**Effective Maintenance of
Filtration Systems (part2)**
*by C.H. Gordon*

*In part 1 of this article we discussed the "common type of filters; understanding efficiency terminology; service procedures for air filtration systems and specific instructions for servicing air filters". Part 2 will inform you about "specific instructions for types of filters; time standards for servicing major filter types; modifying and upgrading filter systems; what to do when filtration has not been maintained and conclusion - the pay-off."*

**Specific instructions for types of filters**

**Roll Renewable Media**

Roll media filters come in a variety of media constructions and resulting efficiency characteristics that allow their use as a prefilter, used alone as the principal filtration device, or to retain agglomerated dust from electrostatic precipitators. The distinguishing feature roll media filters have in common is the use of two spools on either side of the plenum, advancing clean filter media as the used media reaches its final resistance, just as film is advanced in a camera after taking a picture.
The media usually is marked for the last few feet of the roll to show that a clean roll will be needed soon. Some models have a media runout switch actuated through an arm resting on the clean media roll. When the supply is exhausted, this switch opens the circuit, stopping the drive motor and turning on a warning light.
To change media rolls, first the old roll must be advanced to run off the remaining media onto the rewind spool. Then the drive switch must be moved to the off position. Remove the used roll and store in carton for removal and final disposal. Take the empty spool from the supply side and put it into the rewind side. The new roll will be covered with a paper wrapper. Leave this on until the roll is completely in place, as it keeps the media from unrolling as the roll is on a spool under tension.
After placing the new roll in the metal media, cover; and assuring that all pins, slots, latches, etc., are in proper position, remove the paper wrapper and unwind the media to the rewind spool. The media must rewind spool into the drive socket. Install the keeper.
Engage momentary contact switch and test operation by allowing rewind spool to make two revolutions. The filter should now be ready.

**Activated Carbon Filters**

The primary task in servicing activated carbon filters is to replace the odor-saturated carbon with new carbon. The trick is to know when to replace the carbon, since pressure drop and visual methods are meaningless. Waiting until objectionable odors become noticeable is not recommended. Most activated carbon units are constructed of a number of metal trays filled with activated carbon and stacked like building blocks with alternate ends sealed together by a gasket so that the entire surface of all the trays is presented to the air stream. The number of trays required is a function of the amount of carbon per tray and the velocity of the air flow. Typically, as few as six trays containing 2.5 pounds each would be required for 500 cfm at a velocity of 250 feet per minute. A large bank for 36,000 cfm at 500 feet per minute would require 432 trays of 3.75 pounds of carbon each.
One obvious solution is to have extra trays on hand at all times. This allows exchanging a fresh tray for one in service so that it may be laborary tested to predict remaining useful life of carbon. Some manufacturers will perform the test at no charge. If the useful life remaining is sufficient, new trays may be exchanged for old, a few at a time so that not all trays must be renewed at once. Carbon, available in bulk or trays, may be returned to the manufacturer for renewing.
Some carbon filters units are front-opening and some are side-opening. In either case, the trays slide out and are resealed by gaskets.

**Electronic Air Cleaners**

Agglomeration with Disposable Collector Media: The more modern electronic air cleaners for large installations employ the agglomeration principle. This means that dust particles build upon the collection plates until they break off in larger chunks and are carried downstream to the collection media, which may be bag filters or roll media. The pressure drop across the filter bank gives the cue for removal of soiled media. Standard servicing procedures are followed for the particular media type.
*Household Size Electronic Air Cleaners:* The typical electronic cleaner for household use fits into an air plenum register or duct. The entire collector unit slides out and may be washed in a conventional dishwasher.
*Electrical/Mechanical Servicing:* Besides the agglomeration collection media, all electronic air cleaners have two components in common that require periodic maintenance: the power pack, and the ionizer section.
The power pack is a rectifier that supplies high voltage DC current to ionizer wires and plates. It should be checked regularly for proper operation.
The ionizer section should also be checked frequently to confirm proper operation. When operating property, the wires will be surrounded by a corona visible in the dark as a pale blue glow extending the full length of the wires. The corona is evidence of ionization and the absence of the corona may indicate low voltage or dirty wires. Short circuits will show up as arcs and tripping of the circuit breaker. Broken ionizer wires should be replaced immediately. Occasionally it will be necessary to wipe down or brush dust from ionizer wires, struts, and plates.

**Time Standards for Servicing Major Filters Types**

Time allowances or standard times, which can be applied with confidence to maintenance operations, are very valuable in planning and analyzing work requirements. The following time allowances are a combination of observed or experienced times for performing filter service work under average conditions. They should be attainable by any reasonably well-trained mechanic with proper tools and instructions.

|  |  |
| --- | --- |
| *Filter Type and Operation* | *Unit Service Time* |
|  |
| Permanent Metal Panel Filters |
| - Remove and replace- Wash, dry, and recoat | 0.75 minutes each4 minutes each |
|  |
| Permanent Foam Panel Filters |
| - Remove and replace- Wash and dry | 0.75 minutes each2 minutes each |
|  |
| Disposable Panel Filters |
| - Remove and replace | 0.75 minutes each |
|  |
| Replaceable Media/Metal Frames |
| Open frame, remove, replace and close | 1.5 minutes each |
|  |
| Extended Surface Media Filters up to 24"x24"x36" |  |
| Remove and replace | 1 - 2 minutes each |
|  |
| Roll Renewable Media up to 8 ft width |  |
| Remove and replace | 45 - 120 minutes per roll |
|  |
| Activated Carbon Filter |
| Remove and replace trays | 1.5 minutes each tray |
|  |
| Electronic Air Cleaners |
| Agglomertor type: See renewable Roll Media Removable Collection Unit: |
| Remove and replaceWash in place collection chambers | 4 minutes each |
| Wash, rinse and spray on adhesive | 30 minutes each |
|  |

**Access Time Allowances**

An allowance must be added to the total filter servicing time to provide time for removing fasteners, removing or opening service or access panels, wiping or vacuum-cleaning the chamber, and reinstalling panels and fasteners after servicing the filter.

Some typical access time allowances are shown below.

|  |
| --- |
| Window Air Conditioning Unit |
| Remove, reinstall screws | 2x5x.7 min. = 7.0 min. |
| Remove, reinstall panel | 2x1x1.8 min = 3.6 min. |
| Vacuum interior of unit | 1x5.5 min = 5.5 min. |
|  | total time = 16.1 min. |
|  |
| Package Air Conditioning Unit, 3-9 tons |
| Remove, reinstall screws | 2x12x0.7 min. = 16.8 min. |
| Remove, reinstall panels | 2x2x1.8 min. = 7.2 min. |
|  | total time = 24.0 min. |
|  |
| Package Air Conditioning Unit, 10-49 Tons |
| Remove, reinstall screws | 2x12x0.7 min. = 16.8 min. |
| Remove, reinstall panels | 2x2x2.6 min. = 10.4 min. |
|  | totl time = 27.2 min. |
|  |
| Perimeter Baseboard Fan Coil Unit |
| Lift, reclose panel | 2x1x1 min. = 2.0 min |
|  |
| Overhead Plenum Chamber (from Ladder) |
| Remove, reinstall screws | 2x6x0.7 min. = 8.4 min. |
| Remove, reinstall panels | 2x1x8.9 min. = 17.8 min. |
| Vacuum chamber | 1x6.0 min. = 6.0 min. |
|  | total time = 32.2 min. |
|  |

Other items should be calculated to add to filter changing and access time allowances to get a total picture of service time requirements for filter installations. These items include allowances for reading and zeroing manometers, travel time to and from filter banks, material handling time, etc.

**Modifying and Upgrading Filter Systems**

Many existing filter systems were designed for different purposes than those for which the conditioned spaces are now being used. Codes and requirements have changed. Certainly awareness of the costs associated with energy and maintenance practices affecting consumption and conservation has been heightened. For any number of valid reasons, engineers today are taking a second look at their filtration systems to determine whether a modification is feasible to lower costs, upgrade air quality, or both.
A look at some recent case histories will illustrate the possibilities.

**Case 1 - An Industrial Plant**

The typical air handier plenum had a filter section measuring a nominal 4’high x 8' wide, and was covered with Roll Renewable media. The upgrading consisted of replacing the filter section with holding frames for 24" x 24" x 4" extended area (pleated) filters. Although both the original and replacement media are rated as medium efficiency (20 to 30 percent) by ASHRAE 52-76 standards, the replacement filters are 300 percent as efficient on small particles in the 5 to 10 micron range.

Consequently, coil cleaning has been reduced from two times per year to once per year longer. Labor to change filters has been decreased from 1.5 manhours per change to 10 minutes. Filter media cost is a standoff. List price for eight filters 2’X 2’X 4" comes to a few dollars less than the roll. Frequency of changes is slightly less.

Total results: Improved efficiency, lower cost of labor in both filter servicing and cleaning, and lower resistance to the fan, which could lower energy costs.

**Case 2 - A large bank buidling**

The main air handling units are provided with an oversize filter bank of nonsupported bag filters, which have an average of 50 percent dust spot efficiency. The design velocity was less than 500 cpm at the filter bank, The engineering staff was expecting to experience two to three changes of filters per year at 1- w.g. final resistance. Instead, the first year of occupancy will see most filters changed only once at 0.80" w.g. The main factors appear to be a conservative design of the filter system and an excellent program of housekeeping in the building, preventing the expected accumulation of dust. The housekeeping program includes daily vacuum cleaning of all the traffic areas of the carpets, which are very high quality, tight woven construction. Very little of the usual "fuzz" from the top fibers of the carpet has been seen during the initial wear-in period.
The engineering staff is planning to add 2- pleated disposable filters in front of the bag filters when changed. This will extend the life of the bag filters at very little expense in labor and materials since the prefilters will be very easily changed and are expected to cost $4.00 each, versus $17.00 each for the bag filters.

**What to do when Filtration has not been Maintained**

Results of a poor service program are expensive and easily traced from maintenance records. It includes dirty coils, poor heat transfer with resulting high energy bills, freezing of direct expansion coils, fire hazards in distribution system ducts and registers, dirt spills at registers and diffusers, etc.
The correction requirements are all many times as expensive as a good service program. Some of the obvious corrective measures are:

* *Cleaning coils and plenum chambers*
With a flashlight, determine the extent of residual dirt and fouling on the coils. Dust can be removed by brushing, vacuuming, or blowing with compressed air (and then vacuum-cleaning the settled dust). Oily residue, biological contaminants, and fungus will require chemical cleaning. A number of good chemical cleaning products are available for use a pressure sprayer, which will remove fouling contamination and leave coils bright without damaging the metal surfaces. Rinsing is not generally required.
Plenum surfaces should be brushed or vacuum-cleaned to remove all loose dust and debris.
* *Cleaning ductwork, registers, and grilles*
Heavily contaminated air distribution systems constitute a real challenge Seldom is enough of the ductwork available for conventions vacuum cleaning to remove accumulated dust. The most successful methods is to put throwaway filters over openings and to blow the dust downstream with high volume blowers, collecting it with the filters at diffuser and register openings. Dampers may be closed to section off parts of the system so that blowing and collecting will be limited to only a part of the system at a time.
Heavily soiled registers and grilles should be cleaned with the same solution as the coil cleaner.
* *Cleaning ceilings and walls near conditioned air units*
Try cleaning first with a portable vacuum cleaner, using a soft bristled brush tool on the end of the wand. If smears result or the area will not come clean, use a neutral detergent solution and a damp cloth. Heavily soiled walls should be washed from the bottom up to avoid streaking. Flat paint on walls may not be possible to clean satisfactorily and may require repainting, but a clean surface is required prior to painting.

**Conclusion - The Payoff**

The benefits of a good air filtration service program are definitely worth the investment of management time to get it established and followed through to successful implementation.

* Enhanced building appearance - This definitely affects marketability of tenant space and suitability for other types of occupancy.
* Energy savings - through reduced resistance to air flow, permitting lower fan speed, and resulting in lower horsepower requirement at design air volume.
* Improved air quality - Occupants of the building always benefit from reduction in the carried over contaminants in the building’s conditioned air.
* Labor savings - A good filtration service program will reduce the time to change filters, clean coils and ductwork, and red reduce corrective work requirements. Servicing on a rational, planned basis always saves over breakdown or catch-up-type programs.