Optimizing Water Treatment for Plant Utilities, Offsites and Electrical Generation

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A Practical Guide to Industrial Water Treatment

Boiler and cooling systems are made from metals that try to revert to their natural state, *i.e.*, they corrode. Add a variety of chemical species trying to deposit on heat-transfer surfaces and microbiological species finding the ideal conditions for growth. The result is a complex system that must be carefully controlled to prevent loss of heat transfer or permanent damage. To cope, water treatment has evolved over the years into a rather comprehensive subject. This manual started its life as a course to provide a solid grounding in industrial water-treatment including effluent control. As management is often better able to understand O&M dollars rather than concentrations for individual chemical species, a number of methods that relate analyses to *practical* parameters are included. The water-treatment industry has developed an extensive arsenal of treatment products and programs. How will they perform within your system? What are the risks or benefits from adding less than or more than the prescribed product dosages? What is the fate of a chemical treatment product within the system? ... and in the environment? Are there alternative treatment products that may be more effective or does it make more sense to put the effort into hardware?

Learning Objectives

A knowledge of water treatment principles is vital to those who operate and design industrial boiler-plants and cooling systems. That need is the same whether it be a major electrical generating station, a small cogeneration plant or steel mill. The larger plant may have full-time chemical staff. The smaller plants rely upon operators on shift. This manual is designed to provide operators with that basic water-treatment knowledge, needed to troubleshoot and optimize the water systems in their plants, and designers with an insight into some practical aspects of operating the plants and the most suitable water-treatment equipment.

Who will gain the most from this manual?

The content targets both chemical and non-chemical people who want to know more about the industrial use of water in industry. It is particularly valuable to:

¤ Water-treatment and boiler-plant operators
¤ Plant chemists/chemical engineers/chemical technicians
¤ Water-treatment vendors, plant and equipment designers
¤ Environmental engineers
¤ Chemists and engineers who want to know more about using water in industrial systems.

Ordering Information

¤ Cerlox-bound printed or PDFs for $199 each plus S&H
¤ There is no S&H when PDFs are sent as e-mail attachments.
¤ Add 5% GST to Canadian Orders. (GST# 115142077)
¤ Make all international payments in US dollars.
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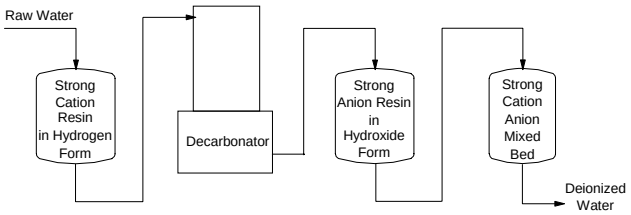
This content is split into several sections, each describing various aspects of water treatment in industrial applications. The following list of topics gives an indication of what can be found



Preparing High-Quality Water for Industrial Applications

This section provides an overview of the options available to make high-quality water for a variety of industrial applications ranging from cooling to boilers and for industries including electrical generation and petroleum recovery.

Why do We Need Water Treatment? - Describes the properties of water from various geographic sources and how they impact upon its industrial use. Includes the basics of corrosion, scaling and microbiological fouling and how they apply within industrial systems.

Disinfection - Describes chlorination, chloramination and the formation of THMs. Also looks at the various alternatives including ozone, chloramination, bromination and chlorine dioxide.

Clarification - Shows how coagulation-flocculation process can be used to convert the colour, natural organic materials and unfilterable colloids into filterable solids. Describes the advantages of different coagulants and clarifier designs.

Filtration - Starts with a discussion of the various conventional methods for mechanically separating solids and then moves into a discussion of membrane techniques including micro and ultrafiltration and reverse osmosis.

Ion Exchange - Describes the operation of ion-exchange systems for both cleanup and polishing and how systems can be returned to service by regeneration. Includes a discussion of resin types, bed designs such as the short-bed and packed beds and compares co and counter-current regeneration. Electrodeionization is discussed as an update on the more traditional designs.

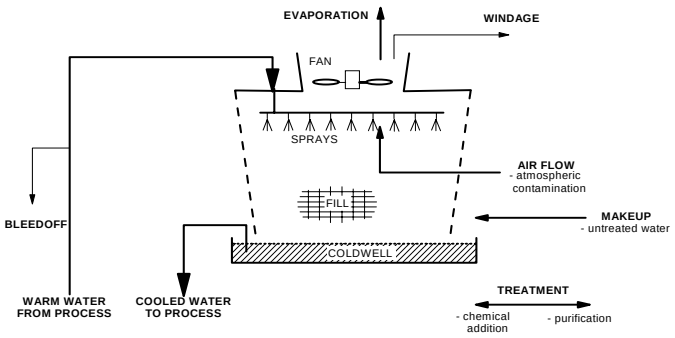
Chemical Treatment - The logic behind chemical treatment products, how they are added to a system.

Meeting the Needs of the System - Shows how to match equipment to the needs of the system. Discusses how closed-loop demineralized water systems can be established for critical cooling applications.

Optimizing the Operation - Describes methods to make a water-treatment plant or a water system behave better. How should it be monitored? What about special techniques such as HazOp? Troubleshooting and priority setting.

Upgrading the Operation - Water-treatment plants can't go on producing forever. What can be done as the plants age and the need for water gets even tighter? Is it better to continue operating your own water-treatment plant when you can contract a service to supply it? Can we build a better plant?

Cleaning up behind us – What do we do to recover and recycling our wastes. What do we do before we can discharge our waste streams? How do we accomplish zero liquid discharge,



Using Water for Industrial Cooling Applications

This section looks at all aspects of using water for cooling in systems ranging from HVAC to heavy industry. It included discussions of methods to monitor the effects of fouling and scaling as well as methods to alleviate the problems.

Why do We Need Water Treatment? - Describes the properties of water and problems they present in its industrial use. Includes the basics of corrosion, scaling and microbiological fouling and how they impact upon cooling systems.

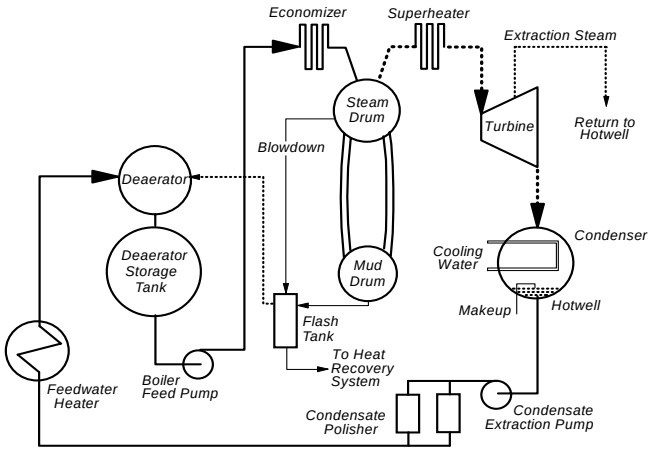
Contact vs. Non-Contact Cooling - Compares systems where the cooling water contacts hot metal or other materials with the various types of cooling systems used for different applications.

Cooling Water Treatment - Compares once-through, open recirculating (cooling tower) and closed recirculating cooling systems. The expected problems that might be encountered in each are described along with the required solutions.

Cooling Systems - A wide variety of cooling systems are described along with a discussion of the expected problems. The systems described include HVAC, industrial cooling towers and direct-contact industrial process cooling.

Monitoring Cooling-System Performance - On-line and off-line methods for detecting the loss of efficiency through scaling or microbiological fouling.

In-Service Cleaning procedures - Techniques for both off-line and on-line cleaning to restore condensers and heat-exchangers back to their original efficiency.



New Trends in Boiler Water Treatment

This section describes water treatment for boiler applications and covers the entire range from low-pressure to high-pressure applications for once-through and recirculating boilers of any size or shape, fossil-fuel fired or nuclear. It is an improved and expanded version of our earlier course with expanded sections on oxygenated treatment along more depth to the discussion of dispersants and scale modifiers.

Introduction to Boiler Systems - Compares boilers according to design and operating pressure. Shows how concentration occurs and its impact on boiler operation. Discusses the mass balance within boilers and the source of the commonly applied specifications.

Alkalinity Control - Shows how alkalinity and pH can be monitored and controlled. Includes discussion of temperature effects upon pH. Discusses the chemical volatile amines and solid products used to control pH.

Dissolved Oxygen Control in Closed Systems - Describes the effects of dissolved oxygen in maintaining boiler integrity and how this can be controlled with mechanical deaeration and chemical oxygen scavengers. Also discusses the newer approach using oxygenating chemistry and the concerns about shifting between oxidizing and reducing states.

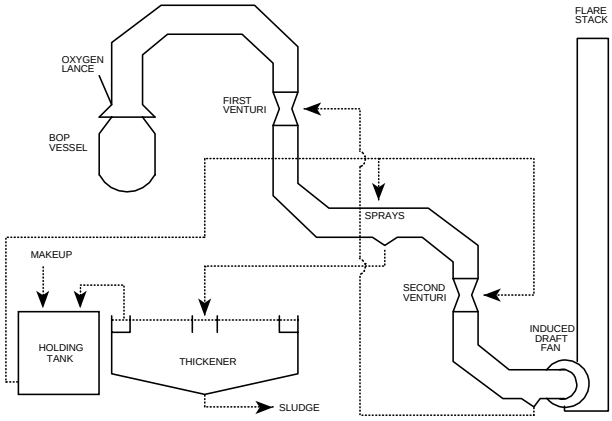
Dissolved and Suspended Solids Control - Demonstrates how makeup, blowdown and condensate return interact to control the concentration of impurities. Shows how to calculate the energy lost through blowdown and how to recover both the water and the energy. Compares the role of external vs. internal treatment to keep boilers clean.

Phosphate Treatment - Describes the evolution of phosphate treatment through coordinated, congruent and the latest equilibrium phosphate treatment.

Monitoring & Controlling a Boiler Treatment Program - Goes through the basics of doing a mass balance within a boiler system. Looks also at methods to find hideout by monitoring chemical changes that accompany load changes.
Flow-Accelerated Corrosion - What causes flow-accelerated corrosion and how can it be monitored and controlled?

Carryover in Steam - What is carryover? How can it be reduced? Can it be measured?

Start-up, Shutdown and Upset Operation - Describes how Start-up, Shutdown and upsets from condenser and heat-exchanger leakage influence boiler operation.



Specific Industrial Applications

Iron &Steel - Coping with the high concentrations of iron oxides that the cooling water contacts directly and makes chemical treatment difficult.

Electrical Generation - Combined cycle, fossil-fired, nuclear.

HVACR - Air conditioning, refrigeration, compression and adsorption chillers.

Oil and Gas - Water used for oil recovery including SAGD for heavy oils, refinery process waters, treatment of produced and waste waters.

Metal Production and Finishing - Metallic wastes, neutralization, sludge concentration and dewatering.

Sanitary Wastes - Aerobic and anaerobic processes, lagoons and packaged plants.

and much more …