



## Closed Water Systems

A system which circulates water through a loop, without intentional water loss, is a closed water system or *closed loop*. Example: a vehicle's cooling system carries water from the radiator (water cooled / air heated) to the engine (engine cooled / water heated). Closed heated and chilled loops within buildings are not circulating domestic hot water (body contact) potable water systems.

### Common Problems

A closed loop which is in fact closed, requires little or no chemical treatment because water impurities which cause corrosion and scaling were introduced only once - when the system was originally filled. In operation, however, many "closed" systems are, in fact, indeed open. Water losses from plumbing repairs, leaking pump seals or faulty air-release valves cause make-up water, containing scale-forming minerals and corrosive oxygen and carbon dioxide, to enter. Also, air (20% oxygen) is drawn in during large system temperature / pressure changes in the spring and fall. Too often, the first signs of failure are expensive repairs.

### Rusting Corrosion

**problem** - Oxygen, dissolved in water, not water itself, reacts with iron and forms "rust". If no oxygen were present in a closed loop, oxidation or rusting would be impossible. Scavenging or "using up" the dissolved oxygen in a closed loop ends the possibility of rusting and pitting corrosion.

 = **solution** - Sulfite ion ( $\text{SO}_3^{2-}$ ) reacts with dissolved oxygen ( $\text{O}_2$ ), forming sulfate ion ( $\text{SO}_4^{2-}$ ) oxygen is made permanently unavailable for any other reaction - including that of rusting iron and steel.

### Bi-metal Corrosion

**problem** - Bi-metal corrosion occurs if two or more types of metals are connected in an electrically conductive medium. A closed loop containing tap water which has been dosed with electrically conductive (salty) treatment chemicals satisfies all the conditions necessary for this type of corrosion.

 + **solution** - SLS (sodium lauryl sarcosinate) molecules are electrically charged dielectrics (insulators) which are attracted to and adhere to metal surfaces. Electrical potentials (voltages) between bi-metals coated with SLS are insulated from each other by SLS and do not carry electrical currents and corrode.

### Glycol Degradation

**problem** - In the presence of dissolved oxygen, hot ethylene and propylene glycols can oxidize and form corrosive organic acids.  $\text{COH} + \text{O} \rightarrow \text{COOH} \rightarrow \text{COO}^- + \text{H}^+$

**solution** - Remove dissolved oxygen with sodium sulfite:  $\text{O} + \text{SO}_3^{2-} \rightarrow$   
Neutralize acids with dipotassium phosphate pH buffer.

