

# Household Water Treatment and Safe Storage Factsheet: Solar Distillation

## Potential Treatment Capacity

Very Effective For:	Somewhat Effective For:	Not Effective For:
<ul style="list-style-type: none"> <li>• Bacteria</li> <li>• Viruses</li> <li>• Protozoa</li> <li>• Helminths</li> <li>• Turbidity</li> <li>• Chemicals</li> <li>• Salt and hardness</li> <li>• Taste, odour, colour</li> </ul>		

## What Is Solar Distillation?

Solar distillation is an ancient method of using the sun's energy to treat drinking water. Distillation is the process of evaporating water into vapour, and then capturing and cooling the vapour so it condenses back into a liquid. Any contaminants in the water are left behind when the water is evaporated.

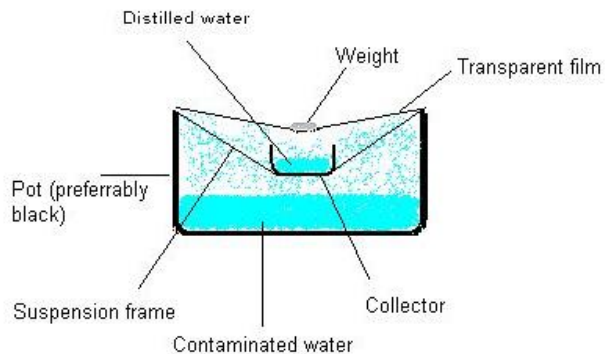
There are many different designs for solar distillation units (also known as stills). The simplest are a piece of plastic stretched over a container with the source water in the bottom. The plastic is weighted down in the middle so that the condensate can drip into a smaller collection container inside the bucket.

A simple design requiring some basic construction, but yielding more water, is that of a flat bed, basin or box solar still. It consists of a shallow reservoir containing water covered with an angled piece of clear glass or transparent plastic sheet. The sunlight heats the water through the glass or plastic, and the water vapour collects and condenses on it, drips down, and flows into the collection channel.

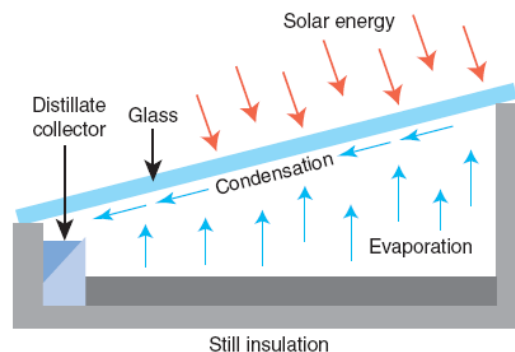
Another simple still uses a removable plastic cone rimmed on the inside edge with a collection channel. The condensed water flows down the sides of the cone into the channel. Water is removed by opening a cap at the apex of the cone, and turning the still upside down into a container.

## How Does it Remove Contamination?

As the radiation from the sun heats the water, it evaporates leaving behind any contaminants, including pathogens, chemicals and minerals. The contaminants collect in the bottom of the still and are periodically flushed or cleaned out.



Container Still (Credit: [www.ehow.com](http://www.ehow.com))



Box Still (Credit: Smith, 2005)

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## Operation

### *Flat Bed/Box Still:*

The still is filled daily with two to three times as much water as will be produced. This is so that the excess, using the built-in overflow outlets, will flush the unit clean each day (to remove accumulated salts and other contaminants). Treated water is collected in a safe storage container placed under the outlet.

If systems are not designed to be self cleaning and flush out accumulated contaminants, the reservoirs should be regularly cleaned using soap and clean water.



**Flat Bed Still**  
(Credit: [www.planetkerala.org](http://www.planetkerala.org))

### *Cone Still:*



1. Pour salty / brackish Water into pan. Then float the WaterCone® on top. The black pan absorbs the sunlight and heats up the water to support evaporation..



2. The evaporated Water condensates in the form of droplets on the inner wall of the cone. These droplets trickle down the inner wall into a circular trough at the inner base of the cone.



3. By unscrewing the cap at the tip of the cone and turning the cone upside down, one can empty the potable Water gathered in the trough directly into a drinking device.

**How to Use the WaterCone® (Credit: [www.watercone.com](http://www.watercone.com))**

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## Key Data

### Inlet Water Criteria

- No specific limits

### Treatment Efficiency

	Bacteria	Viruses	Protozoa	Helminths	Turbidity	Chemicals
<b>Laboratory</b>	> 99.9% <sup>1</sup>	Not available	> 100% <sup>1</sup>	> 100% <sup>2</sup>	> 100% <sup>2</sup>	> 99.9% <sup>1</sup>
<b>Field</b>	Not available	Not available	Not available	Not available	Not available	Not available

<sup>1</sup> Smith (2005). The pilot project showed the stills to be effective in removing salts and minerals (Na, Ca, As, F, Fe, Mn); bacteria (*E coli*, *cholera*, *botulinus*); protozoa (*giardia*, *cryptosporidium*) and heavy metals (Pb, Cd, Hg). Theoretically should remove arsenic, although no data available at this time.

<sup>2</sup> Not tested, but theoretically distillation should remove helminths and turbidity.

### Operating Criteria

Flow Rate	Batch Volume <sup>1</sup>	Daily Water Supply
Not applicable	4–8 litres per m <sup>2</sup> (box) <sup>2,3</sup> 1-1.7 L for cone <sup>4</sup>	Variable <sup>5</sup>

<sup>1</sup> Solar still sizes can vary from 0.5 m<sup>2</sup> for household use up to around 600 m<sup>2</sup> for community use

<sup>2</sup> Foster (2005)

<sup>3</sup> Planet Kerala (2006)

<sup>4</sup> Watercone®

<sup>5</sup> Daily water supply depends on number sunshine hours and temperature, as well as still size

### Robustness

- No moving or mechanical parts to break
- Requires suitable climate and weather conditions
- Requires airtight seals and smoothly stretched plastic during construction and operation; poor handling can break seals

### Estimated Lifespan

- Box still: 10+ years, depending on materials and construction quality
- Watercone®: ~5 years

### Manufacturing Requirements

#### Worldwide Producers:

- There are many worldwide producers (e.g. Solaqua, Solar Water Distillation Products, Watercone®, Waterpyramid®)
- Simple designs are available at no cost on the internet

#### Local Production:

- Can be built with locally available materials

#### Materials:

- See design details (on internet)

#### Fabrication Facilities:

- Workshop space for filter construction

#### Labour:

- Anyone can be trained to construct solar distillation units

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## Key Data

### Hazards:

- No specific manufacturing hazards.

### Maintenance

- Some systems are designed to be self cleaning to flush out accumulated contaminants
- Systems without a flushing function should be regularly cleaned using soap and clean water
- Very turbid water can be sedimented or filtered prior to distillation to reduce cleaning the reservoir

### Direct Cost

Capital Cost	Operating Cost	Replacement Cost
US\$10-400/m <sup>2</sup> (box still) <sup>1</sup> ~US\$32 (cone still) <sup>2</sup>	US\$0/year	US\$0

Note: Program, transportation and education costs are not included. Costs will vary depending on location.

<sup>1</sup> A square meter for a single basin solar still costs about \$400 in Mexico (Foster et al., 2005)

<sup>2</sup> Watercone®

### Other

- About 0.5 m<sup>2</sup> of solar box still is needed per person to meet potable water needs consistently throughout the year (Foster et al., 2005)

### References

Foster, R., Amos, W. and S. Eby (2005). Ten Years of Solar Distillation Application Along the U.S.-Mexico Border. Solar World Congress, International Solar Energy Society, Orlando, Florida, August 11, 2005. Available at: <http://solar.nmsu.edu/publications/1437ISESpaper05.pdf>

Planet Kerala (2006). Solar Distillation: A Natural Solution for Drinking Water, Now Practical. Available at: [www.planetkerala.org/downloads/SolarDistillation.pdf](http://www.planetkerala.org/downloads/SolarDistillation.pdf)

Smith, K. (2005). Still Distilled! Water Conditioning & Purification Magazine. Available at: [www.wcponline.com/pdf/0705%20distilled.pdf](http://www.wcponline.com/pdf/0705%20distilled.pdf)

### Further Information

Planet Kerala, Participatory Learning and Action Network, India:  
[www.planetkerala.org/downloads/SolarDistillation.pdf](http://www.planetkerala.org/downloads/SolarDistillation.pdf)

Solaqua, Solar Water Distillation Products, USA: [www.solaqua.com/solstilbas.html](http://www.solaqua.com/solstilbas.html)

AquaCone™: [www.solarsolutions.info/main.html](http://www.solarsolutions.info/main.html)

Watercone®, Germany: [www.watercone.com](http://www.watercone.com)

Waterpyramid®, The Netherlands: [www.waterpyramid.nl](http://www.waterpyramid.nl)

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