# Prevention of Corrosion in Cast Iron Water mains

And how Flow rate and Phosphate levels alter corrosion rate


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## 01 Introduction

Cast iron pipes are widely used due to their strength and durability, but they are susceptible to corrosion, leading to iron oxide (rust) formation. Over time, rusted pipes become nonfunctional, requiring costly replacements. Corrosion inhibitors are added to extend the lifespan of these pipes.

A commonly used inhibitor is **phosphate**, which prevents lead leaching (**plumbosolvency**) into water. However, past studies suggest phosphate might **accelerate corrosion** in iron pipes. This research aims to verify this claim.

## 02 Aim

1. **Develop a flow-based corrosion testing system:** Past tests were conducted in static environments, which may not reflect real-world conditions.
2. **Evaluate phosphate's role in corrosion:** The study will determine whether phosphate promotes or mitigates corrosion when water is flowing.
3. **Investigate alternative corrosion inhibitors:** The experimental setup will be used to test new inhibitors.

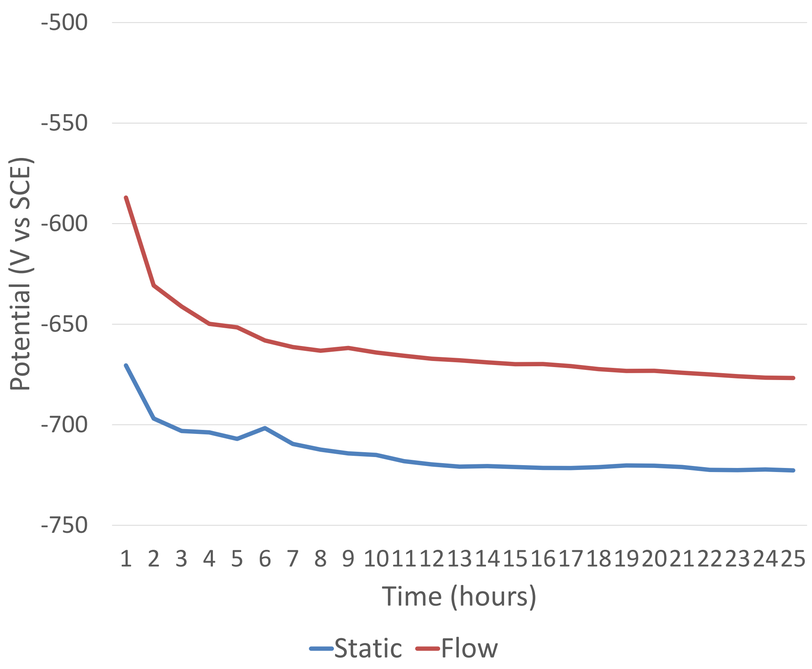
## 03 Testing

An experiment has been designed to mimic the flow which occurs within working pipes. It involves a reservoir, the testing container which holds the sample and electrochemical equipment and a pump. The set up works as followed:

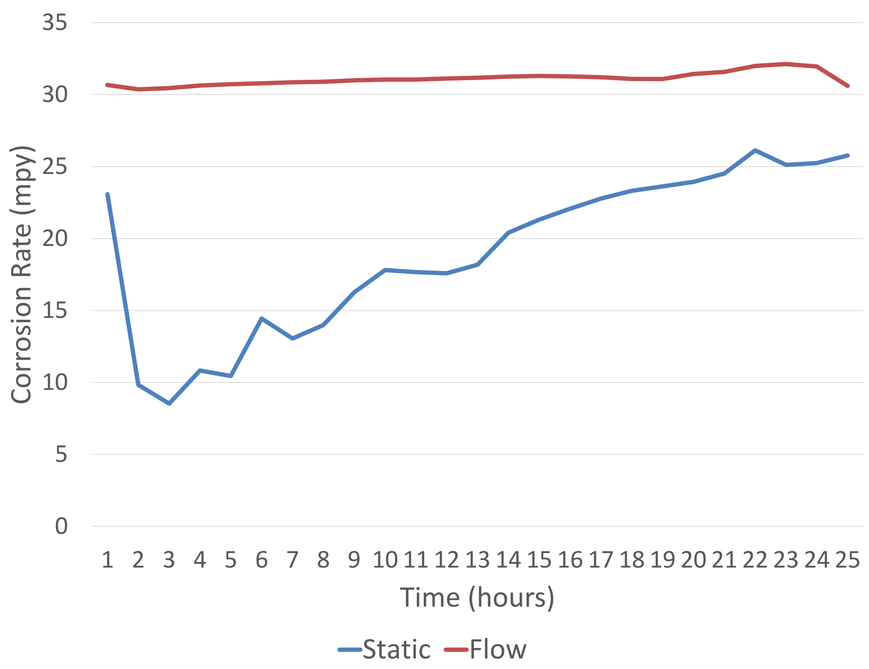
1. The water is pumped from the reservoir to the testing container
2. Inside the testing container the water is flown over the exposed area of the sample
3. The water is then pumped out of the testing container

## 04 Results

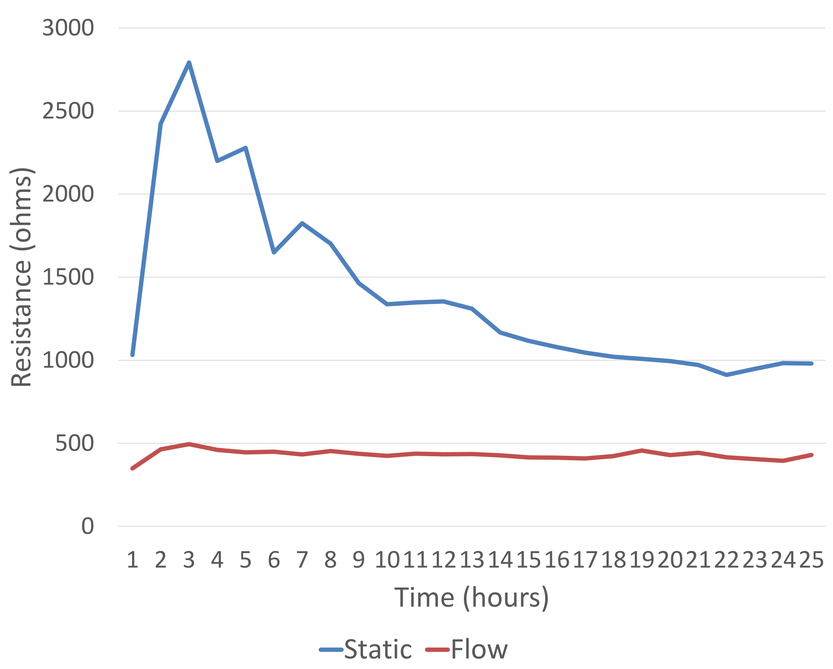
Open Circuit Potential: Potential Vs Time




Polarisation Resistance: Corrosion Rate Vs Time




Polarisation Resistance: Resistance Vs Time




## 05 Analysis

The graph compares two tests using a 1% NaCl electrolyte: one with a static solution and one with flowing conditions. The flowing electrolyte results in a more stable corrosion rate and resistance, likely due to the continuous removal of ions, prevention of protective oxide buildup, and disruption of localized corrosive environments leading to a more consistent corrosion environment. In contrast, the static test allows these processes to occur, leading to an initial decrease in corrosion as a protective oxide forms followed by a gradual increase due to the evolution of the corrosive environment next to the exposed area of the sample.

However, despite its stability, the flowing system experiences higher overall corrosion due to the constant supply of oxygen and salt-rich water. The increase in potential and corrosion rate is also indicative of the cathodic activation of the flowing system due to the constant supply of oxygen to the surface of the sample, whereas the static system must rely on the diffusion of oxygen from the surface of the water to the sample.

## 06 Conclusion

This research will provide crucial insights into corrosion mechanisms in cast iron water mains and how flow effects corrosion. A flowing system has a multitude of factors that could affect corrosion, from replenishment of ions to the removal of localised environments, and so it is difficult to predict whether the effect will be positive or negative.

The findings will help optimize water treatment strategies and reduce long-term infrastructure costs and the testing methods will change how future lab-based corrosion tests are done.

## Thanks for Taking the Time to Read

Please contact me if you have any further questions or suggestions: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