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Building Air Quality Improvements

By

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Introduction

As the result of the 9/11 attacks, the Federal Government published a NIOSH report in April of 2003 entitled: GUIDANCE FOR FILTRATION AND AIR-CLEANING SYSTEMS TO PROTECT BUILDING ENVIRONMENTS FROM Airborne Chemical, Biological, or Radiological Attacks". Air filters serve three main purposes: 1) to capture and retain particulate matter and pathogens; 2) to improve indoor environment for staff and clients; and 3) to protect expensive HVAC equipment. During the 1930's it was determined that an air filter that was capable of removing 35% of the particulate matter would prevent explosions in heating systems with direct fired burners. The 35% filter was set as the minimum standard and remains that today. The 35% particulate removal does not protect modern heat exchangers from blockage or corrosion, and does not prevent the recirculation of biological materials and pathogens. Modern systems need to remove particles finer than 2.3 microns, (at which size they are considered respirable and are able to pass from the lungs into the blood stream), and also to remove mold spores, bacteria, viruses, SVOC's, aerosols, and organic and inorganic material.

Filter Blow-by

The biggest air filtration problem is blow-by, which is the result of air leakage around filters, seals, and through filter defects such as rips, tears, and assembly defects. Air leaks are often easily overcome by taping joints between filters, by using filtering seals, and by careful inspection of the filter for defects prior to installation.

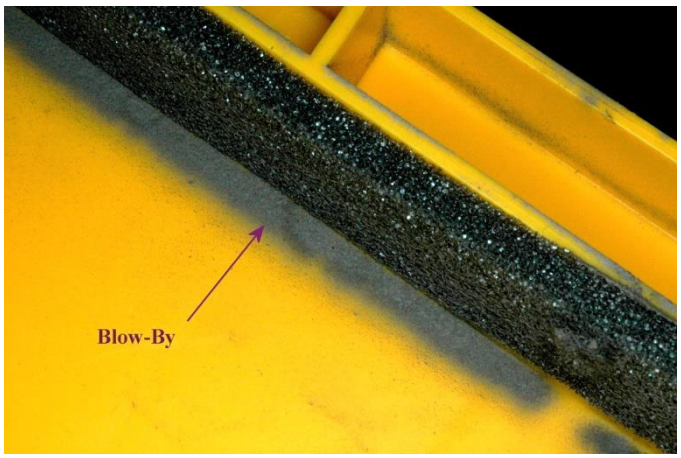

Figure 1 – Seal Blow-by on Very Expensive Medical Grade HEPA Filter

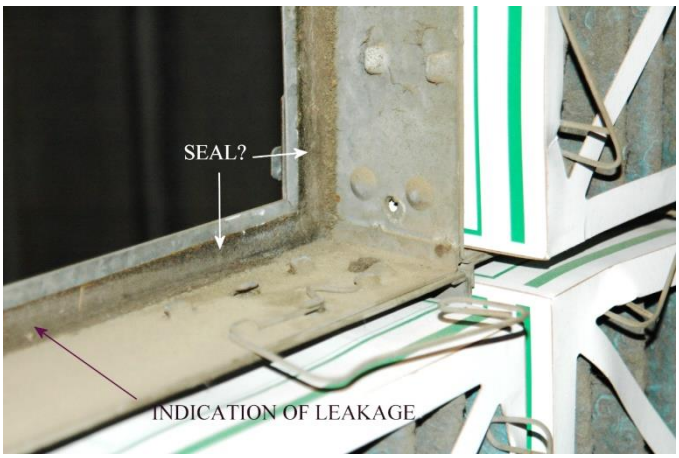

Figure 2 – Defective Rack Seals for Pre-filters in Government run Hospital

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Figure 1 shows blow-by found during inspection of a high end HEPA filter bank at a major commercial hospital. The photo is of one of the better filters that were inspected.

Figure 2 shows defective seals in a pre-filter rack in a government run hospital. The pre-filter rack was ahead of the HEPA filters. The purpose of the pre-filter is to protect the more expensive HEPA filters. In a case like this, the rules state that the pre-filters are to be changed when the pressure drop across them reaches one inch of water column. The filters had been in place for 18 months, and the pressure drop across the pre-filters was 0.2 inch of water column, indicating that they were not doing a good job. Because of the ineffective pre-filters, the HEPA filters in this air handler had been replaced three times over the 18 month period.

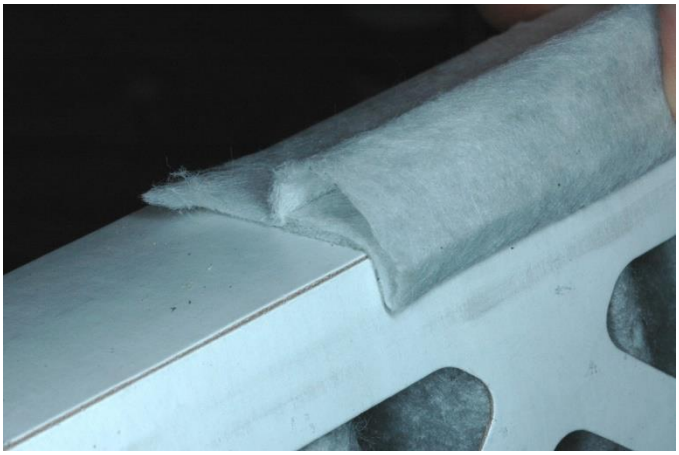

Figure 3 – Effective Seal – made from Filter Media

An effective seal to use is made with filter media installed where there is blow-by. Filter media seals are very effective in reducing the effects of blow-by. The seals need to be replaced with each filter change. Figure 3 shows one way of installing the media. Media seals work well if the filter fits loosely in the rack or slots.

Mechanical Air Filters

The main type of air filter most commonly used is the mechanical filter, which consists of filter media that has a tackifier coating to hold captured particles in place. Once the media fibers are coated, the filter is no longer effective, even though there is little, or no pressure drop across the filter. The two most common causes of fiber coating are dander, dead skin, and aerosols. Humans and pets are the most common source of dander, while cooking and engine exhaust are the most common sources of aerosols. Failure to change mechanical filters frequently enough results in build-up of dander, aerosols, and other particulate matter. This type of filter also needs to be changed after unusual weather events, such as dust storms, and before and after any building repair that generates dust.

Electro-static Air Filters

Electro-static filters use a polyester as the filtering media. According to the NIOSH Report of April 2003, the big difference from mechanical filters "…is that little change in pressure drop occurs during loading of an electro-static filter…" The major problem with electro-static filters is uniformity of electro-static charge across the filter face. US Patent Numbers 7,416,581 and 7,892,326 B2, held by Point Source Solutions, Inc., provide a solution to electro-static charge uniformity.

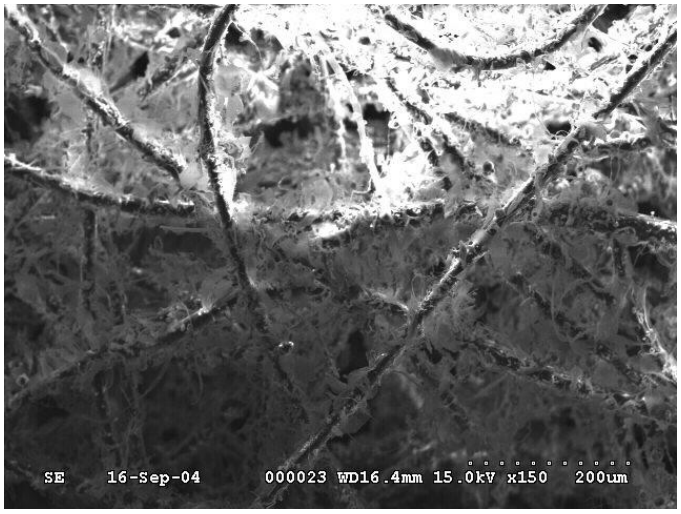

Figure 4 – 150X Excessive Dander Build-up on Electro-static Filter

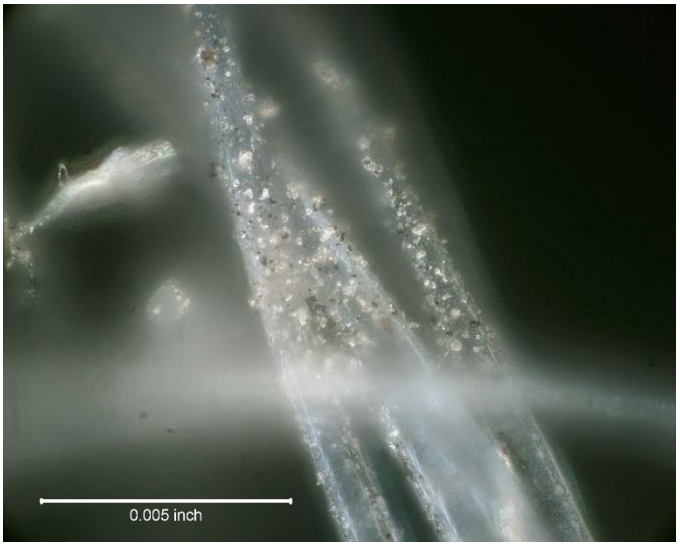

Figure 5 – 400X Normal Build-up on Electro-static Filter

The excessive dander build-up that is shown in Figure 4, from a hospital that changed to electro-static pre-filters, shows what often occurs when a facility or home changes from using mechanical filters. It usually takes several filter changes to remove the loose dander and pathogens from the system itself. Figure 5 shows a more typical particle build-up on an electro-static filter from the same air handler with a number of years separating the filters. The building is very clean, and has very high indoor air quality, typically 5 to 10 times better than outdoor air.

If you need assistance on your specific filtration problems, or for more information, please contact me, or James Raetz, President, at Point Source Solutions, Inc. jimraetz@gmail.com.