SOLUTIONS for AIR QUALITY management

1. Avoiding emissions

1.1. Cross-cutting/general

1.1.1. Influence of efficient driving: eco-driving and Driver Advisory Systems (DAS)

1.1.2. Electrification and alternatives to combustion engines

1.2. Brake system wear

1.2.1. Brake system pollution prevention

1.2.2. Electrodynamic/electromechanical braking

1.3. Wheels/track wear

1.3.1. Steering bogie

1.3.2. Maximise track curve radius

1.4. Pantograph/catenary wear

1.4.1. Rolling pantograph

1.5. Maintenance works (Grinding, ballast management)

1.5.1. Work zone air flow control with vacuum cleaning

2. Reducing emissions

2.1. Brake system wear

2.1.1. Mechanical brake system management

2.1.2. Low emission brake pads

2.2. Wheels/track wear

2.2.1. Lubrication of wheels and tracks

2.3. Pantograph/catenary wear

2.3.1. Optimising emission-influencing factors in pantograph-overhead contact line (OCL) system

2.4. Exhaust

2.4.1. HVO

2.4.2. Electrification (see 1.1.2.)

3. Reducing concentration

3.1. Capture onboard trains

3.1.1. Vacuum cleaner train

3.1.2. At source brake dust collection system

3.1.3. Filtration via the HVAC system

3.2. Capture inside stations

3.2.1. Station/tunnel cleaning

3.2.2. Plant filtration (green wall)

3.2.3. Particle traps

3.2.4. Liquid filtration

3.2.5. Filtration by ionisation

3.2.6. Passive trap filtration

3.2.7. Mechanical filtration

3.2.8. Filtration with the existing station HVAC system

3.3. Ventilation/ barriers / doors inside stations

3.3.1. Ventilation

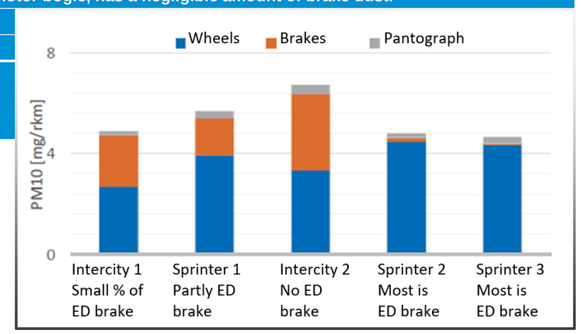
3.3.2. Platform screen/edge doors (PSD/PED or automatic platform gates)

AIR QUALITY MANAGEMENT IN RAIL

PROMISING SOLUTION:

- **Electrodynamic/electromechanical braking**

Field	**Air quality, wear, dust, rolling stock, brake system, Electrodynamic braking (ED)**
Solution	**Prioritise the use of electronic braking systems over other (friction based) braking systems (Electrodynamic/electromechanical/regenerative braking)**
Description	**These braking mechanisms, by nature, do not use friction to reduce the momentum of the wheel.** **Braking using the electric engine up to a few kilometres per hour, braking to stand still is still done using the mechanical brakes.**
Objective	**Reduce brake dust emissive wear from friction of brake pads and disks (from mechanical braking)**
How to	**Maximise electrodynamic braking by allocating braking needs to electrodynamic brakes before using mechanical braking, and this to the further possible braking point.** **To do so, it is possible to define a notch on the brake handle at the point where only regenerative braking is applied for the majority of the time (approx. -50%). The train's TCMS must be programmed accordingly. Safety & training aspects are to be considered for efficient implementation.**
Costs and resources required	**Costs for** • **TCMS programming plus testing and approval** • **Installing notches on brake handles** • **Safety & training considerations** • **New rolling stock**
Benefits Effects	• **Avoided emissions from mechanical brakes** • **Reduce the wear of mechanical brakes** • **Maximise regenerative brake energy being fed into the grid** • **Impact on noise**
Ease of implementation	**Already a standard option in new trains. Existing trains can be modified to optimise the electronic braking**
Constraints, challenges, or lessons learnt	• **Sole use of regenerative braking and the possibility of feeding back the regenerated energy into the grid may be limited in some countries** • **TSI Requirement, see EN 50388-1**
S/M/L term	**Short to medium term**
Efficiency	**Below are the PM10 calculations given for different types of trains with different amounts of ED braking. The PM10 was calculated using the number of worn brake pads and an average wear profile. The intercity (stops every 35 km) with almost no ED-braking, due to it being older trains, show a large percentage of brake dust. The new sprinters (stops every 5 km) with ED brakes in every motor bogie, has a negligible amount of brake dust.**
Maturity	**TRL 9**
Mentioned by	**NS, SBB (brake handle notch)**
Experience	**SBB: Notable effects on amount of recovered energy, thus related mechanical wear is also reduced**



SUSTAINABILITY Action Week