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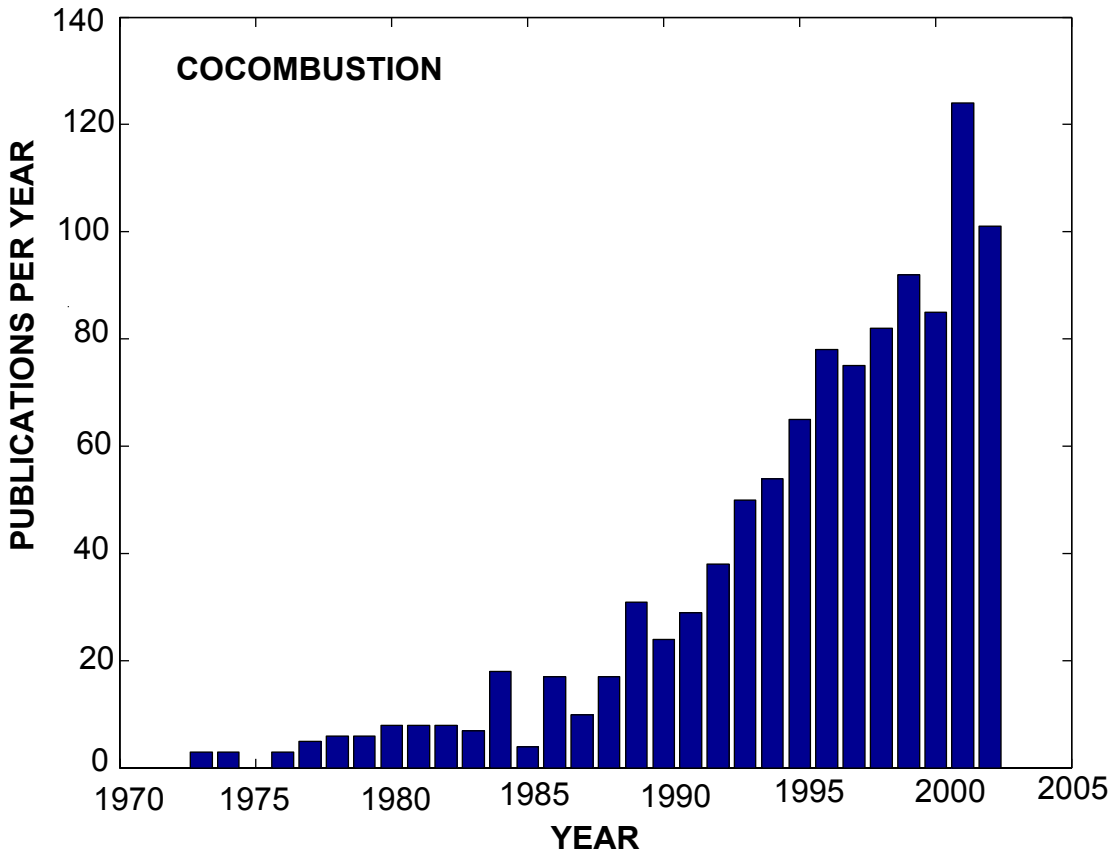
CO-COMBUSTION OF BIOMASS, WASTE AND COAL

BO LECKNER and LARS-ERIK ÅMAND
Department of Energy Conversion
Chalmers University of Technology
Göteborg, Sweden

NUMBER OF PUBLICATIONS PER YEAR ON CO-COMBUSTION



PURPOSE OF CO-COMBUSTION

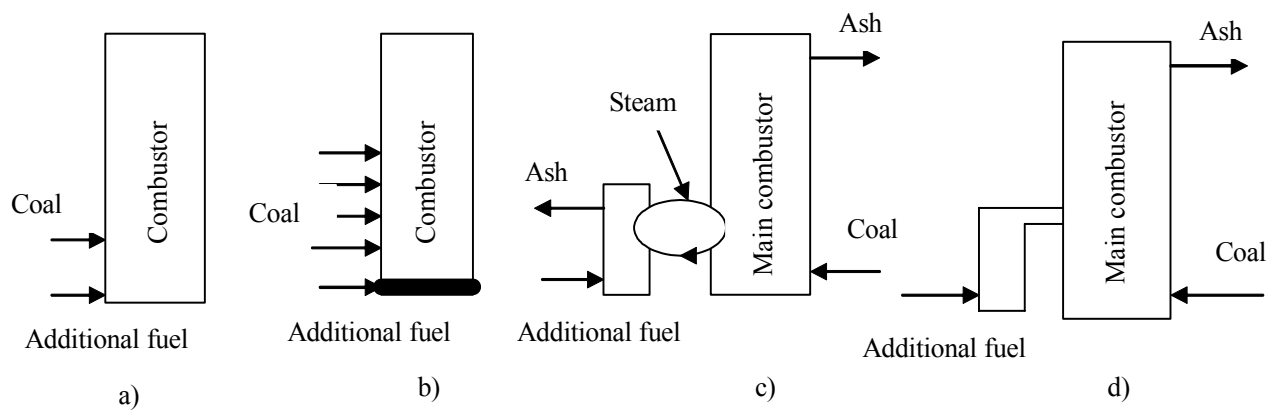
- Conventional—many applications in FBC
- CO_2 reduction, utilization of biomass
- Waste reduction with energy utilization

THE CONSEQUENCES OF CO-COMBUSTION DEPEND ON FUEL PROPERTIES

- Energy content (moisture) and volatiles
- Precursors to gaseous emissions (N,S,Cl)
- Ash-forming elements (K,Na,Ca,Mg,Al,Si,P)
- Trace elements (As,B,Cd,Hg,Pb,Se,....)

FIVE METHODS OF CO-COMBUSTION

a) Together with the base fuel (PC and FBC) h1
b) Additional bed to a pc/gas/oil-fired furnace hb
c) Additional combustor connected on the steam side h2
d) Additional combustor connected on the gas side h3,hz
Additional fuel for reburning or afterburning

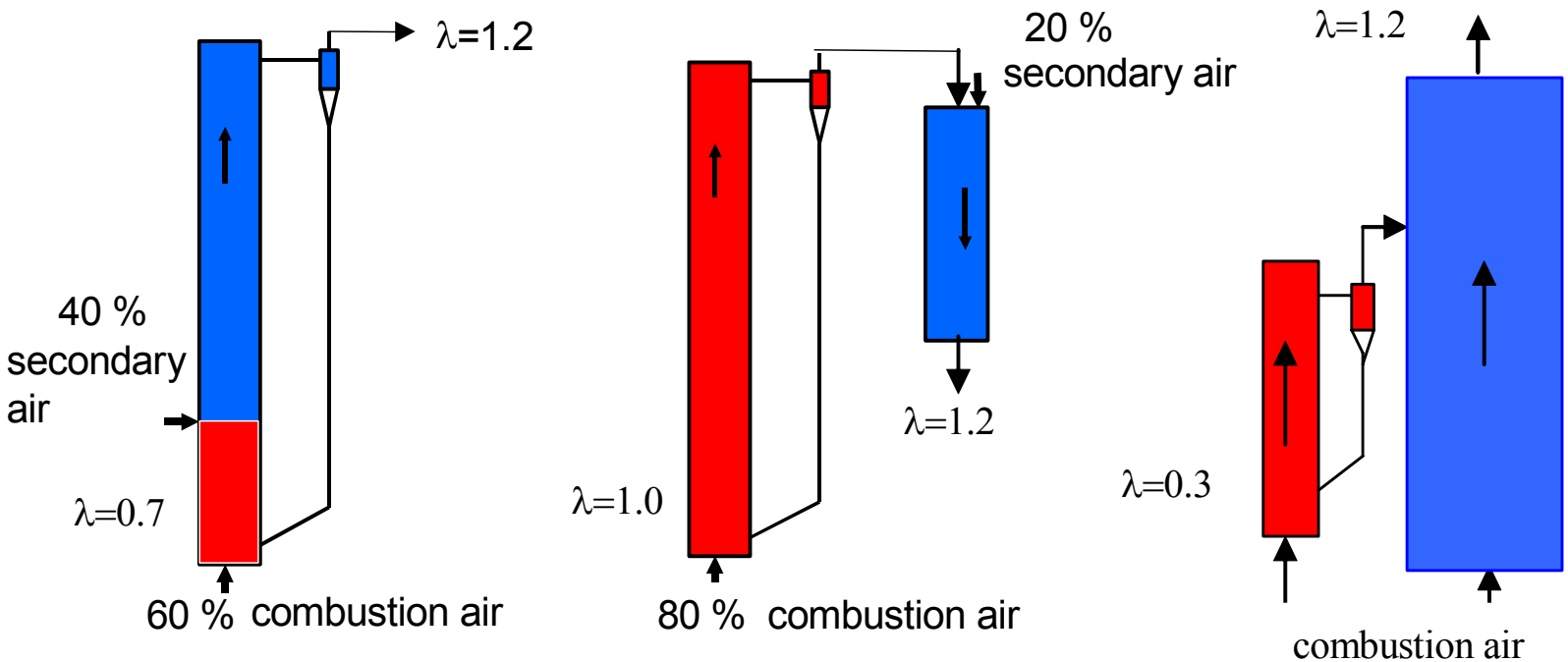


FLUIDIZED BED CO-COMBUSTION ARRANGEMENTS

Normal staging

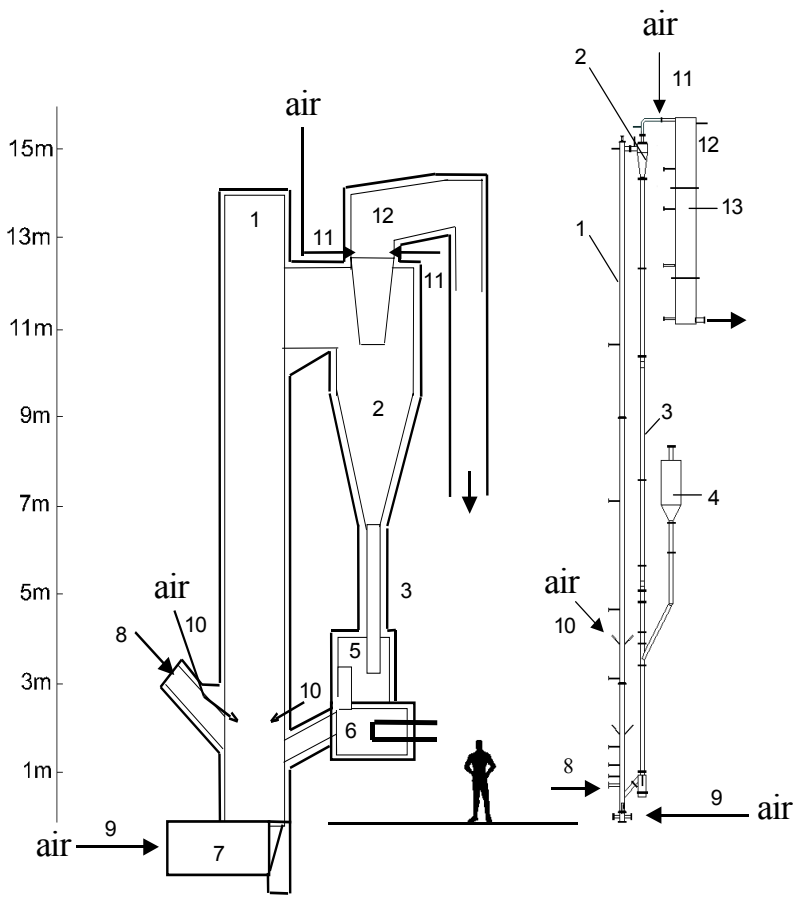
Advanced staging

Gas producer +boiler



CFB PLANTS USED FOR CO-FIRING

CTH TUHH



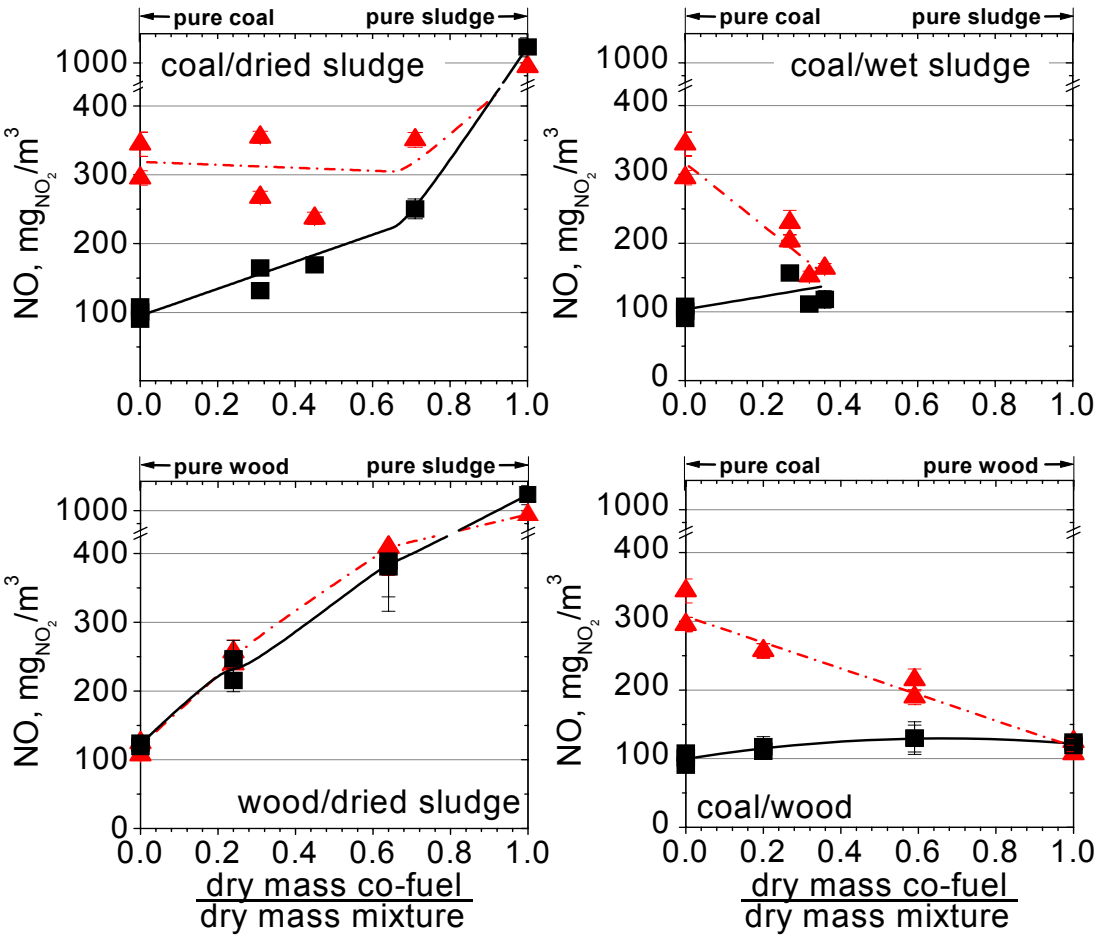
EXAMPLE: EMISSIONS FROM CO-COMBUSTION OF SLUDGE WITH COAL OR WOOD

Fuel type	Coal	Wood	Sewage sludge
Proximate			
Water (wt-%, raw)	8.7	9.1	15.9
Ash (wt-%, dry)	15.7	0.8	42.1
Volatiles (wt-%, daf)	35.3	81.2	91.1
Ultimate (wt-%, daf)			
C	82.5	50.5	53.2
H	5.0	6.0	7.1
O	9.9	43.4	30.6
S	0.9	0.02	1.9
N	1.7	0.14	7.1
Cl	0.07	0.01	0.05
Lower heating value (MJ/kg)			
H_u, daf	31.4	18.9	20.9
H_u, raw	24.2	16.8	9.4

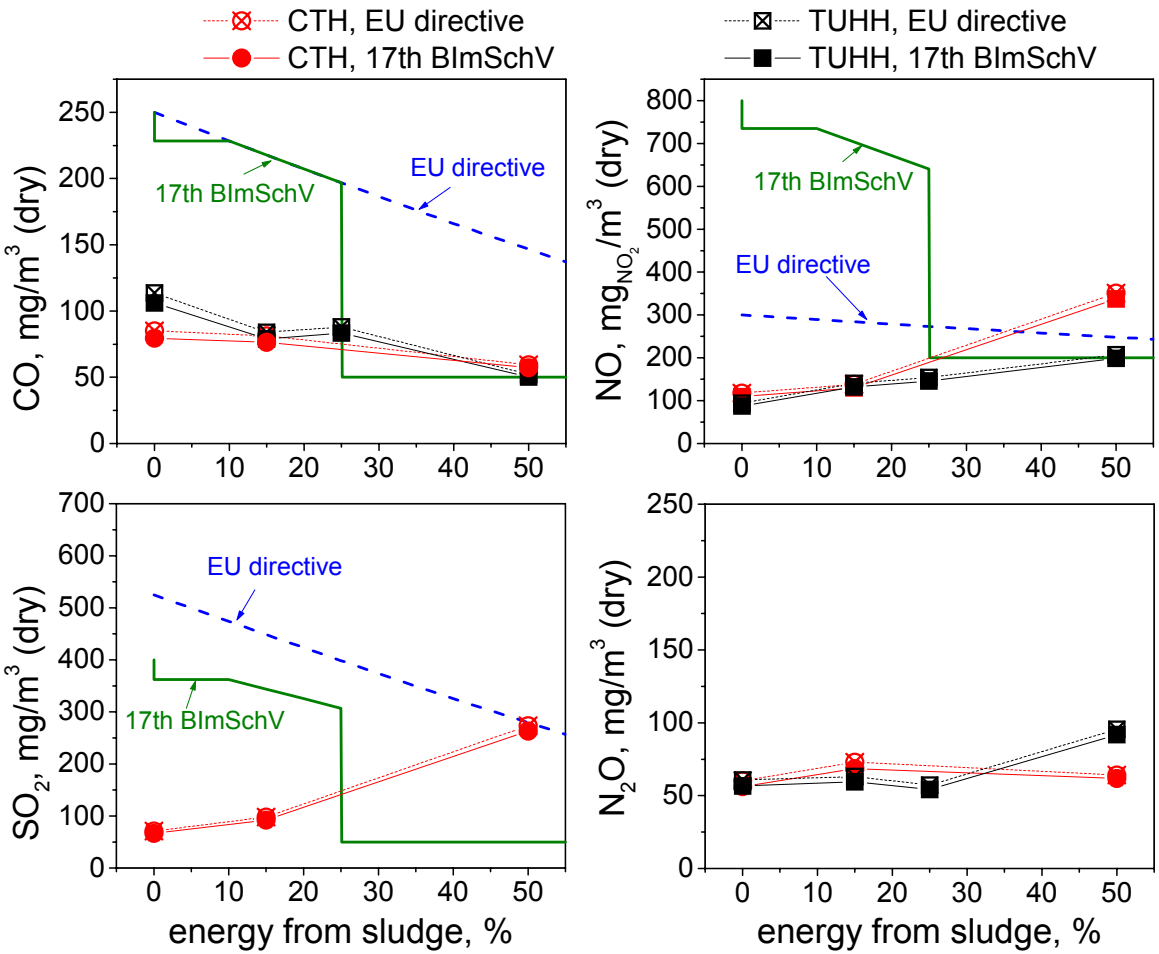
daf = dry and ash free

SOME RESULTS

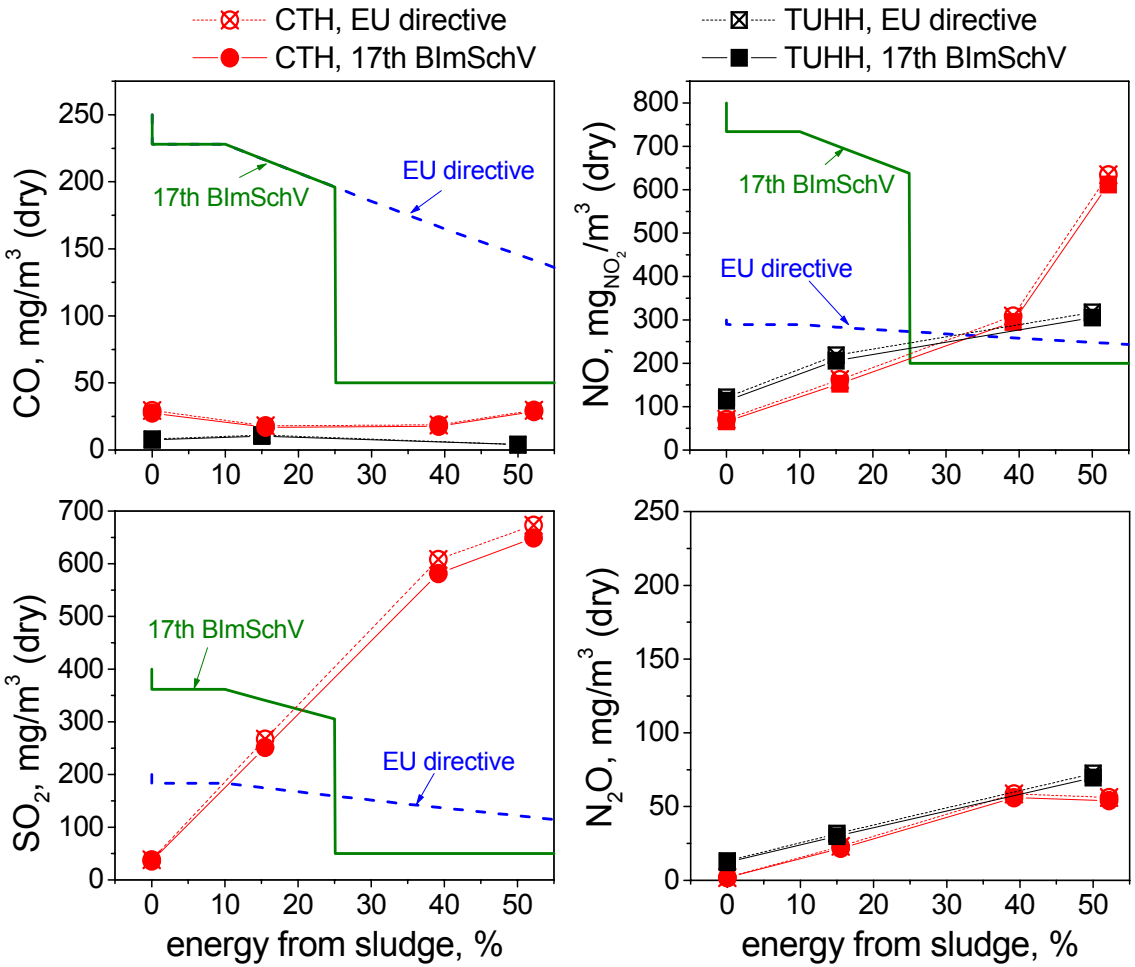
(advanced staging—black, no-staging –red)



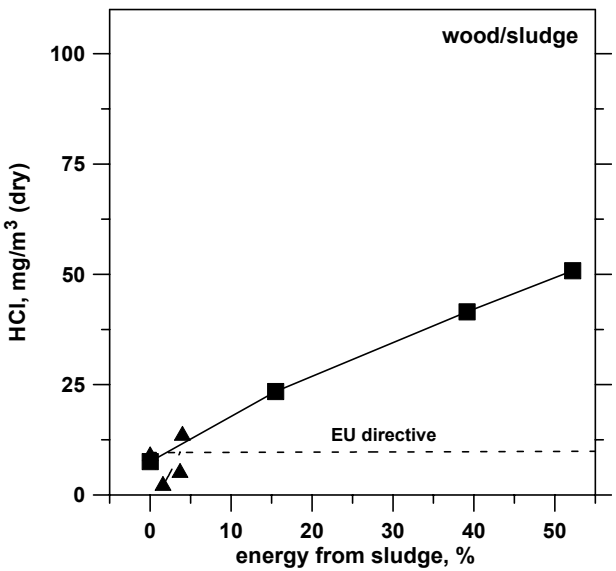
COMPARISON WITH EU AND GERMAN EMISSION STANDARDS (Base fuel coal)

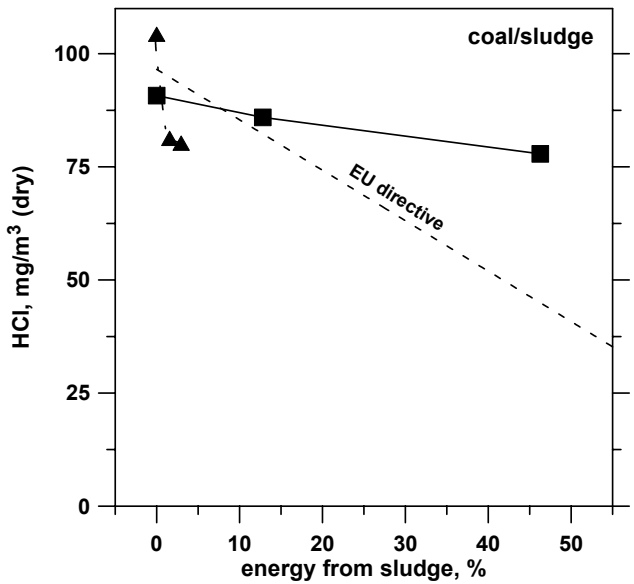


COMPARISON WITH EU AND GERMAN EMISSION STANDARDS (Base fuel wood)



COMPARISON WITH EU EMISSION STANDARDS FOR CHLORINE EMISSIONS





Wet ▲ and dry ■ sludge with wood and coal as base fuels compared with the EU directive completed with local regulations. Advanced staging.

CONCLUSIONS

- FBC is an excellent method for co-combustion
- Coal is suitable as a base fuel.
- The high N and S contents of sludge have to be considered, but with FBC stringent emission limits can be satisfied.
- Wood is also a good base fuel, but in the case of sludge containing sulfur the EU emission limits are fulfilled only for small ratios of sludge.
- EU's emission limit for chlorine requires flue gas cleaning for additional fuels containing more than 0.01 wt%daf chlorine.