NADCA
DucTales
MAY/JUNE 2005
Vol. 17, No.3

VOLUNTEERS
The Key to NADCA's Strength

Commercial Coil Cleaning:

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A Case History

Facility managers and HVAC engineering supervisors have limited budgets to handle all maintenance and repair needs. As a result, some Air Handler Units (AHUs) containing coil systems 6 to 12 inches thick or greater can become severely blocked. As an alternative to expensive coil replacement, we have developed methodologies that can restore original airflow and pressure drop characteristics. This paper examines a case study of 20 AHUs in a research facility located in St. Louis, Missouri.

An article entitled "Coil Cleaning: Myths and Misrepresentation" appeared in the 2003 September/October issue of DucTales, questioning the validity of coil cleaning methodologies for AHUs containing 6-inch thick (or greater) coil surfaces exhibiting pressure drops exceeding 1.5 to 3 times their original specifications. While we agree with the authors' recommendation for an aggressive preventative maintenance program including coil cleaning on an annual basis, we take exception to their conclusion that when actual pressure-drops nearly double their original specifications it is time to change out the impacted coil. Methodologies do exist that significantly reduce pressure-drops, increase airflow, and efficiently remove impacted materials from the core of 6-inch, 12-inch, or greater sized coils. In addition, there could be significant savings on utility expenses to the building owner.

Professional Abatement Remediation Technologies (PART), a member of NADCA with three ASCS certified project leaders on staff, provides HVAC system cleaning (including ductwork) to commercial clients and specializes in serving healthcare, food and drug manufacturers, and research-oriented facilities. Based on our years of experience, association with other NADCA member companies, and the guidelines and procedures recommended by the NADCA ACR 2005 we typically clean coils using a high pressure (1000 psi) approach.

Three years ago, Washington University School of Medicine (WUSM) hired PART to clean several 12-inch thick coils experiencing pressure drops 2 to 3 times their original specifications. When an independent engineering firm observed little-to-no improvement in pressure drops after a standard high pressure treatment, we modified our procedures to a low pressure, high volume approach, resulting in measured pressure-drops characteristic of their original specifications. Effective coil cleaning and a redesign of the AHUs serving this building resulted in a 30 to 40 percent savings on utility bills for WUSM.

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BACKGROUND

Figure 1: Air Handler Unit—Each AHU is designed to provide approximately 20,000 CFM of conditioned air to a space containing a volume of approximately 80,000 cubic feet, thus creating 15 air exchanges per hour or a fresh air turnover every four minutes.

Many of PART's clients include healthcare facilities and research institutions where indoor air quality (IAQ) requirements are given a significantly higher priority than in most other commercial environments. However, they also experience budgetary constraints and personnel shortages that handicap their ability to handle all preventative maintenance program requirements for all their facilities and equipment.

One of our more proactive clients is WUSM in St. Louis, Missouri. Their Clinical Science Research Building (CSRB) is a 10-story facility, housing medical research laboratories, offices, and animal facilities; it was built approximately 20 years ago. From an HVAC perspective, the building is divided in half (A and B sides) with a different AHU serving each side of the floor.

Each AHU is designed to provide approximately 20,000 CFM of conditioned air to a space containing a volume of approximately 80,000 cubic feet, thus creating 15 air exchanges per hour or a fresh air turnover every four minutes. The dimensions of a typical CSRB AHU are 25 feet long, 10 feet wide, and 8 feet high (shown in Figure 1). Each AHU contains three distinct coils (reclaim, heat, and cooling) and is compartmentalized as designated in Figure 2.

A 12-inch thick reclaim coil is positioned between a pre-filter compartment composed of 2-inch pleated sheet filters (MERV 6) and a bank of high-efficiency filters. With only a 2-inch pleated filter between the reclaim coil and fresh air, significant amounts of particulate deposits accumulate on the upstream side of the reclaim coil.

About four years ago, WUSM's engineering and HVAC departments were facing a serious air pressure/ventilation problem in the CSRB building. An independent engineering firm was hired to measure pressure drops and airflow across each coil within all 20 AHUs. Their analysis, taken during the summer of 2000, indicated the second and third coils in the airflow sequence (see Figure 2), the heat coil and cooling coil, respectively, were operating at levels similar to those at the time of installation. However, 16 of the 20 AHUs (80 percent) demonstrated a pressure-drop increase of greater than or equal to 1.5 times the original designed pressure-drop (0.8–1.0 inches) across the reclaim coils.

Furthermore, five of the reclaim coils (25%) exhibited pressure-

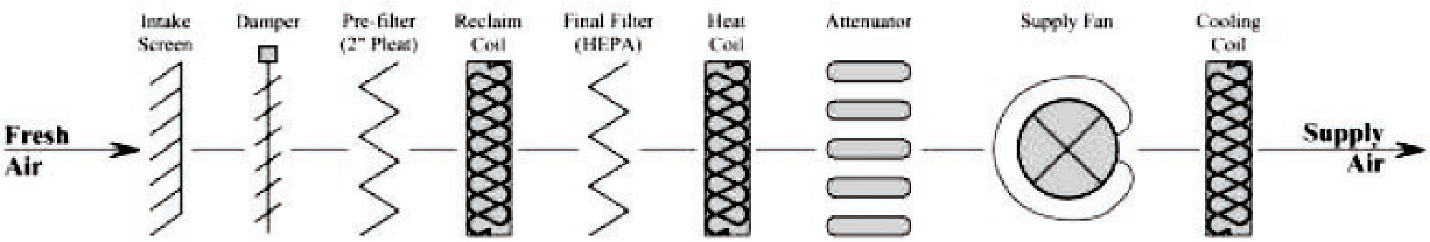

Figure 2: Air Handler Unit Flow Diagram

drops greater than 2.0 times their originally designed pressure-drop. In the fall of 2001, WUSM contracted PART to clean the reclaim coil of AHU 3B. The pressure drop across this coil was remeasured and the resultant pressure drop was reduced from 2.68 inches to 2.16 inches as shown in Table 1 – Airflow and Pressure- Drop.

This pressure variation is almost within the limits of statistical accuracy of the monitoring equipment and suggests that standard operating procedures for coil cleaning, using high pressure washing methods, were not effectively removing the particulate residue blocking airflow within this 12-inch thick coil matrix.

PROCEDURES

Hundreds of variations of Coil Cleaning exist, varying in temperatures, pressures, and chemicals used; however, the following main steps are involved:

High Pressure Coil Cleaning Step Procedure

Step	Procedure
1	HEPA vacuum coil surfaces on both sides until all visible debris is removed.
2	Pre-wet coil with a high pressure stream of water and apply coil cleaner.
3	Allow a 10- to 15-minute "dwell time" for the cleaner to break down particulate aggregates.
4	Power wash and rinse with pressures up to 1000 psi until no further debris is released. Water temperatures used varied from room temperature to 55°C.
5	Repeat steps 3 and 4 from both sides of the coil until no visible debris or black particulate sludge is being released from the coil.

Note: For a typical 12-inch thick coil, this procedure usually requires 4 to 6 hours for a 2-person crew to complete.

Low Pressure/High Volume Coil Cleaning Step Procedure

Step	Procedure
1	HEPA vacuum coil surfaces on both sides until all visible debris is removed.
2	Pre-wet coil from both sides using a standard 3⁄4-inch garden hose and nozzle (set to a straight stream approximately 100 psi). Apply water (predominantly from the downstream side of coil) until a stream is observed coming through the opposite side (approximately 20 to 30 minutes).
3	Apply cleaner to both sides of coil and allow a 10- to 15-minute dwell time. We prefer a KOH concentrate manufactured by PUMA Chemical Company. Dilute one part of the cleaner with four parts water and apply 2.5 gallons to each side of the coil with a Hudson sprayer. A thorough pre-wetting enhances the cleaner's ability to penetrate and be distributed more efficiently within the matrix of the coil.
4	Using a garden hose, rinse until water released from opposite side is clear. Always begin rinsing from the downstream side; assuming the upstream side of the coil contains a higher concentration of particulate located closer to the surface.
5	Repeat steps 3 and 4 until the full volume of water released in the flushing step con

Note: For a typical 12-inch thick coil, this procedure usually requires 8 to 16 hours for a 2-person crew to complete.

OBSERVATIONS

On October 8 and 9, 2001, we recleaned the reclaim coil on AHU 3B using the low pressure/high volume procedure listed below. Our staff observed the release of large amounts of black and rust colored particulate sludge during the first several hours. We continued this process from each side of the coil until no further debris was released. At this point, we observed that water flowed through the entire coil with minimal loss of pressure and exited the coil almost directly across from the point of application.

Approximately one week later, the same engineering company was brought in to remeasure the pressure-drop and airflow across the reclaim coil of AHU 3B (results shown in Table 1, Column 3). Their results indicated that airflow dynamics across this coil had been restored to specifications similar to those originally achieved after initial installation of the air handler unit. A few weeks later, this process was repeated for AHUs 9A and 9B, resulting in similar improvements to airflow and pressure drops (Table 1).

When using the "High Pressure" method, our staff observed that even at the end of our cleaning process, very little, if any, of the water applied by power sprayer to one side of a thick coil would even trickle out of the bottom of the opposite coil side.

Most likely, the high-pressure approach may clean the first inch or so in from each side of the coil; however, particulate located in the central portion of the coil remained. Even worse, the high-pressure strategy may be compressing and packing the remaining particulate debris in the central core of the coil.

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Saves Time and Money

Once a thorough "high volume" cleaning has been performed, preventative maintenance cleaning each year should require less time and cost

Table 1: Airflow and Pressure Drop

Air Handler Unit	Pre-Cleaning	High Pressure Cleaning	Low Pressure/High Volume Cleaning
3B			
Airflow	NA	15,249	18,536
Pressure Drop	2.68	2.16	0.59
9A			
Airflow	NA		20,699
Pressure Drop	3.24		1.46
9B			
Airflow	NA		17,375
Pressure Drop	1.54		0.96

Test results measured by McClure Engineering Associates, St. Louis, MO.

HIGH VOLUME/ LOW PRESSURE CLEANING BENEFITS

We have mentioned some of the cost and performance benefits derived from an efficiently operating coil system and AHU; however, there are some additional benefits a well cleaned and rinsed coil system may provide. Since conventional "High Pressure" cleaning has been shown to leave a residue of sludge inside the coil matrix, we can assume deposits of chemical cleaning agents can also be trapped in this matrix sludge. Several types of cleaners (especially acidic formulations) can be abrasive to coils, causing damage to metal surfaces, rusting of Fe++/Fe+++ containing metals, and oxidation of aluminum fins. In addition, low pressure cleaning eliminates mechanical damage to the coil fins. Once a thorough "High Volume" cleaning has been performed, preventative maintenance cleaning each year should require less time and cost.

CONCLUSION

Methodologies do exist to effectively clean severely restricted thick coils in commercial sized AHUs. Equipment requirements are minimal; however, labor requirements are significant. Compared to the cost of coil replacement, the savings are substantial.

Based on our success with the reclaim coil in three of the AHUs, WUSM commissioned PART in the spring of 2002 to clean and disinfect all surfaces and coils inside each of the 20 AHUs. Following this work, WUSM retrofitted the control systems and balanced each AHU. A year later, in the spring of 2003, PART met with WUSM's power plant manager who informed us that as a result of our work and re-engineering of the 20 AHUs in the CSRB building, their use of steam for heating the building was significantly reduced. We are informed that savings from WUSM's utility bills will pay for PART's work and the engineering retrofit in just over three years. ■

ACKNOWLEDGEMENTS

The authors wish to thank those individuals who have provided their time, information, and resources to support this project. This includes Tom Brandt, Randy Hensler, Jim Ide, and Jim Stueber (Washington University School of Medicine), as well as Erich Blaufuss (McClure Engineering Associates).

Washington University School of Medicine in St. Louis does not endorse commercial products.