4.7 Water Treatment

Applicability

This BMP is intended for those industrial water users that use water treatment systems in processing, production or finishing operations. Water treatment is used to produce improved quality water such as softened or ultra-pure water to produce water of a specific quality necessary for a certain production process, to improve water quality for reuse within a facility, or for a second use within a facility. Industrial users who treat water for a rinsing or cleaning process should refer to the Rinsing/Cleaning BMP; users that treat water for cooling tower use should follow the Cooling Towers BMP; and those using boilers to produce steam should consult the Boiler and Steam Systems BMP.

Description

Most major industries and power plants and many commercial operations need water purity higher than that provided by the local municipal water supply. In addition, many industries use raw water directly from lakes, streams, or wells and require additional treatment before use in the process. The focus of this BMP is water efficiency in the provision of additional treatment of water for use within the facilities.

In addition to treatment for boiler feed, rinsing/cleaning processes, and cooling tower water, common examples of water treatment in industries include softening of water to prevent scaling and preparation of ultra-pure water. Specialized water treatment is important in such industries as metal finishing and plating, food and beverage, chemicals, pharmaceuticals, electronics and micro-chip production, and most other process industries requiring especially clean water.

On the commercial and institutional side, examples include soft water for the laundry industry, spot free car wash water for commercial car washes, hospital needs such as kidney dialysis, and high purity water for injection fluids in medical facilities.

Water conservation opportunities arise in increased efficiency through improvements in flow rates, pressure, temperature, chemistry, filtration or timing. Metering both inflow and outflow from the system provides the operator information to determine if the system is meeting design efficiencies. Process control is often an area where increased efficiency can be obtained. Many operations can also increase efficiency by recirculating water or by filtering contaminants and reclaiming water for reuse internally.

Specific processes in which this BMP can be implemented will have been identified in the Industrial Water Audit BMP. Each process requires careful evaluation to determine the most economical and efficient measures to implement. The initial cost-effectiveness analysis should begin with the simplest measures such as adjustment of operating parameters on existing equipment. Often reductions in water pressure, changes in timing, repair of leaks or other adjustments to plumbing can achieve measurable results in water savings.

Equipment upgrades can also be cost-effective, including use of smaller sinks and tanks, changes in pumps, nozzles, pipes, solenoid switches, and instrumentation or machinery that control the timing and volume of rinsing or cleaning processes. Reuse of water within a water treatment process is one of the most effective means of saving water.

When filtering of water is necessary, the simplest process is often just recirculation of water, with dust or other solids removed in settling tanks. Filtration may include oil water separators, centrifugal separation, sand filters, bag filters, or even more sophisticated membrane filtration. In processes where ultra-pure or very high quality water is needed, careful engineering of pre-treatment and treatment processes is necessary to ensure removal of organics and other materials which can damage membrane filters. Flocculation or coagulation can help prevent fouling of membranes.

Careful balancing of cost-effectiveness considerations should be considered when choosing between reverse osmosis ("RO"), nanofiltration, electrodialysis, ultrafiltration, microfiltration or other treatment processes. Issues such as membrane fouling, multiphase processes, organic and inorganic constituents in the feed stream, pressure levels, and discharge levels should all be considered. Careful evaluation of filter media should take into account the relative efficiency of the process in terms of the ratio of filter backwash to through-put and reject water to product water.

Adjusting the chemical requirements of the process can also lead to significant water savings. Coagulation should be optimized by adjustments to pH, coagulant type, and feed rate to achieve the most effective removal of turbidity, particulates, precursors and/or disinfection byproducts. Some processes can be adjusted to use higher levels of chemicals in a process, reducing water pressure and flow volumes used to scour a product. Corrosion control is another area where proper water treatment process selection can result in greater water use efficiency.

Where treated water is used for potable purposes, all applicable Texas Commission on Environmental Quality ("TCEQ") rules and regulations for design and operation of public drinking water systems must be followed. Although the underlying mission is to protect the public health, the TCEQ has the Texas Optimization Program ("TOP"), a voluntary, non-regulatory program designed to dramatically improve the performance of existing surface water treatment plants without major capital improvements.

Additionally, discharged effluent water quality must meet all TCEQ water quality discharge constraints. Instead of discharge, in facilities that use filters for treatment processes, filter backwash water or RO reject water should be considered for use in other processes where lower quality water can be utilized. (*See* the Industrial Alternative Sources and Reuse of Process Water BMP)

The level and type of treatment are dependent on the purity of water required and the end use needs, but reuse opportunities for the waste streams generated by treatment should be evaluated. Other than cartridge type filtration, almost all treatment processes produce both a product water and waste stream.

Implementation

Implementation of this BMP should consist of the following actions:

1) Perform a water efficiency evaluation on each water treatment process within a facility to identify areas of improvement for water savings. The evaluation should review amounts of water treated and produced, amounts and types of chemicals used, use of automatic controls, repair and maintenance schedules and procedures, and water quality characteristics. The efficiency evaluation should review the end use needs of the specific processes for which the treated water is used. Where manufacturers' specifications or industry specific information is not available, company engineers or third party contractors should perform an empirical evaluation of existing equipment.
2) Water treatment processes should be operated in a water efficient manner with consideration for:
   a. Optimal repair and maintenance of water treatment equipment and facilities to keep water treatment equipment, lines and related equipment in good repair.
   b. Timing of existing equipment, reduction in flow rates by changes in nozzles, changes in sizing of filters or holding tanks.
   c. Use of proper filters and settings for water quality necessary for end-use, including optimal timing of and amount of backwash water.
   d. Use of reject or backwash streams in other uses, where water quality is appropriate.
   e. Upgrades of apparatus including tanks or sinks, nozzles, valves, pumps, and control equipment.
   f. Optimal use of chemical additives to minimize water use.
   g. Use of water quality instrumentation to control when to recharge or regenerate the water treatment process.
3) Water softening processes should be operated in a water efficient manner with consideration for:
   a. Optimal repair and maintenance of water softening equipment and facilities to keep water treatment equipment, lines and related equipment in good repair.
   b. Timing for efficient use of existing equipment for optimal flow rates.
   c. Full knowledge of the chemistry of the water to be softened as well as the application uses of the softened water (laundry, boiler feed, process water, condensate polishing, etc.).

d. Optimum design for maximum water use efficiency, minimum pressure drop, minimum regeneration waste water discharge and lowest capital cost.

4) When cost-effective, reuse and reclamation equipment should be installed or upgraded.

a. Optimal repair and maintenance of reclaim equipment and facilities to keep rinsing/cleaning equipment, lines and related equipment in good repair.

b. Install most cost-effective system, with highest water efficiency.

c. Consider potential use of filter backwash or reject water in other operations.

5) Based on the requirements and uses of the system, alternative water supplies should be considered.

Schedule

If the water user chooses this BMP, the following is a recommended schedule:

1) The industrial water user should complete the efficiency evaluation of on site water treatment systems in a timely manner. Most site evaluations should be completed within three (3) months of beginning this BMP.
2) The industrial water user should implement the opportunities for water savings identified in the efficiency evaluation during the normal business cycle or within twelve (12) months after completion so that maximum water efficiency benefits can be achieved in a reasonable time frame.
3) Water treatment equipment should be operated optimally at all times following the guidelines of this BMP.

Scope

To accomplish this BMP, the industrial water user should do the following:

1) Industrial water users with one or more water treatment systems operated with the same or very similar parameters should perform an efficiency evaluation and perform upgrades as outlined in the schedule of Section D.
2) For industrial water users with multiple systems, or multiple sites that have systems with significantly different operational parameters, a progressive implementation schedule should be followed, implementing the BMP in successive facilities until all facilities have been evaluated and conservation measures implemented.
3) Cost-effectiveness considerations may result in partial implementation of this BMP at one or several of a large number of facilities.

Documentation

To track this BMP, the industrial water user gathers and maintains the following documentation and can utilize industry accepted practices:

1) Operating and design information on all on site water treatment systems, including capacity design, descriptions of the end use processes the water from the treatment system is used for, system requirements for temperature, volume, and duration of flows (hr/day). Operating information should also include design information for maximum levels of contaminants that can be tolerated while maintaining an acceptable water quality rate.
2) Water use records for each treatment system that include the volume of water treated and produced.
3) Description of chemical compounds and amounts used to improve water quality and the costs of chemical treatment before and after efficiency measures are implemented.
4) When applicable, description of reclaim and reuse system and water savings achieved.

Determination of Water Savings

The industrial water user should calculate water savings based on the calculation methodology appropriate to the identified water efficiency opportunities. For example, estimated overall water savings for implementing water treatment efficiencies have been in the range of 10 percent to 15 percent for process adjustments and 50 percent to 85 percent for installing some reclaim systems. Actual water savings should be measured by comparing water use prior to water use after the measures are installed.[1]

Cost-effectiveness Considerations

The industrial water user should determine the cost effectiveness to implement each identified replacement or equipment upgrade to its water treatment processes, utilizing its own criteria for making capital improvement decisions. Many operating procedures and controls that improve the water use efficiency should be implemented simply as a matter of good practice. A cost effectiveness analysis under this BMP should consider capital equipment costs, increased staff and labor costs, chemical and treatment costs, additional costs or savings in energy use, costs for waste disposal, and potential savings in wastewater treatment costs.

References for Additional Information

1) *Handbook of Water Use and Conservation*, Amy Vickers, Waterplow Press, May 2001.
2) *A Water Conservation Guide for Commercial, Institutional and Industrial Water Users*. New Mexico Office of the State Engineer, July 1999. Available in PDF at http://www.seo.state.nm.us/water-info/conservation/pdf-manuals/cii-users-guide.pdf
3) Water Efficiency Guide for Business Managers and Facility Engineers, State of California Department of Water Resources, October 1994.

4) *Rules and Regulations for Public Water Systems* (30 TAC Chapter 290, Subchapter D), Texas Commission on Environmental Quality.