Environment Activities

2nd Geneva Conference

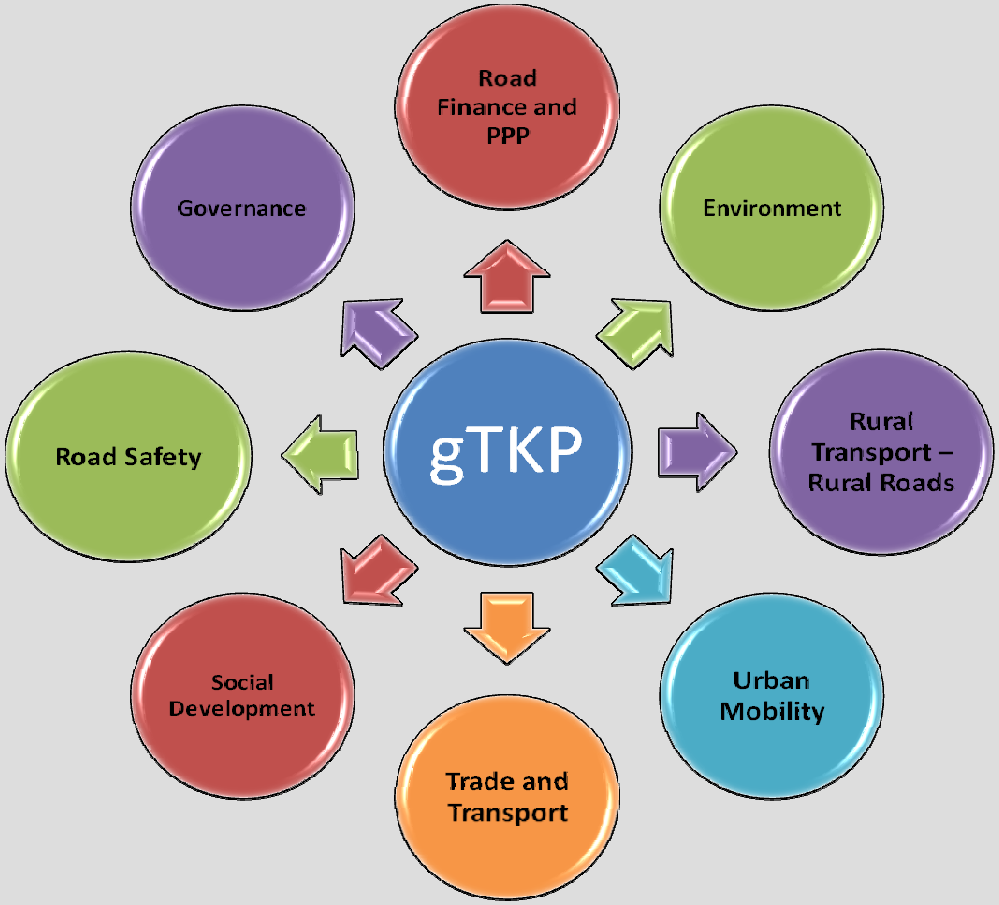
‘ Roads and the Environment ’

- 36 countries represented
- Round table – Carbon Markets
- Conference Recommendations

IRF GHG CALCULATOR

- EPFL Validation
- Software development
- Partnerships
- Change in legislation

Global Transport Knowledge Partnership



www.gtkp.com

- Focus: Dev. Countries
- Knowledge sharing and dissemination
- Communities of practices
- Partnerships

Partnerships

50BY50
GLOBAL FUEL ECONOMY INITIATIVE
www.50by50campaign.org

ITDP Institute for Transportation & Development Policy

Partnership for Sustainable Low Carbon Transport

Collaborations

THE PEP Transport, Health and Environment Pan-European Programme

WORLD HEALTH ORGANIZATION EUROPE

UNECE

WORLD ROAD ASSOCIATION MONDIALE DE LA ROUTE

AIPCR PIARC

International Transport Forum

more sustainable roads for a better transportation future

What is it?

Greenroads is a rating system designed to distinguish more sustainable new or redesigned/rehabilitated roads. It awards credits for approved sustainable choices/practices and can be used to certify projects based on point value.

How does it help?

More sustainable roadways. This means less impact on the environment, lower life cycle costs/impacts and more positive societal outcomes.

Greenroads

more sustainable roads for a better transportation future

Greenroads is a project-oriented system.

It does not deal with planning and it does not deal with operations.

Greenroads Categories (Version 1.0 preview)

Category	Description	Points
Project Requirements	Minimum requirements for a Greenroad	Req
Environment & Water	Stormwater, habitat, vegetation	21
Access & Equity	Modal access, culture, aesthetics, safety	30
Construction Activities	Construction equipment, quality, use	14
Materials & Resources	Material extraction, processing, transport	23
Pavement Technology	Pavement design, material use, function	20
	Total Voluntary Credit Points	**108**
Custom Credits	Write your own credit for approval	10
	Grand Total	**118**

Greenroads

Greenroads Category

Construction Activities (CA)

Description	Credits
Quality Process Management	2
On-Site Recycling and Trash Collection	1
Track Water Use	2
Fuel Use Reduction	1-2
Equipment Emissions Reduction	1-2
Reduce Paving Emissions	1
Joint Environmental & Safety Training	2
Performance-Based Warranty	3
Total Points Available	**15**


If you are producing more sustainable roadways,
how do you let people know?
Greenroads
certified

Achievement Levels

Version 1.0 (preview): 108 Voluntary Credit Points

Greenroads certified	Greenroads certified SILVER	Greenroads certified GOLD	Greenroads certified EVERGREEN
32-42 points	43-54 points	55-63 points	64+ points
PR + 30% VC	PR + 40% VC	PR + 50% VC	PR + 60% VC

Greenroads

Why bother with a rating standard?

- More sustainable roads
- Specific benefits:
  - Defines basic roadway sustainability attributes
  - Greater participation in roadway sustainability
  - Better evaluation of tradeoffs and decisions
  - Provide means for sustainability assessment
  - Allows innovation because it is end-result oriented
  - Confer marketable recognition on projects

Greenroads

Greenroads effort right now…
(21 July 2009)

- Who is developing Greenroads?
  - University of Washington and CH2M HILL
- Who is funding Greenroads so far?
  - TransNow (DOT Region 10 University Transportation Center)
  - State Pavement Technology Consortium (WA, CA, MN, TX)
  - Federal Lands Highway Division (FLHD)
- What is the status right now?
  - Version 0.95 now
  - Version 1.0 by end of 2009
  - Online: www.greenroads.us
- When can it be used?
  - Pilot projects: NOW
  - General use: 2010

Where are we now?

- Manual
  - 95% done
  - Finish up in 2009
- Website
  - www.greenroads.us
  - Online registration
- Outreach
  - 50+ presentations
  - Agencies, designers, contractors, students, ARTBA, etc.
- Case studies (retrospective)
  - WSDOT (6)
  - City of Seattle (2)
- Pilot projects (integrative)
  - WSDOT
  - Caltrans
  - City of Bothell, WA
  - City of Denver, CO
  - Oregon DOT (3)

Greenroads

Overview of the Tire Industry Project

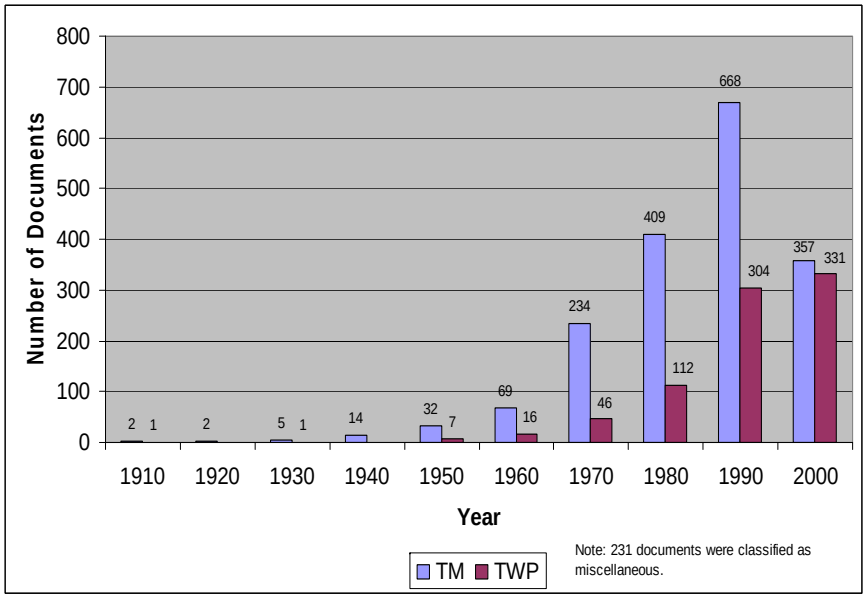
International Road Federation –
Environmental Working Group
October 5, 2009

Background

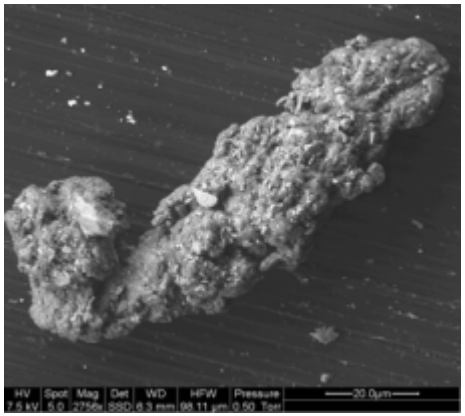
- In 2005, CEOs from 11 Largest Tire Companies Reviewed Six Potential Issues for Study:
  - Tire wear particles (“TWP”)
  - Tire materials
  - Recycled content of tires
  - Scrap tires
  - Rubber trees
  - Environmental reporting standards
- The CEOs concluded:
  - Environmental/Health information is incomplete for tire wear particles and some tire materials and that further study was needed.
  - Work on other issues was already underway industry-wide or at individual companies
- Tire Industry Project launched in 2006 and organized as a sector project at the World Business Council on Sustainable Development (WBCSD)

Research Focused

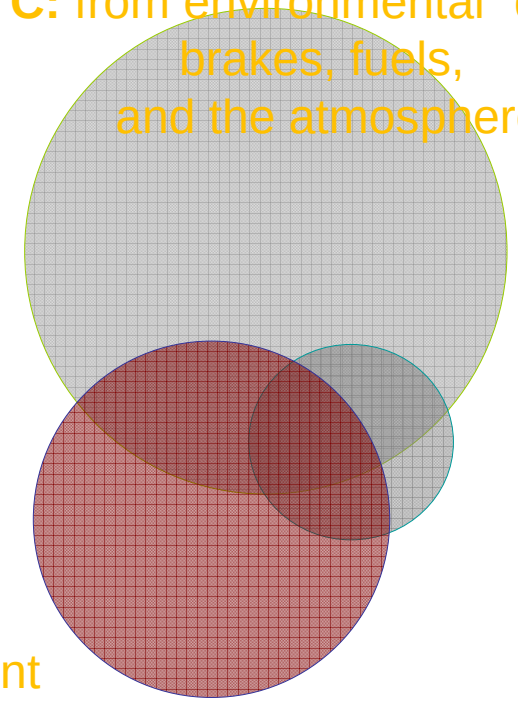
- What are the potential human and ecological health risks associated with tire wear particles (TWP) in the environment?
- Thorough review of the literature identified several data gaps:
  - Accurate description/characterization of TWP
  - Reliable estimates of TWP in environmental media
  - Aquatic toxicity data
  - Human toxicity data



Types of particles



C: from environmental “dust”, brakes, fuels, and the atmosphere



RP (A+B+C)
= All particles on the road
= **Roadway Particles**

B: from pavement

A: from tire

TWP (A+B)
= Particles from wear
= **Tire Wear Particles**

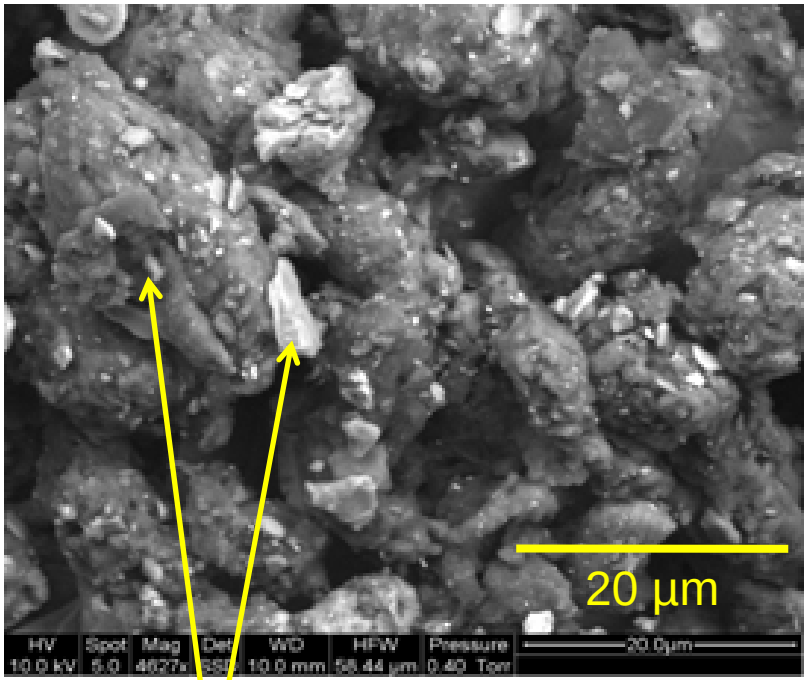
TP (A)
= Particles from tire
= **Tire Particles**

On-Road Collection System

- Designed and constructed by Michelin Engineering Services
- On-road system Components

Results of Research
Roadway Particles (RP)

- Microscopic evaluation of the particles indicates that roadway particles are a mix of rubber from the tire tread and minerals from the pavement and other components of “road dust.”



Examples of mineral and other road debris incorporated with rubber tread material

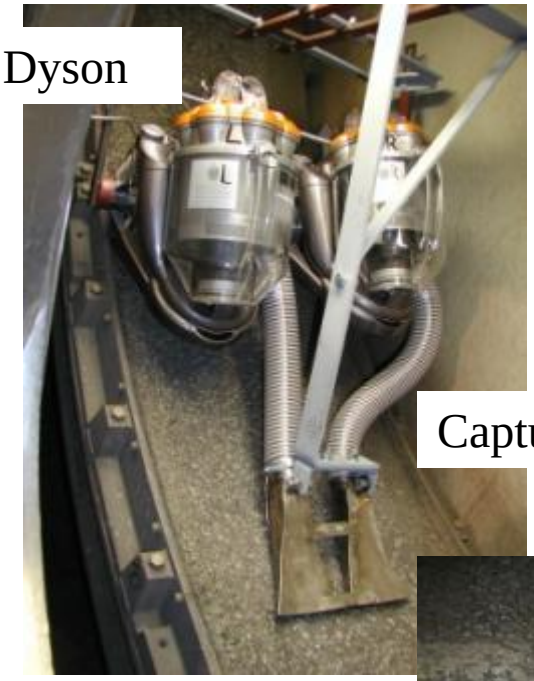
Laboratory Collection

- Two laboratories were identified:
  - Bundesanstalt für Strassenwesen (BASt) (Germany Federal Highway Research Institute)
  - VTI, the Swedish National Road and Transport Research Institute
- Goals :
  - Simulate driving conditions on real pavement
  - Avoid interference from other constituents of road dust

BASt (Bensberg, Germany)

Particle Collection - BASt

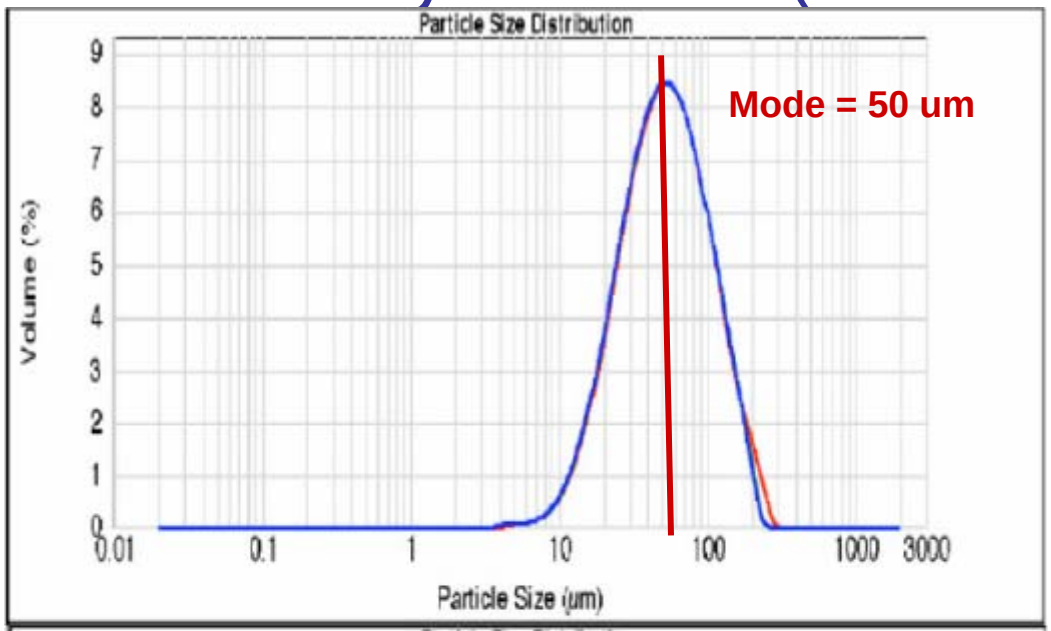
Dyson



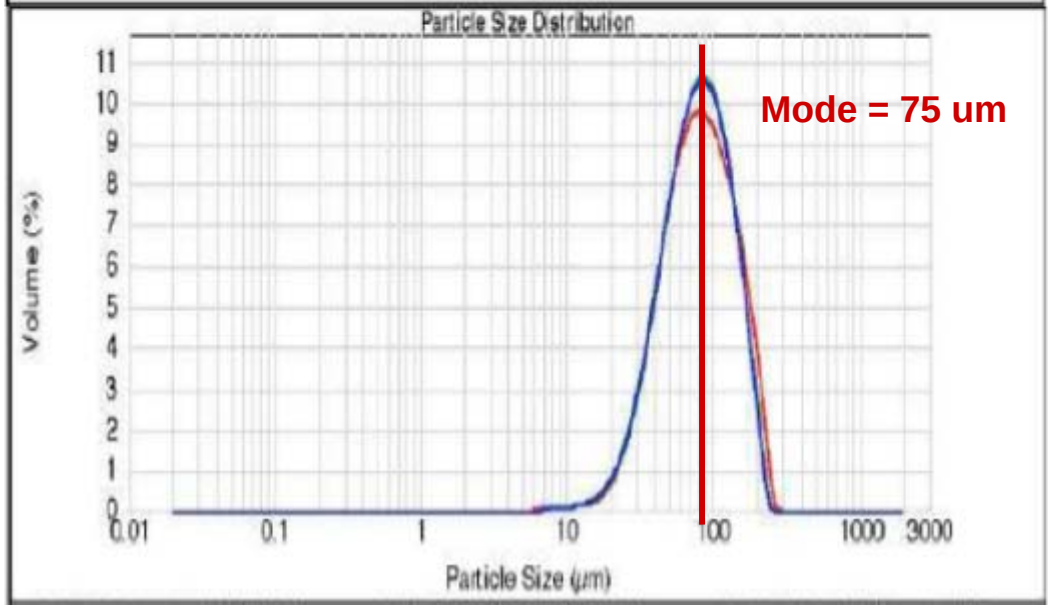
Capture Hood

Size Distribution by Volume (laser diffraction)

RP



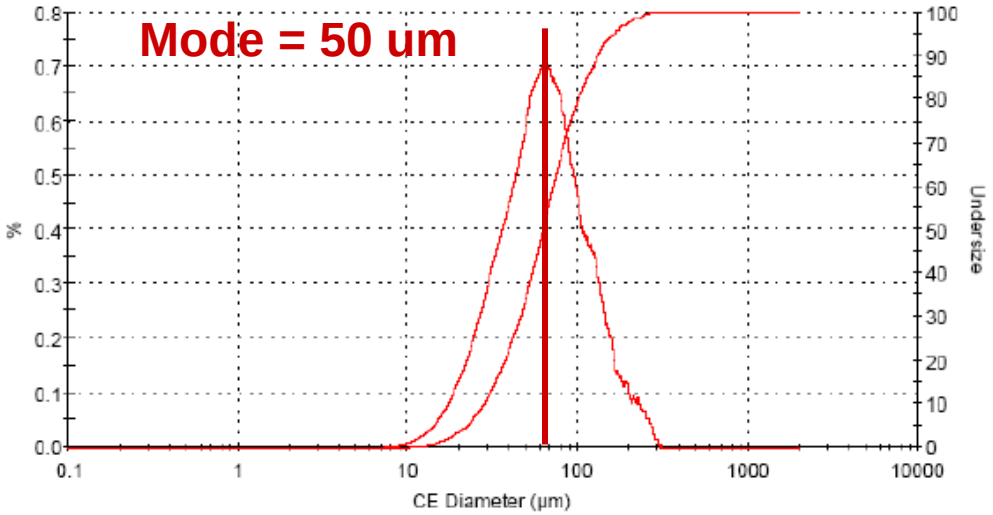
TWP



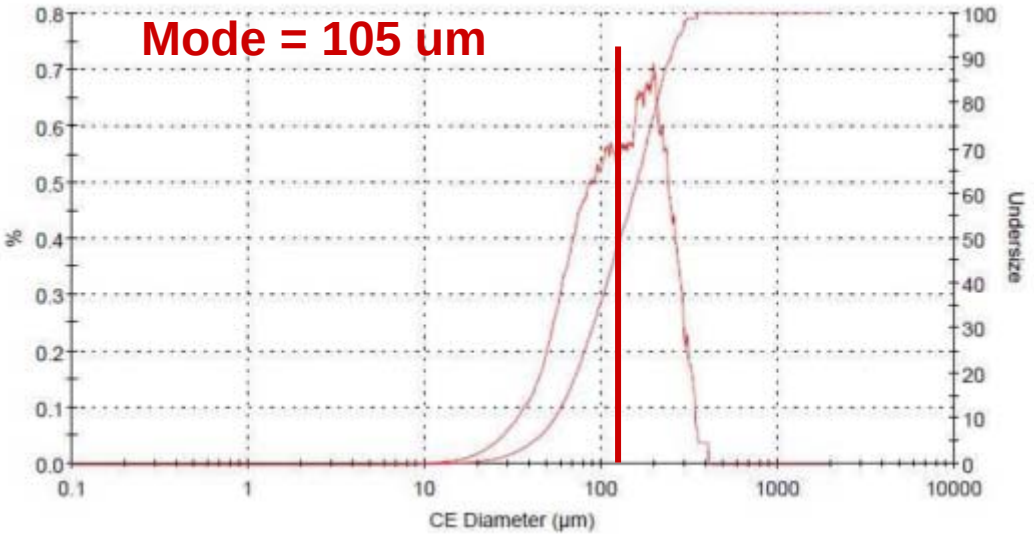
Size Distribution by Volume

Transmission Optical Microscopy

RP



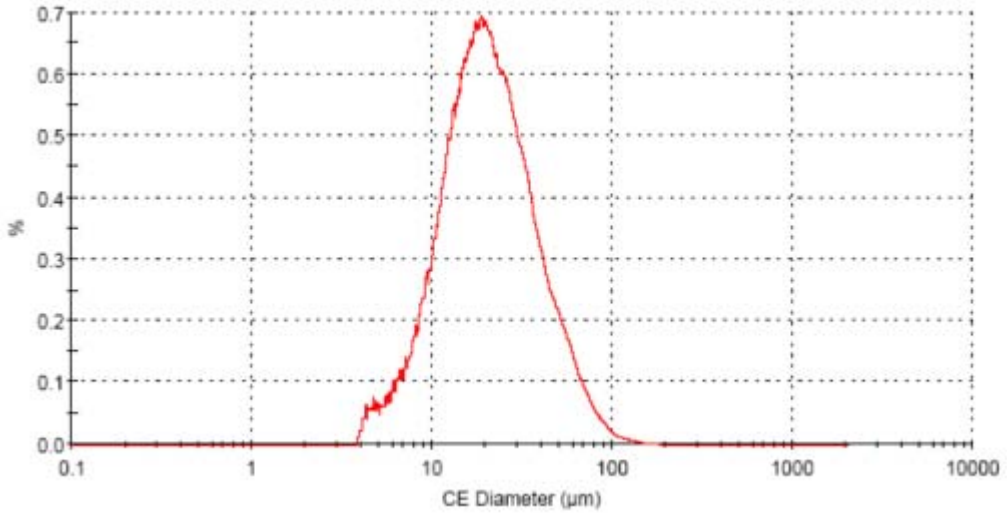
TWP



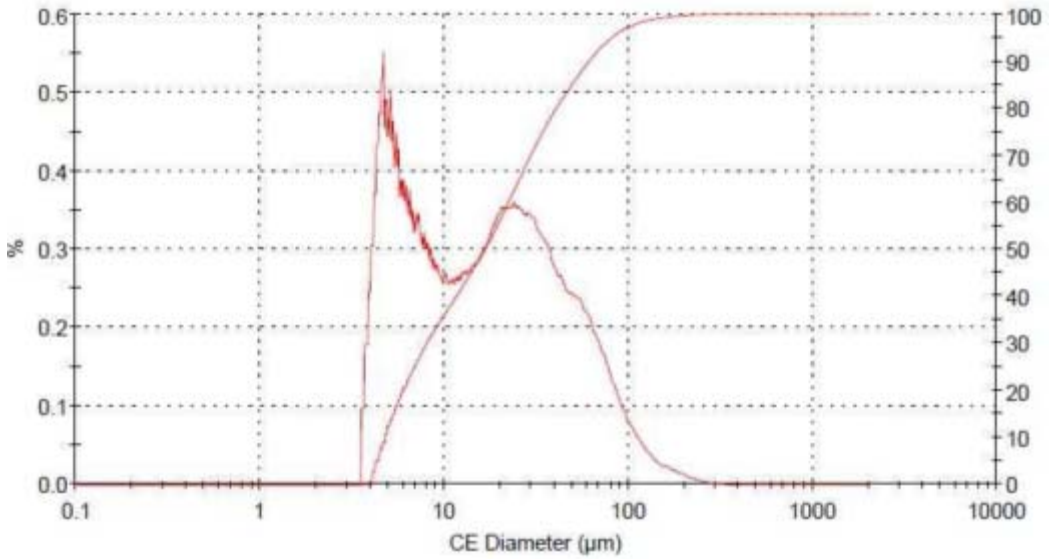
Size Distribution by Number

Transmission Optical Microscopy

RP



TWP



General Compositional Analysis

Chemical Family	RP (% w/w)	TWP (% w/w)	TP (% w/w)
Plasticizers and Oils	13	10	19
Polymers	23	16	46
Carbon Blacks	11	13	19
Mineral	53	61	16

- Polymer content in TP 2-3x RP and TWP
  - RP and TWP contain less material originating from tire
- Mineral content in RP and TWP >> TP
  - RP and TWP contain mineral from the road surface (or road and environment)
  - TWP contains more mineral than RP

Elemental Analysis

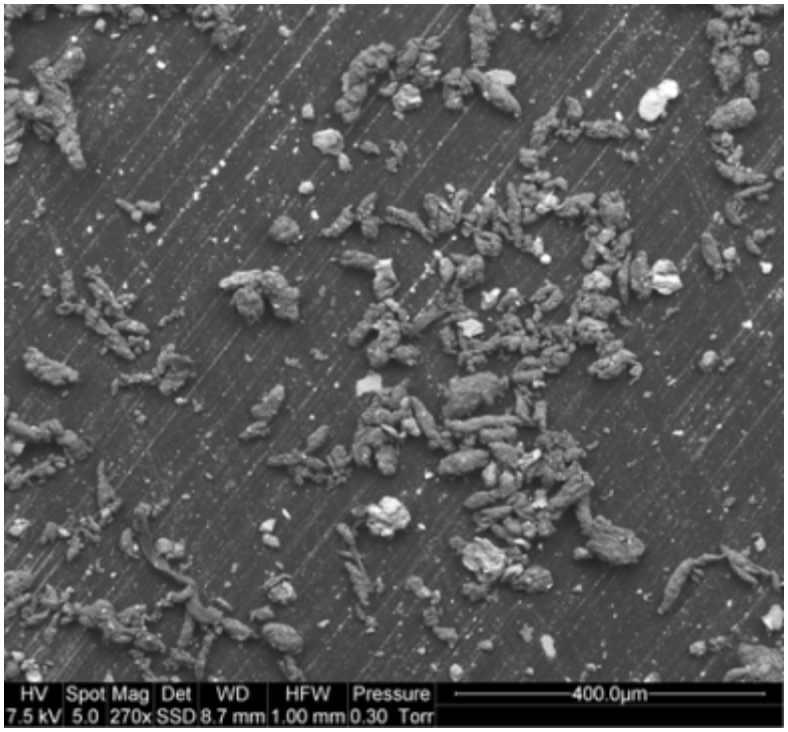
Metal	RP (%)	TWP (%)	TP (%)
Aluminum	3.4	2.8	0.03
Silicon	8.6	8.7	5.4
Sulfur	0.9	0.5	1.2
Zinc	0.4	0.3	0.9

- Aluminum and silicon, major components of most asphalt types, are present in far higher quantities in RP and TWP than TP
  - Silicon also present in TP from use as filler in tires
- Sulfur and zinc, used during tire manufacturing, are present in higher quantities in TP than RP or TWP
  - Zinc content in TWP is less than RP

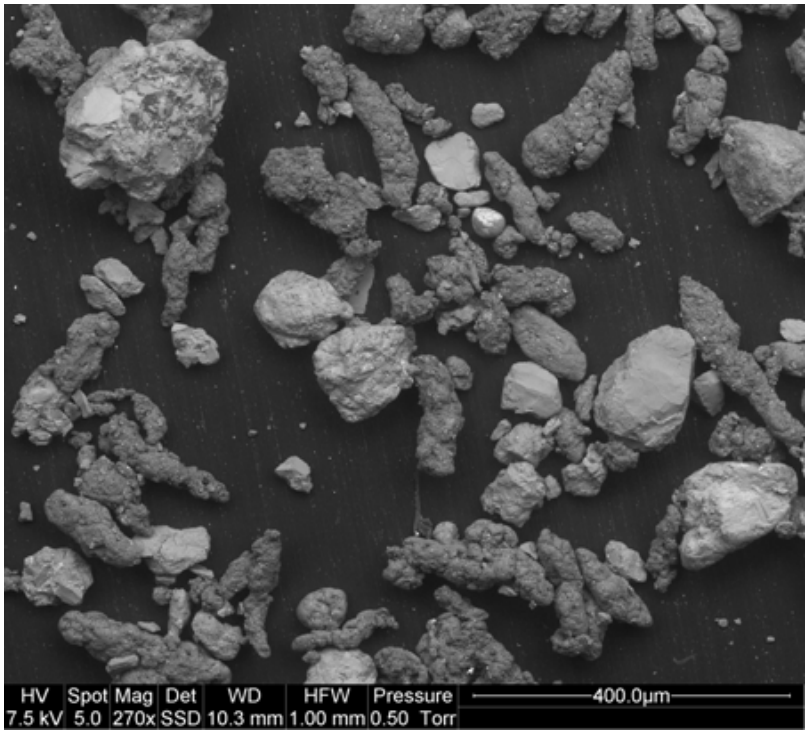
VTI (Linköping, Sweden)

Airborne Particle Collection at VTI

Microscopic analysis of wear particles



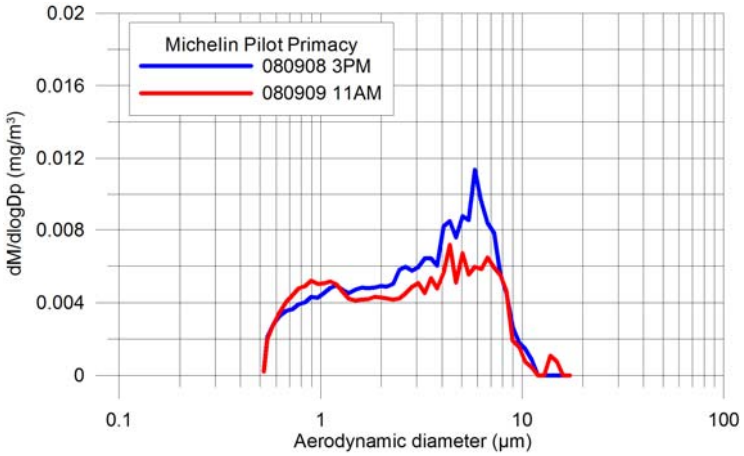
Michelin sample n°1
(150µm sieved)

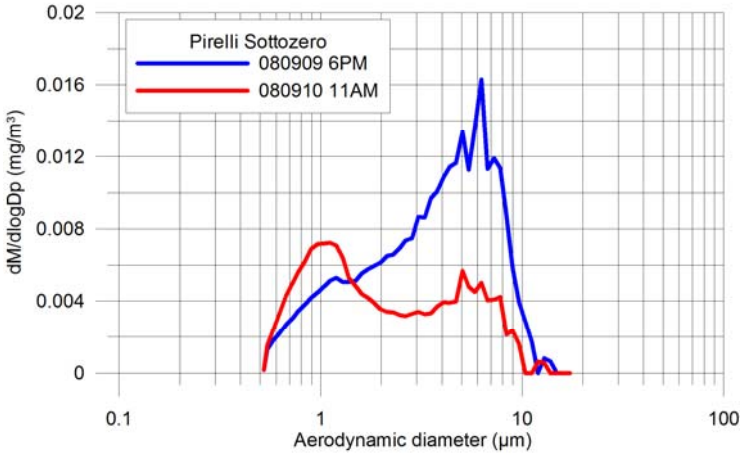


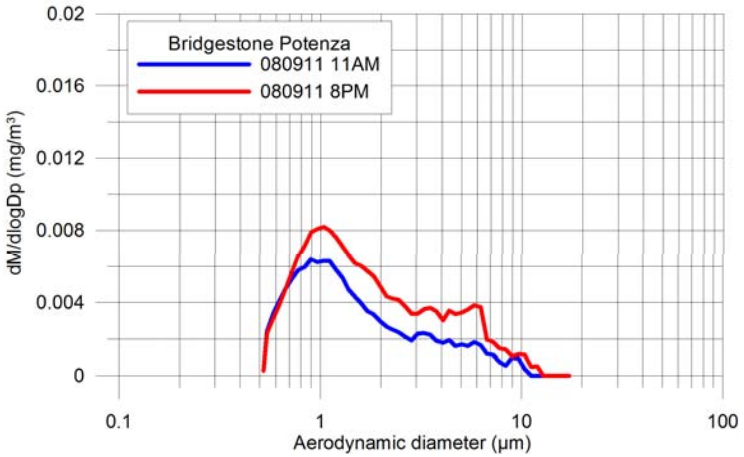
BAST sample n°3
(150µm sieved)

Results – Airborne Particle Size Distribution Coarse Fraction

Note: Airborne concentration of PM10 and PM2.5 was low, rising initially and then steady at approximately 6-10 µg/m3

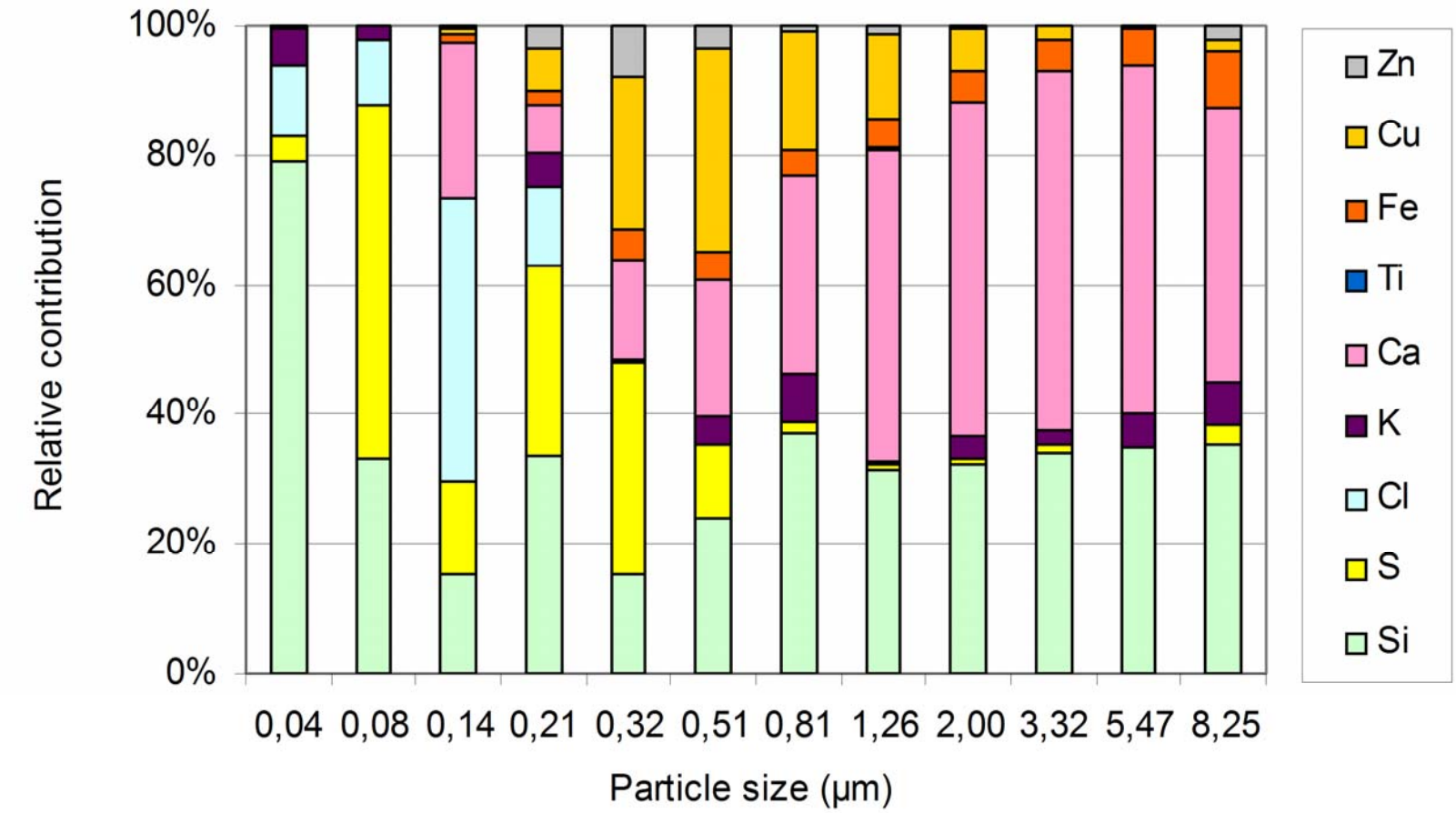






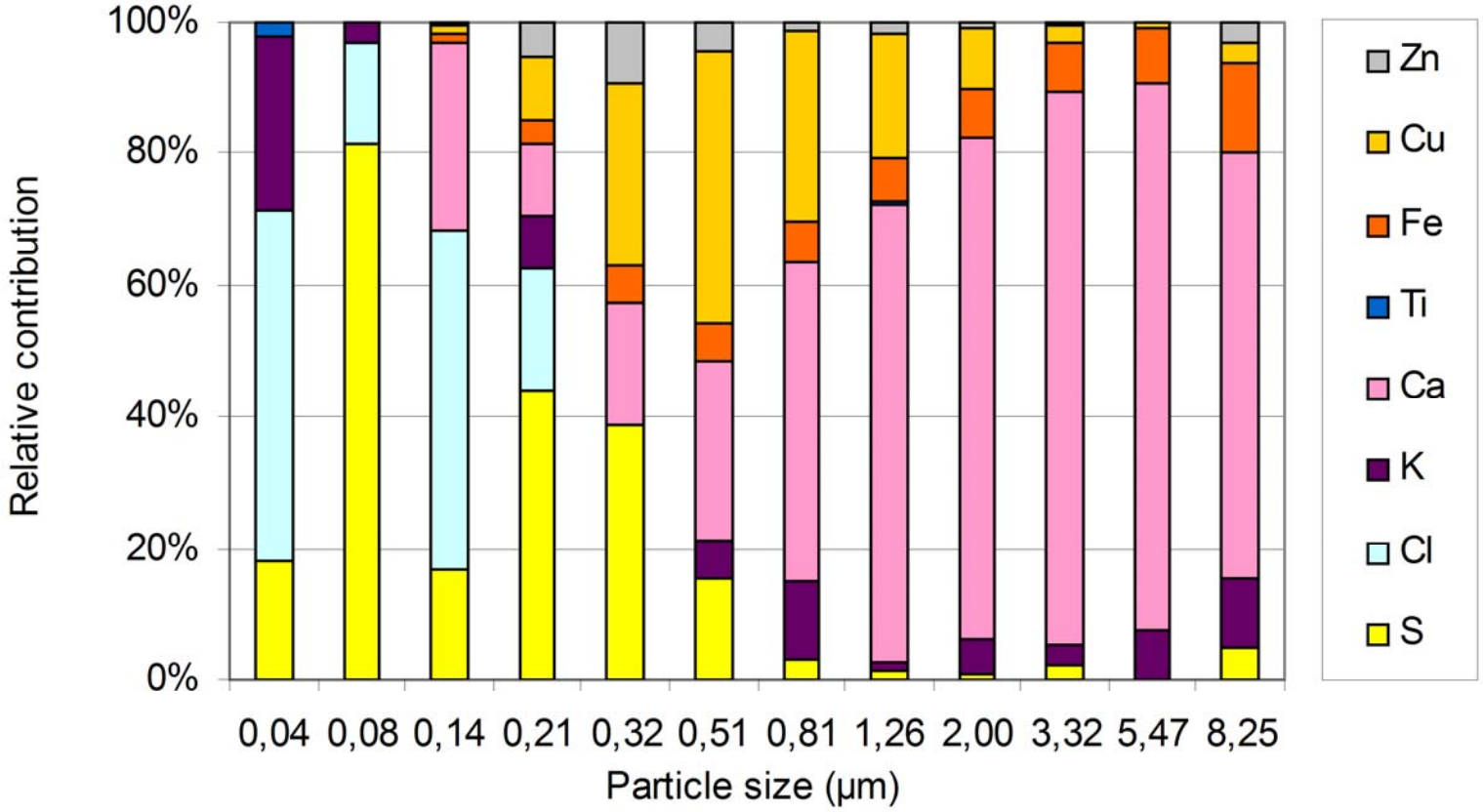
Results –

Airborne fraction compositional analysis



Results –

Airborne fraction compositional analysis without silica contribution



Particle Collection Methods Summary

	Michelin Outdoor	BASt Indoor	VTI Indoor
Efficient bulk collection?	Yes	Yes	No
Material collected	20% test tire, 80% pavement, other tires and dust	Test tire and pavement material	Test tire and pavement material
Collection of PM_{10} and/or $PM_{2.5}$?	No	No	Yes
Variable driving conditions?	Yes – all conditions	Yes – programmable	Only speed and road material
Capable of differentiating tire types?	No	Yes	Yes
Truck tires?	Yes	No	No

TWP Testing Results

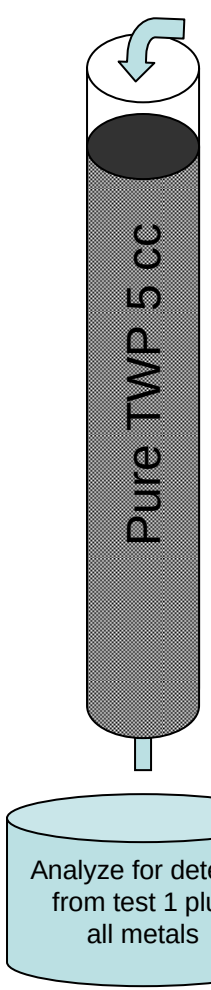
TWP Testing - Leaching Studies

Test 1:
Acetone Extraction

ASTM method

Test 2:
pH optimization

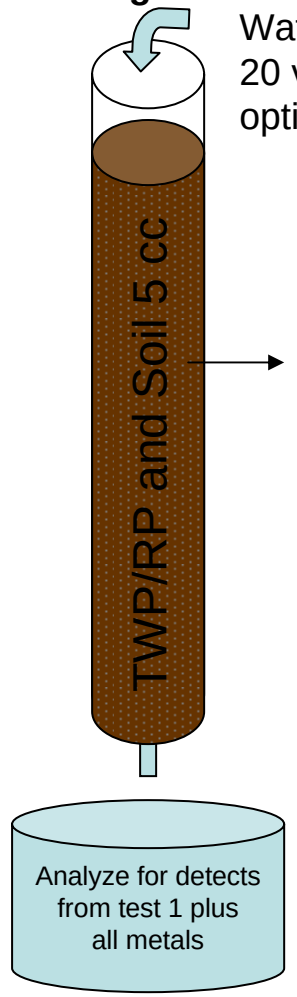
Water
10 volumes
pH 6.5, 7.5, 8.5



Test 3:
Leaching Studies

Water
20 volumes
optimized pH

Soil: TWP
1:0, 0:1, 100:1, 500:1, 1000:1;
RP also used as control



All columns were run in triplicate to ensure repeatability

Results of Research - Road Particles Environmental Leaching Potential

Objective:

To determine if toxic/hazardous materials are leached out of these particles into the environment.

- Leachate from RP + soil
  - No significant concerns identified.
  - No further analysis required.
- Leachate from RP + water
  - Some zinc detected from RP
  - Risk impact
    - No concerns from stormwater runoff from highways to nearby ecological habitats (i.e. wetlands), due to adsorption of zinc onto soil.
    - Open issue: stormwater runoff from urban environments to be evaluated.

TWP Testing - Acute Aquatic Toxicity

- Objective:

  To determine toxicity effects of leachate from RP on algae, invertebrates and fish.

- Results
  - No significant concerns identified for algae, invertebrates, and fish.
  - Minor effect in algae at the highest concentration (10,000 ppm) was observed.
  - Open issue: Long-term (chronic) testing needed to understand this effect.

Recommended Next Steps

- Understand differences in results between our acute toxicity test with TWP and others conducted using TP
- Conduct longer term (chronic) testing for water and sediment dwelling organisms.

TWP Testing: Human Bioaccessibility

- Inhalation of TWP may impact human health as a result of direct particle interaction in the respiratory system, or from leaching of constituents into the lung fluid (i.e. bioaccessibility).
- Bioaccessibility study conducted using airborne TWP and simulated lung fluid
- Lung fluid was analyzed for metals.
  - significantly more aluminum and zinc compared was measured in the simulated lung fluid containing the TWP PM10 than the leachate of blank filters ($p<0.05$).
  - ~55% of Zn was bioaccessible
- Data gaps regarding inhalation toxicity exist

Open Issues with respect to Airborne TWP

- Contribution of pavement and tread to ambient air PM10 and PM2.5 fractions
- Contribution to total vehicle emissions.
- Contribution of pavement and tread to the ultrafine fraction
  - Collection and analytical challenges
  - Representative pavements
  - Representative driving conditions
- Comparisons of TWP toxicity potential to other constituents of airborne PM
- Data gaps regarding cardiopulmonary toxicity potential
  - Availability of health benchmark

Thank you for your attention !

- Additional information for the Tire Industry Project can be found at www.wbcsd.org