Closed Loop Water Recycling System

Abstract

To drastically reduce water usage and eliminate wastewater discharge, one can install a computer controlled closed loop water recycling system.

Prior to the year 2001, a company used a traditional once-through water cooling system to control the temperature of process equipment. After passing through the production equipment, the water was treated and discharged into a river. This process used approximately 1,728,000 gallons of city water per month, at a cost of around $14,400 dollars a year. Investigating P2 options for reducing water usage and waste disposal, the company implemented a closed loop water system in their manufacturing operations. The closed loop system re-circulates water so there is no discharge to the river. The closed loop system gave cleaner water at a constant pressure and temperature. This consistency improved the operations of the cooling water system. Furthermore, a savings of 97.5% in water costs is realized per year.

Process Description

The closed loop cooling system in this study is comprised of, a water pumping station (Thermo Care Inc.), a 1,600 gallon in-ground tank, a 90-ton chiller and a remote condenser, shown in Figure 1.

Figure 1: Closed loop water cooling system to remove heat from process equipment.

To remove heat from process equipment, water from an in-ground cement tank is used. The tank is divided into two cells. Water from cell 1 is fed to process equipment at 53 °F and 70 psi. After which, the water is returned to cell 2 through 6-inch PCV pipe, located in the floor of the facility.
The temperature of water in cell 1 is maintained at 53 °F by circulating water through a chiller. Water, at 65 °F, from cell 2 is pumped at a rate of approximately 100 – 160 GPM to the chiller and is returned to cell 1. This loop continuously circulates water at 30 psi through 4-inch pipe.

To maintain the volume of water in the closed loop system, city water is used to replace what is lost through evaporation.

**Biological Contamination:** There are various methods for treating water in closed looped systems, such as the use sodium nitrite based inhibitors and biocides to prevent biological contamination. Bacterial monitoring may also be necessary, especially when using biodegradable treatments such as nitrate.

In this case study, a Hydromatic™ Cool water treatment/filtration unit, purchased from e-H₂O, South Lyon, is used to control bacteria by using ultraviolet sanitation.

**Corrosion / Fouling:** Corrosion is often a problem with closed-loop systems. The recommended treatment technologies to prevent metal corrosion include: oxidizing agents that form a passive layer on the metal, other film-forming agents that protect metal surfaces, and corrosion-reducing agents that remove oxygen from the solution. In addition to metal corrosion, scaling and biological fouling of non-metallic parts is possible.

In this case study, scale minerals and dirt are removed with the Hydramatic™ Cool treatment system.

**Costs**
The total cost of the 100-160 GPM closed loop water system is approximately $140,000.00.

**Case Study**
This case study is proved by Alpha Plastics, Inc., St. Louis, Michigan

**Commercial Applications**
Below is a list of a few industrial applications of closed loop water systems:
- Closed loop cooling water system to remove heat from process equipment
- Closed loop rinse water recycling

**Benefits**
- Eliminates wastewater to be discharged.
- Reduces water consumption: water consumption was reduced by 90%.
- Reduces costs: a 97.5% saving in water costs per year was realized.
Improves production: less scrap material is generated which translates into less solid waste.

Disadvantages

- Biological contamination: there are various treatment processes available to control bacteria.
- Scaling and corrosion. This needs to be controlled as described above.

Vendors

Thermal Precision, http://www.thermalprecision.com (closed loop cooling water system)
Diversified Air Systems, http://www.diversifiedair.com (closed loop water recovery systems)