CLOSED-RECIRCULATING-SYSTEMS:

In closed recirculating systems, heat is transferred to the cooling water from the hot process, and then it is transferred out of the cooling water by conduction in another piece of heat transfer equipment. No water is evaporated or concentrated. A system is considered "closed" when it is designed to be filled with water once, shut off and then run continuously for long periods of time without any significant amount of makeup water added. In closed cooling systems, the heat is usually dissipated by an auxiliary open cooling loop or forced air that passed over tubes contains the closed system water.

Common Operating Problems

Corrosion, Scale, Fouling and microbial growth are considered the four major problems in all types of recirculating water systems. All of these problems are of importance in closed recirculating systems because **corrosion** is significantly affected by fouling and microbial activity. Scaling interferes with heat transfer of the process and can lead to process-side problems. Looking at minimum heat transfer and less temperature of circulating water the chances of scaling is minimum comparing corrosion.

Corrosion (Major)

The dissolution of a metal in water is essentially an electrochemical process. Metal dissolves at anodes, leaving electrons behind. These electrons flow through the remaining metal to other points called cathodes where reactions that consume electrons occur. In this reaction, the anode is the site of obvious corrosion.

The two points between which electrons flow form a corrosion cell. However, a corrosion cell can be established as a result of a number of different mechanisms.

1. Oxygen reactions in water
2. Dissimilar metal coupling
3. Differential concentration cells

Oxygen in water reacts with active metal ions and upsets the normal equilibrium conditions at the metal surfaces, permitting corrosion to continue. In a closed system, the oxygen in the recirculating steam could be rapidly depleted due to corrosion. Unfortunately, many closed recirculating systems require significant makeup due to loss of water from leaks, overflows through pressure-releasing valves and unauthorized use of

water for wash-up purposes. Oxygen can enter with this makeup and through other air in-leakage at pumps, valves and air cushion tanks.

Another type of attack is galvanic corrosion. This attack results from the potential difference that exists when two different metals are physically joined. The factors shown that accelerate or control galvanic corrosion serve as a basis for avoiding or minimizing corrosion either by design change or by corrective treatment measures. Galvanic attack is of particular concern in closed recirculating systems because joined dissimilar metals are frequently found in such systems.

The metals that are of most concern when considering galvanic corrosion are nonferrous-type metals that are Cathodic to steel in galvanic cell. One example is the use of steel adjacent to copper or copper alloys. In this case, the steel, being anodic to copper, corrodes rapidly.

Physical deposition of solids is another important factor that can establish a potential difference with resulting corrosion. A difference in electrolyte concentration between two points on a metal is sufficient to promote corrosion, because this difference is all that is needed to encourage the flow of electrons. The fact is that such a difference can exist between metal surfaces in crevices or beneath deposits. Good design should minimize crevice attack and proper water treatment should be eliminating the presence of deposits.

Scale

Theoretically, under the conditions that exist in a truly closed recirculating system, all of the common scale-forming constituents in the system water [such as calcium carbonate, calcium sulfate, magnesium salts and/or silica] can deposit on metal surfaces without any noticeable results because such small quantities are involved. However, in the more typical, higher makeup closed system, additional scale will precipitate with each new increment of water added to the system. In time, this scale will assume significant proportions plugging water passages, reducing heat transfer and promoting corrosion.

Fouling

Until recently, the terms scale and fouling were interchangeable and mutually included all those materials that coated metal surfaces in recirculating systems. With continual development of improved treatments and better technology, it is more descriptive to restrict the term scale to cover that deposit resulting from the super-saturation of otherwise soluble water constituents. Fouling, on the other hand, includes a broader range of material that is generally softer and les adherent and that come from number of different sources.

Microbial Growth

It may seem that because the average closed system sees little sunlight and has low oxygen content and few nutrients, there is no problem with microbial growth. In reality, microbial growth can be severe for the following reasons.

1. Higher makeup rates introduce more oxygen, debris and nutrients and serve to inoculate the system.
2. Process leaks can also provide excessively high amounts of food.
3. Many closed systems use tanks that are open to the atmosphere and/or have in-leakage of air at steals, so oxygen levels can be at or close to saturation.
4. Some corrosion inhibitors can become food for bugs.

How "ALTRET" 806 CS works: -

The corrosion inhibitor, formulation of Nitrite and borate. The corrosion inhibition mechanism is formation of extremely thin, highly tenacious protective film on metal surfaces. Borate is works as buffer.

Characteristics and dosage of "ALTRET" 806 CS: (Combination of Nitrite – Borate):

- **Nitrite –Borate base Anodic Corrosion Inhibitor**
- **Used extensively for Closed Recerculating Cooling water system.**
- **Gives excellent result to protect Metal.**
- **The aggressiveness of culprits such as chloride, sulphate ions is minimum to this program.**
- **Treatment level depends on water quality.**
- **Generally, 5000 ppm for Programme starts up.**
- **Regular dosage are in the tune of 2500- 4000 ppm base on make up to maintain 800-1000 ppm of Nitrite.**

Characteristics and dosage of "ALTRET" 816 CS: (Combination of Nitrite – Azole):

- **Combination of Nitrite –Azole Corrosion Inhibitor for Multi metal system along with yellow metal.**
- **High Performance corrosion inhibitor for more multi metal where copper or copper base alloy is a part of system.**
- **Protective adherent film on the metal oxide surface.**

- **Less adverse effect due to the high chloride.**
- **Corrosion rate of Copper below 0.2 mpy & Steel below 3 mpy will be achieved.**
- **Generally, 3000 ppm for Programme starts up.**
- **Regular dosage is in the tune of 1500- 2500 ppm base on make up to maintain 400-700 ppm of Nitrite.**

References:

1. **"ALTRET"** Hand Book.
2. The Benefit of the Water Treatment Chemical User (Published Quarterly, Volume 9, Summer 2002).
3. Website: **www.chiller.com**