A Traveling Solution to Cooling Tower DEBRIS

Cooling tower sump screens are intended to protect both the circulation pumps and the downstream exchangers. Using traveling screens instead of fixed screens can prevent pump repairs and heat transfer losses caused by debris.

By Michael D. Moreaux, Industrial Cooling Tower Services Inc.

In 1898, George Stocher, an immigrant from Germany, along with two other industrious young men — C.H. Lilie, a salesman, and Bill Hoffmann, an engineer — began building the first water cooling towers in the United States. Water cooling towers have evolved substantially since then to become much more efficient and cost-effective, but some common components have endured with few changes, including fixed-grate sump screens.

Cooling tower sump screens are intended to perform the dual task of protecting both the circulation pumps and the downstream exchangers from debris. However, pump failures and heat exchanger efficiency losses due to debris continue to be some of the biggest maintenance challenges faced by facilities operating water cooling towers.

Most facilities view such problems as largely inevitable. When pumps fail, few operators investigate the root cause. Their main concern is that the pump is a vital link in the process and must be returned to service as quickly as possible. Likewise, exchanger fouling has been perceived primarily as a maintenance problem that can be addressed during downtime or by back flushing or rerouting the flow through adjacent equipment (in extreme cases) while debris is removed. The vast majority of mild exchanger debris fouling problems usually are overlooked or attributed to mineral deposits, process leaks or complicated water treatment rather than process issues.

What many facilities do not understand is that such pump failures and heat exchanger efficiency problems — along with countless dollars in lost revenue and unnecessary repairs — often can be prevented through a simple change in the sump screens, which are much the same today as they were in 1898.

A Process Problem

Debris in cooling towers often is seen as a maintenance problem. However, the seemingly innocuous task of cleaning single or double fixed-grate screens is usually the very act that generates the problem-causing debris in downstream equipment. When the screens are removed for cleaning, debris lying on the sump pit bottom is stirred up (figure 1). The

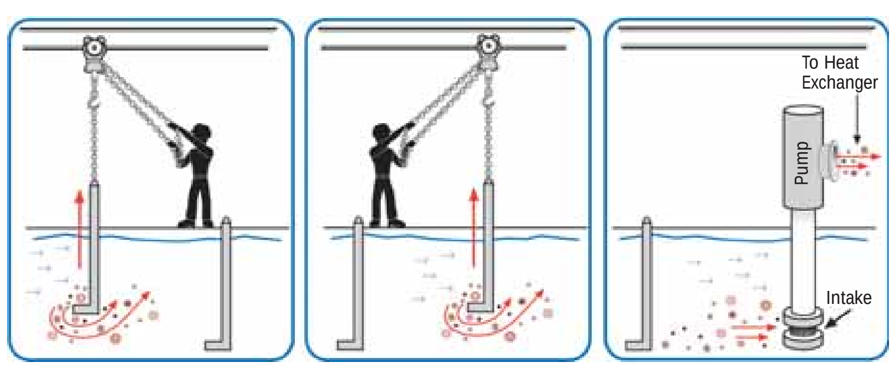

Figure 1. Cleaning traditional single or double fixed-grate screens can generate debris in downstream equipment. The absence of a pressure drop below the screen as it is lifted creates a reverse-eddy effect that pulls debris from the first screen into the second screen or suction pit (left). With double fixed-grate screens, the debris is stirred up when the second screen is removed for cleaning or periodic maintenance (center). Once the contaminants enter the suction pit, they are ground up by the pump and sent downstream to the heat exchangers (right).

absence of a pressure drop below the screen as it is being lifted creates an undertow, or reverse-eddy effect, that pulls debris from the front face of the first screen into the front face of the second screen (or directly into the suction pit in the case of single fixed-grate screens).

With double fixed-grate screens, the action is repeated when the second screen is removed for cleaning or performing periodic maintenance (figure 1). Once the contaminants enter the suction pit, they are ground up by the pump and sent on their way downstream to the heat exchangers (figure 1). Process losses and pump failures usually occur gradually, and the causes are rarely investigated. However, if the debris could be captured consistently before it reached the pump, many pump repairs and losses in heat transfer due to debris and related blockages could be prevented.

Traveling sump screens are designed to capture debris before it reaches the pump.

A possible solution can be found by looking at once-through systems, in which river or lake water is used to cool heat exchangers and then is returned either downstream or to an area located away from the intake. Such systems typically use large, traveling screens at intake sites to prevent objects such as logs, branches and fish from being introduced into the suction pumps and drawn into the system.

Traveling intake screens often use a chain-and-sprocket drive system to propel a series of individual wire mesh baskets that are hinged together by the chain drive. These screens are designed to hoist thousands of pounds of potential debris with a 360° continuous rotation when necessary. Seemingly, a device such as this could be downsized for smaller applications such as cooling tower sumps.

Engineers set out to accomplish this task, but modifying a pre-designed system to fit into the narrow openings of fixed-grate screens proved a challenge. Other design features of the entering water screens also were stumbling blocks to the effort. For example, using 360° rotating baskets for debris removal required an open area at the base of the sump large enough for the baskets to rotate; however, such an area created an opportunity for bypass to occur. Additionally, existing bar-grate screens range in size from 3' to near 20' to correspond to the size differences in cooling tower sumps. As a result, every screen had to be completely engineered for each particular sump proposed.

The cooling tower environment posed yet another challenge. How could a system that required numerous mechanical and electrical components be engineered to provide a long lifespan in such a corrosive environment?

A successful system would have to overcome these challenges, remove debris efficiently, and be easily maintained by in-plant operations personnel during routine, pre-prescribed intervals in a relatively short period of time.

A Debris-Free Tower

After research and engineering, a traveling screen was developed in which the focus is not based on lifting thousands of pounds but on protecting the process from any debris that might cause problems downstream (figure 2). Instead of 360° rotating baskets, non-bypassing 180° models are used that can be operated manually or pneumatically, depending on size and other design criteria. Screen size openings vary based on the size of the heat exchanger tubes installed at each user's particular process, as well as pressure drop and velocity issues. However, the typical size of screen openings in the traveling screen is 0.375". Mechanical bearings and other corrosive components have been replaced with parts made of plastics and composites to alleviate maintenance concerns below and above the water line.

One final obstacle that could not be changed was the customization requirement of the traveling screens. Cooling tower sump screens do not conform to any standard physical size guidelines. Instead, each screen must be custom-designed for each cooling tower. As a result, these products will not ever fit into large, mass production modes that require off-the-shelf replacement screens. However, they can be used in many water cooling towers as long as critical measurements are taken in the field and the appropriate design parameters are followed.

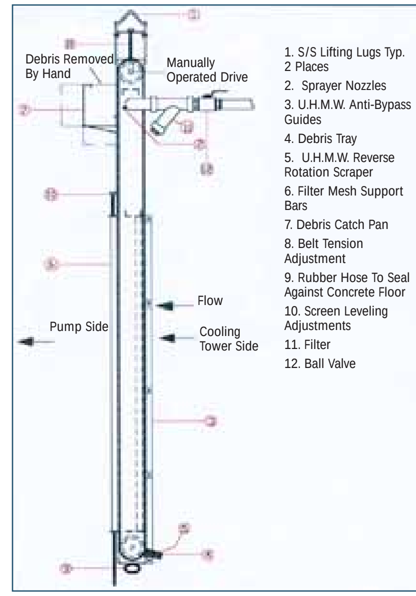

Figure 2. The traveling screen is designed to protect the process from any debris that might cause problems downstream.

Once process operators and facility owners realize that debris-induced pump failures and exchanger fouling problems are a reality, the next logical step is to investigate the cause of these silent issues. The solution may be as simple as replacing a fixed-screen design with a traveling screen. **PCE**

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