Heavy Metal Emissions from Danish Road Transport

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Disposition

› Background: National study made in order to improve the Danish inventory for road transport HM

› Inventory overview
  › Emission types
  › Emission components
  › Vehicle categories (sources)

› Methodology

› Results

› Conclusion
Inventory overview

› Emission types
  › Fuel
  › Engine oil
  › Brake wear
  › Tyre wear
  › Road abrasion
Inventory overview

- Emission components: As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn (UNECE metals)
Inventory overview

› Vehicle categories
  › Cars (gasoline, diesel, LPG)
  › Vans (gasoline, diesel)
  › Trucks: 4 size categories (COPERT III), and gasoline
  › Buses: urban and coaches
  › Mopeds
  › Motorcycles
Methodology - fuel

- Metal content: Literature review and key experts
  - Gasoline, diesel: μg/kg fuel
- Fuel consumption factors: COPERT data for Denmark
- Fleet and mileage data: Danish inventory
Methodology – engine oil

› Metal content: Literature review and key experts
  › Gasoline, diesel: µg/kg oil
› Functions for consumption of engine oil (l/1000 km)
  › Cars & vans, trucks & buses, motorcycles
› Fleet and mileage data: Danish inventory
Methodology – tyre wear

- Metal content of brake material mg/kg: Literature review
  - No distinction per vehicle type (except Zn)
- Wear rates from Danish Tyre Trade Organisation
  - Cars, vans, trucks (4 size categories), urban buses, coaches, mopeds, motorcycles: mg/vkm
- Speed corrections: EMEP/EEA (2009)
- Airborne fraction of worn material: PM_{10} \sim 5 \% of total wear
- PM size distributions: EMEP/EEA (2009)
- Fleet and mileage data: Danish inventory
Methodology – brake wear

› Metal content of brake material mg/kg: Literature review
  › Cars & vans, trucks, buses

› Airborne fractions of worn material: EMEP/EEA (2009)
  › Cars, vans, Trucks (4 size categories), urban buses, coaches, mopeds, motorcycles: mg/vkm

› Speed corrections: EMEP/EEA (2009)

› Fleet and mileage data: Danish inventory
Methodology – road abrasion

› Metal content of asphalt mg/kg: Literature review
› Airborne fractions of worn material: EMEP/EEA (2009)
   › Cars, vans, trucks & buses, 2-wheelers: mg/vkm
› Fleet and mileage data: Danish inventory
Results – per emission type

Almost all Hg emissions come from fuel usage.

**Engine oil**: Largest shares are noted for Cd (83 %). Substantial emission shares of Cr (33 %), Zn (28 %) and Ni (25 %).

**Tyre wear**: Most important emissions are Se (58 %), Zn (33 %) and Ni (15 %).

**Brake wear**: Most important source of emissions for Cu (100 %), Pb (96 %), As (82 %), Ni (46 %), Zn (39 %) and Cr (37 %). For Se the emission share is 40 %.

**Road abrasion**: the most important emission species are Cr (12 %) and Ni (11 %).
Results – per vehicle type

• Cars are the most important source category, followed by vans, trucks, buses and 2-wheelers.
Results – new vs previous inventory for road transport

The emission difference between the new and the previous inventory for Pb is huge (around 10000 %) due to the emissions from brake wear. For Cu and Zn, large emission differences of around 600 % are noted. Brake wear is a very dominant emission source for Cu also. For Zn, brake and tyre wear and engine oil are all important sources of emissions.
Results – road transport share of revised Danish inventory

Road transport is a key source for Cu (95 %), Zn (54 %) and Pb (53 %), and of some relevance for Cr (15 %). For the remaining emission components, road transport is only a small source of emission.
Conclusion

› Estimates of heavy metal emissions can be made for other years than 2007.
› The basis data can be input for models e.g. COPERT
› The emission factors are independent from inventory year.
› The emissions for each source/fuel/vehicle type combination are calculated as the product of the specific emission factor and the specific activity data; fuel or engine oil consumption or total mileage.
References

Thank you for your attention!