

The Laboratory Technology Conundrum- written by Paul Gagliardo, MPH, PE

Technology conundrums can be defined as when a new technology or innovation has unintended or unexpected consequences. Nuclear power was seen as a source of electricity that generated no pollution and had an unlimited supply of raw material. Not until the problem of spent fuel rods and the issue of long-term storage of this radioactive material did this reality become unwound. We face the same waste disposal issue with electronic equipment and photovoltaic panels. These are issues that were not fully appreciated when the technology first came into popular use.

In the water business there is another version of the technology conundrum. It can be stated by paraphrasing the line Kevin Costner's character heard in the movie *Field of Dreams*; "If you detect it, they will regulate." This has happened many times over the last 200 years. In the 1880's Robert Koch developed methods and procedures that led to the isolation of bacteria that caused human diseases. In the 1890's chlorine was first used to disinfect drinking water. In the 1940's scientists first used cell cultures to detect viruses, including polio, in wastewater. The Safe Drinking Water Act was passed in 1974 regulating these materials. In the 1990's the PCR method was developed to rapidly detect pathogens of all types. In 1957 a mysterious disease killed millions of young chickens in the Midwest. Using X-ray crystallography, it was determined that the cause was 1,2,3,7,8,9 – hexachlorodibenzo-p-dioxin. This dioxin was linked to the tanning industry. Dioxins were banned in 1979. In the 1930's PFAS were invented as non-stick and waterproof coatings. In the 1970's, in occupational studies, they were found in the blood of subjects. Liquid chromatography tandem mass spectrometry LC/MS/MS was used to detect PFAS in environmental samples in the early 2000's. PFAS became regulated in 2009.

In all these cases a contaminant, whether biological, organic, or inorganic, was invented or discovered to be in the environment and when it could be reliably detected it became banned or regulated. This is the laboratory conundrum. Microplastics are the latest in this cycle.

The conundrum is that many of these materials are already in the water well before they are identified. They are causing harm without us knowing. Only until we can detect them is something done about it. The development of new and more precise laboratory methods allows for the detection of contaminants at lower and lower levels of concentration. When we see these materials, we are obligated to do something about them. The improvement in laboratory techniques lead to the regulation of contaminants.

It is important to know and understand what is in the water. Consumers want to know what they are ingesting, or exposed to, and how it might affect them acutely or chronically. Farmers want to know how the water will affect their crops. Utilities need to know what is in the water and wastewater to meet regulatory mandates. Industry must understand water quality to ensure the proper manufacturing of their products. Environmentalists want to know how the lakes and oceans are changing to determine effects on marine flora and fauna.

It is imperative that everyone has access to a certified laboratory that can analyze water samples and determine what is in them. Only then will we know what is impacting our lives and what we must do to mitigate that threat.