



SODIS HANDOUT FOR PROMOTORS WATER AND SANITATION SODIS WATER TREATMENT: SOLAR WATER DISINFECTION

Adapted from: [Solar Water Disinfection: A guide for the Application of SODIS](#)

At least one third of the population in developing countries has no access to safe drinking water. The lack of adequate water supply and sanitation facilities causes a serious health hazard and exposes many to the risk of water-borne diseases:

There are about 4 billion cases of diarrhea each year, out of which 2.5 million cases end in death. Every day about 6000 children die of dehydration due to diarrhea.

SODIS, Solar Water Disinfection, improves the microbiological quality of drinking water, using solar UV-A radiation and temperature to inactivate pathogens causing diarrhea.

SODIS is a method for the disinfection of water that works in the following way:

When the direct sunrays, and especially the ultraviolet radiation present in them, penetrate the water, they completely destroy the human pathogens. Also, the sunlight increases the water temperature, which also contributes to killing the microbes.

In this way, the combination of the two effects caused through ultraviolet radiation and increased temperature produce disinfected water, suitable for human consumption. It is important to know that ultraviolet radiation is a strong disinfectant that is also used in water treatment plants in industrialized countries.

Other effects of the ultraviolet radiation are that they can cause burns of the skin, damage the eyes or even cause skin cancer. The human pathogens present in the water are very sensitive to solar radiation because they are used to live in our stomach and intestines. Therefore they do not have any protection mechanisms against sunlight. For this reason the UV-radiation can burn and kill the pathogens.

Promoter Checklist

1. Check if the climate and weather conditions are suitable for SODIS.
2. Collect plastic PET-bottles of 1-2 litre volume. At least 2 bottles for each member of the family should be exposed to the sun while the other 2 bottles are ready for consumption. Each family member therefore requires 4 plastic bottles for SODIS.
3. Check the water tightness of the bottles, including the condition of the screw cap.
4. Choose a suitable underground for exposing the bottle, for example a CGI (corrugated iron) sheet.
5. Check if the water is clear enough for SODIS (turbidity < 30 NTU). Water with a higher turbidity needs to be pretreated before SODIS can be applied.
6. At least two members of the family should be trained in the SODIS application.
7. A specific person should be responsible for exposing the SODIS bottles to the sun.
8. Replace old and scratched bottles.

Lessons learnt from the application in the field

Appropriate containers are transparent PET-bottles of up to 2 litres volume.

In warm climatic conditions, where water temperatures reach 50°C during exposure, half-blackened bottles may be used, as the water temperature increases quicker in such bottles.

In high altitude regions, where the water temperature remains cold, fully transparent bottles should be used in order to optimize the effect of UV-A.

The efficiency of SODIS will be increased if bottles are placed on a reflective surface such as for example aluminum or CGI-sheets.

The bottle needs to be exposed to the sun for 6 hours if the sky is clear or up to 50% cloudy.

The bottle needs to be exposed to the sun for 2 consecutive days if the sky is 100% cloudy.

During days of continuous rainfall, SODIS does not perform satisfactorily. Rainwater harvesting is recommended during these days.

If a water temperature of at least 50°C is reached, 1 hour exposure time is sufficient. Water with a turbidity of more than 30 NTU needs to be filtered before it is filled into the SODIS bottle.

The SODIS efficiency is increased at higher levels of oxygen in the water. Aeration of the water can be achieved by shaking the 3/4 filled bottles for about 20 seconds before they are filled completely.

Lessons learnt during the training of promoters

The promoters must have a sound knowledge of the correct application of SODIS, as such a person will be more convincing than an insecure person.

The promoters must apply SODIS for the preparation of their own drinking water. In this way they are certain about the correct application of SODIS and they serve as an example for the target community.

The promoters should be capable to answer questions from the community. Check on this before the promoters start working in the community.

Advise the promoters to never lie in case they cannot answer a question from a user. In such a case they should contact the technical resource person

The promoters must speak the local language.

The optimal size of a promotion team is 2 persons.

The NGO and the promoters have a very important role for the promotion. Their example serves to make SODIS credible.

The technical resource person should develop a list of criteria to select the promoters.

In the training sessions, the same methods should be used that later will be applied in the villages. In this way promoters have the opportunity to train and practice their future work.

During the training, emphasis should be placed on good communication skills and confidence building.

The training should build on previous experiences and existing knowledge of the promoters.

The promoters should be carefully observed during the training to assess their motivation and capabilities.

Inform the promoters that behavioral changes take time. And include a lesson on "resistance to changes" in the training curriculum.

POSTER BASED LESSON PLAN

Useful Links:

SODIS: <http://www.sodis.ch/>

Solar Water Disinfection; A Guide for the Application of SODIS: http://www.sodis.ch/files/SODIS_Manual_english.pdf

The Flipchart Posters can be downloaded at: <http://www.sodis.ch/Text2002/T-EducationMaterials.htm>

Step 1: The water and the environment

Objective: To reflect about different types of water sources, being used for people's daily water supply (rivers, streams waterfalls, wells, ponds, springs etc)

Possible Questions

What kind of water sources do you know?

Content

We can divide the sources of water into two kinds of groups:

Surface water

Underground water

Surface water is found in rivers, streams, waterfalls, lakes, ponds etc.

Underground water is found in wells and springs.

The water sources are formed through the hydrological cycle of water. This means, water first evaporates from the lakes and seas and it falls as rain to the earth. Part of the rainwater infiltrates the ground to form ground water. The other part flows as surface runoff over the soil to form rivers, streams and lakes.

Step 3: The use of water

Objective: To think about the different uses of water at household level and to discuss about the water quality required for the different activities.

Possible Questions

For what purpose do we need water?

For what other purposes do we need water?

For which of the activities on the picture can we use water of minor quality?

Content

We use the water for:

Drinking, cooking, washing ourselves, washing the dishes, giving water to the animals, watering the plants etc.

We also need the water for recreational purpose, for example to swim in ponds or rivers.

It is important, that the water that is consumed during meals or in between is clean and safe. This can be achieved by disinfecting the water.

To take care of and protect the water is a task for girls and boys as well as for adult women and men, then without water life would not be possible. It is therefore important that the whole family has a profound knowledge about water. Let us remember that women and the children are always the ones in charge to carry the water from the sources to their houses.

Step 4: Contamination of the water

Objective: To think about the little attention we generally give to the protection of our water sources, causing its contamination as a consequence and creating the risk for people to consume contaminated water and get ill.

Possible Questions

What are other possible sources for water contamination?

Are humans the only ones contaminating the water?

What happens when we consume dirty water?

Content

We almost always contaminate our water source because we do not take enough care. Our faeces are the primary source of contamination, especially when people and animals defecate into the open field or near to a water source.

Also the industries and other waste producers contaminate the water and make it unsuitable for human consumption. If we see clear water, we believe that it is clean, but also clear water can be contaminated.

Step 5: Habits influencing the contamination of water

Objective: To think about hygiene habits people practice around their house and reflect about the little care that is given to the protection of water sources.

Possible Questions

What is the source of water of this family?

Where do they disperse their faeces?

What are the animals doing? Do they stay in their appropriate place?

Is it correct to defecate in just any place?

What is the child doing?

How can we protect the water we use for our daily consumption?

Content

We contaminate the water not only at its sources but also in the house, when not having well taken care of the cleaning of the containers where we keep the water or when our tank of water storage is not protected against contamination.

Under inadequate hygienic conditions around the house, a major contamination of the water can occur, for example:

If the rope we use to pull out water from the well was in contact with something dirty.

If the birds stay on the water barrel and shit into the water.

If people or animals defecate near the house or near the family's water source.

Step 6: Transmission cycle of faecal microbes

Objective: To show transmission cycle of gastrointestinal illnesses through the contamination of water and food items.

Possible Questions

Can the foods get contaminated if we leave them without protection, as is shown on this Step?

What happens if we leave our plates and cups with foods on them standing around, as is shown on this Step?

How do the microbes arrive into our body?

From where comes the contamination of water?

Content

The hygienic practices determine whether the water is clean or contaminated. Faeces are the principal source of contamination for water as well as for foods.

The first picture shows a defecating child. Every one of us (adults or children) whether we are healthy or ill, has microbes in our intestines that could cause diarrhea in other people. Through the faeces these microbes arrive into the environment.

The faeces we saw in the first picture have been dispersed with the rain, wind or through animals, for example mosquitoes, flies etc. The water as well as the food on the table are now contaminated with faeces.

In the last picture a healthy person consumes contaminated water and contaminated foods. The microbes can produce stomach pain and diarrhea in that person. When this person defecates, the microbes in the intestines are again discharged to the environment. In this way the transmission cycle of faecal microbes is being produced.

Step 7: Consequences of consuming contaminated water

Objective: To show the microorganisms present in contaminated water and the consequences of consuming such water.

Possible Questions

What can you see inside the water?

What is the woman doing?

What can happen if she drinks contaminated water?

What are the illnesses she gets when drinking contaminated water?

Content

If we do not clean the vessels used for keeping the water, the water will be contaminated even if it was clean originally. Inside the water there are very small microorganisms. These microbes are so tiny that we cannot see them with our eyes. When we see clear water, we therefore believe that the water is clean, but it is not always the case. If somebody drinks the contaminated water, the person can get ill through a gastrointestinal infection, with the following symptoms:

vomiting

stomach pain

diarrhea

Step 8: Habits which contribute to the protection of water

Objective: To show what kind of protection measures are to be taken for the water sources as well as for the vessels used for storing the water.

Possible Questions

How can we protect the water sources?

How is the water vessel where the water is stored?

Where do the animals have to stay?

How is the environment of the house?

What is the difference between this and Step Nr. 5?

Content

We have to protect our water sources from contamination:

Take care that the animals keep enough distance to the water source, that they stay inside a fence and that they have a separate water source. Take care of the environment around the house, each thing should have its specific place. Keep the place for defecation far away from the house and from the water source. And especially keep:

Covered wells

A clean rope and clean vessel to pull out the water from the well

Covered barrel for stored water

Waste in a covered vessel In this way a better water quality for the daily consumption can be guaranteed.

Step 9: Personal hygiene, washing the hands

Objective: To show the importance of personal hygiene in addition to the protection of water and the cleanliness of the living place.

Possible Questions

When is it necessary to wash the hands?

What do you have to do after going to the bath/ latrine?

Why is it important to wash the hands before cooking and eating?

Content

It is very important to have adequate habits of personal hygiene. This contributes to an improvement of the family health. Some important hygiene practices are: -

To wash the hands with soap before cooking and eating -

To wash the hands after defecating and cleaning the bottom of the babies.

Step 10: Common methods for water disinfection

Objective: To explain different methods commonly used for disinfecting drinking water such as boiling, chlorination and solar water disinfection.

Possible Questions

What other forms of water disinfection do we know?
Have you already heard about SODIS?

Content

The most common forms of water disinfection at household level are:
boiling the water
chlorination
using SODIS

Step 11: How does SODIS work?

Objective: To clearly explain the effect of sunlight on human pathogens present in the water.

Possible Questions

What do you think happens with the pathogens contaminating the water when the sunlight hits them directly?
How can the sunlight touch the microorganisms in the water?
Do you think that the sunlight can destroy them?

Content

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In this way, the combination of the two effects caused through ultraviolet radiation and increased temperature produce disinfected water, suitable for human consumption. It is important to know that ultraviolet radiation is a strong disinfectant that is also used in water treatment plants in industrialized countries.

Other effects of the ultraviolet radiation are that they can cause burns of the skin, damage the eyes or even cause skin cancer. The human pathogens present in the water are very sensitive to solar radiation because they are used to live in our stomach and intestines. Therefore they do not have any protection mechanisms against sunlight. For this reason the UV-radiation can burn and kill the pathogens.

Step 12: Influence of turbidity and depth of the bottle

Objective: To show the adequate level of turbidity and depth of the water bottle required for an optimal efficiency of solar water disinfection.

Possible Questions

What do you think happens if the water exposed to the sun is very turbid?
What do you think will happen if the water bottle is too big?

Content

In order to achieve a proper effect of the solar radiation, two conditions need to be fulfilled:

1. The Water needs to be clear

If the water we are exposing is very turbid, the sunrays cannot penetrate through all the water because they are absorbed by the particles found in the water. In other words, the particles present in turbid water protect the pathogenic microorganisms and the sunrays then cannot kill them.

2. The size of the bottle needs to be adequate

It is scientifically shown that SODIS is a method for disinfecting small quantities of water. For large volumes of water SODIS will not work. Therefore it is recommended to use bottles with a volume of up to 2 litres for the application of SODIS. The depth of a vessel for applying SODIS should be less than 10cm, If we use vessels with more depth, the sunrays cannot penetrate the profound areas of the vessel with the same intensity. This makes the disinfection process incomplete.

Step 13: Choose good bottles for SODIS

Objective: To present to best bottles for the SODIS application.

Possible Questions

How do the bottles have to be?

Content

For an effective SODIS process it is necessary to choose good bottles. It is important that the bottles have a lid and close tightly. The bottles are made from transparent and not colored plastic, as the sunrays cannot penetrate colored plastic. The bottles need to be intact without breaks, nor splits. The bottles need to be clean. Before you use them the first time, wash the bottles with clean water and a bit of soap. The bottles should have a volume of up to 2 litres.

Step 14: If the water is turbid

Objective: To show what has to be done if the water is turbid.

Possible Questions

What can we do if the water we are going to use for SODIS is turbid?

Content

If the water we are going to use for SODIS is turbid, it is recommended to:
Let the water stand for a while (let the particles sediment and decant the water afterwards)
Filtrate the water with a fine cloth. In this way, the water will be clearer afterwards.
If you have no possibility to filtrate or decant the water, it is also possible to use coagulants (for example lime). The coagulants group the particles together and let them settle more quickly.

Step 15: Fill the bottles completely with water

Objective: To show that the bottles need to be filled with water and well closed afterwards.

Possible Questions

How do we have to fill the bottles?

Content

When the water is ready for SODIS, we have to fill the bottles completely without leaving air bubbles inside the bottle. Then close the bottle tightly so that no water is spilled out. It is important not to leave any air in the bottle, as the air bubbles reflect the sunrays. The lid of the bottle needs to be clean.

Step 16: Expose the bottles to the sun

Objective: To indicate the place of exposition of the bottles and the orientation they must have.

Possible Questions

Where are the bottles?
Where can the bottles be put?

Content

The bottles have to be exposed to the sun on the metal roof of the house, on a piece of corrugated zinc sheet put on the floor or on a tile roof if no corrugated zinc sheet is available.
The bottles are exposed to the sun in horizontal position, facing towards the sun.
It is important that the place of exposition receives sun during the whole time, this means from at least 9 o'clock in the morning until 3 o'clock in the afternoon.

Step 17: Expose the bottles from the morning until the evening (for at least 6 hours)

Objective: To show the exposition time required for the sun to disinfect the water in the bottles.

Possible Questions

How much exposition time is required for the sun to kill the microorganisms in the water?
Why is it important to expose the bottles for at least 6 hours?

Content

In order to guarantee the disinfection of the water, the bottles need to be exposed to the sun from the morning until the evening for at least 6 hours. It is better if the bottles are exposed during the whole day. If the exposure time is less, it is possible that the disinfection will not be complete.

It is important to know that the bottles need to be exposed to the sun during the hours of the biggest sun intensity, around midday. It is not enough to expose the bottles at 6 o'clock in the morning and take them in again for lunch. The bottles need to be exposed

from 9 o'clock in the morning until 3 o'clock in the afternoon. There will be no problem if the bottles remain exposed for longer than that, also not if the bottles remain on the roof over night.

Step 18: Additional recommendations

Objective: To analyze the climatic conditions influencing the performance of SODIS.

Possible Questions

What happens if the day is cloudy?

Content

During very cloudy days it is important to expose the bottles during two consecutive days. If it is raining during the whole day, it is however recommended to use a different method for water disinfection such as boiling the water or using rainwater.

Step 19: The water is clean and safe for consumption

Objective: After all the steps of the SODIS method are applied, the water is ready for consumption.

Possible Questions

Do you believe that the water is disinfected and ready for consumption after all the steps of the SODIS method have been applied properly?

Content

If all the indicated steps of SODIS are done in a correct manner, the water is clean, disinfected and safe for consumption.

Final Recommendations

It is recommended to use double the amount of SODIS bottles required for preparing the daily drinking water. While one bottle is being exposed to the sun, the other bottle stays ready for consumption in the house. The SODIS bottle is a clean and safe container, protecting the water against recontamination. Therefore it is the best to store the disinfected water in the SODIS bottle itself and not in a different container which could be contaminated. Use a clean glass to drink the disinfected water.

It is recommended to consume the SODIS water within two days after exposing the water to the sun.

Finally, it is of advantage for the facilitators using this Steps' guide to study additional literature and information about SODIS in order to deepen their understanding of technical aspects of the solar water disinfection method. Also, it is a requirement for facilitators to collect their own experiences with the application of SODIS through personal use before they start teaching the application procedure of SODIS to others.