STATEMENT N

Plastics Pipe Institute
Position Statement on
Barrier Properties of Plastic Pipe Used for Potable Water Service

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INTRODUCTION

Plastic pipe has been used with confidence in potable water systems for over 40 years and has been demonstrated to be safe and economical in this application. Over these many years of satisfactory use, the occurrence of permeation has been extremely rare. It has been observed only in situations where there was unusual and severe environmental contamination. In these instances, the question of permeation of potable water piping systems—which can affect all types of piping systems—needs to be addressed. Permeation refers to the phenomenon by which chemical substances in surrounding soils can travel through the walls of buried pipe or of piping components such as gaskets.

PROVEN ADVANTAGES

Plastic pipe has been shown to be an environmentally safe way to transport drinking water because plastics used in potable water pipe are inert in the normal environment. Bacteria or fungi do not affect them, and they do not react with acidic or basic soils. Plastic pipe does not rust or corrode. It is resilient, resisting cracking or breaking, even in unstable soil conditions. In short, plastic pipe often works better, lasts longer and is more cost effective than the materials it replaces. The documented performance of plastic pipe has made it a preferred material.

CONCERNS

In potable water systems, one of the primary concerns is the maintenance of water quality—the piping materials must protect the water from any possible external contaminants while also being neutral to water quality. All piping systems appear to have some slight potential for contamination from external reagents though permeation of gaskets, permeation of pipe wall, and liquid exchange through all types of leaks. For example, metal and concrete piping are vulnerable to corrosion by inorganic acid and alkaline contaminants that could make the piping vulnerable to infiltration. Plastic piping is immune to this type of attack. On the other hand, some organic solvents, if present in sufficient quantity and over a prolonged duration, could be absorbed by the pipe

material and permeate in slight concentrations into the potable water. Fortunately, serious environmental contamination of soils are rare and are readily identifiable. In soils heavily contaminated with hydrocarbon solvents, permeation also can occur through the elastomeric gasket joints, which are used extensively with a variety of different types of piping materials. Battelle Research Institute[1] tested piping systems under exaggerated conditions in soil heavily saturated with contaminants that could permeate plastics, have indicated that permeation will occur rather quickly through elastomeric gasketed joints in a variety of different types of potable water piping. In a real life situation, of course, the degree of permeation, if any would depend upon the severity of soil contamination, the type of contaminant, the composition of the soil itself, the pipe size/wall thickness and the flow rate (and dilution) past the permeated materials.

In support of the plastic piping industries' growing need for more detailed information, The Plastics Pipe Institute contracted with Indiana University Purdue University Indianapolis (IUPUI) to develop a report to assist the users titled "ASSESSMENT AND CALCULATION OF BTEX PERMEATION THROUGH HDPE WATER PIPE"[2] which was published in the summer of 2012. Previous work from Ong et al[3] established diffusion coefficients for several aromatic components of gasoline – namely, benzene, toluene, ethylbenzene and xylenes (BTEX) - and permeation rates for those components through a 1-inch diameter (0.146" wall) Iron Pipe Size (IPS) HDPE water pipe in various laboratory conditions similar to the previous Battelle work. In contrast, the PPI supported work from the IUPUI researchers provides a step-by-step methodology for mathematically estimating the amounts of BTEX that permeates into a potable water HDPE pipeline under a wide variety of service conditions "and design variables including bulk concentration of BTEX in soil, ground temperature, groundwater saturation, flow velocity, water stagnation, pipe thickness, and soil characteristics". The example calculations provided in the IUPUI report "show that the presence of BTEX contamination in soil along an HDPE water pipe does not necessarily mean that the drinking water in the pipe will exceed regulatory limits". This PPI supported research is the most detailed to date and "may assist engineers and others when they need to make an engineering decision for water pipe material selection". This PPI supported research is provided on the PPI website free of charge for the benefit of all at http://plasticpipe.org/pdf/permeation-report.pdf. In addition to the IUPUI report, PPI had commented on the previous work by Ong as shown at http://www.plasticpipe.org/pdf/ppi-comment-permeation-hydrocarbons.pdf

RECOMMENDATIONS

In any situation where heavy soil contamination occurs, no pipe system can be considered resistant to permeation. For these reasons, the contaminating source must be controlled or the pipe route avoided altogether, regardless of the pipe material being used. In areas of known or suspected contamination, the design of the distribution

system should be based on a careful analysis of the situation. Situations calling for scrutiny on a case-by-case basis would include (but not be limited to):

- Tank farms or industrial sites containing chemical or petroleum storage tanks and pipelines where a malfunction or leak would contaminate the surrounding soil.
- Storage ponds or land disposal sites for industrial process water or wastewater containing toxic chemicals
- Solid waste disposal sites
- An area that has been known to be contaminated by the long-term presence of toxic chemical substances.

Appropriate technical data and individual manufacturers' recommendations should be consulted on the overall design of a pipe system for these situations.

OUTLOOK

As long as proper consideration is given to these potentially serious contamination sources in planning and installing potable water piping systems, the likelihood of a permeation problem causing a public health hazard is very remote. In situations of serious contamination, everything in contact with the soil is affected—including potable water pipes. Clean up of these types of environmental hazards, of course, must be the first priority. Fortunately, these conditions occur infrequently. Therefore, in the vast majority of circumstances, plastic piping systems can be used with the confidence that they are economical yet very safe way to convey drinking water.

REFERENCES

[1] "Phase One Report on Evaluation of the Permeation of Organic Solvents through Gasketed Jointed and unjointed Polyvinyl Chloride, Asbestos/Cement and Ductile Iron Water Pipes," Cassady, Cole, Bishop, and Pfau, Battelle Laboratories, (1983).

[2] "Assessment and Calculation of BTEX Permeation through HDPE Water Pipe, Final Report", Koo, D. H. (2012). Available on the following website; http://www.plasticpipe.org/pdf/permeation-report.pdf.

[3] "Impact of Hydrocarbons on PE/PVC Pipes and Pipe Gaskets," Ong, S. K., Gaunt, J. A., Mao, F., and Cheng C. L. American Water Works Association Research Foundation, (2008).