

SUMMARY OF AVAILABLE TECHNOLOGIES FOR THE FOOD TRANSFORMATION WITH THE SOLAR ENERGY

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ABSTRACT

This article is a summary of the document entitled: "Available technology for food transformation with solar energy." That document is the result of a bibliographic research about technologies (nowadays used all around the world) to transform food using solar energy: solar stoves, solar ovens, solar dehydrators, etc. Its purpose was to present in an organized, concise and practical way the results from all the information obtained from different bibliographical sources: web sites, books, magazines, etc., and to be a useful document to experts and others who are not experts on the subject. The document explores devices on solar cooking, drinkable water and dehydration. In the original document, we present some annotated references.

As an appendix, we include a table that summarizes general information of every solar device contained in the original document.

Keywords: summary, solar ovens, solar dryers, drinkable water, haybox.

1. INTRODUCTION

In spite of the efforts made to do research, to develop and promote solar energy using solar ovens, solar cookers and solar dryers. These are devices generally unknown. They are used only by a few groups of people.

People who use solar devices are in communities with low economic resources or in which the firewood (with which they habitually cook) is more and more scarce. Sometimes these utilities are self designed and produced in a handcrafted way that makes it difficult to achieve success.

The document (of which this article is a brief version) tries to show a general scene of available solar technologies worldwide used to transform food. Moreover, the use of this technology could contribute to greater awareness of our surroundings and natural resources.

Finally, our proposal is to involve people to add to one data base all solar devices for food processing to help show the available technology. That is an important point to start promoting them on different scales.

2. BACKGROUND

The document that we present in this article is a result of a bibliographical research; therefore the whole document consists on the state of art technology that uses solar energy to process food.

During this research, there has been found much information spread around in books, journals and web pages. However, none of these sources contained all information in a condensed and organized manner. So the idea of preparing a document including general and practical information (plus web links and references) about solar energy to process food, presented in a condensed and organized fashion is new.

In next section we will briefly summarize the resulting document.

3. TECHNOLOGY FOR THE FOOD TRANSFORMATION WITH THE SOLAR ENERGY

The original document entitled "Available technology for the food transformation with solar energy," was the result of the final project for the author's master degree in renewable energy at the Universidad de Zaragoza, Spain. This work was first proposed and advised by Jordi

Miralles and José Manuel Vílchez from Fundació Terra, Barcelona.

3.1 Solar cookers

One of the simplest ways to use solar energy is cooking. General speaking, solar cookers are devices that concentrate or accumulate solar energy in order to get the temperature needed to cook.

Concentration makes sunbeams go to a specific direction using reflective materials (mirrors, metallic sheets, etc.). Depending on the reflective material's quality and using appropriated forms it is possible to increase energy density (W/m^2).

If dark elements (like dark pots) are used in order to absorb thermal energy and increase inner temperature, baking occurs.

3.1.2 Solar Cooking Pots

In this section we present results about solar cooking pots (8), there are many kinds, but in general they have to absorb solar energy and give it quickly to the food. Most of them are black and metallic. There also exist different design that avoid heat loss. For more ample discussion on the subject we refer the reader to the original document.

3.1.2 Haybox

The haybox (9)-(12) is nothing but an insulated box. The food is cooked just with the retained heat. These boxes can be used as a complement to solar cooking, thus its inclusion in the report.

3.1.3 Available Technology

The devices found in the research work are displayed (in the original document) with a specification sheet form as shown in figure 1. Every specification sheet include a photograph, a brief description and the web site (if one exists). They also provide the available technical information (size, materials, weight, reached temperatures); how to get construction plans if any; general information on the commercial devices (construction place and price) and, finally, links and contact data.

The solar cookers are classified as: solar ovens, solar panels, parabolic cookers and indirect solar cookers. The indirect solar cookers are included just as an example of this kind of equipment.

As a whole there are 35 solar cookers. In order to show in this article specification sheet's information, we have made a table called "Solar Cooker's Summary" (Appendix 1).

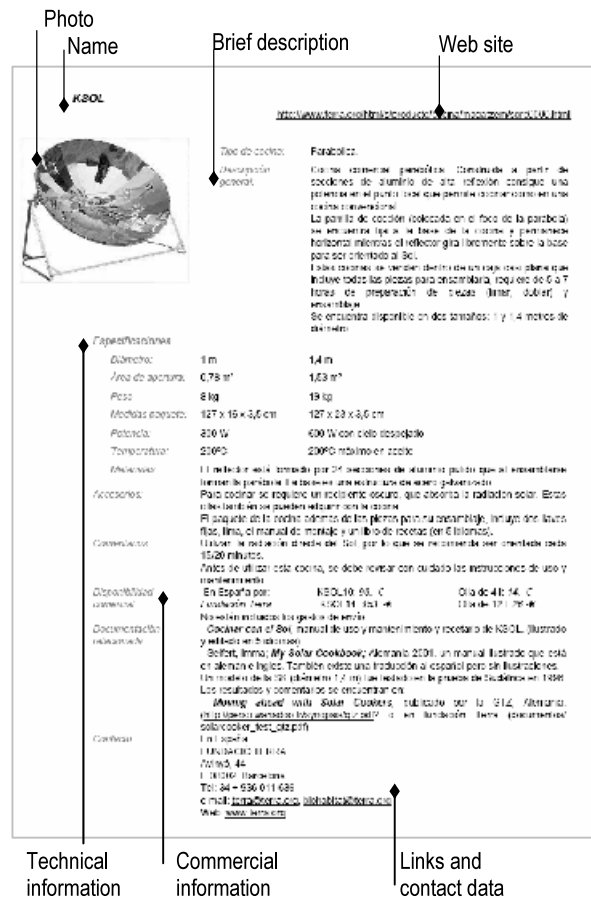


Fig. 1 Example of specification sheet.

3.2 Drinkable Water

Besides solar cooking, we can use solar energy to get drinkable water (1). The purification techniques used will depend on the type of contaminants that the water has. According to the kind of pollution, microbial or salt and heavy metals, there are two techniques of purification: pasteurization and distillation.

3.2.1 Available Technology

In this section the technology to get drinkable water is classified as pasteurization devices and distillers. It is important to point out that every solar cooker could be used as a pasteurization device because of the reached temperatures. However, there are eleven specification sheets - three pasteurization devices and eight distillers. A summary of these specification sheets is in the table: "Drinkable water device's summary" (Appendix 1)

3.3 Solar Dehydration

Solar drying or dehydration is an old food preservation technique (14)-(17). There are many ways to dry food, if we have good environmental conditions, solar dehydration is a suitable and practicable option.

Among the big variety of dryers, the direct drying is the simplest way.

The indirect drying uses a solar collector that heats the air. Then, this air passes through the product by natural or forced convection.

3.3.1 Available Technology

Due to the variety of designs and sizes in solar dehydrators, the goal in this section of the original document was to show one of each of the different kinds of solar dehydrators: direct and indirect drying, and natural and forced convection. There are just six specification sheets. A summary of this information is in the Appendix 1.

4. CONCLUSION

This compilation, although not exhaustive, includes the majority of the available information at this time. The final document has 52 specification sheets that we have summarized in this article in the form of tables which are presented in the appendix. In this sense, this document could be the starting point for people getting involved with applications of solar energy (in particular food transformation).

On the other hand, we expect people already involved with domestic use of solar energy (cooking and drying) could contribute to improve and to bring up to date the information, making use of the format we propose. In this way it could be possible to create an international solar devices summary.

In order to promote the use of technology for the food transformation with solar energy, the information included in the original document (in Spanish and probably soon in English) is available in Fundación Terra's web site (www.terra.org). There is also a database that contains some of the devices plans.

In general, we have learnt that technology and materials are available and that there are many successful examples of solar cooking and solar drying all around the world. Therefore, is not easy to reach people in poor countries but the solar energy offers enjoyment and benefits if we can offer to them. It also is a tool to sensitize families in rich countries about renewable energies.

5. BIBLIOGRAPHY

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- (16) *Secado Solar de Cosechas* <http://www.solarwall.com/spanish.html>
- (17) *Secado Solar De Alimentos* <http://www.epsea.org/esp/alimentos.html>

SOLAR COOKER'S SUMMARY

Name	TECHNICAL							GENERAL INFORMATION					
	type*	Temp. (°C)	Size** (cm)	Weight (kg)	Materials***	Handcrafted	Commercial	Price	Plans	Manuals	Web Site	Who	@
1 Box cooker		150	variable	v		✓			✓	✓	www.solarcooking.org		
2 Collapsible		150	variable	v		✓			✓	✓	www.solarcooking.org		
3 Sun Star		150	variable	v		✓			✓	✓	www.backwoodshome.com/articles	Joe Radabaugh	PO Box 111, Mt Shasta, Ca 96067, EUA
4 30-60 oven		180	43x43x48	11		✓			✓	✓		Fundación Terra	terra@terra.org
5 Ulog		150	67x67x50	9		✓	✓	199 eu	✓	✓	www.ulog-solar.de	Ulog-Solar	info@ulog-solar.de
6 Ulog familiar		150	120x67x50	13		✓	✓	299 eu	✓	✓	www.ulog-solar.de	Ulog-Solar	info@ulog-solar.de
7 Ulog light		130	52x52x45	5	nylon		✓	290 eu			www.couisinesolaire.com	Dr. Michael Götz	cuisine.solaire@suisse.org
8 Sun Cook		150	59x55x29	12			✓	215 eu		✓	www.son-co.pt	Sun Co	contact@sun-co.pt
9 SOS Sport		142		5			✓	99 dls		✓	www.solarovens.org	Solar Oven Society	sos@solarovens.org
10 Global Sun oven		182	43x43x37	9,5			✓	229 dls			www.sunoven.com	Sun Ovens International	info@sunoven.com
11 through the wall		140	82x66x30			✓			✓	✓	www.solarcooking.org	Kerr-Cole	mkerrcole@skyboot.com
12 tire cooker			variable		tire	✓			✓		www.solarcooking.org		
13 Villager Sun Oven		260		444			✓	10000 dls			www.sunoven.com	Sun Ovens International	info@sunoven.com
14 Gianni Crovatto oven		110	58x58x40	5		✓			✓	✓	digilander.libero.it/giannicrovatto	Gianni Crovato	gianni.crovatto@libero.it
15 Gianni Crovatto oven		200	51x51x39	6		✓			✓	✓	digilander.libero.it/giannicrovatto	Gianni Crovato	gianni.crovatto@libero.it
16 Gianni Crovatto oven		360	∅ 1.55	60		✓			✓	✓	digilander.libero.it/giannicrovatto	Gianni Crovato	gianni.crovatto@libero.it
* - box - panel 17 Sunstove		parabolic 100	** ∅ - diameter 51x69x35	3,6	- metal		- wood - cardboard - plastic	v - variable 20 dls	✓	✓	www.sungravity.com	Sunstove Organization	POBox 21960, 1515 Crystal Park, Sudáfrica
18 Synopsis		147	88x101x96				✓				www.synopsis.org	synopsis	synopsis@wanadoo.fr
19 Bernard panel		100	23x25x30	1		✓			✓	✓		Roger Bernard	
20 DSPC			80x70x50	1		✓			✓		www.solarcooking.org	TeongH, Tan	thtan@online.sh.cn
21 Parvati cooker		140	∅ 30	1		✓			✓		www.angelfire.com/80s/shobhaphardeshi/ParvatiCooker_spa.html	Mrs. Shobha Ravindra	ravi_pardeshi@yahoo.co.in

APPENDIX 1

22 funnel cooker			variable	v		✓	✓		✓		www.solarcooking.org	Steven E. Jones	stevejones@byu.edu
23 Fresnel			⊙ 130	5		✓			✓		www.sunspot.org.uk/ed	SunSpot	enorman@travel-net.com
24 Nelpa			70x41x92	11		✓	✓		✓	✓	www.solarcooking.org	Roger Bernard	
25 R. open box		100	46x32x42	1		✓			✓	✓	www.solarcooking.org	Roger Bernard	
26 W S funnel		150	⊙ 70	1		✓			✓		www.solarcooking.org	Kathy Dahl-Bredine	kpdb@prodiqy.net.mx
27 Cookit		100	55x120x33	0.3		✓	✓	25 dls	✓	✓	www.solarcooking.org	Solar Cookers Int.	info@solarcookers.org
28 Cocina SARP		150	46x30x60	0.3			✓		✓		www.cricyt.edu.ar/lahv/xoops/html/modules/freecontent/index.php?=8	Alfredo Esteves	aesteves@lab.cricyt.edu.ar
29 Chinese cooker		v	v	v		✓	✓		✓		www.cc.jyu.fi/~hvirtane/chin2.html	Hannu Vertanen	hvirtane@cc.jyu.fi
30 Clear dome			61x66	3.6			✓	185 dls			www.cleardomesolar.com	ClearDome Solar	hotfood@cleardomesolar.com
31 Hot plate		300	50x50x20				✓		✓		www.sunspot.org.uk	SunSpot Maidenhead	g@sunspot.org.uk
32 SK		200	⊙ 1 & 1.4	8 & 19		✓	✓	98 & 153	✓	✓	www.terra.org	Fundación Terra	terra@terra.org
33 Papillon		300		15		✓	✓	598 eu		✓	www.solar-papillon.com	BSW Alternative Energy	webmaster@bsw-energie.de
34 Solarsizzler			⊙ 91.5	3.5			✓	69.95 dls	✓		www.solarsizzler.com		info@solarsizzler.com
35 Sheffler reflector		v	v	v		✓	✓		✓		www.solare-bruecke.org/	Solar Brücke	solarebruecke-1@t-online.de
36 Gaviota's cooker											www.friendsofgaviotas.org		
37 Tamera's cooker											www.tamera.org		

APPENDIX 1

DRINKABLE WATER DEVICE'S SUMMARY														
TECHNICAL INFORMATION										GENERAL INFORMATION				
Name	Process	capacity (l)	Production (l/d)*	Size** (cm)	Weight (kg)	Materials	Handcrafted	Commercial	Price	Plans	Manuals	Web Site	Who	@
1 SODIS	potabilization			v	v	glass or plastic	✓				✓	www.sodis.ch	SODIS Fundation	sodis@fundacionsodis.org
2 AquaPak	potabilization	5	v	47x40	0.2	plastic		✓	20 dls			www.solarsolutions.info	Solar Solutions	contact@solarsolutions.info
3 Thermos Flask	potabilization	2	v	x5.8 x 1.2		glass		✓				www.solarwyse.cjb.net	Solar Wise	alex@solarwyse.com
4 Simple distiller	distillation	v	v	v	v	glass and plastic	✓			✓				
5 Distiller "caseta"	distillation		1	45 x 51 x 27		glass and metal	✓					www.terra.org	Fundacion Terra	terra@terra.org

6 Rainmaker 550	distillation		6	76x122	26.4	glass and plastic		✓	450dls			www.solaqua.com	SolAqua	POBox4976, El Paso, Texas 79914-4976
7 Rainkit 990	distillation		11	86x196		wood, glass and plastic	✓	✓	235 dls	✓		www.solaqua.com	SolAqua	
8 RSD	distillation	v	5	100x80	16	metal		✓				www.rsd-solar.com		oliver.kopsch@rsd-solar.com
			20	252x105	90	metal		✓						
			31	300x130	100	metal		✓						
9 NMSS	distillation	50	v	2x1				✓	300 dls			www.home.intekom.com/canichem/canichem/html/catalog.html		still@intekom.co.za
10 AquaCone	distillation		1.5- 2.5	x115 x 78	2	plastic		✓	200 dls		✓	www.solarsolutions.info	Solar Solutions	contact@solarsolutions.info
11 Agua del Sol	distillation		3.8	120x90x20	30	metal, glass and plastic		✓	490 dls			www.aguadelсол.com	Agua del Sol	Tonylunt@aguadelсол.com
	distillation		7.6	200x90x20	40.7			✓	590 dls					
	distillation		11.35	240x90x20	49.8			✓	690 dls					
	distillation		7.6	120x90x10	31.7			✓	590 dls					
	distillation		11.35	100x90x10	49.8			✓	690 dls					

SOLAR DRYER'S SUMMARY												
TECHNICAL INFORMATION										GENERAL INFORMATION		
Name	Type	capacity (kg)	Size** (cm)	Materials	Handcrafted	Commercial	Price	Plans	Manuals	Web Site	Who	@
1 Solar dryer	direct, natural convection		50x50x100	metal or wood	✓			✓	✓	www.organicdownunder.com/solar_dryer.htm		
2 solar dryer 1	indirect, natural convection	5 to 10	46x70x110		✓			✓	✓			
3 Coquillage	indirect, natural convection		⌀185 x 95	metal	✓	✓		✓	✓	geres.free.fr	Groupe Energies Renouveables et Environnement	geres@free.org
4 tecnatrop	direct, natural convection		450x850	plastic		✓				www.tecnatrop.com	Tecnatrop	tecnatrop@tecnatrop.com
5 ICARO	indirec, forced convection		100x100x140	metal	✓			✓	✓		Torino's University	
6 Innotech	direc, forced convection		1800x200	plastic		✓				www.innotech-ing.de	INNOTECH	info@innotech-ing.de