

Brake and Tire Emissions in MOVES

Edward Nam, Sujan Srivastava

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The word "MOVES" is displayed in a stylized, metallic, three-dimensional font with a brushed metal texture and a slight shadow effect, set against a dark grey rectangular background.

Outline

- **Background & Overview**
- **Brake**
- **Papers**
- **Methodology**
- **Activity weighted**
- **Tire**
- **Axle counts**

MOBILE6 (PART5)

- **Brake and Tire emissions based on earlier studies**
 - Materials have changed
 - No accounting for type of driving
 - No accounting for road type
 - No accounting for vehicle type

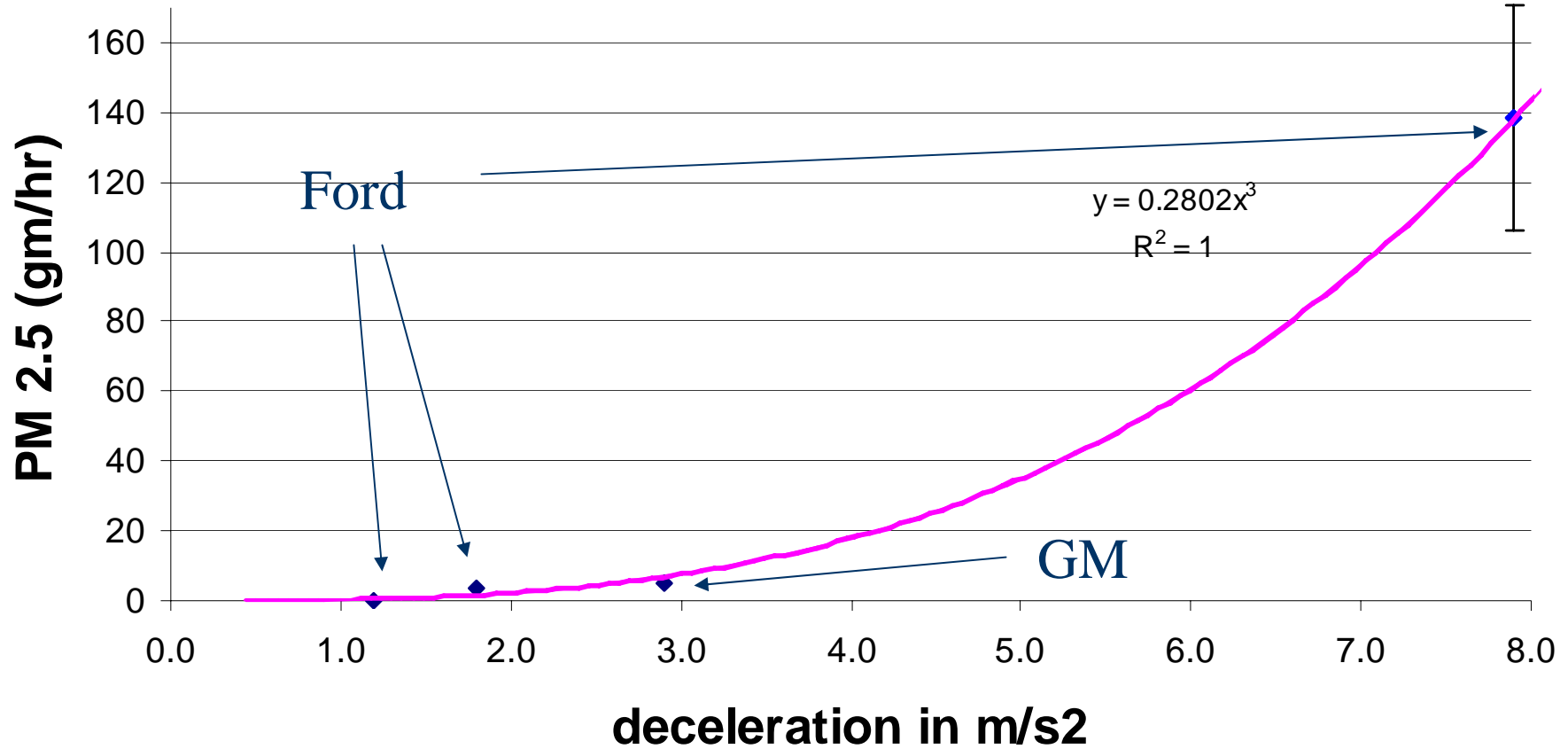
Brake Emissions Literature Search

- **Several top-down (source apportionment) references**
- **Only 2 bottom-up (brake tests)**
 - Garg et al., 2000 (GM paper)
 - Sanders et al., 2003 (Ford paper)
- **Combined rates, accounting for:**
 - Number of brakes
 - Front vs rear braking
 - Composition of brake pad
 - Particle size distribution
 - Braking intensity
 - Airborne fraction

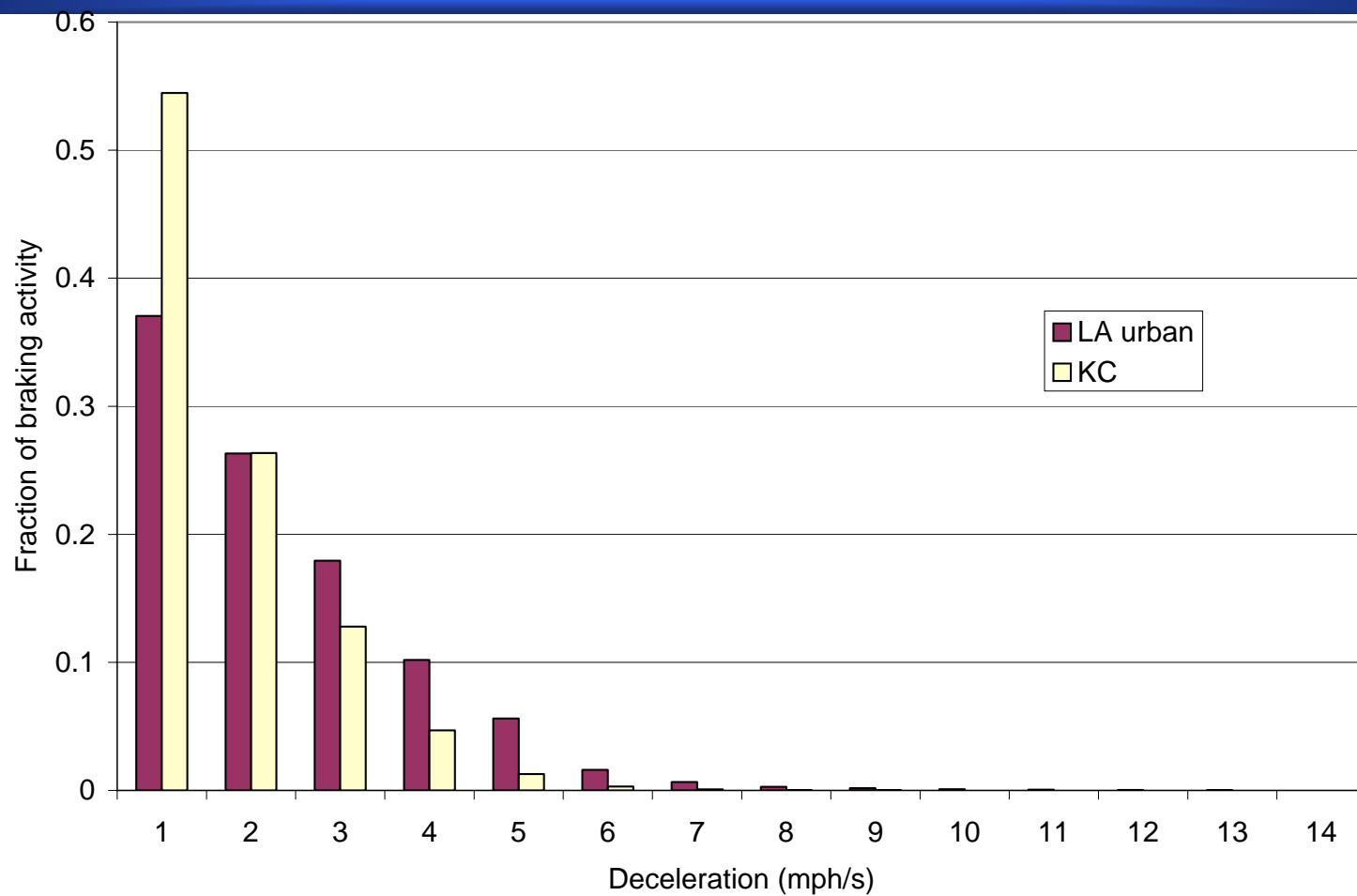
Ford assumptions

- **2/3 of braking power in front brakes (1/3 rear)**
- **Most brake pads are either**
 - Low-metallic (mid-size cars)
 - Semi-metallic (full-truck)
 - Non-asbestos Organic (NAO) (full-size car)
- **Fraction of total PM below 2.5um is ~ 10% (+/-5%)**
- **60% of brake PM is airborne (+/- 10%)**
- **Tests done at 3 different deceleration levels**
- **GM rates adjusted by these assumptions**

PM2.5 Airborne LD Brake Emissions



Braking Activity



EPA Assumptions

- **Straight average of brake pad formulations done**
 - Approximates Fleet
- **Weight of vehicle not compensated**
- **All emissions allocated to only 1 braking “VSP bin” in MOVES**
- **Deceleration $< 1\text{mph/s}$ is assumed to be “coasting” (based on coastdown data)**

Emission Rate

- Emission curve combined with activity to get MOVES rates
- FTP based emission rate (for passenger vehicle)
 - 0.21 g/hr PM_{2.5} (3 mg/mi)
 - 1.79 g/hr PM₁₀ (28 mg/mi)
- MOVES (based on Real-world) emission rate (avg of KC and LA)
 - Will be significantly higher
- For comparison PART5 BER is 12.8 mg/mi total PM

Tire Emissions

MOVES



Tire Literature search

- **Only 1 top down study**
- **Only 1 bottom up paper found**
 - Kupiainen et al., 2005.
- **Circular Track 30km/hr**
- **Emission rate (4-wheel passenger vehicle)**
 - 2 mg/mi PM_{2.5}
 - 9 mg/mi PM₁₀
 - PART5 emission rate 8 mg/mi total PM.

Tire Emissions from Heavy Duty

- **Determined Axle and tire count from 2002 VIUS data**
- **Determined tire emissions in each regulatory class in MOVES**
- **Multipled base emission rate by tire factor**

Conclusions

- **Brake Wear Emissions determined from 2 recent references**
- **Brake wear higher than MOBILE6**
- **Tire wear emissions determined from 1 recent reference**
- **Tire wear higher than MOBILE6**

Next steps

- Estimate Brake wear from Heavy duty based on light duty
- Compare rates with top down (source apportionment) studies

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