On the Water Front

Rocky Mountain Water Quality Analysts Association First Quarter 2010

Emerging Contaminants

By Sara Klingenstein

Institute for Environmental Solutions

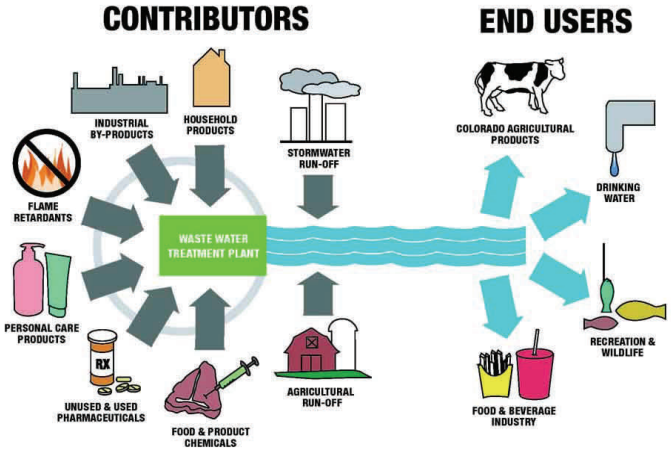
Even after wastewater treatment, chemicals from everyday consumer products, such as soaps, shampoos, and detergents appear in waterways. Although these contaminants of emerging concern (CECs) occur at very low concentrations, their environmental impacts have been documented. Since state and federal regulations do not address their impact, CECs present challenges.

The Institute for Environmental Solutions (IES; www.i4es.org), a Denver-based non-profit, is collaborating with the City of Golden, Colorado, to implement an innovative pilot project designed to use community education to prevent the release of CECs into the environment.

Contaminants of Emerging Concern: Why Worry?

Many CECs are suspected or known toxins or endocrine disruptors. Endocrine disruptors interfere with the normal physiological functions of both humans and wildlife. They are linked to various biological abnormalities in fish and wildlife, and may have human health implications as well.

This potential public health threat is poorly understood and difficult to fully quantify. "Safe" exposure limits have been determined in laboratory settings for acute exposure to singular chemicals, but the effects of chemical combinations and long-term, chronic exposure are still unknown.



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Where do CECs come from?

As seen in the above diagram, CECs originate from a multitude of sources. Many CECs come from consumer products – shampoo, soap, toothpaste, linings of food cans, laundry detergent, cosmetics, body wash, lotion, and more. Some CECs, such as synthetic fragrances, are added to make certain products more memorable to the consumer. Others, such as triclosan, which is the antimicrobial agent in antibacterial soap, meet a perceived need of the consumer. Many of the CECs present in consumer products are not essential to product effectiveness; for example, all soap eliminates bacteria, regardless of whether it is "antibacterial" and fragrance does not enhance the cleaning potential of laundry detergent.

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A Short History of *E. coli* Testing

By Phil Russell, L/E WWTP

Every day in water and wastewater labs perform microbiology tests to enumerate "fecal coliform" and *E. coli* in water samples from all kinds of sources. Usually little thought is given as to about what is actually measured or where the methods were derived. Recently, the methods have been changing which adds a level of uncertainty about what's going on.

To delve into this subject further, we need to go back in time … way back. Animals and pre-historic man were probably aware that it was not in their best interest to drink water that contained fecal material or dead bodies, unless, of course you had no other choice. Even early civilizations, prior to 2500 BC, in the Mideast, Scotland and the Orkney Islands had primitive toilets and sewers. In 2000 BC, Rome had established Water Commissioners who were able to punish water supply polluters with death.

Since then, as seen on the timeline, the understanding of bacteria has increased greatly. Yet now we seem to still be at a loss at defining if a water body is polluted by bacteria. Part of the problem, of course, is that a lot more definitions of pollution exist. Is it human biological pollution, typically human excrement, non-human biological pollution, or something else non-biological? And then there is the issue of risk and whether risk applies just to humans or to a wider range of animals/organisms—another worthy discussion.

Timeline of Bacterial Knowledge

1667	Robert Hooke Invented the Microscope
1676	Antione VanLeeuwenhoek discovered bacteria
1854	John Snow discussed the link between sewage contaminated water and cholera in London
1862	Louis Pasteur developed the Germ Theory (microorganisms cause disease)
1900	Robert Koch, the father of bacteriology, used selective media to develop pure cultures of bacteria
1919	Theodore Escheric discovered the bacteria *E. coli* in human fecal material
Present	Knowledge of bacteria to the molecular & atomic level, including DNA/RNA maps

To simplify risk identification and regulation, a single test for human pollution focused on a culture test, developed using samples collected from human fecal material, which was developed long ago…. so far back that a reference to the original development process could not be found for a genetically diverse group of bacteria called "fecal coliform". Even though this test has been the primary test for water contamination for a long time, it was becoming clear that this was not a clear indicator of human pollution and was not very scientifically defensible.

There have been many attempts to refine this test and make it an easier procedure, increase its sensitivity, and make the results available faster. Within the last ten years, the use of a single species of "fecal" bacteria found in human feces (in diapers, actually) was proposed for use as a better organism to work with. It's name is

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Changing Phases

Greg Harp, Greeley Water and Sanitation District

One of the newest board members for the RMWQAA is Greg Harp, the Water Quality Lab Analyst at the City of Greeley. He recently took over the post of Database Chair and has been working hard for the organization getting important information out to the membership.

Greg is a relative newcomer to the water and wastewater field, though his experience wouldn't let you believe it. After much of his adult life working in the insurance industry, Greg went back to school to obtain his BS and then MS in Watershed Science at CSU in Fort Collins. In between degrees, Greg spent a summer working for the USGS in the field measuring sediment in streams affected by the road crossing Guanella Pass.

During grad school he worked for the National Parks Service (NPS) working on water quality data from all over the country. After two years with NPS, he was hired on with the US Forest Service as a research assistant working out of the Rocky Mountain Research Station. There he continued research with water, but also added air quality to his resume. All this time he was also doing his own research and assisting another grad student. Once school was behind him, Greg rounded out his water experience at a consulting firm collecting rainfall data for early flood warning systems.

After answering an ad in the paper, Greg was hired on by the City of Greeley. Greg's current work involves wastewater analyses

required under NPDES permitting, and monitoring of the Cache La Poudre River. He hopes to gain a better understanding of the wastewater treatment process and the water quality issues in the plant. He would also like to become more involved in WQ issues and professional groups that promote them.

With all this water in his life, Greg still finds time for the important things in life, snowboarding and beer. Greg is an avid snowboarder and enjoys spending time with his wife of twenty-one years while vacationing in New Mexico. All the time down there has given him a new appreciation for all things chili, specifically chili beer. Greg also enjoys camping, and tries to include his yellow lab, Barley, whenever he can.

Do you like to be kept up to date on the many federal rules and regulations? Then visit the new **Regulations.gov** site. The new site has everything the old has, plus more. You can find, review and submit comments on Federal rules, and look for grant information. Plus you can regulate the frequency of e-mails received from List Serve. This new site should make searching for documents easier.

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Consumers have the ability to select products that contain fewer CECs without noticeably changing their lifestyles or spending more money. These contributors are a promising place to cut down on chemicals released into the environment, since these choices are easy to change.

Why Prevention

For these reasons, the Institute for Environmental Studies (IES) considers prevention to be a promising avenue for addressing the emerging issue of CECs. Preventing CECs from entering the environment costs less than removing these contaminants downstream. Other potential approaches to mitigation, such as regulation and technological advances in wastewater processing are also important but require more time and money. Prevention can begin now and can reduce the need for regulation and technology while ensuring cleaner water through community education and action.

Prevention through Community Education: The CEC Project

IES believes that improvements in water quality following community education will be measurable and will test this hypothesis over the next several months with a community education campaign in the City of Golden. The CEC Project employs a novel educational framework called community-based social marketing. Community-based social marketing directly engages a community to encourage sustainable behavior.

The CEC Project uses two objective measures to evaluate the effectiveness of the education campaign: wastewater sampling and analysis measures actual changes of CEC concentrations in raw wastewater, and community surveys measure differences in the community's awareness and behavioral choices as they pertain to CECs and downstream water quality. These quantitative, objective measures are critical to evaluate the success of the CEC Project's pilot Community Education Program in improving downstream water quality.

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Wastewater sampling and analysis

To establish a baseline, the CEC Project wastewater sampling program began with raw wastewater collection samples three times daily for five days prior to the beginning of the education campaign. The sample point was at the location where Golden's municipal sewer lines join prior to treatment. After the education campaign, raw wastewater samples will again be collected on the same schedule. These values will be compared to the initial wastewater samples. For background, samples of drinking water will also be taken and analyzed on both occasions.

The water samples are being prepared and analyzed by the Environmental Soil Chemistry Laboratory of Dr. Thomas Borch at Colorado State University and by Dr. Mark Murphy at the U.S. Environmental Protection Agency's Region 8 Laboratory in Golden. Analysis will be done for over 50 contaminants using a direct inject method on the API5000 triple quadrupole LC/MS/MS with a Waters Acquity UPLC at the EPA Laboratory. The expected calibration range for this method is 10 ppt to 1,000 ppt.

For more information on IES and the CEC Project, please refer to www.i4es.org/emerging.html, or contact CEC@i4es.org.

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Escherichia coli (E.coli).

E. coli was chosen as a candidate because it was assumed to be a better indicator of human pollution and was the best understood bacteria in history. The popularity of *E. coli* is quite arbitrary, It happened because it is easy to grow or culture and has become the "standard" bacteria to study at levels from the atomic level to population dynamics because everybody else studies it. This is a kind of like a vicious positive feedback loop.

To be continued...check out more on E.coli testing in the 2nd Quarter RMWQAA Newsletter.

Some interesting facts about bacteria

- Less than 99.9% of all bacteria (including those in human guts) can be isolated by culturing
- Intensive work is now being conducted using molecular biological techniques which can identify all bacterial species and subspecies
- Only a very, very small fraction of bacteria in the human gut are *E. coli*
- Only a very small fraction of sub species of *E. coli* cause disease. In fact, *E. coli* and fecal coliform are only used as indicators of possible human contamination (or other animals)
- Because bacteria are rarely found as individual organisms in water (they are typically found in groups that interact biochemically to improve survival, e.g. "biofilms") analytical results are usually expressed as "colony forming units per unit of water" (cfu/100ml).

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Water Law Training Review

The Water Law Training put on by the RMWQAA and hosted by Metro Watstewater was interesting and informative. Here are just a few things we learned:

Usufructory Right: You have to use your water right, or you will lose it (they really got creative to come up with this word).

Overappropriation: When there are too many water rights and not enough water. (When doesn't this happen?)

Discharge of a Pollutant: Any addition of any pollutant to navigable waters from any point source (can you fit the word "any" this many times into any other definition!)

Navigable Waters: The waters of the United States, including the territorial seas (sounds straightforward, but many law suits proved this is anything but straightforward)

Thank you to Alix Joseph and Scott Clark of Burns, Figa and Will P.C. for a great class!

Analyst Scholarship Recipient

Congratulations to Diana Trujillo, the recipient of the 2009 Fall Semester RMWQAA scholarship. Diana is working on completeing a Masters in Environmental Science, Water Quality Option at the University of Colorado, Denver. She first became interested in water quality while interning at Metro Wastewater. She really enjoyed the field, and was hired on at Metro Watewater as an Analyst II. Diana hopes to research ways to improve wastewater analyses and procedures. She is also interested in habitat improvement projects. "Water is our most precious resource, and I feel very happy to be part of such an important process". Congratulations Diana, it is great to have you in the Water/Watewater field. Please see the rmwqaa.org for information on future scholarships.

Adams County Career Expo

On November 17, 2009, Kelley Merrit, Michelle Ryerson, and Steve Frank from the Metro Wastewater Reclamation District's Environmental Services Department participated in the sixth annual Adams County Commissioners' Career Expo. South Adams County Water and Sanitation District, one of the newest members to join the Metro District, also hosted a booth.

The Expo was held at the Denver Merchandise Mart where approximately 4,200 students explored over ninety exhibit tables. Representatives from healthcare industries, community colleges, information technology firms, interior design studios, food service providers, and manufacturers were involved. Even staff from the Denver Zoo participated. The Metro District and South Adams County booths were geared toward educating students about the water and wastewater industry and showcasing the variety of careers that are available within these fields.

Eighth grade may seem a bit young for choosing one's career, but one focus of the Expo was to show students that it is never too early to be exposed to the avenues and possibilities that lie ahead. In an effort to reach every student at least once, the Expo targets all eighth-graders in the five Adams County school districts. The purpose is not to find them jobs now, but to help teach them about career choices and how to network when they do discover an area in which they are interested.

With cooperation from schools and teachers, students are taught how to properly introduce themselves and how to dress appropriately for professional situations. They are even instructed on how to ask important questions about a company such as fringe benefits. A few enterprising students even had their own business cards to hand out to the exhibitors.

Michelle Ryerson and Kelley Merritt of Metro Wastewater talk to kids about wastewater at the Adams County Commissioners' Career Expo.

The Expo provided an opportunity to educate students about where wastewater comes from and how treatment facilities protect people and the environment. Many of them were not at all aware of the process and began to understand the importance of this kind of work. Participation in these types of events is not only beneficial for the kids but also provides an opportunity to share information about water and wastewater treatment to other businesses and teachers who attend.

Save the Date! April 30, 2010

The RMWQAA Water Quality Symposium will be Friday, April 30th at the Ramada Plaza Denver North (I-25 and 120th).

Once again, the Analyst of the Year award will be awarded at the symposium. Think of analysts you feel are doing an superior job and nominate him/her for the award. Nominations are due April 15, 2010 and can be submitted along with the Symposium Registration.

Mark your calendars and look for the registration in the 2nd Quarter newsletter.

Approximately 30% of members who were receiving the newsletter by mail have now opted for a greener electronic version! Way to go Analysts.

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Algae Workshop Registration Form

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Time: 9:00am until 3:00pm

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Instructor Keith Hancock has over 30 years of wide ranging experience in the water treatment field. He has been a past president and owner of an EPA and State Certified Protozoan Water Quality Laboratory with an Algal Analysis section. His photomicrographs have been published in the AWWA monthly journal and the special Algal publication: M7 Problem Organisms in Water: Identification and Treatment. Keith has authored 3 publications for AWWA's Opflow and created educational algae and plankton posters. He has served as Operations Chief of a Water Treatment Plant along with instructing courses in the Water/Wastewater Technology programs at various University and Community Colleges.

(Please submit a separate registration for each attendee)
Registrations due by **February 20, 2010**.

Registrant Name: _____ Date: _____
Employer: _____
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Check the Appropriate Registration:

( ) $30 Algae Workshop (member)

( ) $45 Algae Workshop (includes membership fee for non-members)

Please call Phil Russell at 303-762-2611 or e-mail him at prussell@englewoodgov.org to reserve your space. Class size is limited. Please register early. The cost includes lunch. If your lab does not have a microscope, call Phil to reserve one. Slides, cover slips and other supplies will be provided.

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