

SIDE STREAM FILTRATION – A CASE STUDY

Introduction

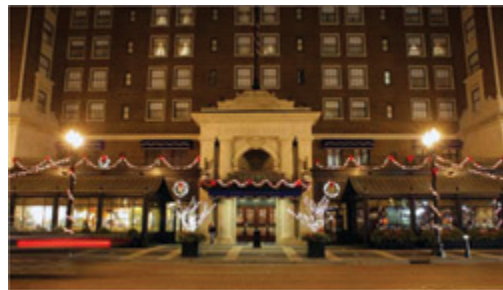
Prior to the era of the *Green Movement* and the recognition of sustainability involving energy and natural resources, proactive building managers were already addressing the initiatives to reduce electricity and water consumption. These reductions are producing a more profitable bottom-line by investing in efficient technologies. Fortunately, these practices also conform or align themselves with the requirements to meet LEED (Leadership of Energy and Environment Design) certifications and the marketing value perception associated with that achievement. Successful and measurable building energy saving techniques benefit future projects by reducing the learning curve for design and engineering teams engaged in this business environment.

USGBC (United States Green Building Council) states that buildings use 70% of the electricity generated in the United States. This usage is broken down into three major categories; lighting 33%, chiller/cooling 25%, boilers/heating 23%, and all other building uses 19%. The U.S. Geological Survey estimates that the United States uses 400 billion gallons of water per day. The operation of buildings including landscaping accounts for approximately 47 billion gallons per day - 12% of total use. Not only is the purchase of potable water a cost concern, but in most cases the fees for waste water treatment is even costlier resulting in a higher negative impact for the building operating budgets. So, the motivation is very high to find solutions and reasonable paybacks for investing or modifying building infrastructure. The primary focus of this case study involves the chillers/cooling systems and associated water usage.

Amway Grand Plaza Hotel

The Amway Grand Plaza is a 29-story, 4-star, 4-diamond luxury hotel located on the Grand River waterfront in Grand Rapids, MI. Guests are treated to an elegant Beaux Arts atmosphere straight out of the 1920s, when the hotel was named one of the 10 finest in America.

To remain competitive and cost effective the Amway Grand Plaza and their TEAM of engineers are always in the search for energy savings and being environmentally proactive. Like most major metropolitan cities, Grand Rapids water usage and energy consumption are the first things on the minds of building managers.



The Amway Grand Plaza.

Cooling towers have a great effect on water and energy consumption that are most overlooked as a potential candidate to save on operating capital. The primary purpose of cooling towers located outside the buildings are for HVAC (Heating Ventilation & Air Conditioning) applications and rejecting heat from the chillers used in process of cooling the buildings. The quality of the water has a great effect on the efficiency of the tube bundles, which are the primary interface for the heat-exchange process. Dissolved solids from the water can precipitate-out forming particles, if not remove will form an insulating barrier in the side walls of the tubes. These particulates can also settle inside the tubes reducing the thermal dynamic efficiency of the chillers and the tube coefficient, or reducing the ability to transfer heat, causing the chiller to work harder.

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Special Note - Cleaner process water is even more important now especially with the new air conditioning equipment containing refrigerant gases that do not deplete the ozone layer and contribute to global warming. These new refrigerants are less efficient at heat transfer compared to the older CFC (chlorofluorocarbons) that are banned by the Montreal Protocol treaty on January 1, 1989.

The cooling towers outside the building circulate air and water for the purpose of heat rejection. During this process cooling towers become unintentional efficient air-scrubbers, removing air-borne debris, adding more contaminants and suspended solids to the system, intensifying the problem. These suspended solids become denser as water evaporates from the towers and if allowed to accumulate, can plug the tubes of the heat-exchangers. To keep the heat transfer effective longer; chemicals are added to separate the dissolved solids out of solution, control suspended solids, and to maintain the proper pH and physical properties of the water. Once the solids reach a high density the chemicals become ineffective, it is common to flush/dilute them out by adding more fresh water and dumping the dirtier water to a drain –called a tower basin blow-down. After the new water is added, more chemicals are injected to combat the solids, and maintain the pH and physical properties of the water. It was obvious that not only high water usage was an issue, but the added expense of chemicals needed to be addressed.

The hotel management decided to seek a solution. Efrain Melendez, Physical Plant Manager, contacted Systemcore, Inc. and Mike Boyd with the Macomb Group M.E.R.I.T. (Macomb Energy Resource Integration Team) in Grand Rapids, to find a compact filtration technology that would be effective and efficient without placing new demands on his maintenance staff.

The Solution

After discussion and checking references with colleagues at hotels that faced similar challenges, Melendez selected an automatic, self-cleaning filter.

The filter similar to the one pictured below was outfitted with a 80-micron, 316L stainless steel



The installed filter is "green technology."

permanent screen and was installed in the main mechanical room of the building for all 6 towers. Compact and virtually maintenance-free, the unit was effective at filtering out suspended particles even during times of high dirt content in the air. Constructed from NSF materials, the filter is "green" technology, with a minimal footprint, low energy demand and minimal water use—less than 1% of the total flow is needed for back flushing the system. This reduces the system's water footprint; just as the filter's compact size reduces its physical footprint. Wastewater generated by the cleaning technology is cut in half compared to older scanner-cleaning technology, saving both water and sewer disposal costs.

Unlike cartridge filters, there are no cartridges elements to replace and discard, minimizing labor demands and eliminating the cost of consumables.



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In addition to the permanent screen element, the filter contains a high-efficiency (HE) cleaning mechanism, consisting of a specially designed suction scanner. HE-focused back flush technology takes advantage of simple physics using half of the water during the cleaning process compared to other suction scanner technologies.

When a preset pressure differential is reached between the two sides of the screen (typically 7 psi), an outlet valve connected to the suction scanner opens. Water and filter cake are pulled through the suction scanning nozzles at a velocity of 50-feet-per-second by the pressure differential between operating and atmospheric pressure. The scanner operates in a spiral pattern, ensuring that the suction nozzles clean the entire screen in a 16-second back flush cycle. The process takes place without interrupting the operation of flow to equipment downstream of the filter.

The cleaning nozzle and screen media are designed to allow impingement between the two surfaces during the cleaning process. The nozzle automatically adjusts itself along the screen surface to compensate for any irregularities, minimizing tangential flow and maximizing the cleaning process at the nozzle orifice.

Results

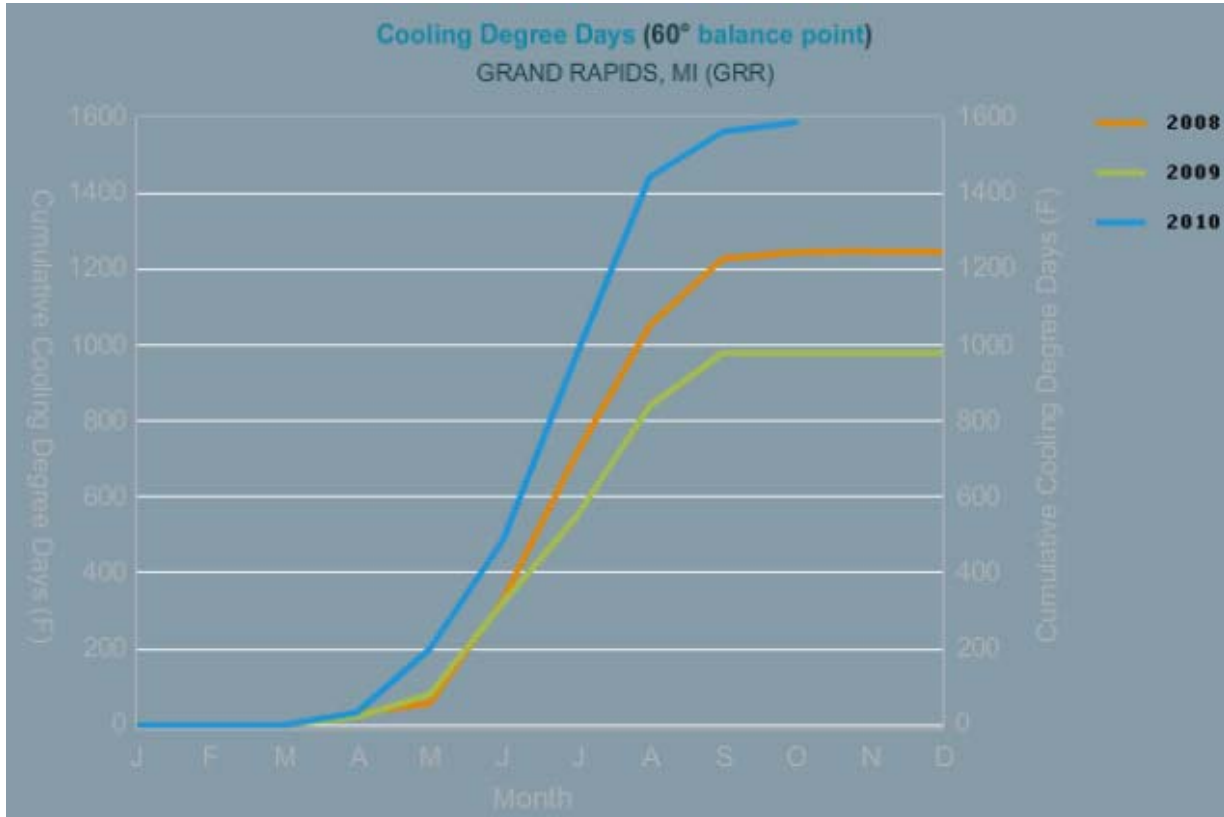
Within a month of selecting the system, the filter was onsite, installed and commissioned. Melendez is enthusiastic about the system. "Finally," he said, "a product that really works as stated by the manufacturer." The simplicity of design, cleaning efficiency and reliability based on just a few moving parts keep the system virtually maintenance-free. The savings of the new filtration system included a reduction in water, sewer, and chemical expenses. This allows for investment in other energy and environmental friendly systems while being cost effective. The improved efficiency of the system adds value to Amway Grand Plaza Hotel.

The Amway has 2676 tons of cooling operating at a rate of 300 GPM on the side stream with a total tower water flow of 5672 GPM. The Filter was installed the first of the season 2009:

SYSTEMS OPERATION SUMMARY											
UTILITY SEASONAL		2008 Pre-Filtration		2009 Post Filtration		2010 Post Filtration		Percent Reduction		Capital Recovery	
		June	July	June	July	June	July	June	July	June	July
		Aug	Aug	Aug	Aug	Aug	Aug	Aug	Aug	Aug	
Electrical (KWH)		1,676,400		1,563,600		1,646,400		4%		\$4,998.00	
Water (GAL)		2,331,516		340,340		504,900		82%		\$26,586.00	
CHEMICAL TREATMENT (GAL)		825		275		275		66%		\$14,000.00	
									2-YR Average	\$45,584.00	

Special Note:

According to the national weather data report below the number of degree days in 2010 increased by 20% for the peak seasonal period of June, July, & August, however the electrical consumption for 2010 is still 2% below the usage for 2008. This information further corroborates the efficiency gains by side-stream filtration.





APPENDIX – Drawings & Photographs

