IFN HVAC TCO Factors

The following slides include excerpts from articles accessible in IFN. Links to the full text are also included. Sentences in red are McIlvaine summaries of TCO Factors addressed.

MPR 2800 Provides High Particulate Removal in Indoor Air

This study by 3M revealed several important facts of the particle transport in a house and impacts HVAC filtration and RAP filtration on the indoor air quality. Firstly, the experimental results showed that particles can travel from the particle source space to other rooms within minutes even with the whole house fan turned off. Secondly, while fiberglass filters showed insignificant impact on removing particulate matters in the house, high efficiency Filtrete HVAC filters, such as MPR 2800 filters, demonstrated excellent performance at reducing the PM concentration in all spaces of the house. The medium efficiency filters, e.g., MPR 800 filter, also delivered fairly effective PM reduction in most spaces of the house. Thirdly, Filtrete RAP unit was very effective at reducing the PM concentration in the room where it operated. Lastly, the combination of high efficiency Filtrete filters and a Filtrete RAP not only provided significant PM removal in a single room, but they also allowed faster PM reduction in other rooms / https://www.filtnews.com/effectiveness-of-hvac-filters-and-room-air-purifiers-in-mitigating-indoor-particulate-matter/

Lowest total cost of ownership needs to include the total cleanliness effect on the space. It will be cumulative and can involve multiple filters.

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Do You Use MERV A or MERV Rating?

Another factor that has been discussed is the difference between MERV and MERV-A-rated filters," says Conlan. "MERV-A-rated filters require the electrostatic charge to be dissipated before it is tested, while MERV testing allows the filter to have an electrostatic charge, which enhances its particle capture performance under test. However, in a real-world scenario, the electrostatic charge is naturally reduced as materials hit the filter, and it is impacted by the relative humidity of the surrounding environment."
https://www.filtnews.com/ashraes-epidemic-task-force-takes-on-the-complicated-case-of-hvac-filtration-in-a-covid-19-world/

The deterioration in the electrostatic charge over time is a TCO factor which is debated based on time and dust loading as well as specific media characteristics.

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Simplify Your HVAC Investment With a Total Cost of Ownership Analysis

1.Do you know the optimal changeout schedule for your filters?
2.Are you able to recognize when a prefilter is required and when it is not?
3.Do you know the benefits of a higher MERV prefilter?
4.What is the total added cost of a higher MERV filter?
5.When was the last time you underwent a complete Air Filter Audit?
6.Is your HVAC system and production equipment optimized for TCO?

Recognizing when a prefilter is required and equally important, when you can go without one, is a key to improving your TCO. Use of a prefilter depends on the results of comparing the costs of energy, lifespan, and MERV of the efficiency filter with that of the prefilter. The higher the MERV of a prefilter the longer the efficiency filter will last before requiring a changeout. HVAC experts help determine the best steps in selecting the MERV of your prefilter. Sometimes a simple step from a MERV 8 to a MERV 10 can have a significant impact on improving downstream filter life and TCO.
(Michael Bruce- Filtration Group)
https://www.filtnews.com/simplify-your-hvac-investment-with-a-total-cost-of-ownership-analysis/

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Can you afford to ignore TCO?

This is the question raided by Michael Bruce in this IFN article.

Hidden costs are everywhere and easy to miss. The purchase of any given filter is often driven by the lowest upfront price. This decision can lead to ballooning hidden costs of higher energy consumption and increased maintenance, adding to overall operation costs.

In the United States, geography plays a significant role in the amount of money spent on energy. Combined with ambient condition fluctuations, energy costs alone can be the difference in an optimal-functioning system and one that costs more than it should.

A closer look: energy and geography

Two customers located in different regions of the country using the same filter experienced marked differences in operational costs. This real-world example demonstrates the importance of considering energy costs, particularly in areas where energy consumption is premium-priced. The energy consumption required to push air through filters is the greatest portion of cost associated with HVAC filters.

In Connecticut, energy costs were $0.1721 per kWhr and in Nevada, energy costs were $0.07465 per kWhr. When comparing the annual TCO of 1 standard 24 x 24 pleat, the TCO in Connecticut is double the cost in Nevada, because the annual energy cost is 130% higher. Using a higher-performing TCO pleat high-cost energy regions like Connecticut reduces the energy to 40%. Simplify your HVAC investment with a total cost of ownership analysis | International Filtration News (filtnews.com)

It would be very beneficial for ASHRAE, IFN, INDA and others to maintain a database of energy costs in each country and in major regions of the U.S. This could be a uniform basis for determination of cost of ownership.

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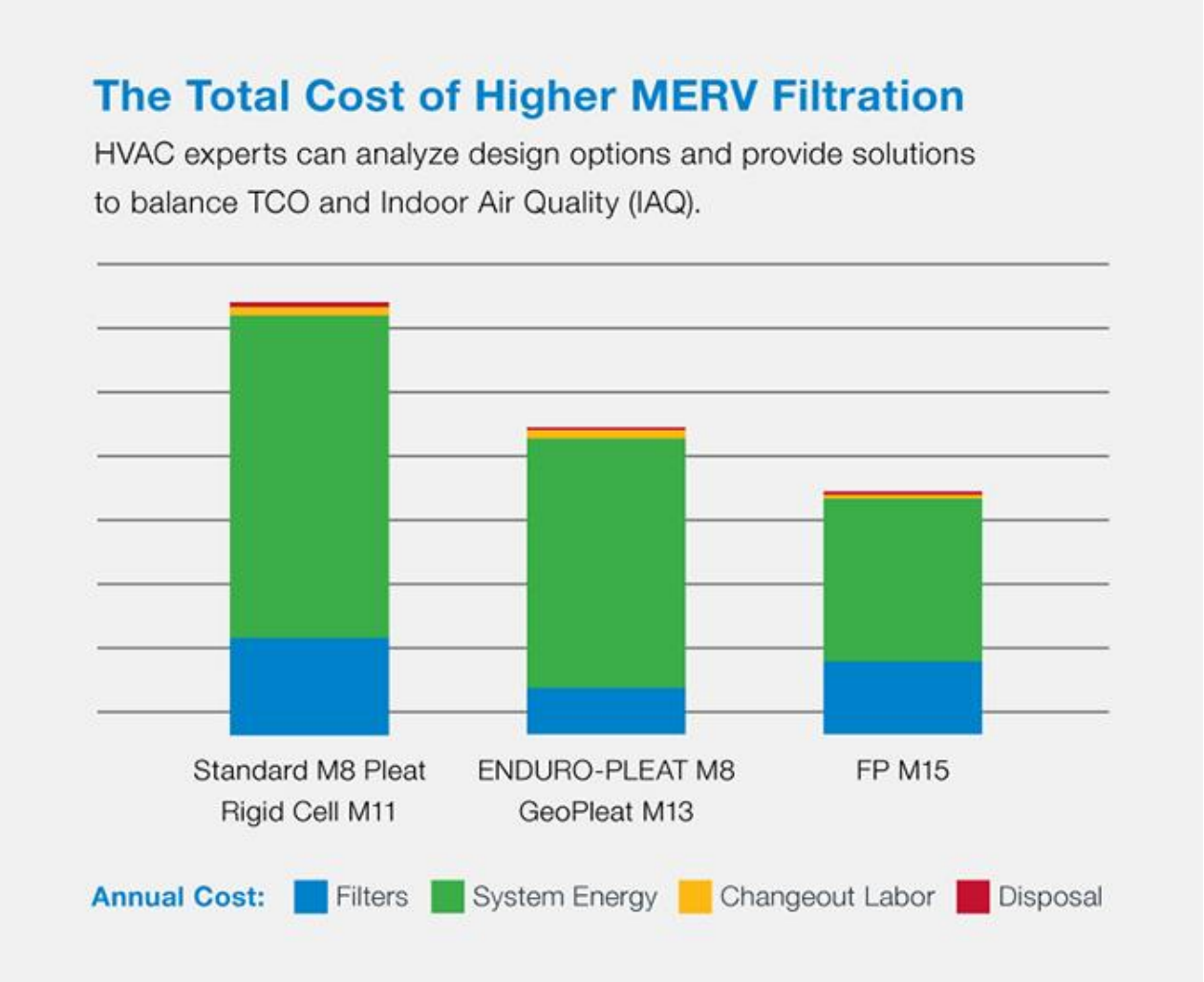
Often, there are questions regarding the higher costs of MERV filters. When evaluating different filters, the balance between pressure drops and dust-loading capacities must be considered, assuming the filters are similarly priced. The savings in energy consumption over time is generally more substantial than the upfront cost of a “better filter.” It is important to remember that just because a filter has a higher MERV does not necessarily mean it has a better or worse TCO, many variables need to be considered, including the filter format https://www.filtnews.com/simplify-your-hvac-investment-with-a-total-cost-of-ownership-analysis/.



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The balance between pressure drops and dust-loading capacities must be considered, assuming the filters are similarly priced.

Can Nanofiber TCO for Mobility Applications be Useful in HVAC Evaluations?

McIlvaine provided an article on nanofibers and lowest total cost of ownership for mobility applications. The conclusion was that Nanofiber media will increase market share in a changing mobility market. It will provide the lowest total cost of ownership based on an efficiency-to-energy consumption ratio, as well as on initial and maintenance costs. There are two major sub-segments of nanofiber media, depending on the thickness of the fibers and the methods by which they are produced.

With the growth in electric vehicle use there will be a big market for nanofiber media in electric vehicles. Meanwhile, the market for filters used with fossil fuels will be negatively impacted. Cabin air will not be impacted by the EV surge, but it will be positively impacted as the recognition of the need for cleaner air for occupants of mobile equipment continues to increase.

Damien Deehan of Verdex says cruise ships can save billions in retrofit costs needed to upgrade HVAC to handle the required HEPA-level filtration. Verdex's E12/H13 media lasts longer, resulting in fewer filter changes, lower replacement and labor costs, and less production downtime. With lower pressure drop due to depth loading of particles, the energy and compressed air costs are also dramatically lower.

https://www.filtnews.com/mobility-applications-provide-significant-opportunity-for-nanofiber/

Some of the same LTCO advantages for nanofibers in mobility applications can also be the case for stationary HVAC applications.

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Thomas Heininger is the director of engineering for Cabin Air Filters at Mann+Hummel. We posed the following question to him.

Q: For cabin air applications particulate efficiency (initially and over the lifecycle), energy consumption, and cost are all important. What role do you see for nanofibers in achieving these goals?

A: The nanofiber filter media produced by Mann+Hummel consists of a carrier media and an extremely thin layer of ultra-fine polymer fibers. This nanofiber-based filter media (fibers with an average fiber diameter of 100 nm) offers the best possibilities to cover all of the main aspects and therefore deliver the best possible air quality inside the vehicle. This fine fiber structure is effectively filtering out particles down to the ultra-fine particles (< 0,1 µm). As they mechanically filter out the particles, the performance stays stable over the filter lifetime.

Today the standard for cabin air filtration is the so-called electret-based filter media. They offer a good efficiency at the very beginning, but under the influence of temperature and humidity (which is a real challenge for the filter as being installed in the HVAC close to the evaporator), they will decrease in efficiency.

At Mann+Hummel we have developed nanofiber-based filter media for the mobile applications to overcome this issue and have proven the stable efficiency over lifetime in the lab, as well as in extensive field test campaigns. As we are taking about extremely fine fibers, also the resistance against the airflow passing through the filter structure is well balanced and optimized for the application in the vehicle´s HVAC systems where typically cabin air filters are installed. By constant development work over the years and process optimization nanofiber-based filter media also offer a good balance between performance and costs. All this yields the best cabin air quality, which is more important than ever as bad air quality and the proven negative health impacts linked to are becoming more evident. Therefore, innovative filter media like this are the way forward in the goal to get clear air everywhere and for everyone.

https://www.filtnews.com/mobility-applications-provide-significant-opportunity-for-nanofiber/

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Are the LTCO factors for cabin air also valid for HVAC Filters?

McIlvaine Interviewed Barry Kellar of Freudenberg

Q: What about the use of nanofibers or other technologies for cabin air filtration?

A: Currently the main technology used in cabin air filtration incorporates electrostatic technology in the nonwoven media. It allows for high collection efficiency of particles, while maintaining a low-pressure performance, which is desirable by OEMs. But with the demand for even higher levels of performance, combined with installation of IAQ sensors, incorporation of nanofiber and membrane technology is increasing. While electrostatic media technology will not simply go away, combining this technology with a membrane or nanofiber layer in a composite structure will increase in use.

While not all electrostatic technology is the same, and Freudenberg technologies are quite robust, discharge does occur over time. While the build-up of the dust cake on the upstream side of the filter assists in balancing out the efficiency as the filter discharges, for products that wish to maintain HEPA-like levels of performance through the life of the filter, adding a layer of membrane or nanofiber media makes sense. Of course, the trade off in using more mechanical media is higher levels of pressure drop, if OEM customers can increase the size of the cabin air filter, usually the pressure drop differential is not too much.

https://www.filtnews.com/mobility-applications-provide-significant-opportunity-for-nanofiber/

Are the LTCO factors for cabin air also valid for HVAC Filters?

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HIFYBER's Nanofiber Filtration Efficiencies Range From MERV 6 – 16 , F7 – E12

HIFYBER's high-performance nanofiber media meet ever-increasing demands to reduce energy requirements and CO2 emissions. Likewise, our extraordinary, structured nanofiber media help to decrease the transmission of COVID-19.

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- Outstanding Energy Savings – delivers lowest level of pressure drop and minimizes energy consumption

https://www.filtnews.com/nanofiber-filter-media-for-a-range-of-air-filtration-applications/

Low pressure drop and no fiber shredding. This is important for cleanrooms but how important is fiber shedding in HVAC?

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True Cost Metrics for Filter Selection

This McIlvaine article in the March 2021 issue of IFN introduces the concept of life quality as an important TCO metric.

Robert De Niro and other celebrities are promoting the Well Health Safety Seal for buildings, which includes air and water as well as other life quality impacts.
More efficient filters will protect against viruses but also indoor air pollutants. These examples are simplified to display years. But they represent equivalent Quality Enhanced Life Years. Someone who is sick not only reduces his/her own life quality but that of those who must take care of him/her or depend upon him/her.

https://www.filtnews.com/new-metrics-for-filter-selection-and-true-cost-determination

The Well Health Safety Seal assigns a value to life quality in the total cost of ownership. QELD developed by McIlvaine is a unique metric for better determining life quality impacts.

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High Efficiency Filtration Goes Mainstream by Chris Plotz

There are some complications relating to the installation of MERV 13 filters in systems with 1” and 2” filter racks, as MERV 13 filters are typically deeper to minimize pressure drop. A basic switch to a MERV 13 from a lower-rated filter in a 1” or 2” system presents unintended consequences, which result in a cascade of increases within the HVAC system. These manifest in higher resistance, increased pressure, as well as increases in energy use in the system. This can cause airflow reductions, freezing of the air conditioner coil and, potentially, damage to the compressor. A workaround could be to retrofit a larger rack to accommodate a deeper filter with significantly more filtration media. This is not a simple or cheap task. Cost is not the only factor though, as a retrofit would also require steps to ensure the enlarged filter rack is as airtight as possible to prevent air bypass or depressurization effects from occurring.
https://www.filtnews.com/high-efficiency-filtration-goes-mainstream/

The cost of upgrading filters can include major system modifications.

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HEPA Filters for HVAC

The MANN+HUMMEL Group now offers its HEPA H13 air filter for air conditioning and ventilation systems. In accordance with EN 1822, the HEPA H13 air filter filters more than 99.95 percent of viruses, bacteria, and micro-organisms from the supply air. The Nanoclass Cube Pro membrane allows for the use of energy-efficient systems using circulation air modes. Its ePTFE medium reduces the pressure drop by 50 percent compared to conventional HEPA air filters based on micro-glass fibers.
The Nanoclass Cube Pro membrane meets the requirements of fire protection class E according to EN 13501. The air filter is suitable for most HVAC systems.
https://www.filtnews.com/mannhummel-announces-hepa-h13-air-filters/

Perceived life quality is improved with HEPA HVAC filters. If the installation costs and energy consumption are low, then the higher first cost is not significant.

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The Future of Filtration

Matt Migliore interviewed Scott Tennison of Kimberly Clark.

“The overall health risk due to poor air quality is more than just the spread of these viruses during global pandemics. Everything from heart issues and birth defects to a full range of respiratory illnesses have been directly linked to the quality – poor quality to be exact – of air that people are breathing day in and day out. We need to continue to tell the story and push the importance of healthy indoor air daily, not only during times of global pandemics.

With that said, I do believe that the COVID-19 situation has put a very public lens on how microscopic particles in the air can affect our health, and this will impact the future of filtration in this post COVID-19 new normal. There is a growing awareness of IAQ and critical filtration in both commercial buildings and residential homes.

Higher MERV-rated products that can filter out the very smallest particles I believe will be the largest growth segments along with HEPA filtration. Personally, I believe that MERV 13 and above will be the new demand growth for both residential and commercial filtration in pleated media. Bag media and mini pleats will also look to MERV 13 and up to MERV 16 to deliver the best air quality in locations that use these types of filtration devices.”

https://www.filtnews.com/the-future-of-filtration-how-does-covid19-change-the-filtration-industry/

In the future greater weight will be placed on the negative costs of air filter ownership (life quality benefits which offset costs).

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Filter Sensors Can Be Used to Reduce Total Cost of Ownership

Adrian Willson writing in the April 2020 IFN focused in part on sensors. 3M, for example, has introduced the first-ever Bluetooth-enabled HVAC air filters. Its Filtrete-branded products are being integrated with Amazon's dash replenishment service via a pressure sensor that, in combination with a special app, allows household consumers to track filter life based on airflow and usage, not just time.

Among recent developments from Minneapolis, Minnesota-headquartered Donaldson, is iCue, a subscription service which monitors industrial dust collectors with an accuracy said to far surpass traditional non-connected gauges, sending maintenance alerts directly to plant management teams. The information is designed to achieve energy savings by prompting timely maintenance – and of course filter replacement.
https://www.filtnews.com/energy-savings-at-the-forefront-of-nonwoven-filter-technology-development/

Lowest total cost of ownership can be achieved by a filter supplier who provides sensors and a solution for the life of the filter instead of just offering the filter.

McILVAINE

MERV - A Test is Not Valuable

Robert Martin of Kimberly Clark outlined the electret advantages in this 2014 article. He adds that the MERV-A test subjects the filters to extreme loads of fine KCl (potassium chloride) particles many times what the filter would be exposed to over its real-world, installed, useful life. It does not represent actual use conditions at all, but instead represents a “worst-case” scenario that is likely to never happen. In addition, differences in environmental conditions and lab-to-lab variances have also been uncovered, leading to the conclusion that techniques, which “condition” the filters, are not repeatable. Moreover, these same conditioning techniques have been shown to decrease the filtration efficiency of certain mechanical-only filters as well. These are some of the reasons the electret masking step was not added to the 52.2 Standard as a mandatory part of the test but was included as an option only.
https://www.filtnews.com/nonwoven-fabrics-mechano-electret-filter-media-advantages/

How useful is the MERV-A rating in LTCO evaluations?

McILVAINE

Meltblowns and Electrostatic Charging

The filter efficiency can be considerably increased by means of so-called electro-charging – where the nonwovens are electrostatically charged. There are two options for charging nonwovens for industrial applications: triboelectric charging or corona charging. Today, corona charging is the method predominantly used.
Oerlikon Neumag, one of the leading manufacturers of meltblown systems, is currently developing its own concept for electrostatic charging of meltblown nonwoven materials. This distinguishes itself from concepts currently available on the market due to its high flexibility with regards to charging the most varied nonwovens. Users can freely choose from a large number of variation possibilities and set the optimum charging method depending on the filter application. This multifunctional charging unit operates on the basis of corona charging and is suitable for thick and thin nonwovens with low and high basis weights.
https://www.filtnews.com/featured-articles-efficient-flexible-economical-meltblown-technology-filtration-applications/

Electrostatic charging methods differ. This impacts both the variety of media which can be charged and the effectiveness.

McILVAINE

Neenah has Range of Efficiencies with Melt Blown Products

Neenah Filtration's filter media portfolio NeenahPure supports efficiencies from ePM10 50% to ePM1 80% (ISO 16890) and M5-F9 (EN779:2012), with the highly charged materials capable of efficiencies > 99.9% (KCL, 0,3µm, 5.3cm/s). NeenahPure filter media are available for pleatable and bag filter elements.

Besides the standard NeenahPure portfolio, Neenah Filtration provides tailormade solutions to satisfy individual requirements in regard to performance and runability. Neenah Filtration offers high precision slitting according to customers specifications (combination of different widths, narrow widths etc.), online inspection systems, high flexibility in the composition of media, and different bonding technologies.
NeenahPure media avoids harmful fiber sheddings, has a very high dust holding capacity (DHC), a good pressure loss and efficiency ratio, a very high mechanical stability, and flame retardancy.

https://www.filtnews.com/neenah-filtration-launches-neenahpure-filter-media-portfolio-capable-of-99-9-efficiencies/

Improvements in melt blown and other media need to be continually assessed.

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Nanofiber Media from HIFYBER has Advantages for HVAC

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