

# Tyre and Brake Wear Pollution

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# The Statistics

"Every year, the abrasion of motor vehicle tyres from some 280 million to 290 million U.S. vehicle tires, releases 4 times the Deepwater Horizon spill volume in TWP (tyre wear particulate) composed of zinc, latex rubber, carbon black, polyaromatic hydrocarbons (PAHs) and other constituents. This volume is equivalent to 4 ultra supertanker capacities of tire rubber particulate spilled into the U.S. environment every year."

Bad Water Journal



# Environmental Impact

- Tyre and brake wear ends up in the road runoff when it rains or it is suspended in the air as PM (Particulate Matter) contributing to non-exhaust emission based air pollution

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# The Composition of Tires

As a rule of thumb, Camatini et al. (2001) quote 75 % styrene butadiene rubber (SBR), 15 % natural rubber and 10 % polybutadiene for passenger car tyres. Metal and organic additives are also introduced to this blend to obtain the desired properties during the manufacturing process and to give the required road performance.



# PAH's in Car Tyres

Table 4 – Measured PAH content in car tyres (mg/kg/tyre)

Source		Nilsson <i>et al.</i> , 2005		Keml, 2003 BLIC, 2002	Baumann <i>et al.</i> , 1998		LUT, 2004	NBI, 2004
PAH component	Total PAH	P <sup>1)</sup>	L <sup>1)</sup>	P 13% HA oil	P	L	P	P
Fluoranthene	Yes	9.4	15.4	1.4	7.4	3.8	4.3	7.5
Pyrene		24.2	33.2	3.3	14.0	3.5	17.0	23.5
Benzo[a]fluorene				0.1				
Benzo(a)anthracene	Yes	0.8	0.9	4.4	1.0	0.7	8.5	1.3
Chrysene	Yes	5.5	5.3	51.3	7.0	2.3	6.0	2.2
Benzo[b+j+k]fluoranthene	Yes	1.8	2.1	4.2	3.8	1.9	5.8	3.0
Benzo(b)fluoranthene	Yes	6.4	6.4	9.5	6.4	6.4	3.3	2.4
Benzo[e]pyrene		5.5	5.9	14.7				
Benzo(a)pyrene	Yes	1.3	2.6	1.7	3.0	0.4	3.0	2.1
Dibenzo[a,j]anthracene				0.6				
Dibenzo[a,h]anthracene		1.2	0.8	0.7	0.1	0.2	0.5	1.1
Indeno(1,2,3-c,d)pyrene	Yes	2.3	1.0	0.8	0.1	0.4	0.2	0.8
Benzo(ghi)perylene	Yes	12.9	7.3	2.3	0.5	2.4	6.0	3.6
Ananthrene				0.9				
Naphthalene	Yes	1.6	4.5	1.6	2.7	4.5	0.6	0.4
Acenaphthene					0.1	1.0	0.3	0.2
Acenaphthalene					0.4	0.3	5.6	0.6
Fluorene					0.1	4.4	0.2	0.4
Phenanthrene	Yes	4.3	2.3	4.3	4.2	2.3	4.3	5.5
Anthracene	Yes	0.8	0.1	0.8	0.7	0.1	0.8	2.0
<b>Total (VROM-PAH + BbF)</b>		46.9	47.9	82.3	36.8	25.2	42.8	30.8

NB: PAHs in red are the PAH components forming part of the calculated total PAH.

<sup>1)</sup> P = Passenger cars, L = Lorries



# Heavy Metal Content of Tyres

Table 7 – Contents of types of metal in tyres

Metal type	Concentration range (mg/kg)	Metal type	Concentration range (mg/kg)
Ag	0.08	Mg	32 – 444
As	0.8	Mn	2 – 14
Al	81 – 956	Mo	2.8 – 10
Ba	0.9 – 4.1	Na	610
Ca	113 – 1,500	Ni	0.9 – 50
Cd	0.28 – 4.96	Pb	1 – 160
Co	0.88 – 39	Sb	2
Cr	0.4 – 49	Se	4 – 20
Cu	1.8 – 69	Sr	1.16 – 3.13
Fe	2 – 2,800	Ti	195
K	180	V	1
Li	0.23 – 2.3	Zn	8,000 – 13,500

Source: Malmqvist (1983), Hewit *et al.* (1990), Brewer (1997), Legret *et al.* (1999), San Miguel *et al.* (2002).

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# Wear Factors for Tyres vs. Driving Style

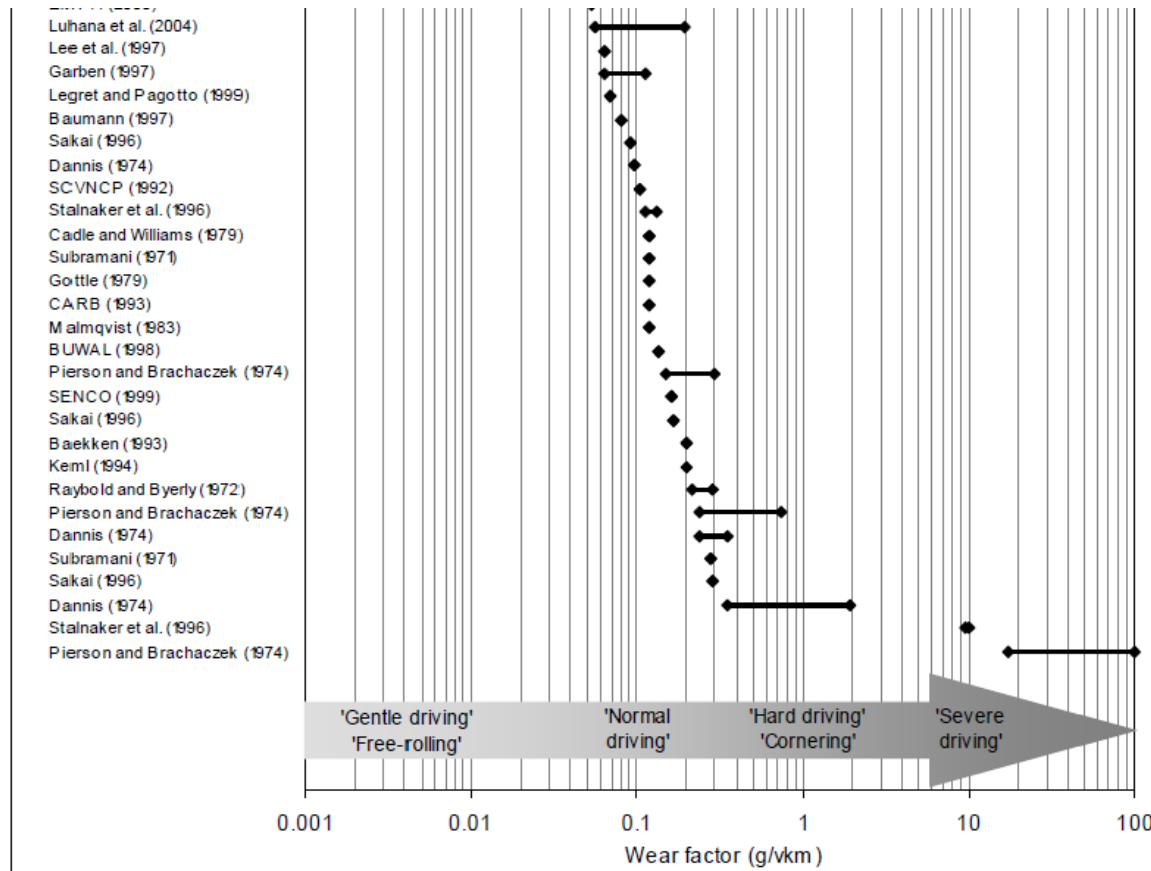


Figure 2-1 Wear factors for light-duty vehicle tyres (Boulter, 2005). 'vkm' = 'vehicle-km'



# Driving Style vs. Emission Factors

Table 9 – Effects of driving style and environment on emission factors

Condition	Value	Unit	Source
Highway – 120 km/h	24	mg/km/tyre	Dannis (1974)
Taking bends – 50 km/h	490		
Road bends in urban areas	30	mg/km/tyre	Le Maitre <i>et al.</i> (1998)
Driving gently	12		
Driving "professionally" <sup>1)</sup>	70		
Dry conditions	150	%	
Winter compared to summer	140		

<sup>1)</sup> "Driving professionally": Accelerating quickly, keeping to the maximum speed as much as possible and braking little.

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# Brake Wear Pollution

- brake wear responsible for 20 per cent of all traffic emissions
- Particles released by cars when they brake have been found to cause damage to lung cells.
- brake wear particles contained large amounts of iron, copper and organic carbon.

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# Recommendations?

- If you don't need to drive in the city, take a bus instead or ride a bicycle
- If you do need to drive, drive like a "gentleman": it's safer and better for the environment
- R&D into tyres that are wear proof

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# References

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- **Controlling Nonpoint Source Runoff Pollution from Roads, Highways and Bridges**

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- **Particles from car brakes harm lungs - The Ecologist**

[http://www.theecologist.org/News/news\\_round\\_up/367875/particles\\_from\\_car\\_brakes\\_harm\\_lungs.html](http://www.theecologist.org/News/news_round_up/367875/particles_from_car_brakes_harm_lungs.html)

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