

Distribution System Water Quality

Protecting Water Quality with Pigging and Swabbing



Pigging and swabbing can be used to remove biofilm, scale, and accumulated sediment from water mains. These maintenance practices help to reduce microbial contamination risks, decrease chlorine demand and disinfection byproduct levels, address customer complaints, and increase distribution system flow. Compared to flushing, pigging and swabbing use less water, remove more sediment, and more aggressively remove biofilm. Pigs and swabs typically enter the water main under the force of water from a fire hydrant or another supply source, and then they are pushed along by water from the distribution system. This fact sheet is part of EPA's Distribution System Toolbox developed to summarize best management practices that public water systems (PWSs), particularly small systems, can use to maintain distribution system water quality and protect public health.

Examples of Utility Actions

A PWS serving about 500,000 people in the midwestern U.S. was unable to find a commercially available tool for improving water main cleaning effectiveness suitable to their needs. In 2014, the PWS developed a swabbing tool made of 4-inch-thick low-density foam that could be dipped into a dilute chlorine solution, inserted into the pipe, and pushed and pulled to scrub pipe surfaces to remove dirt and contaminants and coat surfaces with a bleach residue. The PWS decided to use it during all water main repairs.

A PWS serving 420 people in the southeastern U.S. received customer complaints about discolored water and was not able to conduct regular flushing due to limited finished water storage capacity. The PWS used ice pigging to remove 350 pounds of sediment from 18,000 ft. of 6-inch diameter PVC water mains. The PWS found that ice pigging used one-third as much water as regular flushing, improved water quality, and reduced customer complaints to near zero.

Conventional Pigging and its Use for Pipe Cleaning

- Conventional pigging is a technique used to mechanically scrape hard scale (corrosion tubercles), biofilm, soft scale, and loose deposits from pipes with a hard body, conical-shaped mechanical cleaning device made of foam, steel, or plastic. Pigs are forced through a water main by water pressure.
 - *Bare pigs* made of high-density foam may be launched first to determine the inside diameter of the pipe and find any obstructions.
 - *Cleaning pigs* have a special coating to help remove scale or biofilm.
 - *Scraping pigs* are equipped with wire brushes or scrapers to remove corrosion tubercles.
- Pigs can sometimes get stuck in more complex piping configurations.
- If pigging is used to scrape corrosion tubercles from unlined cast iron pipe, the pipe surface should be protected prior to putting back into service.

Ice Pigging and its Use for Pipe Cleaning

- Ice pigging involves using a slurry of crushed ice and salt in the flushing water to scrape pipe surfaces clean.
- Compared to flushing, ice pigging uses less water and removes more sediment. It generates higher shear rates along pipe surfaces than flushing and is more effective in removing biofilm and accumulated manganese coatings.
- The ice slurry can navigate obstructions more easily than swabs or other pigs.

Swabbing and its Use for Pipe Cleaning

- Swabs are simple polyurethane foam plugs that are larger than the inside diameter of the pipe and forced through the pipe by water pressure. Swabs are generally less aggressive than hard body pigs and can navigate some bends, tees, and diameter changes.
- Swabs can remove biofilm, soft scale, and loose sediment and do not require a high velocity water flow. They can be used to clean new or repaired water mains but not to remove corrosion tubercles.
- Compared to flushing, swabbing uses less water and removes more sediment and biofilm. It is also more effective in removing sticky manganese deposits.
- Swabs can be purchased in various grades from soft to hard depending on the cleaning objective (type of deposits) and the water main age and diameter.

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Table 1: Resources and Guidelines for Pigging and Swabbing

Resource Title and URL	Relevance to Pigging and Swabbing
<p>Miller et al., 2019. Ice Pigging Creates Clean Mains and Water Quality Insights. <i>Opflow</i>. www.awwa.org.</p> <p>Note: There may be a fee associated with obtaining this resource.</p>	<p>Describes ice pigging technology. Explains how to collect and analyze sediments removed from the pipe. Includes a case study.</p>
<p>Brandhuber et al., 2015. <i>Legacy of Manganese Accumulation in Water Systems</i>. Denver, Colo.: Water Research Foundation. www.waterrf.org</p> <p>Friedman et al., 2016. <i>Metals Accumulation and Release within the Distribution System: Evaluation and Mitigation</i>. Water Research Foundation, Denver, CO. www.waterrf.org</p> <p>Note: There may be fees associated with obtaining these resources.</p>	<p>Summarizes literature and presents utility survey findings and case studies on using swabbing and ice pigging for removing manganese deposits from water mains. Swabbing and ice pigging are more effective than flushing in removing manganese deposits. Includes utility guidance and a framework for assessing manganese deposits.</p>
<p>World Health Organization (WHO). 2004. Safe Piped Water, Managing Microbial Water Quality in Piped Distribution Systems. https://www.who.int/</p>	<p>Describes swabbing techniques, including advantages and limitations.</p>
<p>Ellison, D. 2003. <i>Investigation of Pipe Cleaning Methods</i>. Denver, Colo.: Water Research Foundation. www.waterrf.org</p> <p>Note: There may be a fee associated with obtaining this resource.</p>	<p>Discusses pipe cleaning applications for pigging and swabbing. Describes costs, expected results, and methods for handling discharges.</p>

