

# Brake Pad Partnership

Stakeholder Conference

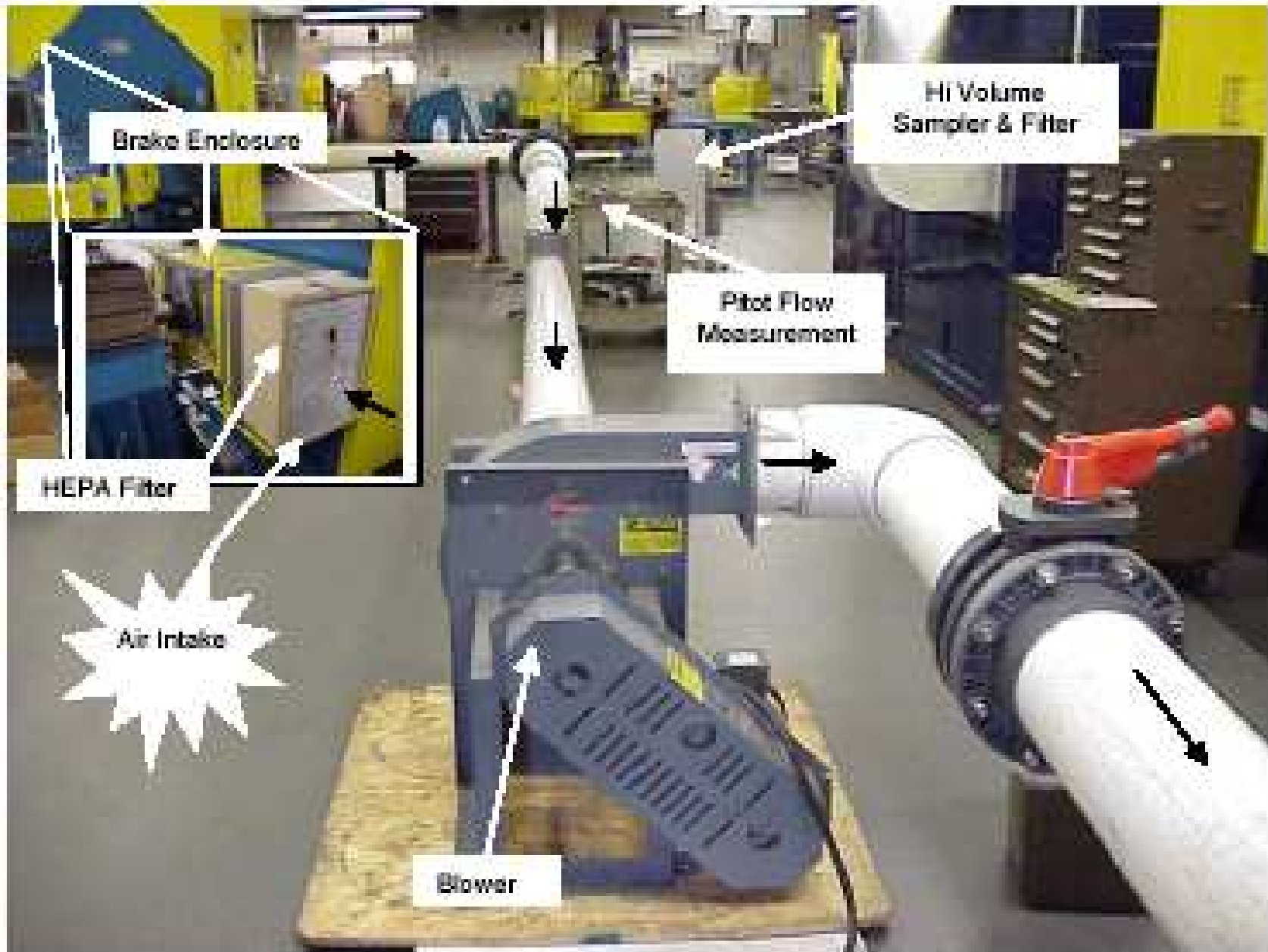
July 31, 2007



# About Brake Pad Wear Debris

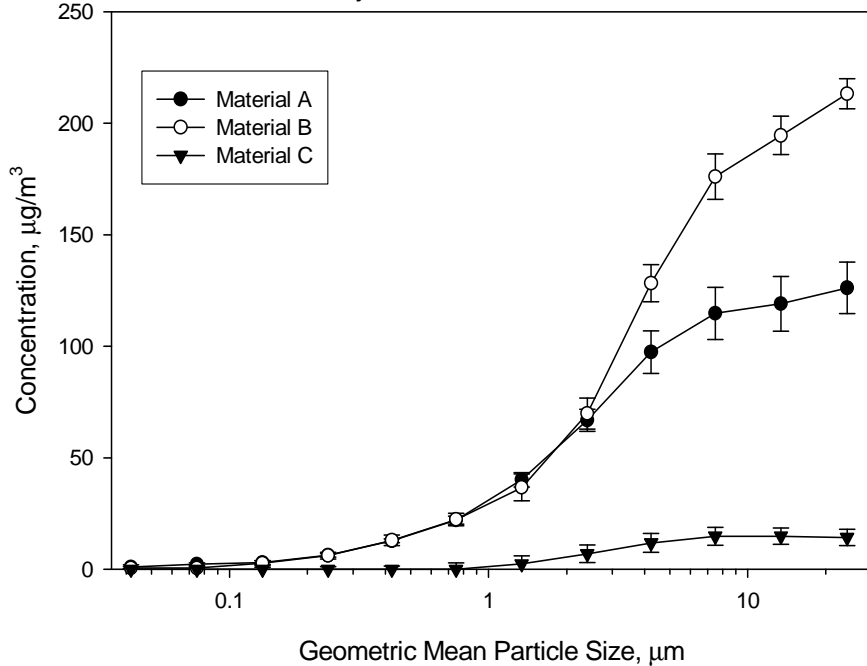
- Generating a representative sample
- What physical and chemical properties will affect the environmental transport and fate of copper from BPWD?
  - BPWD particle size (and size distribution)
  - Leaching of copper from BPWD in aqueous solutions

## Wear Debris Collection Apparatus Photo

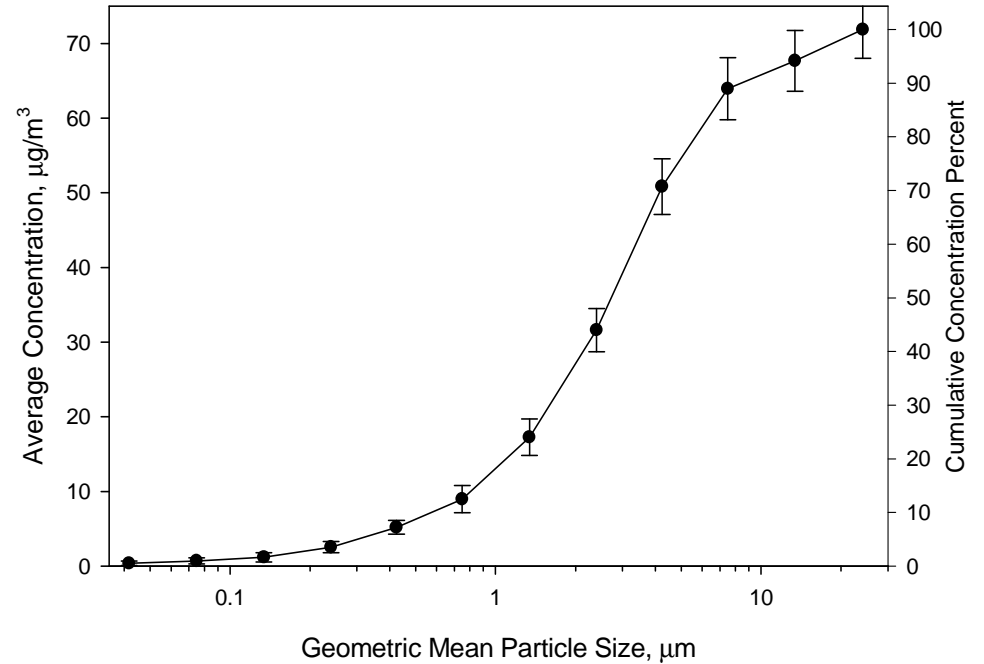


# Airborne Characterization Results

Average Cumulative Concentration-Based Particle Size Distributions after Blank Adjustment for All Brake Pad Materials



Theoretical Composite Cumulative Concentration-Based Particle Size Distribution after Blank Adjustment



*Material A = 26.4%*  
*Material B = 14.1%*  
*Material C = 59.5%*



*Calculated PSD for  
 Representative Sample*

# Non-Airborne Characterization Results

**Table 2. Leaching test results for the representative nonairborne BPWD sample.<sup>a</sup>**

Leaching Solution <sup>b</sup>	Cu recovery (%)	Fe recovery (%)	Final pH
TCLP	72.7 ± 3.9	16.8 ± 1.8	4.9
WET	101.0 ± 1.9	71.7 ± 3.1	4.9
SPLP	2.5 ± 1.1	BD <sup>c</sup>	6.5
Inorganic synthetic rainwater	0.6 ± 0.1	BD	7.7
Synthetic rainwater	0.1 ± 0.1 <sup>d</sup>	BD	7.1
Concentrated synthetic rainwater	70.5 ± 1.0	1.4 ± 0.9	5.3
SRFA (3 mg C/L)	3.5 ± 0.1	1.6 ± 0.4	6.4
EDTA (8 × 10 <sup>-5</sup> M)	63.5 ± 3.7	2.9 ± 0.9	7.1

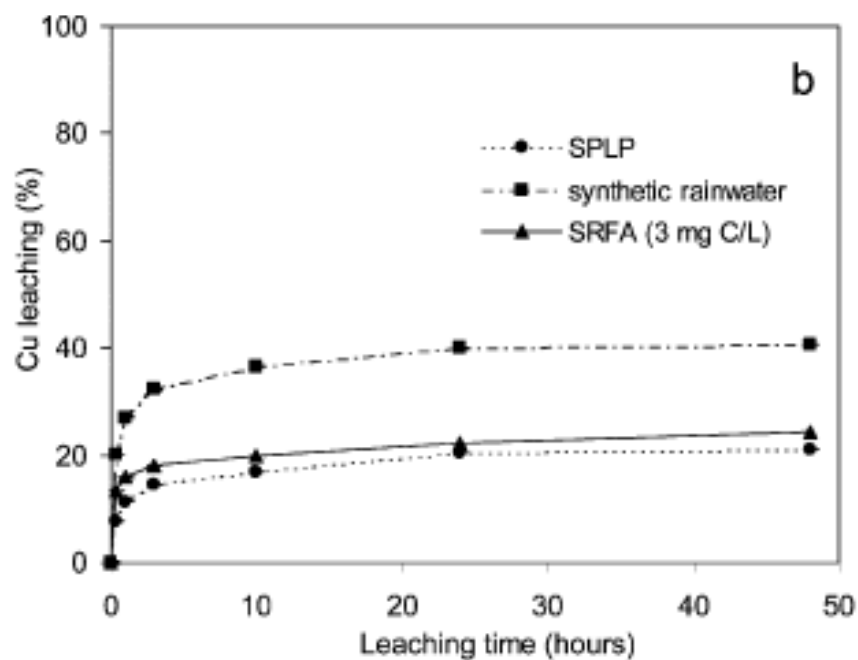
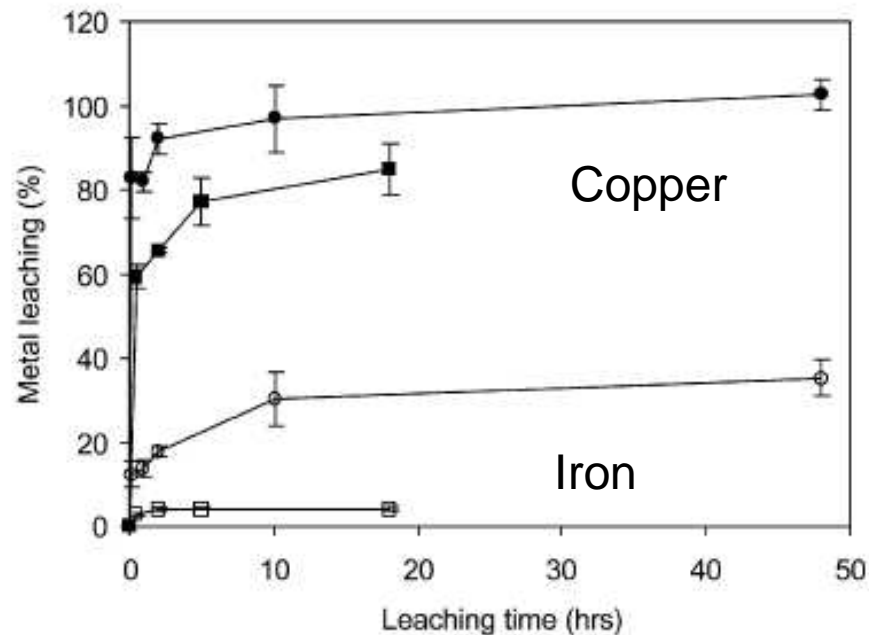
<sup>a</sup> Recovery percentages (mean ± standard error) were calculated based on background subtracted leaching and total Cu/Fe determinations for each replicate sample. Background subtracted samples values that resulted in negative numbers were assigned the value of zero in these calculations. <sup>b</sup> All test solutions used a solid-to-liquid ratio of 1:10<sup>4</sup> (g/g) and had a nominal initial pH of 4.9 (TCLP) or 5.0 (all other leaching solutions). Leaching times for all tests were 18 h, except for the 48-h standard WET test. <sup>c</sup> BD, below detection. For these samples, the background concentrations were greater than or equal to all replicate sample values. <sup>d</sup> The mean and standard error values shown are based on one replicate value of 0.44% recovery and two replicate values that were BD and therefore set to zero.

## Physical and chemical properties affecting the environmental transport and fate of copper from BPWD

- Fine atmospheric deposition model
  - central value =  $d_{50} = 3.5 \mu\text{m}$
  - lower value =  $d_{25} = 1.5 \mu\text{m}$
  - upper value =  $d_{75} = 5.6 \mu\text{m}$
- Coarse atmospheric deposition model
  - central value =  $d_{50} = 3.5 \mu\text{m}$
  - lower uncertainty limit of central value =  $3.1 \mu\text{m}$
  - upper uncertainty limit of central value =  $4.0 \mu\text{m}$

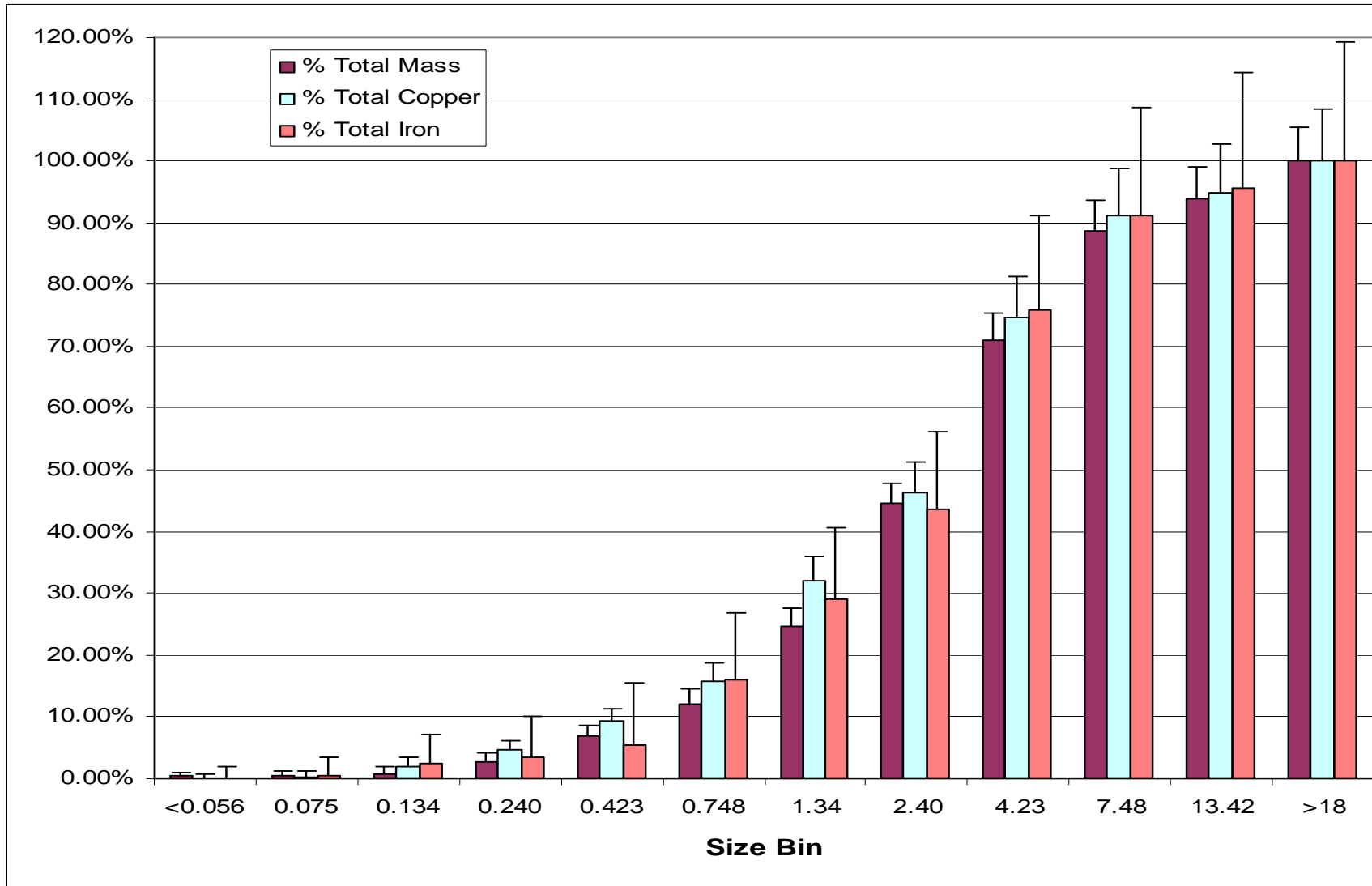
# Physical and chemical properties affecting the environmental transport and fate of copper from BPWD

- Copper leaching results
  - not used as a direct input in the environmental transport and fate models (but serves to provide guidance on the key processes involved and applicability of the models)
  - leaching of Cu from the nonairborne representative BPWD ranged from 60% to 100% in the more aggressive leaching solutions, and from less than 1% up to 3.5% in the less aggressive leaching solutions
  - rate of leaching is fast (i.e., order of a few hours)



**How fast is the leaching of copper from brake pad wear debris?**

# Airborne Characterization Results



*PSDs based on total mass, Cu, and Fe*