Reuse of PET Bottles for SODIS – Blessing or Curse?

Allegations of health risks related to carcinogenic substances from PET bottle material in drinking water are circulating in the media of countries where such bottles are used for SODIS (solar water disinfection). A recent study shows that there is no reason for concern. Samuel Luzi

Solar water disinfection (SODIS) is an inexpensive and effective method to destroy pathogens in drinking water at household level. The disinfection mechanism is based on the biocidal effect of UV-A radiation in sunlight. Contaminated water is filled into colourless PET or glass bottles and exposed to direct sunlight for six hours (or two days during mostly cloudy weather).

Solar water disinfection is one of several technologies for household water treatment and safe storage (HWTS) recommended by the World Health Organisation. The application of SODIS significantly reduces the risk of infection by water-borne bacteria, viruses and protozoa, and decreases diarrhoea incidence in countries where access to safe drinking water is limited. An estimated two million people in more than 30 countries already apply SODIS for drinking water treatment.

Though PET (polyethylene terephthalate) is generally considered a very inert material suitable for food packaging, concern has been raised about the potential health risks related to the migration of chemical compounds from the bottle material into the drinks in PET bottles. As SODIS users rely on daily reuse of PET bottles, the SODIS Reference Centre at Eawag/Sandec has decided to assess the extent of migration of chemical compounds from PET bottles into water treated with SODIS, and quantify the associated potential health risks.

Earlier studies show that antimony – a catalyst in the PET production process – is indeed released into the bottled water during storage [1]. However, the antimony concentrations in the range of the WHO maximum levels for drinking water are only reached at very high temperatures (above 80 °C) and/or after very long exposure times (several weeks to months). These conditions are not typical for the SODIS process, as the water is kept in the bottles for only a couple of days and the water temperatures reached are well below 70 °C.

Other studies focused on the migration of phthalic acid and phthalate esters from PET and glass bottles into mineral water [2]. A recent article published by researchers from Empa (Swiss Federal Laboratories for Materials Testing and Research) and Eawag/Sandec illustrates the migration of organic compounds – with special focus on plasticisers – into the water contained in PET bottles under typical SODIS conditions [3]. For this study, colourless PET bottles of different origin were exposed for two consecutive days to sunlight at a geographic latitude of 47 °N (horizontal solar radiation varying between 194 and 845 W). Screening with GC/MS for organic compounds in the water after exposure revealed only food flavour constituents stemming from previous bottle contents – e. g. Coca Cola – at concentrations above the detection limit of 1 mg/L. Quantitative determination of the plasticisers di(2-ethylhexyl)adipate (DEHA) and di(2-ethylhexyl)phthalate (DEHP) revealed maximum concentrations of 0.046 and 0.71 µg/L, respectively. These concentrations are in the same range as the levels of plasticisers found in tap water or in commercially bottled water and range well below the WHO maximum concentration levels for drinking water (80 µg/L for DEHA; 8 µg/L for DEHP, Fig. 1). Only minor differences in plasticiser concentrations were observed in different experimental setups. The country of origin of the bottle was the most decisive factor, while the impact of storage conditions (sunlight exposure and temperature) was less evident.

According to the results of this study, the risk of negative health effects caused by reused PET bottles for SODIS treatment is negligible. These findings are contradictory to the allegations circulating in a number of print media in developing countries on the carcinogenic risk of (re-)using PET bottles. Such unfounded media reports potentially discourage SODIS users from applying this effective method for drinking water treatment and may instead expose them to a high risk of infection by diarrhoea-causing pathogens. The experiments conducted at Empa and Eawag/Sandec will be repeated in India to confirm the harmless nature of the technology in a country where media reports on the dangers of PET bottles are particularly widespread.

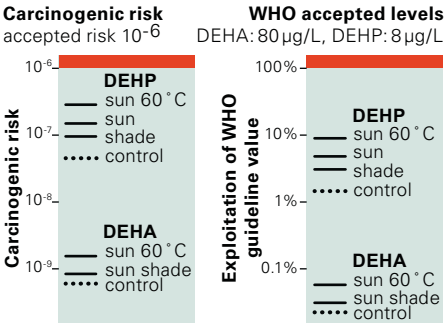

Figure 1: Carcinogenic risk and measured concentrations of DEHA and DEHP in PET-bottled water under different conditions relative to WHO guideline values.

Eawag/Sandec has been involved in SODIS (solar water disinfection) research and promotion since the 1990s. Today, the SODIS Reference Centre at Sandec provides support to SODIS projects in more than 20 developing countries.

Further information can be downloaded from www.sodis.ch

Contact: samuel.luzi@eawag.ch

[1] Westerhoff P., Prapaipong P., Shock E., and Hillaireau A. (2007): Antimony leaching from polyethylene terephtalate (PET) plastic used for bottled drinking water. Water Research 42 (3) pp. 551–6. doi:10.1016/j.watres.2007.07.048.

[2] Montuori, P., Jover, E., Morgantini, M., Bayona, J. M., and Triassi, M. (2007): Assessing human exposure to phthalic acid and phthalate esters from mineral water stored in polyethylene terephthalate and glass bottles. Food Additives & Contaminants 25 (4), 511–518. doi: 10.1080/02652030701551800.

[3] Schmid P., Kohler M., Meierhofer R., Luzi S., and Wegelin M. (2008): Does the reuse of PET bottles during solar water disinfection pose a health risk due to the migration of plasticisers and other chemicals into the water? Water Research 42 (20) pp. 5054–5060. doi:10.1016/j.watres.2008.09.025.