SAE Brake Friction Materials Chemical Analysis Methodology Taskforce

Greg Vyletel
Meritor
Commercial Vehicle Systems

Charter

- Propose the simplest analysis technique / methodology that can accurately and repeatedly quantify the targeted chemical species in brake friction materials

Team Members

- Steve Bell, ABS Friction
- Dr. Peter Filip – Southern Illinois University
- RaeAnn Haynes – Oregon State DEQ
- Stuart Magoon – Washington State Ecology
- Dr. Mark Phipps – Bosch Brake Components
- Dr. John Quinn – California DTSC
- Dr. Paul Sanders – Michigan Tech. University
- Chris Shepley – Affinia
- Ryan Vicary – ITT Motion Technologies
- Dr. Greg Vyletel – Meritor (Chair)
- Kevin Wolford – AMECA

Existing Quantification Methods

- For asbestiform fibers, quantification methods are
  - EPA Method 600-R-93-116
  - California Air Resources Board (CARB) 435
- For Hexavalent Chromium
  - No need to run if bulk analysis shows no Cr presence
  - EPA Method 3060A/7199
  - ASTM E396-05
- For Mercury
  - EPA Method 7471A – Cold Vapor Atomic Absorption

Optical, Mass and X-Ray Methods

- Optical Emission Spectroscopy (OES)
- Atomic Emission Spectroscopy (AES)
- Atomic Absorption Spectrometry (AAS)
- Mass Spectroscopy (MS)
- Energy Dispersive X-Ray Spectroscopy (EDS or EDX)
- X-Ray Fluorescence (XRF)
- Particle Induced X-Ray Emission (PIXE)
- Neutron Activation Analysis (NAA)

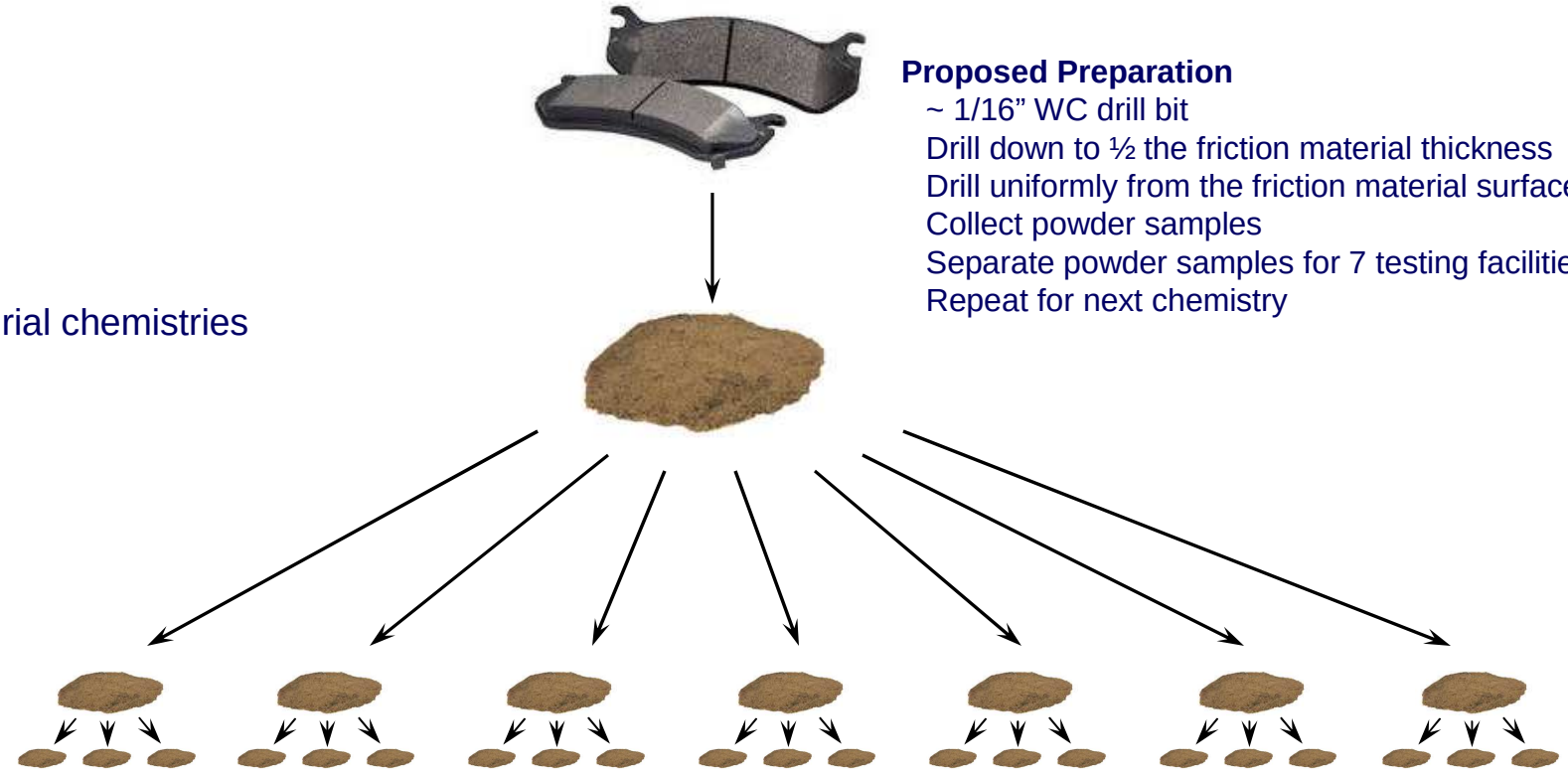
All methods are capable of ppm or ppb resolution

"Public Domain" Formulations

	Preferred Grade	Specific Gravity	*High Copper (8 wt%)*		*Mid Copper (5 wt%)*		*Low Copper (2 wt%)*		*2025 Copper (0.5 wt%)*		*Two Cu Sources*		*Brass Fiber (5% Cu)*	
			wt%	***vol %***	***wt%***	***vol %***	***wt%***	***vol %***	***wt%***	***vol %***	***wt%***	***vol %***	***wt%***	***vol %***
Phenolic Resin (straight)		1.20	9.50	20.22	9.50	20.13	9.50	20.04	9.50	19.93	9.50	20.21	9.50	20.24
Aramid fiber	1F538	1.44	3.40	6.03	3.40	6.00	3.40	5.98	3.40	5.95	3.40	6.03	3.40	6.04
Graphite (synthetic)	20x100	2.20	8.70	10.10	8.70	10.05	8.70	10.01	8.70	9.96	8.70	10.09	8.70	10.11
Cashew	Brown 40 mesh	1.06	5.40	13.01	5.40	12.95	5.40	12.90	5.40	12.83	5.40	13.00	5.40	13.02
Rubber Powder (nitrile)	Nipol 1411	0.96	2.60	6.92	2.60	6.89	2.60	6.86	2.60	6.82	2.60	6.91	2.60	6.92
Potassium Hexatitanate	TXAX-MA	3.30	19.50	15.09	19.50	15.02	19.50	14.96	19.50	14.88	19.50	15.08	19.50	15.11
Zirconium silicate	200 mesh - Trebol	4.65	7.80	4.28	7.80	4.27	7.80	4.25	7.80	4.22	7.80	4.28	7.80	4.29
Zinc Powder	Horsehead 44	7.12	0.00	0.00	2.00	0.71	4.00	1.42	4.00	1.41	2.00	0.72	2.00	0.72
Barytes	Cimbar Barite 22	4.45	25.30	14.52	26.30	15.03	28.30	16.10	29.05	16.44	23.30	13.36	24.45	14.05
Chromite	Prince Minerals Chromox	4.40	1.00	0.58	1.00	0.58	0.00	0.00	0.50	0.29	0.00	0.00	0.50	0.29
Mica	Suzorite 200 S	2.66	5.20	4.99	5.20	4.97	5.20	4.95	5.20	4.92	5.20	4.99	5.20	5.00
Antimony Trisulfide	Anti69 - Asbury	4.64	3.60	1.98	3.60	1.97	3.60	1.96	3.60	1.95	3.60	1.98	3.60	1.98
Copper (Fiber)	GMT GCU540	8.94	5.00	1.43	5.00	1.42	2.00	0.57	0.00	0.00	6.00	1.71	0.00	0.00
Copper (Powder)	Acupowder 165	8.94	3.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brass Fiber	GMT GBR540	8.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.35	2.24
Copper Sulfide (CuS)	Chemetall CB500	4.70	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.40	3.00	1.63	0.00	0.00

- Passenger Car / Light Truck pads:
  - ~ 55-65 cm^2 front
  - ~ 35-40 cm^2 rear
- Shape is dependent on friction material supplier tooling
- 30-50 pads dependent on mixer size (ideally 20 liter or larger)
- Process dependent on friction supplier

Proposed **Sampling and Measuring**



6 Different material chemistries

7 Laboratories

3 Repeats

Proposed Preparation

~ 1/16” WC drill bit

Drill down to ½ the friction material thickness

Drill uniformly from the friction material surface

Collect powder samples

Separate powder samples for 7 testing facilities

Repeat for next chemistry

Moving Forward

- ICP-OES method is preferred
- Several manufacturers produce "public domain" formulations (March – April 2011)
- Prepare test samples at one location for distribution (May)
- Blind test the samples at seven different laboratories and three separate set-ups (May – June)
- Assess / analyze data to determine capability and any refinements (June – July)

Thank you for your attention

gregory.vyletel@meritor.com