

Cathodic Protection Monitoring in Water and Wastewater Systems

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ABSTRACT

Web-based remote monitoring is widely used in the oil and gas pipeline industry to ensure corrosion protection systems are functioning reliably. The water and wastewater industries are not subject to the same regulatory mandates governing the oil and gas industry but are no less a part of the critical infrastructure. As these systems age and fail, the effects go beyond cost and inconvenience into potentially significant public health and safety issues. The water and wastewater industries deal with different challenges than the oil and gas pipeline industry. The budgets available for equipment and personnel for corrosion management are significantly lower. The materials requiring corrosion protection are much more varied, and there are typically less personnel within the organization trained to meet and overcome the challenges of implementing and maintaining effective corrosion prevention systems. This paper shows some case studies of municipal water and wastewater systems that successfully use web-based monitoring to evaluate the effectiveness of the corrosion protection systems, enabling the personnel resources available in the organization to focus on proactive, preventive maintenance and system improvement.

Other than some municipal water systems in the western US, corrosion prevention and the regular maintenance of the upkeep and repair of corrosion prevention systems is not widely seen in the water industry. Municipal utilities suffer from budget constraints, lack of experienced and well-trained personnel, and corrosion challenges that differ from those on typical oil or gas pipelines due to material differences, etc. Municipalities in areas of the US where water is considered more valuable than simply a convenient commodity have focused more on proactive pipeline integrity than have municipalities in the US as a whole. One result of this is a need to provide a few trained personnel within an organization with the data necessary to focus their efforts on preventing corrosion issues rather than reacting to pipeline failures. Remote monitoring provides a reliable and cost-effective means through which that critical data can be provided to the proper personnel.

Key Words: Cathodic protection, maintenance, water, primary water, wastewater

INTRODUCTION

In 2002 NACE International published a cost of corrosion study backed by the U. S. Federal Highway and Safety Administration estimating the annual cost of corrosion in the U. S. to be \$276 billion. In the more detailed breakdown of these costs by industry/market segment the cost associated with the water and wastewater utilities segment in the “Utilities” category was estimated at \$36 billion. The water and wastewater utilities segment represented the single largest cost segment in the study. The \$36 billion estimate for this single segment of the Utilities category represented more cost than any of the other four categories: Transportation, Infrastructure, Government, and Manufacturing & Production.¹

Many factors contribute to the corrosion issues facing the water and wastewater industries. First off, the average age of the estimated 1.6 million miles of water and wastewater pipes reached 45 years in 2020. Additionally, over 600 towns have cast iron pipes over a century old. As metropolitan areas expand, more gas distribution pipelines and electrical transmission lines are built, often sharing or near existing water and wastewater pipeline rights of way. These factors, along with concentrations of road salts, fertilizer runoff, and ground pollutants that alter soil chemistry all combine to increase the corrosion risk on the aging infrastructure.

Water and wastewater pipeline systems, unlike their oil and gas counterparts, are almost exclusively public utilities. As such, their budgets and revenue are tightly regulated making it more difficult to keep the infrastructure, systems, and processes up to date and in good working order. Also, unlike the oil and gas pipeline industry, there are not strict regulations and standards mandating adherence to corrosion protection, leak detection, and other common practices for maintaining a good pipeline integrity management program. The budget constraints imposed on most municipal utilities also prohibit these utilities from having trained and experienced corrosion prevention personnel necessary to develop and maintain the corrosion prevention programs that are commonplace in the oil and gas pipeline industry.

Maintaining effective cathodic protection corrosion control is reliant on timely and accurate data acquisition. More importantly, the data requires evaluation by personnel properly trained and qualified to act on the information. Due in part to the budget constraints, the use of cathodic protection remote monitoring is limited in the water and wastewater utilities except for areas with a history of water shortages, particularly west of the Rocky Mountains. Some utilities in the mountain regions and to the east have recently incorporated monitoring into their system integrity management programs but the use is far from widespread. Federal spending on capital improvements (repair and replacement) in water utilities peaked at \$17 billion annually in the late 1970s and has steadily declined in subsequent decades to an annual rate of less than \$4 billion by 2014. In the same period, the spending by state and local agencies for capital improvements in these utilities has grown from approximately \$14 billion in the 1970s to more than \$30 billion by 2014 (Figure 1).² As the water utilities infrastructure has continued to fall into disrepair, the money spent on keeping these systems operational has increased substantially, with the bulk of the bill footed by the state and local governments. This level of spending required for repair and replacement leaves little in the budget for corrosion prevention systems and trained personnel required to administer effective pipeline integrity programs. It is to this end that more efficient data acquisition methods can provide significant benefits to water utilities in their corrosion management systems.

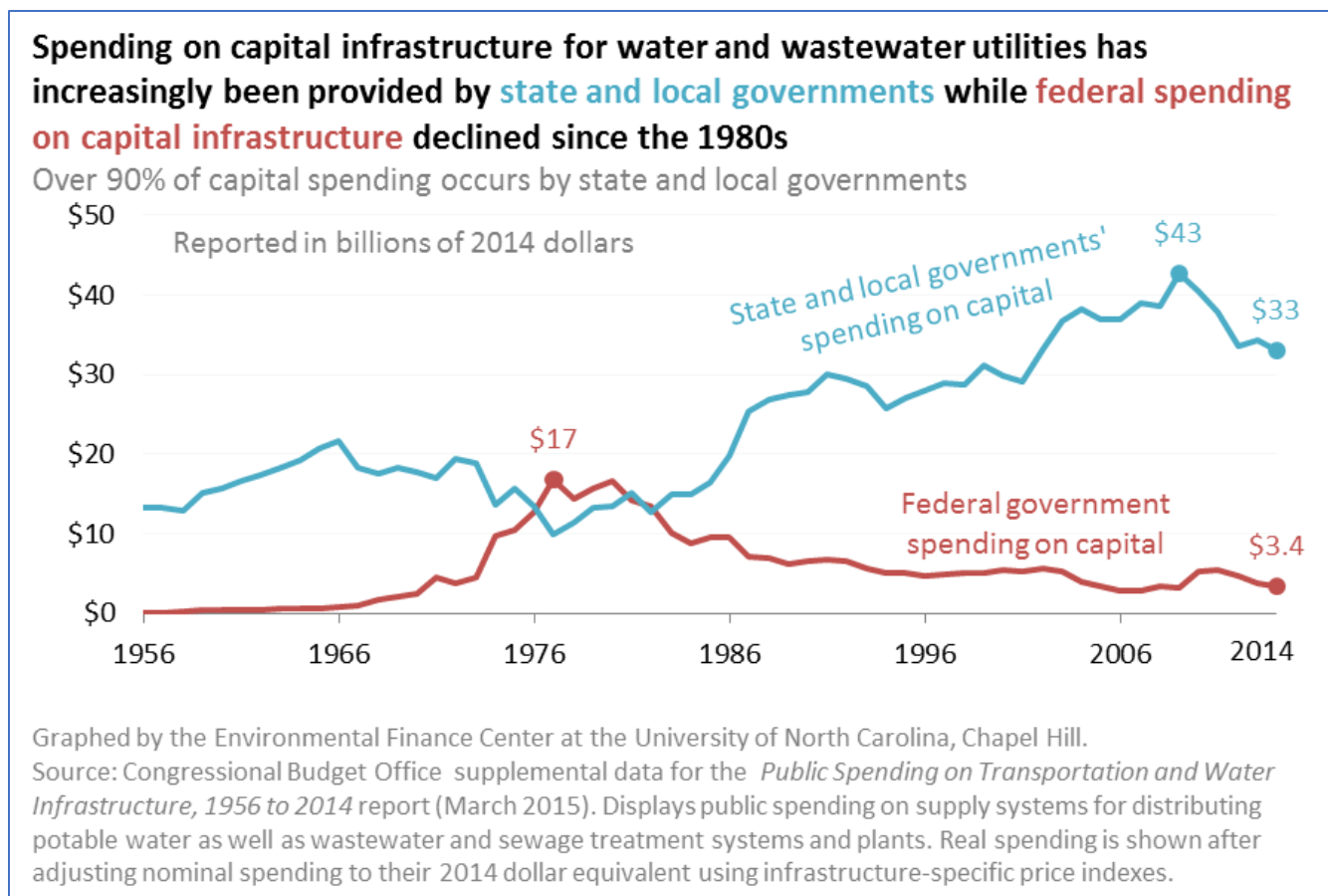


Figure 1: Graph showing State and Federal spending on municipal water infrastructure²

CORROSION PREVENTION AND DATA ACQUISITION

The water and wastewater industries share most of the external corrosion challenges faced by the oil and gas pipeline industries. As noted in the introduction, there is a significant difference regarding the personnel and resources available to water utilities in managing the corrosion issues. Often, evaluating corrosion risk and executing and maintaining corrosion prevention measures are the responsibility of operations personnel with many other tasks and insufficient training and experience in corrosion. As a result, the work required for maintaining an effective corrosion prevention program is often outsourced to third party contractors. The workarounds necessitated by the resource constraints facing the utilities can contribute in part to a lack of continuity over the long term regarding a comprehensive integrity program.

Municipal water and wastewater utilities have some unique pipeline materials and applications presenting a different set of challenges from both a cathodic protection and data acquisition/analysis than what is common in the oil and gas pipeline industry. Cast iron pipes, ductile iron pipes, and prestressed concrete pipes are all in widespread use in the water and wastewater infrastructure in the U.S. Each of these present challenges in the application and evaluation of cathodic protection corrosion control. Cast iron has not been used very frequently since the 1950s, when it began being replaced in new construction and rehabilitation projects by ductile iron. Still, it is estimated that over 600 counties and municipalities have cast iron pipes that are over 100 years old. Even with the aging infrastructure, corrosion, not age is the primary cause of water main breaks in iron pipes.³ Typically, both cast iron and ductile iron systems consist of short pipe segments joined together using rubber seals at the joints, making the electrical continuity necessary for impressed current cathodic protection impossible without the installation of metallic bonds across the joints. Additionally, much of this infrastructure was installed without cathodic