Selection of energy efficient air filters for general ventilation – ISO16890

Mr Anil Nair
Head-Projects & Applications
Camfil India

Energy use

How much money does one save..

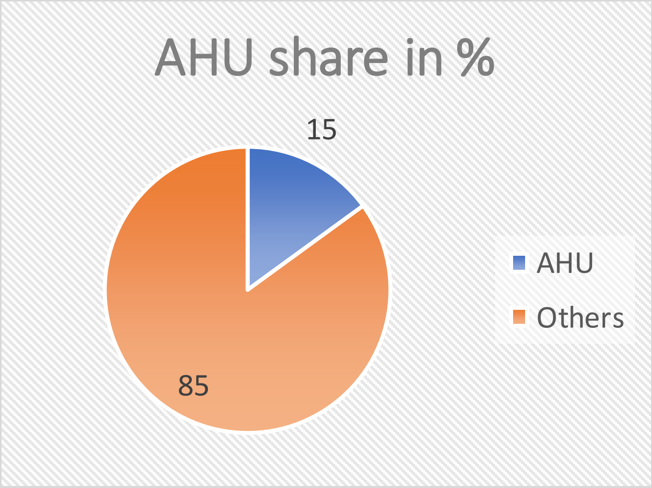
to change a light bulb?

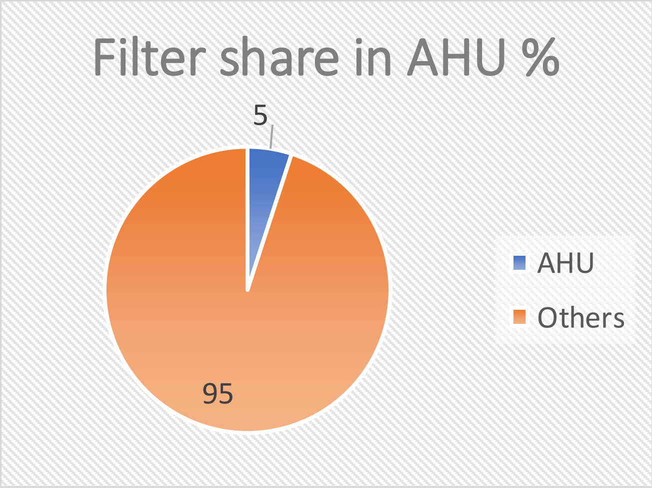
How much money does one can save..

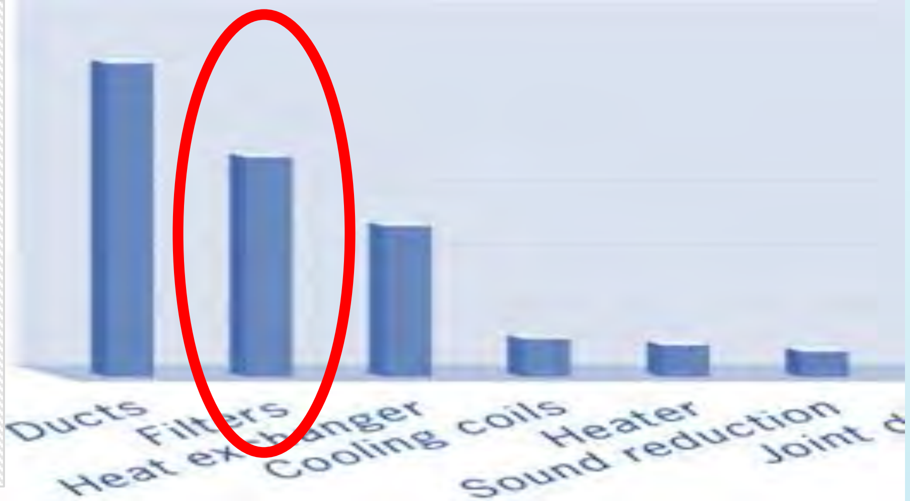
to change to a sustainable air filter?

Did you know?

- HVAC system accounts for approx. 60~70% of the energy used in commercial buildings
- Filter is the most inexpensive part of the HVAC system to improve
- In HVAC, filters stand 2nd when it comes to contributing air flow resistance and hence the pressure drops and hence the energy costs



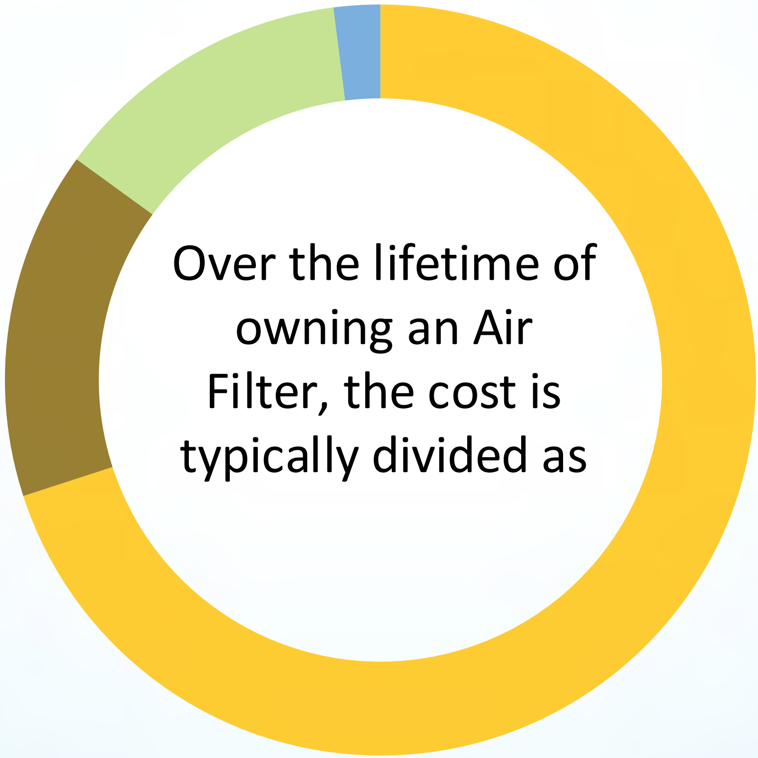




TCO — Total Cost of Ownership

13%
REPLACEMENT FILTER COST

15%
FILTER COST



2%
LABOUR & DISPOSAL COST

70%
ENERGY COST

Life Cycle Cost – Case Study:
Conventional Filters v/s ISO16890 Rated Energy Efficient Filters

Formula

Energy Cost $(E) = (Q * ΔP * T) / (η * C_o) P_c

Q = Airflow (m^3/s)

Δp = Average Resistance Over Alloted Time (Pa)

T = Total Operating Time (Hours)

η = Estimated Fan Efficiency

C_o = Horse Power Conversion Constant

Assumptions

1 AHU for 5 years (24/365)

Airflow 16.000 cfm

90% return air

ODA 3 / SUP2

Fan efficiency 80%

SUMMARY

INR 1.13m Saved

27% CO_2 Reduced

5.60 m^3 Waste saved

27% Lower TCO

COST ANALYSIS

INR 1.13m
Savings over 5 Year(s)

22,720,860
That can be added additional per year

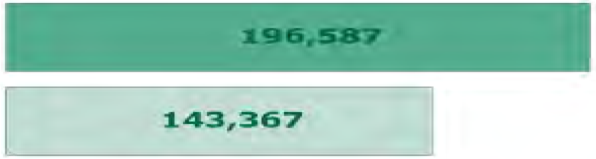
CO_2 ANALYSIS

Difference 31.93 Ton

27%
Lower CO_2 emissions

Camfil Existing   Conventional

ENERGY SAVINGS



Camfil Existing   Conventional

ENVIRONMENTAL IMPACT

31.93 ton of CO_2 saved

12K liters of diesel
Consumed by a passenger car.

53 MWh energy saved

5 homes
Average yearly energy use.

5.60 m^3 waste saved

34 trash cans
Full of waste diversion saved.

Note!

- Smart filter design can reduce pressure drop without compromising filtration efficiency by as much as 75%
- The more dirt an air filter can capture and hold while maintaining a lower pressure drop means the speed of the fan can remain lower while still providing the required airflow to maintain comfort.
- Energy efficient air filters save significant amount of energy and money!

Eurovent Recommendation 4/23


EUROVENT 4/23 - 2022

SELECTION OF EN ISO 16890 RATED AIR FILTER CLASSES FOR GENERAL VENTILATION APPLICATIONS

FOURTH EDITION

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Eurovent, 80 Bd A. Reyers Ln, 1030 Brussels, Belgium
secretariat@eurovent.eu

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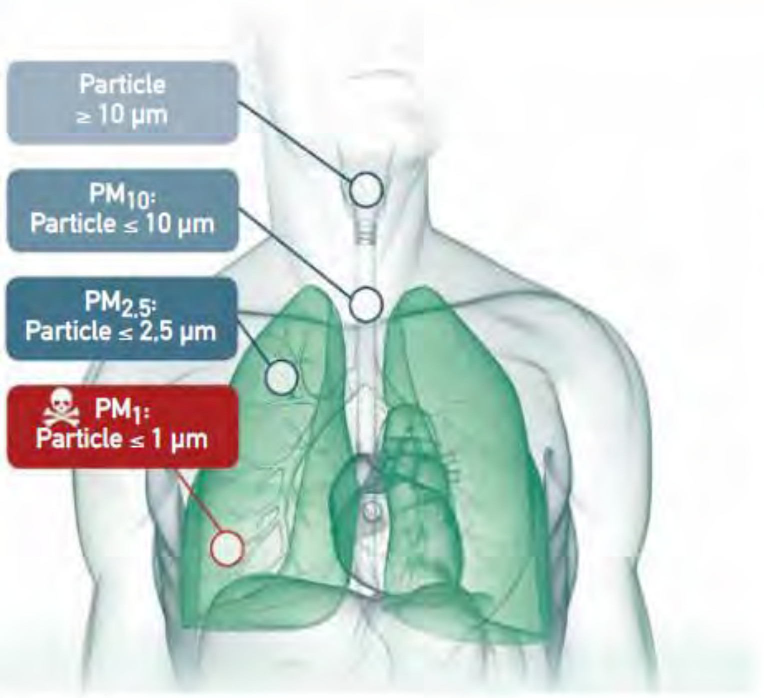
- Recommendation for the selection of ISO 16890 rated air filters for general ventilation applications
- Developed in a joint effort by the participants of the Eurovent Product Group ‘Air Filters’
- Published on 09 January 2018
- Updated in January 2022

Particulate Matter – the smaller, the worse

https://eurovent.eu/?q=content/eurovent-423-2022-selection-en-iso-16890-rated-air-filter-classes-fourth-edition-english

PM_{10}	$PM_{2.5}$	PM_1
Particles 10 µm in diameter or smaller can reach the respiratory ducts and potentially cause decreased lung function.	**Particles 2,5 µm** in diameter or smaller can penetrate the lungs and cause decreased lung function, skin and eye problems.	**Particles 1 µm** in diameter or smaller are most dangerous. They are tiny enough to enter the bloodstream and lead to cancer, cardiovascular diseases and dementia.



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1.1.2 BURDEN OF DISEASES

Conducted researches determined an impact of IAQ on the burden of diseases (BoD). The burden of diseases is measured by the means of a so-called disability-adjusted-life-year (DALY). This time-based measure combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health and was originally developed in 1990.

The total estimated burden of disease attributable to IAQ in the European Union is approx. 2m DALYs per year, which means that two million years of healthy life is lost annually. It is worth noticing that, according to latest estimation carried out by French economists, the cost of 1 DALY can amount up to 100.000 EUR. On a global scale, losses resulting from an inadequate IAQ are large.

Step 1 – Outdoor Air

- Selection of local outdoor air quality based on particulate matter levels acc. latest WHO Air Quality Guidelines
  - PM2.5 (particulate matter < 2.5 µm)
  - PM10 (particulate matter < 10 µm)
- **ODA 1** = below WHO limits
- **ODA 2** = less than 50% above WHO limits
- **ODA 3** = more than 50% above WHO limits
- **India = ODA 3**

Category	Description	Typical environment
ODA 1	OUTDOOR AIR, WHICH MAY BE ONLY TEMPORARILY DUSTY Applies where the World Health Organisation WHO (2021) guidelines are fulfilled (annual mean for $PM_{2,5} \leq 5$ µg/m^3 and $PM_{10} \leq 15$ µg/m^3).	
ODA 2	OUTDOOR AIR WITH HIGH CONCENTRATIONS OF PARTICULATE MATTER Applies where PM concentrations exceed the WHO guidelines by a factor of up to 1,5 (annual mean for $PM_{2,5} \leq 7,5$ µg/m^3 and $PM_{10} \leq 22,5$ µg/m^3).	
ODA 3	OUTDOOR AIR WITH VERY HIGH CONCENTRATIONS OF PARTICULATE MATTER Applies where PM concentrations exceed the WHO guidelines by a factor of greater than 1,5 (annual mean for $PM_{2,5} > 7,5$ µg/m^3 and $PM_{10} > 22,5$ µg/m^3).	

Table 1: Outdoor air categories

Step 2 – Required supply air quality

CATEGORY	GENERAL VENTILATION	
SUP 1	-	-
SUP 2	**Rooms for permanent occupation.** Examples: Kindergardens, offices, hotels, residential buildings, meeting rooms, exhibition halls, conference halls, theaters, cinemas, concert halls.	
SUP 3	**Rooms with temporary occupation.** Examples: Storage, shopping centers, washing rooms, server rooms, copier rooms.	
SUP 4	**Rooms with short-term occupation.** Examples: restrooms, storage rooms stairways.	
SUP 5	**Rooms without occupation.** Examples: Garbage room, data centers, underground car parks.	

Table 4: General ventilation - indicative examples of application matched to corresponding SUP categories

CATEGORY	INDUSTRIAL VENTILATION	
SUP 1	**Applications with high hygienic demands.** Examples: Hospitals, pharmaceutics, electronic and optical industry, supply air to clean rooms.	
SUP 2	**Applications with medium hygienic demands.** Examples: Food and beverage production.	
SUP 3	**Applications with basic hygienic demands.** Examples: Food and beverages production with a basic hygienic demand.	
SUP 4	**Applications without hygienic demands.** Examples: General production areas in the automotive industry.	
SUP 5	**Production areas of the heavy industry.** Examples: Steel mill, smelters, welding plants.	

Table 4: Industrial ventilation - indicative examples of application matched to corresponding SUP categories

Step 3 – Selection

Outdoor air quality		Supply air quality				
		SUP 1	SUP 2	SUP 3	SUP 4	SUP 5
ODA 1	Example 1	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%	ePM10 50%	ePM10 50%
	Example 2	ePM1 70%	-	-	-	-
ODA 2	Example 1	ePM1 50% + ePM1 60%	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%	ePM10 50%
	Example 2	ePM1 80%	ePM1 70%	ePM2,5 70%	ePM10 80%	-
ODA 3	Example 1	ePM1 50% + ePM1 80%	ePM1 50% + ePM1 60%	ePM10 50% + ePM1 60%	ePM1 50%	ePM2,5 50%
	Example 2	ePM1 90%	ePM1 80%	ePM2,5 80%	ePM10 90%	ePM10 80%

Table 7: examples of filter classes meeting respective ODA/SUP categories requirements

ePM10 55%

ePM1 80%

Example – Multi stage filtration

Office in Gurgaon: ODA 3 & SUP 2 = min. ePM1 80%

Stage 1
ePM1 60%

Stage 2
ePM1 60%

$$ePM1_{cum} = 100 \times \left(1 - \left(1 - \frac{60}{100}\right) \times \left(1 - \frac{60}{100}\right)\right) = 84\%$$

Summary

- Significance of Filters in Air Handling Units and its contribution to Energy Consumption
- TCO/LCC- a more holistic view on selection of filters, taking in consideration energy efficiency and sustainability.
- Selecting ePM1 filters will result in improved air quality and lower health risk
- Eurovent 4/23 merges theoretical and practical aspects of designing Indoor Air Quality in terms of air filtration
- Eurovent 4/23 provides hands on and effective advice for HVAC planners and manufactures of ventilation equipment to correctly design filtration

“Energy waste elimination is the most green energy one can buy!!”

Thank You!

Mr Anil Nair
Head- Projects & Applications
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