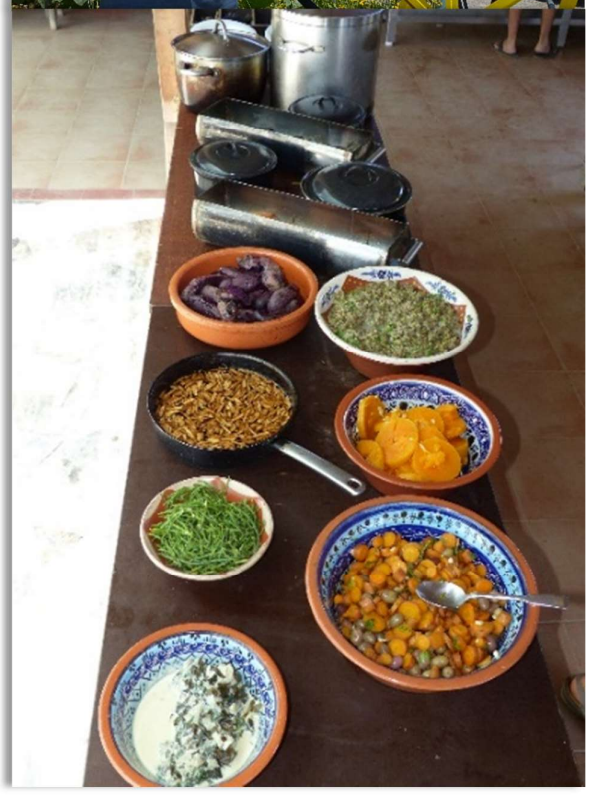

Introduction

The solar kitchen cooks daily for 50 up to 100 people using just direct solar energy and complemented by a 6 m^3 biogas digester. The goal of the solar cooking week was to test, optimize and integrate different smaller solar cooking devices into daily use in the solar kitchen of Tamera. Also, to gather technical and practical experience and information of these devices. Beside that it was an opportunity to research the social aspects of solar cooking, like social acceptance characteristics and different points of view between technicians and cooks.

The solar kitchen of Tamera is not just a central social point for the community, but it is also where different research cycles come together, like the water, food and energy cycles. In order for solar cooking to be accepted by the end user, the devices available for cooking should meet these characteristics:

- Simple to use. A small explanation and introduction is always necessary with new devices, but technical support shouldn't be a daily task.
- Robust and weather-resistant. The devices stand outside all year round. This must be considered in the choice of construction materials.
- Sufficient capacity. This communitarian kitchen cooks for groups between 10 to 60 people on a daily basis.
- Low fire hazard, also when not in use. This problem appears mostly with off-axis parabolic concentrators.

This report is intended to give an overview of the devices tested and integrated in the solar kitchen during this week.

Technical data in this report refers to the particular version of each cooker tested. Different optimizations of design details, for example reflector and collector area, can change characteristics.

Scheffler Reflector

Introduction

The Scheffler Reflector is an off-axis parabolic reflector with a stationary focus: a small lateral section of a larger paraboloid. The reflector rotates around an axis parallel to Earth's axis, focusing the sunlight to a stationary point that can be under a roof. The whole mirror can be tilted and flexed for seasonal adjustment to the sun's elevation. The stationary focus makes the Scheffler reflector very comfortable to use and similar to conventional cooking.

Conventional pots of up to 40l are placed over a secondary reflector. A baking oven can also be placed at the focus instead of the pot holder/secondary mirror assembly.

This well-established technology was open-sourced by Wolfgang Scheffler from Solare Brücke/Simply Solar in Germany. Different sizes of this reflectors are now available.

Technical Characteristics

Aperture area	4.3 – 6.4 m^2 (varies according to season)
Estimated power input (at 900 W/m^2 solar irradiation)	2.2 - 3.2 kW (varies according to season)
Maximum temperature	400°C
Tracking intervals	Automatic
Baking/Cooking volume	Pots up to 40 liters
Cost of material	~2000 Euros

Practical Characteristics

+ Cooking under a roof
+ Simple materials
+ Easy operation
+ Suitable for frying
+ Good weather resistance
+ High power

- Construction requires special training
- Requires special kitchen construction

How to get one?

Contact Simply Solar in Germany: www.simply-solar.de

More information: www.solare-bruecke.org

“The Parabola” Yaholnitzky

Introduction

``The Parabola´´ is a parabolic trough solar concentrator. Direct sunlight falling into the parabolic form is reflected onto the black tube positioned in the focal line of the parabola. The black tube absorbs the light and transforms it into heat. Up to three standard baking trays can be slided into the heated tube for baking or cooking.

The original design was made by Ivan Yaholnitzky from SolarSoft in Lesotho. We took the original design and adapted it to our local materials and manufacturing possibilities.

Technical Characteristics

Aperture area	1.6m^2
Estimated power input (at 900 W/m^2 solar irradiation)	1 kW
Maximum temperature	170°C
Tracking interval	15-20 min
Baking/Cooking volume	3 of 30x7x10cm bread loaf tins
Cost of material	220 Euros

Practical Characteristics

+Easy to build (metal and wood experience required)
+Simple materials (except mirror surface)
+Easy operation
+Suitable for baking
+Good weather resistance

- Low performance in windy locations
- Tracking interval is short

How to get one?

Blueprints coming soon.

Contact Tamera technology team: solarvillage@tamera.org

Tolokatsin

Introduction

The Tolokatsin is a CPC (compound parabolic concentrator) with a cylindrical absorber in the focal line. This CPC device has an incidence acceptance angle of ~28°, making the tracking interval comfortably long. In a time of 2 hours the cooker does the job by itself and turns off automatically. This device is comparable to a slow cooker.

The original design was made by Prof. Eduardo Rincon from Mexico. We adapted his design to our materials and made the tube 16cm diameter and 90cm long to be able to cook 9 liters of food at a time.

Technical Characteristics

Aperture area	1.1m^2
Estimated power input (at 900 W/m^2 solar irradiation)	700 W
Max. temperature	150°C
Tracking interval	2 hours
Cooking volume	2x 45cm custom-made tins (total 9 liters)
Cost of material	150 Euros

Practical Characteristics

+Easy to build (woodwork experience required)
+Simple materials (except mirror surface)
+Easy operation
+Suitable for boiling
+Simple tracking system
+Suitable for windy locations

- Wooden housing should be protected from rain

How to get one?

Blueprints coming soon.

Contact Tamera technology team: solarvillage@tamera.org

``Pukka´´Funnel Cooker

Introduction

The Funnel is a panel cooker. It is well known because it is very easy to build from various materials. With a good reflective material, it is a very cheap and effective cooker.

This cooker uses two recycled washing machine door glasses as a heat trap to prevent convection losses from the pot.

This concrete version is resistant to weather conditions and doesn't blow away even with strong wind. Other versions like the one built from cardboard are portable and lightweight, perfect for a Sunday trip to the beach.

This is a design from Prof. Celestino Ruivo from Portugal.

Technical Characteristics

Aperture area	0.5 m^2
Estimated power input (at 900 W/m^2 solar irradiation)	300 W
Maximum temperature	150°C
Tracking intervals	1 Hour
Baking/cooking volume	3-liter pot
Cost of material	40 Euros

Practical Characteristics

+Easy to build
+Simple materials
+Easy operation
+Suitable for cooking and baking
+Good weather resistance

- small cooking volume

How to get one?

Blueprints and information for cardboard version: www.mueller-solartechnik.com/FunnelCookerCelestinoRuivo.pdf

Blueprints for Concrete version

Contact Tamera technology team: solarvillage@tamera.org

SK-14

Introduction

The SK-14 is a parabolic bowl into which a black pot is placed at the focus. The mirror surface can be moved around the pot, which remains stationary. It is a very effective and fast solar cooker due to its large aperture. Big pots can be placed at the focus for cooking, or smaller pots inside glass bowls can be used for better results. An SK14 can also be used in conjunction with a Pukka, by using the SK14 to bring a pot quickly up to cooking temperature, and then transferring the pot to the funnel for slow easy cooking.

The original design was made by Dr.-Ing. Seifert from Germany.

Technical Characteristics

Aperture area	1.5m^2
Estimated power input (at 900 W/m^2 solar irradiation)	600 W
Maximum temperature	170°C
Tracking interval	15 min
Cooking volume	10 liter pot
Cost of material	450 Euros

Practical Characteristics

+Easy to buy
+Easy operation
+Suitable for boiling
+Good weather resistance except for wind

- Frequent stirring of food required
-Tracking interval is short
- Not very robust

How to get one?

Blueprints and cookers for sale at: www.energiesparkwerk.de and www.sunandice.de

Practical Summary

We invested significant time in receiving and working on feedback from users, getting to know the details that made a cooker easy or difficult to use. These small details have a big impact on the long-term acceptance of the solar cookers:

- **Handling**: Setting up the device and tracking system should be as simple as possible. Its functions should be clear and easy to understand intuitively. This must be combined with good documentation and of course training of the end users. Ergonomics of handling the pots when they are hot and full should be good.
- **Weather resistance**: The less the cookers have to be moved inside and outside the kitchen because of rain, the more they will be used.
- **Tracking intervals**: Longer is better. If the cooks have to go under the sun to a cooker very often to reposition the cooker, the probability the cooker will be liked and used is lower. However, the Yaholnitsky cooker's baking capabilities extended the kitchen's creative possibility to the point where the cooks were also happy to reposition it frequently.
- **Burning food**: If the cooker has a hot spot, so the cooks have to go under the sun to a cooker very often to stir the food, so it doesn't burn, the probability the cooker will be used is lower. This effect is mostly observed in the point focus solar cookers. Slow unattended cooking is in general a big advantage of solar cookers.

Usage of solar cookers depends on many factors, particularly cloud cover and wind conditions, so the cooking time for a specific dish can vary significantly. With experience, the cooks develop an intuition for this.

The week held a magnifying glass to the question of why knowledge transfer is such a delicate and important issue. Two very different worlds are meeting when the technical world of design, angles and precision meets the world of good flavour, nourishing, caring and a totally different level of precision. These two worlds speak different languages and it needs a conscious decision to communicate and to invest time into this communication. Generosity in the face of mistakes is needed in order to make the new possibilities of solar cooking a pleasure for both sides.

For the next solar cooking week:

- Hold the awareness of the global importance of precise communication, knowing how critical this is in the context of knowledge transfer.
- Invest in feedback loops around the technical details. For instance, the volume of the cookers should be discussed, and the cookers should be redesigned if bigger volume is needed by the kitchen team. Lids and heat traps should be discussed and make it as simple and functional as possible, etc.
- It was a great week, and we will definitely do it again. Thank you to all participants!