LUCHTVERDELING IN TIJDEN VAN EEN PANDEMIE

Studiedag Ventilatie

Datum 11/02/2022

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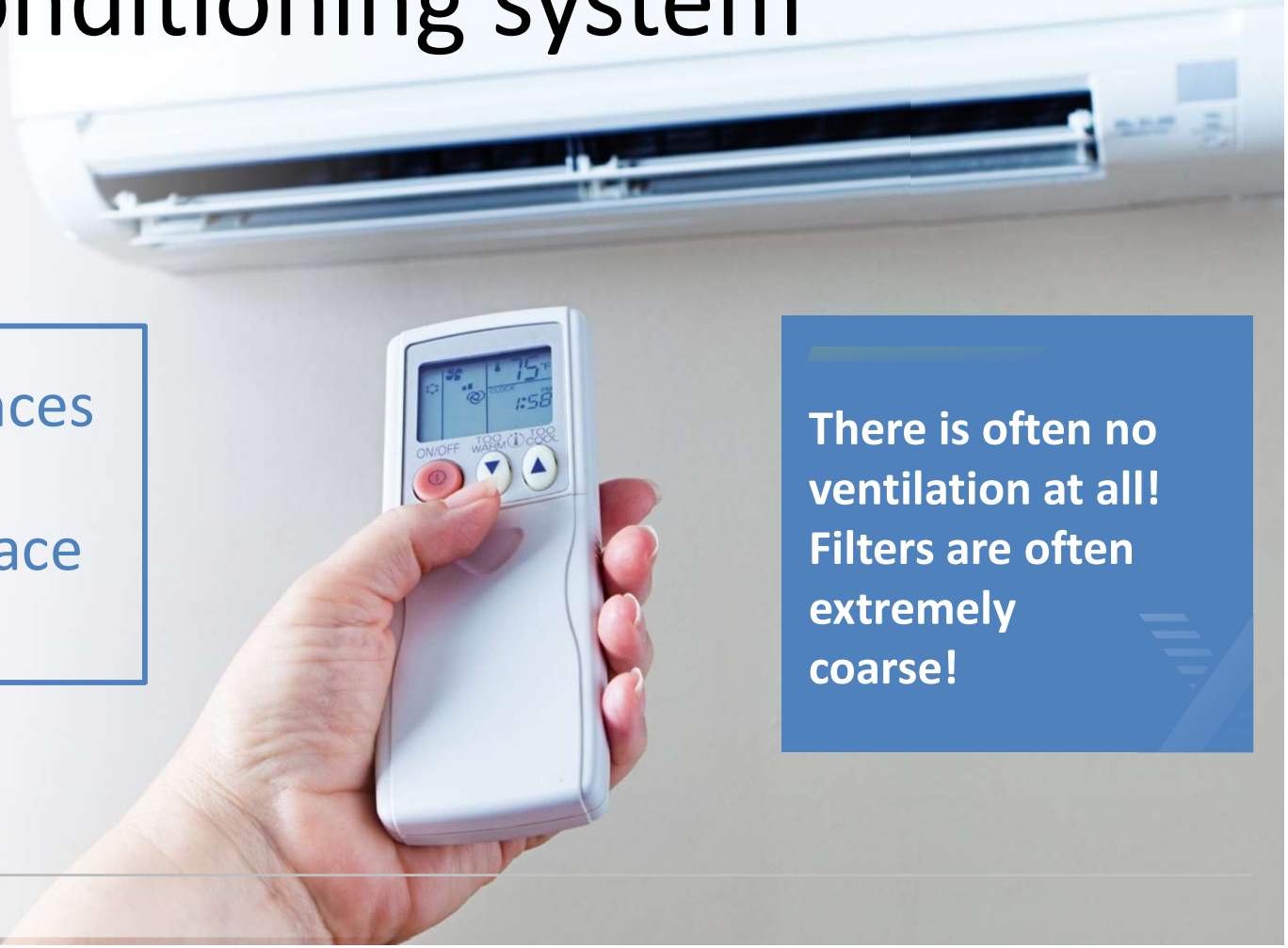
Air conditioning system



> Combination of appliances designed to supply conditioned air to a space
>
> **EN 16798-3**

There is often no ventilation at all! Filters are often extremely coarse!

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Ventilation system

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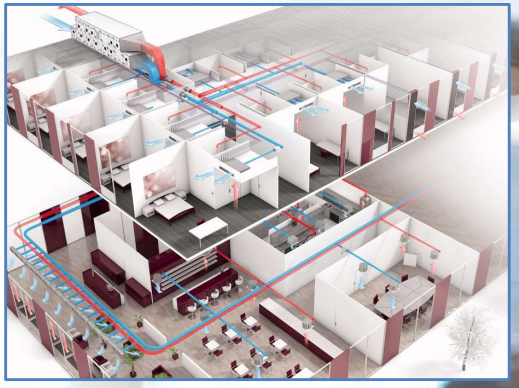
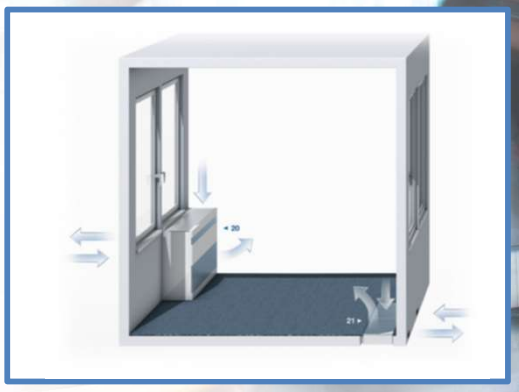
> Combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air
>
> **EN 16798-3**





Year-round guaranteed and energy-efficient ventilation!

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Coronavirus

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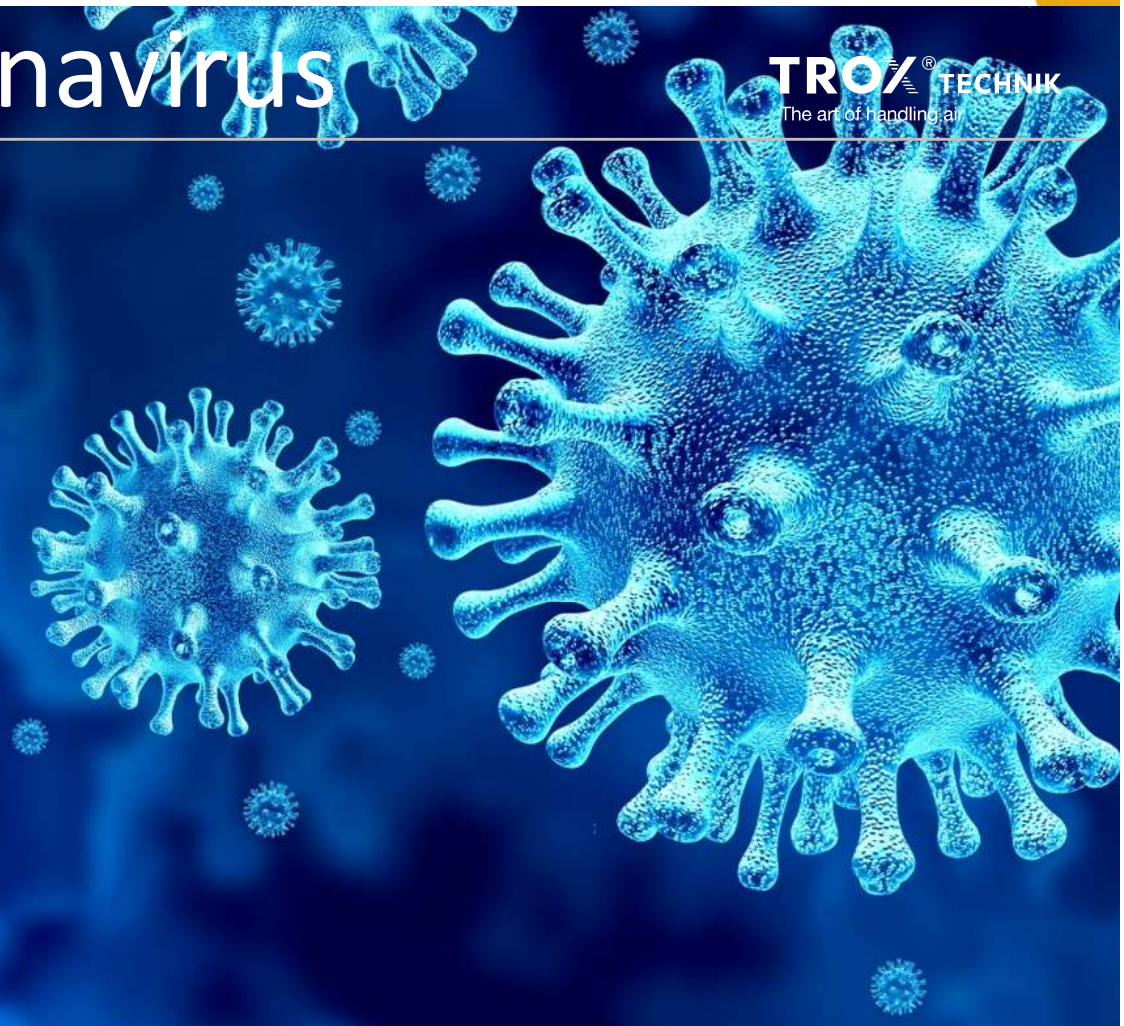

Coronaviruses are
a family of viruses

SARS and MERS are
examples of such viruses

Frequently used as phrase
for SARS-COV-2

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Aerosol

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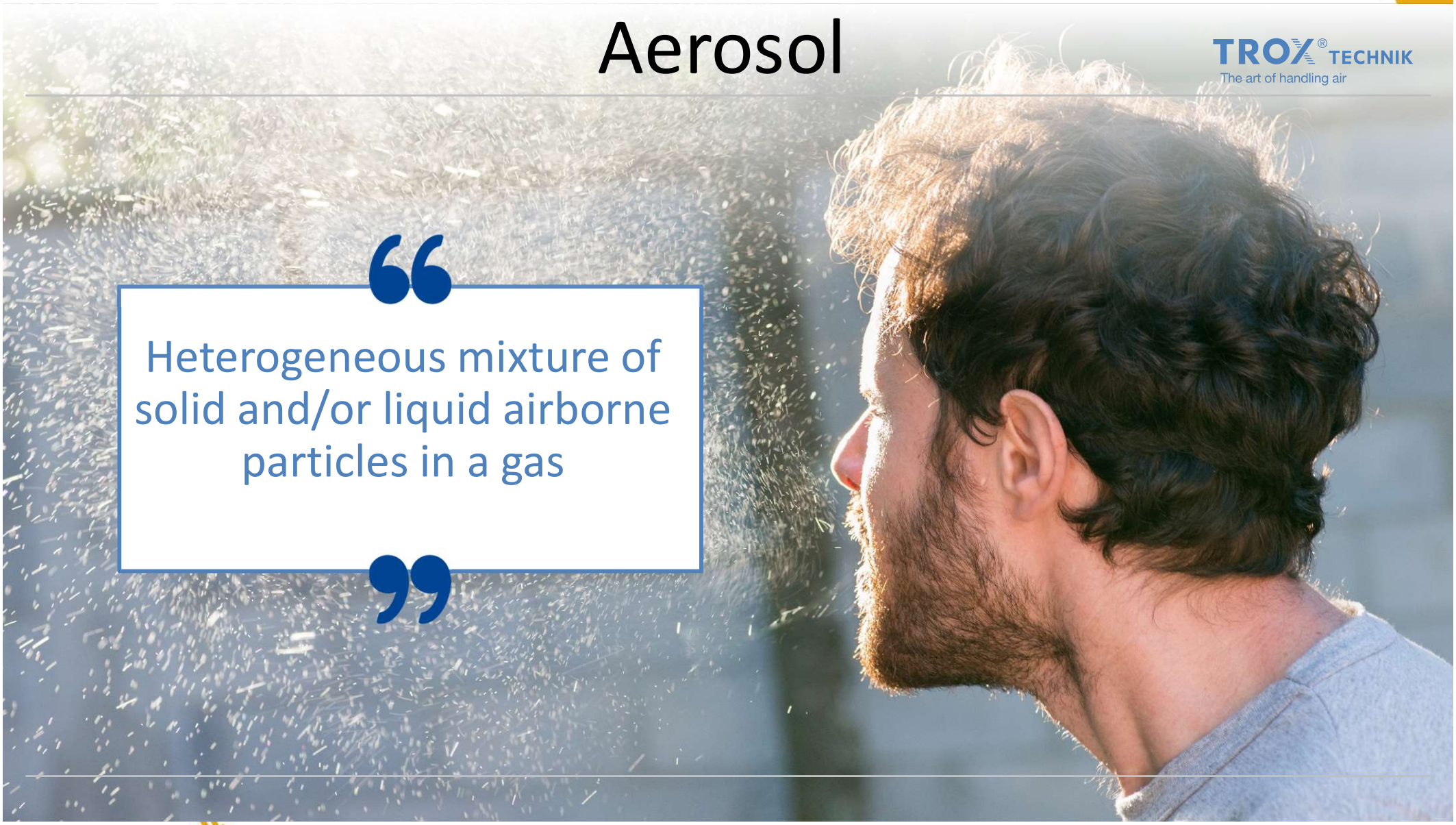

> Heterogeneous mixture of solid and/or liquid airborne particles in a gas

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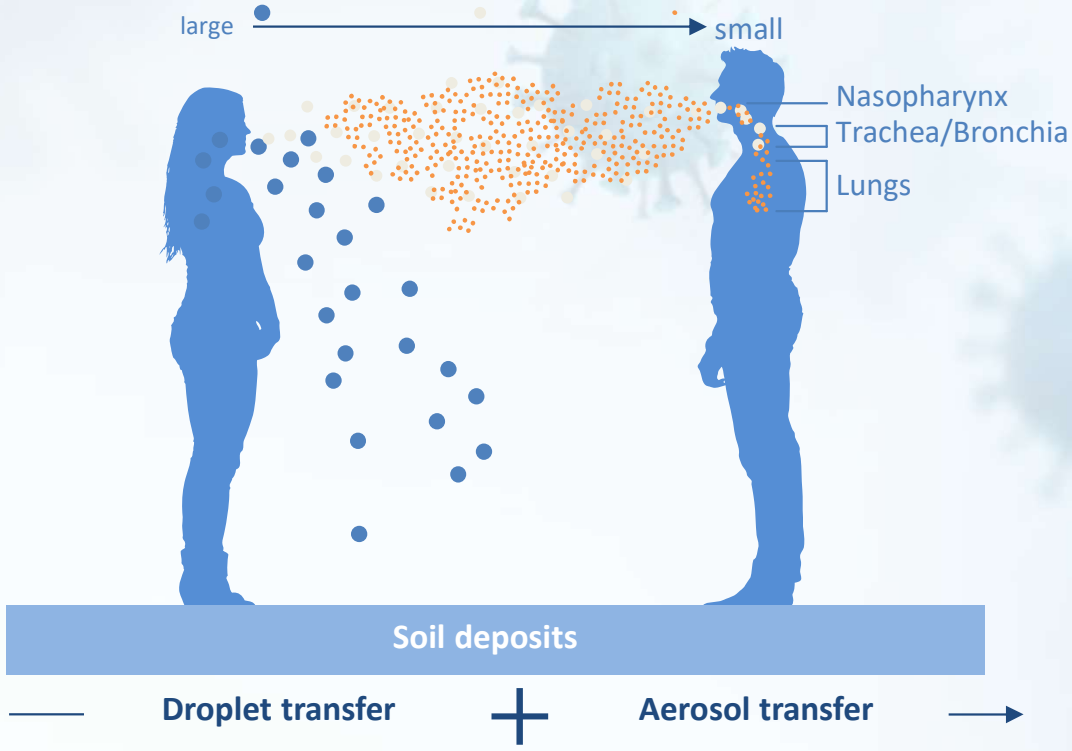
- People as the source of the virus

Behaviour of particles containing the virus?



Comparison between droplet transmission and aerosol transmission (Pan et al. 2019)

- Large particles fall down or can be intercepted by mouth and nose protection
- Smaller particles can remain in the air and pass through mouth and nose protection
- Airborne particles move via body heat, movement, airflows, etc.
- Airborne particles change their characteristics (through vaporisation, loads, etc.)

Influence of air velocity

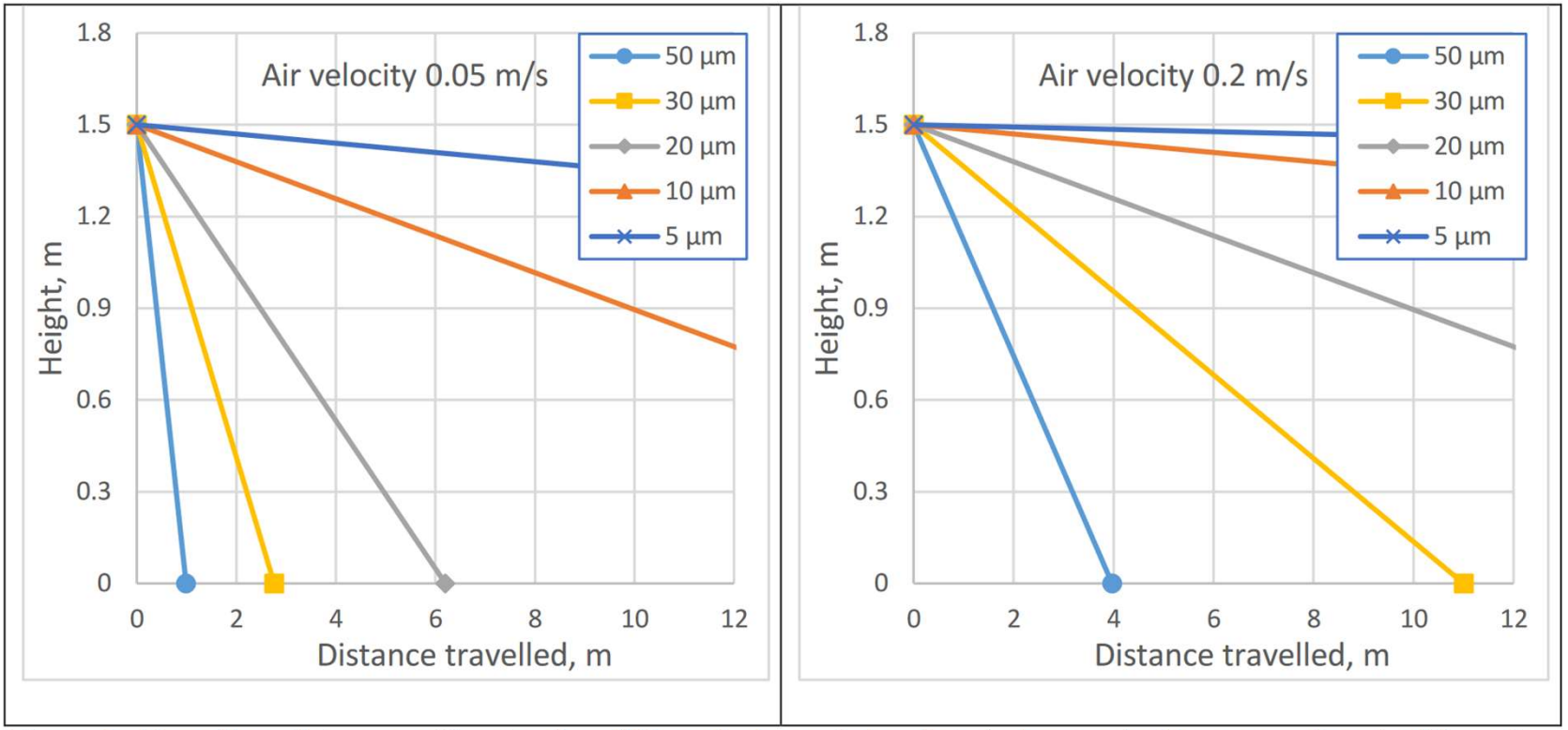


Figure 2. Traveling distance estimates for different sizes of droplets to be carried by room air velocities of 0.05 and 0.2 m/s before settling 1.5 m under the influence of gravity. The travelled distance accounts for movement after the initial jet has relaxed and is calculated with the equilibrium diameter of completely desiccated respiratory droplets (µm values in the figure refer to equilibrium diameters). With turbulence distance travelled is less, but settling time is longer.

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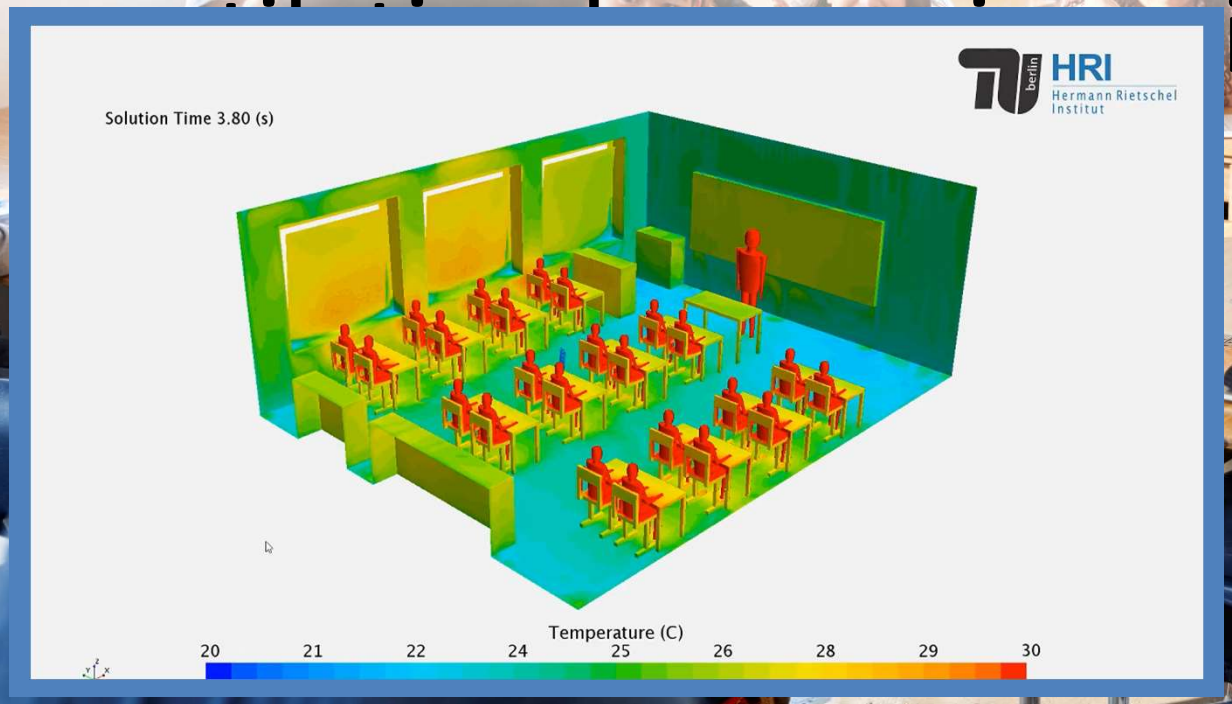
- People as an aerosol source

Behaviour of particles containing the virus? – e.g. classroom / indows



Source: Technical University of Berlin, Herman Rietschel Institute

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How ma particles ny generally occur then?

Measured emission rates of test persons during different activities

	Breathing through the nose	Breathing through the mouth	Speak	Cough
Mean value	23P/s	134P/s	195 P/s	13.709 P/Cough
Minimum value	0 P/s	7 P/s	17 P/s	181 P/Cough
Maximum value	296 P/s	1018 P/s	626 P/s	287.697 P/Cough
Number of test persons	10 (4 w/6 m)	18 (8 w/10 m)	17 (8 w/9 m)	8 (4 w/4 m)

Source: Technical University of Berlin, Herman Rietschel Institute

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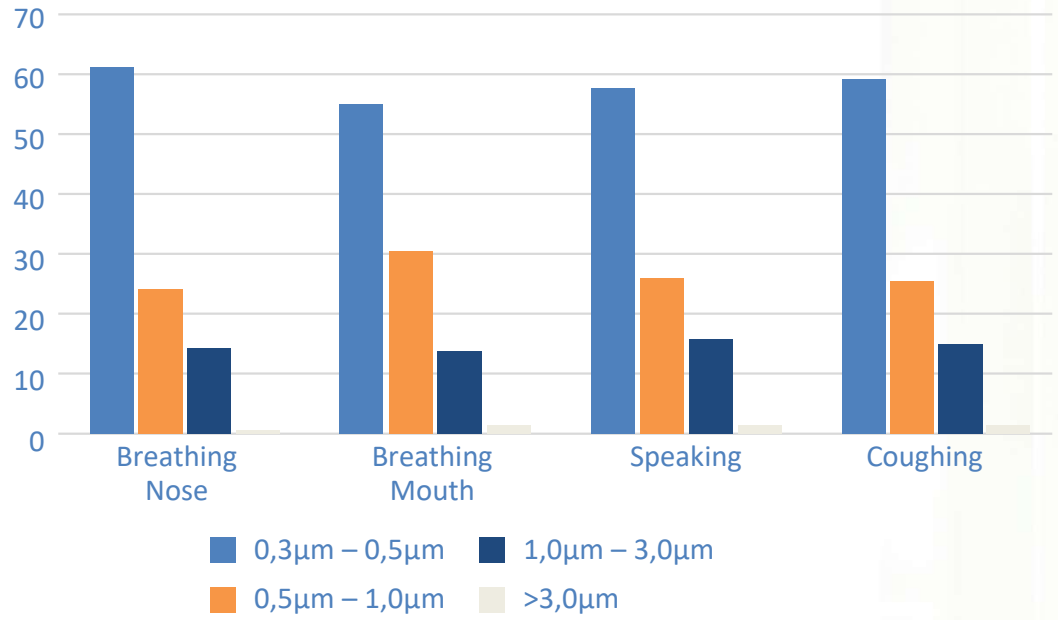
How large are the particles that occur?

Decimal source strength per particle size na the total source strength in %



Source: Technical University of Berlin, Herman Rietschel Institute

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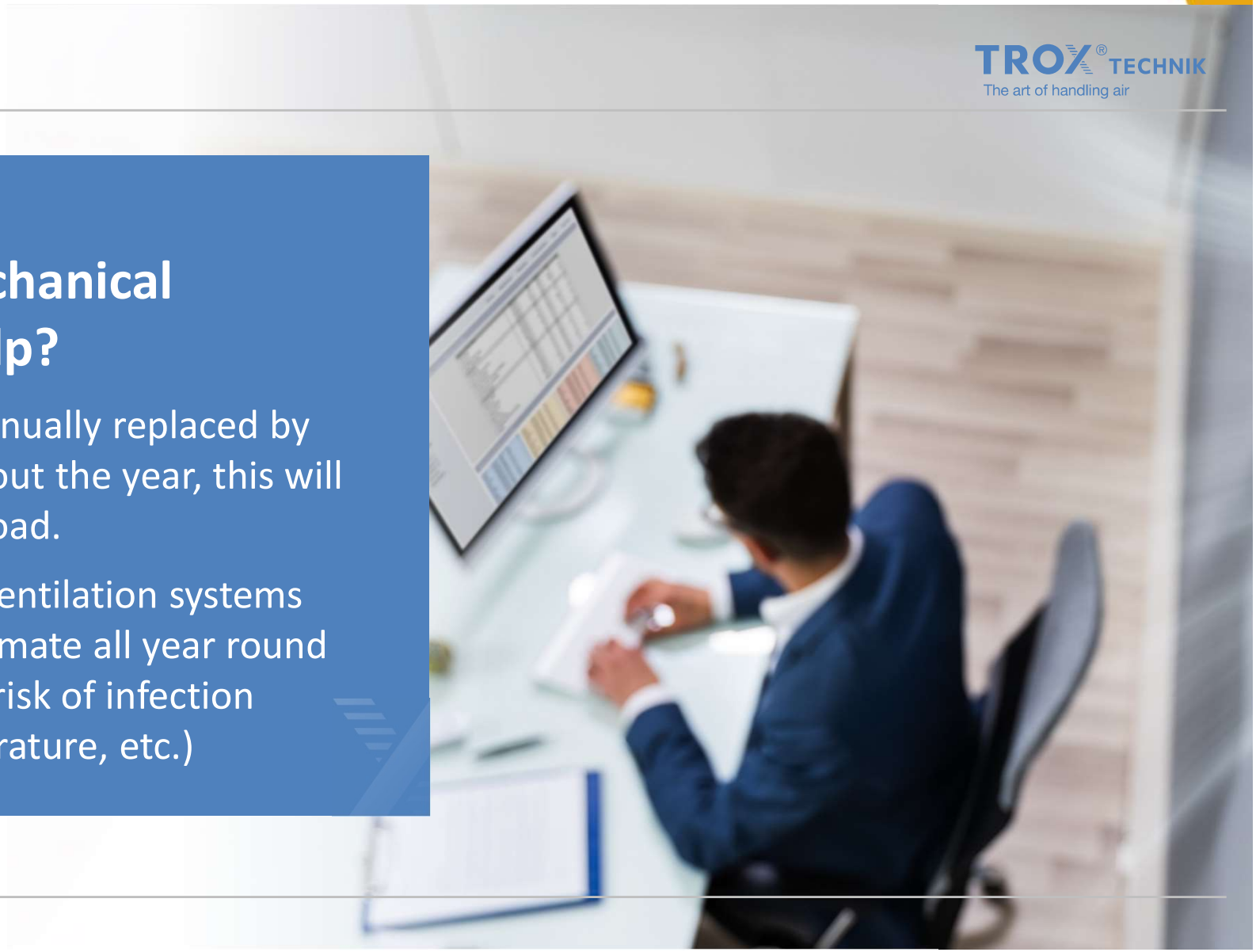
Why does mechanical ventilation help?

- If used air is continually replaced by fresh air throughout the year, this will reduce the viral load.
- State-of-the-art ventilation systems ensure a room climate all year round that reduces the risk of infection (humidity, temperature, etc.)



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Influance of mixed ventilation

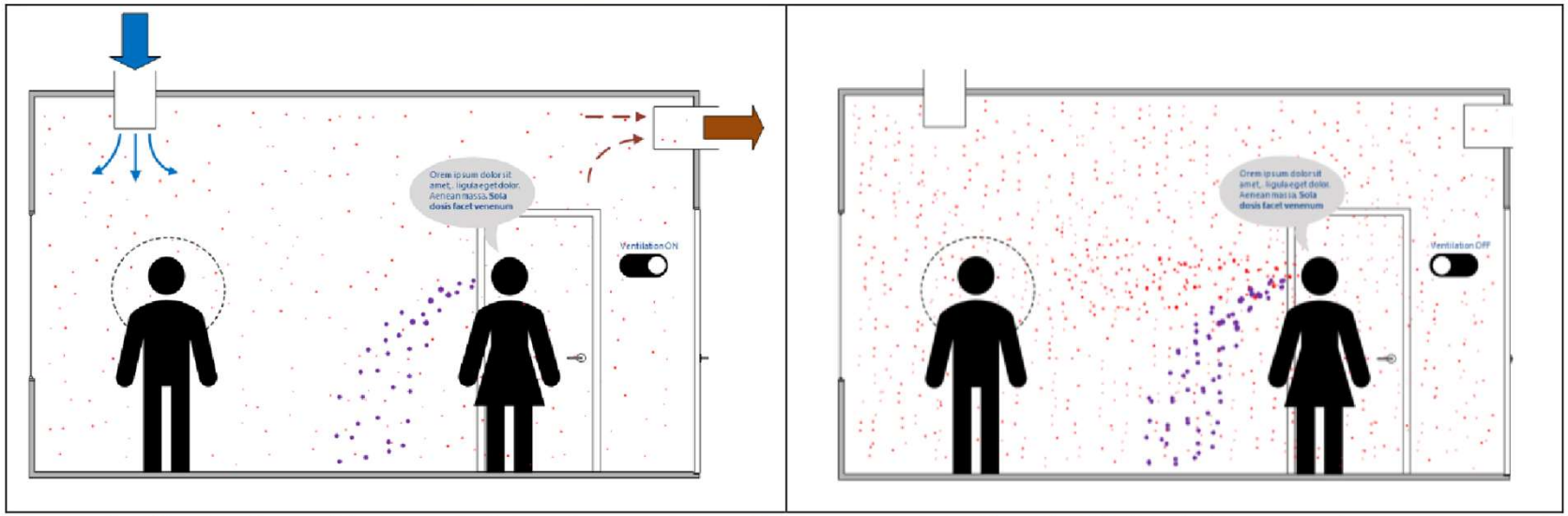

Figure 3. Illustration of how an infected person (speaking woman on the right) leads to aerosol exposure (red spikes) in the breathing zone of another person (man on the left in this case). Large droplet exhalation is marked with purple spikes. When the room is ventilated with mixing ventilation system, the number of virus-laden particles in the breathing zone is much lower than when the ventilation system is off. Left figure: ventilation system on, right figure: ventilation system off.

- **Source REHVA COVID19 Guidance version 4.1**

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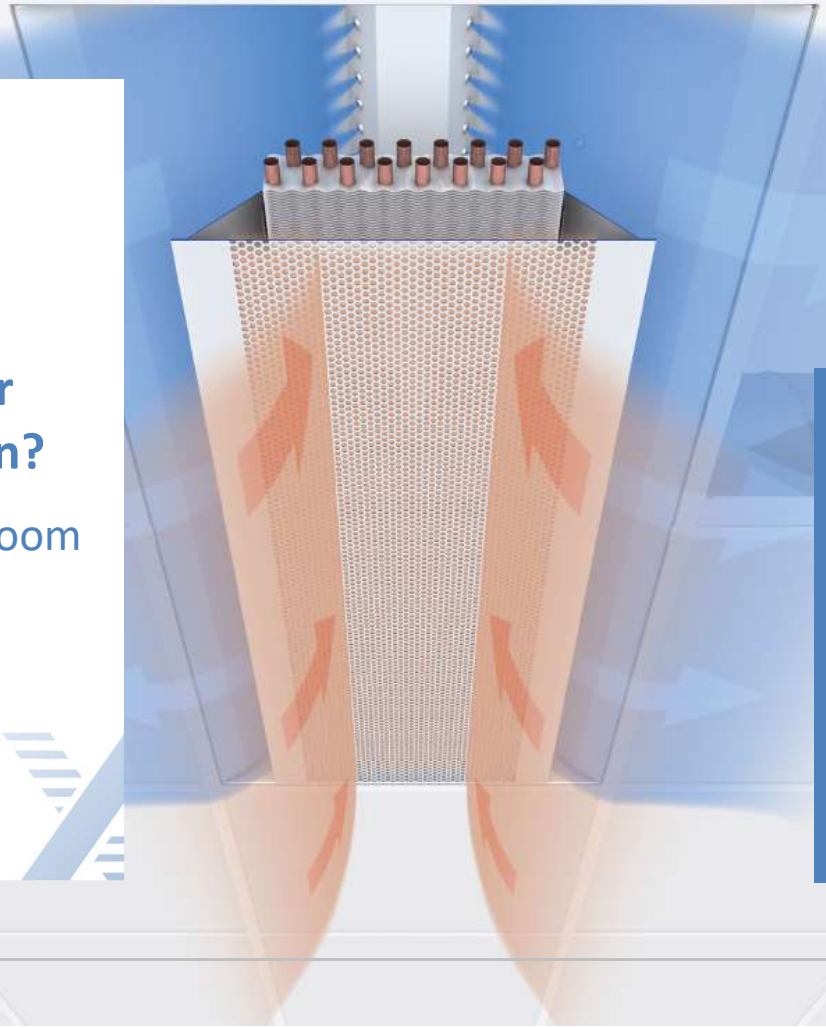
Which is better for reducing the risk of infection? Mixed flow or displacement ventilation?

- Depends heavily on the room use and on the distances
- Both systems have advantages and disadvantages



However, air distribution is often not the determining factor in aerosol distribution, but rather the free convection of loads and movement in the room

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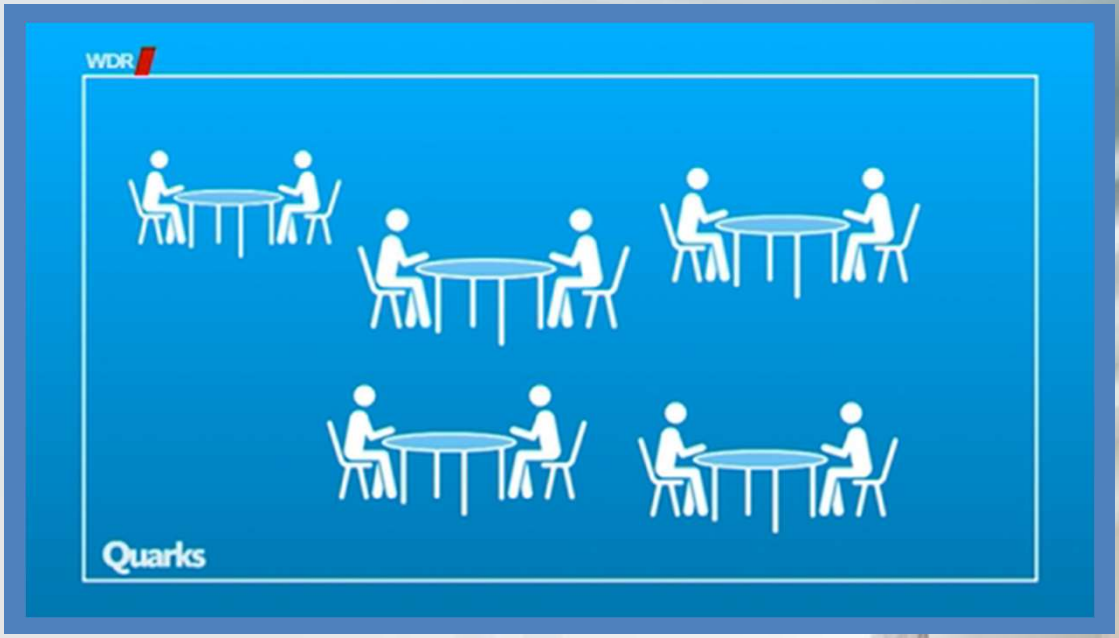
Why is ventilation from opening windows frequently inadequate?

- Without wind and when there are only minor temperature differences between indoor air and outdoor air, air exchange is only minimal
  - no year-round guaranteed ventilation effectiveness
- Room climate cannot be adjusted
- Many rooms do not have an adequate number of windows

How can an "air conditioning system" increase the risk of infection?

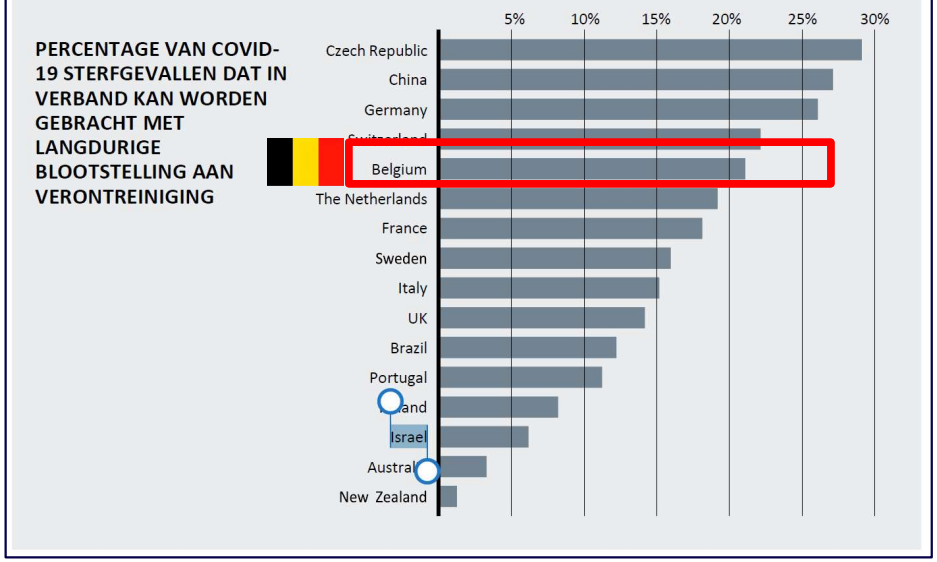


"Air conditioning systems" without a proportion of fresh air and without a sufficient filter can help the virus to spread faster! Such systems do not reduce the viral load at all!

Combinatie van besmette lucht en vervuilde lucht verhoogt het besmettingsgevaar

VERBAND TUSSEN VERVUILING EN COVID-19

Er is een toenemende hoeveelheid bewijsmateriaal dat een verband legt tussen verontreiniging en gevoeligheid voor verhoogde impact door Covid-19. Regional and global contributions of air pollution to risk of death from Covid-19' [31] De conclusie was dat de procentuele toename van het Covid-19 sterfterisico per mg/m3 toename van de blootstelling aan PM2.5, 8% bleek te zijn. Dit komt overeen met ongeveer 19% van het sterftecijfer als gevolg van Covid-19 in Europa.



corona

Lucht is voeding
1pers eet +/-1,2kgvoeding/dag
1pers ademt +/-12m³lucht/dag (0,84kg zuurstof)

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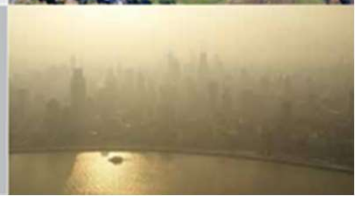
Filtration as a determenating factor for indoor air quality

OUTDOOR AIR			SUPPLY AIR				
			SUP 1* PM2.5 ≤ 2.5 PM10 ≤ 5	SUP2* PM2.5 ≤ 5 PM10 ≤ 10	SUP3** PM2.5 ≤ 7.5 PM10 ≤ 15	SUP4 PM2.5 ≤ 10 PM10 ≤ 20	SUP5 PM2.5 ≤ 15 PM10 ≤ 30
Category	PM2.5	PM10	ePM_1	ePM_1	$ePM_{2.5}$	ePM_{10}	ePM_{10}
ODA 1	≤ 10	≤ 20	60%	50%	60%	60%	50%
ODA 2	≤ 15	≤ 30	80%	70%	70%	80%	60%
ODA 3	> 15	> 30	90%	80%	80%	90%	80%

Category	Description	Typical environment
ODA 1	**OUTDOOR AIR, WHICH MAY BE ONLY TEMPORARILY DUSTY** Applies where the World Health Organisation WHO (2005) guidelines are fulfilled (annual mean for PM2.5 ≤ 10 µg/m³ and PM10 ≤ 20 µg/m³).	
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 PM2.5 ≤ 15 µg/m³ and PM10 ≤ 30 µg/m³).	
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 PM2.5 > 15 µg/m³ and PM10 > 30 µg/m³).	

CATEGORY	GENERAL VENTILATION		CATEGORY	INDUSTRIAL VENTILATION	
SUP 1	-	-	SUP 1	**Applications with high hygienic demands.** Examples: Hospitals, pharmaceutics, electronic and optical industry, supply air to clean rooms.	
SUP 2	**Rooms for permanent occupation.** Example: Kindergardens, offices, hotels, residential buildings, meeting rooms, exhibition halls, conference halls, theaters, cinemas, concert halls.		SUP 2	**Applications with medium hygienic demands.** Example: Food and beverage production.	
SUP 3	**Rooms with temporary occupation.** Examples: Storage, shopping centers, washing rooms, server rooms, copier rooms.		SUP 3	**Applications with basic hygienic demands.** Example: Food and beverages production with a basic hygienic demand.	
SUP 4	**Rooms with short-term occupation.** Examples restrooms, storage rooms stairways.		SUP 4	**Applications without hygienic demands.** Example: General production areas in the automotive industry.	
SUP 5	**Rooms without occupation.** Examples: Garbage room, data centers, underground car parks.		SUP 5	**Production areas of the heavy industry.** Examples: Steel mill, smelters, welding plants.	

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Are rotary heat recovery units or internal leakages

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When rotary units are correctly designed and installed, leakage is reduced to a minimum (irrelevant for the occurrence of infection)

The other internal leakages are also irrelevant for the risk of infection in high-quality systems.

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