



International Headquarters & Laboratory
Phone 630 505 0160

WWW.WQA.ORG
A not-for-profit organization

PPCP & EDC FACT SHEET

Contaminant	In Water As	Maximum Contaminant Level
<ul style="list-style-type: none"> • Pharmaceuticals • Personal Care Products • Endocrine Disrupting Compounds and their metabolites 	Multiple organic and inorganic forms	Not Applicable – Several compounds are listed on EPA's Contaminant Candidate List III (CCL III)
Sources of Contaminant	Elimination from the body Flushing of unused, or expired product Leachate from landfills Rinse off from showering or bathing Agricultural runoff	
Potential Health Effects	Levels in finished drinking water supplies are 10 ³ to 10 ⁶ times lower than therapeutic dose, or effect levels and given that no health effects have been attributed to these compounds at these low concentrations. However, consumer sensitivity (emotional) to the presence of these compounds have brought them to the forefront of the industry and led to the development of testing to evaluate performance capabilities of residential treatment devices.	
Treatment Methods Point-of-Entry Point-of-Use	Active media (carbon) Reverse Osmosis Peroxidation	

The presence of pharmaceuticals, personal care products and endocrine disrupting chemicals (PPCP/EDC) in water supplies has been known for many years, dating back to the 1980's and before. Much of the original concerns were associated with reports of physiological abnormalities associated with fish and other aquatic organisms in areas near or surrounding discharge sites of wastewater treatment facilities. Over time the concerns associated with wastewater effluent have expanded into the drinking water arena. These concerns are further heightened as a result of periodic media reports, or other reports reaffirming the presence of these compounds, albeit at trace levels, in drinking water source waters or finished drinking water supplies. To put these concerns into perspective, there are several aspects that must be clearly understood. In terms of definitions, PPCP refers to products used by individuals for personal health/well-being or for cosmetic purposes. In terms of ingestible products, this would also include metabolites of the parent compound. Included within this definition are products targeted for use with pets or livestock. Illegal drugs, or ubiquitous chemicals like caffeine can fall within the scope of PPCP. EDCs are chemicals/compounds that have or are suspected of having an adverse effect on the body's endocrine system. They may be naturally occurring, or manmade chemicals. This would include developmental, reproductive, neurological and immune system. For purposes of this bulletin, the scope of EDCs discussed is limited to those compounds most commonly associated with pharmaceutical products. PPCP and EDCs include literally thousands of compounds and associated metabolites. Examples include prescription and over the counter drugs, veterinary drugs, fragrances, lotions, cosmetics, detergents, plasticizers, pesticides and flame retardants. Due to the sheer number of possible chemicals generalized, performance claims for PPCP or EDC reduction are likely non-supportable.

There are a number of routes by which PPCP and EDCs can find their way into surface water and ground water supplies. Elimination from the body, flushing or disposal in landfills of unused or expired drugs, or in the case of personal care products, rinsing down the drain while showering or bathing are common pathways to the environment. In the case of agricultural focused products or veterinary drugs, runoff offers another pathway to surface water or groundwater reserves.

The occurrence of PPCP and EDCs in both surface water and groundwater sources is global in nature. The number of compounds being detected in these waters continues to grow as advancements in analytical equipment and techniques drive quantifiable reporting levels to lower and lower concentrations. To that end, there is not a finite limit to the number or type of compounds that will be identified in the coming years. At this point we are only viewing as a snapshot in time.

HEALTH EFFECTS

By their very nature, pharmaceutically active compounds are intended to have an effect. The question is whether the concentration found in finished drinking water supplies will elicit an effect. A number of different approaches have been taken to evaluate the risks associated with PPCP/EDCs detected in drinking water. Generally this has involved the calculation of an acceptable daily intake

(ADI) or tolerable daily intake (TDI). In calculating the ADI or TDI the minimum therapeutic dose (MTD) or no-observed-adverse-effect-level/lowest-observed-adverse-effect-level (NOAEL/LOAEL) in conjunction with an uncertainty factor. Depending upon the chemical, the uncertainty factor could range 1000 to 10,000 in order to provide a safety buffer considered to be sufficiently conservative. From that a **drinking water effect level (DWEL)** can be calculated. Comparing the DWEL against available occurrence data for a given chemical allows for the calculation of the margin of safety. See Table 1 for examples of the margin of safety calculated for select PPCP/EDC chemicals based upon the corresponding DWEL value.

Chemical	Type (EDC/PPCP)	Finished Water Concentration	Safety Level (DWEL)
Meprobamate	Anti-anxiety	3.8 – 42 ng/L	6000
Phenytoin	Anti-convulsant	2.3 ng/L	210
Atenolol	Beta blocker	1.2 – 18 ng/L	2700
Carbamazepine	Anti-seizure	6.3 ng/L	670
Naproxen	Analgesic	0.52 ug/L	40,000,000
Bisphenol A	Plasticizer	25 ng/L	72,000
Linuron	Herbicide	6 – 6.2 ng/L	8400
Nonyl Phenol	Surfactant	100 ng/L	16,000

Table 1: Select PPCP/EDC chemicals and a calculated margin of safety in drinking water.

TREATMENT METHODS

PPCP/EDCs are subject to a variety of potential treatment technologies in both waste water treatment and drinking water treatment processes. Conventional wastewater treatment technologies can be effective in reducing some compounds. However, advanced wastewater treatment processes, including ozonation, UV irradiation, photolysis, reverse osmosis, peroxidation (peroxide and UV), and ultrasound can generally achieve higher reduction percentages than conventional treatment.

While there are a wide range of drinking water treatment processes in use, none have been specifically designed for the reduction of PPCP/EDCs. The effectiveness of the current processes used in drinking water treatment are largely dependent upon the properties of the PPCP/EDC material. For example, activated carbon (both powdered and granular) has demonstrated effectiveness in reducing a number of PPCP/EDCs, with effectiveness related to both chemical adsorption as well as biodegradation. Carbon type, loading and contact time are critical factors. Reverse osmosis has also

demonstrated effectiveness. Chlorination, ozonation, and peroxidation are also effective in the oxidation of many PPCP/EDCs. The effectiveness of oxidizing agents is highly dependent upon pH and dose.

ANALYTICAL METHODS

For chemicals that fall within this category, measured levels are typically in concentrations of nanograms per liter (parts per trillion). It is only due to recent advances in analytical techniques and instrumentation that have allowed for the reportable measurement of concentrations at such low levels. The most common analytical techniques utilized for the more commonly found PPCP/EDCs in finished drinking water include liquid chromatography mass spectroscopy (LC MS), liquid chromatography tandem mass spectroscopy (LC MS/MS), gas chromatography mass spectroscopy (GC MS) and gas chromatography tandem mass spectroscopy (GC MS/MS).

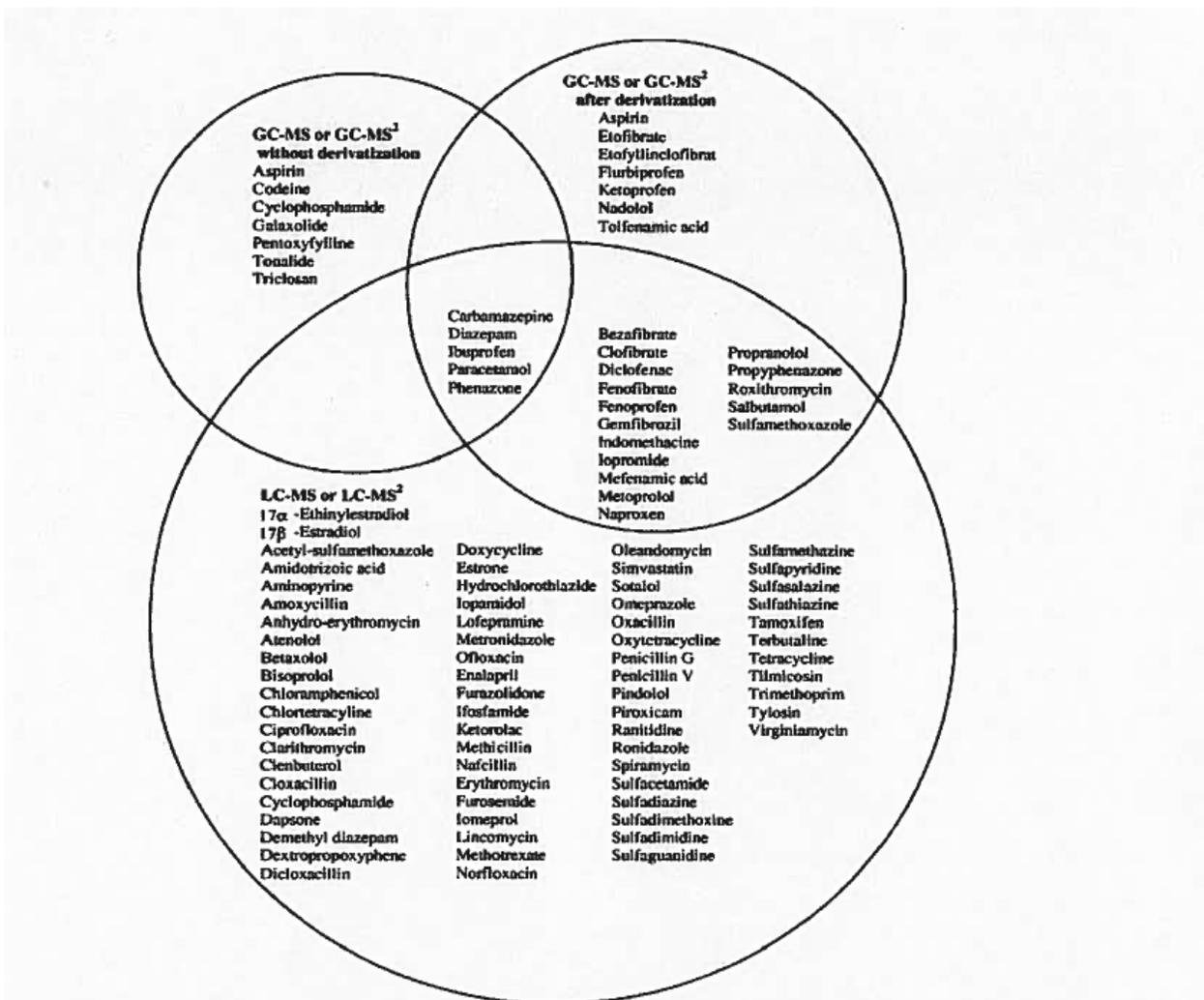


Figure 1 Fatta et al., 2007

REGULATIONS

The lack of data and monitoring has resulted in little to no regulation of PPCP/EDCs in finished drinking water supplies. Monitoring data is essential to better characterize occurrence levels and frequency of PPCP and EDCs in surface waters, finished drinking water, and drinking water in distribution. Such data will help fill in existing knowledge gaps and allow for better risk characterization.

The US EPA has included 12 PPCP/EDC materials in the Chemical Contaminant List 3. Inclusion on the CCL 3 list is an indication that these compounds need further evaluation in terms of both occurrence and safety. It is through this review that the decision is made as to whether any given contaminant should be regulated under the Safe Drinking Water Act with an established maximum contaminant level assigned.

Similarly, a number of other markets/countries have implemented additional monitoring PPCP and EDCs, including the EU, Australia, Japan and Korea.

As this issue is global in nature, organizations like the World Health Organization (WHO) have continued to stress not only the need for monitoring water and drinking water, but also for countries to develop programs for the retrieval and proper disposal of unused or expired pharmaceuticals.

SUMMARY

First it has to be recognized that these compounds have been present in drinking water at some level since the inception of the use of pharmaceuticals. The increase in the amount of drugs being used, coupled with the increased analytical capabilities and the ability to measure lower and lower concentrations of these chemicals is in large part the reason why this issue has been driven forward.

The data collected to date does not indicate that the trace levels of PPCP/EDCs in finished drinking water supplies pose an unacceptable risk in terms of health effects. However, there remain extensive data gaps in terms of occurrence levels, pervasiveness, and synergism/interaction between chemicals that require additional investigations.

Separate to the health effect concern, there remains an emotional factor for consumers. Media reports, internet postings and social media sites have heightened the awareness of consumers as to the presence of these chemicals in drinking water and people remain concerned. Residential treatment technologies or devices that can demonstrate effectiveness on one or more of these compounds can help to lessen the anxiety associated with this issue.

REFERENCES/SOURCES

American Chemical Society Series: Contaminants of Emerging Concern in the Environment: Ecological and Human Health Considerations (2010)

AWWA Research Foundation: Toxicological Relevance of EDCs and Pharmaceuticals in Drinking Water (2008)

Global Water Research Coalition: Research Brief – Pharmaceuticals in the Water System (2009)

Ontario Ministry of Environment: Survey of the Occurrence of Pharmaceuticals and Other Emerging Contaminants in Untreated Source and Finished Drinking Water in Ontario (2010)

World Health Organization: Pharmaceuticals in Drinking Water (2012)

ACKNOWLEDGEMENT

WQA wishes to express sincere appreciation for the unselfish contributions of the members of WQA who contributed their time and expertise toward the completion of this bulletin.

Arvind Patil, Ph.D., CWS-I
Gary Hatch, Ph.D.
Charles Michaud, CWS-VI
Mark Brotman, CWS-VI
P. Regunathan, Ph.D.
Rebecca Tallon, P.E.

Richard Andrew
Shannon Murphy
Steve VerStrat
Pauli Undesser, M.S., CWS-VI
Kimberly Redden, CWS-VI

The Water Quality Association publishes this Technical Application Bulletin as a service to its members and the interested public. Information contained herein is based upon the most recent public data known as of the publication date, which is printed at the bottom of the last page, and of course, cannot take into account relevant data published thereafter. The Water Quality Association makes no recommendations for the selection of a treatment system, and expressly disclaims any responsibility for the results of the use of any treatment method or device to reduce or remove a particular contaminant.

This reference document is published by:



National Headquarters & Laboratory

**4151 Naperville Road • Lisle, Illinois 60532
Tel: 630 505 0160 • Fax: 630 505 9637**

Copyright © 2013 by Water Quality Association. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electric, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.