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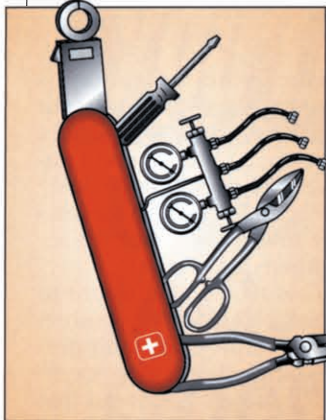


Coil Cleaning: MYTHS AND MISREPRESENTATION

William M. Dillard and Justin S. Salmon

When you discover severely restricted air flow through a coil during normal service, it may be time to suggest a replacement, since attempting to clean such a coil may only make matters worse.

A Case Study

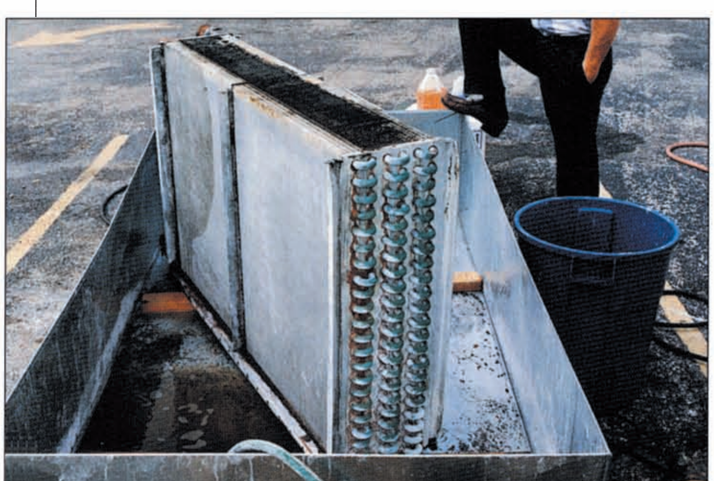
We've long touted the benefits of coil cleaning to our customers. It's only been in the last three to four years that we've questioned the validity of the processes we'd gone through to clean their coils, tested for results, and come up with some surprising conclusions.

First let me state that we've tested a wide variety of coil cleaners, and for extreme cleaning, we now use an industrial pressure sprayer/boiler that supplies 180F water to apply such cleaners.

In this case, our customer was getting repeated complaints from tenants that there was "black stuff coming out of the vents." It was a recurring problem that a number of other contractors had attempted to correct.

Our Environmental Services Group re-cleaned the coils (25 sq. ft., 4 row) using 180F water and an aggressive new coil cleaner we'd been wanting to try. We had our technicians collect all the water in a 55-gal. drum, decant the mixture and strain the residue through a standard paint strainer.

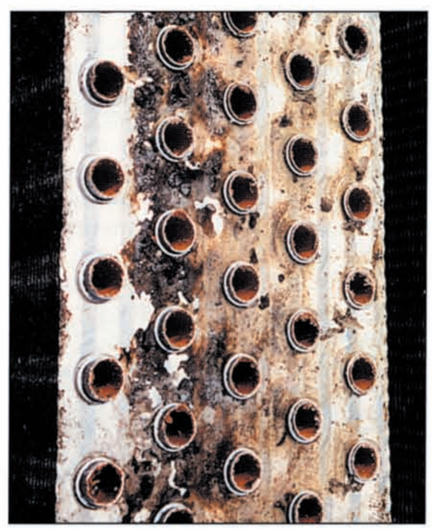
The result was about 1 lb. of sludge that looks remarkably like the material that was landing on the desks of people at the end of the line served by that air handling system. Under the microscope at Grove Scientific (an Industrial Hygiene Group we partner with) we could see vibrant life in what should have been sterile sludge after being blasted with 180F water and coil cleaner. What's the bottom-line? In cases where coils have been neglected, it's often far cheaper to replace them than to try to clean them.



When this coil was removed from service, an interior packed with dirt and grime was revealed, despite hours of cleaning effort.

Why? Because we simply aren't getting coils clean with traditional coil cleaning strategies.

No matter how good the coil cleaner, no matter how good the sprayer used to apply the cleaner, what we've really been doing is "packing" the coil with organic and biologically active matter. The packing process occurs using the traditional cleaning methods (which include applying coil cleaner according to manufacturer's recommendations and then using a high-pressure sprayer/boiler to wash the particulate out of the coils.



Dissection of this coil, after it was removed from service, revealed excessive internal contamination. It appears that previous cleaning efforts had little effect, reaching only an inch or so into the coil.

Many sources advise cleaning the coil from one side to prevent this packing but modern fin design can severely restrict the effectiveness of the pressure sprayer beyond about one inch into the coil. Better "visible" results are obtained by cleaning from both sides, but unfortunately, this often packs the particulate further into the coil interior causing an increase in the air pressure drop through the coil.

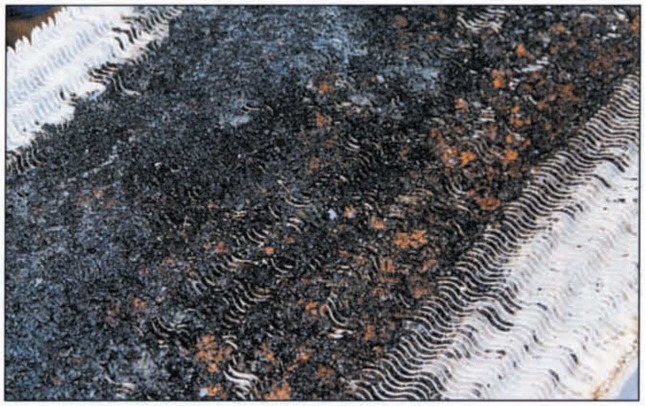
How do we know? We simply use basic National Environmental Balancing Bureau NEBB test and balance procedures to measure air pressure drop and air volume across the coils and compare them with factory conditions. In coils that have been poorly maintained, the pressure drops consistently exceed the manufacturers ratings indicating the packed conditions we've confirmed by dissecting such coils.

When the material still resident in the coils is tested, it's almost always biologically active — meaning it's alive with multiplying organisms that live and grow in that wonderful, nutrient-rich, wet atmosphere known as the cooling coil.

That kind of research has driven us to a higher standard when attacking this problem.

In order to determine the condition of the coil, it's necessary to measure both the pressure drop and the airflow through that coil (a dirty coil will exhibit a decrease in air volume and an increase in pressure drop). Then, a simple calculation to predict pressure drop at design air volume will complete the picture.

To illustrate this, let's imagine a coil designed for 4,000 CFM at .4-in. WG pressure drop. Your test measurements indicate only 3,000 CFM (25% low) at .5-in. WG (25% high). Neither of these results looks too serious, but using the fan law formula:



Full-strength coil cleaner applied to the surface of cooling coils then flushed with high-pressure hot water will result in a coil that appears to be clean, but may actually be a hotbed for microbial growth. Increased pressure drop and reduced air volume through such coils is a red flag that says it's time for a replacement.

$$\frac{SP2}{SP1} = \frac{(CFM2)^2}{(CFM1)^2}$$

where CFM2 = 4,000, SP1 = .5-in., and CFM1 = 3,000 CFM

The result is that SP2 (the static pressure that it would take to push the design air volume through the dirty coil) equals =

$$\frac{4{,}000 \times 4{,}000 \times .40}{3{,}000 \times 3{,}000}$$

which = .71 in., more than 1.75 times the design pressure drop.

A Time To Change

Based on the above, and our hands-on coil cleaning experience, if your calculated pressure loss for a cooling coil that's over four rows in thickness is in excess of 1.5 to 3 times the factory ratings, it's time to consider a coil change. Why? Simply because you're not going to get that coil clean with presently known cleaning procedures.

You've reached the point where the labor cost to attempt cleaning such a coil is likely to exceed the cost of materials and labor to replace it. And, chances are your efforts to clean it will fail anyway.

What about all the claims by the producers of coil cleaning products regarding those products' ability to clean such surfaces?

If properly maintained and regularly cleaned with coil cleaners and hot water, a coil's interior as well as its exterior can be kept clean. The bubbling action of foaming cleaners can actually lift the dirt from the coil's interior.

We've removed contaminated coils, soaked them in various coil cleaners (overnight) and were still unable to remove the "packed" biological mass from the interior fin surfaces. (see the accompanying photos)

This article isn't meant to attack coil cleaning product manufacturers, or their performance claims. Our experience merely points out that the accepted industry cleaning procedures aren't adequate in cases where coils have been neglected. Depending on the environment that cooling coils operate in, a coil doesn't have to be very old before it requires replacement versus standard cleaning procedures.

What We've Learned

What have we learned from all our research?

First, good coil cleaning procedures have to start when coils are put into operation, not two or three years down the road!

Second, in cases where the pressure drop exceeds 1.5 to 3 times the rated capacity, it's time to estimate a coil replacement. If you complete the estimate and you're still not sure of the economics in the cost of the fan energy required to deliver air at the new pressure drop, remember that increasing the pressure drop through the coil dramatically increases the amount of fan energy required to deliver the designed air quantities.

By suggesting a changeout when coils become impacted, you'll be doing your customer a tremendous favor because he/she will be saving both energy and improving the indoor environment. And, after you've changed that coil, don't forget to upgrade those filters — after all, that's the primary reason you had to change the coil in the first place. CB

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YOU'LL WANT TO KNOW

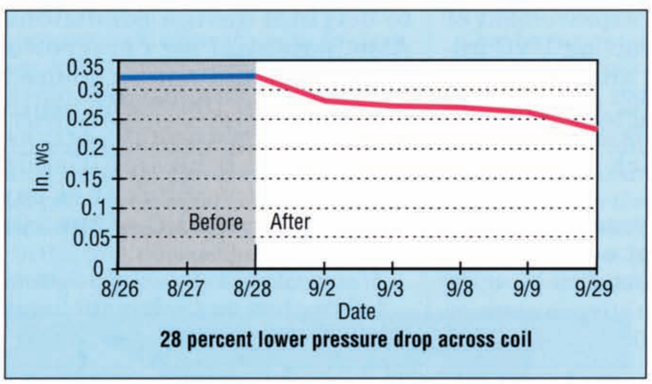
UVC Lights Enhance IAQ, Reduce AHU Operating Costs

CITY OF INDUSTRY, CALIF.—Southern California Air Conditioning Distributors (SCACD), the world's largest Carrier distributor, wanted to investigate additional indoor air quality (IAQ) improvement methods in its 30-year-old administrative facility located here. According to Bruce Fuhrmann, commercial manager for SCACD, he knew from visual inspections that there were typical accumulations of dirt and mold around the cooling coil and drain pan in the central station air handler. He believed that this condition might be the source of non-specific odors in the building and knew it was impeding heat transfer efficiency.

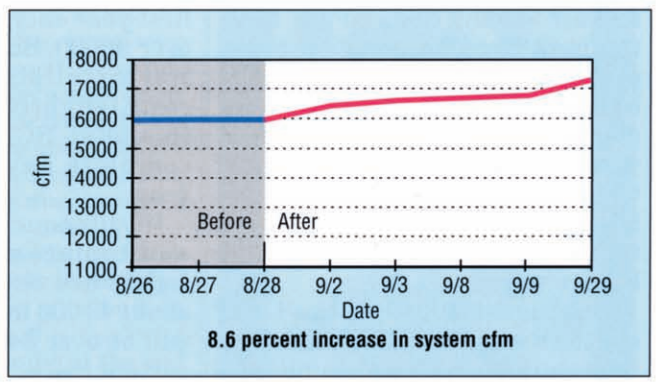
Fuhrmann had heard that a new, high-output UVC light source designed for HVAC applications was being marketed specifically for these problems. He had also heard about this product's ability to degrade accumulated organic materials, so he decided to try it and evaluate the results.

SCACD had another reason for testing the UVC Emitter™, manufactured by Steril-Aire, Inc. If it worked, SCACD would market the device to the engineering community and commercial and residential customers through its network of contractors and dealers. Before taking that step, they needed to be sure that the device worked as claimed.

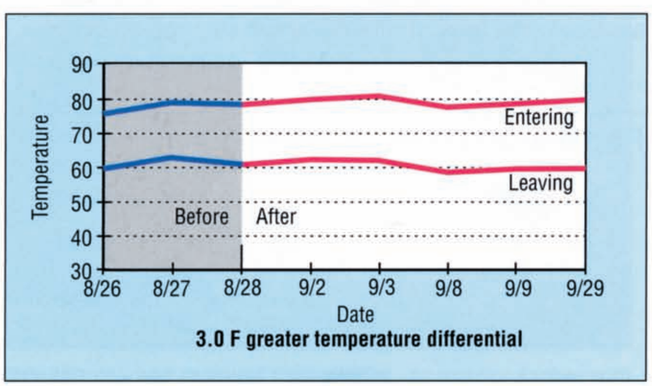
The product is a multi-patented, germicidal device that uses a newly developed combination of tube construction and



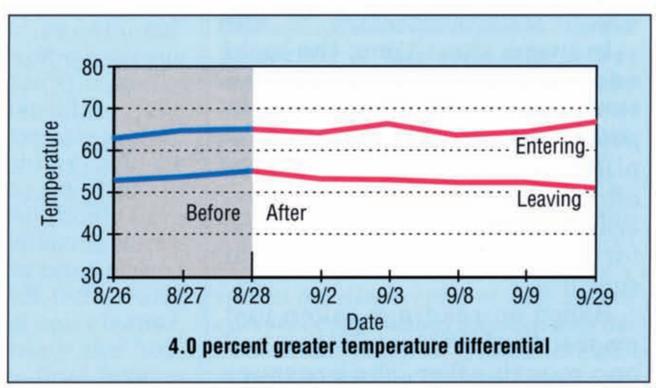
1 Cooling coil pressure drop (DX).



2 System air flow.



3 Dry bulb temperatures.



4 Wet bulb temperatures.

matched solid-state power supply to eradicate mold, bacteria, viruses, and other pathogens that grow and circulate in HVAC systems. The Steril-Aire device operates at peak efficiency in the cold and/or moving air environments of air handling systems—a major breakthrough in artificial UVC production and bioaerosol control. It also breaks down organic materials, including volatile organic compounds (VOCs) and other odors. SCACD also selected this product because its performance was independently tested and selected by NIOSH on behalf of the Centers for Disease Control (CDC) for efficacy testing of tuberculosis in HVAC air streams.

Prior to installation, microbial sampling was performed on and around the cooling coils and drain pan. Laboratory testing on the samples showed average to high counts of mold and bacteria growth. Also, pressure drop readings across the cooling coils were recorded, along with air entering and air leaving dry and wet bulb temperatures, to determine the system's existing capacity. According to Fuhrmann, these steps established a baseline that would enable him to determine whether any of the system's existing performance characteristics would actually change and by how much.

The UVC emitters were installed according to manufacturer's recommendations. The lights were easily installed in the 16,000 cfm constant volume DX system.

In just a short time, the mold and bacteria in the system and the associated odors disappeared. Identical microbial sampling gathered only a few days after installation verified an average 99 percent drop in colony-forming units over the original samples.

Based on readings taken just prior to the UVC installation and one month after, the pressure drop across the cooling coil decreased by over 30 percent (Fig. 1), while system air flow went from 16,000 to 17,400 cfm; an 8.6 percent increase (Fig. 2). Wet and dry bulb coil leaving temperatures also dropped (Fig. 3 and 4), thus providing a greater temperature differential between entering air and leaving air. This combination of factors has brought about an increase in capacity.

Because the rejuvenated coils allow more heat transfer and air volume, SCACD is enjoying a 30 percent increase in total system cooling capacity from 548,502 (prior to UVC installation) to 797,094 Btu. SCACD has since performed monthly testing for nearly a year, and every result is equal or better, thereby maintaining the increased capacity.

Because of these operational improvements, SCACD reports an improvement in energy efficiency. Based on a conservative 3000 annual operating hours, an energy efficiency ratio (*EER*) of 8, and an energy cost of $0.10 per KWH, the company is close to realizing a first-year energy improvement of over $5000. Subtracting UVC initial installation and operating costs (slightly over $5000) from this total, SCACD anticipates a complete payback in the first year.

In subsequent years, operating and replacement costs for the lights are expected to be only about $1000 annually, so savings will be over $4000 per year using current costs.

Fuhrmann noted that when the lights were installed, the IAQ and health aspects were of prime consideration. And while the devices have definitely enhanced air quality in the building, he was impressed with the operational benefits. The device's ability to increase system performance to almost "as-new" levels is expected to prolong the life of the mechanical equipment, and the increase in capacity is a much-needed advantage, given the current occupancy of the building.

Savings can manifest themselves in several ways, depending on operating conditions, stated Fuhrmann. In SCACD's case, it was able to eliminate the costs of adding supplemental cooling, and the cost of replacing the entire unit. For others, it can reduce the compressor and fan run-time of a DX system, or allow chilled water users to raise their chilled water temperature back to original design conditions. Also, potential air horsepower savings should not be ignored, especially for those who utilize variable frequency drives. These can all be significant, hard-dollar savings that can continue for the life of the system.

Information and schematics courtesy of Steril-Aire Inc. www.steril-aire.com

