

Disinfection By-Products and the Safe Water System

In the early 1900's, chlorine began to be widely used as a disinfectant. Chlorine revolutionized water purification and dramatically reduced the incidence of waterborne diseases. The provision of safe drinking water has been hailed as the major public health achievement of the 20th century. Chlorine remains the most widely used chemical for water disinfection in the United States.

However, in 1974 it was discovered that chlorine reacts with organic matter and bromine naturally present in the water to create disinfection byproducts (DBPs), including trihalomethanes (THMs). Although trace amounts of many different DBPs are formed during water chlorination, THMs are generally the most prevalent potentially harmful compounds formed by the addition of chlorine to water. The following information is known about THMs:

- The WHO International Agency for Research on Cancer (IARC) reviews research conducted on potential cancer-causing agents. Based on research on animals, only two of the four THMs are considered *potential* human cancer-causing agents. None of the compounds is a proven human cancer-causing agent.
- The WHO has established guideline values for the concentration of the four THMs allowed in drinking water. These guideline values are conservative, as they are based on a maximum of 1 additional cancer in 100,000 people who drink 2 liters of water every day for 70 years.
- More importantly, however, WHO specifically and repeatedly states in the Guidelines for drinking-water quality (1996): “Where local circumstances require that a choice must be made between meeting either microbiological guidelines or guidelines for disinfectants or disinfectant by-products, the microbiological quality must always take precedence, and where necessary, a chemical guideline value can be adopted corresponding to a higher level of risk. Efficient disinfection must *never* be compromised.”

The addition of chlorine to water can lead to the formation of disinfection by-products (DBPs), such as trihalomethanes. A significant amount of energy and time has been invested in Europe and the United States to restructure water treatment processes to minimize DBP formation in order to reduce the slight risk of cancer from long-term exposure to DBPs. Diarrheal disease in developing countries is still a leading cause of infant and under-5 mortality and morbidity. The risk of death or delayed development in early childhood from diarrhea transmitted by contaminated water is far greater than the very small risk of cancer later in life from DBPs.

The Safe Water System (SWS) is a proven intervention that consistently reduces diarrheal disease incidence by about 50% in users in the developing world. This reduction of diarrhea morbidity leads to healthier children and adults. The SWS uses sodium hypochlorite, a chlorine compound, to inactivate the disease-causing organisms. There is a slight risk, measured in one additional cancer per 100,000 people after 70 years, to the ingestion of THMs at the WHO guideline value level. We are currently investigating THM concentrations formed in the SWS and strategies to mitigate THM production in the SWS. Although the risk from THMs is important to address, and to investigate, until centrally treated, piped water can be delivered to every family, the initial critical need is the provision of microbiologically safe drinking water that has been proven to reduce the incidence of diarrhea.

If you have any questions or comments, please visit <http://www.cdc.gov/safewater> or email safewater@cdc.gov.