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Reduction of Dioxin Emissions from Thermal Treatment Plants

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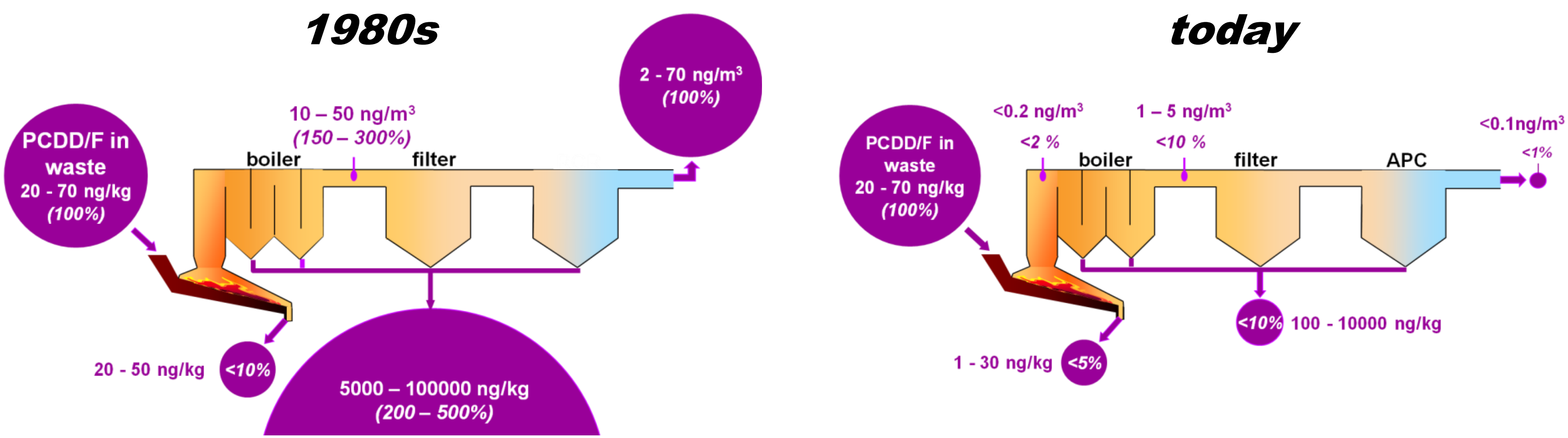
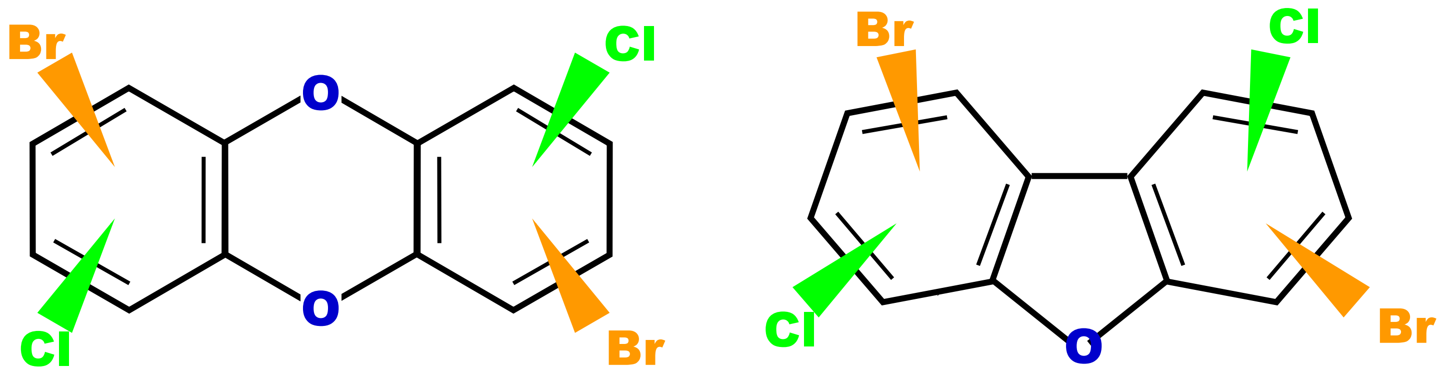
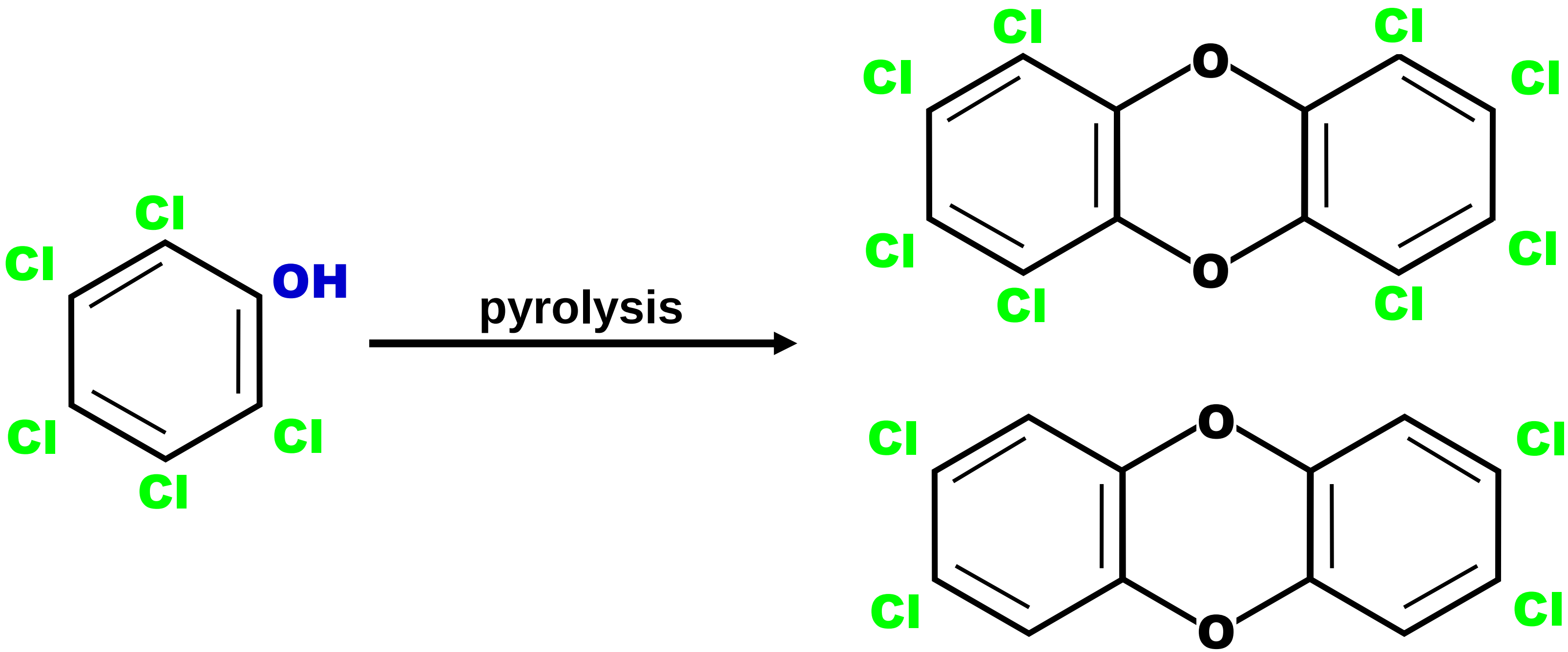




congeners:

chlorinated	**210**
brominated	**210**
mixed halogenated	**5020**

polyhalogenated dibenzo-p-dioxins und -furans



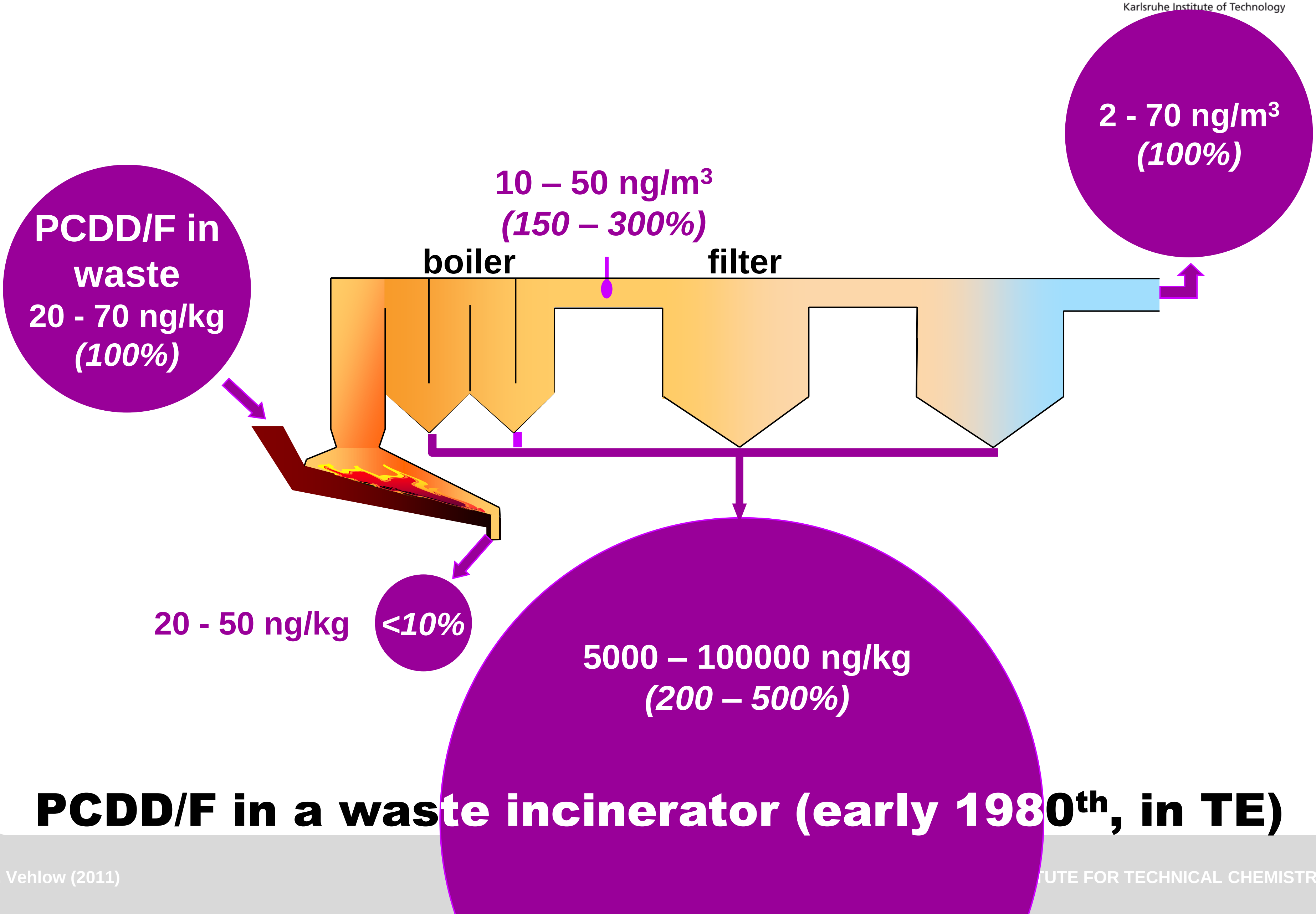
'since this compound caused heavy chloracne it did not invite to further investigations' (Stockmann/Sandermann)

1957: birth of halogenated dioxins

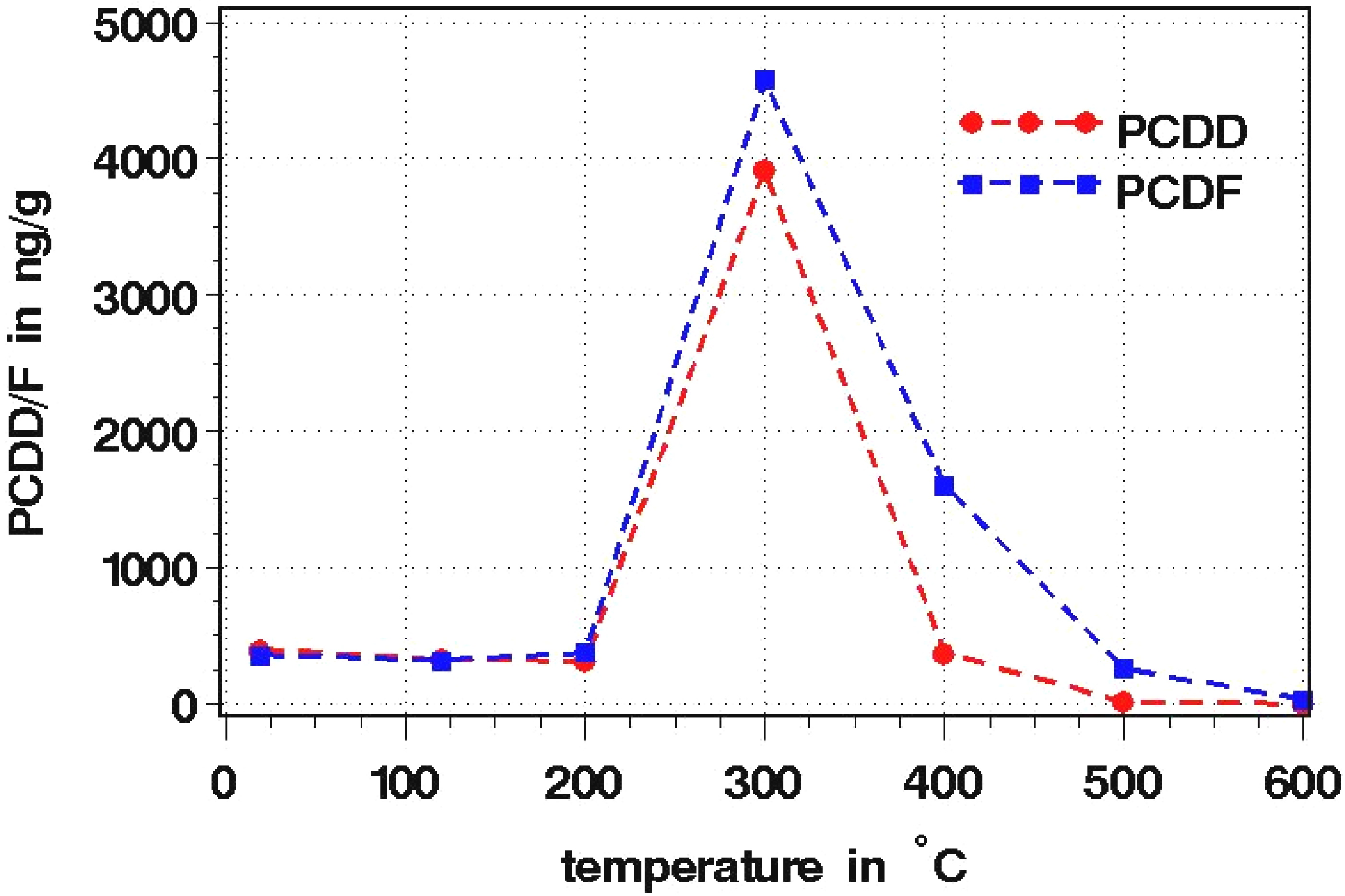
birth of a problem

1976 Seveso accident (10. July)

1977 detection of dioxins in
fly ashes from
Dutch waste incinerators



PCDD/F in a waste incinerator (early 1980th, in TE)

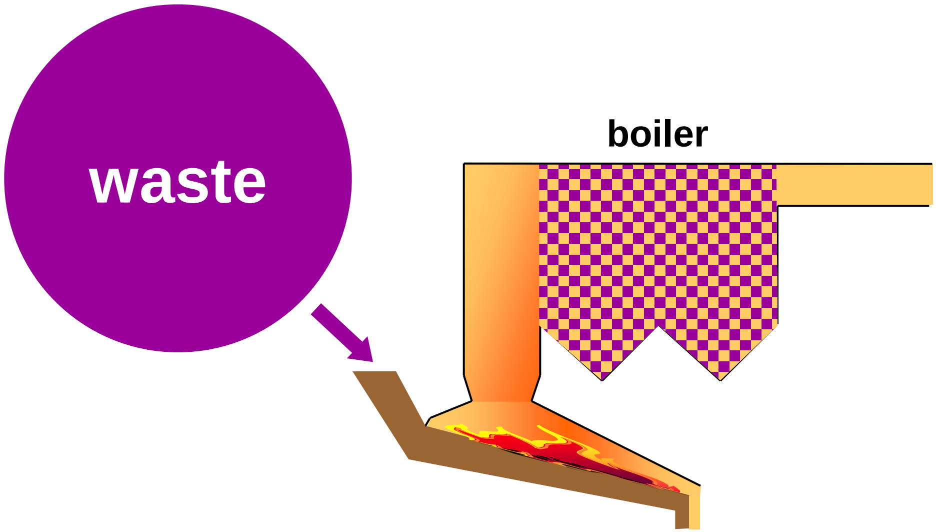


source: Vogg/Stieglitz 1984

formation of PCDD and PCDF in fly ashes

de-novo synthesis

(Vogg / Stieglitz 1985, Hagenmaier 1986)



ingredients:

- PICs (e.g. soot)
- halogenides (Cl^-)
- catalysts (Cu)

conditions:

- oxidising atmosphere
- T > 200 °C (300-350 °C)

main PCDD/F formation mechanism

options for reducing dioxin emissions

suppression of generation

(head-end techniques)

and (/ or)

efficient abatement technologies

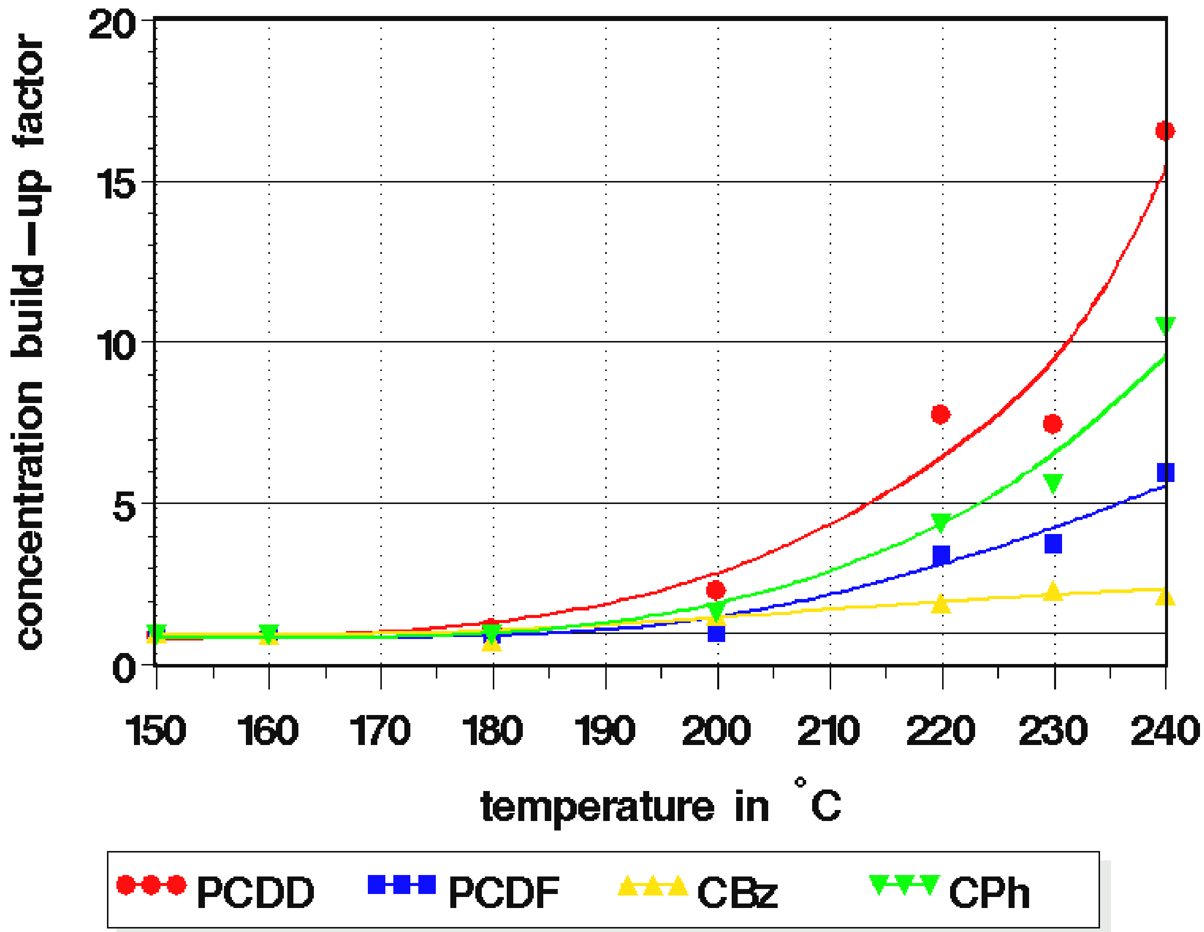
(secondary measures)

head-end techniques

- complete burnout
- limited dust release
- low oxygen surplus in the flue gas
- reduced Cl/S ratio

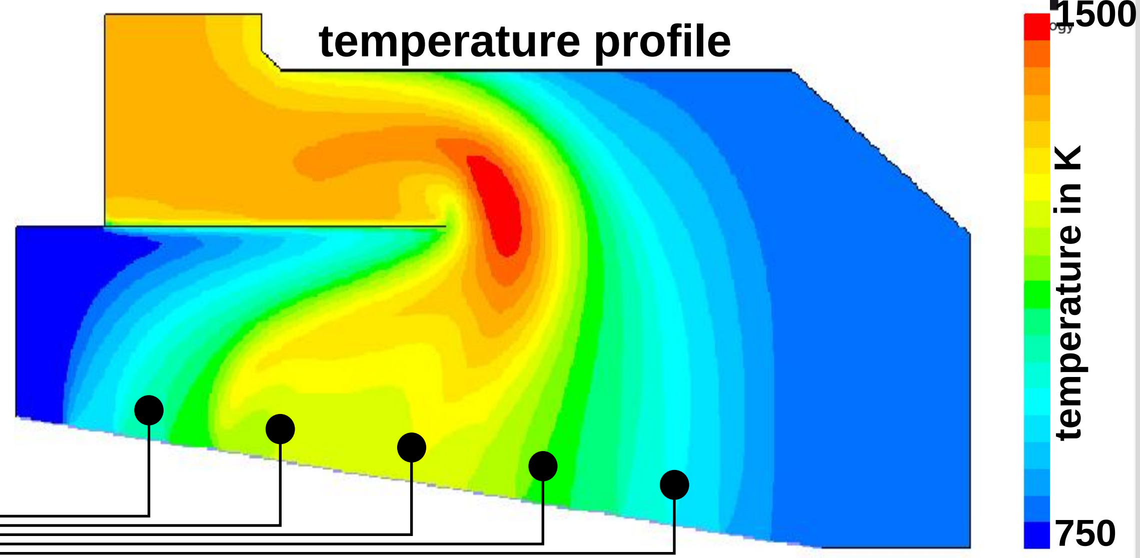
➢ stationary combustion

- clean boiler
  - limited dust deposits
  - limited residence time of dust deposits
- filter temperature < 200 °C



source: Hunsinger 1994

build-up of organic micropollutants with temperature

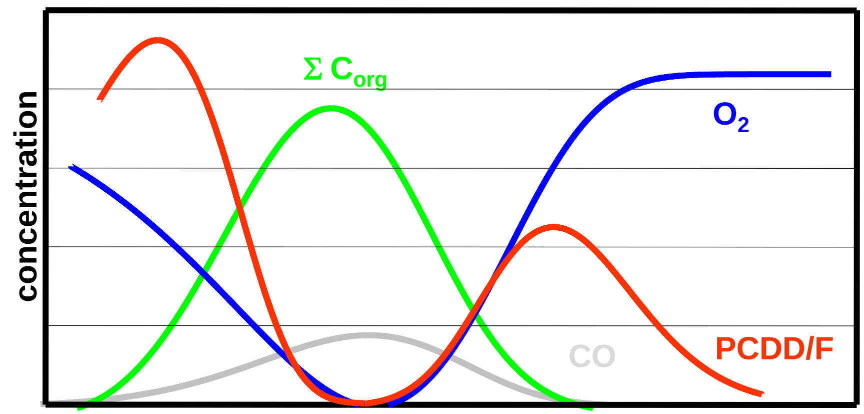


online analysis

O_2, CO_2, CO,
H_2, CH_4, C_6H_6,
N species,
calorific value

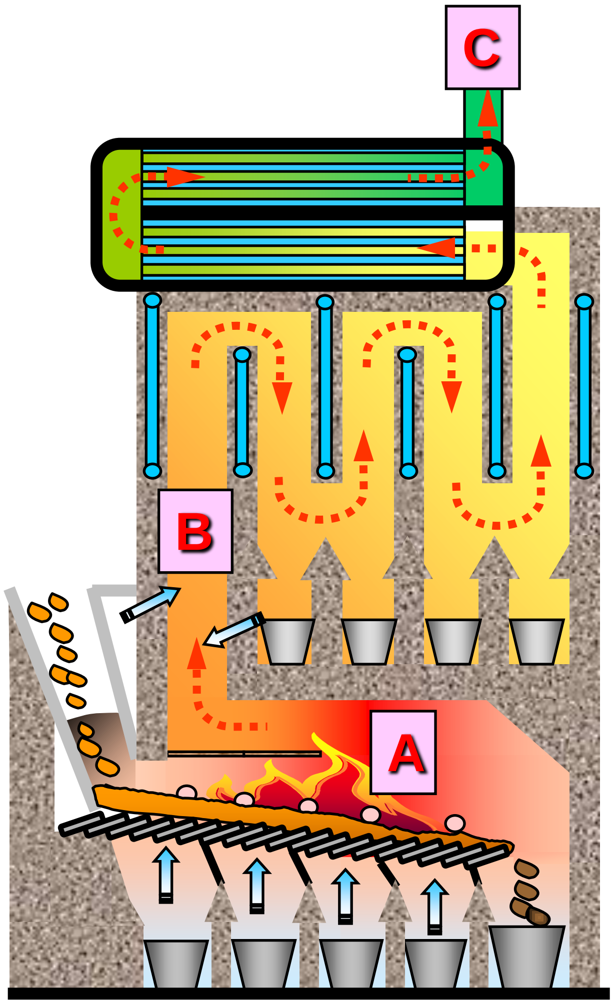
sampling

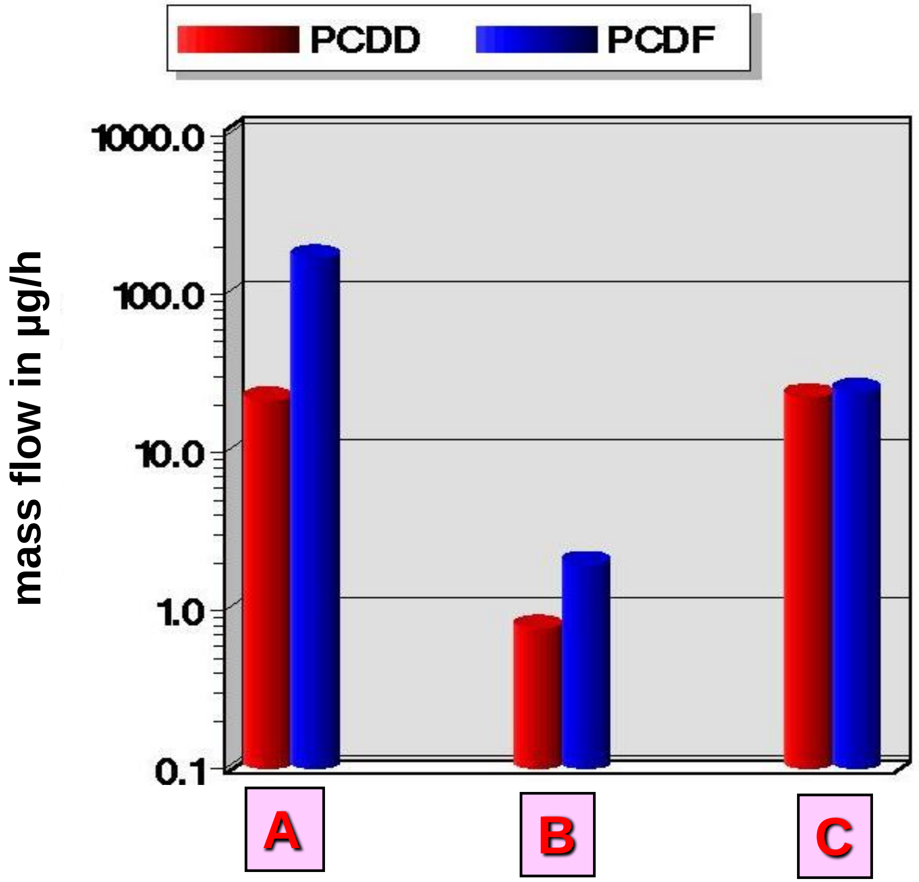
PAH, PCDD/F
metals



source: Hunsinger et al. 2000

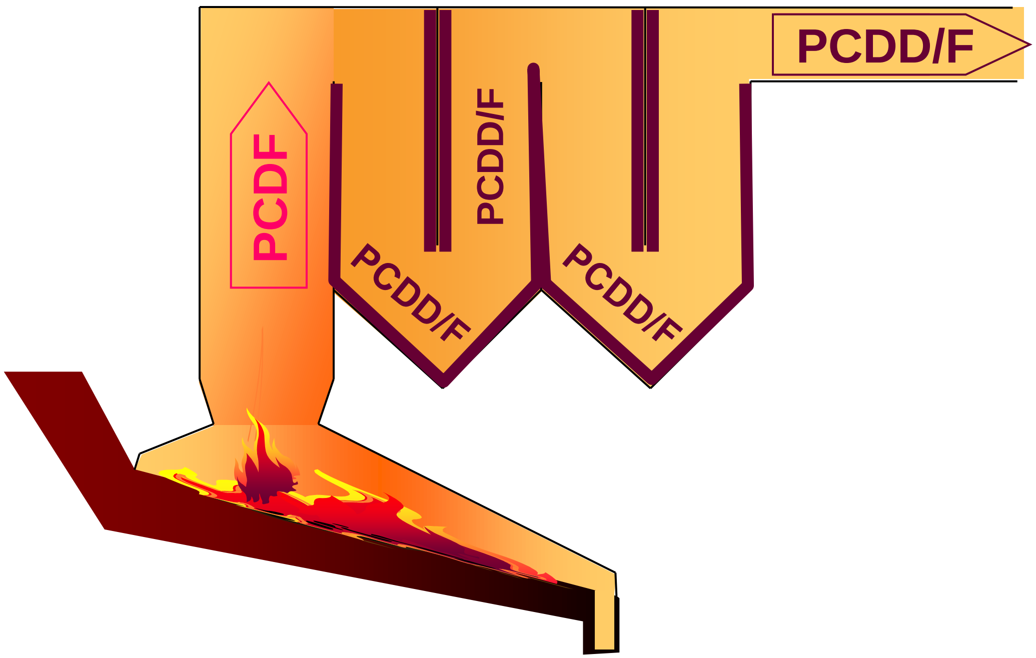
formation of PCDD/F inside the furnace





source: Hunsinger et al. 2000

PCDD/F mass flow in TAMARA furnace



fast reaction:

1. PCDF, PIC in raw gas

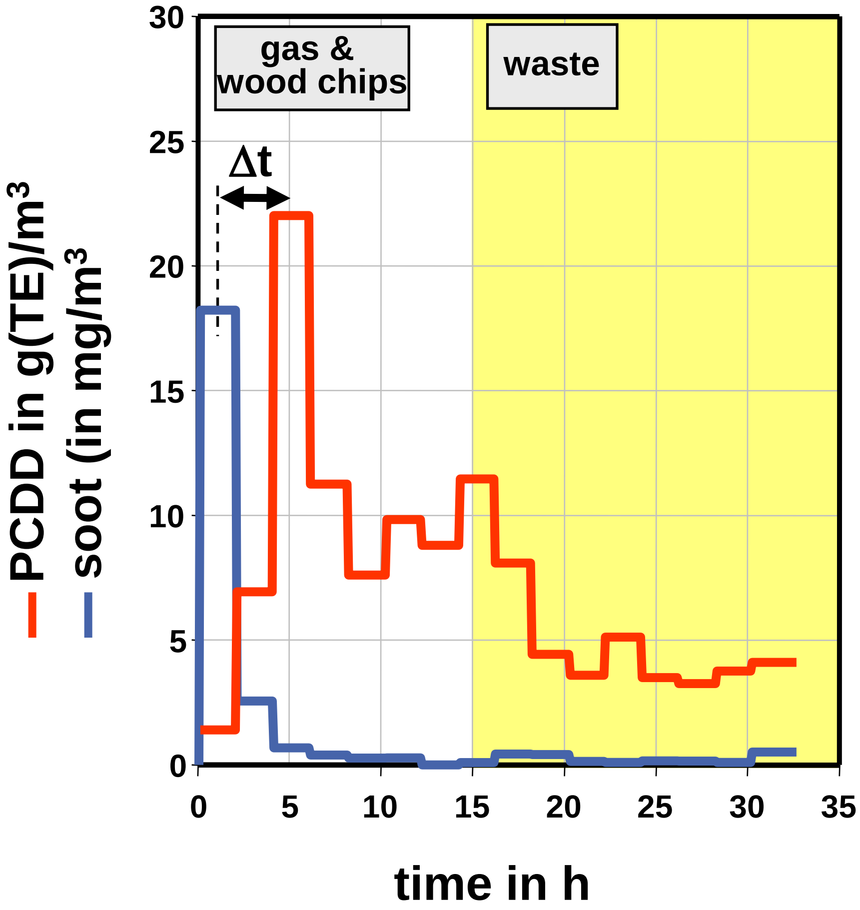
2. PIC deposition

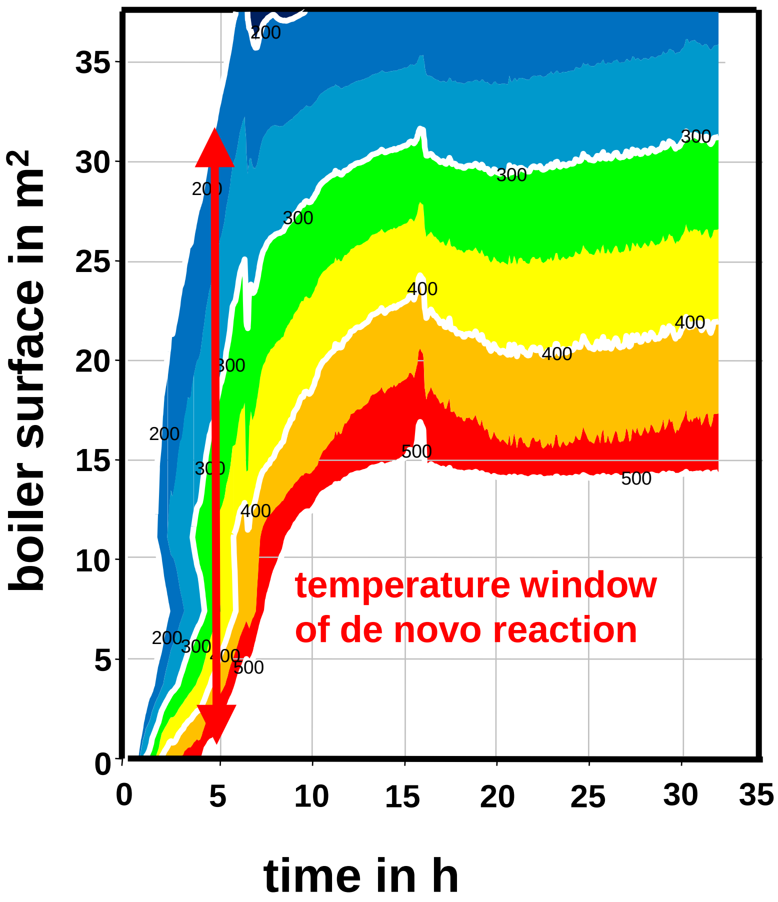
slow reaction / memory effect:

de novo synthesis

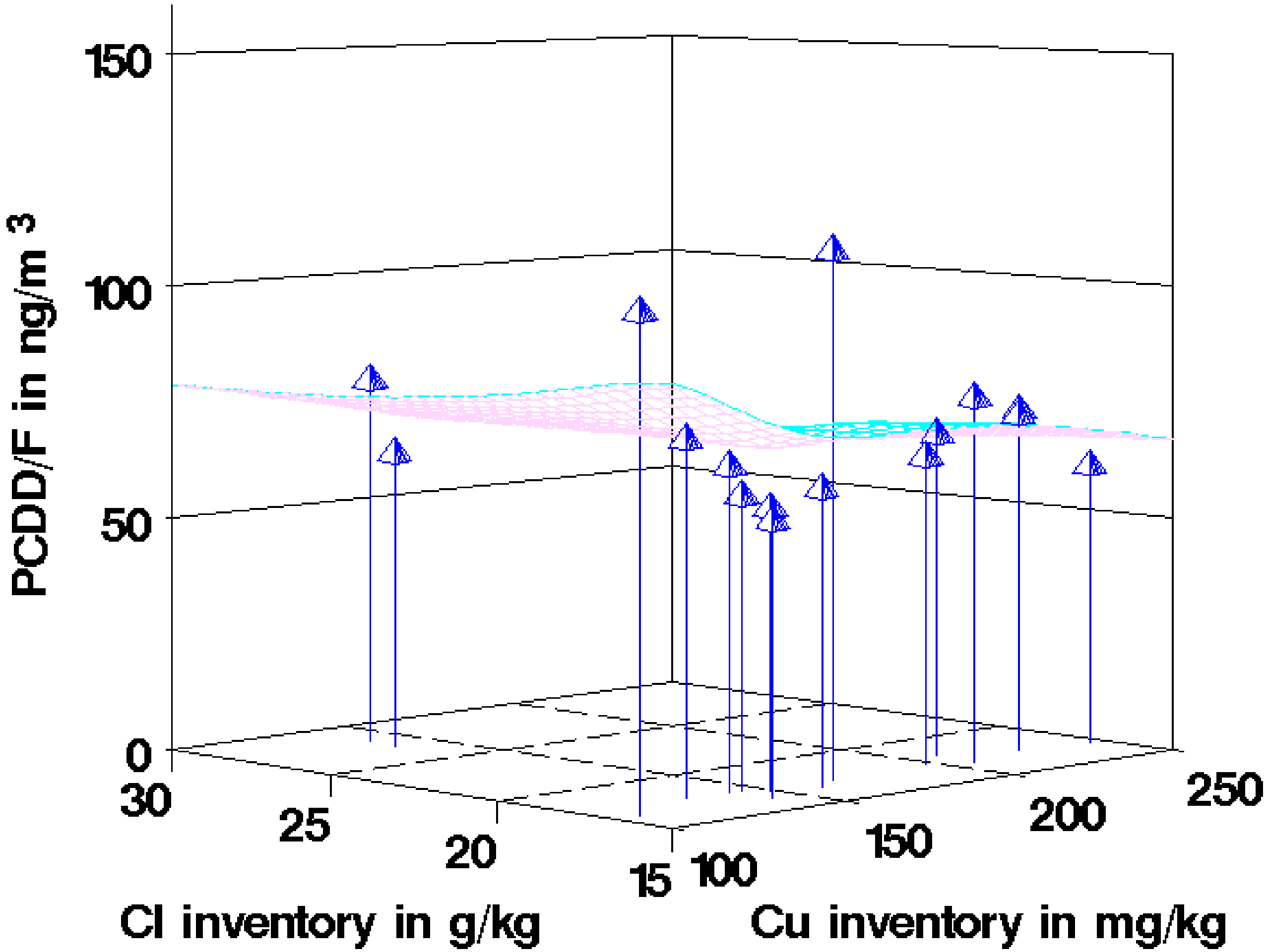
source: Hunsinger et al. 2002

stationary combustion





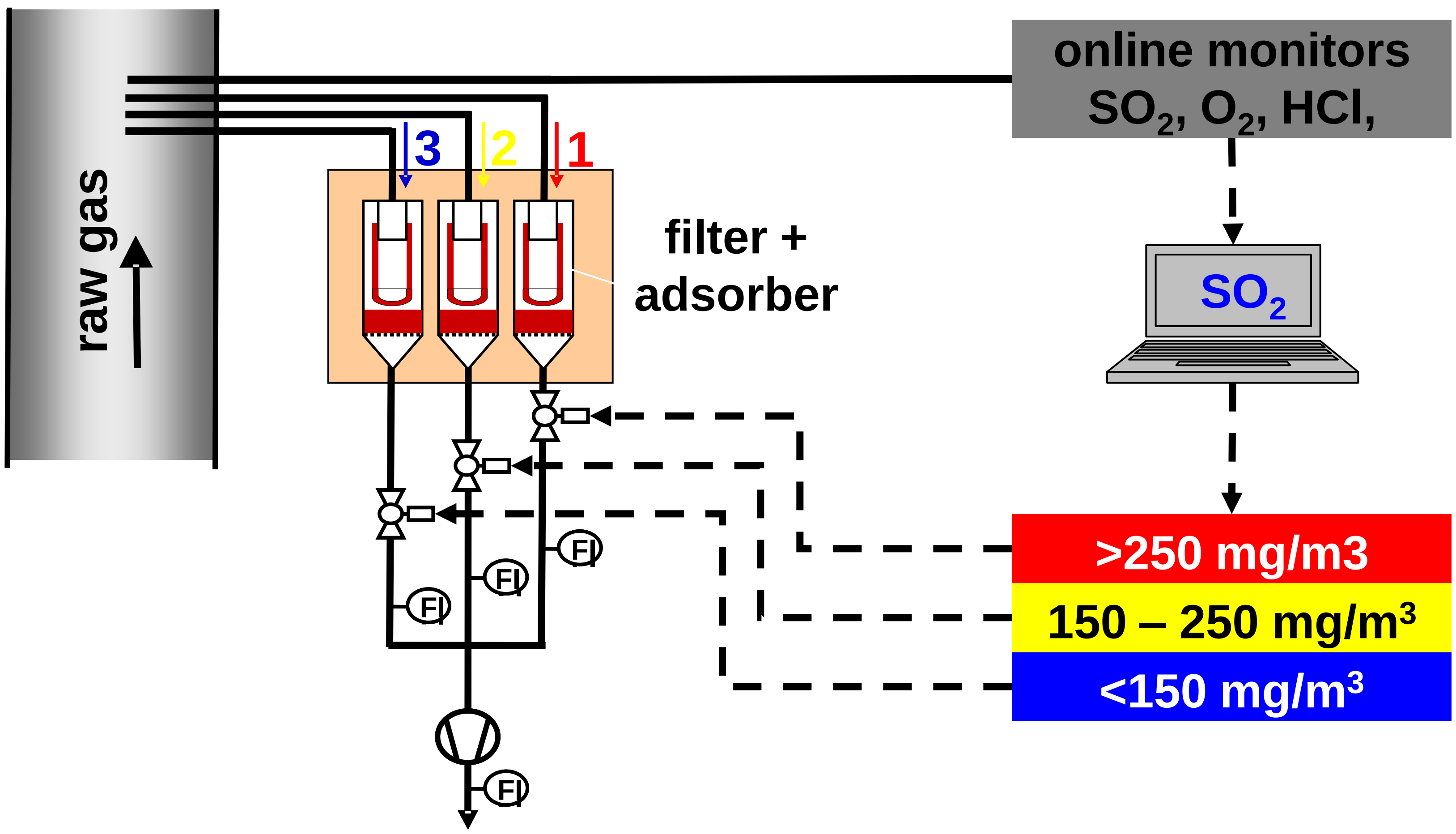
transient conditions – start-up



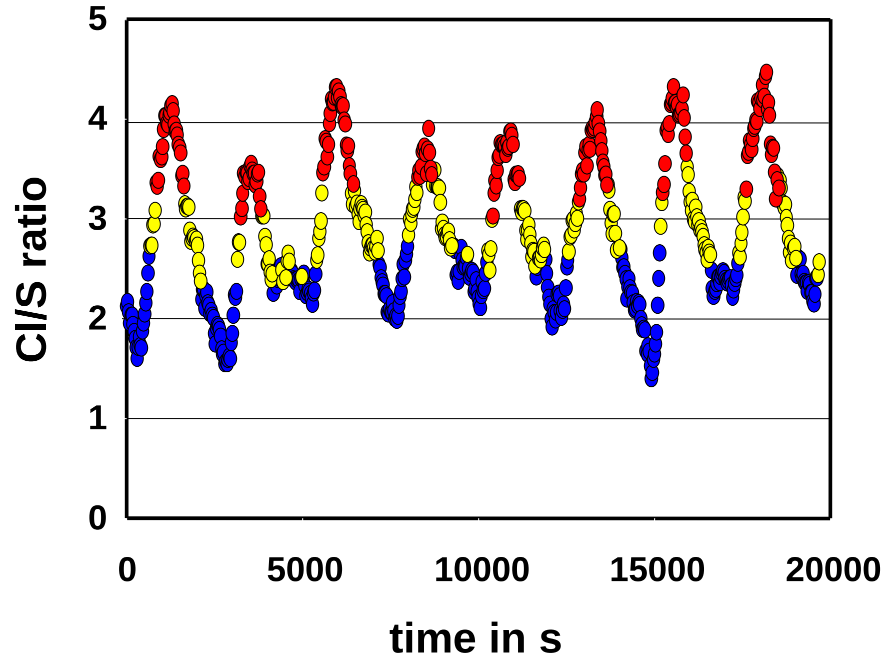
source: Vehlow et al. 1996

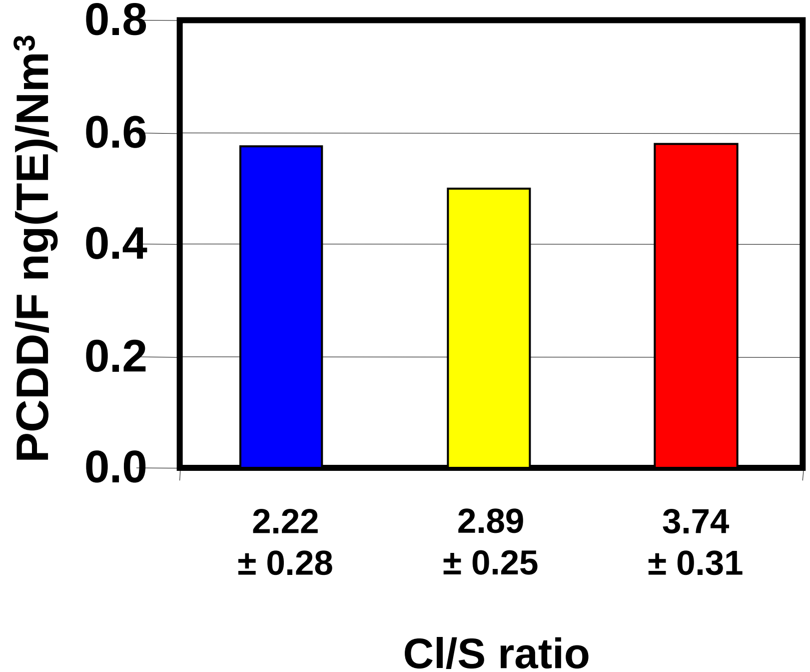
influence of PVC on PCDD/F raw gas level in TAMARA

Griffin hypothesis: $Cl_2 + SO_2 + H_2O \rightleftharpoons SO_3 + 2\,HCl$



SO_2 specific raw gas sampling (full scale)

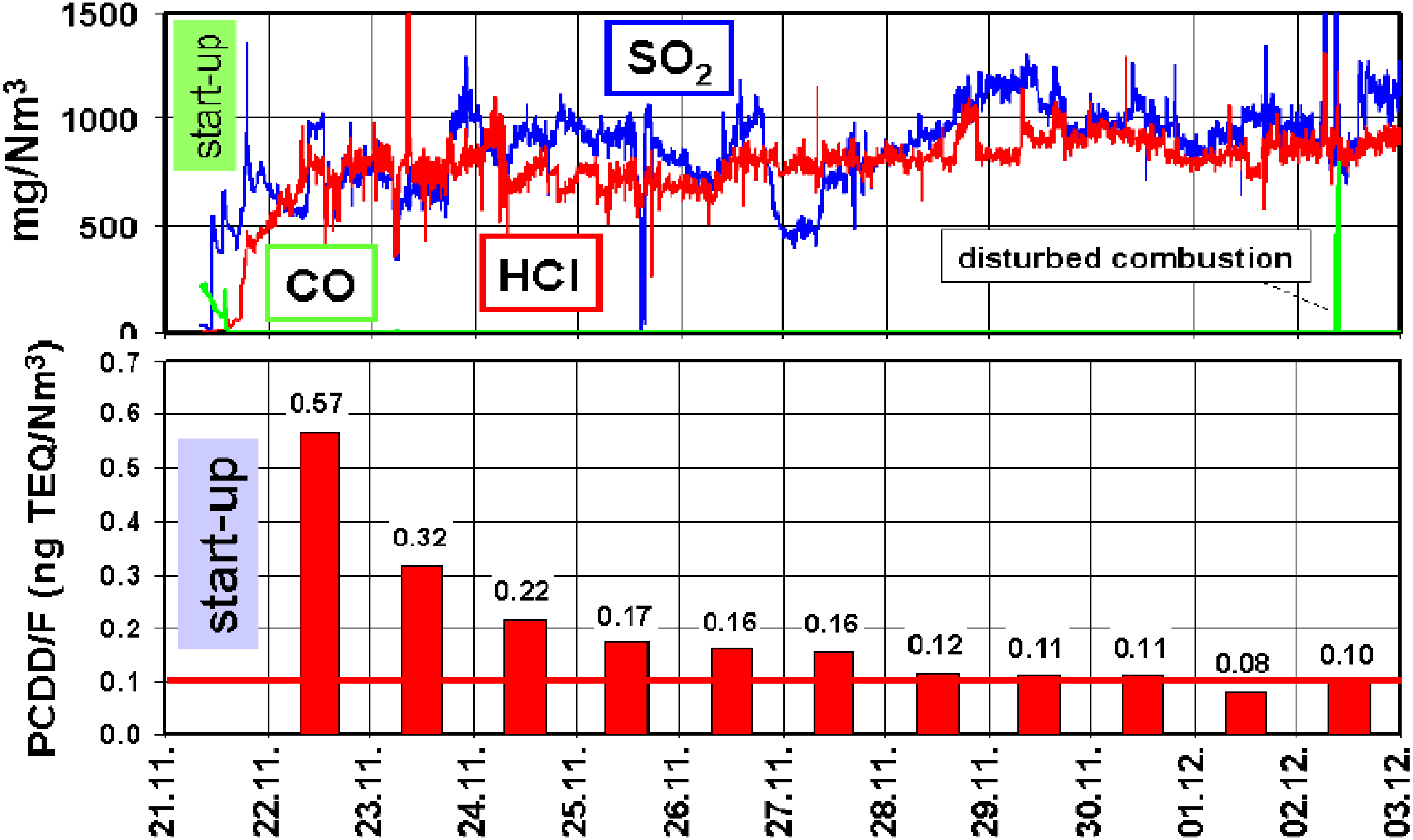




source: Hunsinger et al. 2004

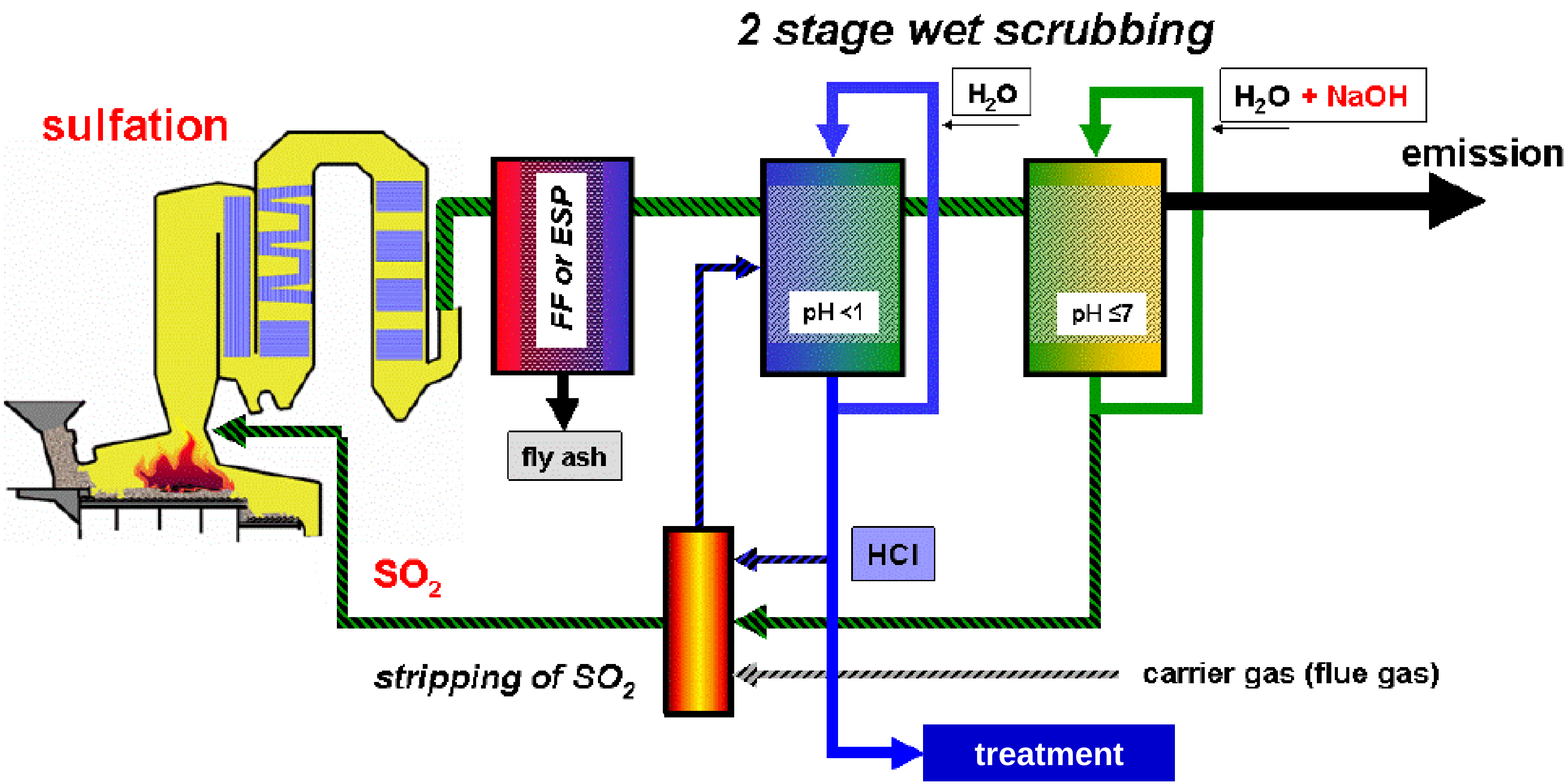
influence of Cl/S ratio in the flue gas (full scale)

Cl / S ≈ 1.5



source: Hunsinger et al. 2006

PCDD/F raw gas concentration (TAMARA)



scheme of a S recycle process

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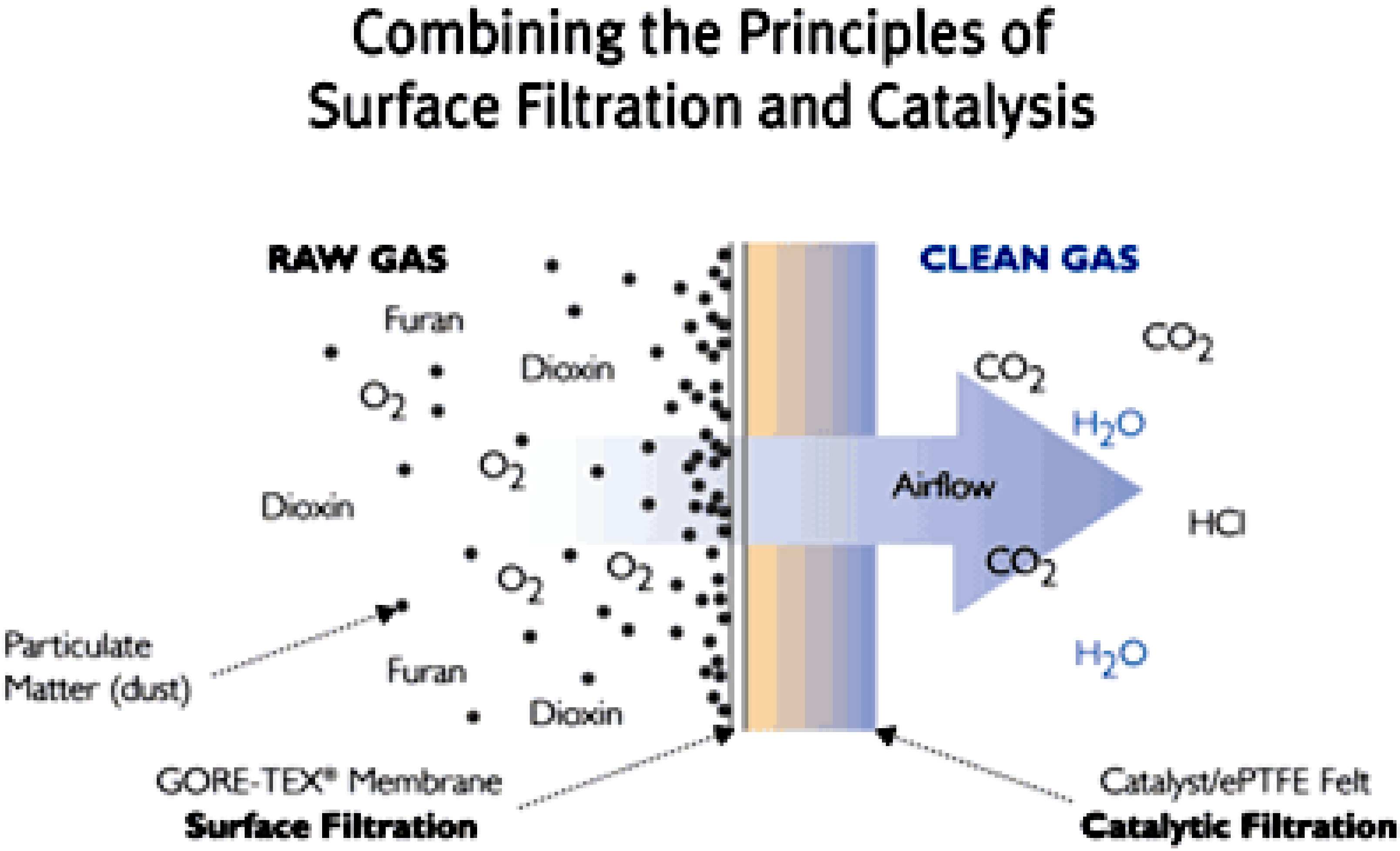
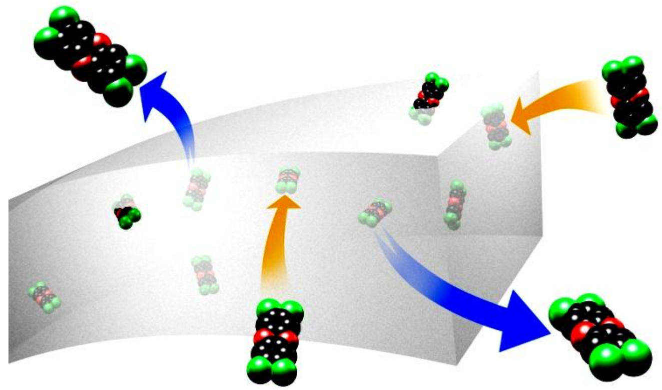
abatement technologies – flue gas

- *carbon adsorption (fixed or moving bed, scrubber)*
- *PAC injection + dust removal*
- *oxidation catalyst*
- *chemical oxidation in the flue gas*
- **combined filtration and catalytic destruction**
- **absorption by polymers**



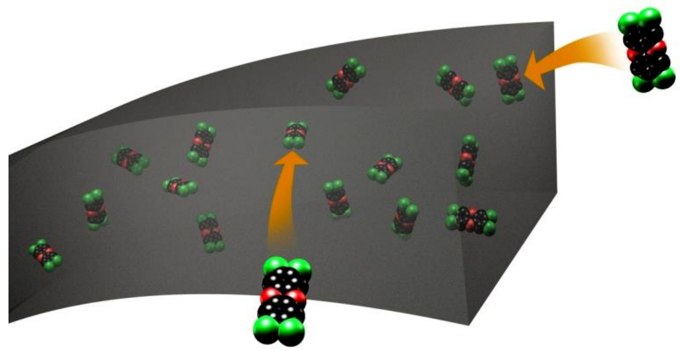
Gore REMEDIA Process

PCDD/F in pure plastic



adsorption-desorption equilibrium: ”memory effect”

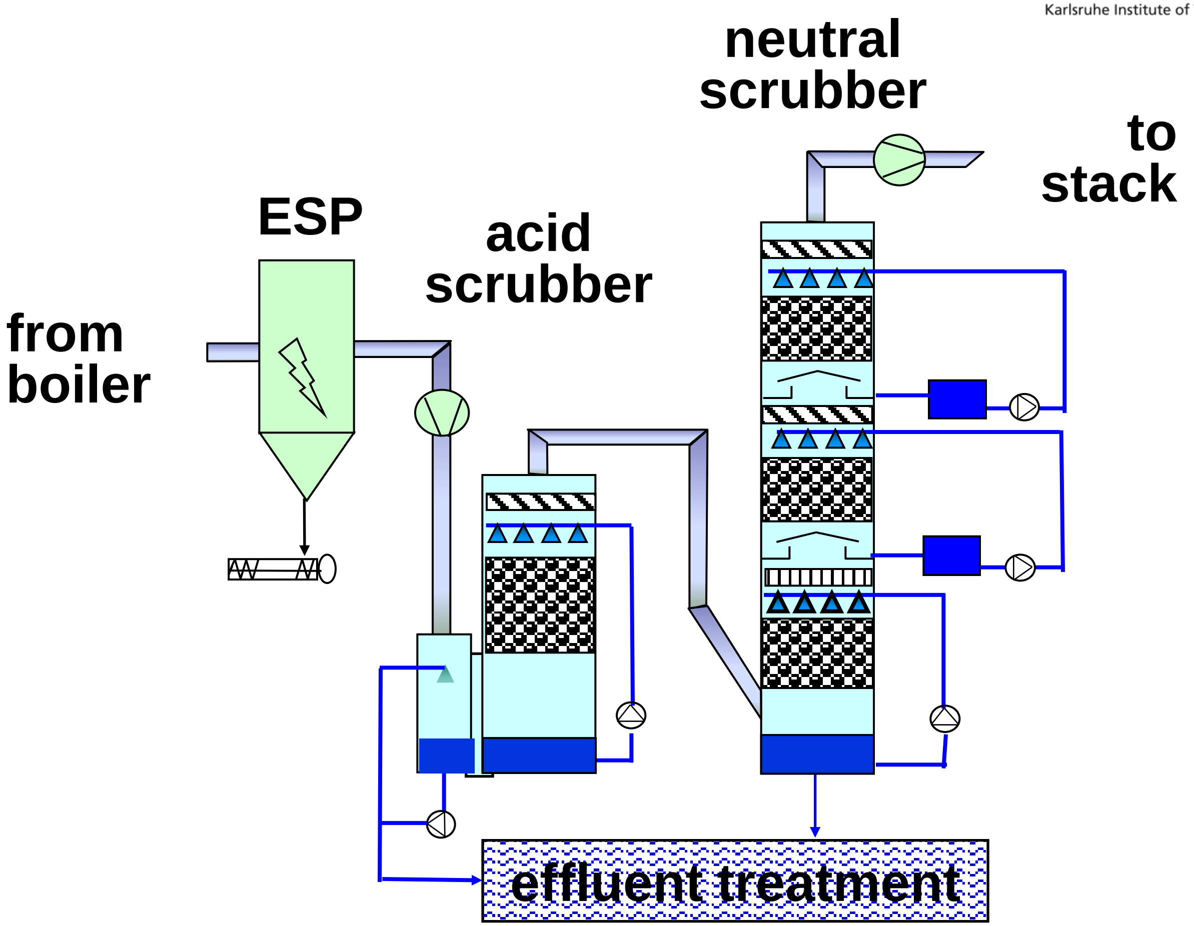
PCDD/F in ADIOX®



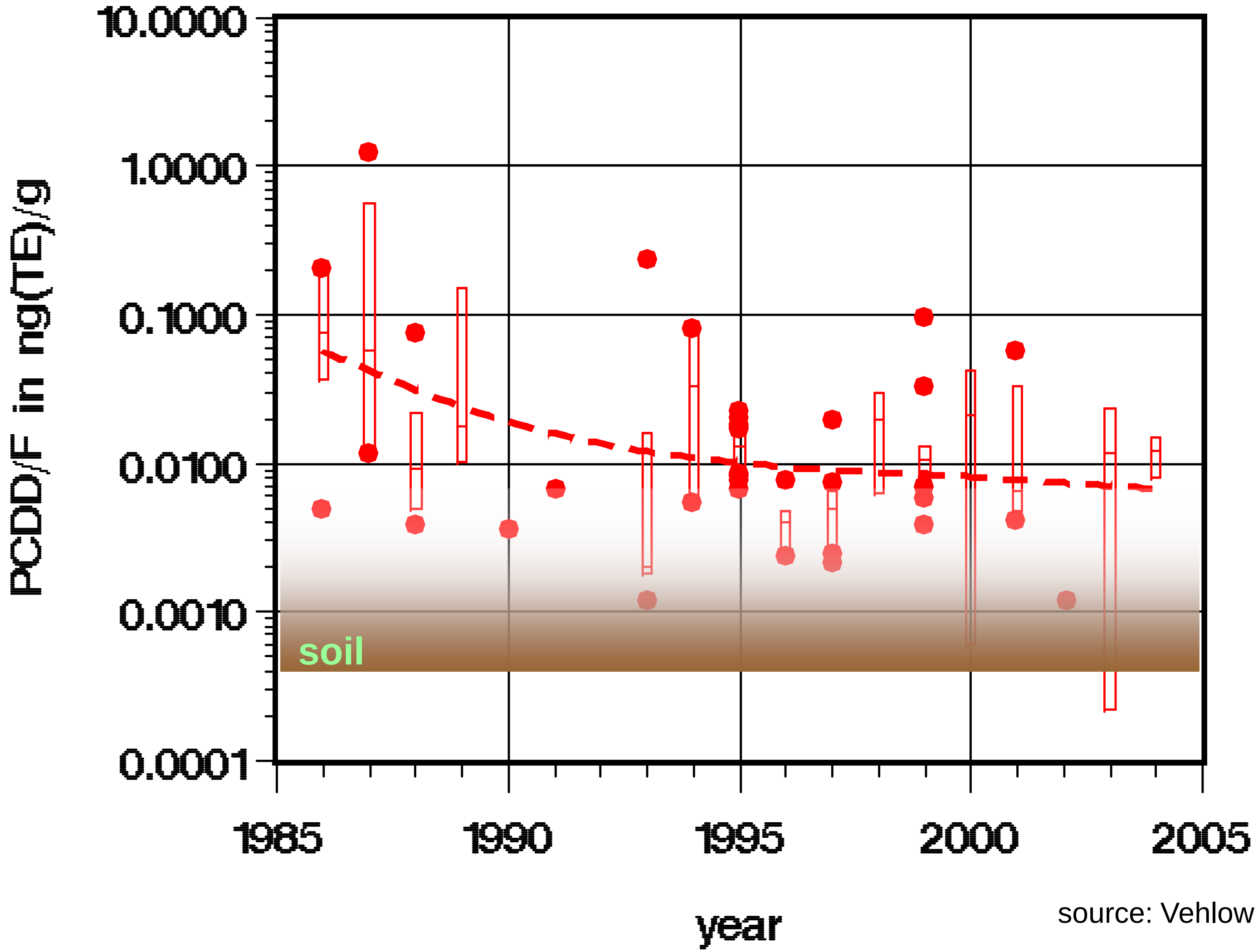
absorption in plastic and adsorption at carbon particles: ”dioxin is fixed”

ADIOX® PCDD/F abatement system

C filled PP packings



ADIOX® application

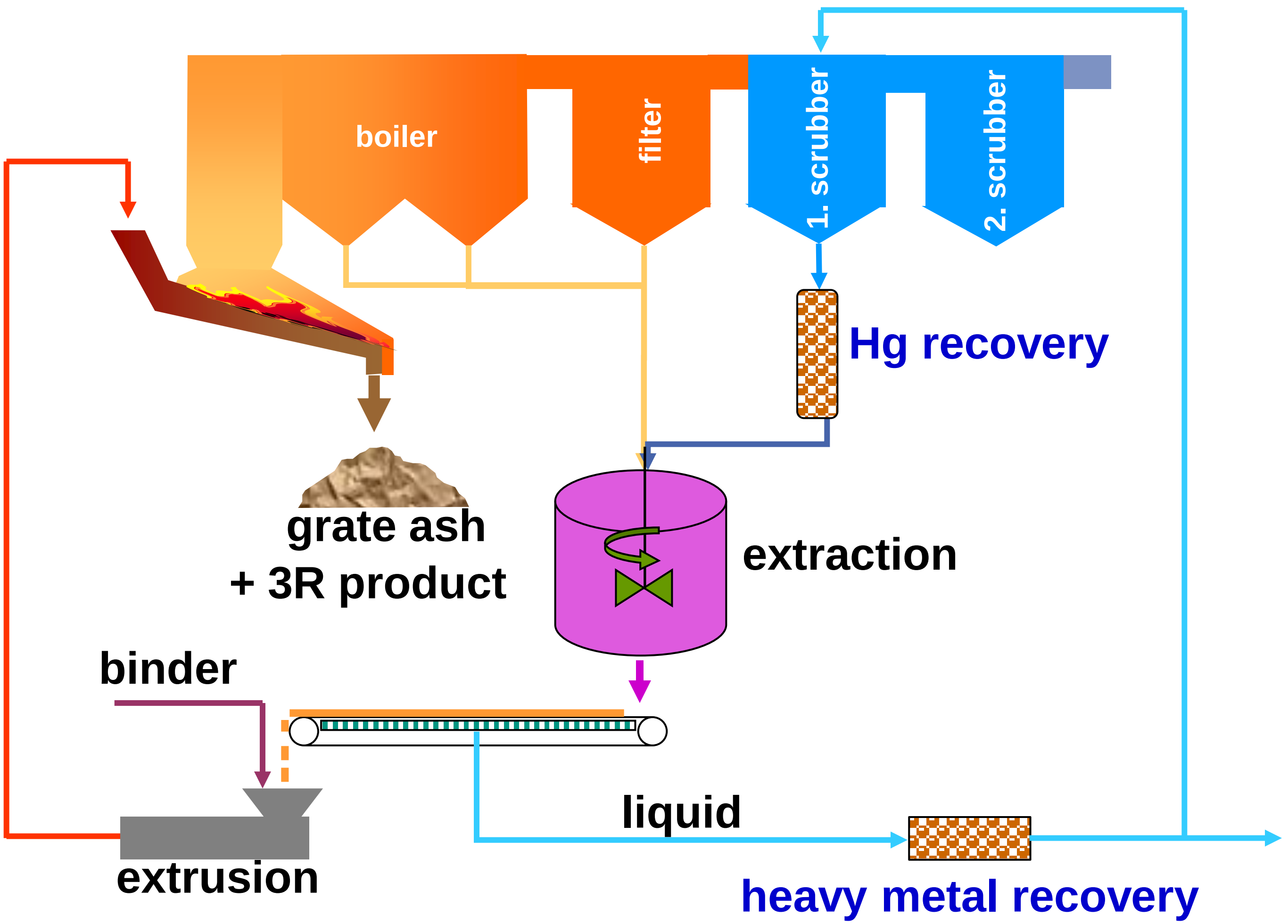


source: Vehlow et al. 2006

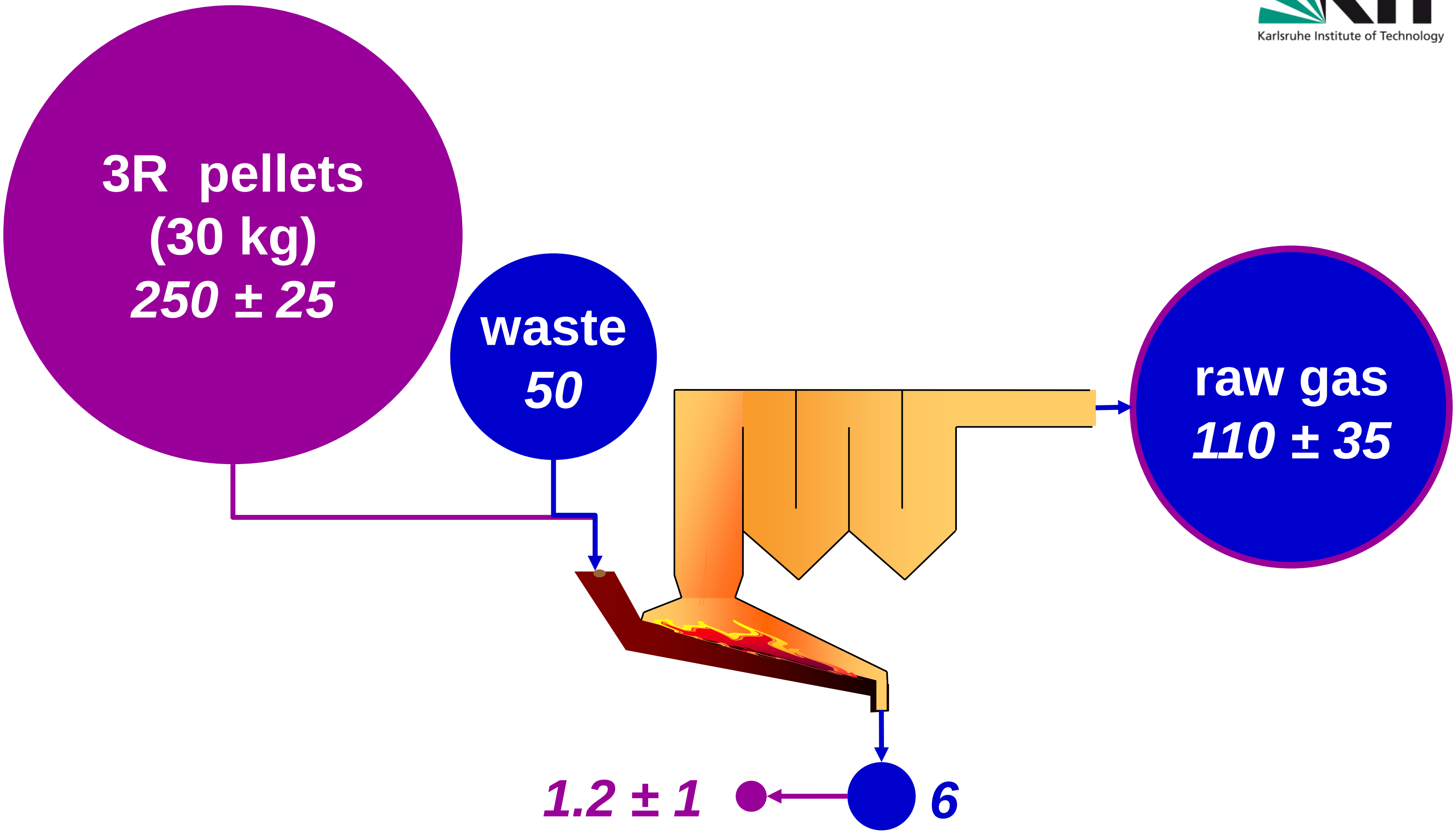
PCDD/F in bottom ash between 1985 and 2005

abatement technologies – residues

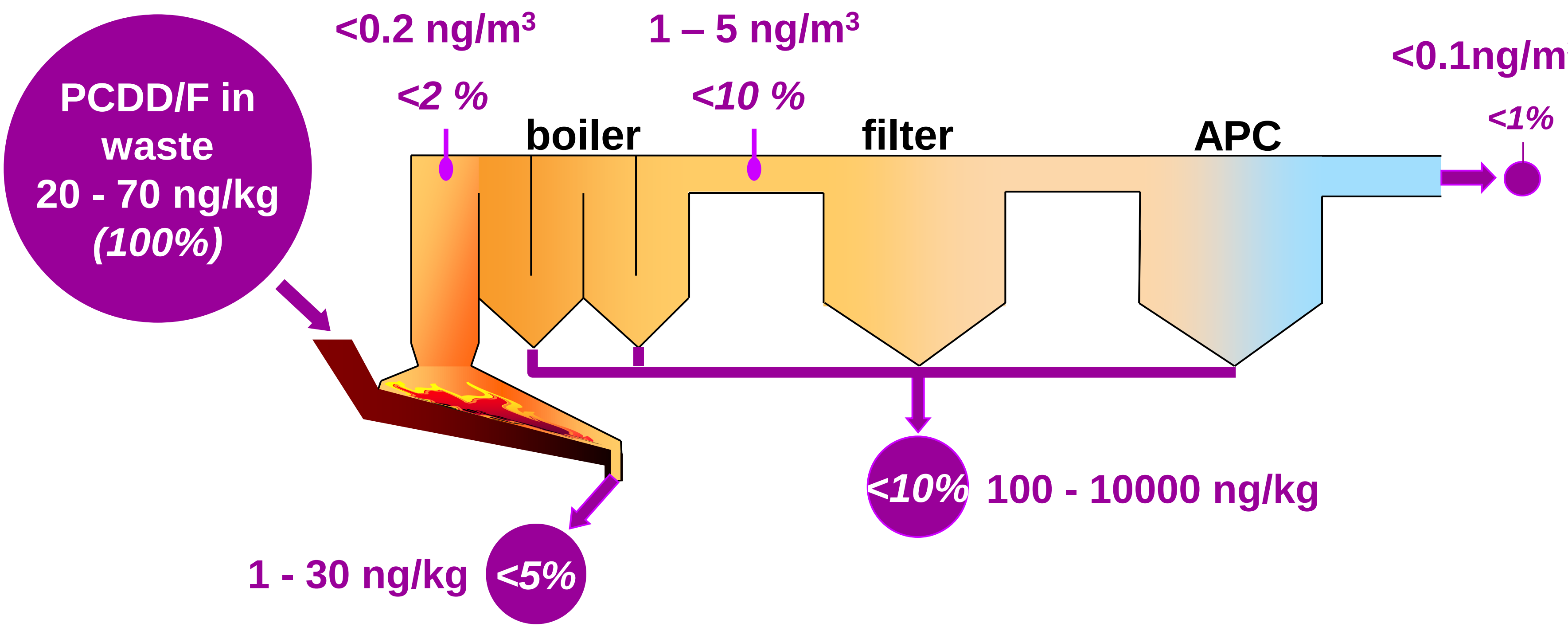
- *vitrification*
- *Hagenmaier drum*
- 3R Process



scheme of the 3R Process



PCDD/F flow during 3R pellet recycling (1 Mg MSW)



PCDD/F in a state-of-the-art waste incinerator

conclusions

- the formation of PCDD/F can be minimized by optimized combustion control
- the boiler cleaning should be improved
- the temperature in the dedusting unit should be kept below 200 °C
- efficient secondary abatement measures have been developed
- the method of choice is depending on the gas cleaning strategy and the economics

65 million years ago

source: Spektrum der Wissenschaft 7/2002