Credit: SDWF

Left: This foam on Saddle Lake is generated under windy conditions and is caused by the high level of natural organic material. It is a bit like whipping cream, but here we whip water. **Right:** A reverse osmosis membrane was used to split Saddle Lake water into a waste stream (left) and a pure water stream (right). Currently, as in conventional treatment systems, the two buckets are mixed and colour is frequently bleached out using chlorine just like when chlorine is added to tea. Bleaching water has remained the mainstay of water treatment for more than 100 years, but its application to poor quality water sources does not solve all water quality problems and indeed generates some on its own.

A Framework for Safe Drinking Water

Using science over politics in the search for safe water solutions.

By Dr. Hans Peterson and Dr. Colin Fricker

The question of what needs to be done to move toward safe drinking water is not as simple as most people assume. It is a question that can have both a political and a technical answer. First, if we look at the Canadian Drinking Water Quality Guidelines, it is the result of negotiations between provincial and federal agencies and the guidelines are really a mix of political and technical solutions.

When Health Canada studied the effects of cancer-causing trihalomethanes (THMs) it was concluded that the level should be decreased from 350 to 50 micrograms/litre (mg/L). But, several provinces balked at this and a compromise level of 100 mg/L was set. The United States Environmental Protection Agency (USEPA) set the level at 80 mg/L. Several agencies are now considering below 50 mg/L levels. Political or technical?

Arsenic in drinking water has also hit a downward spiral moving from 50 to 25 to 10 mg/L in Canada. Some provinces remain at 25 mg/L, including Saskatchewan as it needs more time to get its treatment plants to meet the 10 mg/L guideline. The USEPA stated more than a decade ago that the level should really be below two mg/L. Health Canada wanted to set it to five mg/L, but again some provinces balked and the level was set to 10 mg/L. The Safe Water Drinking Foundation (SDWF), in a 2006 review of effects of arsenic, stated that communities that supply its residents with arsenic levels above five mg/L should have its residents tested for the ill effects of arsenic. Political or technical?

The dilemma is that many water sources have high levels of natural organic material (NOM) giving rise to high levels of THMs when the water is chlorinated. The removal of NOM often requires specialized treatment techniques which are not widely applied. The situation is further complicated by the fact that the most suitable treatment technique for NOM removal varies according to the chemistry of the source water. Arsenic too requires targeted water treatment processes, especially if the guideline level drops to five mg/L or less.

If engineers and water treatment process manufacturers have guidelines for what qualities safe drinking water should have, they can work towards finding effective solutions.

Government agencies may, however, not look at the production of truly safe drinking water, but, instead, means of circumventing particular guidelines. For example, when chlorine reacts with organic material a myriad of chlorination by-products are generated and the THMs are only one group. But they are the only group with a guideline in Canada. Regulated elsewhere, haloacetic acids (HAAs) have similar carcinogenic potential as the THMs. One way to reduce the THMs is to lower the pH, which works well in Canada because we don't look at the HAAs. This is a recipe to increase the HAAs and the total carcinogenic potential may stay the same or indeed increase, yet the water may now meet the Canadian Drinking Water Quality Guidelines. Similarly, the use of monochloramine as a secondary disinfectant has been widely adopted to reduce the formation of THMs. However, chloramines actually increase the formation of nitrogenous by-products, such as N-nitrosodimethylamine, which is highly toxic and a suspected human carcinogen. However, these compounds are not regulated. Political or technical?

A large concern with drinking water safety is the need to have low or no disease-causing microbes in the water. In Canada this is mainly measured through the use of "indicator bacteria"—specifically E. coli and total coliforms. Parasites (including cryptosporidium and giardia), while regulated elsewhere, have not become mandatory in Canada. Indeed, the North Battleford outbreak of cryptosporidiosis was caused by a water meeting the Canadian and Saskatchewan Drinking Water Quality Guidelines. Difficulties in measuring the parasites have been used as an excuse to not introduce them into the guidelines, yet in other countries, such as the United Kingdom, continuous monitoring of these parasites has been a requirement for years.

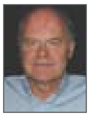
Are E. coli and total coliforms good indicators of protozoan parasites? In one word, no. Measuring E. coli and coliforms in chlorinated water can be misleading as these organisms usually die at low chlorine exposures while protozoa, such as cryptosporidium, giardia, and some bacterial and viral pathogens, are far more difficult to kill using chlorine. In fact, measuring E. coli and total coliforms simply means that you have met a regulatory requirement. Monitoring of public water supplies for the presence of indicator organisms does little to protect public health.

Microbial safety of drinking water has become tightly associated with liability. In Milwaukee a 1993 cryptosporidiasis outbreak caused some 400,000 people to become infected and around 100 people died. The cost was estimated to be more than US$25 billion according to the U.S. National Research Council. Cities are therefore not so concerned about Canadian guidelines, but about potentially devastating lawsuits should they supply unsafe drinking water. So, expect major Canadian cities to do everything they can to remove protozoan parasites and any other disease-causing microbes.

SDWF found E. coli, total coliforms and campylobacter in all raw water sources, but it was only campylobacter that showed up in treated drinking water in some of the rural water treatment plants. The dilemma for rural water treatment plants is that they typically have much poorer quality water sources than cities yet need to treat their water in minutes while cities take hours. Also cities have typically many water treatment processes. The *Canadian Medical Journal* recognized this in an article titled, "Safe Water? Depends on where you live!" Indeed, in the United States, communities smaller than 10,000 people were responsible for 96 per cent of the violations of U.S. Environmental Protection Agency's Total Coliform Rule. Rural water treatment plants need better treatment processes than cities to be able to deal with the poorer quality water and limited resources in rural communities.

There are many other examples of how politics is interfering with technical drinking water issues in Canada, such as allowable pesticide residues, but isn't it time that we instead started to think about the provision of safe drinking water?

To help move towards truly safe drinking water, the SDWF is working on a Framework for Safe Drinking Water where problems and solutions are highlighted by using science rather than what is politically expedient. If engineers and water treatment process manufacturers have guidelines for what qualities safe drinking water should have, they can work towards finding effective solutions. They would then truly start living up to their number one priority: protecting public health. W



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