CITY OF SAN DIEGO WATER PURIFICATION DEMONSTRATION PROJECT
ADVANCED WATER PURIFICATION

It is commonly known that human activities over the years have resulted in contamination of our water bodies worldwide. Whether it's runoff from agricultural farms or health and beauty products we use daily to improve the quality of our lives, contaminants find their way into water bodies as a result of human activities. Many of these water bodies are used as public water supply sources. Recently, the public has become more aware about human activities and the associated impact of contaminants from those activities on water supplies, as well as the potential impacts of exposure to contaminants on both humans and wildlife. For more than a decade, water professionals and regulators have studied various contaminants, which are sometimes called "constituents of emerging concern" (CECs), because of their consistent occurrence in source waters throughout the United States and internationally.

While the presence of CECs is of concern, many of these compounds are not being detected as a result of recent events. Instead, the elevation of the level of compounds is a result of the improvement of our ability to detect them in the environment. In fact, our ability to detect CECs has outstripped our knowledge of what kind of impact they might actually have on humans. *Detection of these compounds does not necessarily imply a risk*. For example, typical concentrations of pharmaceuticals found in water supplies are millions of times lower than one therapeutic dose of that same pharmaceutical. In fact, the highest concentration of any pharmaceutical detected in U.S. drinking waters is approximately 5,000,000 times lower than the therapeutic dose (AWWA, 2008). Nonetheless, strategies have been developed to manage potential risks to the public.

The primary objective of water and wastewater treatment is to protect human health and promote economic vitality while minimizing adverse ecological impacts from the use of the water. Improved public health protection, through effective drinking water treatment, is one of the outstanding civil engineering accomplishments of the twentieth century. At the same time, advances in wastewater treatment have greatly reduced the ecological impacts of wastewater discharges.

While wastewater treatment has been shown to be an effective barrier at reducing CECs, many agencies have embraced the advanced purification of water that will find its way back to a public water supply. Advanced water purification has been proven to positively remove CECs and provide a superior water quality that meets all drinking water standards.

What is Advanced Water Purification?

Advanced Water Purification (AWP) is a state-of-the-art process that further purifies highly treated wastewater. After the wastewater is biologically treated and filtered, the water is considered to be high quality but is not considered suitable for drinking water. AWP involves several additional treatment steps that scientists and health professionals recognize will produce a very high quality water supply. The high quality of this water is achieved by filtering the water through membranes that remove CECs, which are much larger in size than the very small pores in the membrane material. A subsequent step involves advanced oxidation, the combination of hydrogen peroxide and ultraviolet light, which provides one of the most powerful oxidants on the planet to provide an additional barrier and disinfect the purified water. Analysis of the water produced by this process indicates that advanced water purification facilities consistently produce water with significantly lower concentrations of constituents than raw (untreated) imported water supplies.

What type of treatment is provided by Advanced Water Purification in the Demonstration Project?

This advanced water purification process includes membrane filtration (microfiltration and/or ultrafiltration), reverse osmosis, ultraviolet light disinfection, and advanced oxidation. These

technologies have been utilized in the water industry for many decades, and are proven barriers that remove CECs and safeguard public health.

Microfiltration and Ultrafiltration

Microfiltration (MF) and ultrafiltration (UF) are types of filters that utilize fibers that resemble a sponge-like material when magnified. The pores, or openings in the fibers that allow the water to pass through, are 0.2 microns, which is approximately 300 times finer than one human hair. MF and UF are very effective at removing materials in the water, but not good at removing dissolved compounds or CECs. These filters are used to "polish" the water. This improves the operation of the reverse osmosis system that is very effective at removing CECs and dissolved materials.

Reverse Osmosis

Reverse osmosis is a membrane filtration method that removes compounds that are very small, such as dissolved salts, by using pressure to push water through a semi-permeable membrane, leaving other unwanted materials behind. The reverse osmosis membrane is designed to allow only water to pass through while preventing the passage of dissolved materials, such as salt. While these membranes have been used for years to desalinate seawater, they are also being used today to purify water by removing CECs from reuse supplies. The membrane essentially acts like a very fine filter that separates out any remaining minerals and pollutants, salts, viruses, bacteria, metals, pesticides and other materials, resulting in very high quality water. Many bottled water companies use reverse osmosis because of its proven purifying capability.

Ultraviolet Light Disinfection

Following reverse osmosis, water is treated by ultraviolet (UV) light as an additional barrier to CECs. The system is designed to deliver a dose of UV light significantly higher than natural UV from sunlight. This breaks the chemical bonds of the compound into their more natural elements like carbon or nitrogen. The UV system also provides disinfection of the water. Hospitals and dental offices utilize UV light to sterilize instruments.

Advanced Oxidation

The addition of hydrogen peroxide before the UV process creates an additional step called advanced oxidation, providing an additional or backup barrier to CECs. Many of the operating AWP facilities use advanced oxidation to target chemicals typically not found in reuse waters in San Diego. The other intended use of advanced oxidation is as a safety net to address any remaining trace chemicals, which are in extremely low concentrations and thus difficult to detect even with the improvements in analytical testing.

Water Quality Testing

Awareness of our impact on the environment has increased over the years, but this is particularly true in the last 10 years with the improved sensitivity in analytical testing. Decades ago, compounds could only be detected at the parts-per-million levels (one part compound to one million parts water). In the last ten years this has advanced to parts-per-billion. Now, with very sensitive equipment, we are able to detect compounds at the parts-per-trillion level, and are near the parts-per-quadrillion boundary. In fact, lab technicians have to wear special gloves, clothing and breathing filters in order avoid contaminating the samples of water they are testing. While this low level of detection is necessary for analytical purposes, it is not always necessary to determine a human health impact. Experts agree that just because a compound is detected doesn't mean there is an associated health concern.

While humans worldwide have sent many compounds into the environment, many of these compounds are of little health or environmental concern. For those compounds that are a health or environmental concern, the risk of their presence is balanced by the extremely low concentrations at which they occur. Improvements in wastewater treatment have resulted in a very effective barrier to the CECs that that are introduced into the water. Advanced water purification has been proven to be an extremely effective system at providing a superior quality of water that meets all drinking water standards.

If the Demonstration Project were to result in a decision to implement a full-scale project that would augment San Vicente Reservoir with purified water from the AWP, it would have one benefit that other similar projects do not possess. All of the other projects in Southern California use the purified water to supplement groundwater supplies and then pump that groundwater directly to the consumer's taps. A full-scale reservoir augmentation project would send the purified water from the AWP to the San Vicente Reservoir where it would blend with untreated water stored there. Ultimately the blended water would be sent to one of the City's water treatment facilities where it will be further treated before being sent into our drinking water system.

SIDEBAR

What can you do to help reduce pharmaceuticals in water supplies?

Pharmaceuticals and personal care products are products used by individuals for personal health or cosmetic reasons. They comprise a diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, fragrances, soaps, lotions, and cosmetics. These products are considered pollutants when they enter the wastewater stream through such means as bathing or flushing unused or expired medications down the toilet. Many cities have established "take back" centers or, as with the City and County of San Diego, an annual "Take Back Day", for unused medications. Additionally, the City of San Diego Environmental Services Department recommends that medications and pharmaceuticals be securely packed and disposed of in the trash: http://www.sandiego.gov/environmental-services/ep/medical.shtml. You can help reduce pollution in our water supplies by returning unused or expired medicine to a center or by properly disposing in a landfill rather than flushing it down your toilet.

References

American Water Works Association (AWWA). 2008. *Statement of Dr. Shane Snyder, Southern Nevada Water Authority before the Senate Subcommittee on Transportation Safety, Infrastructure Security, and Water Quality on Pharmaceuticals in the Nation's Water: Assessing Potential Risks and Actions to Address the Issue.* April 15. Accessed on May 12, 2011. http://www.awwa.org/files/GovtPublicAffairs/AWWA2008FlyinTestimonyPharmaceuticals.pdf