Solar water pasteurization unit

KENT LAURSEN INDUSTRIAL DESIGN

Contents

In this age of The Global Village access to clean and healthy drinking water must be looked at as an entitlement. There are none the less more than one billion people who do not possess such an entitlement. This problem was made a top priority at the UN environmental meeting in Johannesburg September 2002 where more than 150 heads of Government from all over the world participated.

Sustainable solutions to the problem were called for, that is, solutions which do not involve the use of chemicals or add to the CO2 emission.

We have worked on this problem for more than ten years, and through collaboration with a number of foreign and domestic institutions, we have developed a device that heats water until all germs have been killed, - a device that uses solar power.

The device was microbiologically tested by the Danish Food and Environment Agency in Zambia, Denmark and Tanzania from 1995 to1998. It was tested using water from the Mlalakua River in Dar es Salaam and with water from Lake Tanganyika and it passed all tests in all locations. We found that by heating the water to 65C° or above all pathogenic microorganisms were killed, – even though extra pathogenic bacteria were added to the Mlalakua water as part of the experiment.

Following pilot field tests, eight villages on the shores of Lake Tanganyika had community plants installed. The villages with some 25,000 inhabitants had suffered from repeated cholera epidemics. Together with other hygienic measures the frequency of diarrhoea was reduced by 90% when households consumed the decontaminated water.

During another cholera epidemic in the area the devices proved their worth. None of the people receiving solar pasteurised water got cholera, but other people living in the area without access to the pasteurised water got cholera (migrant workers and fishermen). This revealed the need for portable water pasteurisers.

A prototype for this purpose was developed. It uses a so-called Trombe-Meinel reflector which concentrates the sunlight onto a centrally placed cylinder. Inside the cylinder one places an ordinary Coca-Colaish bottle. The water it contains is then heated by the Sun's rays to the temperature needed.

This device was also tested using water from the Mlalakua River and passed the tests so successfully that the water exceeds the WHO standards for 'Excellent' drinking water.

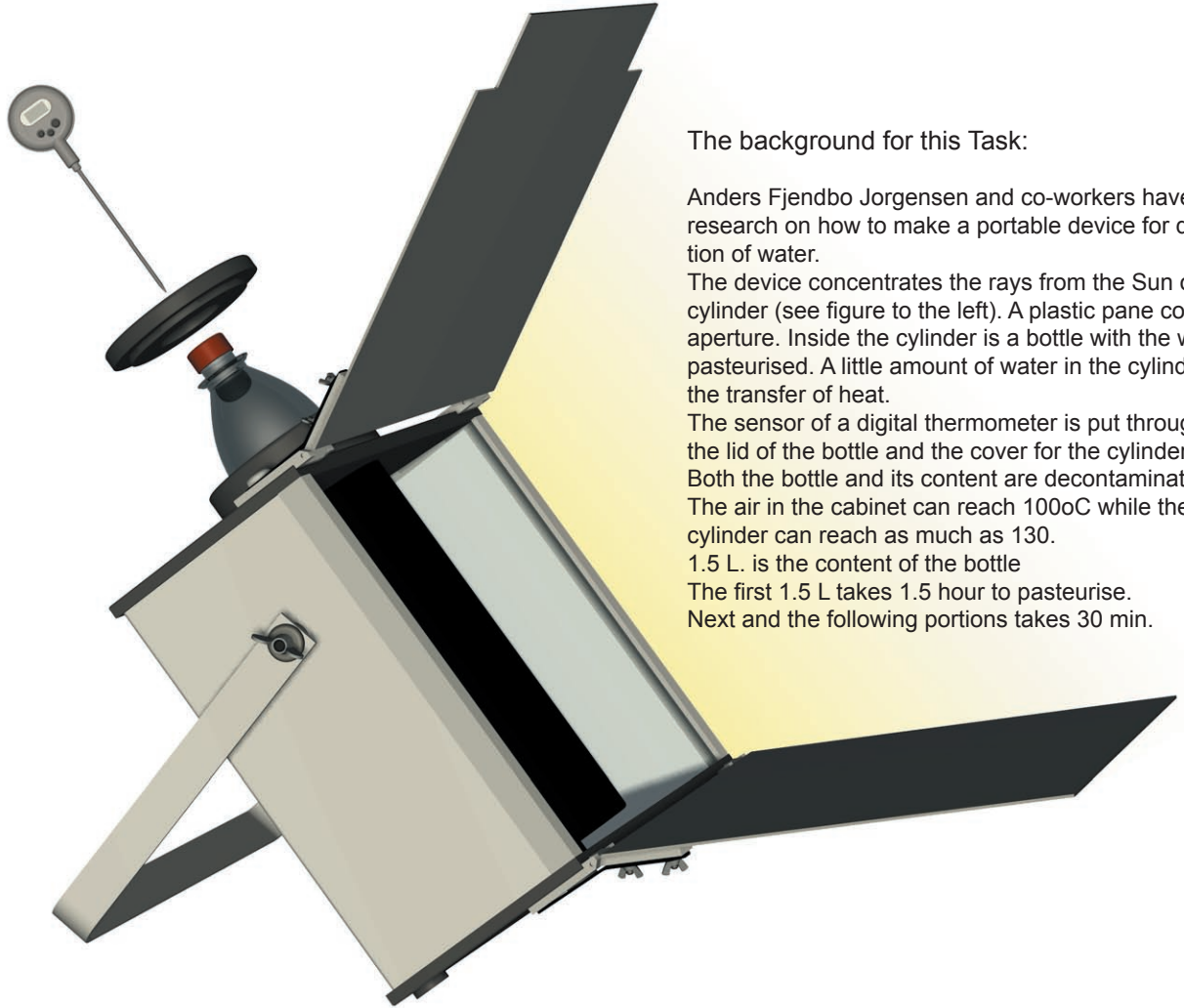
Furthermore, milk can also be pasteurised using the same device and have dangerous bacteria such as Salmonella, Shigella, Streptococcus, Stafylloccocus, Brucella and not least Tuberculosis killed. Once again a great number of pathogenic bacteria were added and the tests showed that they were all killed.

Following the tests, a number of prototypes were manufactured. These are now used in Dar es Salaam and in different Masai villages. In these villages they have problems with clean drinking water as well as with Tuberculosis bacteria in the cows' milk. This milk mixed with blood from cattle is the main means of nourishment for many Masai, so pasteurising the mixtures prevent many children from being infected.

Later, the method of pasteurising milk using solar power was also tried on HIV-infected mothers' milk, and both the added and the mothers' HIV were successfully killed.

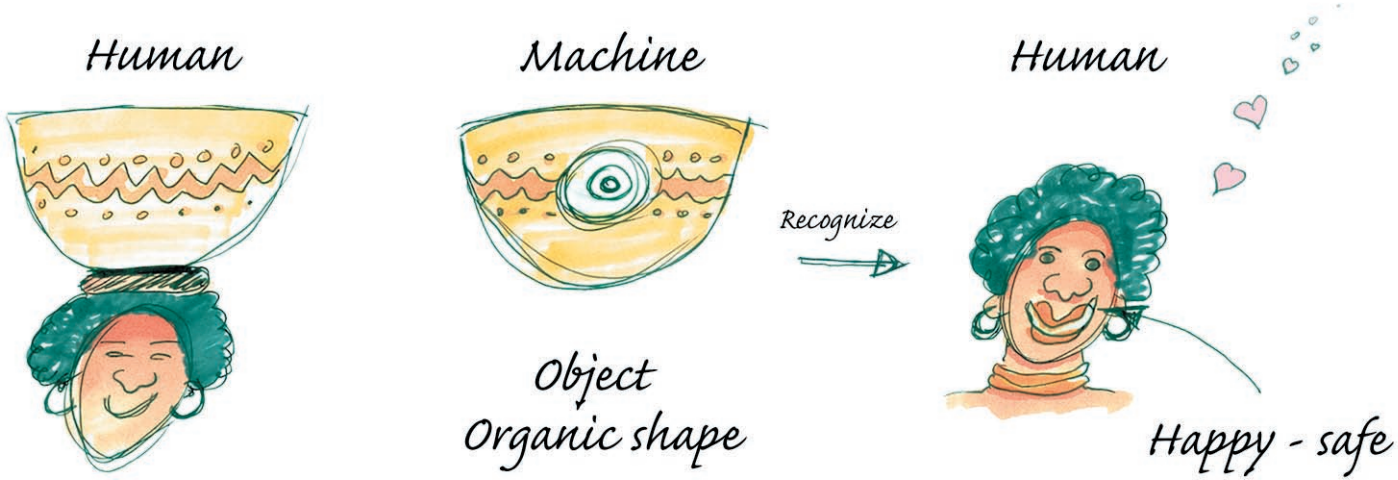
Anders Fjendbo Jorgensen
Chief Physician
Specialist in Tropical and Infectious Diseases


Africa
North Atlantic Ocean
South Atlantic Ocean
Indian Ocean
Indian Ocean
Mediterranean Sea
Black Sea
Equator
Tropic of Cancer
Tropic of Capricorn
Gulf of Guinea
Red Sea
Gulf of Aden
Persian Gulf
Caspian Sea
Lake Victoria
Lake Tanganyika
Lake Nyasa
Lake Turkana
Lake Chad
Lake Kariba
Lake Nasser
Lake Volta
Lake Kivu
Lake Mobutu
Lake Rudolf
Lake Albert
Lake Edward
Lake Kariba
Lake Tanganyika
Lake Nyasa
Lake Turkana
Lake Chad
Lake Volta
Lake Kivu
Lake Mobutu
Lake Rudolf
Lake Albert
Lake Edward
Lake Nasser
Lake Victoria
U.K.
London
Amsterdam
Brussels
Bonn
Berlin
GERMANY
Prague
POLAND
Warsaw
BELARUS
Kiev
UKRAINE
Budapest
ROMANIA
Bucharest
RUSSIA
KAZAKSTAN
Tashkent
UZBEKISTAN
Dushanbe
TAJIKISTAN
Ashgabat
TURKMENISTAN
AFGHANISTAN
Kabul
Islamabad
PAKISTAN
Tehrān
IRAN
Baghdad
IRAQ
Al Basrah
Kuwait
Bandar-e Abbas
Manama
BAHRAIN
Doha
QATAR
Muscat
OMAN
Riyadh
SAUDI ARABIA
Jeddah
Sanaa
YEMEN
Asmara
ERITREA
Port Sudan
Khartoum
SUDAN
Addis Ababa
ETHIOPIA
Djibouti
Berbera
SOMALIA
Mogadishu
Nairobi
KENYA
Kampala
UGANDA
Bujumbura
BURUNDI
Kigali
RWANDA
Dodoma
Dar es Salaam
TANZANIA
Mombasa
Victoria
SEYCHELLES
Mwanza
Mbeya
Kasanga
Kananga
Kisangani
Bukavu
Kalemie
Lubumbashi
Kolwezi
Lusaka
ZAMBIA
Harare
ZIMBABWE
Bulawayo
Beira
Nacala
Tete
Blantyre
Lilongwe
Nampula
Maputo
Mozambique
Antananarivo
Mahajanga
Toliara
MADAGASCAR
Port Louis
MAURITIUS
Réunion (FRANCE)
Mayotte (FRANCE)
Comoros (FRANCE)
Antsiranana
Moroni
Mogadishu
Victoria
Pretoria
Johannesburg
SWAZILAND
Durban
Maseru
LESOTHO
Port Elizabeth
Cape Town
SOUTH AFRICA
Kinshasa
ZAIRE
Brazzaville
Pointe-Noire
CONGO
Libreville
GABON
Luanda
Malanje
Lobito
ANGOLA
Lubango
Namibe
Menongue
Luena
Windhoek
Walvis Bay
NAMIBIA
Lüderitz
Gaborone
BOTSWANA
Yaoundé
Douala
CAMEROON
Bangui
CENTRAL AFRICAN REPUBLIC
Lome
Accra
Abidjan
Lagos
Abuja
Maiduguri
NIGERIA
Kano
Niamey
NIGER
Agadez
Zinder
Bamako
MALI
Tombouctou
Ouagadougou
BURKINA FASO
Nouakchott
MAURITANIA
Nouadhibou
Dakar
SENEGAL
Banjul
THE GAMBIA
Bissau
GUINEA-BISSAU
Conakry
GUINEA
Freetown
SIERRA LEONE
Monrovia
LIBERIA
Praia
CAPE VERDE
Rabat
MOROCCO
Marrakech
Agadir
Tindouf
Tamanrasset
ALGERIA
Tunis
TUNISIA
Tripoli
LIBYA
Benghazi
Al Jawf
Cairo
EGYPT
Aswan
Khartoum
Al Fāshir
Wāw
Juba
Kampala
Nairobi
Mombasa
Dar es Salaam
Lusaka
Harare
Windhoek
Gaborone
Pretoria
Maseru
Cape Town
Port Elizabeth
Luanda
Kinshasa
Brazzaville
Libreville
Yaoundé
Abuja
Accra
Lome
Abidjan
Monrovia
Freetown
Conakry
Bissau
Banjul
Dakar
Nouakchott
Rabat
Algiers
Tripoli
Cairo
Khartoum
Addis Ababa
Mogadishu
Nairobi
Kampala
Bujumbura
Kigali
Dodoma
Lusaka
Lilongwe
Maputo
Antananarivo
Port Louis
Victoria
Moroni
Mogadishu
Scale 1:67,000,000
Azimuthal Equal-Area Projection
0 500 1000 Kilometers
0 500 1000 Nautical Miles
Boundary representation is not necessarily authoritative.



The background for this Task:

Anders Fjendbo Jorgensen and co-workers have done research on how to make a portable device for decontamination of water.
The device concentrates the rays from the Sun on the black cylinder (see figure to the left). A plastic pane covers the aperture. Inside the cylinder is a bottle with the water to be pasteurised. A little amount of water in the cylinder secures the transfer of heat.
The sensor of a digital thermometer is put through a hole in the lid of the bottle and the cover for the cylinder.
Both the bottle and its content are decontaminated.
The air in the cabinet can reach 100oC while the air in the cylinder can reach as much as 130.
1.5 L. is the content of the bottle
The first 1.5 L takes 1.5 hour to pasteurise.
Next and the following portions takes 30 min.


Human
Machine
Human
Recognize
Object
Organic shape
Happy - safe

Solar water pasteurization unit for cooking and pasteurization of water and AIDS infected mothermilk

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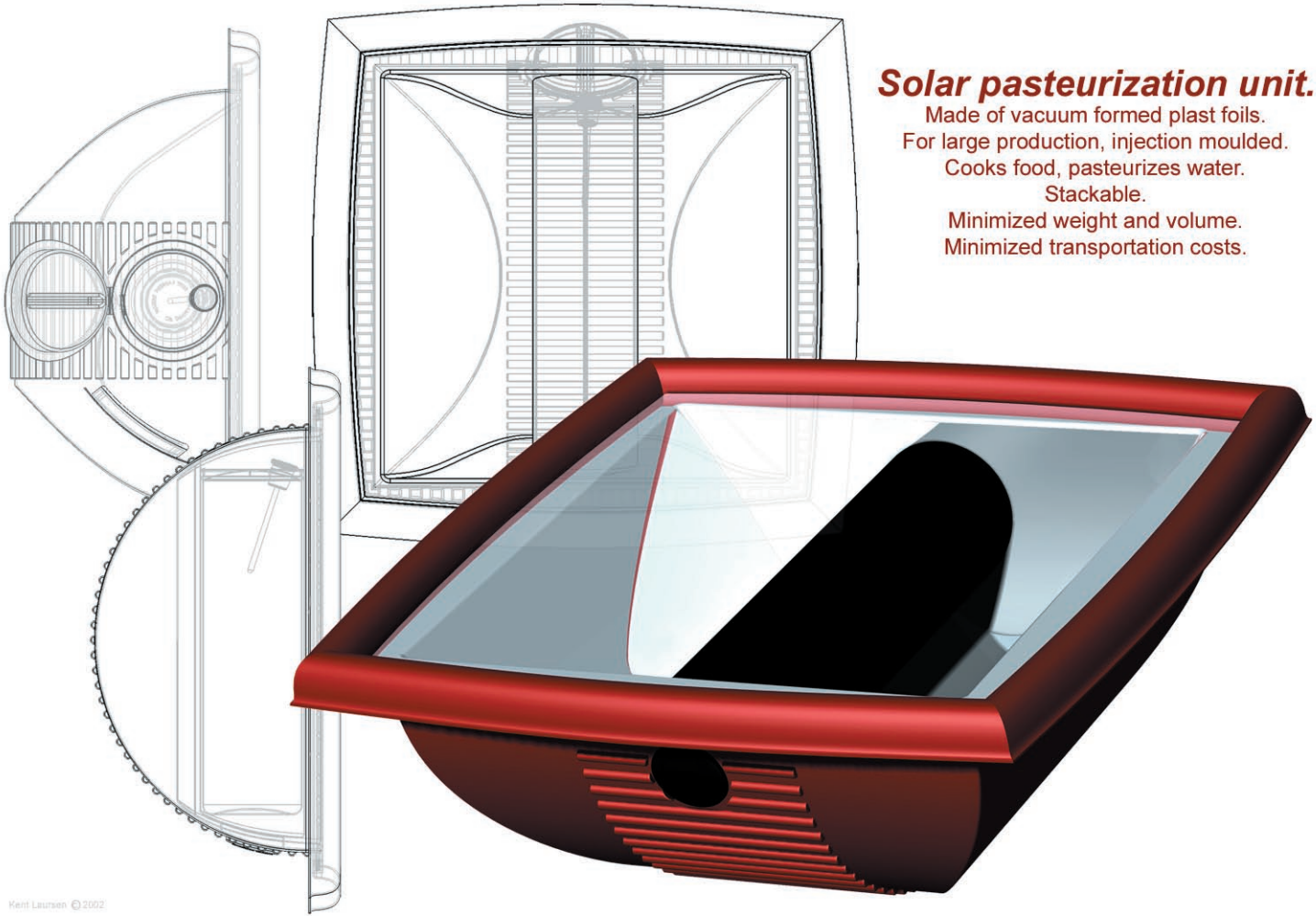
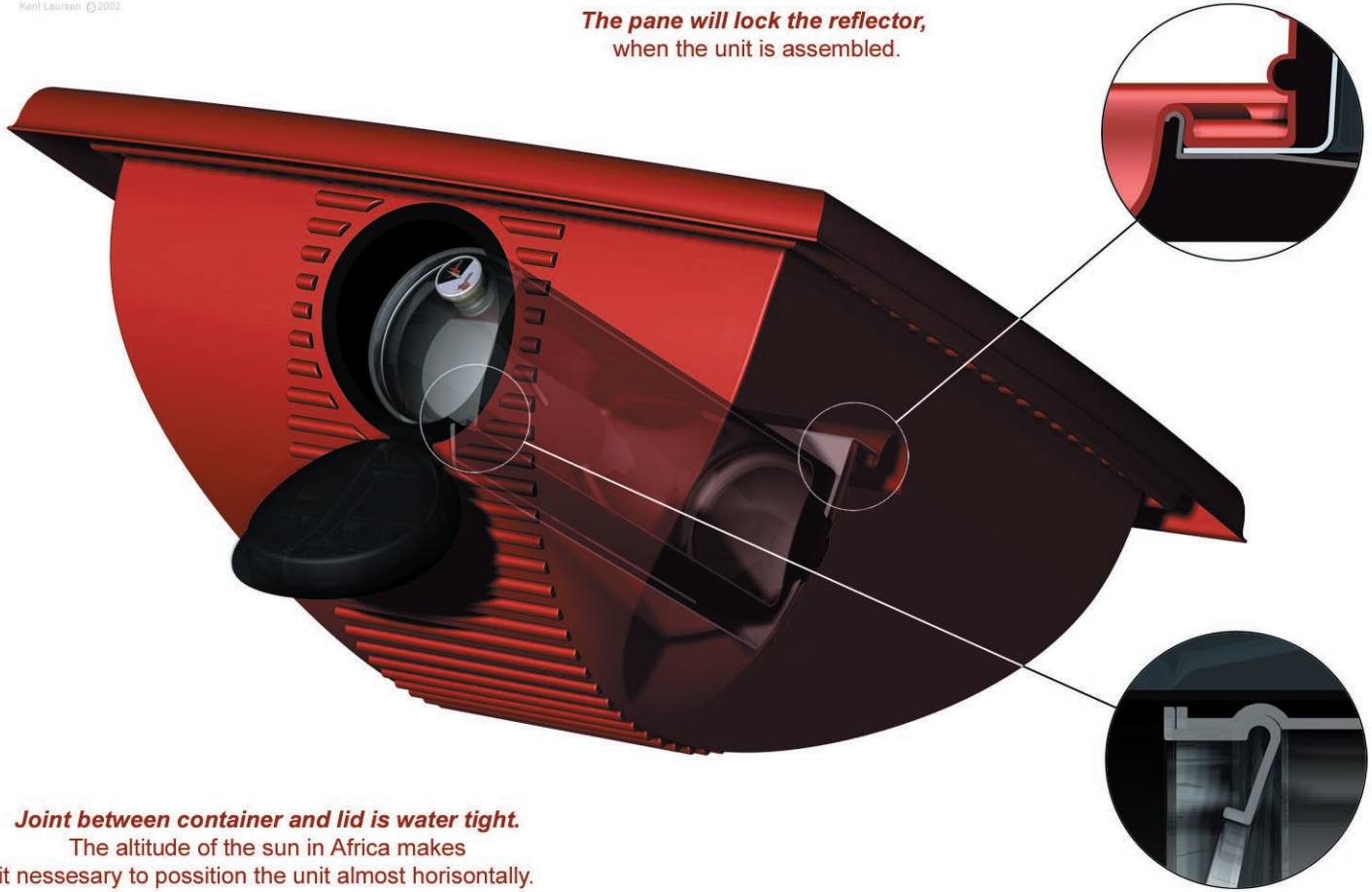
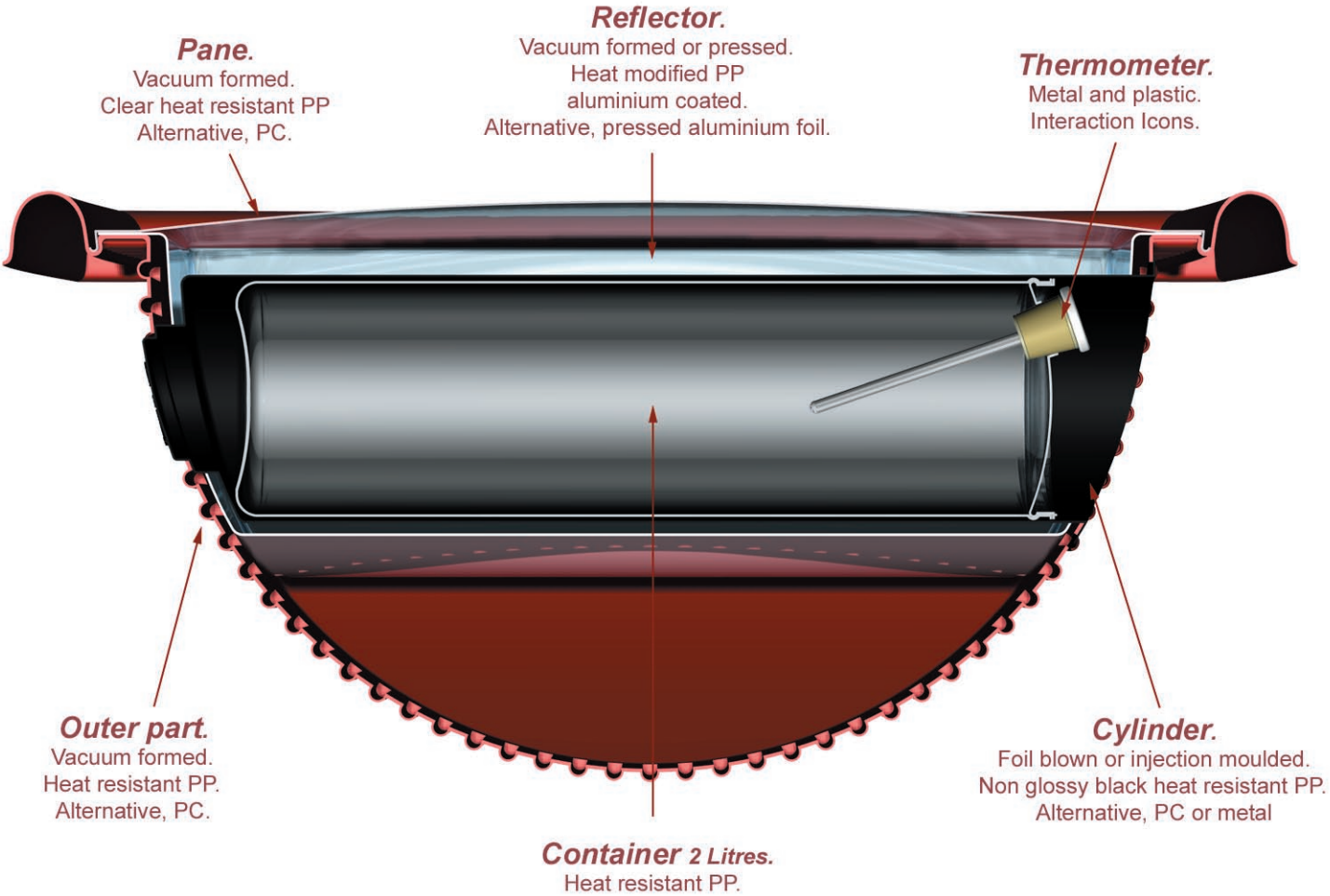
Instruction in and motivation to use of the
solar water pasteurisation unit is an important part of the design

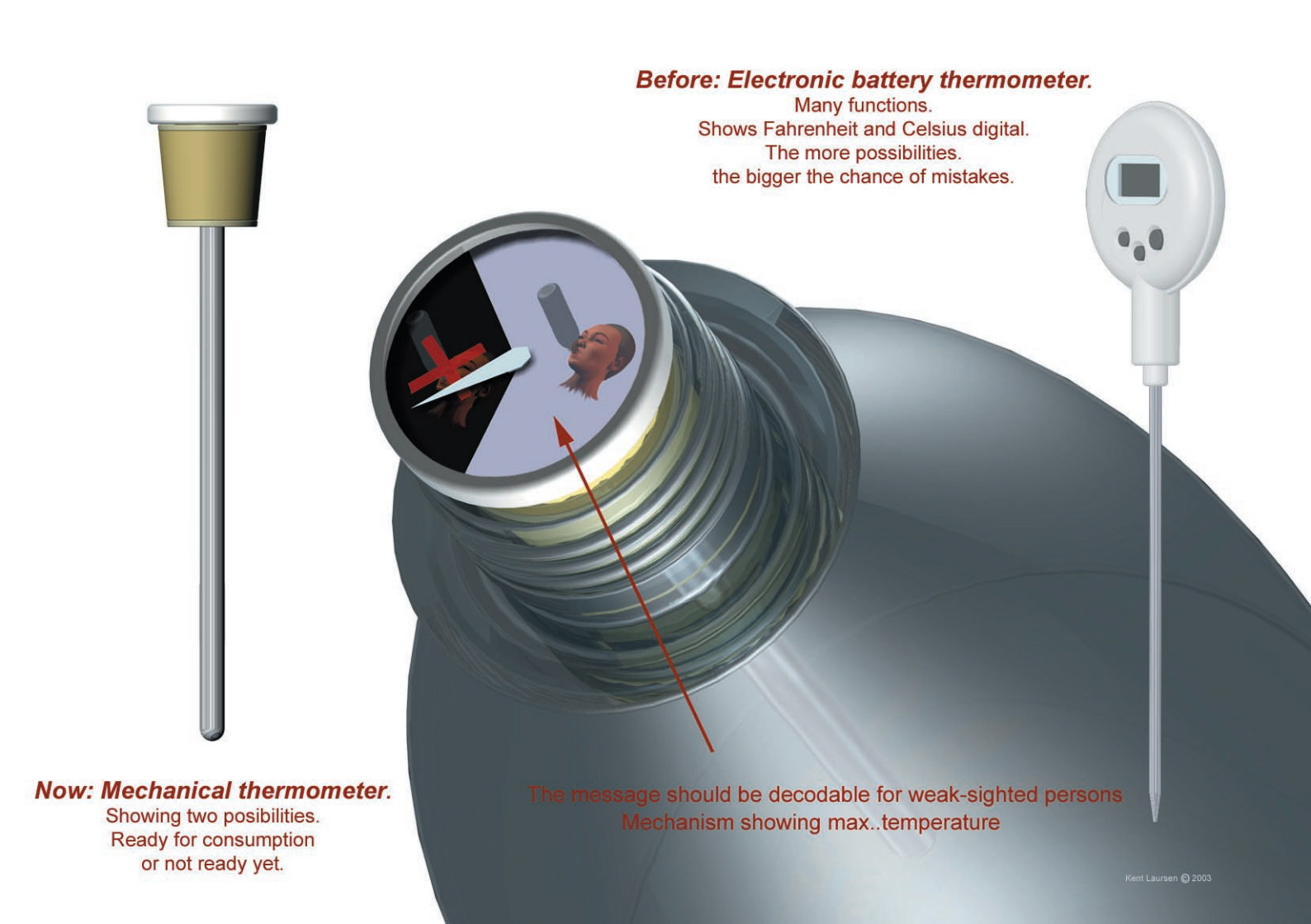

Solar pasteurization unit.
Made of vacuum formed plast foils.
For large production, injection moulded.
Cooks food, pasteurizes water.
Stackable.
Minimized weight and volume.
Minimized transportation costs.
Kent Laursen © 2002

The pane will lock the reflector,
when the unit is assembled.

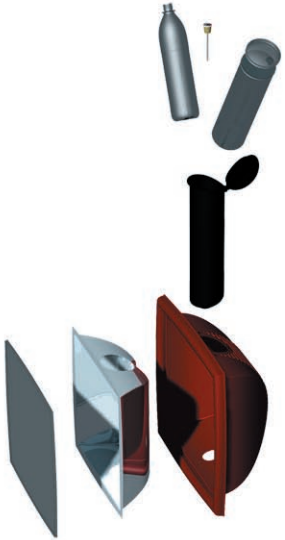


Joint between container and lid is water tight.
The altitude of the sun in Africa makes
it nessesary to possition the unit almost horisontally.

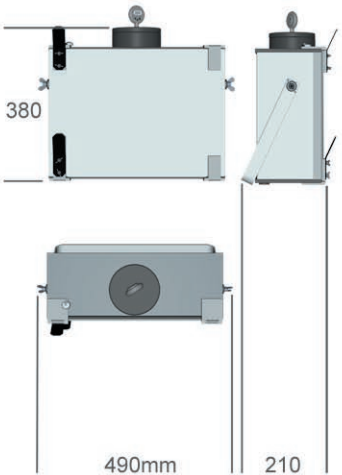


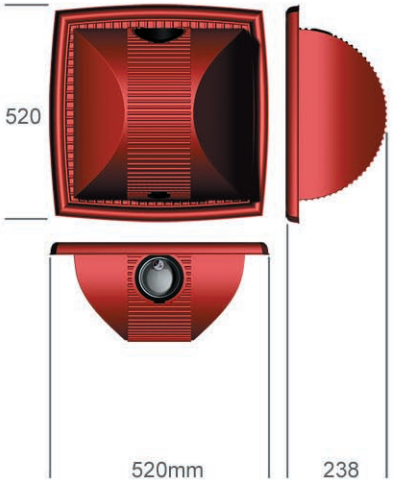

Before: Electronic battery thermometer.
Many functions.
Shows Fahrenheit and Celsius digital.
The more possibilities.
the bigger the chance of mistakes.
Now: Mechanical thermometer.
Showing two posibilities.
Ready for consumption
or not ready yet.
The message should be decodable for weak-sighted persons
Mechanism showing max..temperature
Kent Laursen © 2003

Measurements 5 units.
W=540 D=430 H=560 mm



T***ransport costs***
to distant arears in e.g. Africa may ***surpass***
the ***productioncosts.***
Stackable units reduce
the transport volume.





Transport measurements
5 units

490 x 945 x 380 mm

540 x 430 x 560 mm

Advantages

High efficiency.
Long lifetime.
Handle can be used for
angling unit towards the sun.
Inexpensive production initiation.
Can be produced in Africa.
No filter to be blocked
No Co2 emission

Disadvantages

Production costs pr unit 300 dollars.
Veight.
Volume.
Transportation costs.
Large number of parts.
No instruction.
Lid not hinge mounted.
Battery in thermometer.
Thermometer not protected.
Thermometer has 4 buttons.
User must be able to read numbers.
User must know pasteurisation temperature.
Hole must be drilled in bottlecap.
Doubt about orientation
towards the sun.
Sharp edges.
Looking like a machine.
Unit not in ballance
when carryed in the handle.
African women carryes
objects on their heads.
Due to estimated lifetime of 10 years,
the aluminium can be remanufactured
to other products, making the
unit unusable.

Advantages

Production costs 7-8 dollars per unit.
Variation of outer shape possible.
Low weight.
Easy to handle.
Stackable
Minimal transportvolume.
Transportation costs reduced.
Instructions on the backsite.
No hole in bottle cap..
Thermometer interface with icones.
Thermometer protected.
No battery.
Easy understandable orientation
towards the sun.
Few parts.
Outer plastic cover can be printed with patterns
or collors giving the user an impression
of “something seen before”
Round and kind design.
Low price, maybe more units per family.
Usable for decontaminating water -
cooking - sterilizing - etc.
Less deforestation.
Large surface for sponsorlogoes.
Heat resistant PP cylinder and/or
bottle included.
No filter to be blocked
No Co2 emission

Disadvantages

Expensive production initiation.
Thermometer is under the lid.
Extra costs for heat resistant
inner cylinder.

Kent Laursen Industrial design 2003 - Consultant Morten Dall - Consultant Chris Heape