

The ultralight solar cooker for travellers : 2kg including the cooking pot

La cocina solar ultraligera para viajeros: 2 kg con recipiente para cocinar.

Dr. Michael Götz, ULOG Suisse, Rue Matile 71, CH-2000 Neuchâtel, Switzerland,
info@cuisinesolaire.com, www.cuisinesolaire.com

Many solar cookers are adapted to stationary use or are adapted to car travellers. The goal of this project is the development of an ultralight solar cooker for backpackers and cycle travellers. Market, patents and mirror geometries were studied before a series of prototypes were constructed and tested. The latest model fulfils the weight goal of 2kg with the cooking pot, but lacks power w.r.to the technical goals.

1. Motivation

Backpackers, cycle tourists and travellers hardly find solar cookers appropriate to their needs (while many cookers are suitable for car travellers). Box cookers are heavy and rather slow for travellers, parabolic cookers too bulky and heavy. There are a few lightweight cookers on the market, but they disappoint from the point of view of the convenience of use.

The aim of this project was therefore to develop an ultralight solar cooker which is easy to set up, easy to unfold, faster than a box cooker and which 'looks good'.

2. Technical goals

The following technical goals were defined (among others):

Boiling time for 1 litre of water:	45 minutes	Easy set up, easy unfolding in max. 1 minute	
Cooking time for a meal for 2 persons:	1 hour	Stable w.r.to wind	
Weight with cooking pot:	2 kg	Robustness:	allows transport on a backpack and by airplane
Folded size:	max length 45cm		

3. The study

3a) Market study: 22 types of 'transportable' solar cookers have been identified studying the internet and our archives.

3b) Patent study: The 254 patents of the 'solar cooker' section of the European patent database have been checked and the most interesting examined in order to find existing solutions for the different functions of the cooker.

3c) Study of mirror geometries: 14 potentially interesting 2 or 3-dimensional geometries have been identified.

Two geometries were chosen for the first prototypes: a 'vertical linear Fresnel mirror' (with an additional horizontal mirror to optically double the height of the cooking pot) and a 'section of a parabola'. One criteria for the choice of a geometry was the idea to keep the cooking pot at or near the ground to avoid a heavy stand for the pot.

4. Prototype and testing equipment

A large number of prototypes have been built and tested. A 'seasons simulator' has been created in order to test the optical quality of the focus for different illumination angles (sun at 30°, 45° and 60° inclination; azimuth oriented to the sun or +/- 30 or 60 minutes): a platform which can be oriented in order to find the desired illumination angles (inclination, azimuth) between platform and sun (see figure 2).

Of the two first prototypes, the 'section of a parabola' was abandoned, as we could not find a simple folding mechanism. We continued the way of the linear Fresnel geometry - combined with a

'scissor' structure for the frame as a simple folding mechanism. Figures 3 to 6 show details of the development. The initial 2-dimensional structure was changed to 3-dimensional and bent, a polycarbonate windshield has been added and the dimensions of the upper and lower scissor were optimised. The horizontal mirror was changed from flat to bent as well.

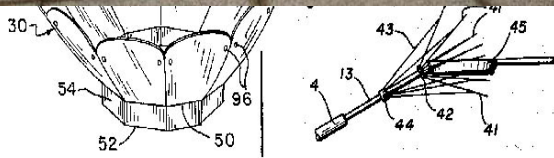


Figure 1. Drawings from different solar cooker patents.

Figure 2. A first 'Fresnel' prototype on the 'seasons simulator'



Figure 3. This is better



Figure 4. The following model works with a 3-dimensional fresnel geometry.



Figure 5. The 'scissor' mechanism allows for an easy folding of the cooker.

Figure 6. A polycarbonate windshield protects the cooking vessel.

5. State of the project and future

The prototype being tested in April and Mai 2005 fulfils the weight goal with a total weight of 2kg including cooking pot, windshield and transportation bag.

Its (measured) maximum power is 100W, lower than the aimed 130W. Under many illumination angles, the outermost mirrors do not reflect to the cooking pot. A further prototype will therefore be higher and less wide. More technical means to enhance power have to be tested: using a cooking pot with a low emissivity coating, using a windshield with an antireflective coating and insulation below the cooking pot.

Only very few actual *travelling* tests have been done so far. Further tests in real travelling conditions are foreseen before a first small series of cookers can be fabricated. Since the aim of this project is the development of an ultralight solar cooker which is easy to set up, easy to unfold, faster than a box cooker and which finally should have an appealing design.

The author would like to thank the Swiss energy department for the funding of the project (grant number 100666 / 151010) and Cyril Goujon for his collaboration.