

## PVC PIPE: RESISTANT TO PERMEATION BY ORGANIC COMPOUNDS

Permeation is the migration of chemical compounds through a pipe wall that is in contact with contaminated soil or groundwater. For water utilities, permeation is an important design consideration because water quality can be negatively affected.

Independent research has confirmed that PVC pressure pipe is highly resistant to permeation of hydrocarbons and organic compounds, primarily due to PVC's dense molecular structure. This makes PVC pipe suitable for installation in soils impacted by petroleum products or chemical contaminants.

Permeation has been thoroughly researched since the 1970s. Many independent studies have confirmed PVC pipe's excellent permeation resistance. PVC pipe is:

- an effective barrier against permeation of most environmental pollutants
- impermeable to gasoline and gasoline-saturated solutions
- impermeable to benzene, toluene, and TCE at concentrations commonly encountered in the field.

The Water Research Foundation (WRF; formerly AWWARF) found that hydrocarbons do not permeate PVC pipe at concentrations found in typical field conditions. Specifically, WRF states that, "PVC pipes were impervious to premium gasoline and gasoline saturated water for over two years of exposure and, therefore, can be used in soils contaminated with gasoline, regardless of the level of contamination." U.S. EPA also concluded that PVC pipe remains impermeable to fuels and solvents in contaminated soils. Additionally, case studies by utilities have shown no evidence of permeation-related failures for PVC pipe after decades of service.

| Study/Source                      | Findings   | Relevance                                |
|-----------------------------------|--|--|
| Water Research Foundation         | PVC pipe can be used in soil contaminated with gasoline, regardless of the level of contamination. | Confirms suitability for potable water   |
| U.S. EPA                          | PVC pipe is impermeable to hydrocarbon and solvent migration in contaminated soils.                | Supports health and environmental safety |
| Field Investigations by Utilities | PVC pipe had no permeation failures after decades of service.                                      | Validates long-term performance          |

## DESIGN CONSIDERATIONS

Although PVC pipe itself is resistant to permeation, joint gasket materials should be carefully selected to ensure complete system integrity. The WRF study stated that gasketed joints had low susceptibility to permeation. For PVC pipe joints with SBR or NBR gasket materials:

- Gasoline contaminated groundwater – no level of contamination will cause the maximum contaminant level (MCL) for benzene to be exceeded.
- Gasoline at full concentration – the MCL for benzene will not be exceeded as long as there is minimum flow in the pipe.

The [Handbook of PVC Pipe Design and Construction](#) provides guidance on the permeation resistance of gaskets and includes a chemical resistance guide for elastomeric gaskets. Proper gasket selection is critical for installations in potentially contaminated soils.

## A PROVEN SOLUTION WHERE RESISTANCE TO PERMEATION IS REQUIRED

PVC pressure pipe offers utilities a reliable, proven solution where resistance to permeation is required. Independent studies, extensive research, and field experience all confirm PVC's impermeability to hydrocarbons at levels typically found in the field. Utilities can confidently specify PVC piping in areas with potential soil or groundwater contamination. For additional information, see the [Handbook of PVC Pipe Design and Construction](#).

*References: Ong, Say Kee, James Gaunt, Feng Mao, Chu-Lin Cheng, Lida Esteve-Agelet, and Charles Hurburgh. "Impact of Hydrocarbons on PE/PVC Pipes and Pipe Gaskets." Denver, CO: Awwa Research Foundation, January 2008; AWWA and Economic and Engineering Services, Inc., "Permeation and Leaching," United States Environmental Protection Agency, August 15, 2002, <https://www.epa.gov/sites/default/files/2015-09/documents/permeationandleaching.pdf>.*