

# How to Conduct a Water Treatment Corrosion Study

Part 2 of this six-part series explains how to set up and prepare a corrosion study.

**S**tep one in any study should be to establish a plan. There are many different corrosion inhibition options of which only one can likely be implemented at any given time. Before any corrosion study is conducted, one should have answers to the following questions. These are posed only as guidelines as particular problems or water chemistries may dictate additional concerns.

**IDENTIFY THE PROBLEM(S).** Examples include red, blue, or black water; high Cu or Pb levels; high asbestos fiber counts; numerous distribution system and consumer leaks; and restricted flows.

**IDENTIFY AN INITIAL TREATMENT APPROACH.** As there are many different types and formulations of inhibitors available, you can not consider all of them. Usually this step would involve consulting with others ideally in your area where similar problems have been encountered. Keep in mind that what worked at a neighboring treatment plant may not necessarily work in your case but it is a good place to start searching for a solution. Other ideas would be to contact local regulatory officials or vendors who can offer advice.

**DETERMINE AN EVALUATION TECHNIQUE.** This could amount from a quick beaker type test to a full scale plant evaluation of the product. If the problem involves the need to sequester iron or manganese a quick lab scale test can be done. On the other hand a true corrosion problem can sometimes involve many months to evaluate on either a plant scale or lab scale basis. There are

many tools such as test loops, corrosion chambers, coupons, and corrators, each having their advantages and disadvantages. Care should be given to select the tool that most closely models the conditions being met were the problem exists. For example, test loops generally provide for faster flow rates than the corrosion chamber so if the problems exist in areas where faster flow rates are present, the test loops would be a better choice. Of course for low flow areas the test chambers would be a better choice.

**DETERMINE A TIME FRAME.** Generally speaking, the longer a corrosion test is run the more accurate the results. This must be tempered however with the objective of obtaining a result as the problem will still likely exist while the study is being conducted. While 30 days for a coupon evaluation is considered minimum, it is often the most practical approach where a solution is needed and multiple products will be evaluated.

**DETERMINE A COMMON DENOMINATOR IN COMPARING VARIOUS TREATMENTS.** One of the most common mistakes in conducting a study is not establishing a basis to compare the results of the test. On a research level the constant used is typically a specific concentration of a component such as PO<sub>4</sub> or zinc. On a treatment level the most practical constant would be an acceptable cost per MG of treated water. At the end of the evaluation period you could then compare the results of two or more inhibitors at the same cost of treatment to determine which inhibitor is better.

## An Example of a Corrosion Study

The Pine City treatment plant superintendent John Doe has been getting a lot of calls lately from customers complaining about red water. Mr. Doe has spoken to the director of public works, Mr. Smith, about the problem and been asked to conduct a study. Mr. Smith has authorized a treatment program not to exceed the cost of \$10.00/MG (\$1.20/million lb) of water treated to solve the problem.

Superintendent Doe has called several of the local treatment plants and found that one of them has the same problem and is using a phosphate product to successfully treat the problem. Mr. Doe calls up the local state engineer and is told that this would be a good approach to solve the problem. Based upon this information Mr. Doe has asked his local chemical supplier Biff King to suggest a phosphate treatment and provide samples of his two best products. Biff suggests his products Superphos which costs \$1.00 per pound and Superphos Plus which costs \$1.20 per pound.

Based upon his treatment cost limit of \$10.00/MG, Doe determines that he can apply a dosage of 1.2 ppm of Superphos and 1.0 ppm of Superphos Plus. These figures are determined by using the following formula:

$$\text{inhibitor dosage} = (\text{cost} \div \text{MG budget}) \div (8.34 \text{ lb/gal}) \times \text{cost of inhibitor per pound.}$$

Using the above example to determine the dosage of Superphos Plus would be as follows: inhibitor dosage = \$10.00 ÷ 8.34 lb/gal x \$1.20, which yields 1.0 ppm.

As there were more complaints from households near the end of the distribution system where the flow rates were typically slower, Doe chose to use the corrosion test chamber. As his distribution system was made up of mostly cast iron pipe and he has had no problem passing the lead copper rule, mild steel coupons were chosen to evaluate one product against the other. A flow rate of two gpm was used for the corrosion test chamber. As the test chamber flow is split evenly between two sides, the flow rate for each of the two inhibitors was 1 gpm. As Doe has been asked to solve the problem as soon as possible, a 30-day test period is chosen.

To determine the amount of inhibitor that will be needed to run the test, Doe must first figure out how much water he will be treating during the 30-day period. As each side of the chamber will be flowing at 1 gpm for 30 days, the total amount of water treated will be  $1 \text{ gpm} \times 1,440 \text{ minutes per day} \times 30 \text{ days} \times 8.34 \text{ lb/gal} = 360,000 \text{ lb}$  of water or, put another way, essentially .36 million lb of water.

As the Superphos will be applied at a 1.2 ppm dosage, the amount needed to run the 30-day test would be  $.36 \text{ million lb of water} \times 1.2 \text{ ppm of Superphos} = .432 \text{ pounds of Superphos}$ . For the Superphos Plus using the previously determined 1.0 ppm dosage the amount needed would calculate out to .36 lb.

As the pumps used to pump the inhibitor solution are found to pump 25 mls per hour, it is determined that 18,000 mls (about 4.76 gal) of inhibitor solution will be needed to run the test. This is determined through the following formula:  $\text{pump rate in mls} \times 24 \text{ hours per day} \times \text{number of days for test}$ .

In using our example this would be  $25 \times 24 \times 30 = 18,000 \text{ mls}$ , which equals 18 liters or about 4.75 gal.

Keep in mind that the volume of inhibitor solution include both the dilution water and inhibitor itself. Accordingly, the amount of inhibitor added should be included in the total amount of solution needed which, in our example, is the 18 liters calculated above.

Now that Doe has determined his dosages, dilution rates, and inhibitors, he can proceed to set up the test units and proceed with the test. After 30 days

the coupons are removed and analyzed for weight loss to determine the corrosion rates of each inhibitor. Whichever inhibitor gave the lower corrosion rates should be considered superior as both tests were run at equal costs.

## Closing

It is important to thoroughly evaluate the steps and procedures in con

ducting a corrosion test before you begin. To miscalculate or choose the wrong test, dosage, or inhibitor can result in significant delays as these tests take a minimum of one month to complete. **GE**

*The preceding is courtesy of Sweetwater Technologies, [www.sweetwatertech.com](http://www.sweetwatertech.com). Part 3 of this series will discuss corrosion control testing methods.*