"Non-Chemical Water Conditioning at Schick: A Pollution Prevention Case Study" [1]

Overview

Since 1994, the Schick company of Milford has systematically eliminated the use of conditioning chemicals in its cooling tower water by installing commercially available electrically powered water conditioning units. The company now operates all its cooling towers without the use of conditioning chemicals. This has dramatically reduced conditioning chemical costs, associated management costs and regulatory burdens. These changes have resulted in a cleaner environment, improved profitability and a healthier workplace.

Facility Background

Schick is a division of the Warner-Lambert Corporation, a provider of health care and consumer products. The Milford facility has been in business since 1961 at the present site. The plant encompasses about 435,000 square feet and employs about 900 workers. It operates 24 hours per day, 7 days per week. At the Milford facility, Schick makes shaving products including safety razors and razor blades. Raw materials include stainless steels, plastics and specialized protective and lubricant coatings. The razor blade manufacturing processes include various machining, heat treating, grinding, cleaning, vacuum vapor deposition and coating operations.

The plastic razors are either injection molded with the blade subsequently assembled into the handle, or insert molded, incorporating the blade into the handle in a single step. The finished products are then packaged for sale before shipping.

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Cooling Systems / Water Conditioning Background

To meet its need for cooling both machinery and office space, Schick operates several cooling towers. These towers achieve the desired cooling effect through evaporation of a portion of the water passing through the tower. This cooled water is pumped to various equipment to extract excess heat and is then returned to the tower. Traditional practice at Schick for all cooling tower systems operation included the use of various chemicals to control scale deposits and biological growth, to adjust pH and to prevent foaming. These systems had to be inspected regularly and water samples taken for analysis. Based on the analyses and direct observation, a variety of chemicals had to be added to keep them operating properly. Schick's chemically conditioned cooling towers typically needed to be monitored monthly to keep them working properly. The chemical supplier took care of replenishing the chemicals, monitoring the systems and then adjusting doses via an automated feed system as necessary.

The evaporative cooling process incurs water loss which results in a concentration of naturally occurring minerals (from the water supply), added chemicals and other contaminants in the system. To control the buildup of these contaminants, water must be bled out of the system on a regular basis. This blowdown contains chemicals added to condition the water, thus necessitating their replacement. The uncontrolled release of these chemicals poses a threat to the environment and human health. As a result, the blowdown is regulated under the federal Clean Water Act. In Connecticut, the discharger must obtain a permit from the DEP and the discharge must be sampled periodically to ensure specific permit limits are met. The employees who handle these chemicals must be trained in how to handle them safely and how to stay in compliance with discharge permits.

A variety of operational conditions affect the pH of recirculating water in any cooling tower system. Acid rain, biological growth/decay and many added chemicals can cause the pH to fall (become more acidic). Operating the tower at higher cycles of concentration results in the recirculating water having a higher concentration of bicarbonates (present in a dilute concentration in the incoming water). This increased concentration of bicarbonates causes the pH to rise (become more alkaline). Controlling pH to a lower range, if desired, can be accomplished by increasing the amount of blowdown (decreasing the cycles of concentration).

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Opportunity for Cost Reductions

With the chemically conditioned systems, Schick's Senior Project Engineer estimated the company was spending almost $55 per ton of cooling in its plant (A Ton of Cooling equals 12,000 BTU/hour). This included initial equipment purchase, chemicals, water, discharge permits, discharge monitoring, employee time to maintain the system, employee training (environmental & OSHA), chemical dosing systems(pumps, piping, etc.) and repairs.

Pumps and other chemical dosing equipment occasionally broke down and needed to be repaired. Wastewater discharged from the cooling towers had to be sampled and analyzed. If the results showed an exceedence of permit limits, the company was subject to fines and/or other enforcement actions. Schick wanted to minimize or eliminate the use of chemicals in its cooling tower systems to reduce chemical costs, improve reliability, reduce employee exposure to harsh chemicals, reduce potential company liabilities and reduce exposure to regulatory action.

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Trial of Conditioning Unit on New Cooling Tower

When a new 110-ton cooling tower (Marley - Model MN-3861, 330 gallons per minute) was scheduled to be brought on-line in June of 1994, the Senior Project Engineer convinced the company managers to try a non-chemical water conditioning unit. He believed this would be a good trial for the technology since it would be starting with a clean cooling tower system.

Schick selected a Connecticut vendor to supply, install and provide support for the new water conditioning unit in the new cooling tower. The unit consists of two main components: a transformer panel and a coil-pipe assembly. The transformer panel brings the line voltage down to the coil operating voltage (about 35 volts). The coil-pipe assembly contains an unobstructed replacement pipe spool, coils and electronic circuitry. Installation consisted of replacing a length of the 6@ diameter recirculating pipe with the coil-pipe assembly and connecting the transformer to a 120 volt / 15 ampere line.

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Test Results

During the summer cooling season of 1994, the circulating water in the new cooling tower system was monitored closely. (The system runs 24 hours per day during the cooling season, which is from May to November for this particular tower.) Subsequent to this first season, the vendor continued sampling and analyses to ensure that the system continued to operate smoothly. The results obtained from July 1994 to April 1999 are summarized as follows:

*** pH - started at 7.37 and slowly rose to 8.61 - easily controlled through rate of blowdown**

*** total dissolved solids (TDS) - maintained between 183 to 829 ppm - also controlled through blowdown rate**

*** total bacterial counts - maintained between 1 to 17,000 CFU/mL, as compared to the chemically controlled cooling towers which had counts between 30,000 and 100,000 CFU/mL over the same time period.**

*** observations noted no odors, no algae, water appears clear from the 1994 installation through the spring of 1999**

*** Decreased water consumption (increased cycles of concentration) as a result of decreased blowdown.**

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Lessons Learned

The new water conditioning unit maintained the cooling system in good operating condition. With minimal biological activity, no added chemicals and the typical quantity of acid rain experienced in Connecticut, the pH of the recirculating water rose with increasing cycles of concentration and plateaued at a value between 8.0 and 9.0. After start-up, the pH of the recirculating water varied between 7.37 and 8.61, with a mean value of 8.2. Schick has observed no evidence of corrosion attack on any of the components of the system.

Compared to a cooling system maintained with chemicals, a system conditioned with an electrically powered water conditioning unit needs less monitoring and maintenance. Chemically controlled systems must be monitored for several properties which can affect chemical dosing requirements. Among these are the functioning and calibration of multiple additive pumps, adequate chemical supply, heat demand on the system, incoming water quality, biological species variations, short-term ambient temperature fluctuations and blowdown rate/amount. With the electrically powered water conditioning unit, only the failure, malfunction or poor operation of the blowdown equipment affects water quality through excessive build-up of contaminants or water consumption.

The vendor helped ensure a successful switch to the new water conditioning method. Additionally, standard monitoring uncovered mechanical problems before they became apparent to maintenance personnel. For example, because the electrically powered water conditioning unit eliminated numerous variables involved in chemical conditioning, an instance of high pH and TDS in analysis results was a clear indication of a lack of blowdown. In Schick's case, this was traced back to a faulty automatic blowdown system valve.

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Employee Acceptance

The employees are pleased with the new system because it eliminates the need to work with several strong chemicals and the need for personal protective equipment.

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Economic Analysis

Schick's Senior Project Engineer states that a financial analysis calculated a payback of less than one year for the first unit. In the years since the first trial, the company has installed similar units on all of its cooling tower systems, including retrofitting existing, problematic systems. Schick reports that all cooling systems are operating smoothly with the electrically powered water conditioning units.

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Plant-wide Roll-Out

These units also work on boilers to control scale and eliminate the need for conditioning chemicals. Schick has installed units on all of its boilers, totally eliminating the use of all water conditioning chemicals. The company reports that a boiler inspection showed clean tubes and completely satisfied the insurance company which has strict requirements for boiler upkeep.

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[1] Adapted from the case study prepared by the Connecticut Department of Environmental Protection. For more information about this case study call the Office of Pollution Prevention at (860) 424-3297 or Jim Fitzpatrick of Schick at (203) 882-2497.

Note: Jeff Wilson of Schick is Jim Fitzpatrick’s replacement, after Jim left the company.