

Process Chillers & Condensing Coil Maintenance

Balancing Deferred Maintenance Risks With Maintenance and Budgetary Decisions

By Randy Simmons

As most facilities and maintenance engineers know, proper maintenance on chiller and condensing units is critical to efficient, trouble free operation. However when you combine the fact that most chillers and condensing units are situated in low traffic locations and out of sight (i.e., behind buildings, hidden behind walls, on rooftops, etc.) with the fact that the coil cleaning portion of the maintenance process is an unpleasant and time consuming task, chiller and condensing unit maintenance isn't one of those jobs that most maintenance engineers look forward to. In situations where the maintenance department is busy or understaffed, coil cleaning is likely to be deferred beyond the time when maintenance is actually required by the equipment.

“When budgetary constraints are placed on the maintenance of “mission critical” equipment, the results can be catastrophic to the business”

It is commonly known throughout the HVAC industry that even the slightest coil fouling leads to what can be described as the first level of failure which is distinguished by the following characteristics:

First level Chiller Failure (*characteristics*)

- Higher operating compressor head pressure (*caused by elevated refrigerant pressure resulting from restricted air-flow and poor heat exchange*).
- Reduced cooling capacity (*caused by poor air-flow through the coils*).
- Increased kW draw coupled with a reduction in cooling tonnage capacity
- Unit runs longer and works harder to achieve set temperature points.
- Compressor keeps cycling off and on under high head pressure. (*Compressor is being stressed under dirty coil conditions – system is overheating*).

Chillers suffering from high-head pressure conditions pass the impact along in the form of tenant discomfort, customer complaints, a reduction in employee productivity and higher energy costs. While tenant and employee discomfort manifests itself during occupancy periods, the energy penalty occurs during all hours of operation (during both part-load and full-load operation). Unless you monitor the chiller kW draw with an energy management system or with a separate metering device, you will most likely learn about the problem when it's hot and you are unable to maintain chilled water and/or environmental temperatures, when you see your energy consumption sky-rocketing or when your compressor fails.

In process cooling applications where a chiller supports production, fouled coils have other ramifications such as the overheating of production equipment which can cause product quality problems and even failure of the equipment, (*e.g., process computer control equipment, robotic welding systems, injection molding systems, press equipment, etc.*) bringing production to a grinding halt.

Consider this real life situation:

A 20 ton chiller used to cool a computer control room of a major automotive parts manufacturer becomes fouled and is in need of cleaning; but because the maintenance department was short handed, they didn't have the time to perform the maintenance when it was needed hence; maintenance was put-off for an unspecified period of time. Eventually, the debris load completely fouled the chiller coils resulting in a second level of failure which had a catastrophic impact on the business:



Split Coil System with a Dirty Inner Coil

Second Level Chiller Failure (characteristics & cost implications)

- The compressor failed
- The computer room experienced computer failure due to overheating and the company was forced to replace the failed computer equipment while running production at reduced capacity until the chiller was back on-line.
- Procurement of the new compressor took 2-days and resulted in two days of downtime and lost productivity on three computer controlled production lines resulting in a \$500,000 per day production loss (Note: lost production cost will vary depending upon product and production process).
- Management sent home production workers with full pay and benefits until the chiller was back up and running. The company paid production workers for lost productivity.
- The company missed shipments resulting in customer dissatisfaction.
- Compressor replacement cost - \$7,500
- Compressor installation cost - \$4,000
- Production equipment start-up cost \$10,000 (includes the cost of raw material waste resulting from make-ready and production line start-up).
- Coil Cleaning Cost: \$1,500

As you can see, if the coil cleaning and maintenance had been performed before the first level of failure, it would have only cost \$1,500; however because it was deferred and operation continued until the second level of failure, the costs associated with the second failure level wound up costing the parts manufacturer over \$1,000,000.

Now you might be wondering why there wasn't a back-up unit in place for this mission critical application. Well, the fact is the "back-up" consisted of spot coolers that were moved around the computer room to vital locations, but the spot coolers were only used to augment the cooling when needed – they weren't designed for the full load of the computer room. So the question still stands – where was the back-up chiller? The answer is - they didn't have one. This particular operation had converted their mechanically controlled production equipment to new computer control

systems and as a result, the computer room supported by the chiller took on additional cooling loads and greater strategic significance to the business. Even though the computer room had both computer and electrical back-up systems, the cooling system had not been upgraded and was the *Achilles Heel* of the production facility. Preventative maintenance should have been of vital importance in this facility.



*Coils Severely Fouled With
Cottonwood Seed*

Why Companies Defer Maintenance on Chillers and Condensing Units.

There are many reasons cited by facilities and maintenance directors; however it's important to keep in mind that regardless of the reasons, when equipment is in need of maintenance, deferring it for any reason will not change that fact. Do any of these reasons sound familiar?

- **Budgetary Constraints** – *“We’ll put-off the maintenance until next month so we don’t go over budget”*. When you consider all of the risks to a business associated with a system failure, deferring maintenance due to budgetary constraints is not usually a sound decision. When budgetary constraints are placed on the maintenance of “process and comfort critical” equipment, the results can be catastrophic to the business.
- **Man Power & Time Constraints** – *“We’ll get around to cleaning the chiller as soon as we can – we have too many other things to do right now”*. This reason for deferring maintenance is more common today than ever before. Why? Because companies have been forced to reduce staff and streamline operations to conform to the economic realities of the business, or cannot find

qualified personnel. This places additional demand on maintenance engineers because they now have to do more with less. If chillers and condensing units support mission critical operations and facilities, then maintenance of those systems should be near the top of the TO DO LIST even when the maintenance department is busy or short handed. To help improve maintenance efficiency and reduce the time required for performing the maintenance task, the maintenance should be outsourced to a reliable service company or technologies such as air intake coil filters should be evaluated. In short, investment in technologies that can optimize operational efficiency and reduce the maintenance effort should be considered in lean maintenance staffing situations.

- **Maintenance Complexity and Knowledge Constraints** – *“Maintaining this equipment is very difficult - we don’t have the skills to maintain it correctly”*- this reason is especially common in companies using advanced mechanical systems. Maintenance workers must be trained to properly maintain them or, the maintenance work should be outsourced to a service company that is knowledgeable with the maintenance process.
- **Unfriendly Maintenance Process** – *“We hate cleaning chiller and condensing units because it’s a dirty job – we get dirt and debris all over us when we power wash the coils – we’ll clean the coils later”*. Although cleaning coils are in fact a dirty job, it is not a sound reason for deferring maintenance. When cleaning coils, proper safety equipment including eye and respiratory protection, rubber gloves and protective outerwear should be worn to protect against coil cleaning chemicals and possible mold or bacteria problems that can pose a health hazard. As an alternative, air intake filtration systems that isolate the debris on the outside of the coils where it is visible and easy to clean using an ordinary broom, brush or shop vacuum can reduce the “hassle factor” associated with this important maintenance task.



Air Cooled Chiller & Condenser units shown with coil filters that isolate debris on the outside of unit for quick & easy cleaning. Coils stay clean all season long.

The list of reasons for deferring maintenance can go on and on but one thing is clear, deferring maintenance on HVAC equipment can be risky and can increase the odds that a system failure will occur; and when it does, it will usually cost more than the cost of the maintenance that could have prevented the failure in the first place.

In the end, the decision for performing or deferring maintenance on HVAC systems fall squarely on the shoulders of the maintenance and facilities directors as they balance their maintenance and budgetary decisions, recognizing all the risks involved.■

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