MONITORING CORROSION RATES

Monitoring of corrosion rates in aqueous systems is critical to extending equipment life. By monitoring corrosion rates, fact based decisions can be made on the success or failure of corrosion inhibitors.

Consistent corrosion protection is vital to prevent failure of metal surfaces. Corrosion rate monitoring will not only provide information on the overall success or failure of water treatment programs, it will also provide information on the impact of short term problems within systems. This includes the impact of acid excursions, temporary loss of chemical feed; overfeed of biocides, and the impact of process contamination.

Some water treatment companies will guarantee corrosion rates within acceptable limits as defined by several national organizations. There are several methods for monitoring corrosion rates, these include:

- Corrosion Coupons
- Corrator probes
- Analytical tests of system waters

STANDARDS

The methods and acceptable limits used in monitoring of corrosion rates are set by:

- National Assocation of Corrosion Engineers (NACE)
- American Society of Testing Materials (ASTM)
- American Society of Mechanical Engineers (ASME)
- Others

These organizations publish acceptable rates of corrosion for different metal types as well as standardized methods for installation of equipment used in monitoring corrosion.

Corrosion rates are defined by the following terminology:

- Excellent
- Good
- Fair
- Poor
- Unacceptable

TYPES OF CORROSION

Many types of corrosion can be monitored in aqueous systems, but two common descriptions apply:

PITTING CORROSION represents either pits or tubercle formation. Pitting corrosion can lead to catastrophic failure of a system in a short period of time. Anytime pitting corrosion is identified via corrosion monitoring, immediate steps must be taken to prevent further damage. Some insurance companies will condemn a boiler system if pitting exceeds 50% of the metal thickness.

GENERAL ETCH CORROSION is corrosion that has taken place uniformly across the surface of metal. General Etch is not measurable during visual inspections. Acceptable levels of General Etch Corrosion are set to maintain the integrity of a aqueous system for a 20-year life span. If General Etch corrosion rates are in the "Unacceptable" range, then the life span of the aqueous system is severely shortened.

METHODS OF MONITORING

CORROSION COUPONS

Corrosion Coupons are the most common method for monitoring corrosion rates. Coupons are metal strips that are ½ wide, 1/16 inches thick, and 3 inches long. Coupons are available in any alloy commonly found in aqueous systems. Common alloys used to monitor cooling water are 1010 mild steel and copper.

Corrosion coupons are installed in a corrosion coupon assembly and left for periods of 30 to 120 days. Coupons should not be left for over 120 days.

PVC pipe is recommended. If the coupon assembly is made with mild steel and the coupon touches the pipe, then high corrosion rates will occur on the coupon and provide inaccurate system corrosion information. With PVC piping, a coupon that touches does not electrically corrode. The metal specimen should always be installed with the most active alloy first in contact with water. With mild steel and copper, the mild steel is first and the copper alloy is downstream.

The coupon rack is equipped with a flow meter to adjust the flow in the assembly. Flow adjustment is required to assure proper comparison with published corrosion rates. The system should have a flow velocity of 3 feet per second. The following flow rates apply:

1" pipe 8 gpm

¾" pipe 5 gpm

The corrosion coupons are mounted on a teflon plug using nylon screws.

After the new coupon is mounted, the coupon needs to be washed with acetone or alcohol to remove fingerprints and grease. Surgical gloves may be worn during installation of coupons to prevent grease deposits. If grease is present, no corrosion will occur on the coupon. The coupon holder is then mounted in the system and flow rates adjusted.

Coupons and analysis may be purchased from an independent corrosion test supply company if you desire an independent analysis. New coupons should be installed immediately after a set has been removed. Continuous monitoring assures that problems will be noted and corrected. The use of Corrosion Coupons should not be intermittent.

Corrosion Coupons provide a good approximation of what is expected in the system. Coupons are very useful in establishment of system trends and comparisons. Coupons are useful to determine if the inhibitor program is working. Water treatment chemicals rarely solve corrosion problems by themselves. If the inhibitor cannot reach the metal surface due to dirt, no changes in water treatment will lower the corrosion rates. If coupons have deposits, the deposits should be analyzed to determine the composition and cause.

Many things impact corrosion rates including:

System Temperature

pH

Flow Rates

Corrosion Inhibitor

Makeup water quality

CORRATOR PROBES

Corrator probes are inserted into a flow stream and provide an instantaneous measurement of corrosion. Often the corrator measurements are higher than actual system measurements. Corrator measurements are useful to identify process changes. A rapid increase in corrosion rate might mean loss of pH control, process leaks, or contamination. The trends should be may be logged with a strip chart recorder or computer system.

CORROSION PRODUCT MONITORING

Total iron and copper are often tested for in process water. The total iron may be from dissolving existing corrosion products or from new corrosion from the parent metal. Total iron and copper testing is valuable but does not replace testing by corrosion coupons. Without coupon analysis, you cannot determine if corrosion is from parent metal or removal of existing deposits.

Addition of terpolymers may remove corrosion deposits. Excessive acid feed may dissolve parent metals. Corrosion coupons help to identify if the iron or copper is from parent metal or existing corrosion deposits.

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CORROSION RATE INTERPRETATION

METAL	MILS PER YEAR MPY	RATING
Carbon steel	0-2.0	Excellent inhibition
	2.0 to 3.0	Generally acceptable for all systems.
	>3 to 5	Fair
	>5 to 10	Unacceptable, migrating corrosion products may cause fouling.
Copper	<0.2	Excellent inhibition
	0.2 to 0.5	Generally Acceptable
	0.6 to 1.0	Fair
	>1.0	Unacceptable
Admiralty	<0.2	Generally safe for HX tubing
	0.2-0.5	High rate and may enhance corrosion of mild-steel.
	>0.5	Unacceptably high, significantly effects mild steel corrosion.
Galvanized Steel	<2	Excellent
	>2 to 4	Good
	>4 to 8	Fair
	>8 to 10	Poor
	>10	Unacceptable

Corrosion rates vs. life span of a schedule 40 pipe.

Corrosion Rate MPY	Life of Pipe (years)
0.5	250
1.0	125
2.0	62.5
3.0	41.7
4.0	31.7
5.0	25
10	12.5
25	5