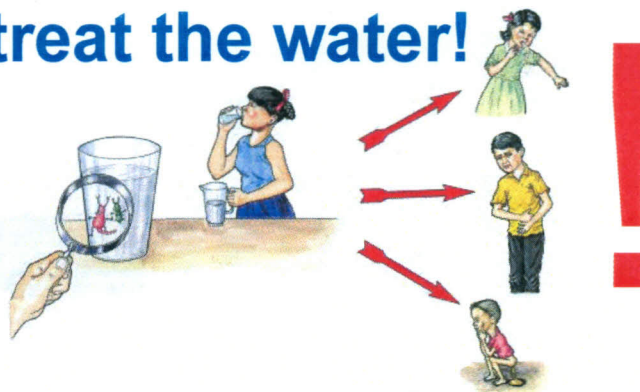


Protect your health, treat the water!

Solar water disinfection - the SODIS method - is a simple procedure to disinfect drinking water. With SODIS you can avoid diseases like diarrhoea, cholera or typhoid.



1



Take a PET bottle. Remove the label. The bottles must be clean, unbroken, transparent, colourless or with a bluish tinge and with a volume of less than three litres.



2



Fill the bottle with water and tighten the lid.



If the water is very turbid, it must be filtered.

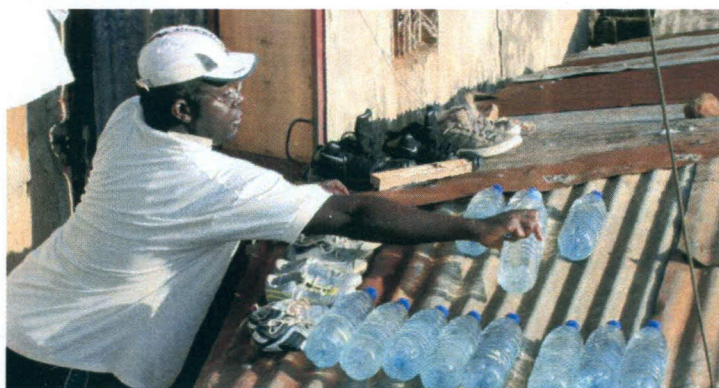
3



Expose the bottle to the sun, morning to evening for at least 6 hours. During this time, the UV-radiation of the sun kills diarrhoea generating pathogens. If more than half of the sky is covered with clouds, the bottle must be placed in the sun for two consecutive days.

4

The water is now ready for consumption. The treated water should be kept in the bottle to prevent recontamination.



The World Health Organisation (WHO), UNICEF, and the Red Cross therefore recommend the SODIS method as a way to treat drinking water in developing countries.

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SODIS
Safe drinking water for all.

SODIS METHOD

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FAQs

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What water can I use for the SODIS method?

The SODIS method needs relatively clear water. You can find out with a [simple test](#) whether the water is too turbid. The source of the water (well, surface water) does not matter.

Water that has been polluted with chemicals (poisons, fertilisers, etc.) must not be used. The SODIS method only kills germs. The chemical composition of the water remains unchanged.

Does the SODIS method change the taste of the water?

The SODIS method improves the quality of the water without changing its taste. The bottles are closed while they are being exposed to the sunlight, so the oxygen dissolved in the water cannot escape. The water still tastes fresh. On the other hand, if we boil water, the oxygen dissolved in the water escapes. This gives the boiled water an unpleasant aftertaste. The use of chlorine also makes the water taste less good.

Where should I place the bottles?

Lay the bottles on a clean surface in the sun, where no shadows will fall for the whole treatment time.

If possible, lay the bottles on a reflective surface, like a sheet of corrugated iron, and protect it from cooling by the wind. The reflection and higher temperature will speed up the disinfection process. However, this is not essential for the application. The bottles can be set down on any surface (wood, concrete, clay brick, etc.).

How long can I store the water that I have treated with the SODIS method?

If the bottle is kept unopened after treatment and stored in a cool, dark place, it can be stored for as long as you wish. The dead bacteria cannot multiply again. The only things that may grow are algae. However, these do not represent a health hazard.

How long can I use the same PET bottle for?

UV-A radiation must penetrate the bottle in order to kill the germs. Clear, unused bottles normally allow more than 60% of the UV-A light over 340 nm to pass through. Experiments have shown that older, used bottles allow less UV-A light to pass through them. Besides the ageing process of the bottle material, scratches on its surface will also mean that it allows less UV-A light through. So it is very important to handle the bottles carefully. We recommend replacing old bottles and bottles that are no longer transparent after about 6 to 12 months of daily use.

How can I tell the difference between a PET bottle and a PVC bottle?

Only PET bottles should be used for the SODIS method because PVC can be harmful to your health. PET and PVC bottles are normally marked accordingly. The labels can vary from country to country, though. If the bottles are not marked, you can only tell the difference between the bottles by setting fire to them.

PET burns quickly and easily when it is held in a flame. When it is taken out of the flame, the fire goes out slowly, or it may keep burning. The smoke smells sweet.

PVC does not burn easily. The material does not burn at all when not in the flame. PVC smoke smells acrid.

Is it dangerous to your health to use PET bottles?

[Scientific studies](#) have confirmed repeatedly that when the SODIS method is applied correctly there

TRAINING MATERIAL

We developed training material for SODIS projects. We compiled them for your projects. | [more >>](#)



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is no danger to health.

How can I improve the efficiency of the method?

If the temperature is increased, the efficiency of the SODIS method can be improved. The germs are killed more quickly. In addition, amoebas are also rendered harmless above a temperature of 50°C. To increase the temperature, lay the bottles on a reflective surface, like a sheet of corrugated iron, and shield them from cooling by the wind.

Old, scratched bottles reduce the effectiveness of the method. Therefore, the bottles should be replaced regularly. But with careful handling, they should be usable without problems for 6 to 12 months.

Turbidity in the water also reduces the efficiency of the method. This problem can be corrected easily by filtering the water.

Does the SODIS method kill all bacteria?

The SODIS method is used to kill germs in the water. While the bottle is being exposed to the sunlight, other, harmless bacteria and organisms that occur naturally in the environment can grow, for example algae or naturally occurring coliform bacteria. However, these organisms do not represent a threat to human health.

Up to what degree of contamination with faecal coli is the SODIS method effective?

Laboratory experiments have shown that when the method is used properly, extreme contamination levels of 100,000 E. coli per 100ml can be made harmless. These concentrations are much higher than are normally found in natural water sources (a few thousand E.coli/100ml water or less).

How can I prove that the SODIS method is effective?

To prove the existence of germs, expensive analytical procedures are often necessary. It is not always possible to use s methods. In such cases, the World Health Organisation (WHO) recommends using E. coli as an indicator organism ([WHO, Guidelines for drinking water quality, 1993](#)).

E. coli is suitable for use as an indicator of faecal pollution because it

- is present in large numbers in human faecal matter.
- cannot survive in natural bodies of water.
- has a similar resistance and survival rate to water treatment methods as other germs.

It is also possible to analyse E. coli under difficult conditions in the field, for example with the [DelAgua field test kit](#) or with [Petrifilms from 3M](#).

It is not recommended to use total coliform bacteria as indicators, because there are harmless strains that occur in natural bodies of water and are much more resistant to UV-A radiation than the germs that harm humans. The total bacteria count is also a poor standard for evaluating the efficiency of the method. Some bacteria grow while the bottle is lying in the sun. However, since they are harmless to people, the water can still be drunk without any ill effects.

What mistakes do new users make most often?

- Using green or brown bottles for the SODIS method;
=> these bottles absorb UV-A light. This is why only colourless, transparent bottles must be used for the SODIS application.
- The bottles used are too big;
=> the bottles must not be able to hold more than 3 litres.
- Bottles are placed upright;
=> the bottles must be laid horizontally in the sun. This increases the area exposed to the sunlight and reduces the depth of the water the light must penetrate. (With turbidity of 26 NTU, only half of the UV-A radiation penetrates farther than 10cm)
- After the SODIS method has been applied, the treated water is poured into dirty containers, so the water is immediately contaminated again;
=> The treated water should be kept in the bottle and drunk directly from the bottle, or poured into a cup or glass immediately before it is drunk.

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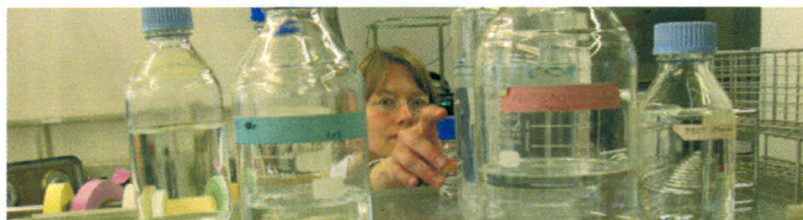
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PET-bottles



Reports from around the world regarding substances in PET bottles that cause cancer are worrying users of the SODIS method. Therefore, a number of research institutions tested the scientific accuracy of these reports and carried out their own analyses of the materials. Studies have been produced for the following substances: antimony, adipates, phthalates, acetaldehydes and formaldehydes. These studies show that when the SODIS method is applied correctly with PET bottles, there is no danger to human health.

Antimony

Antimony speeds up chemical processes in the manufacture of PET (catalyst). However, antimony does not get into the water unless the bottles are stored for a very long time or heated to very high temperatures. The storage times and temperatures in question far exceed those that are involved in the correct application of the SODIS method. There is therefore no danger to the health of SODIS users.

Adipates and phthalates

Adipates and phthalates are used as softeners in the production of certain types of plastics and packaging materials (e.g. PVC). Adding these substances to the plastic makes it more flexible and easier to work. Although these softeners are not particularly toxic, they do represent a threat to health if they are consumed in large quantities. However, softeners are not needed in the production of PET. If softeners are found in the water from PET bottles, they must have been in the water before the bottles were filled.

Aldehydes

Aldehydes are formed when the plastic is heated in the manufacturing process for PET bottles. A research group in Eawag, the Swiss Federal Institute of Aquatic Science and Technology, therefore researched the questions of whether formaldehydes and acetaldehydes are transferred from the PET bottles to the water when the SODIS method is applied, and if so, in what quantities. It was found that exposure to the sun has no effect on the concentration of acetaldehydes, though the concentration of formaldehydes does increase with the length of exposure. However the concentrations of aliphatic aldehydes remained far below the state regulatory limit for drinking water in all samples. Therefore, the SODIS method does not pose a health risk.

Scientific publication

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Health



Drinking water situation in developing countries

Almost one billion people do not have access to clean drinking water. Every day, these people drink water that is infected with germs. This often leads to diarrhoeal diseases such as typhus, dysentery and cholera. These kinds of diseases can quickly lead to death, particularly for small children. Every year, more than 1.6 million people die from the effects of diarrhoea. The World Health Organisation (WHO) estimates that 94% of all occurrences of diarrhoeal diseases are avoidable. Research was therefore begun to find out how the application of the SODIS method affects the health of the population.

Less diarrhoea thanks to the SODIS method

In the 1990s, the Royal College of Surgeons of Ireland carried out the first investigation of the effect of the SODIS method on health. The study was conducted in Kenya and showed that 16-24% of diarrhoea-type illnesses and 86% of cholera occurrences were avoided with the aid of the SODIS method.

In 2002 and 2003, the Swiss Tropical Institute studied children in Bolivia. Children who drank water that had been treated with the SODIS method were 70% less likely to suffer from diarrhoea than those who drank untreated water.

The University of Uppsala in Sweden and the Christian Medical College in Vellore, India, studied children in the slums of Tamil Nadu, India. Here too, the frequency of diarrhoea among children who drank water that had been treated with the SODIS method was considerably lower. The rate of diarrhoea occurrences among this group was 40% lower than among their neighbours who drank the water without treatment.

A study by the Swiss Federal Institute of Aquatic Science and Technology (Eawag) found similar figures among children in the slums of Yaoundé, Cameroon. Children in families that treat their water with the SODIS method fall ill from diarrhoea 42% less often than their neighbours whose parents do not treat their water.

Scientific publications

SODIS method together with washing hands particularly efficient

Not all methods for preventing diarrhoeal diseases are equally effective. A [systematic study](#) of various strategies revealed the following picture:

- Better water at the source prevents 11% of diarrhoea cases
- Better sanitation facilities prevent 32% of diarrhoea cases
- Treatment of drinking water in the home (e.g. SODIS method) prevents 39% of diarrhoea cases
- Washing hands prevents 45% of diarrhoea cases

These results show that, besides methods for treating water in the home, washing hands is the most effective strategy for preventing diarrhoea. We therefore recommend that when introducing a water treatment method, to always discuss hygiene in the home as well.

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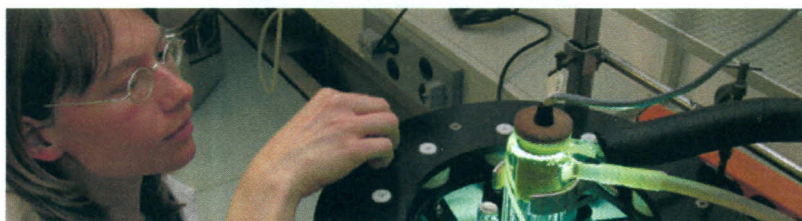
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Research



In order to confirm the effectiveness of the SODIS method, it was necessary to carry out microbiological tests. These tests showed that the method reliably kills germs that cause diarrhoea. Besides research in the field of microbiology, several health studies examined the effect of the SODIS method on the spread of diarrhoeal diseases among people who use SODIS. These studies confirm the positive effect of the method for the population. Sociopsychological studies tested different training strategies to find the most effective for educating people in developing countries. These provided us with important information about the best way to implement projects in the field. Analyses of the chemical substances in PET bottles and in the water prove that use of PET bottles does not represent a danger to health.

Microbiology

When developing the SODIS method, it was important to know which germs die and how much sunlight is required to kill them. These questions have been answered for most of the germs that threaten the health of humans. The SODIS method kills bacteria, viruses, and most parasites. We know not only that the germs die; we are also beginning to find out why. [more>>](#)

Health

The aim of the SODIS method is to improve the health of the people living in developing countries. To determine whether this was happening, specific studies were necessary. Many tests confirmed the positive effect of the SODIS method; the occurrence of diarrhoea is much less frequent among people who treat their water using the SODIS method than among their neighbours who drink untreated water. The method is responsible for more than a direct improvement in the quality of life of the people concerned. Children attend school more often and their parents can go to work more regularly. [more>>](#)

Training strategies

In order for the method to be used all over the world, information about it must be spread as efficiently and inexpensively as possible. For this reason, sociopsychologists have researched a number of different training strategies. Visits to the homes of the people concerned proved to be particularly successful. In these instances, it is essential not only to convince the people to try the method. It is most important to assist them in changing their old habits. It was also found that many people do not know that water can be responsible for spreading sickness. Therefore, this issue is discussed at great length when necessary. [more>>](#)

PET bottles

In recent years, the PET bottle has come under criticism. Particularly on the internet and in emails, rumours have arisen stating that drinking water from PET bottles causes cancer or other diseases. To be certain that the SODIS method has no dangerous side effects for those who use it, Federal Laboratories for Materials Testing and Research (Empa) tested the use of PET bottles. Empa confirms that when the SODIS method is applied correctly, a threat to health does not exist. [more>>](#)

Scientific publications: [Microbiology](#), [Health](#), [Training strategies](#), [PET bottles](#)

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