CHILLED WATER

TREATMENT

WHAT IS CHILLER?

Removes heat from a process by using a fixed volume of cooling water.

Not open to the atmosphere.

No water is evaporated.

Neglible or no makeup.

Secondary cooling is must.

Makeup water choice is

DM / SOFT / RO / DESAL

CHILLER IS USED FOR

CRITICAL PROCESSES – systems that require very clean heat transfer surfaces or cannot tolerate variability of operating conditions. They are also very high heat flux systems.

DISCHARGE RESTRICTIONS – when plant facilities are restricted on volume or thermal discharge limits.

WATER SOURCE LIMITATIONS – when water is not plentiful.

EXTEND EQUIPMENT LIFE – corrosion control is easier in a closed system. Systems such as chillers typically use closed loops to extend the life span.

HOW DOES CHILLER WORK?

- There are three basics parts to every closed recirculating cooling

  system.

First,

There is a pump which moves the water in the loop. Generally the pump draws water from a sump or a cold well.

Second,

There is a heat exchanger that transfers heat from the process to the chilled water. This heat exchanger can have many shapes and sizes.

It can be an automobile radiator, an air conditioning chiller, a hot water boiler, a diesel engine jacket, an air compressor, a mold tube on a continuous caster in a steel mill or a primary cooling loop in a nuclear plant.

Third

Hot & cold wells

HOW DOES CHILLER WORK?

FUNCTIONS AS BELOW

Once the heat is removed from the process heat exchange device, the water moves to a second heat exchange device.

This heat exchange removes the heat from the closed cooling water loop and the cooled water is ready to be pumped to the process again.

This heat exchanger may be a fin-fan cooler,which passes air over coils containing the closed cooling water.

It may be an evaporative condenser which sprays open recirculating cooling water over tubes containing the closed cooling water.

Or it could be a shell and tube heat exchanger on a second cooling water system that is either once-through or open recirculation

HOW DOES CHILLER WORK?

- Closed loop cooling water temperatures can range from 30ºF in a chiller system to 350ºF in a hot water heating system.
- Theoretically there is no water loss from the system. However, water losses do occur from leaks around expansion tanks, seals and valves.
- Generally water losses average 0.1-0.5% of system capacity per day.

HOW DOES CHILLER AFFECT PLANT?

- **Closed recirculating systems are subject to the four major cooling water problems of scale, corrosion, fouling and microbiological growth.**
- **The average system, however, is most significantly affected by corrosion and microbiological fouling.**
- **Scaling is typically not a problem in a tight system.** Even if all the minerals were to scale it would not amount to very much.
- Scale is only a problem if there is a softened makeup water. Under this condition, scale buildup can become significant over time.
- Most of the high heat flux systems use DM water to prevent scaling problems.

HOW DOES CHILLER AFFECT PLANT?

- **Corrosion is the primary concern in a closed system for 3 reasons.**

  NATURE OF MAKEUP WATER - DM

  PLUGGING – Most closed systems contain many small orifices, ports and valves which are easily plugged by corrosion products (iron oxide/rust).

  CORROSION PRODUCT BUILD-UP – Since there is little or no makeup, corrosion products are not readily flushed or removed from the system.

SCALING IS NOT A MAJOR CONCERN

HOW DOES CHILLER AFFECT PLANT?

- Closed recirculating systems are susceptible to microiological growth and fouling.
- The typical closed system treatments are food for certain microorganisms.
- Once a system becomes infected, serious problems will develop.
- These problems have the following effects on plants:
- · **Loss of cooling efficiency**
- · **Increased maintenance and cleaning**
- · **Lost Production**
- · **Reduced equipment life**
- · **Higher operating costs**

USES OF CHILLERS/REFRIGERATION

- **A chiller is a piece of refrigeration equipment. Chillers are found in two general application areas.**
- Air-Conditioning - Chillers and refrigeration equipment are almost

  always part of air conditioning systems in buildings, hospitals, and

  universities.
- **Variety of light industrial applications.**

  These include computer cooling, ice production, machinery cooling and temperature control of pharmaceutical cultures.
- These units are designed to remove heat from an area or a process and expel the heat through a cooling tower system.

- IN SAUDI IT IS USED FOR LARGE INDUSTRIAL APPLICATIONS DUE TO TEMPERATURE CONDITIONS

CHILLER CATEGORIES

Chiller systems can be categorized as follows:

- 1. Vapor Compression Machines
  - Reciprocating Compressors
  - Centrifugal Compressors
- 2. Vapor Absorption Machines

VC

VAPOR COMPRESSION MACHINES

- Both centrifugal and reciprocating type units pick up heat from building air and transfer that heat to Freon® in the evaporator.
- The Freon® carries the heat from the evaporator to the condenser.
- The heat is then transferred from the Freon to the condenser water where it is released to the atmosphere
- at the cooling tower. The Freon® is then compressed and sent back to the chiller where it picks more heat from the chilled water loop.
- So, there are two separate water loops in a Vapor Compression Chiller system, the chilled water loop and the condenser water loop. The Freon® works between the two loops.

VAR

ABSORPTION MACHINES

- Absorption machines are sometimes used in central utility plants where a year-round supply of steam is available, because these systems use steam in their operation.
- Absorption machines use water as the refrigerant and a salt solution (lithium bromide) to absorb and concentrate heat for transfer to the condenser water.

POWER BEHIND THE CHILLER

Refrigeration systems are expensive to operate.

The most important energy used is the electricity needed to operate the compressor for a reciprocating or centrifugal type machine.

- Both the chilled water and condenser water loops are susceptible to efficiency losses due to water side problems.
- This equipment can be affected by all of the four major cooling water problems; scale, corrosion, fouling and microbiological growth. Even a biofilm can insulate a tube and decrease efficiency sharply.

MONITORING

It must be monitored and controlled very carefully for the most efficient operation of a chiller. The following controls are recommended.

- Maintain treatment inhibitors in range.
- Repair leaks to eliminate or reduce make-up water requirement to minimum levels.
- Maintain proper microbio control.

CHEMICALS FOR THE TREATMENT

NITRITE – MILD STEEL ANODIC INHIBITOR

- Nitrites oxidize mild steel surfaces to form extremely thin of tightly adherent iron oxide layer
- Program Characteristics:
- Primarily used in closed systems
- pH buffered at 8 – 11 (optimum range 8.5-9.5)
- High level of nitrite is required (500 – 1000 ppm as NO2)

MOLYBDATE – ANODIC INHIBITOR

- Replacement for chromates, low toxicity
- Program characteristics
- Requires an oxygenated environment (generally at least 1 ppm
- oxygen)
- It is a rather weak inhibitor which requires high inhibitor
- concentrations 80-150 ppm (as Mo) when used alone in closed
- loops.

CHEMICALS FOR THE TREATMENT

- NONOXIDIZING BIOCIDES (FOR ALL PROGRAMMES MUST)

AWC PRODUCTS

PRECLEANING

AWC-B-750

CORROSION & SCALE INHIBITORS

AWC-A-303,AWC-A-301 (Molybdate base)
AWC-A-500,AWC-A-330M (Nitrite base)
AWC-A-550 (Molybdate and Nitrite base)

BIOCIDES

AWC-A-115l, AWC-D-220

AWC B-750

NON-ACIDIC IRON REMOVAL, DESCALING AND DEGREASING CLEANER

- **DESCRIPTION AND USE**

- **AWC B-750** is a CIP cleaning chemical designed for pre-commission cleaning of non-potable water systems such as cooling towers, chillers, locomotive engineers, etc...

- **AWC B-750** contains chelants, sequesterants, dispersants, surfactants and corrosion inhibitors to clean and passivate Cooling Towers that have scaling, iron fouling, organic fouling and biological fouling problems. It is also very effective for us in cleaning of newly constructed cooling towers. It will effectively remove grease, debris,and mill scale. Such deposits will reduce water flow, heat transfer and overall system efficiency while encouraging bacterial fouling and corrosion.

- **APPLICATION AND REQUIREMENTS**

  The actual application of AWC B-750 will depend upon the type of system to be cleaned and the degree of fouling.

AWC A-500

CLOSED SYSTEM CORROSION INHIBITORON

- **DESCRIPTION AND USE**

- **AWC A-500** has been formulated to provide corrosion inhibition in closed water systems operating at low and high temperatures, such as engine cooling systems, chilling and non-potable water storage tanks

  Corrosion in closed water system will result in deposit formation, which will reduce flow, heat transfer and overall system efficiency
- **AWC A-500** provide effective protection for iron and steel,brass,copper and many other metals that are present in such system.

- **APPLICATION AND REQUIREMENTS**

  Effective Nitrite concentrations in system will vary from 500 – 1000 mg/L, depending upon system make-up water and system

AWC A-115I

ISOTHIAZOLIN BASED BIOCIDE

- **DESCRIPTION AND USE**

- **AWC D-115I** is a broad spectrum liquid microbiocide for use in a variety of water treatment applications, including open and closed recirculating cooling systems and air washers. It causes immediate inhibition of growth upon coming in contact with the microorganisms.

- Broad-spectrum activity against algae, fungi, and bacteria including Legionella pneumophila and sulfate reducing bacteria.
- Non-oxidizing.
- Very effective against existing biofilms and inhibits formation of new biofilms.
- Effective over wide range of pH, temperature and water hardness.
- Readily biodegradable when diluted.
- Compatible with low levels of free chlorine or bromine as well as corrosion and scale inhibitors.
- Effective at low concentrations.

ANALYSIS REQUIREMENT

Makeup Water

pH

Conductivity

Alkalinity

Total Hardness

Chloride,Sulfates and Silica

Microbial Count

Turbidity & iron

Closed Loop Water

pH

Conductivity

Alkalinity

Total Hardness

Chloride,Sulfates and Silica

Microbial Count

Turbidity & iron

Corrosion Inhibitors
(Molybdates ,nitrites,Azole)

BACTERIAL PROBLEMS

- NITRIFICATION
- TVC
- SRB
- DENITRIFICATION
- IRON BACTERIA

THANK YOU

American Water Chemicals, Inc.

Mohammed Afifi