Emission measurement from older owner fired wood stoves in residential house

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Presentation of measured real-world emissions of particles, PAH and dioxins from wood stoves and one wood boiler, performed at 13 houses in Gundsømagle in 2003 and 2005.

The stoves was operated as usual by the owner during the test.

Type test emissions

How does real-world emissions differs from the emissions measured in type test?

- **The wood burned is standardized logs or laths in well defined size and wood type.**
- **Operated by a very experienced operator watching the stove during the whole test.**
- **Constant chimney draught.**
- **Direct measured values of CO and O2 concentration and temperatures.**
- **Tests are repeated if the emissions are too high.**

Real-world emissions

Is real-world emission always higher than emissions from the type test?

No, it can be lower, but it is expected to be higher in most cases!

The real-world emissions depends of many parameters, as:

- **stove type and quality,**
- **chimney draught**
- **wood type, size and quality**
- **kindling method**
- **the operators firing skills**
- **etc.**

Wood type - emissions

Average emission factors.

Fuel	CO [mg MJ^{-1}]	NO_x [mg MJ^{-1}]	C_xH_y [mg MJ^{-1}]	PM10 [mg MJ^{-1}]	Odor [OU]
WP FL1	118	94	58	21	ND
WPFL2	188	131	5	31	ND
WP PL	245	74	8	16	ND
BR	1482	63	163	32	1804
EH	1234	110	462	41	536
EB	1410	95	234	66	1563
BPop	1856	65	216	20	2843
TO	1816	88	206	59	1781
SO	3681	131	657	222	4226
PO	3253	104	452	57	1973
BL	2000	118	239	67	1689
SF	3497	105	581	100	5217
EL[a]	1263	58	179	21	2422
NS	1901	69	267	53	3815
BP	1710	64	243	101	1589
SP	1189	70	109	53	2134

Kistler, M. et.al. Odor, gaseous and PM10 emissions from small scale combustion of wood types indigenous to Central Europe

Wood stove emissions

Wood Stove $mg/m^3(13\%O_2)$	Ideal operation 2 x 0.7 kg dry wood at a time	Typical operation 3 x 1.5 kg wood at a time	Smoldering operation air inlet closed
Salts	< 20	< 20	< 20
Soot	< 20	< 100	5.000
Tar	< 5	400	10.000
Total:	< 50	500	15.000
Indeks - Soot	1	≈ 5	> 250
Indeks - Tar	1	> 80	> 2.000
Indeks - Total	1	> 10	> 300

Typical Danish houses and chimneys

Typical Danish houses and chimneys


32 kW
electricity
generator
Office
Air
compressor


CH no: 11


STØJMÅLE-
STATION


Decibella
KV 16 24
DK


SVIGTER
OLIEFYRET?
OK

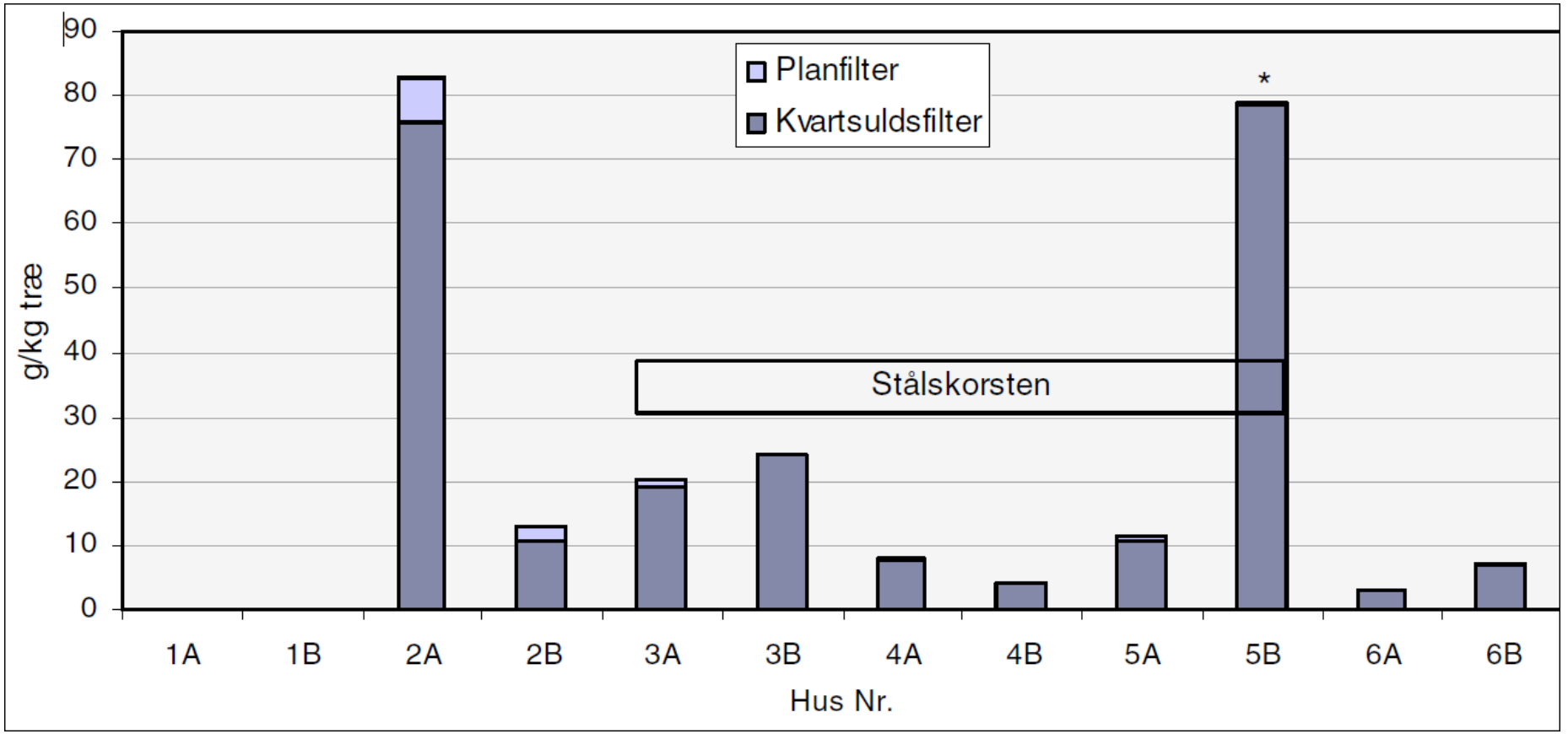
Sampling errors

The purpose of the project was to measure the emission of PAH and dioxin, and the emission of particles was only measured additionally, and did not followed the normal standard procedure.

The particle emission was measured by weighing the quarts woll filter used for sampling PAH and dioxin, and it was only dried in a conditioned room, and not in an oven, which means slightly higher values due to humidity in the particles.

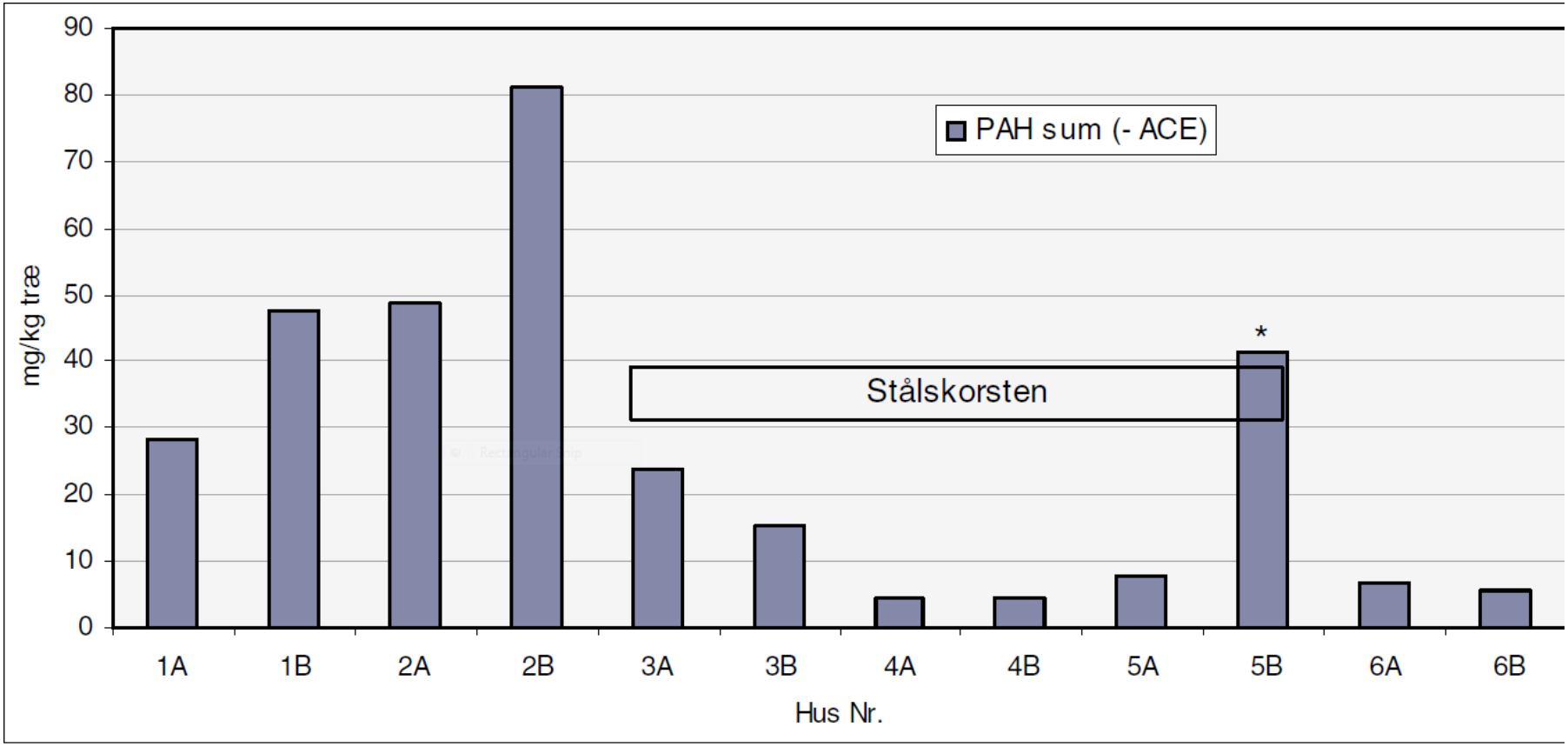
Soot and particle was to some extend deposited inside the dilution tunnel, which means lower measured values.

Gundsømagle 2003 - Particle

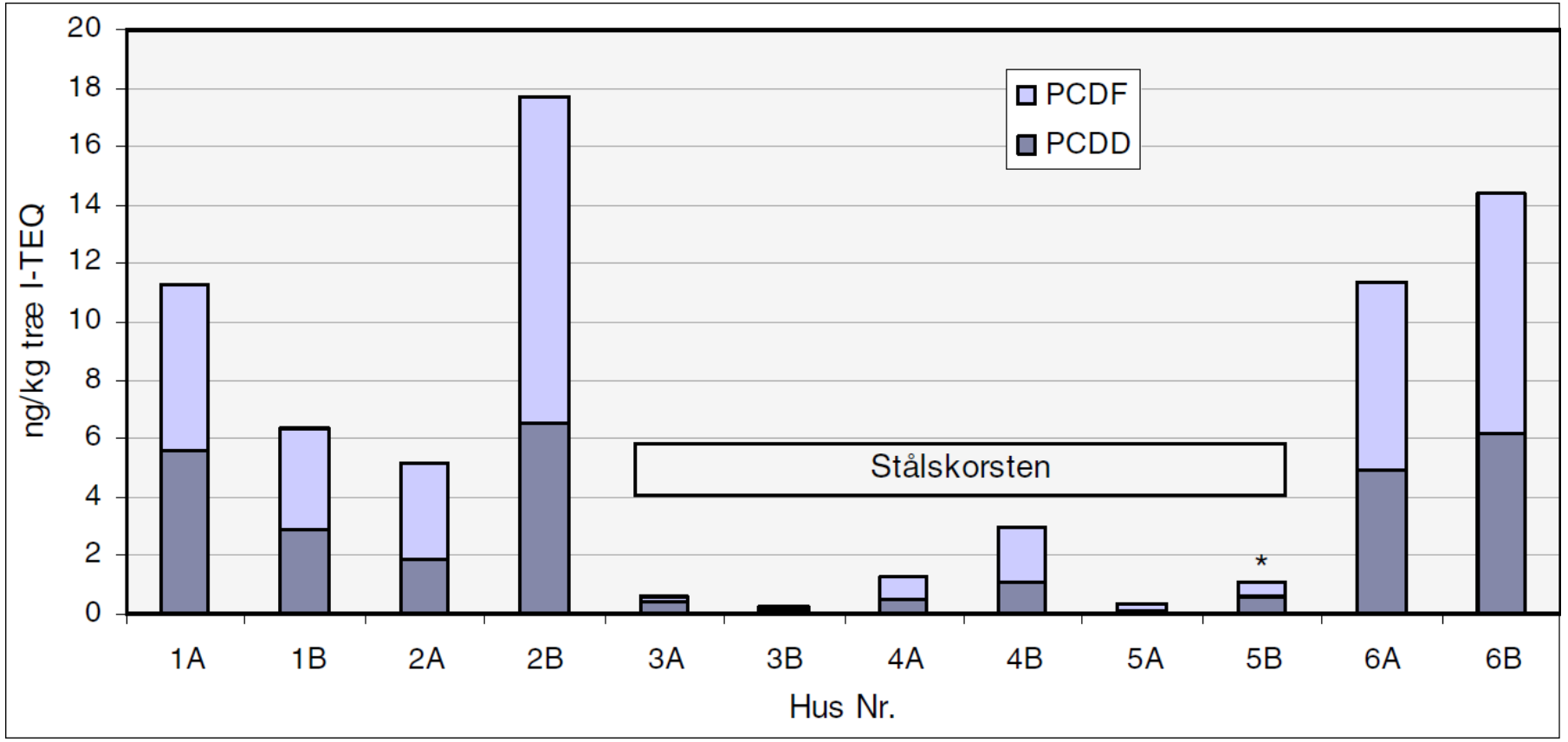


5B fired with demolition wood

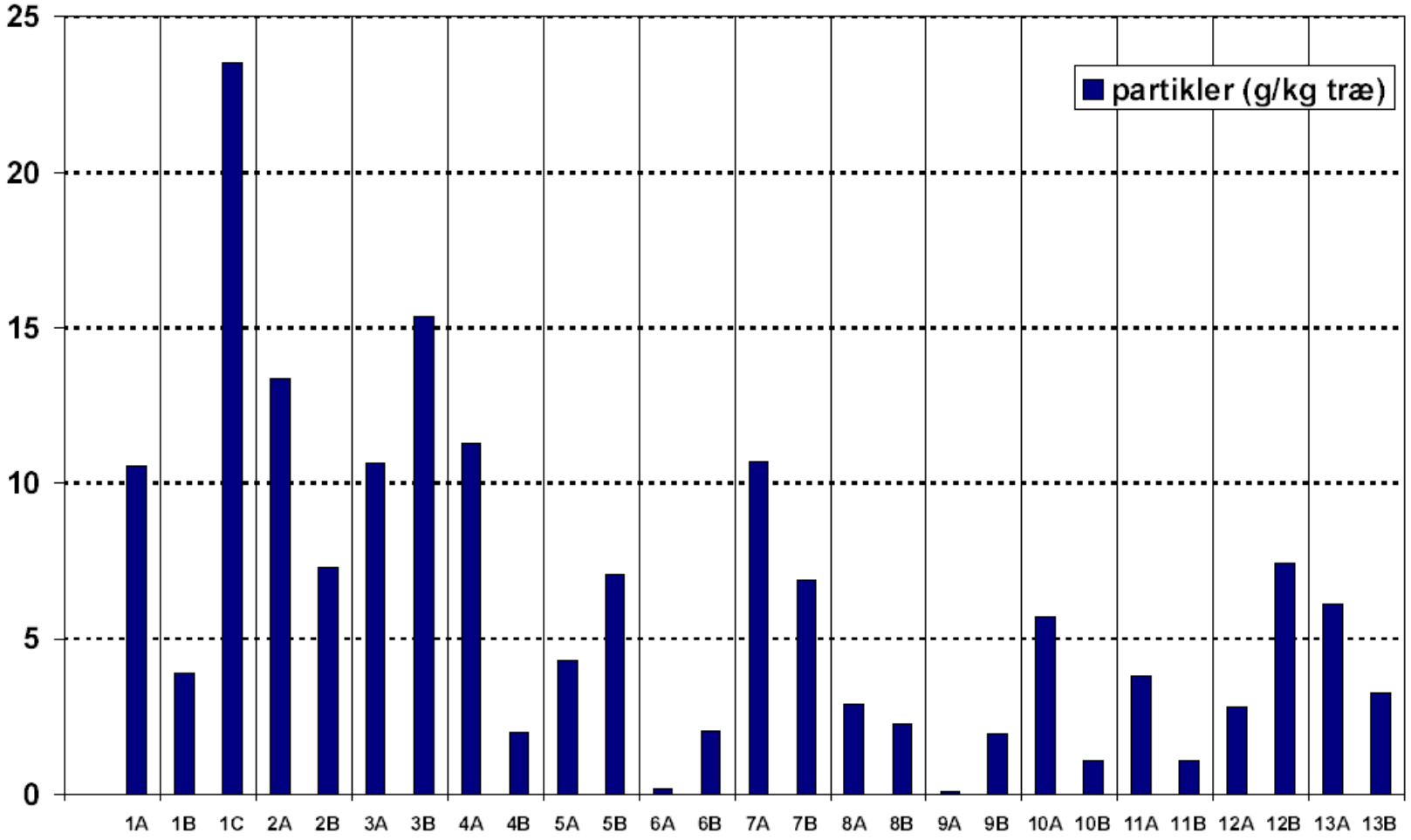
Gundsømagle 2003 - PAH



Gundsømagle 2003 - Dioxins

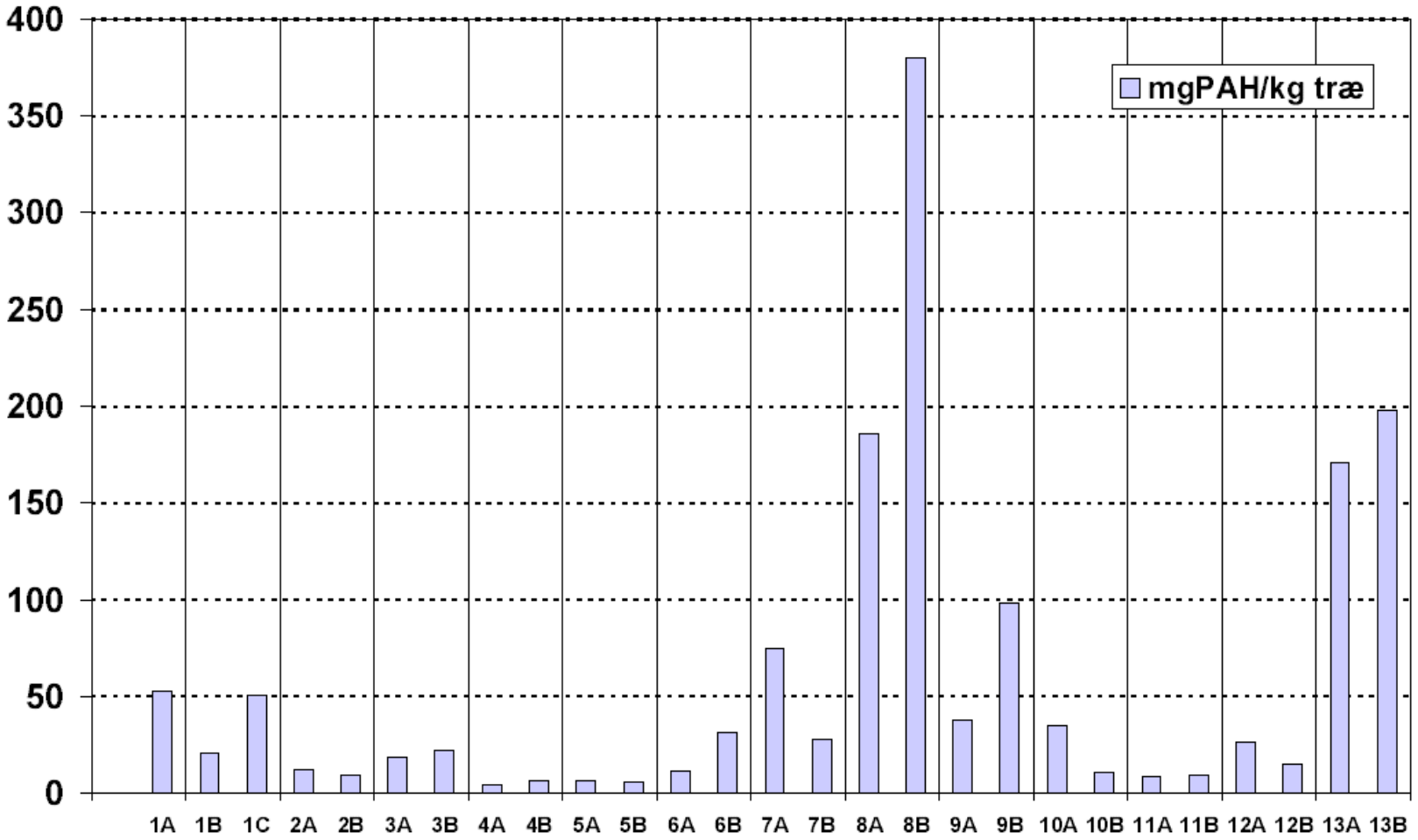


Gundsømagle 2005 - Particles



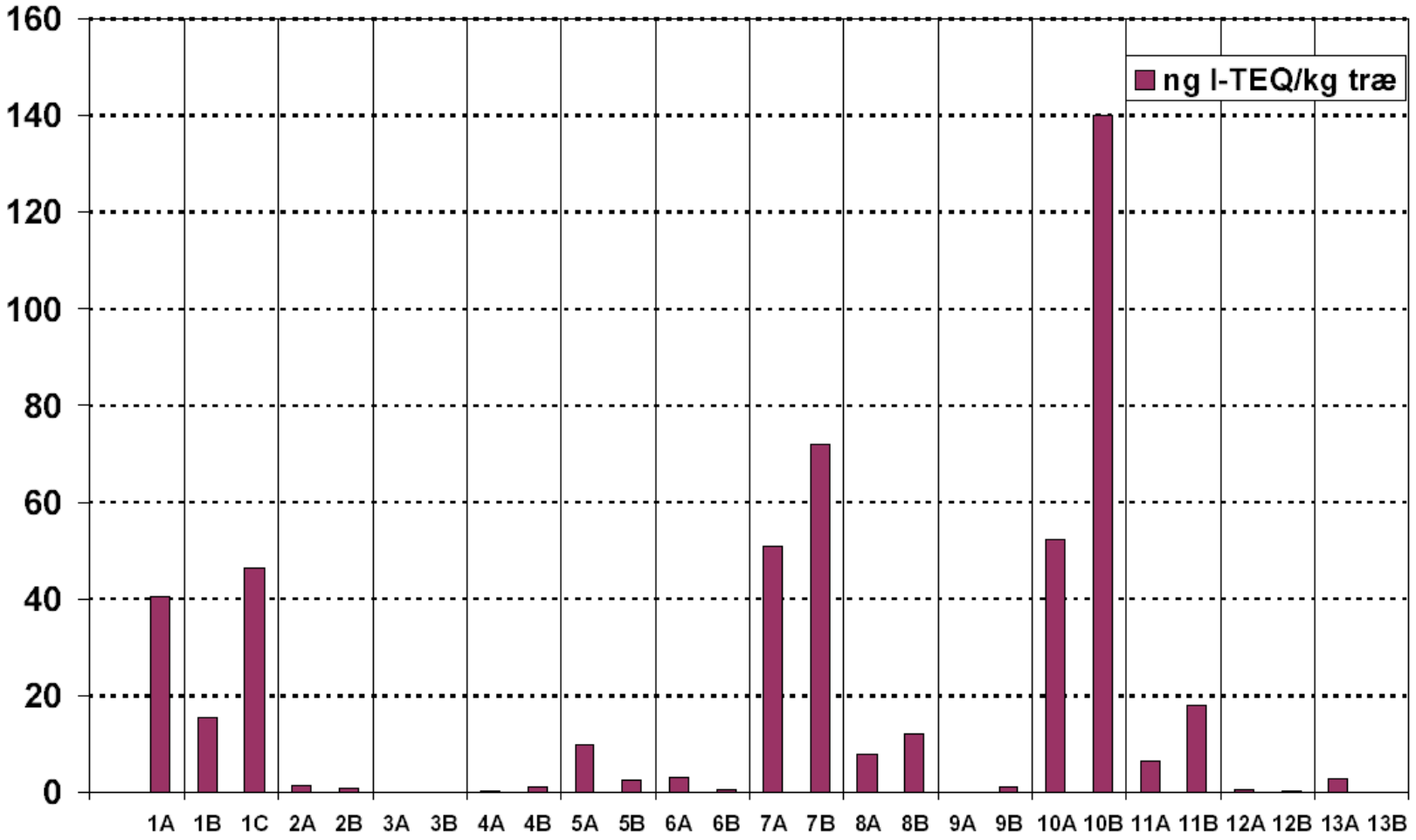
Average: 6.2 g/kg (0.1 – 23.5 g/kg = factor 235)

Gundsømagle 2005 - PAH



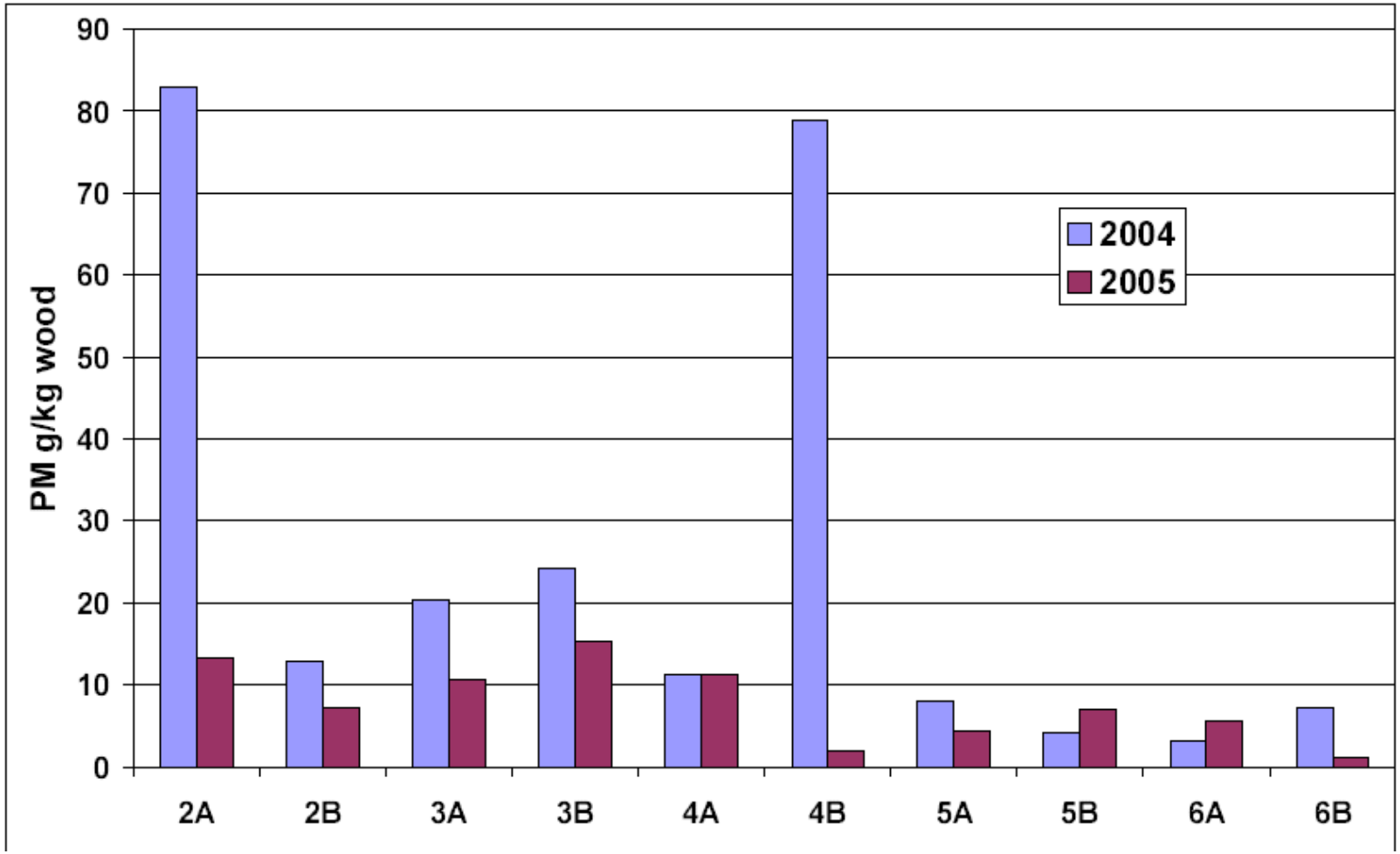
Average: 57 mg/kg (4 – 380 mg/kg = factor 90)

Gundsømagle 2005 - Dioxins

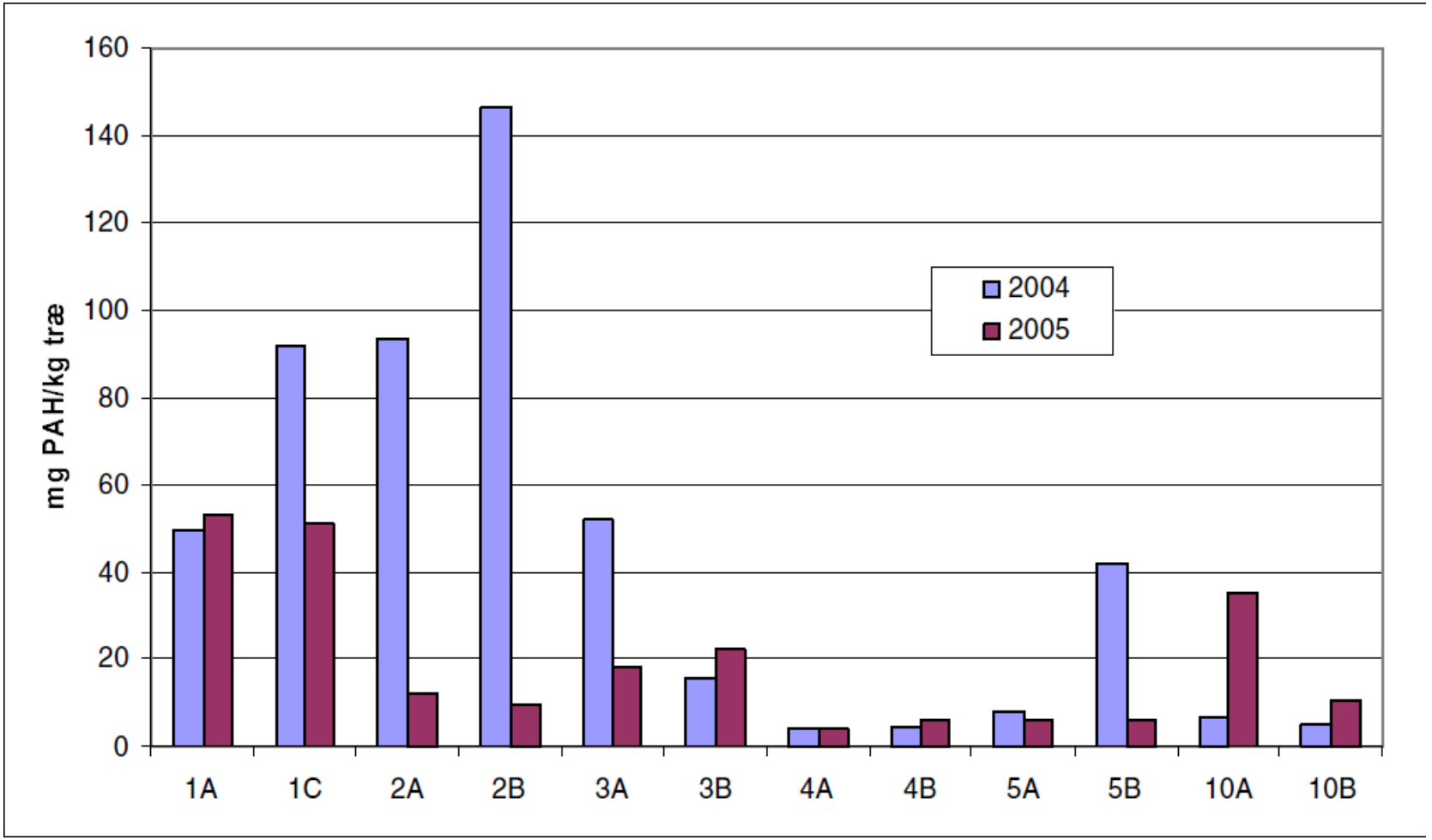


Average: 0.027 ng I-TEQ/kg (0.027 – 140 ng I-TEQ/kg = factor 5200)

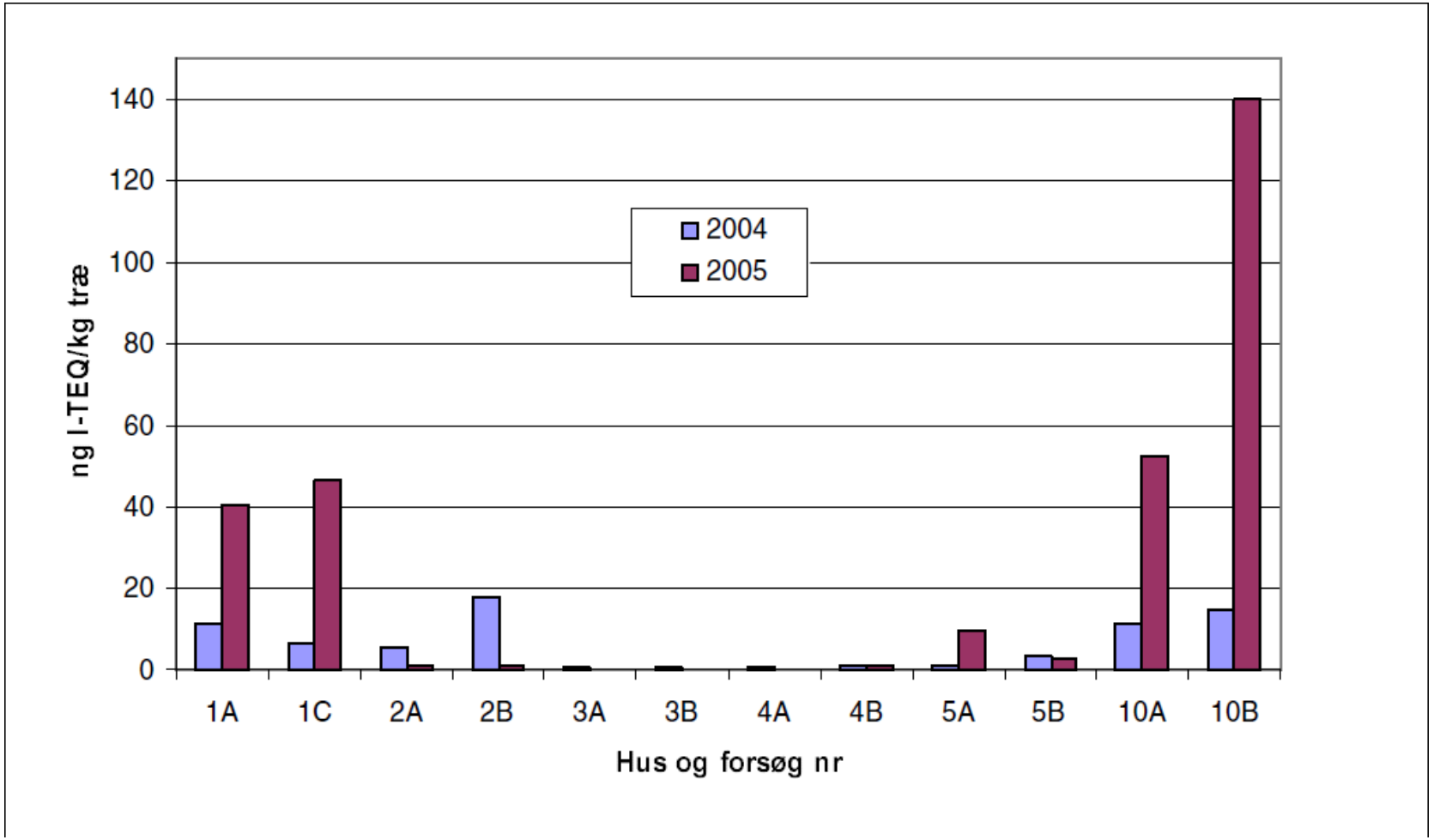
Gundsømagle 2003/2005 - Particles



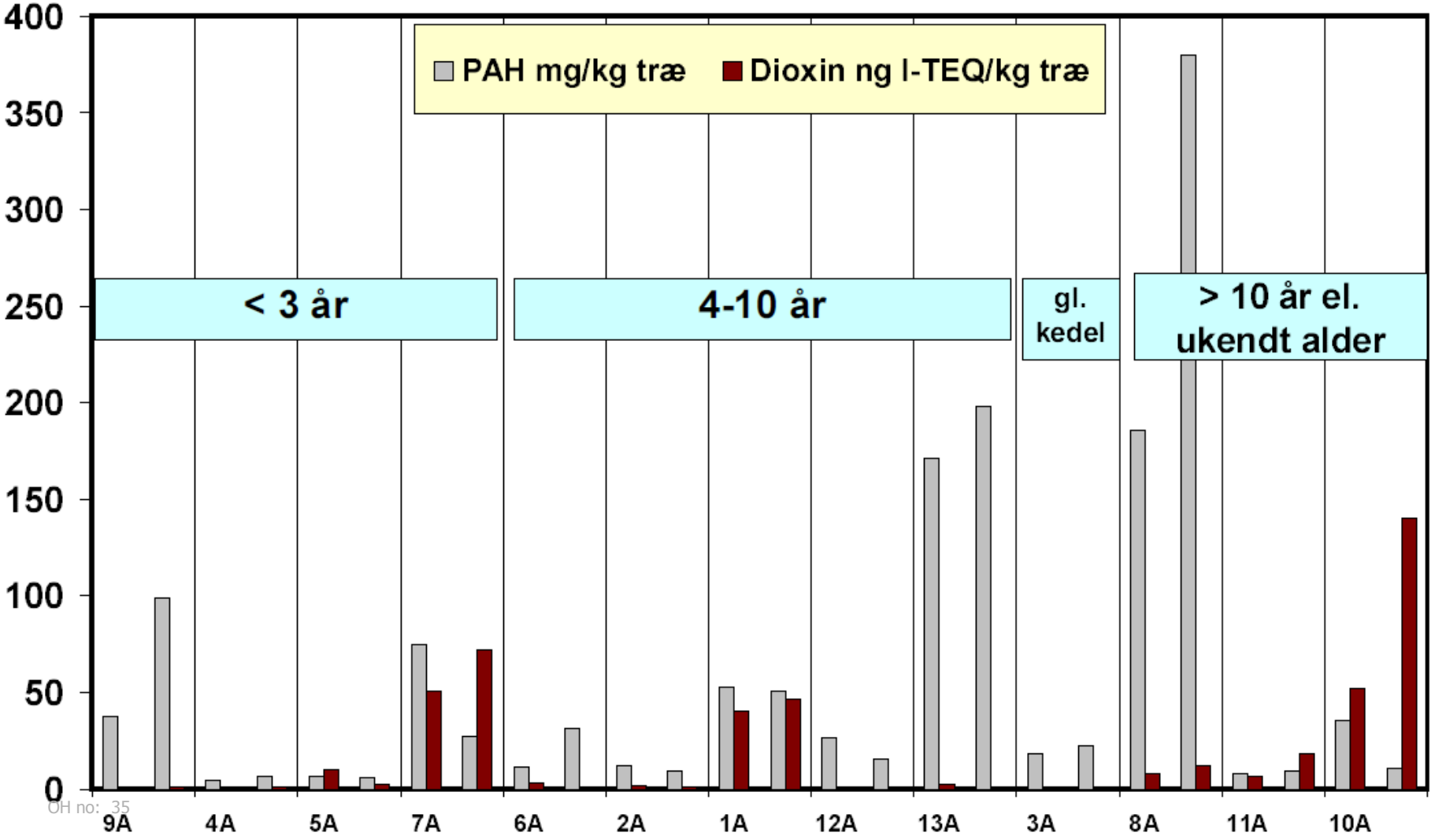
Gundsømagle 2003/2005 - PAH



Gundsømagle 2003/2005 - Dioxins



Gundsømagle 2005 - Stove age



Conclusion and thoughts!

- **Real life PM emissions can apparantly be lower than the former official limit value and emission factors**
- **Very big variations in the measured real-world emissions.**
- **The measured particle emission are most likely too low, because of sampling errors**
- **Sampling method with dilution tunnel could be improved by reducing the pipe by placing the sampling equipment on a platform on the roof!**

Thanks for your attention!