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Tires Road Wear Particles (TRWP)

Results of TIP PM2.5 Global Sampling Programme

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UNECE PMP IWG
8 October 2015

Outline

- Tire Industry Project (TIP) and project time table on Tire and Road Wear Particles (TRWP) studies
- Environmental markers
- Global air sampling study for airborne TRWP - PM10
- Global air sampling study for airborne TRWP - PM2.5
- Overall conclusions

All data presented today have been generated in the framework of WBCSD TIP Work Programme - http://www.wbcsd.org/work-program/sector-projects/tires/overview.aspx

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- Overall conclusions

TIP (TIRE INDUSTRY PROJECT)

- **In 2005, CEOs from 11 Largest Tire Companies decided** to anticipate, study and determine potential environmental and health issues relating to the life cycle impacts of tires that could impact the tire industry globally and to communicate results to the appropriate stakeholders.

- The tire Industry Project launched in 2006 and organized as a sector project through the World Business Council for Sustainable Development (WBCSD).

- In the beginning, the CEOs decided in 2005 that **the main goal is to anticipate the potential environmental and health issues related to wear of tires.**

  Technical support provided by ChemRisk, LLC, scientific consulting firm.

BRIDGESTONE
Continental
COOPER TIRES
GOODYEAR
HANKOOK
KUMHO TYRES
MICHELIN
PIRELLI
SUMITOMO
TOYO TIRES
YOKOHAMA
TECHNOLOGY THAT DELIVERS

TIMELINE OF TIP ON TRWP

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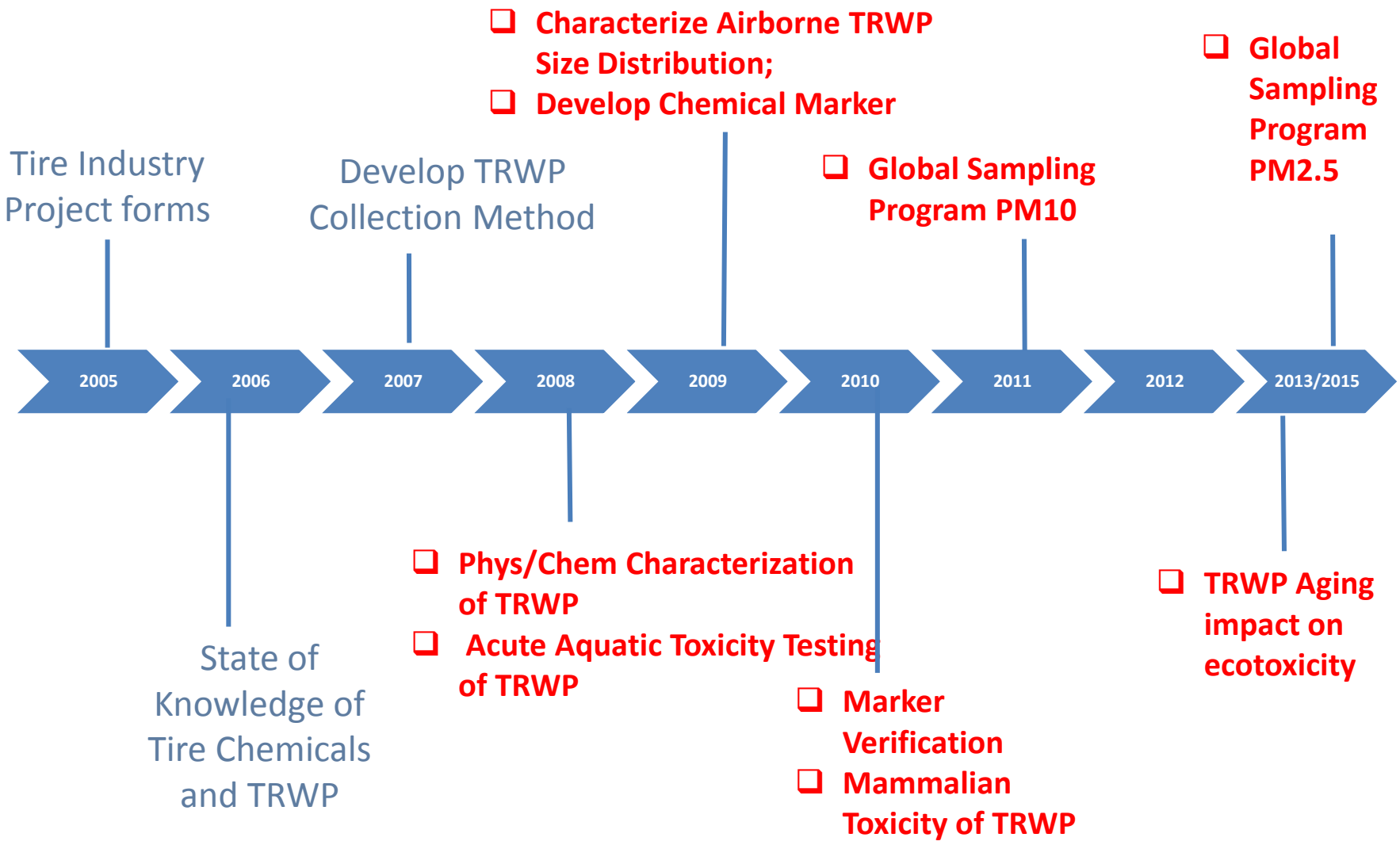

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TIMELINE OF PYROLYSIS MARKER DEVELOPMENT AND VERIFICATION

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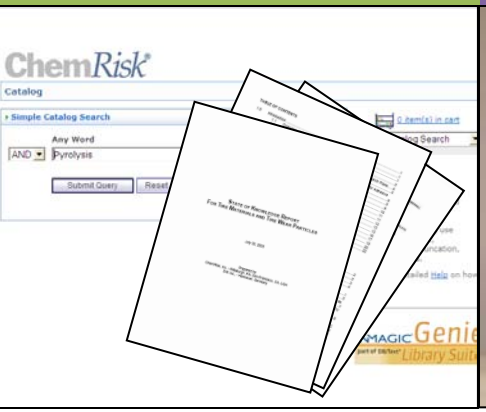
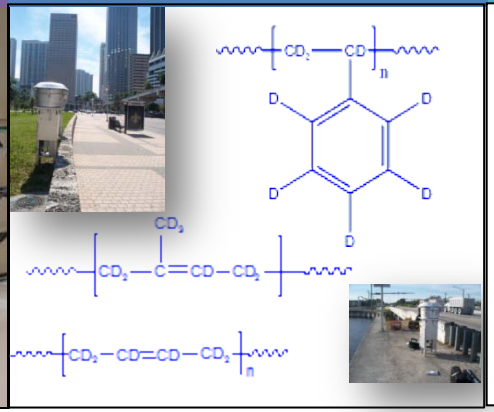
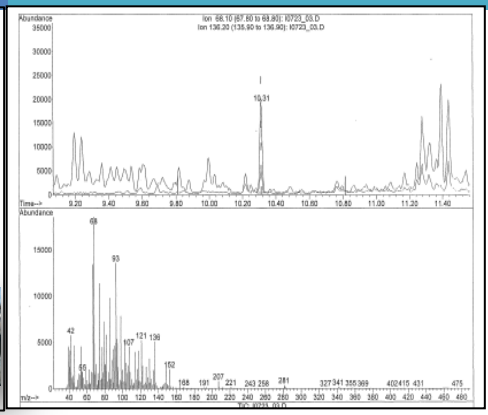
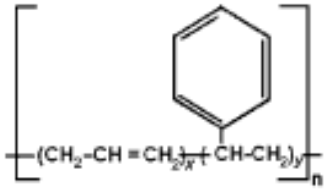
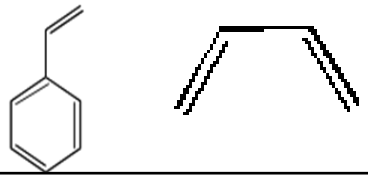
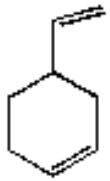
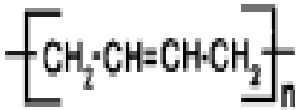
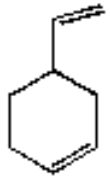
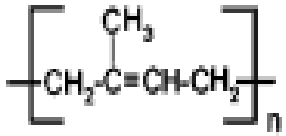
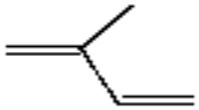
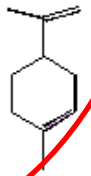
2007-2008	2009	2010	2011
Literature Review *State of Knowledge Assessment*	**Method Comparison** *Organic Zinc Extraction versus External Standard Pyr-GC/MS*	**Method Selection and Refinement** *New Internal Standard Pyr-GC/MS Method*	**Method Finalization** *Detection Limit Study Completed with Int. Std.*







FINAL PYROLYSIS MARKER SELECTION (2010)

Polymer	Monomer	Dimer
SBR 	Styrene Butadiene 	Vinylcyclohexene (butadiene dimer 
BR 	Butadiene 	Vinylcyclohexene (butadiene dimer) 
NR 	Isoprene 	Dipentene (Isoprene dimer) 

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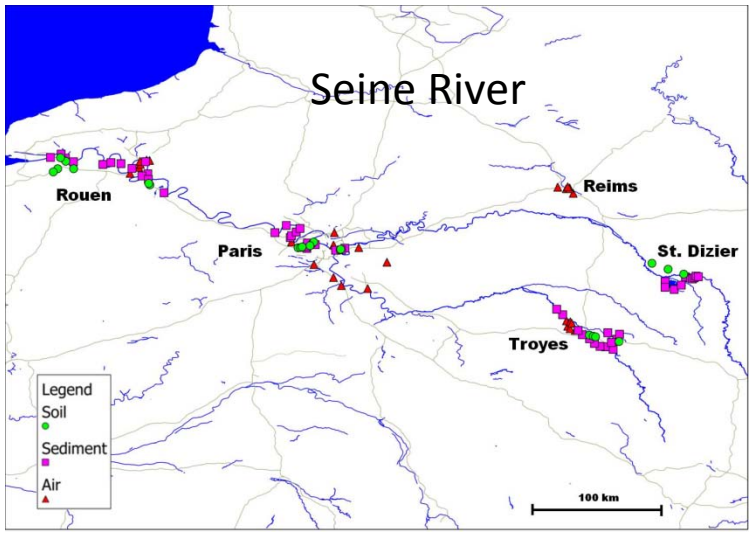
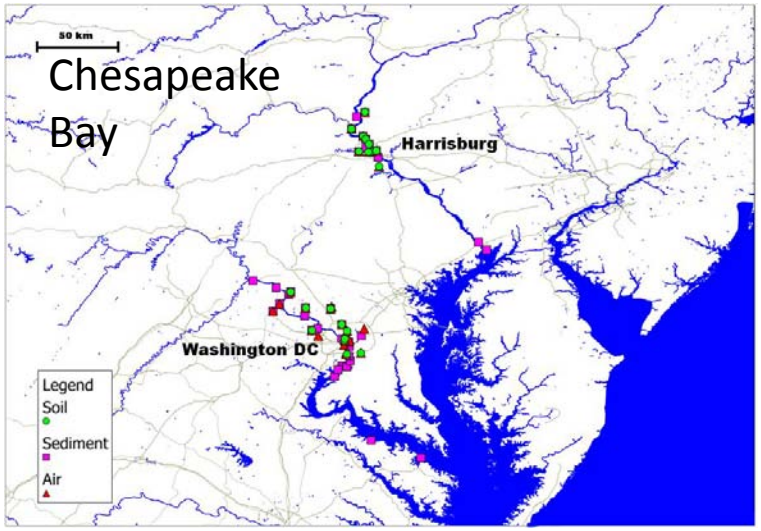
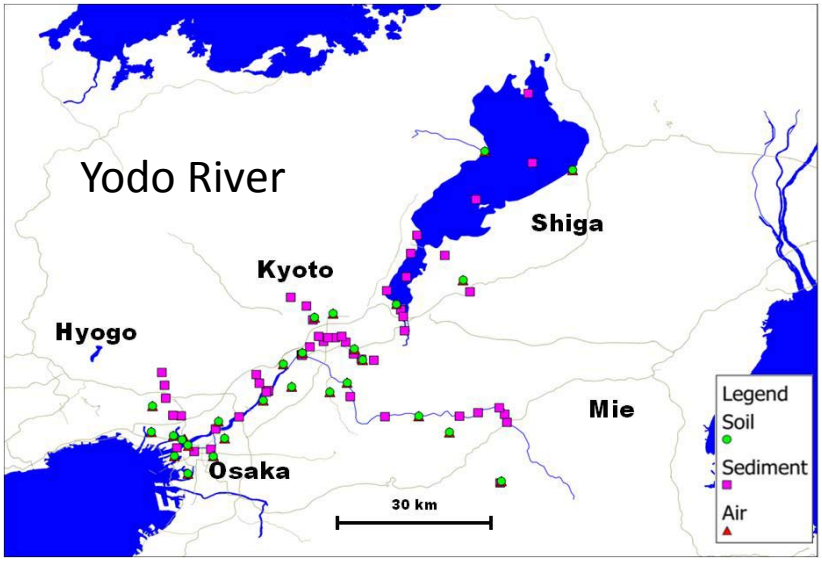
GLOBAL SAMPLING STUDY – TRWP IN AIR

- After determination of detection limit, a preliminary field study was performed in Miami (USA) in 2010 to confirm the capability of the method.
- Then from fall 2010 to summer 2011 global air sampling field work in Europe, the US and Japan
  - Air sampling for PM10 was conducted according to country-specific regulatory standard methods.
  - Samples were collected at street level.
  - Approximately 27 PM10 samples were collected in each country and PM10 monitoring was conducted at 25 percent of the sites in each country using a real-time dust analyzer.
  - Samples were analyzed using the pyrolysis chemical marker for polymer proposed by Kitamura et al (2007) and validated by TIP.

SAMPLING LOCATIONS







RESULTS FROM GLOBAL AIR SAMPLING

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Watershed	Area (n)	Average PM10 (µg/m³)	Average (µg/m³) TRWP	Max (µg/m³) TRWP	% Contribution to PM10 (Average) TRWP
Seine (France)	**Troyes (6)**	**26**	**0.70**	**1.34**	**2.80**
	Reims (6)	**10**	**0.17**	**0.70**	**1.74**
	Paris (9)	**48**	**0.05**	**0.11**	**0.14**
	Rouen (6)	**20**	**0.17**	**0.86**	**0.86**
Chesapeake (USA)	Harrisburg (9)	15	0.13	0.32	**0.94**
	Washington, D.C. (4)	23	0.24	0.48	**1.04**
	Maryland (7)	16	0.12	0.26	**0.72**
	Virginia (7)	14	0.10	0.16	**0.84**
Yodo (Japan)	Shiga (4)	49	0.18	0.32	**0.38**
	Kyoto/Mie (10)	24	0.09	0.22	**0.50**
	Hyogo (3)	35	0.06	0.09	**0.18**
	Osaka (10)	33	0.09	0.15	**0.38**
Seine	*All (27)*	28	0.24	1.34	**1.24**
Chesapeake	*All (27)*	16	0.14	0.48	**0.88**
Yodo	*All (27)*	32	0.10	0.32	**0.40**
All	***All (81)***	**25**	**0.16**	**1.34**	**0.84**

Remark : The method used is in discussion in ISO/TC146/SC3 to become a standard (expected deadline:2016)

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- Global air sampling study for airborne TRWP - PM2.5

BACKGROUND

- The evaluation of air pollution was done for particles smaller than 10 microns (PM 10) but did not specifically measure particles smaller than 2.5 microns (PM 2.5).

- Contribution of PM 10 from TRWP to atmospheric pollution is negligible.

- Public authorities concerns are now more and more focused on PM 2.5 rather than on PM 10 and possible regulation might impose constraints on air quality related to PM 2.5.

GLOBAL PM2.5 SAMPLING PROGRAM

Objective: Quantify TRWP in ambient PM2.5 to understand contribution to total PM2.5 and variability.

Status: Sampling in 3 cities is complete : Los Angeles, Tokyo and London.

USA - SAMPLE RESULTS FOR GREATER LOS ANGELES

Overview - Los Angeles:

Sampling was conducted from July 15 - 23, 2014.

Six locations were established

- LA-1: Pico Rivera
- LA-2: Compton
- LA-3: Anaheim
- LA-4: Exposition Park
- LA-5: Long Beach
- LA-6: Mira Loma

TRWP was consistently detected in the samples from LA-1, but not the other locations.

TRWP ranged from 0.19 – 1.3% of total PM2.5 at LA-1.

TRWP – LOS ANGELES SAMPLING

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Sample Number	Average Total PM2.5 (µg/m3)	Average TRWP in PM2.5 (µg/m3)	Average % TRWP	Traffic Counts (x 1000)
LA-1: Pico Rivera	7.07	0.042	0.59	20-255
LA-2: Compton	5.00	N.D.*	N.D.	1-225
LA-3: Anaheim	6.14	N.D.	N.D.	256
LA-4: Exposition Park	12.9	N.D.	N.D.	25-288
LA-5: Long Beach	6.26	N.D.	N.D.	20-280
LA-6: Mira Loma	10.9	N.D.	N.D.	18-362
Average	8.1	N.D. level	N.D. level	---

- ✓ Sampling was conducted from July 15 - 23, 2014.
- ✓ TRWP was only detected in the samples from "Pico Rivera".
- ✓ Total PM2.5 was very low.

* N.D. = Non Detected

JPN - SAMPLE RESULTS FOR GREATER TOKYO

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Overview - Greater Tokyo

Sampling was conducted from July 15 - 23, 2014.

Four locations were established

- Site A: Kawasaki city, Kanagawa Pref. (PM2.5 and PM10).
- Site B: Setagaya ward, Tokyo, Ring road No.8, (PM2.5 and PM10).
- Site C: Machida city, Tokyo, Suburban way (PM2.5).
- Site D: Shinagawa ward, Tokyo, Route 15 (PM2.5).

Total PM2.5 was lower than expected and ranged from 10-15 µg/m³.

http://www.mapquest.com/maps?city=Tokyo&country=JP

JPN – TOKYO SAMPLING

Sample Number	Average Total PM2.5 (µg/m³)	Average TRWP in PM2.5 (µg/m³)	Average % TRWP	Traffic Counts (x 1000)
TKO-1: Kawasaki	15.2	0.023	0.18	37
TKO-2: Setagaya	11.6	0.038	0.33	66
TKO-3: Machida	11.2	0.012	0.10	16
TKO-4: Shinagawa	12.0	0.015	0.13	52
Average	12.5	0.022	0.18	---

- ✓ Sampling was conducted from September 10-26,2014.
- ✓ Total PM 2.5 was lower than expected and ranged from 11-15 µg/cm³.
- ✓ Average contribution of TRWP to total PM2.5 was 0.18%.

http://www.mapquest.com/maps?city=Tokyo&country=JP

UK - SAMPLE RESULTS FOR LONDON

- Overview - London
  - Sampling was conducted from March 3-31, 2015.
  - Seven locations were established
    - North Kensington (PM2.5)
    - Camden (PM2.5)
    - Falconwood (PM2.5)
    - Marylebone Road (PM2.5)
    - Brent (PM2.5 and PM10)
    - Blackheath (PM2.5 and PM10)
    - Tower Hamlets (PM2.5 and PM10)
  - Most of the total PM2.5 values were in the ranges expected

TRWP – LONDON SAMPLING

Sample Number	Average Total PM2.5 (µg/m³)	Average TRWP in PM2.5 (µg/m³)	Average %TRWP	Traffic Counts (x1000)
North Kensington	16.9	0.046	0.30%	--
Camden	20.9	0.028	0.13%	39
Falconwood	6.2	0.016	0.26%	74
Marylebone Road	30.1	0.089	0.31%	71
Brent	28.1	0.033	0.11%	84
Blackheath	6.4	0.014	0.37%	74
Tower Hamlets	27.2	0.131	0.61%	74
Average	19.4	0.051	0.30%	69

- ✓ Sampling was conducted from March 3-31, 2015
- ✓ Total PM2.5 varied and ranged from 6-30 µg/m^3
- ✓ Average contribution was 0.3%

GENERAL CONCLUSIONS OF PM2.5 STUDY

- TRWP is a small contributor to total PM2.5
  - Measured concentrations ranged from 0.004 to 0.11µg/m³
  - Average contribution to ambient PM2.5 was 0.27%
- No significant differences in TRWP PM2.5 concentrations between any of the sampling sites.
  - TRWP in PM2.5 fraction did not show strong trends with any likely factors (traffic, weather, land use, etc)
- The range of TRWP in PM10 was similar to that reported in Panko et al. 2013 despite completely different sampling locations

Discussion