FACTS

Disinfection By-Products in Drinking Water

NEW JERSEY DEPARTMENT of HEALTH and SENIOR SERVICES

Division of Epidemiology, Environmental and Occupational Health
Consumer and Environmental Health Services

FACTS Disinfection By-Products in Drinking Water

Introduction 3

What Are Disinfection By-Products (DBPs)? 4

Why is Chlorine Added to Drinking Water Supplies? 5

How Can DBPs Get into Your Drinking Water? 6

Where are DBPs Most Often Found? 7

What About Private Well Water? 8

How Can DBPs Get into Your Body? 9

Are DBPs Harmful to Your Health? 10

How Can You Find Out if DBPs Are in Your Drinking Water? 11

Is There a Safe Level of DBPs in Your Drinking Water? 12

What Steps Are Being Taken to Reduce DBP Levels in Public Drinking Water? 14

Are There Home Water Treatment Devices For DBPs? 15

What About Using Bottled Water? 16

What Else Can You Do to Protect Yourself From DBPs? 17

For More Information 18

Other Available Materials 19

INTRODUCTION...

The protection of our nation's drinking water supply has been a priority for many years. In fact, a major accomplishment in public health during this century has been the chlorination of public drinking water supplies. This practice has greatly reduced serious illness and death associated with many waterborne diseases, such as cholera and typhoid.

We are often reminded of the important role that chlorination plays in protecting the public each time we hear about an outbreak of waterborne disease resulting from inadequate disinfection. But, as with many issues, it sometimes becomes necessary to weigh the benefits against the potential risks. The presence of disinfection by-products in drinking water supplies, formed when chlorine reacts with natural organic materials in water, has raised concerns about the overall safety of chlorination.

As a result, many members of the drinking water protection community have been actively working to more clearly understand the possible health problems from exposure to disinfection by-products, *while at the same time* ensuring a high level of protection against waterborne diseases.

Meanwhile, federal and state governments have taken steps to protect the public from the potential health risks from disinfection by-products by conducting health effects research, strengthening drinking water regulations, and supporting improvements in water treatment technology.

WHAT ARE DISINFECTION BY-PRODUCTS (DBPS)?

Disinfection by-products (DBPs) consist of a wide variety of chemicals that form when chlorine is added to drinking water during the treatment process. Chlorine is added to drinking water for disinfection purposes.

DBPs include:

- ***Trihalomethanes (THMs)***
- ***Haloacetic Acids (HAAs)***
- ***Haloacetonitriles (HANs)***
- ***MX***

Of these chemicals, *THMs* and *HAAs* are most often found in chlorinated drinking water. Others, such as *HANs* and *MX*, are formed in smaller amounts during the chlorination process. Still other *DBPs* have not yet been chemically identified.

Some water treatment plants use other types of drinking water disinfectants, such as ozone, chlorine dioxide, and monochloramine, usually in combination with chlorine. Each of these disinfectants produce their own group of by-products during the treatment process.

WHY IS CHLORINE ADDED TO DRINKING WATER SUPPLIES?

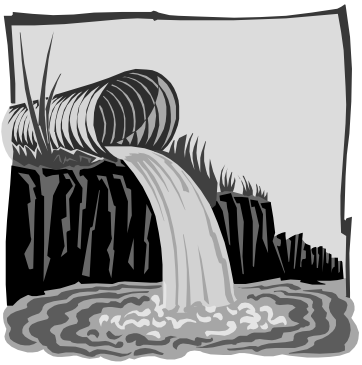
Chlorine is widely used during the water treatment process because it is very effective in destroying harmful bacteria and viruses. Disinfection of drinking water is one of the most important accomplishments of public health practice because it has resulted in a major reduction in cholera, typhoid, and other waterborne diseases.

HOW CAN DBPS GET INTO YOUR DRINKING WATER?

DBPs are formed when chlorine reacts with the natural, organic materials found in water, such as algae and decaying plants.

Chlorine + Decaying Plants = DBPs

Organic materials can wash into surface water from surrounding lands, such as farms and wooded areas. Urban runoff also carries organic material into surface water when it rains. During the warmer months, surface water often contains a lot of organic material. As a result, *DBP* levels are generally higher in the summer and fall than other times of the year.



THMs and HAAs are two families of related chemicals that contain different amounts of chlorine and bromine. During the water treatment process, bromine is formed when chlorine reacts with naturally-occurring bromide in the water. Bromine, like chlorine, can combine with organic material naturally found in water to form THMs and HAAs.

WHERE ARE DBPS MOST OFTEN FOUND?

Surface water, such as rivers, lakes and reservoirs, are likely to contain large amounts of organic materials, especially during the warmer months of year. These materials can easily wash into the water from the surrounding land. As a result, drinking water from surface water supplies are likely to form *DBPs* after chlorine is added during water treatment.

Under certain conditions, groundwater can contain some organic materials. For example, organic materials may reach shallow wells that obtain water from close to the ground's surface. Likewise, wells may draw in organic materials if they are located near surface water bodies. This is referred to as groundwater *under the direct influence* of surface water.

Groundwater, such as well water, does not commonly contain the organic materials necessary to form *DBPs*. And some public water suppliers do not chlorinate groundwater when it comes from a *protected* underground source. Therefore, the amount of *DBPs* in well water is usually very low, and in many cases, is so low it cannot even be measured.

WHAT ABOUT PRIVATE WELL WATER?

Groundwater is unlikely to contain the organic materials needed to form *DBPs* as long as it comes from a protected underground supply. Also, well water does not usually need to be chlorinated on a regular basis.

Although *DBPs* are not commonly found in private well water, there are certain conditions under which they may be present:

- In some instances, it may be necessary to add chlorine to a well to make sure it is free of harmful bacteria. For example, a well should be disinfected following installation or repair work, or if it is found to be contaminated with disease-causing organisms. If chlorine is not properly flushed out of the system afterwards, *DBPs* can form in well water when organic material is present.

- *DBPs* can form in household septic systems when organic material reacts with chlorine based cleaning products. Water discharged from the septic system can enter into the underground water supply and nearby wells.

- Chlorine can get into groundwater from leaking in-ground swimming pools. *DBPs* can form in the underground water supply when chlorine reacts with organic material discharged from a nearby septic system and can enter a nearby well.

HOW CAN DBPS GET INTO YOUR BODY?

There are several ways that DBPs can get into your body:

- ***DBPs can get into your body by drinking tap water.*** People that get their drinking water from a surface water supply are more likely to be exposed to DBPs than those that get their water from a groundwater source.

- ***DBPs can get into your body when you breathe.*** Some DBPs can be released into the air in your home when you use your tap water. This can happen when you are taking a shower or washing dishes. And the hotter the water is, the more likely it is that DBPs will be released into the air. DBPs can also get into the air when you boil your tap water, such as when you make tea or soup.

- ***DBPs can get into your body through your skin.*** You can be exposed to DBPs when your skin comes into direct contact with water, such as when you are bathing or showering. But for most people, only very small amounts of DBPs get into the body though the skin. However, these amounts can increase to much higher levels as your contact time with water increases, for example, if you typically take long baths.

ARE DBPS HARMFUL TO YOUR HEALTH?

The health risks from exposure to low levels of *DBPs* in drinking water are not well understood:

- Some studies have found that people who drink chlorinated surface water have a higher risk of developing cancer of the bladder, rectum and colon.

Your drinking water may contain some amount of *DBPs*, especially if it comes from a surface water source disinfected with chlorine.

- Other investigations have suggested that chlorinated drinking water may contribute to the risk of birth defects of the brain and spinal cord. Several studies have found that exposure to chlorinated surface water may result in reproductive health effects, such as low birthweight babies, premature births, and miscarriages.

- In some animal studies, exposure to very high levels of certain *DBPs* resulted in kidney and liver damage, reproductive effects, and cancer. But these effects occurred at levels that were much higher than those typically found in drinking water.

Additional research is in progress to further study if exposure to low levels of chlorinated water can cause harmful health effects in people.

HOW CAN YOU FIND OUT IF DBPS ARE IN YOUR DRINKING WATER?

Your public water supplier is required to test for *THMs* in your drinking water every 3 months. At least 4 samples collected over a 12 month period are used to determine an *average THM level* for the year. You can find out the results of these tests by contacting your water supplier or the New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water (see page 18). Also, public water suppliers are now required to send information about the quality of their water to customers each year.

In 1999, certain large public water suppliers must start testing regularly for *HAAs.* Currently, there are no monitoring requirements for other *DBPs* in water supplies.

The U.S. Environmental Protection Agency (USEPA) has collected information on the presence of certain DBPs in large surface water systems in New Jersey. Contact the USEPA, Safe Drinking Water Hotline (see page 18) to request this information.

Private well water is unlikely to contain *DBPs* because it does not need to be chlorinated on a regular basis. And well water from protected underground sources does not usually contain the necessary organic materials to form *DBPs*. Contact your local health department for more information and guidance about whether private well testing is necessary based on your individual situation.

IS THERE A SAFE LEVEL OF DBPS IN YOUR DRINKING WATER?

Maximum Contaminant Levels (MCLs) have been established to protect the public from exposure to *DBPs* in chlorinated drinking water. They are set at levels that reduce the chances that harmful health effects will occur.

MCLs, developed by the New Jersey Department of Environmental Protection and the U.S. Environmental Protection Agency, limit the amount of certain *DBPs* that can be present in public drinking water supplies.

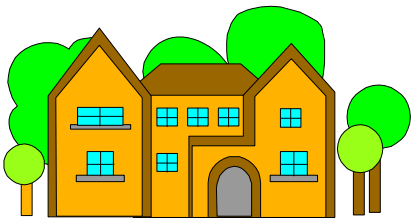
The MCLs for *DBPs* are listed in the following table. Beginning in 2003, some MCLs will be lowered for certain large public water systems in order to be more protective of public health. MCLs have not been set for all *DBPs* since there is not enough health effects information currently available to do so.

Maximum Contaminant Levels (MCLs)

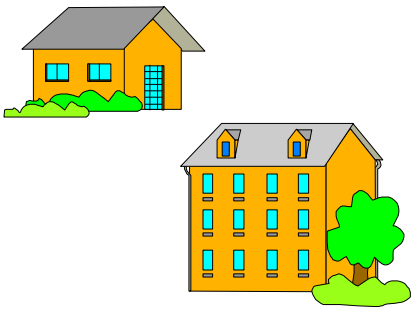
Contaminant	MCL[1]
THMs	100 (80[2])
HAAs	— (60[2])
HANs	—
MX	—

[1]measured in parts per billion (ppb) or micrograms per liter (ug/l)
[2] Public water systems using surface water or ground water under the direct influence of surface water, and serve 10,000 or more people, must meet the MCL by 12/16/03
Source: Federal and NJ Drinking Water Standards, 11/96, 12/98

- ***If you have public water,*** your water supplier is required by law to test for *THMs* to make sure that *average annual levels* (based on 4 consecutive testing periods) do not exceed the MCL. If the MCL is exceeded, the water provider must lower *THM* levels to below the MCL within a time period sufficient to protect your health. Your water supplier can describe any steps they are taking to lower *THMs* in your drinking water.



- ***If you have a private well,*** you can use the MCLs as guidelines to determine if you need to take any steps to lower *DBPs* in your drinking water. Keep in mind that any chlorine added to a well for disinfection purposes can be removed by properly flushing out the system afterwards.



WHAT STEPS ARE BEING TAKEN TO REDUCE DBP LEVELS IN PUBLIC DRINKING WATER?

Information Collection: The USEPA, with the assistance of many large water suppliers in New Jersey, is gathering information about the amounts and types of *DBPs* that typically result from the disinfection of drinking water supplies. In addition, numerous health studies are being conducted to further investigate the possible links between harmful health effects and different amounts of *DBPs* in drinking water.

Drinking Water Regulations: Water quality information, along with the results of ongoing health effects research, will be used by federal and state government agencies to decide whether current drinking water regulations need to be strengthened or new regulations need to be developed to further protect the public from *DBPs*. Other regulatory approaches focus on improving drinking water quality by protecting water supplies at their source.

Water Treatment Technology: The USEPA is evaluating the effectiveness of different water treatment technologies in protecting the public from harmful organisms in drinking water while minimizing the formation of *DBPs*, such as through the use of chlorine alternatives (ozone, ultraviolet light) and the development of better water filtration methods.

ARE THERE HOME WATER TREATMENT DEVICES FOR DBPS?

While scientists continue to learn more about the possible health effects from *DBPs* in drinking water, certain home water treatment devices can be used to reduce your exposure:

Granulated activated carbon (GAC) filters are effective in lowering *DBP* levels in your drinking water. These filters are also capable of improving the taste and odor of your drinking water by removing chlorine.

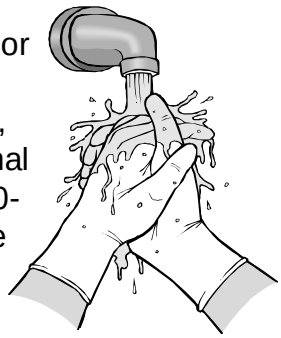
Several types of GAC filters are available for home use. ***Point-of-use filters*** include those that are attached to the faucet itself or connected to the cold water line beneath the sink. Free-standing units are separate from the water supply but can only filter small amounts of water at one time. These filters do not totally eliminate exposure to *DBPs* in the water *and* the air since treatment is limited to only a portion of the household water supply. ***Point-of entry filters*** treat all the water coming into the home and, therefore, are effective in preventing exposure to *DBPs* through ingestion and inhalation.

In order to ensure that your treatment device works properly, GAC filters must be replaced periodically according to the manufacturer's instructions. Also, regular maintenance is needed to prevent bacterial growth. Contact NSF International for more information on home water treatment devices (see page 18).

WHAT ABOUT USING BOTTLED WATER?

Bottled water must meet the same drinking water standards as public water supplies. In general, bottled water that comes from a ground water supply is less likely to contain *DBPs* than bottled water from a surface water source. In New Jersey, bottled water companies are required to test the water regularly to make sure it meets standards and to identify the source of the water on the product label.

When deciding whether or not to purchase bottled water, keep in mind that bottled water usage will not reduce your exposure to volatile *DBPs* that get into the air when you use your tap water for non-drinking purposes. You can get more information about bottled water from the New Jersey Department of Health and Senior Services, Consumer and Environmental Health Services, (609-588-3123), the International Bottled Water Association (800-928-3711), or by contacting the bottled water company directly.



WHAT ELSE CAN YOU DO TO PROTECT YOURSELF FROM DBPS?

There are several simple steps you can take to reduce your exposure to *DBPs*:

Use less water

Take shorter showers and baths, and use shorter wash cycles for dishes and clothes. Some *DBPs* can evaporate or "volatilize" into the air in your home when you use the water.

Use cooler water

Reduce the amount of hot water that you use when you shower or bathe, and wash clothes. Volatile *DBPs* are more likely to get into the air in your home when the water is hot.

Provide adequate ventilation

Open windows or vent air to the outside during and after water use. Spend less time in the bathroom after the water has been used. Volatile *DBPs* can build up in the air in your home, especially in an enclosed area. And the longer you remain in the area, the more likely you will be exposed.

Flush out your private well system after disinfection

Be sure to properly flush out your private well system after adding chlorine to your well for disinfection purposes. Chlorine can be quickly eliminated from your well by flushing out the system afterwards.

FOR MORE INFORMATION...

♦ **Local Health Department**
Local telephone directory
Local water issues, private well testing guidance, and health effects of *DBPs* in drinking water

♦ **New Jersey Department of Health and Senior Services**
Consumer and Environmental Health Services
PO Box 369
Trenton, NJ 08625-0369
(609) 588-3120
Health effects of *DBPs* in drinking water

Visit our website at: www.state.nj.us/health

(609) 588-3123
Bottled water regulations

♦ **New Jersey Department of Environmental Protection**
Bureau of Safe Drinking Water
(609) 292-5550
Federal and State drinking water regulations and public water supply monitoring results

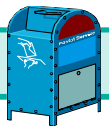
Office of Quality Assurance
(609) 292-3950
NJ certified laboratories for *DBPs* in drinking water

♦ **United States Environmental Protection Agency**
Safe Drinking Water Hotline
(800) 426-4791
Federal drinking water regulations, health effects of *DBPs* in drinking water, and other water safety issues

♦ **Public Water Utility**
Local telephone directory
Public drinking water regulations and monitoring results

♦ **NSF International**
(313) 769-8010
(800) NSF-6275
Home water treatment device and bottled water information

OTHER AVAILABLE MATERIALS...



- ❒ *FACTS: Cryptosporidium in Drinking Water*
- ❒ *FACTS: Lead in Drinking Water*
- ❒ *FACTS: Mercury in Drinking Water*
- ❒ *FACTS: Microorganisms in Drinking Water*
- ❒ *FACTS: Nitrate and Nitrite in Drinking Water*
- ❒ *FACTS: Pesticides in Drinking Water*
- ❒ *FACTS: Volatile Organic Compounds in Drinking Water*
- ❒ *Contacts and Information: Drinking Water Issues*
- ❒ *Parasites and New Jersey Drinking Water: Information on Giardia and Cryptosporidium*
- ❒ *Private Well Testing*
- ❒ *Don't Drink Lead* (11" x 17" poster)
- ❒ *Keep Your Baby Safe From Lead* (11" x 17" poster)

Name_____

Address_____

Town_____**State**___**Zip**_____

Please send this order form to:

New Jersey Department of Health and Senior Services
Consumer and Environmental Health Services
PO Box 369
Trenton, NJ 08625-0369

July, 1999

Division of Epidemiology, Environmental and Occupational Health
Consumer and Environmental Health Services
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