



Just the Facts...

Corrosion of Household & Water Utility Piping

❖ **The Corrosion Problem**

For more than 100 years, metal pipes have been successfully used for transporting drinking water by water utilities and consumers, and during this time, corrosion has been found to be a nuisance. This phenomenon can be described chemically and biologically and is nonselective in that pipes, valves, fixtures, and even hot water heaters are affected. Some readily noticeable effects of corrosion include changes in drinking water taste, odor, and appearance. Other results of corrosion include pinhole leaks, leaching of metals into the drinking water, gastrointestinal distress (i.e., nausea, vomiting, diarrhea), and even catastrophic pipe failures. Corrosion causes considerable costs to the military as well as the civilian population.

❖ **Aesthetic Effects**

Consumers frequently judge the safety and quality of their drinking water by its appearance and recognizable tastes and odors. Appearance, for instance, can be affected by the presence of small flakes that break off the pipe. Also, metallic or astringent tastes can be noticed when certain metals or metal containing salts are present. Some researchers have even proven that humans have the ability to smell metals, thus water containing elevated concentrations of metals can be detected by the sense of smell. All of these water quality attributes are undesirable to consumers.

Adverse water quality conditions are frequently blamed on the water utility when in some cases they are caused by the household plumbing.

❖ **Health Effects**

Corrosion byproducts are many but the most common “buzz words” of corrosion are lead and copper. Ingestion of these metals or others above their maximum contaminant levels can affect consumer health and have shown to cause gastrointestinal illness. In 1991, the U.S. Environmental Protection Agency (EPA) set primary drinking water standards for these metals because of their negative health affects.

Other metals that can be produced from corrosion depending on the pipe material are aluminum, cadmium, iron, nickel, and zinc. Once in the drinking water, these leached metals can combine with other constituents present and then may or may not be harmful. Also, pathogenic microorganisms, such as *Legionella*, can harbor themselves within the biofilm on the corroded pipe material avoiding disinfection. Additionally, pipe breaks caused by corrosion can introduce sediment and pathogenic bacteria into the water system posing a health risk. Furthermore, point-of-use devices installed at consumer households to remove corrosion byproducts can also be a cause for illness if these units are not adequately maintained. These are only a few of the reasons why corrosion of utility and consumer plumbing materials is a health concern.

❖ **Economic Implications**

Catastrophic pipe failures caused by corrosion are usually the most costly to utilities and consumers; however, the cost for fixing multiple small leaks can add up. These costs can range from several hundred dollars to more than \$20,000 and are highly dependant on the nature of the pipe failure as well as the location. In an effort to reduce aesthetic water problems caused by corrosion, consumers install point-of-use devices. Depending on system complexity, these costs can be minimal or reach the hundreds of dollars. Neither water utilities nor consumers are prepared for these unexpected costs, which according to the EPA may reach the millions of dollars in the next few years.

❖ **The Plastic Alternative**

Many homeowners and water utilities are deciding to use plastic piping rather than the conventional metallic piping. Plastic materials are gaining more acceptances, because in comparison to metal pipes, they are longer lasting and cheaper. Although, the common misconception is that plastic does not fail. Some plastic pipe alternatives for conveying drinking water are polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), polyethylene (PE), polybutylene (PB), and cross-linked polyethylene (PEX). Unfortunately, not much research has been completed which evaluates the affect of these materials on the treated, safe drinking water they are transporting. For instance, some of the research that has been conducted indicates that the strength of these materials decreases when in contact with chlorinated water. Also, some plastics have been found to leach chemicals that have negative health affects such as phthalates, organotin, and vinyl chloride monomer.

Unlike metal pipes, these plastics are vulnerable to permeation, or the intrusion of chemicals outside the pipe, through the pipe walls, and into the drinking water. While many of these plastics may solve the aesthetic water quality problems and may be less expensive than metal pipes, consumers and water utilities must ensure that before installing them, these materials are ANSI/NSF-approved for potable water.

❖ **Informational Sources**

This paper was developed following U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) attendance at an international Materials Use: Science, Engineering, and Society meeting held 27-29 September 2002 (Washington Suburban Sanitation Commission, Laurel, Maryland). This meeting was developed to bring experts together from multi-disciplinary fields to discuss problems related to corrosion of potable water plumbing and define new research ideas. The represented groups included the U.S. Department of Human Health Services, USACHPPM, American Water Works Association, American Water Works Research Foundation, Philadelphia Water Department, Washington Suburban Sanitation Commission, Montana State University Center for Biofilm Studies, University of Chile Institute of Nutrition and Food Technology, Virginia Water Resources Research Center, and Virginia Tech's Civil and Environmental Engineering Department, Food Science and Technology Department, and Center for Community Health.