Does a closed system need chemical treatment?

Closed systems are sealed off from the atmosphere and circulate the same body of fluid all the time. Therefore they are quite stable and never need any form of chemical treatment to protect them. Right?

Well of course we know this isn't quite true. Modern automobile cooling systems are essentially closed loops, but would you ever consider running one with just plain water? We know what the result would be - rusty water and pretty soon, a bill for a new water pump.

The effects on a closed system used for any kind of heating or cooling are the same - corrosion, deterioration of components and loss of heat transfer efficiency. What causes this?

The water that we use to fill a closed loop is sometimes acidic and always contains dissolved oxygen. Mild steel and iron corrode rapidly under these conditions releasing small flakes of rust into the circulating stream. These particles are abrasive and tend to erode the components of the system. This can be particularly harmful in the area of the pump shaft seals.

What about after all this oxygen and acidity have been used up. Won't the system become stable and no more corrosion take place?

Perhaps in an ideal situation, but if we discount for a moment the damage that will be done to our brand new system along the way, can we guarantee that the water in this system will ever reach a stable condition? There are several reasons why we cannot. Consider this.

Most so-called closed loops are not truly closed. There has to be provisions made to automatically compensate for any pressure changes or water losses. To accomplish this, the system will normally utilize an expansion tank and relief valve, at the same time being connected to the water main via a pressure reducing valve, (PRV). Expansion tanks usually have a volume of air trapped above the water. The oxygen dissolves in the water and is then circulated throughout the system. Makeup water enters the system as a result of bleeding air from the loop or because of water leaks, bringing with it a fresh supply of dissolved oxygen. Sometimes quite substantial leaks or losses can go undetected for a long time since the PRV automatically makes up for them.

The net result of this is the introduction of a small but continuous supply of acidic water containing corrosive oxygen. The problem is aggravated considerably if the system is opened for any kind of routine maintenance or component replacement. As corrosion in the loop continues, heat-transfer surfaces become coated and lose efficiency, and tubes become plugged. Layers of debris lead to an effect known as under-deposit corrosion which can cause pitting, a form of concentrated, localized corrosion. Pitting should be avoided at all costs because it leads to rapid perforation or component failure.

What can be done to protect a closed loop system?

- Application of a suitable corrosion inhibitor: The corrosion inhibitor is used to coat all internal surfaces of piping and equipment with a protective monomolecular film, in order to prevent an attack on the metal surfaces in the system.
- Regular testing of system: The operator on site should perform routine chemical testing on the water in the closed loop system. This will allow the operator to determine the strength of the corrosion inhibitor in the loop, as well as, to determine when more chemical treatment needs to be added to the system. It is also very important to have a qualified water treatment technician who will make regular site visits. This is necessary because the water treatment technician will be able to point out potential problems with the chemical levels in the system loop, and ways to improve the water quality in the system.