Pharmaceuticals in Drinking Water

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Pharmaceuticals are chemical compounds that are used in prescription medicines, veterinary medicines, and over-the-counter drugs. Researchers worldwide have been detecting many of these chemicals in water, beginning with human hormones, since the late 1960s when oral contraceptives gained wide use. The majority of these contaminants enter the water supply when they are excreted by people who are being treated with these products or when they are flushed down the drain unused. Conventional wastewater treatment does not completely remove them from the wastewater stream; nor does conventional water treatment completely remove them from drinking water.

Improved detection methods in recent years have allowed the tracking of these so called "micropollutants" easier than was previously possible. The majority of these products are present in very low concentrations, normally in the range of 1 to 100 ng/L (nanograms per liter). One ng/L is equal to 1 part per trillion. They are present nonetheless, and more research needs to be conducted to identify the effects of long-term exposure to even low levels of pharmaceuticals on human health. However, a recent report by the World Health Organization suggested that "appreciable adverse impacts" are unlikely at current levels of micropollutants concentration in drinking water.

Treatment Methods

The obvious concern is how to treat water to remove these substances from drinking water. In 2007, scientists at Gwangju Institute of Science and Technology near Seoul, South Korea published the results of a study of the effectiveness of several commonly used water treatment technologies in the removal of a variety of pharmaceuticals. This research was funded in part by the American Water Works Association Research Foundation.

The Korean researchers found granular activated carbon (GAC) filtration was effective in removing a variety of micropollutants. Of the six micropollutants detected at measurable levels in drinking water in Seoul (pharmaceuticals: Ibuprofen, Dilantin, Carbamazepine, and Caffeine; flame retardant: TCEP; insect repellant: DEET) GAC reduced the concentration in the treated water below the current practical detection limits (10 ng/L for TCEP and Caffeine; 1 ng/L for all others).

A number of micropollutants were detected in higher concentrations in wastewater treatment plant effluent that was also tested. A total of 17 contaminants (10 pharmaceuticals: Erythromycin, Sulfamethoxazole, Hydrocodone, Acetaminophen, Trimethoprim, Naproxen, Ibuprofen, Diclofenac, Carbamazepine, and Caffeine; three hormones: Estriol, Testosterone, and Androstenedione; and four miscellaneous compounds: TCEP, DEET, the sunscreen Oxybenzone, and the antibacterial Triclosan) were detected at significant levels. In all cases except one, treatment by reverse osmosis (RO) or by nanofiltration (NF) reduced the concentrations of the contaminants below the currently practical detection limit for each. The one exception was TCEP, which was reduced from a concentration of 284 ng/L to 14 ng/L by RO treatment and to 13 ng/L by NF treatment. In each case, this is approximately a 95 percent reduction in contaminant concentration.

In summary, growing evidence of micropollutants such as pharmaceuticals and hormones in water supplies has caused increased concern of long-term effects on human health. Recently published research has shown that conventional methods of treating drinking water such as coagulation and chlorination are ineffective in removing pharmaceuticals. Advanced methods such as ozonation, granular activated carbon (GAC), reverse osmosis, and nano-filtration (NF) can remove more than 99 percent of targeted pharmaceuticals. If GAC or NF systems are used to remove these contaminants, the filters must be replaced on a regular schedule and disposed of properly to avoid contaminating the environment. Experts offer point-of-use solutions to consumers concerned about the quality of their drinking water. Proper disposal of unused medicines has a significant impact on reducing the concentration of micropollutants in water resources.

References:

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