CLIMATE CONTROL SYSTEMS

CLEAN AIR BY EBERSPÄCHER

DAVID ROLLS

HOW TO GAIN THE PASSENGER'S CONFIDENCE?

GLOBAL CONCERN TO GET PEOPLE SAFELY BACK ON BUSES

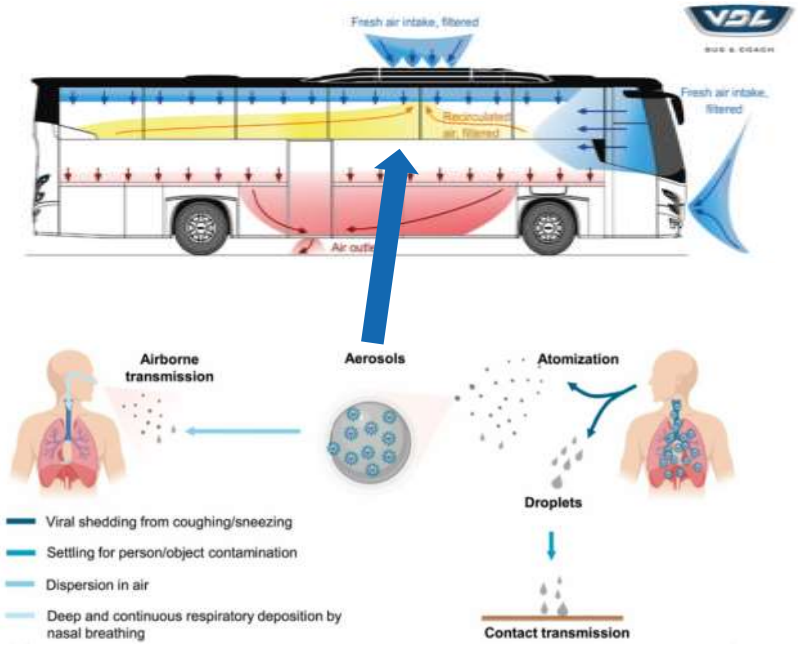
Passengers be safe AND feel safe

- A UITP survey shows that when the pandemic first hit India early 2020: 90% reduction in ridership and 81% of operators had no ridership at all
- Ridership reduction is still down
- Get passenger confidence with awareness of solutions and benefits of an air conditioned bus
- Add simple label: promote ‘safe-bus’
- Global solutions must offer low life cycle costs to allow bus operators to remain competitive
- Global solutions must be able to meet local climate conditions
- Global solutions should be adaptable to all kinds of bus and AC system

WHAT DOES THE AIR CONDITIONING DO ?

WHAT THE AIR CONDITIONING SYSTEM DOES AND DOES NOT DO WITH REGARD TO THE SPREAD OF COVID

- The virus is shed by people coughing and sneezing
- Larger droplets fall onto surfaces insides the bus
- Smaller atomised particles remain in the air and are either transmitted to other passengers or are carried by the air movement up into the AC unit
- It would be more effective to utilise fresh air, but this very inefficient, specially in tropical climate zones
- The AC system creates the air movement inside the bus; therefore our solutions concentrate on treating 100% of the air movement within the AC unit
- A well maintained AC unit can help reduce the virus concentration in the bus and actually make bus environment a safer place to be



https://www.pnas.org/content/117/26/14857

WHAT IS OUR APPROACH?

INTRODUCTION TO CLEAN AIR BY EBERSPÄCHER

Treatment of 100% of the air moving through the AC unit without generating ozone

- Our 3 step approach:
  - Level 1 = air filtration
  - Level 2 = air cleaning
  - Level 3 = air sterilisation
- Filtration = **particle filtration**
  => virus capture
- Cleaning = **Polarised media electronic air cleaner**
  => virus capture
- Sterilisation = **UV-C LED Module**
  => virus de-activation

CLEAN AIR BY EBERSPÄCHER LEVEL 1

PARTICULATE FILTRATION

PARTICULATE FILTERS

High Efficiency Particle Air Filtration

- Used inside the AC unit and replaces the foam filters next to the heat exchangers
- Filter both fresh and recirculation air
- Different filter grades available, depending on local climate zones
  - \+ Lowest initial cost
  - \+ Mechanical installation only, no electrical interface (or power consumption)
  - \- Short service intervals in dusty conditions (i.e. weeks)
  - \- Not applicable to all global climate zones

CLEAN AIR BY EBERSPÄCHER LEVEL 2

POLARISED MEDIA ELECTRONIC AIR CLEANER

EAC (ELECTRONIC AIR CLEANER)

How does polarisation work?

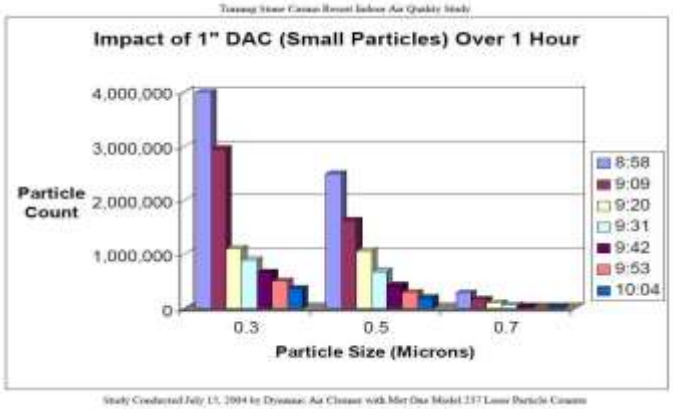
- Polarised media electronic Air Cleaners combine both passive filters and electro-static precipitators.
  - A high voltage is applied to the centre screen of the media pad.
  - This creates an electrostatic field between itself and grounded external screen/frame.
  - This field polarises the fibres of the media pad and the particles that enter the air cleaner.
  - The polarised particles stick to both the media pad and each other in a process called agglomeration.
  - This results in 360° loading which means that every fibre of the filter can catch more dirt particles
  - This type of air cleaner can collect far more dirt particles before it becomes ‘blocked’

EAC (ELECTRONIC AIR CLEANER)

9+ years experience & proven effectiveness

- Replaces the normal return air grille
- Cleans recirculation air only
- Different sizes available to suit most applications
- Operates on less than 1,5 Watts of 24VDC
- Performance: removes 97% of the particles 0,3µm or larger

- Proven effectiveness to remove more than 90% of particles 0,3 micron in 1 hour
- Medium initial price and low life cycle costs
  (media pad change every 3 months in Singapore city bus application)



CLEAN AIR BY EBERSPÄCHER LEVEL 3

UV-C LED AIR STERILISATION

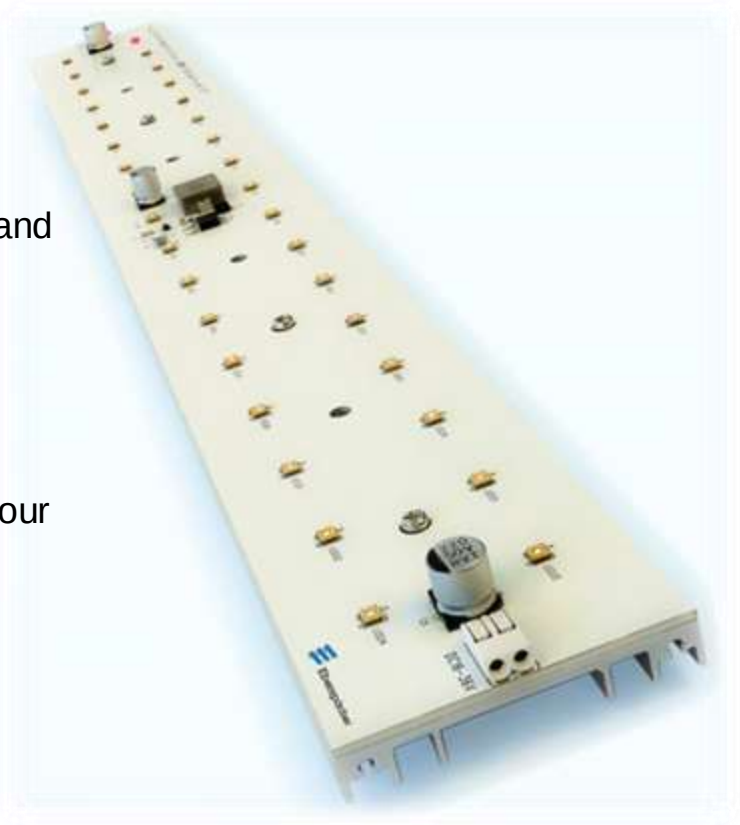
AIR STERILISATION

Why UV-C?

- UV-C radiation (also known as germicidal or microbicidal radiation) that results in the inactivation of microorganisms and viruses as used in hospitals for many years

Why LED?

- Led lights are known for their reliability and long life
- UV-C can also be produced from low pressure mercury vapour lamps, but these were not considered for bus use due to:
  - durability
  - safety concerns if they are broken
  - production of ozone as they ‘warm up’
  - Drifting away from UV-C to UV-B or UV-A as they age
  - heat generation



UV-C LED

- Eberspächer uses a modular UVC-LED solution using modules of different lengths
- They can be fitted inside the AC unit (typically before the heat exchangers) or within the air channel of the bus
- When fitted inside the AC unit, they sterilise both fresh and recirculation air

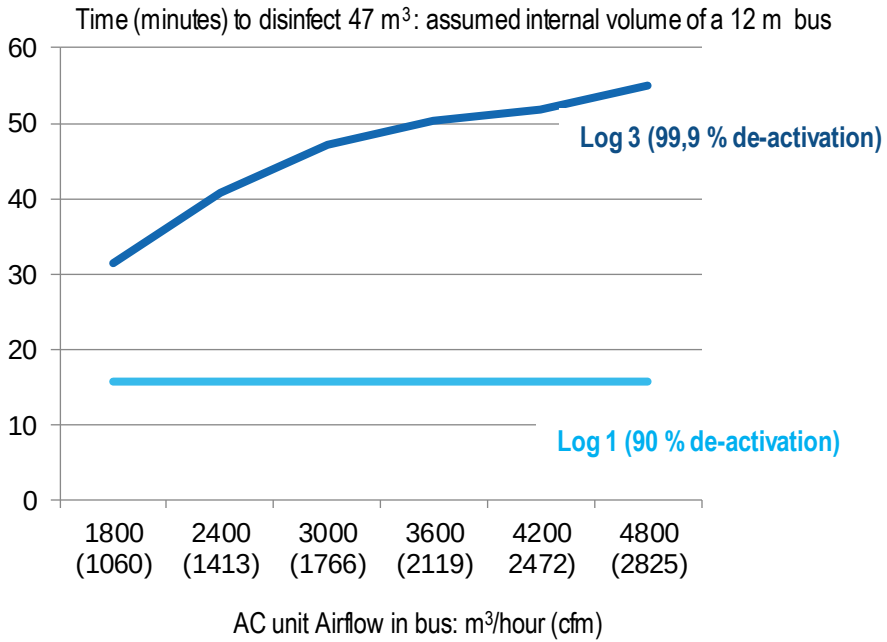
- Minimum power consumption: 0,8 Amp 24VDC per module
- The UV-C LED module is not a filter:
  therefore a filter is still required.
  (It is possible to keep the existing foam filter and service intervals do not need to change)
- Only maintenance required is to periodically clean the profile with a soft brush
- Affordable initial cost with no servicing costs

UV-C LED

Proven effectiveness against viruses, validated by:

- Well reputed Guangdong Centre of Microbiology
  - Influenza virus H1N1
  - Influenza virus H3N2
- Perfectus Biomed (UK test laboratory)
  - Human coronavirus 229E
  - Human rhinovirus (common cold)
  - Murine norovirus (winter sickness bug)

Calculated bus air disinfection times based on measured irradiance:



CLEAN AIR FOR INDIAN BUSES

WRAP UP

- Viruses are transmitted by people coughing and sneezing
- Smaller particles are atomised and our solutions concentrate on the treatment of these particles in the air
- A well maintained AC unit can help reduce the virus concentration in the bus and actually make bus environment a safer place to be

Eberspächer solutions:

1. We treat 100% of the air moving in the AC unit
2. We have different solutions for different climate zones around the world
   - Different levels of air treatment
   - Different life-cycle costs

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