# ALTRET Industries Private Limited

# Corrosion Coupon Installation Method:

## Introduction:

A common method of determining corrosion rates is by using corrosion coupons, which are uniform-sized, pre-weighed strips of metal. Corrosion coupons, representative of system metals, are inserted into a coupon rack installed on the system to be checked. Normally, system water is allowed to circulate over the corrosion coupons for about 30 - 90 days. The coupons are then removed and returned to a lab where they are cleaned and re-weighed. From this weight loss and the dimensions of the coupon, a corrosion rate in mils/year (mpy) is determined. 1.0 mil/year translates into 1/1,000th of an inch of metal loss per year. To convert corrosion rates expressed in millimeters/year (mm/y), a common metric measurement, to mpy, multiply mm/y times 39.4.

## Interpretation of Results:

Whether a corrosion rate is good or bad is relative to the water used and the operating conditions. No absolute interpretation is practical. However, below Table gives guidelines that have been published for assessing corrosion in cooling tower systems and closed loops using fresh water make up. Keep in mind these rates and comments assume general system corrosion. Pitting corrosion can cause rapid metal failure even if the overall corrosion rate is low.

| System | Mild Steel | Copper and Copper Alloys | Aluminum | Stainless Steel | Comment |
|---|---|---|---|---|---|
| Cooling Towers | <1.0 | <1.0 | -- | <1.0 | Excellent Corrosion Rates |
| | 1.0 - 3.0 | 0.1 - 0.3 | -- | -- | Good Corrosion Rates |
| | 3.0 - 5.0 | 0.3 - 0.5 | -- | -- | Fair Corrosion Rates |
| | >0.5 | >0.5 | | >0.1 | Poor Corrosion Rates |
| Closed Loops | <0.2 | <0.1 | <0.1 | <1.0 | Excellent Corrosion Rates |
| | 0.2 - 0.5 | 0.1 - 0.2 | 0.1 - 0.3 | -- | Good Corrosion Rates |
| | 0.5 - 1.0 | 0.2 - 0.3 | 0.3 - 0.5 | -- | Fair Corrosion Rates |
| | >1.0 | >0.3 | >0.5 | >0.1 | Poor Corrosion Rates |

*All corrosion rates in mpy

**The following describes different forms of attack that can be observed on coupons:**

Generalized Attack - Uniform corrosion over entire surface of the coupon. Not usually a concern unless the mpy is high.

Pitting Attack - A general term given to any depression on the metal surface caused by corrosion. Pits can vary considerably in size and depth as well as density. Less than 10 pits per side is sometimes termed isolated pitting. Low inhibitor levels, high chlorides, pH excursions, under-deposit attack, or copper plating can all cause pitting.

Localized Areas of Attack - Usually the result of under-deposit corrosion. May indicate the need for better deposit control and/or low flow rates through the coupon rack. If the depression shows concentric rings with the deepest penetration in the center, it may be due to corrosive bacteria attack, such as can be caused by microbiologically induced corrosion (MIC).

Copper Plating - Results from the deposition of soluble copper on mild steel or other non-copper alloys. Copper plating can cause severe galvanic corrosion and metal failure due to pitting attack.

Edge Attack - Since the edges of coupons are highly stressed during fabrication, they tend to be preferential sites for corrosion. Edge attack does not generally indicate a major problem unless severe.

Attack Under the Coupon Holder - If metal loss is localized to the area under the coupon holder, this may merely represent the influence of the coupon holder to stimulate under-deposit or crevice attack and not reflect the characteristics of the recirculating water. Although these effects cannot be eliminated from corrosion rate calculations, they should be noted when interpreting the results. Insuring the coupon holder and bolts are fastened tightly helps minimize these effects.

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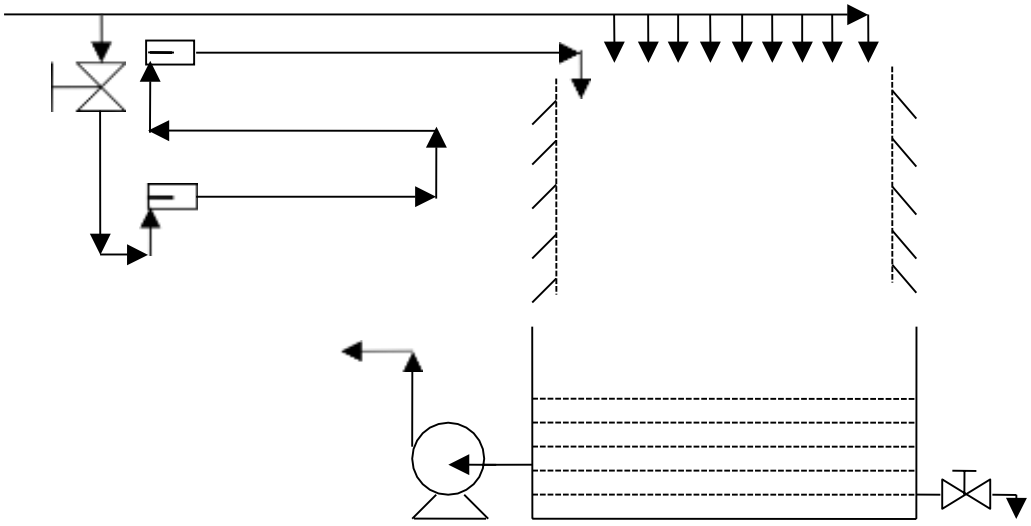
## Following steps are required before installation of corrosion coupon:

1) Cleaned the cooling tower & cooling water system by pre – treatment chemicals.

2) After completion of pretreatment give heavy blow down, cleaned all the Algae and Microbiology from the cooling water system.

3) Make a tapping in return line of cooling tower (attach 1inch external threaded nipple) as sketch given below,



4) Cleaning of corrosion coupon as follow:

   a) MS, SS and Cu coupon are cleaned by inhibited HCl or **"ALTRET" 3600** and dipping coupon in it for 5 min.
   b) Nickel coupon is cleaned by formaldehyde.
   c) Now all the coupons are washed with fresh water or running water of cooling tower.
   d) After washing, all the coupons are neutralized by 5% sodium carbonate and again wash with water.
   e) After neutralization, soaked all coupons in Acetone for 5 min.

5) a) Calculate the surface area of each coupon using following equation:

Surface Area (A) = $2*[(L*B) + (B*T) + (L*T)] + 3.14\ D * T - (3.14*D^2/2)$

Where, L = Length of the coupon.
B = Width of the coupon.
T = Thickness of the coupon.
D = Diameter of hole in coupon

b) Weigh all the coupons carefully & note the weight as initial weight (W1).

6) Now install the coupons (co-current to water flow) in rack as shown in sketch, other position of installation may crate erosion and deposition problem and it also influence the rate of corrosion and we can't find out accurate corrosion rate.

7) After 30 days (min.) remove the coupons and cleaned by same procedure as above and weigh it again. Final weight is (W2).

8) Calculate the weight loss (Wf) in milligram and find out corrosion rate using following formula:

$$\text{Corrosion Rate} = \frac{\text{Weight loss (mg)} \quad * 365 \quad * 39.4}{\text{Density of metal (mgm/mm}^3\text{)} * \text{Surface area (mm}^2\text{)} * \text{No. of days}}$$

$$= \_\_\_\_\_ \text{ mpy (mils per year)}$$

Density of different metals is as under:

1) Mild steel (MS) :7.86 mgs/mm$^3$
2) Stainless Steel (SS) : 8.00 mgs/mm$^3$
3) Copper (Cu) : 8.96 mgs/mm$^3$
4) Nickel (Ni) : 8.90 mgs/mm$^3$

**Note: Standard limit for Corrosion rate is less than 5 mpy for MS & less than 2 mpy for Copper & SS.**

**Specimens Dimensions:**

1. Length of the coupon :**50 to 100 mm**
2. Width of the coupon :**10 to 25 mm**
3. Thickness of the coupon :**0.8 to 1.6 mm**
4. Hole diameter :**6 to 10 mm**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