



Dioxin research paves the way for better flue gas sampling and cleaning

Eva Weidemann, PhD
Department of Chemistry
Umeå University

Dioxins – What are they?

- 75 dioxin and 135 furan isomers
 - Organic molecules
 - 1-8 chlorines
 - Persistent in the environment
 - Accumulates in fatty tissue

- Isomer abundance depend on process
 - Enables source tracing

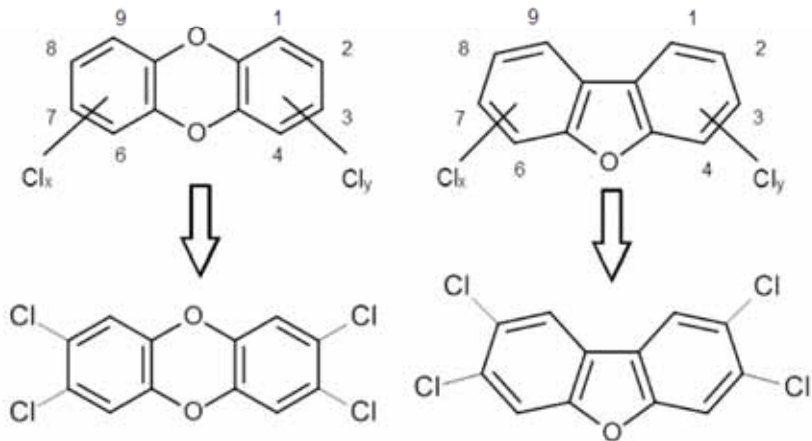


Dioxins – Why do we care?

- 17 of 210 exhibit toxicity
 - 2,3,7,8 chlorination

- Effects include:

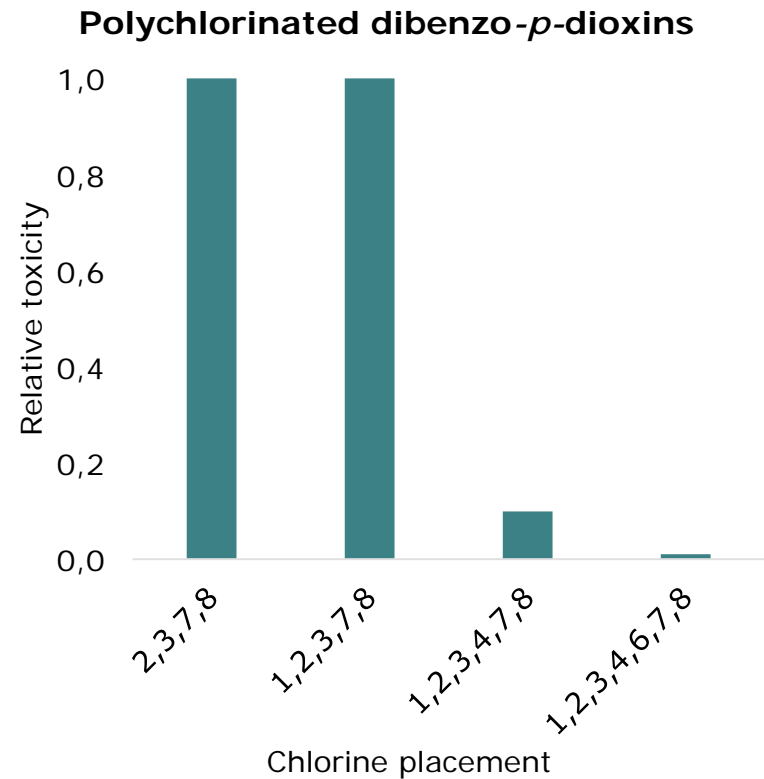
- Skin disease
- Cancer
- Disrupted immune system
- Reproductive and developmental disruption



Dioxins – TEQ explained

Used to summarize amount of toxic isomers in a sample

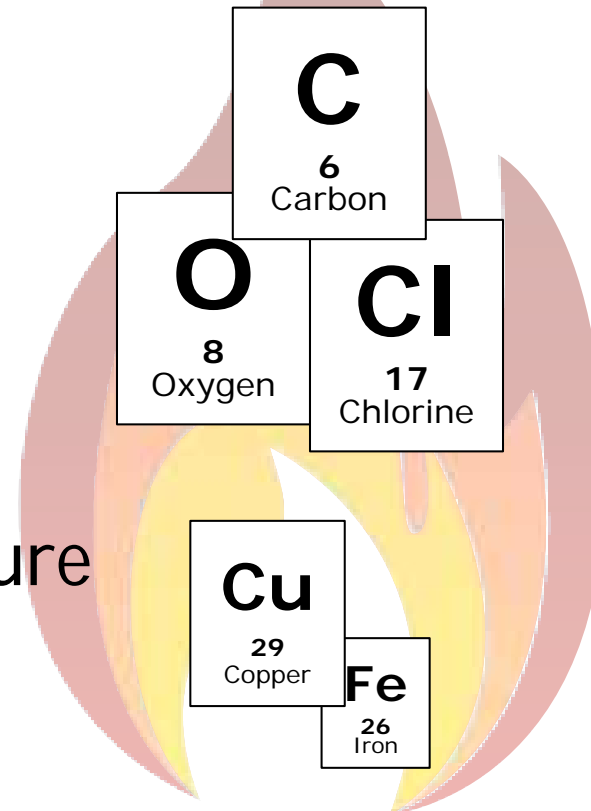
- Enables comparison
- Number of chlorines
- Chlorine placement



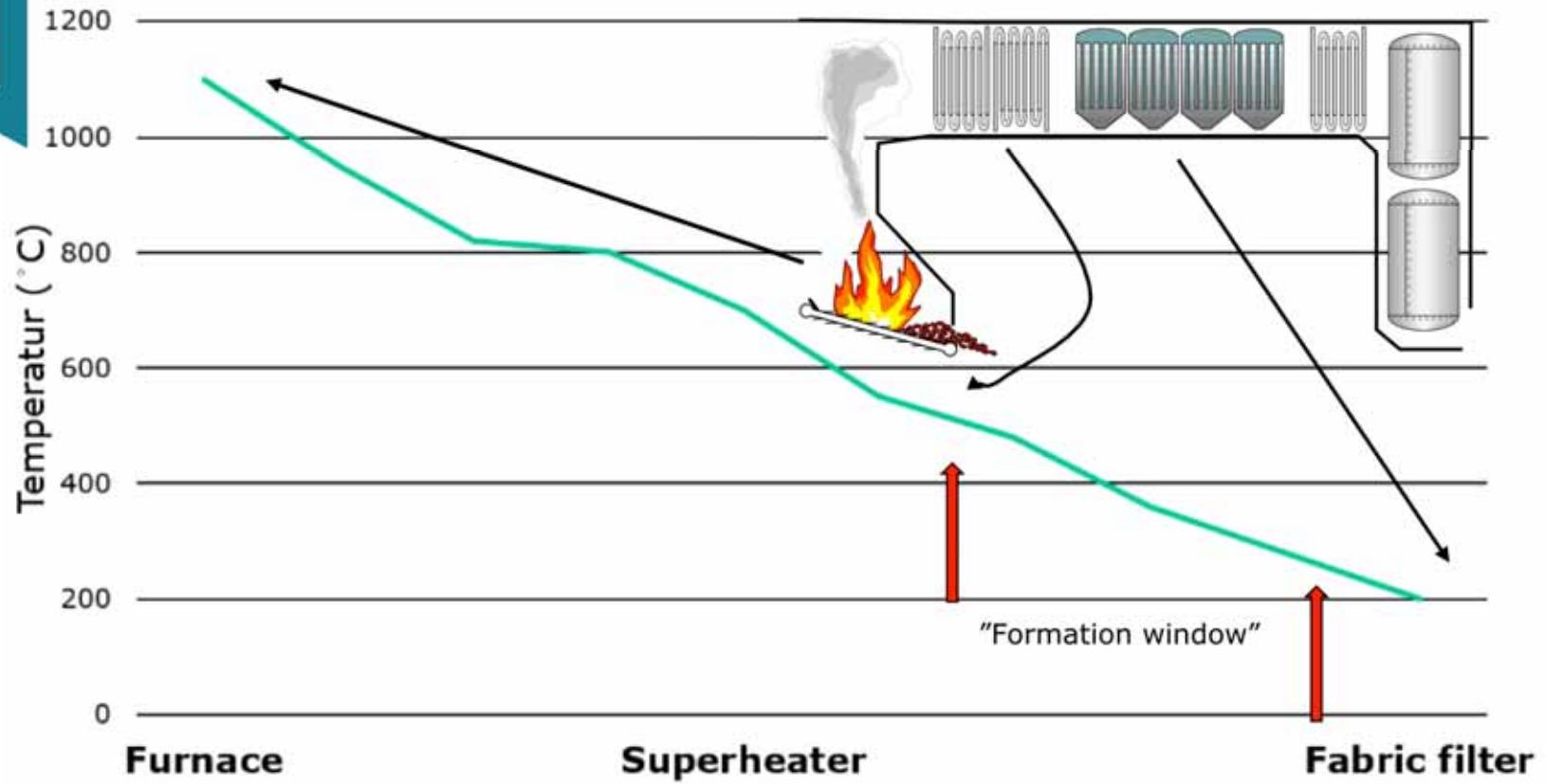
Dioxins – Why do they form?

Prerequisites for dioxin formation in waste incineration/combustion:

- Carbon structures
- Oxygen
- Chlorine
- Catalyst - metals
- Sufficient temperature and residence time



Dioxins – Where do they form?





Flue gas sampling



Flue gas sampling – Essential questions

WHY?

- Legislative purposes or research?
- Process control?

WHERE?

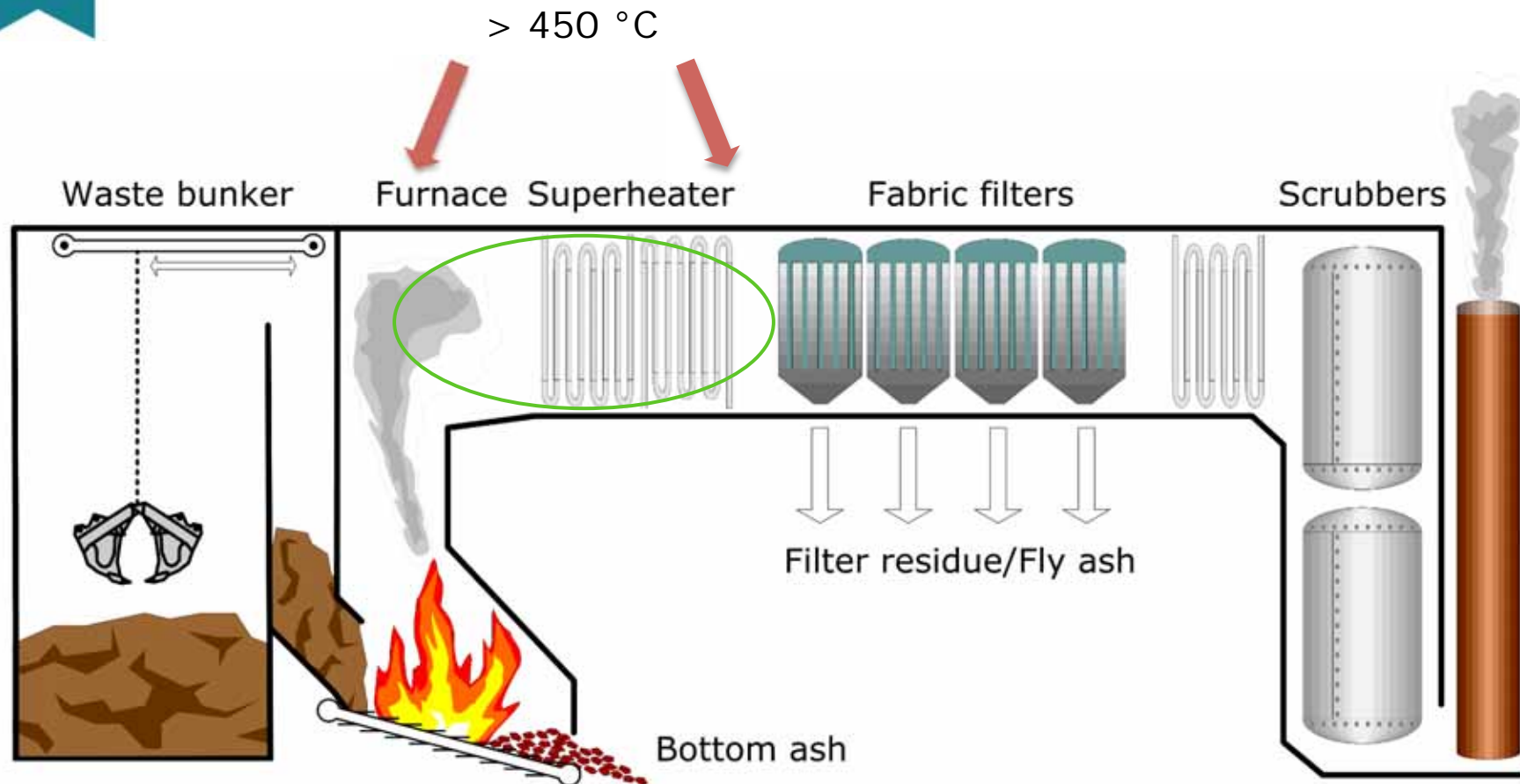
- Representative samples?

HOW?

- Suitable sampling method?
- Special conditions



Flue gas sampling – High temperature sampling

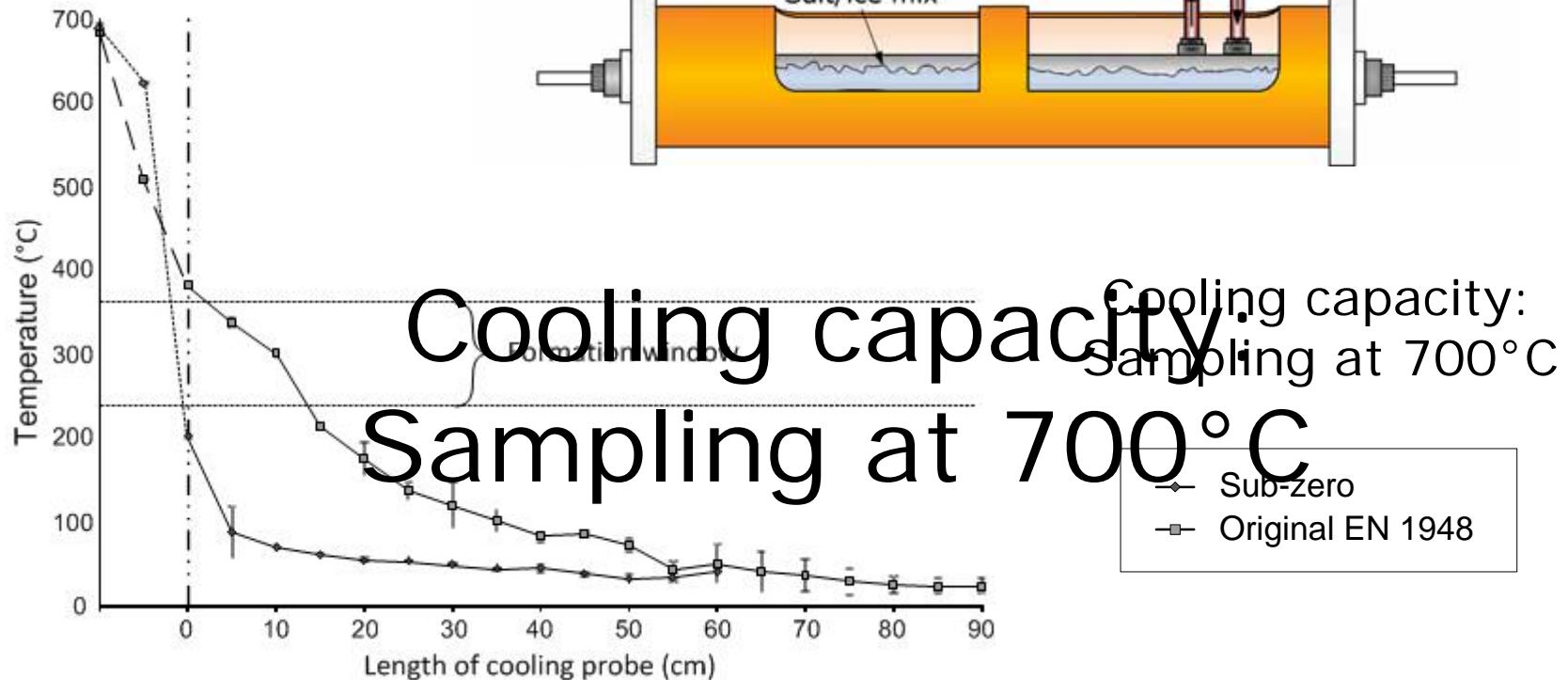
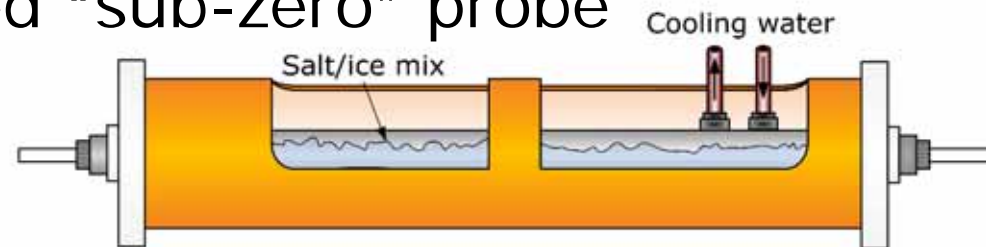


Flue gas sampling probes

Original EN 1948 probe

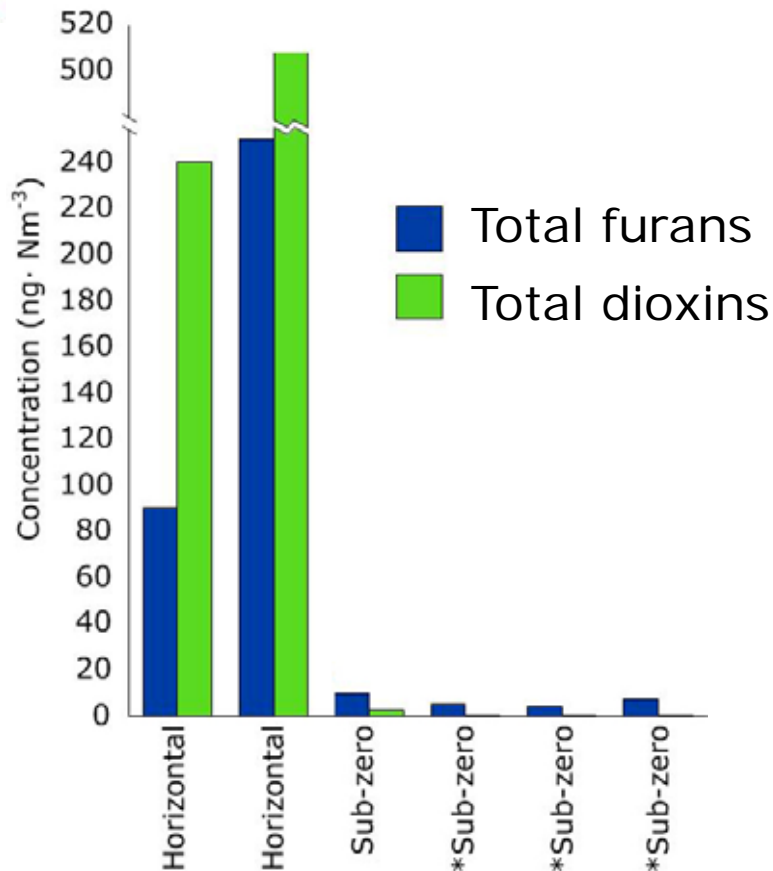


Modified "sub-zero" probe



Flue gas sampling

– Artefact formation at 700 °C

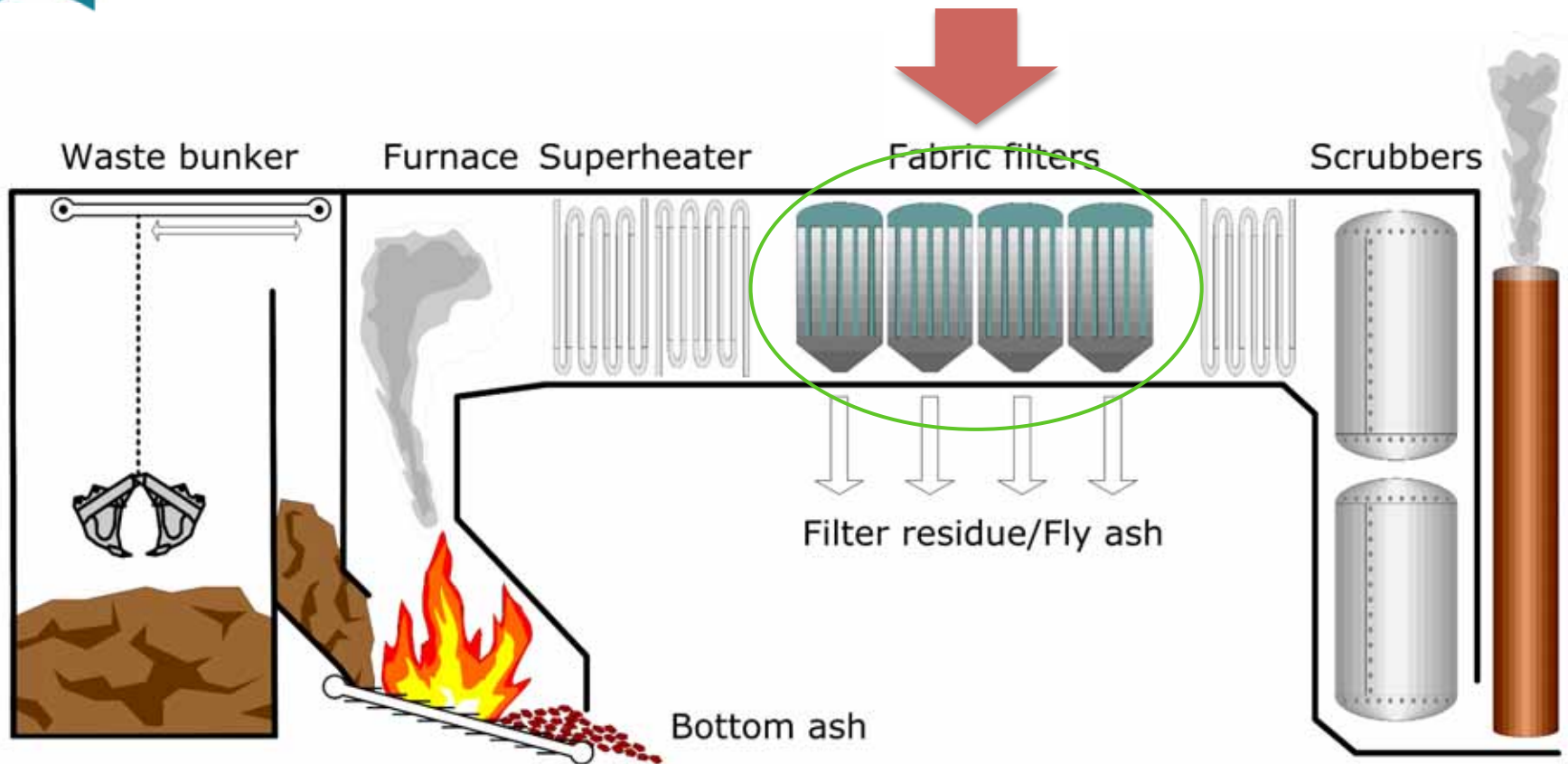


- High temperatures incur special conditions
- Suitable sampling for the occasion is essential

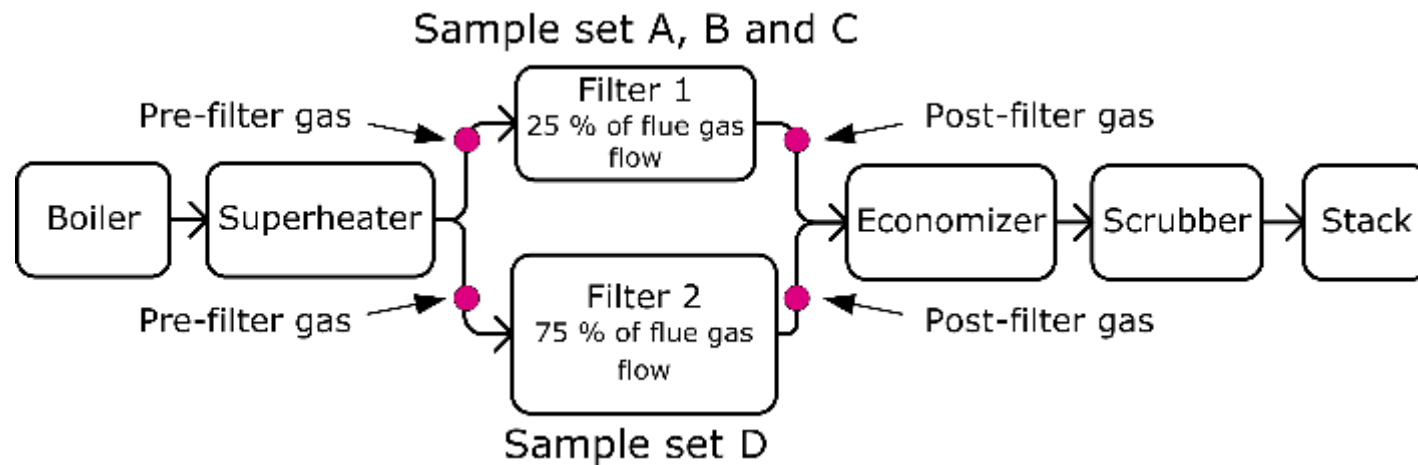
**DON'T
UNDERESTIMATE THE
REACTION RATES!**

In-filter dioxin formation – A case study

Textile filters with CaO/carbon injection



In-filter dioxin formation – A case study



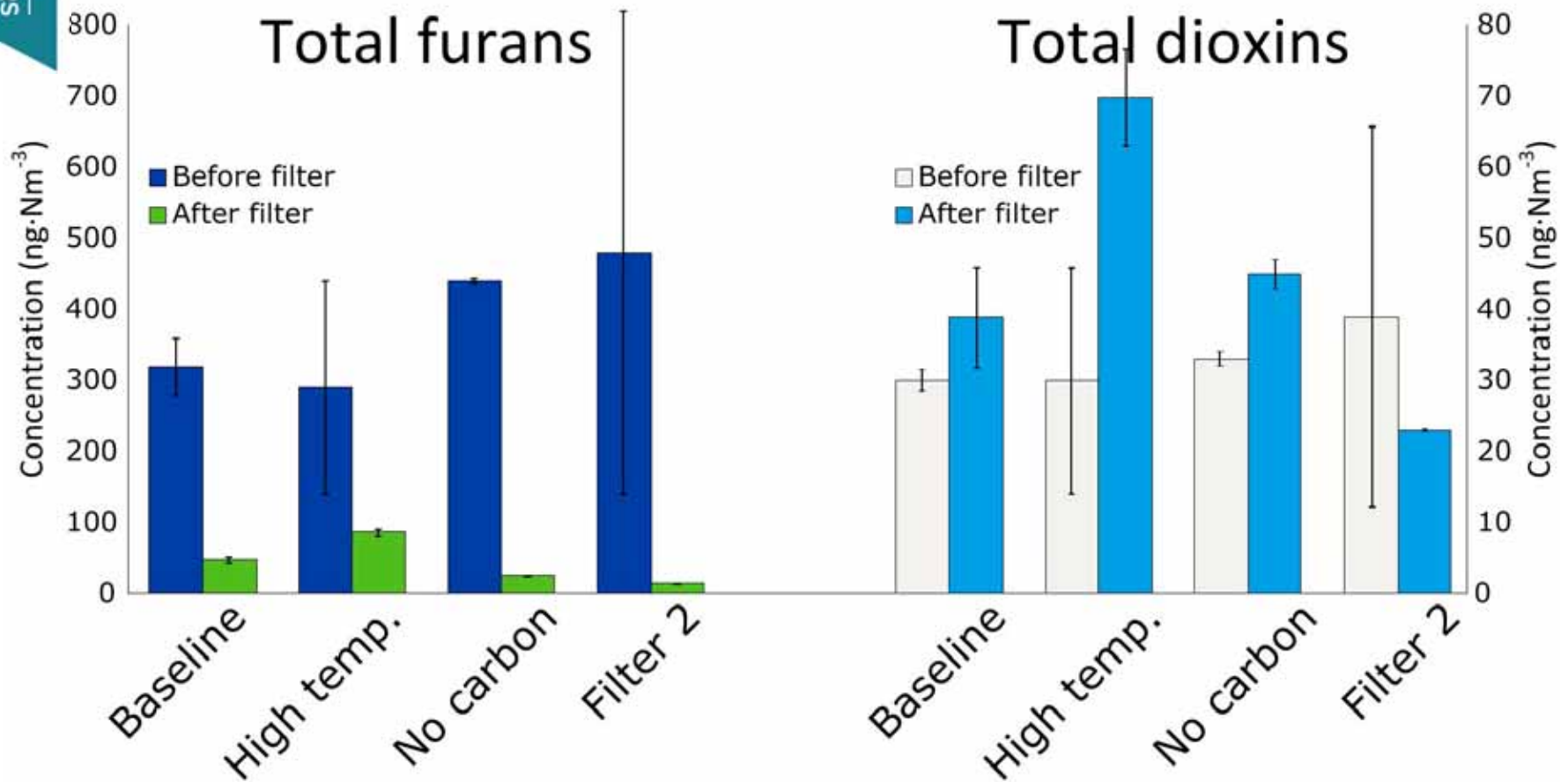
Filter 1 ("new" filter)

- A: Baseline (210 °C, carbon inj.)
- B: Elevated temperature (220 °C, carbon inj.)
- C: No carbon injection (210 °C)

Filter 2 ("old" filter)

- D: Baseline (210 °C, carbon inj.)

In-filter dioxin formation – A case study



In-filter dioxin formation – A case study

All dioxins with 4 to 8 chlorines

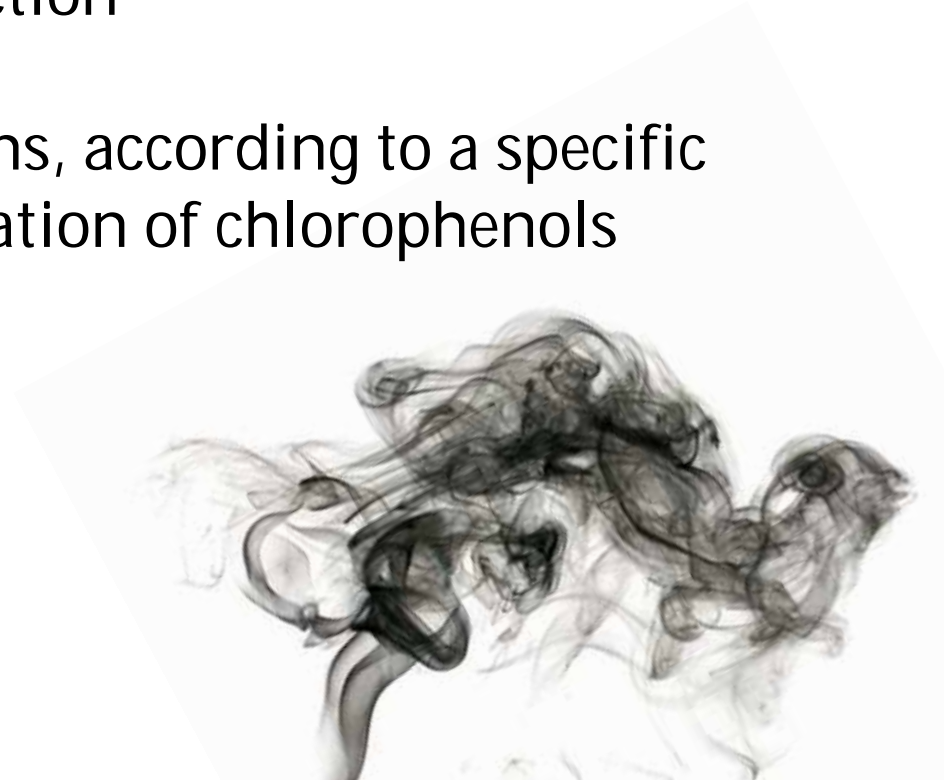


In-filter dioxin formation – A case study

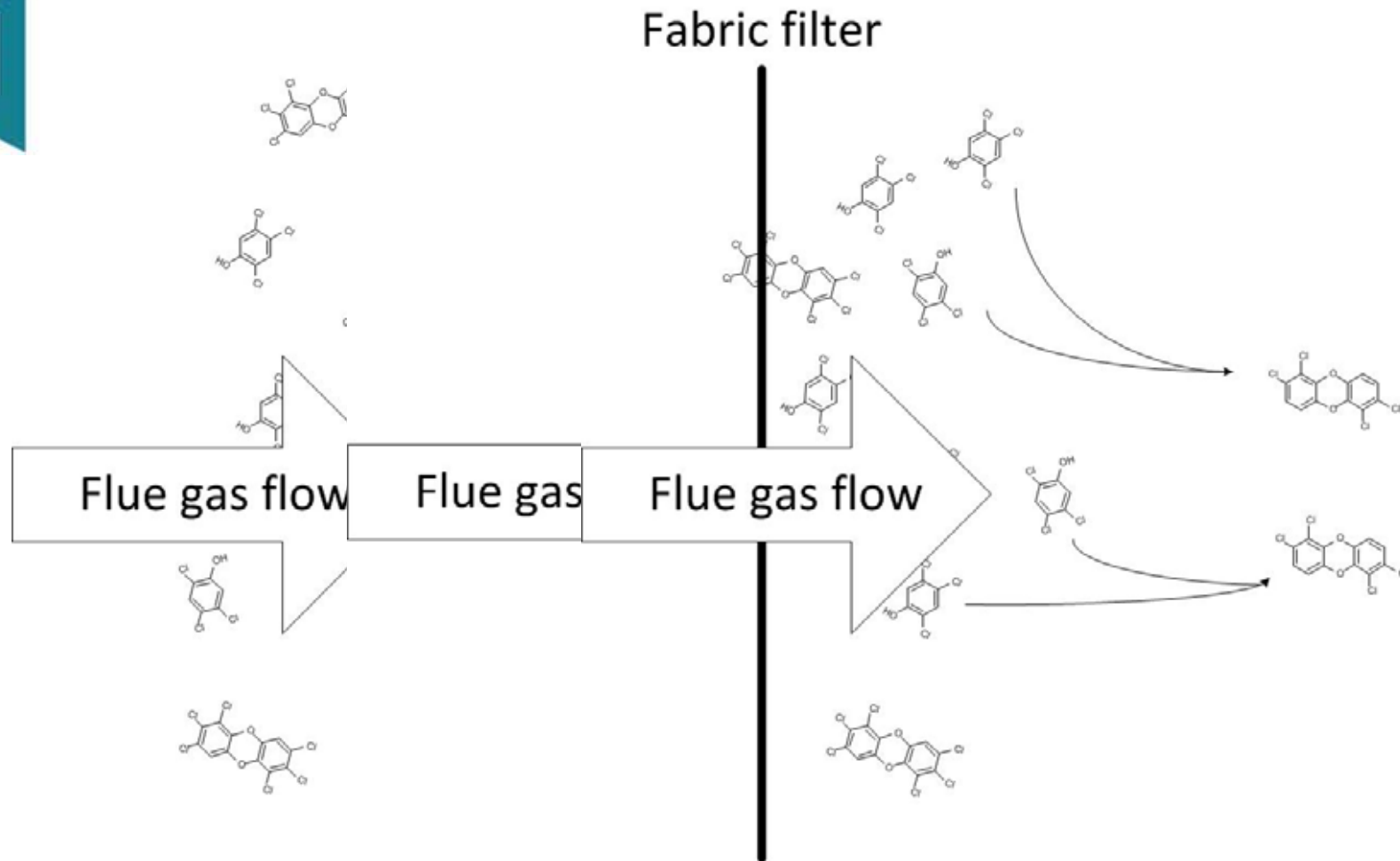
Formation took place within the filters

- At a “safe” temperature (below 250 °C)
- Despite carbon injection

Mainly formation of dioxins, according to a specific pattern linked to condensation of chlorophenols



What happens in the filter?





Conclusions

- Formation rates are very fast
 - Sampling at high temperatures require special equipment and care
- “Safe” temperatures might not be
 - Under favorable conditions reactions can take place where they “shouldn’t”



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We don't know everything yet

40 years down the line things still can surprise us



Thank You!

Acknowledgements:

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