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Treatment Methods for Removal of Pharmaceuticals and Hormones from Drinking Water

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Recent studies have highlighted the detection of medications, hormones, and other pharmaceuticals in a number of public water supplies around the nation. 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 there is little research on what effects long-term unintended exposure to even low levels will have on human health.

Of 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 detected at measureable 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 over long-term effects on human health. Recently published research has shown that granular activated carbon filtration, reverse osmosis filtration, and nanofiltration all effectively remove the majority of these contaminants. These findings offer point-of-use treatment solutions to consumers concerned about the quality of their drinking water. 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.

(Adapted from: S.D. Kim, Jaeweon, C., Kim, I.S., Vanderford, B.J. and Snyder, B.J. Occurrence and removal of pharmaceuticals and endocrine disruptors in South Korean surface, drinking, and waste waters. *Water Research* 41 (2007): 1013-1021.)

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Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

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