

Detecting EDCs and Finding a Solution

Company offers chemical-free solution to global problem of hormone mimicking chemicals in drinking water.

By Brian Butters and Tony Powell

Recently there have been many reports of endocrine disrupting chemicals (EDCs) found in drinking water in many cities in North America and in growing and cumulative concentrations. This problem is global in nature and an issue of population. EDCs are included as emerging contaminants of concern, which also include pharmaceuticals, personal care products (PCPs) or organics such as PCBs, TCE, 1,4-dioxane, benzene and other industrial chemicals. So what has changed? What was once perceived as an industrial or remediation problem has grown to include personal lifestyle or drinking water problem.

EDCs are a large group of chemicals that affect estrogen, androgen, and/or thyroid hormone function in animals and humans. There are also regional challenges such as retirement communities and hospital areas where the water is high in pharmaceuticals. Ecstasy is being found in more urban centers and DEET (insect repellent) and triclosan (antibacterial soap) have made a rapid appearance in drinking water since the focus on West Nile Virus and SARS.

The chart below lists the 31 most common contaminants detected in the recent report AWWARF-2758, Removal of EDCs and Pharmaceuticals in Drinking and Reuse Treatment Processes. Of the 31 detected, you can

see some are common compounds like bisphenol A, fluoxetine and herbicides.

The problem is that these EDC contaminants are not easily destroyed in nature, they are dispersed and this dilution has gone full circle and now come back to haunt us in our drinking water supply.

Detection

Detecting the presences of EDCs in the water supply is another daunting challenge, especially when you consider the many thousands of chemicals that can be present in water at the PPM, PPB and PPT levels. Sampling and detection costs for all these compounds quickly gets out of hand because of the sophistication and complexity required to identify and measure.

However there is a solution that has been demonstrated and proven by researchers. According to the AWWA paper, research is showing you don't need to detect individually all the EDCs each time you test; you can use surrogates or flags as key indicators to save time and money. Ideally you would wish to test for the common leading indicators, say bisphenol A and ethynylestradiol, if you were confident that all the rest were destroyed at the same time with the purification process of choice.

What is meant when we say purification versus treatment? Treatment is generally just masking or conditioning the water;

chlorination or pH adjustments are good examples of this. Purification means removal of the contaminants in the water without adding anything; distillation, reverse osmosis (RO) and Photo-Cat are good examples of this. So what happens to EDCs when various technologies are applied?

Some solutions can create additional challenges, which are not acceptable in drinking water. Ozonation under certain circumstances can produce bromate, a carcinogen, in the water. RO, which

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is costly, can not remove all EDCs and removes essential nutrients that must later be added back.

Hydroxyl radical based processes may form part of the solution but it depends on how the radical is produced. If it is produced using a chemical oxidant, such as hydrogen peroxide, then chemical stabilizers or unidentified constituents in the oxidant may be added and can become another compound of concern in time just like the stabilizer 1,4-dioxane. In addition hydroxyl radical solutions, which get a lot of attention, have difficulty dealing with recalcitrant EDCs such as pesticides and fire retardants from clothing.

Further complicating this whole water treatment/purification challenge is that the total organic carbon present in the water may contain precursors in which disinfection processes can produce the regulated compounds in the drinking water supply known as trihalomethanes (THMs) and haloacetic acids (HAAs).

Consequently, there is a need for a process that can also reduce the levels

Top 31 EDCs Detected in North American Drinking Water Study

PHARMACEUTICALS

Sulfamethoxazole (antibiotic)
Atenolol (beta blocker)
Trimethoprim (antibiotic)
Iopromide
(heart medication)
Fluoxetine (Prozac)
Meprobamate
Dilantin
(epilepsy medication)
Carbamazepine
Diazepam
Atorvastatin (Lipitor)
Benzophenone

Primidone
Gemfibrozil
Diclofenac
Naproxen (Aleve)
Octylphenol
Ibuprofen
Ethynylestradiol
(birth control pill)

PERSONAL CARE PRODUCTS

Triclosan
Antibacterial soap
Musk Ketone

HORMONES

Testosterone
Progesterone
Estrone
Estradiol

OTHER CHEMICALS

Caffeine
Atrazine (herbicide)
TCPP (fire retardant)
DEET (insect repellent)
TCEP (fire retardant)
Bisphenol A (plastics)
BHA (food preservatives)

of all EDCs while not contributing to the toxicity of the drinking water if the flags or surrogate EDC detection process proposed by researchers is to be applied.

Solution

A true purification solution is needed that will purify without adding toxicity to the water and remove the full spectrum of EDCs present if they are detected or not.

For the answer we need to go back to the AWWA paper, where researchers spiked the water of Lake Mead simultaneously with the 31 top contaminants of concern as identified in the chart, then treated the water with several different processes and tested the resulting water with limited results. Subsequently, they tested Purifics' Photo-Cat technology and found it to be effective simultaneously against all of the 31 contaminants of concern.


In reference to and support of the work identified in the paper, you therefore have to detect only the main contaminants and treat them, and the others will be purified at the same time. This greatly reduces your detection costs and simplifies the process.

The Photo-Cat process also generates an electron for reduction, and a photogenerated hole, which is a stronger oxidant than other processes as illustrated in the following table. In addition it has a reductive component, which is able to treat refractive compounds such as fire retardant.

Relative Oxidizing Power Versus Various Oxidizing Species

Oxidizing Species	Relative Power
Photo-Generated Hole on TiO ₂ *	2.35
Fluorine	2.23
Hydroxyl Radical*	2.05
Atomic Oxygen	1.78
Ozone	1.52
Hydrogen Peroxide	1.31
Permanganate	1.24
Hypochlorous Acid	1.10
Chlorine	1.00

*Oxidizing Species Generated by Photo-Cat

The Photo-Cat is a chemical-free, triple barrier purification process. This sustainable development technology has a much lower operating cost and with no costly inputs and labour required becomes a very economic and environmentally appealing solution to a complex and somewhat challenging EDC problem in drinking water. 



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Tony Powell is also a member of the Professional Engineers of Ontario. His experience is in the areas of photocatalytic treatment, regulation development, and advanced oxidation technology.



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