Fact Sheet

# DISINFECTION BY-PRODUCTS

Emerging DBPs

## Understanding Alternative Nonregulated Disinfectants

### Quick Facts

- The disinfection methods many utilities use to minimize the formation of regulated DBPs may form unregulated DBPs
- Nitrogenous DBPs form when nitrogen-containing compounds in water react with certain oxidants/disinfectants
- Iodinated DBPs form when iodine-containing water is disinfected with chlorine or chloramine
- Many other DBPs have yet to be identified

### Overview

Since the early 2000s, many water utilities have moved away from chlorine disinfection to alternatives such as chloramine, chlorine dioxide, and ozone. Most of these utilities changed their method of disinfection to comply with U.S. Environmental Protection Agency (EPA) standards for regulated disinfection by-products (DBPs), such as trihalomethanes and haloacetic acids.

Although these alternative disinfectants may reduce the formation of regulated DBPs, they often form other DBPs that are not currently regulated and may have adverse health effects. These DBPs include nitrogenous DBPs (N-DBPs) and iodinated DBPs (I-DBPs).

### Nitrogenous DBPs

N-DBPs are formed when nitrogen-containing compounds react with certain oxidants/disinfectants. These N-DBPs include nitrosamines, nitriles, and hydrazine. They can sometimes be found in water distribution systems.

A nationwide assessment of nitrosamine occurrence found that approximately 1 in 10 samples in the data from the Second Unregulated Contaminant Monitoring Rule (UCMR2) contained N-nitrosodimethylamine (NDMA). The study found that NDMA formation is more significant in chloraminated water systems with long contact times of precursors with chloramines and without the benefit of a free chlorine (or ozone) oxidation step (Russell et al. 2012).

N-DBPs are being researched for potential health risks, and some of these compounds are one to two orders of magnitude more toxic than the regulated DBPs (Plewa and Wagner 2009).

Although federal rules for N-DBPs have not yet been established, California and Massachusetts have set regulatory levels for NDMA. As part of its new Drinking Water Strategy, the EPA may regulate six nitrosamines, including NDMA.

## Iodinated DBPs

I-DBPs are formed when iodine-containing water is disinfected with chlorine or chloramine. These I-DBPs are most often formed during chloramination and in situations when complete oxidation is prevented. They are found occasionally in waters originating from treatment plants located in coastal saltwater areas (Weinberg et al. 2002).

I-DBPs often cause medicinal tastes and odors in drinking water and are being researched for possible adverse health effects. Preliminary research indicates I-DBPs are highly toxic to cells. One I-DBP, iodoacetic acid, is greater than 250 times more toxic to cells than the regulated DBP chloroacetic acid (Plewa and Wagner 2009).

## Other Nonregulated DBPs

Measurements of total organic halogen indicate that many other DBPs have yet to be discovered. The use of structure-toxicity relationships in predictive models has identified potential DBPs with high probabilities of being potent cancer-causing agents or developmental toxicants.

Determining the existence of nonregulated DBPs in drinking water is confounded by the fact that no single analytical method can be used to identify all classes of DBPs, and commercially available standards do not exist for most of them. Nonetheless, some classes have been identified and analytical tools have been developed to verify the formation and occurrence of a handful of DBPs such as haloquinones, organic chloramines, and cyclopentenoic acids upon chlorination and chloramination of water (Li et al. 2011). For those classes of DBPs that have been discovered, it is difficult to gauge their health effects at this point. However, several predictive models have identified potential DBPs with a high likelihood of being carcinogenic.

**A nationwide assessment of nitrosamine occurrence found that approximately 1 in 10 samples contained NDMA.**

## References

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