UCR | College of Engineering- Center for Environmental Research & Technology

Real-time Measurement Methods To Detect High PM Emissions From Light-duty Gasoline Vehicles

17th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP
March 26, 2007

John Collins
CE-CERT

UCR | College of Engineering- Center for Environmental Research & Technology

Sponsor

Air Resources Board

UCR | College of Engineering- Center for Environmental Research & Technology

Co-Investigators

CE-CERT

Wei Li, Thomas Durbin

ARB

Tao Huai, Alberto Ayala

Plan

- Recruit vehicles
- Measure PM emissions
- Repair vehicles
- Re-test

Vehicle Recruitment Targets

Selective Sample:

- Range of Emission Levels
- Range of Emission Types

Emission Categories

Baseline	No Smoke	
Light (Invisible):	Blue	Black
Medium:	Blue	Black
Heavy:	Blue	Black
Medium:	Gray	

Vehicle Identification

#	MY	OEM	Model	Type	Disp.(L)	Mileage	Target Smoke Type	Target PM (mg/mi)
1	1997	Ford	Escort	PC	2.0	25,598	Normal emitter (no smoke)	< 5
2	1985	Toyota	Camry	PC	2.0	268,423	Light Black (invisible)	25 to 75
3	1991	GMC	Sonoma	LDT	4.3	171,487	Light Blue (invisible)	25 to 75
4	1981	Toyota	Pickup	LDT	2.4	119, 728	Moderate Blue	50 to 500
5	1995	Dodge	Dakota	LDT	2.5	123,974	Moderate Black	50 to 500
6	1963	Studebaker	Avanti	PC	4.6	high	Heavy Blue	50 to 500
7	1998	Toyota	Camry	PC	3.0	82,704	Heavy Black	50 to 500
8	1986	Mitsubishi	Max	LDT	2.0	163,913	Gray	50 to 500

PC = Passenger Car; LDT = Light-Duty Truck.

Measurements

Augmented Idle

Augmented ASM

Augmented Unified Cycle CVS

RSD (reported in separate paper)

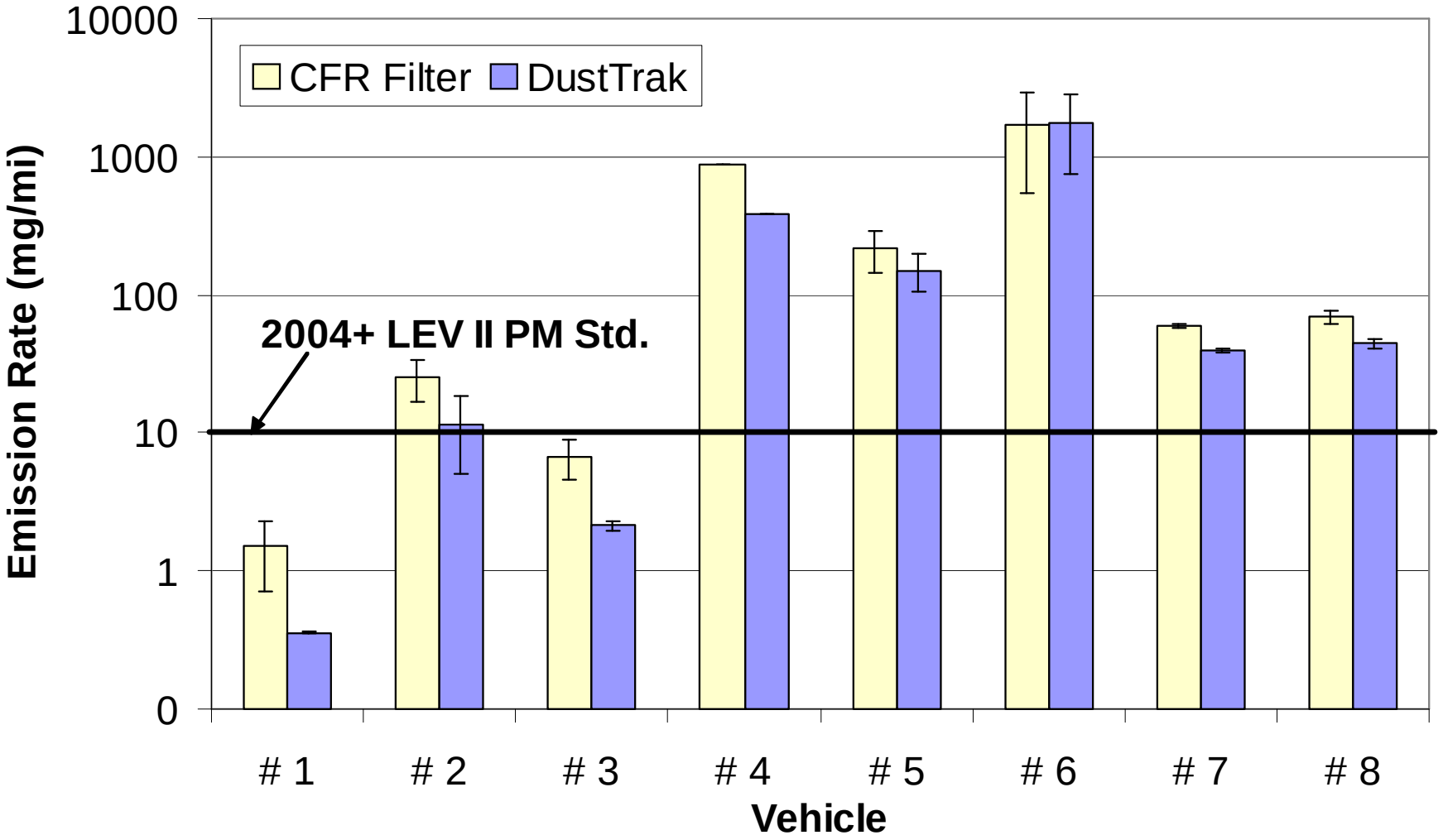
Unified Cycle Measurements

Mass on Teflon filter

DustTrak (Mass)

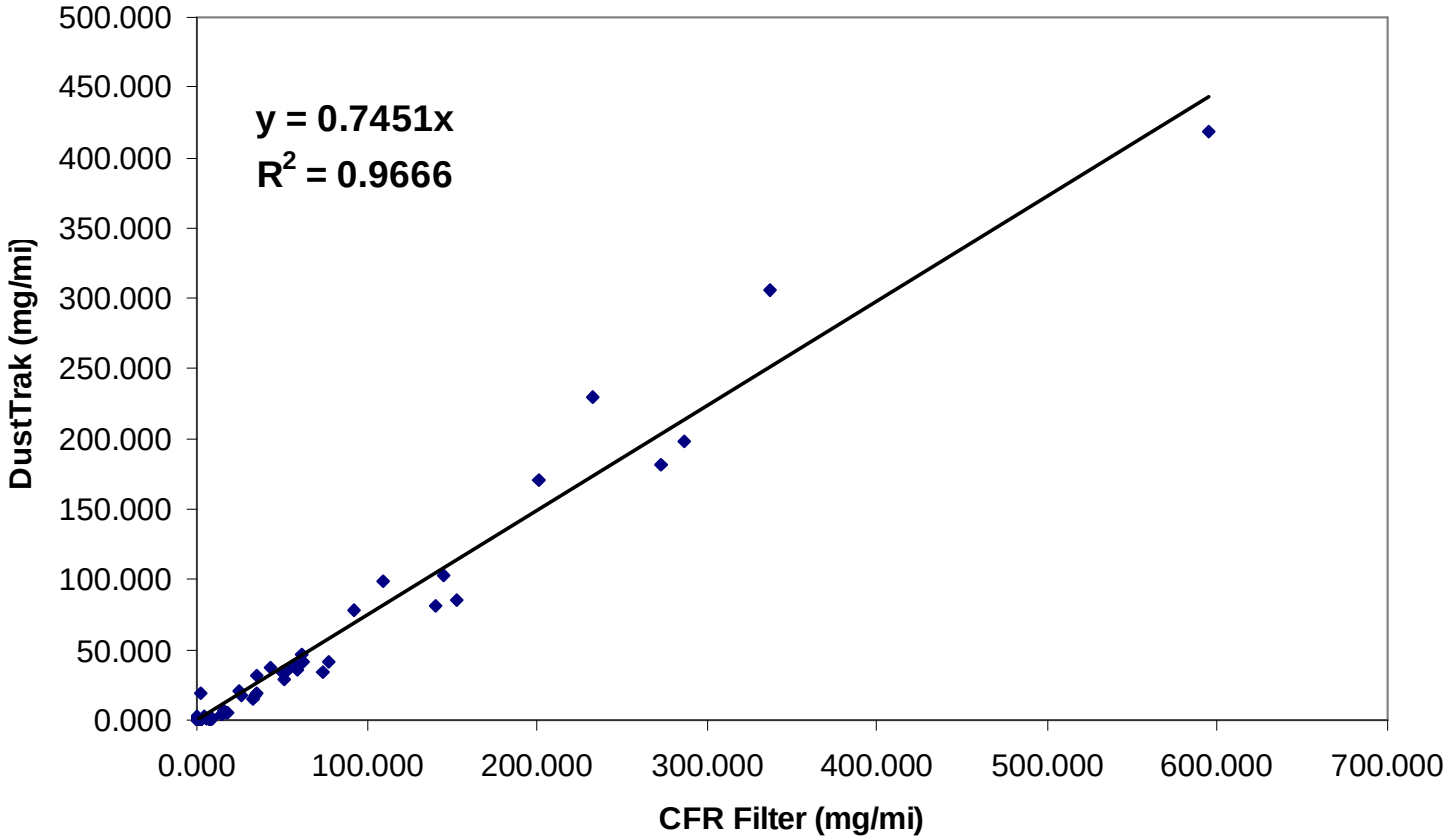
CPC (Particle Number)

Mass over Unified Cycle

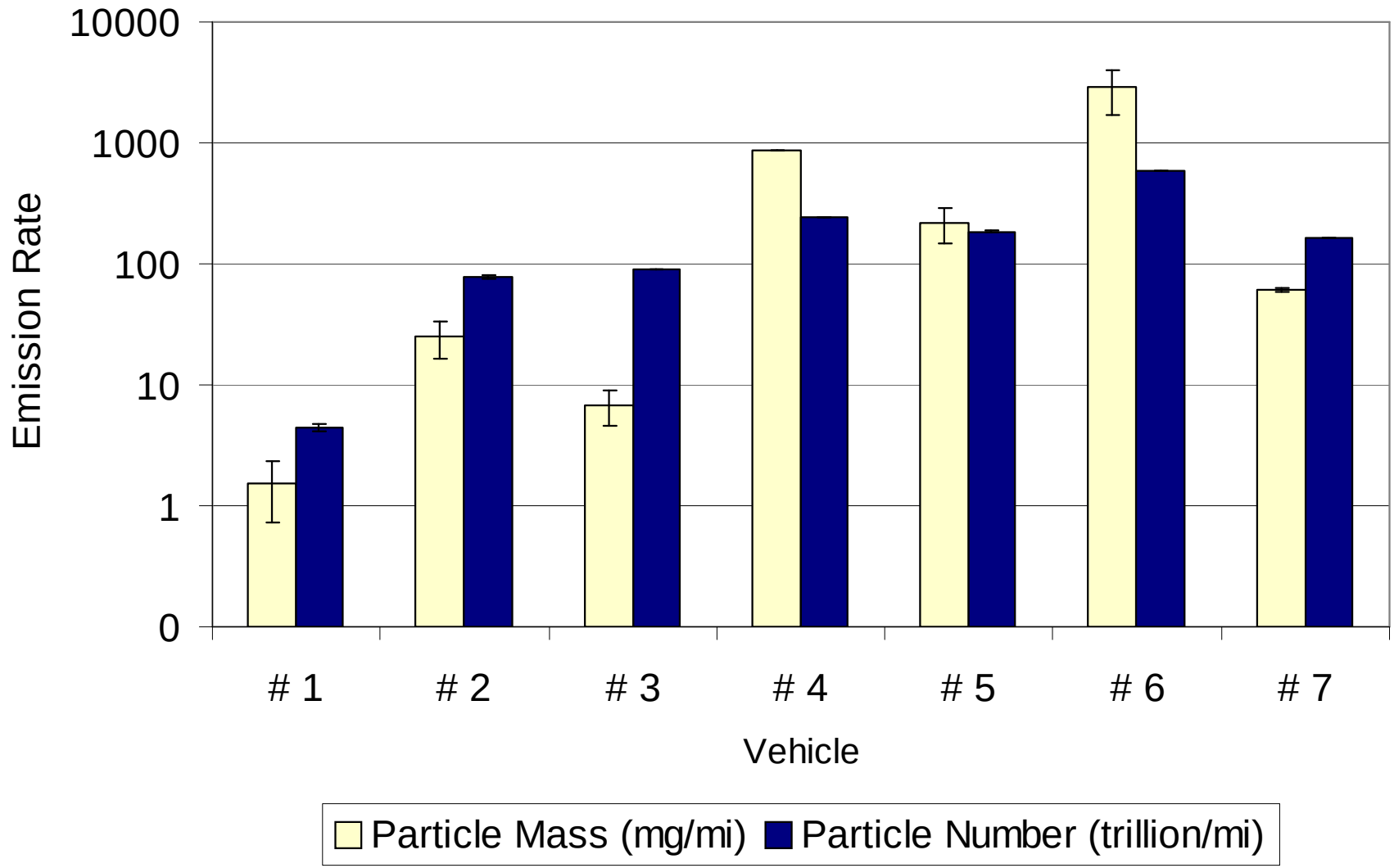


DustTrak Correlation

(excluding blue smokers)



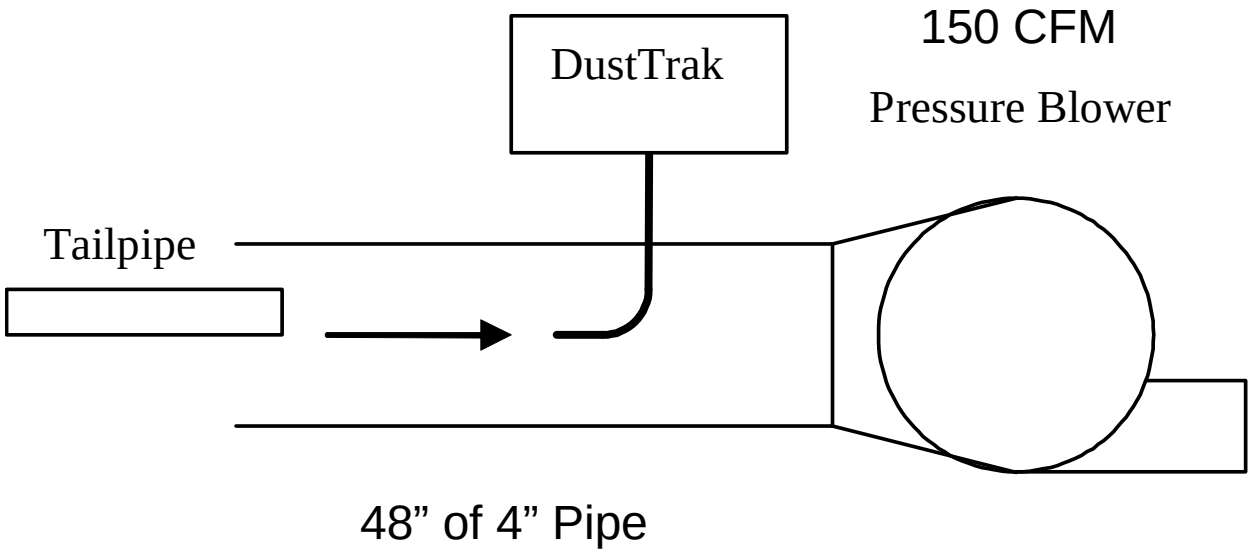
Particle Number over Unified Cycle



ASM and Idle Testing

Augmented with mini-CVS screening device to measure PM mass

Mini-CVS



Mini-CVS

Total Flow = 150 cfm

Dilution air = Unfiltered ambient air

Sensor = DustTrak

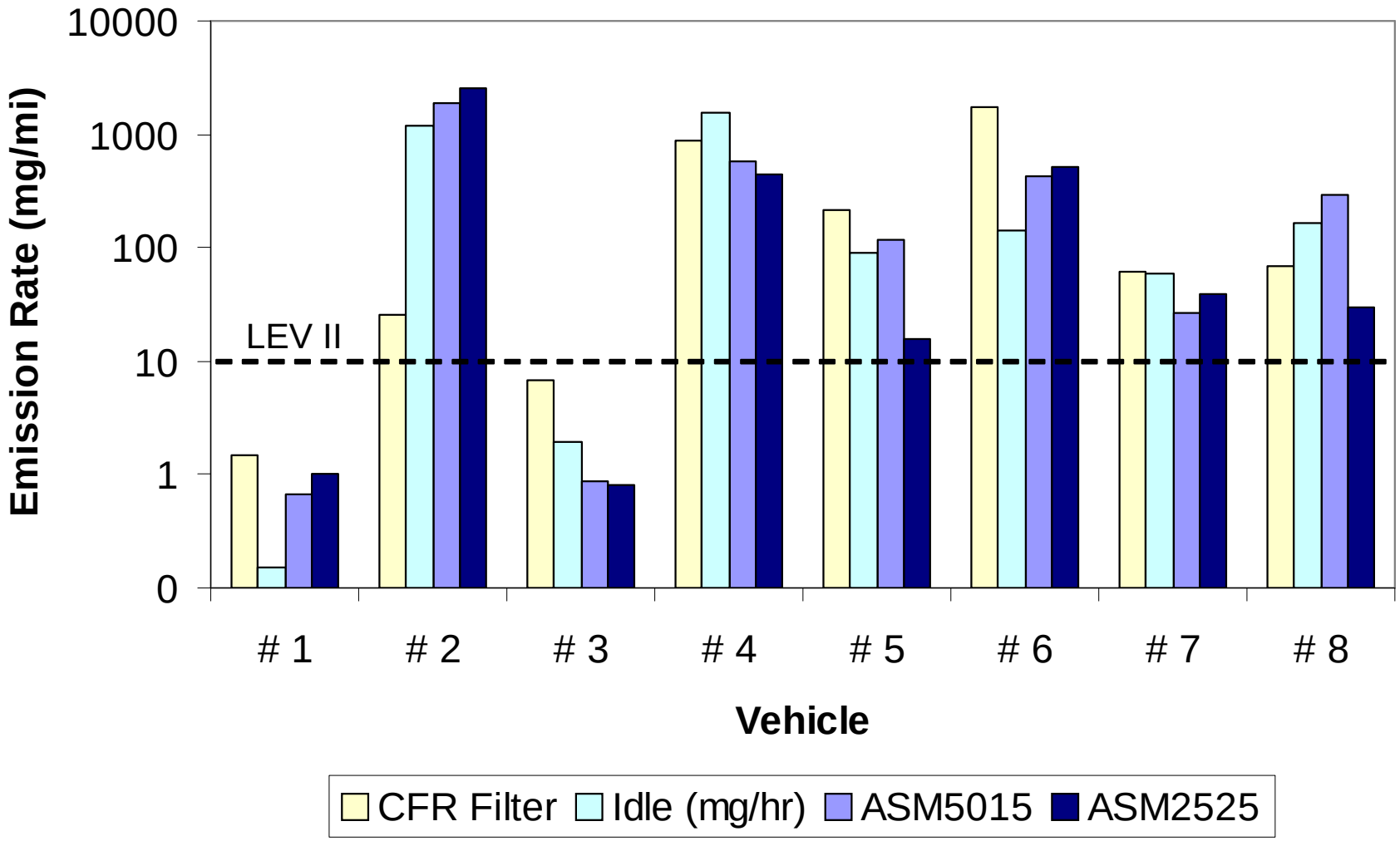
Power = 12-volt car battery

ASM Criteria Gas Results

Vehicle	First Test	Second Test	Failed Emissions
1	√	√	
2	√	√	
3	√	**X**	HC
4	**X**	**X**	HC, NO
5	**X**, GP	**X**, GP	HC, +
6	**X**, GP	**X**, GP	HC, CO
7	**X**, GP	**X**, GP	HC, CO
8	√	**X**	HC, CO

√ = Pass **X** = Fail GP = Gross Polluter

Unified Cycle, Idle, and ASM



UCR | College of Engineering- Center for Environmental Research & Technology

Vehicle Repair

MY	Model	Book	Est. Cost	Repair Needed	Repaired?
1997	Escort	$2,500	N/A	None	
1985	Camry	$ 500	$7,300	Rebuild/new	
1991	Sonoma	$2,000	N/A	(Valve guides)	
1981	Toy. PU	$ 500	$6,300	Rebuild/new	
1995	Dakota	$1,500	$2,200	Fuel and Wiring sys.	*
1963	Avanti	$9,500	N/A	Rebuild	
1998	Camry	$6,500	$2,000	O2 Sensor, Catalyst	*
1986	Max	$1,000	$1,700	Valve guide, Carb.	*

Conclusions

DustTrak PM correlates well with filter mass for LDGV emissions

Supplemented ASM or Idle testing can identify high-PM emitters

Black Smokers are repairable