Experience from waste co-combustion in Vattenfall fluidized bed boilers

Matts Almark

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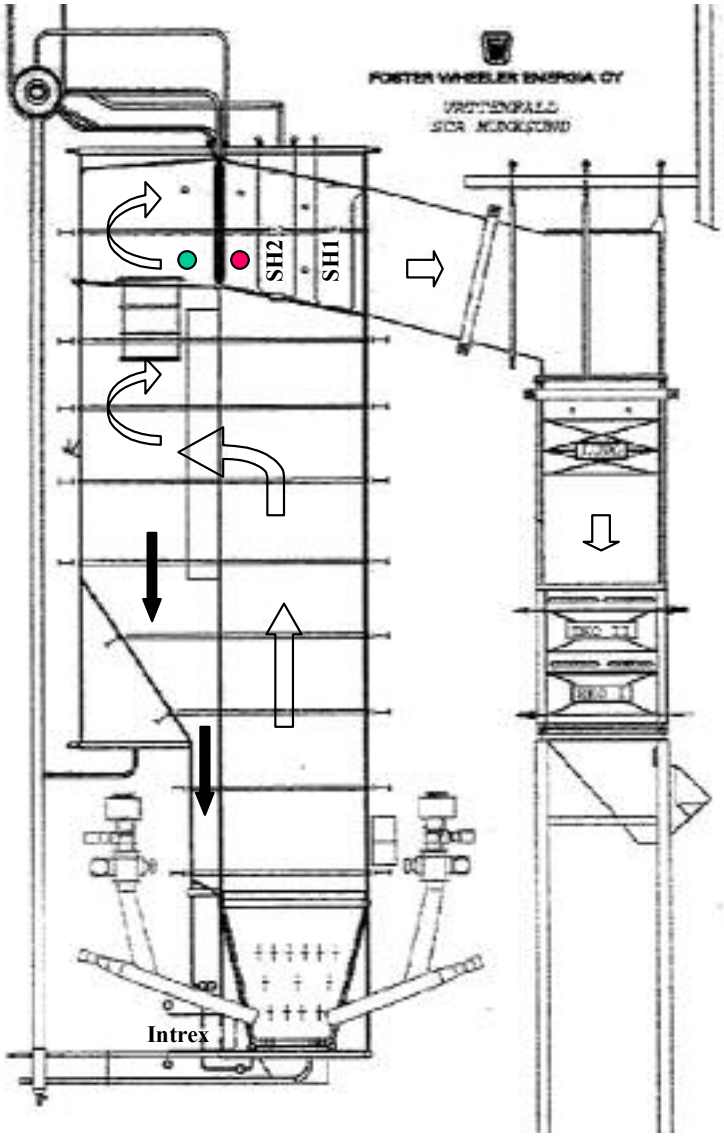
Co-combustion, waste & biofuels

- Waste fractions containing unwanted elements
  - Chloride, alkali, heavy metals
- Increased fouling & corrosion compared to “clean” biofuels

- Some experiences and observations with different amounts of waste derived fuels in fuel mix
- Measurement of alkali chlorides in flue gas - monitoring fuel quality
- Additives and other solutions
- Myllykoski, Idbäcken, Munksund

Munksund

- CFB
- 96 MW_{th}
- Bark (> 80%)
- Sawdust, woodchips
- Cardboard reject (<6%)



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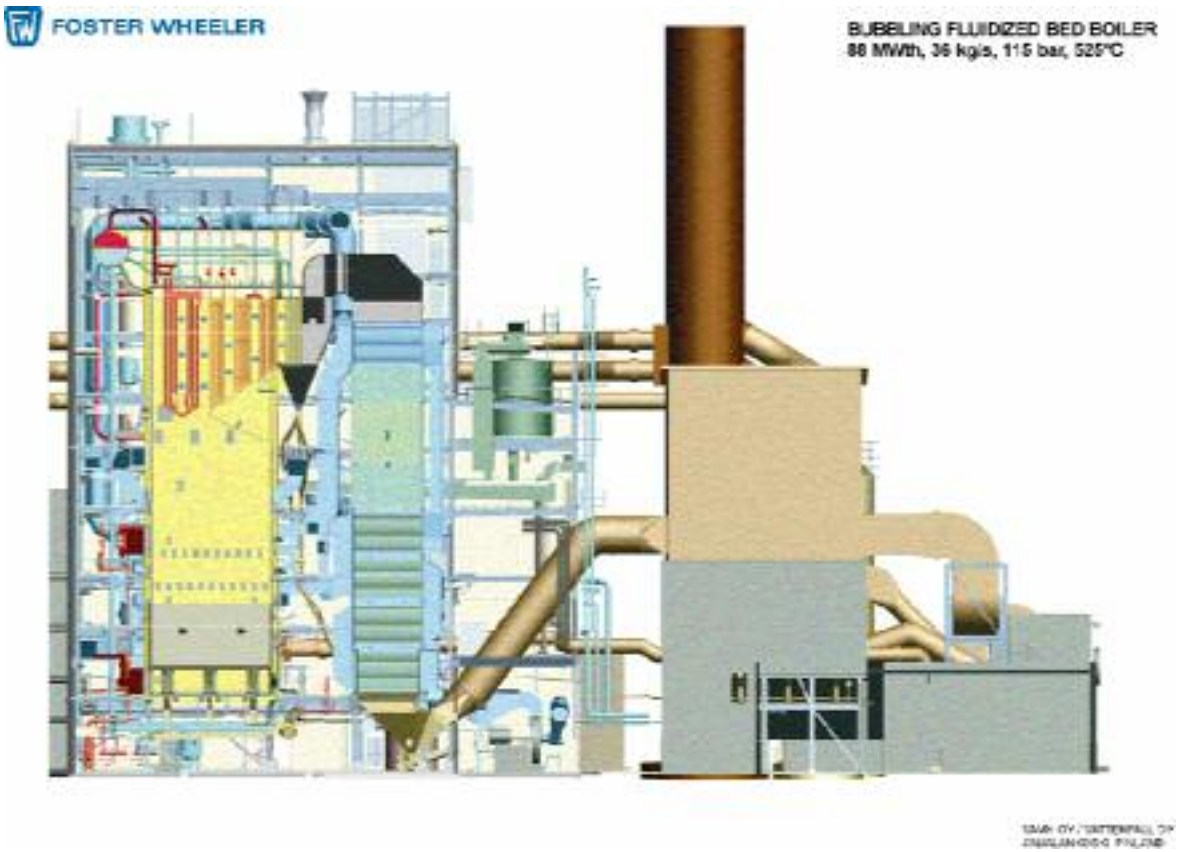
Myllykoski

- BFB
- 88 MW_{th}
- Bark, peat, forest residues,sludge, recycled wood
- (Recycled Energy Fuels)



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Idbäcken

- BFB
- 105 MW_{th}
- Biomix + Recycled wood (50%)

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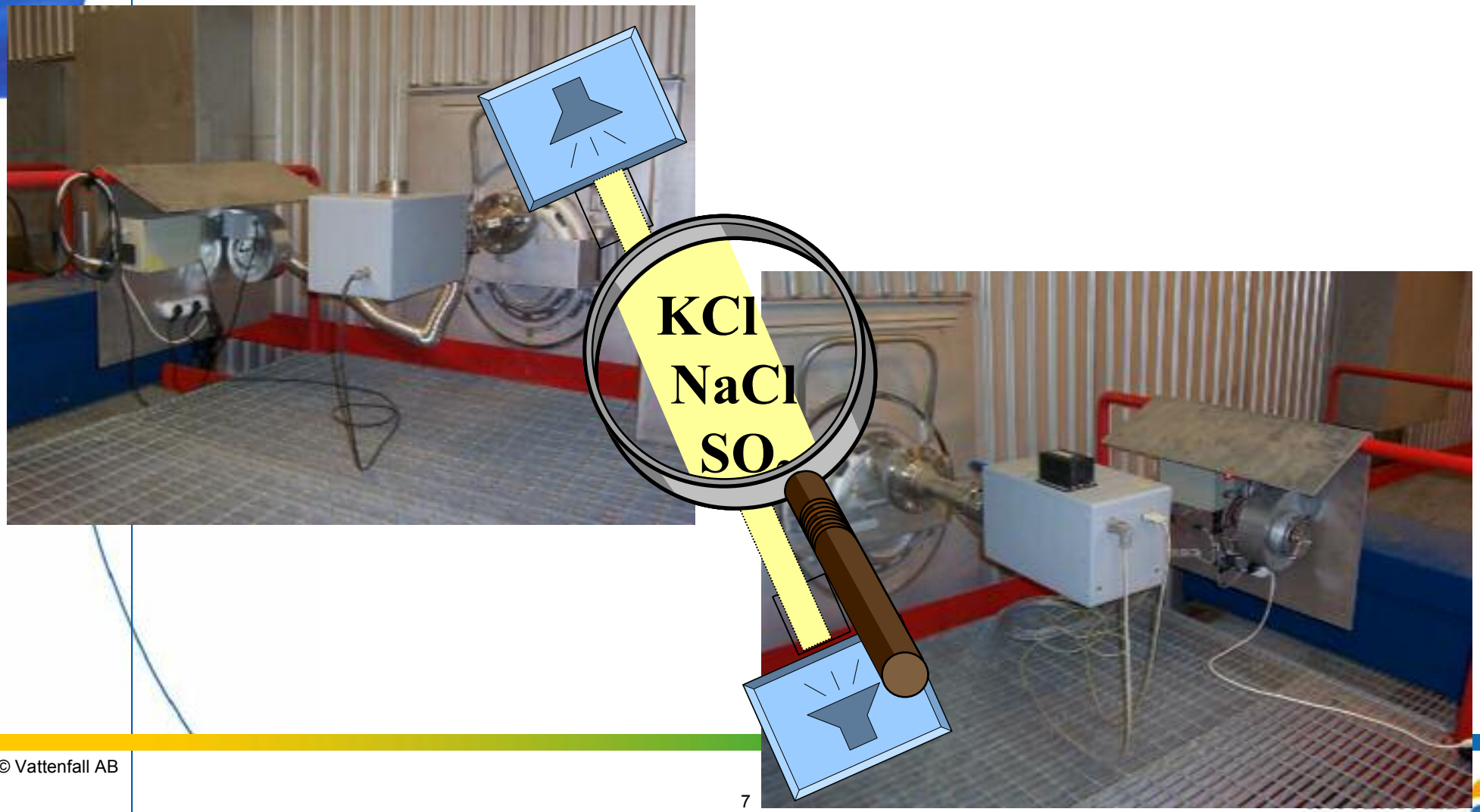
Fuel chemistry derived problems - characterization

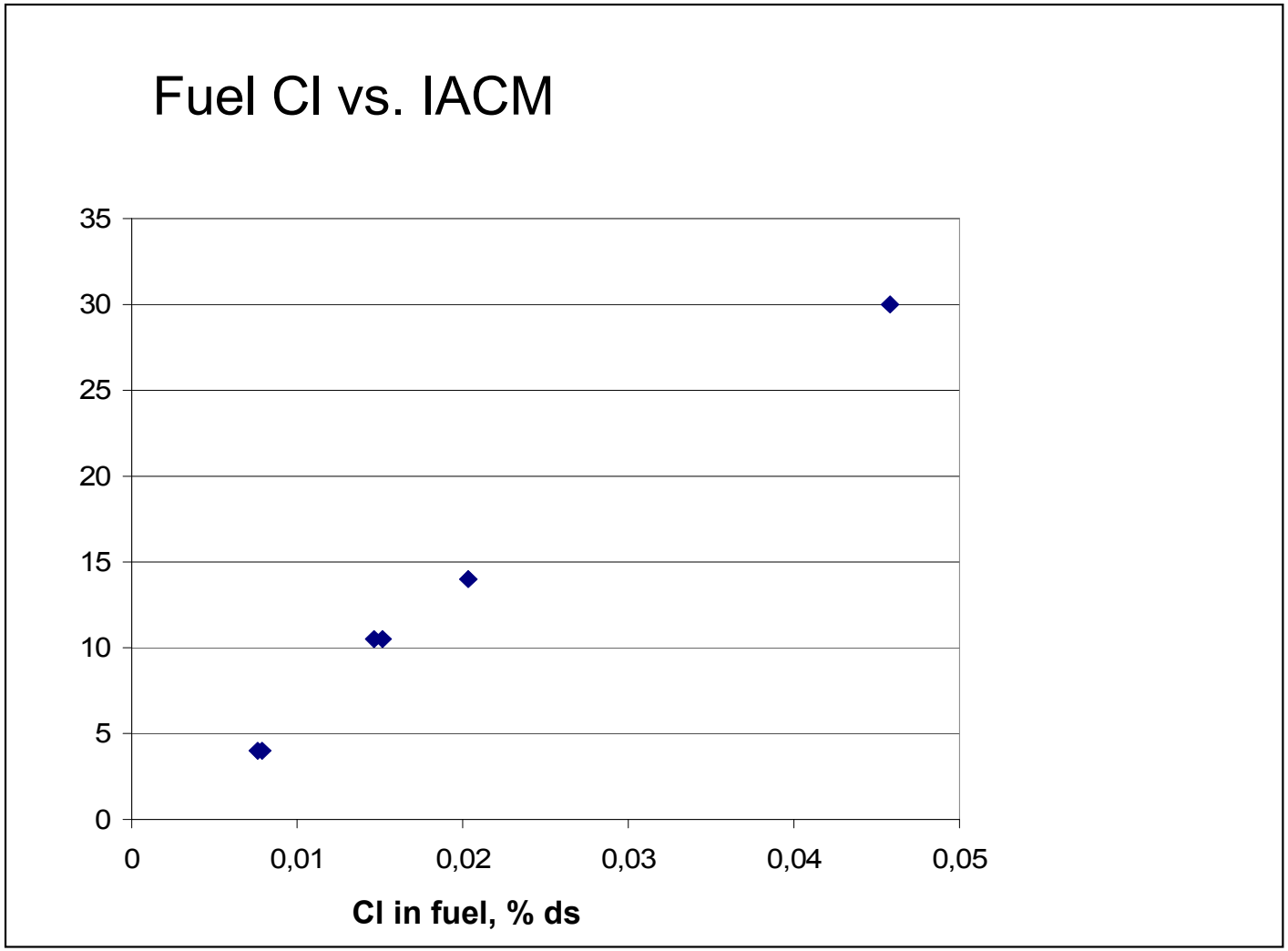
- Measurement of gaseous alkali chlorides – IACM
- Deposit probes
  - Fouling rates
  - Deposit chemistry – corrosion rates

IACM – In situ Alkali Chloride Monitor

- UV lamp and detector



IACM as fuel quality monitor



(Biofuel boiler)

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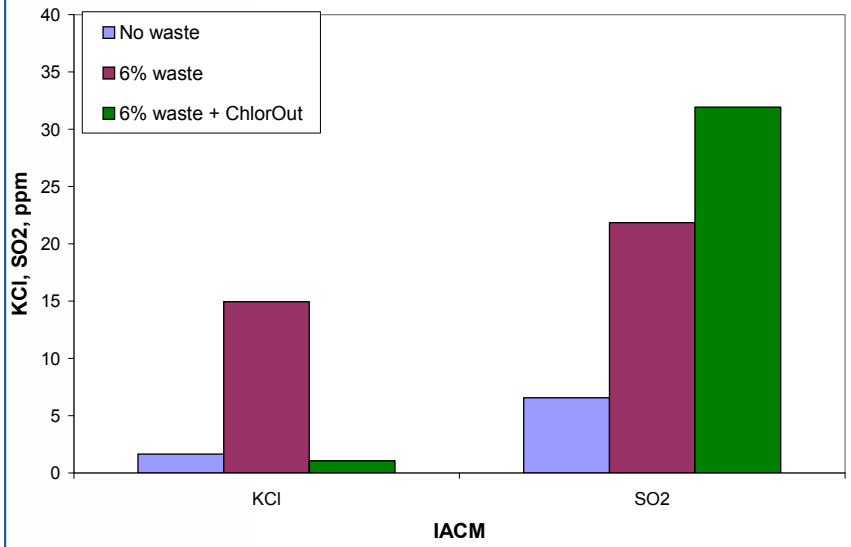
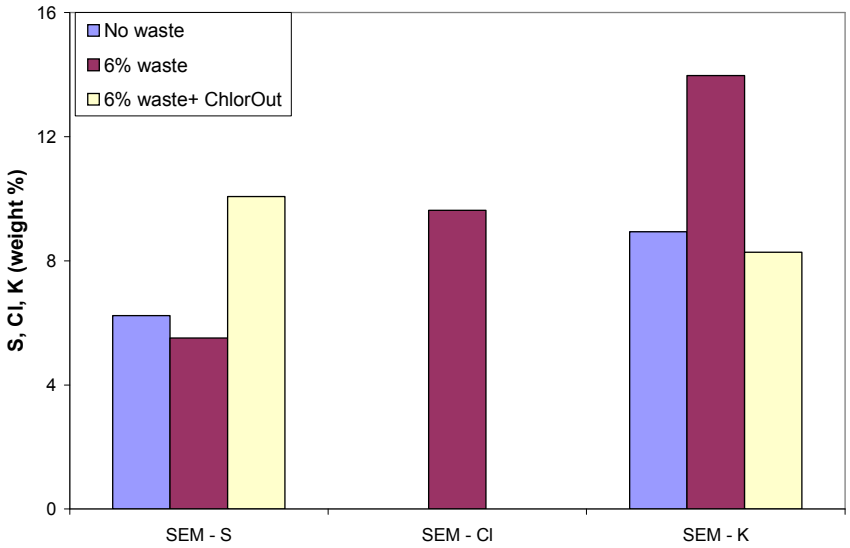
Reduction of alkali chlorides - ChlorOut

- $(NH4)_2SO_4 \rightarrow 2\ NH_3 + SO_3 + H_2O$
- $SO_3 + H_2O + 2KCl \rightarrow 2HCl + K_2SO_4$
- Also reduction of NO_x and CO emissions

Munksund

- No waste; waste addition; waste + ChlorOut
- Measured levels of KCl and deposit chlorine content





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Normal & with ChlorOut addition

Without ChlorOut
Chloride conc. 12%
deposits 6 g/m^2/h

With ChlorOut
Chloride conc. <0.2%
deposits 2 g/m^2/h

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Bio/recycled wood 50/50

Without ChlorOut

Chloride 25%

Fouling rate 21 g/m2/h

With ChlorOut;

Chloride <0.2%

Fouling rate 6 g/m2/h

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Myllykoski K7

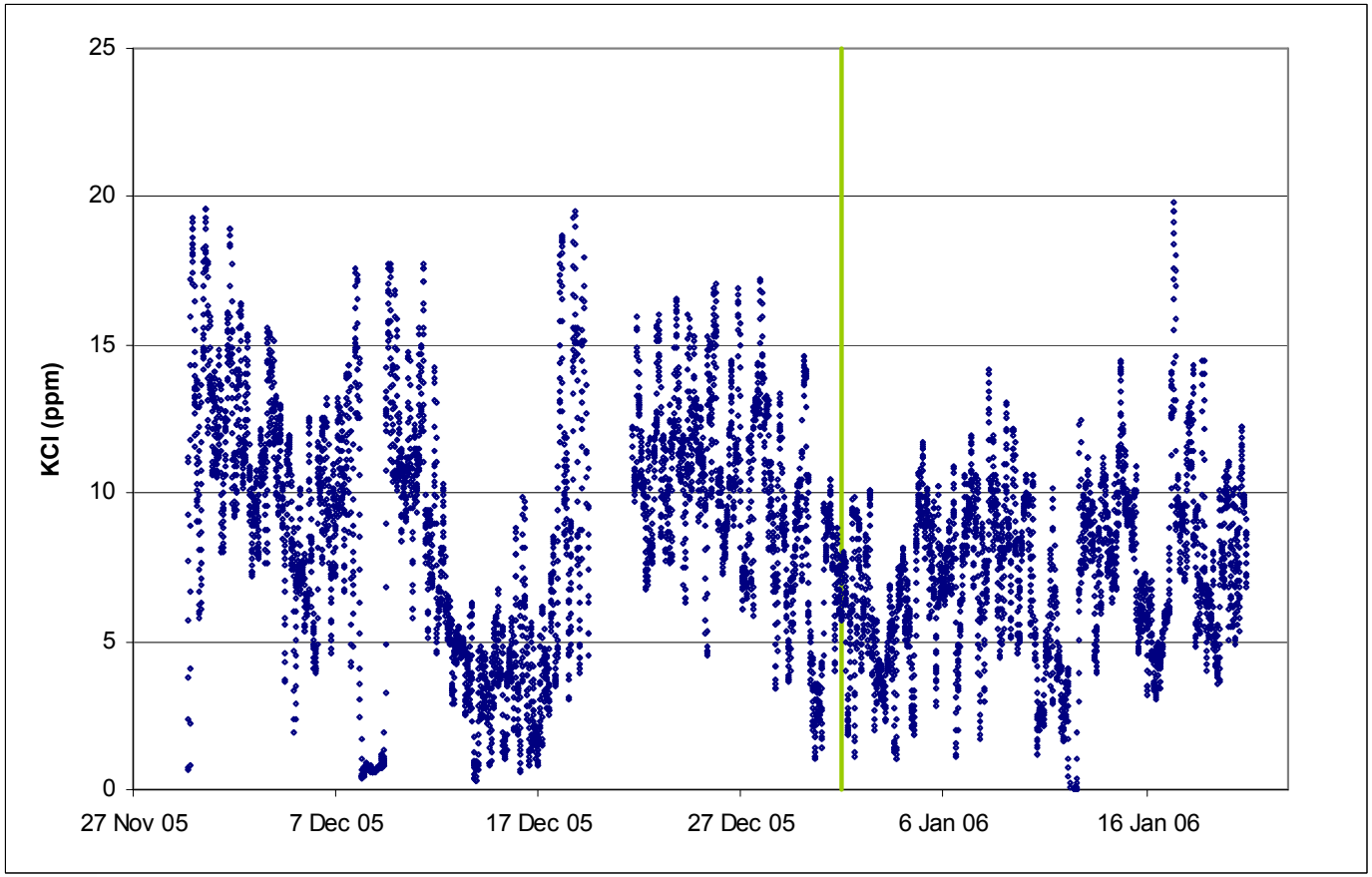
- Operating on a wide mix of fuels
- Peat, bark, forest residues, sludge
- Recycled wood, recycled energy fuels
- REF (~5%)

- High levels of S from peat and sludge

- S/Cl or S/alkali above what usually considered critical limits

Myllykoski K7, IACM

- Removal of REF from fuel mix; week 50/2005 & 2006



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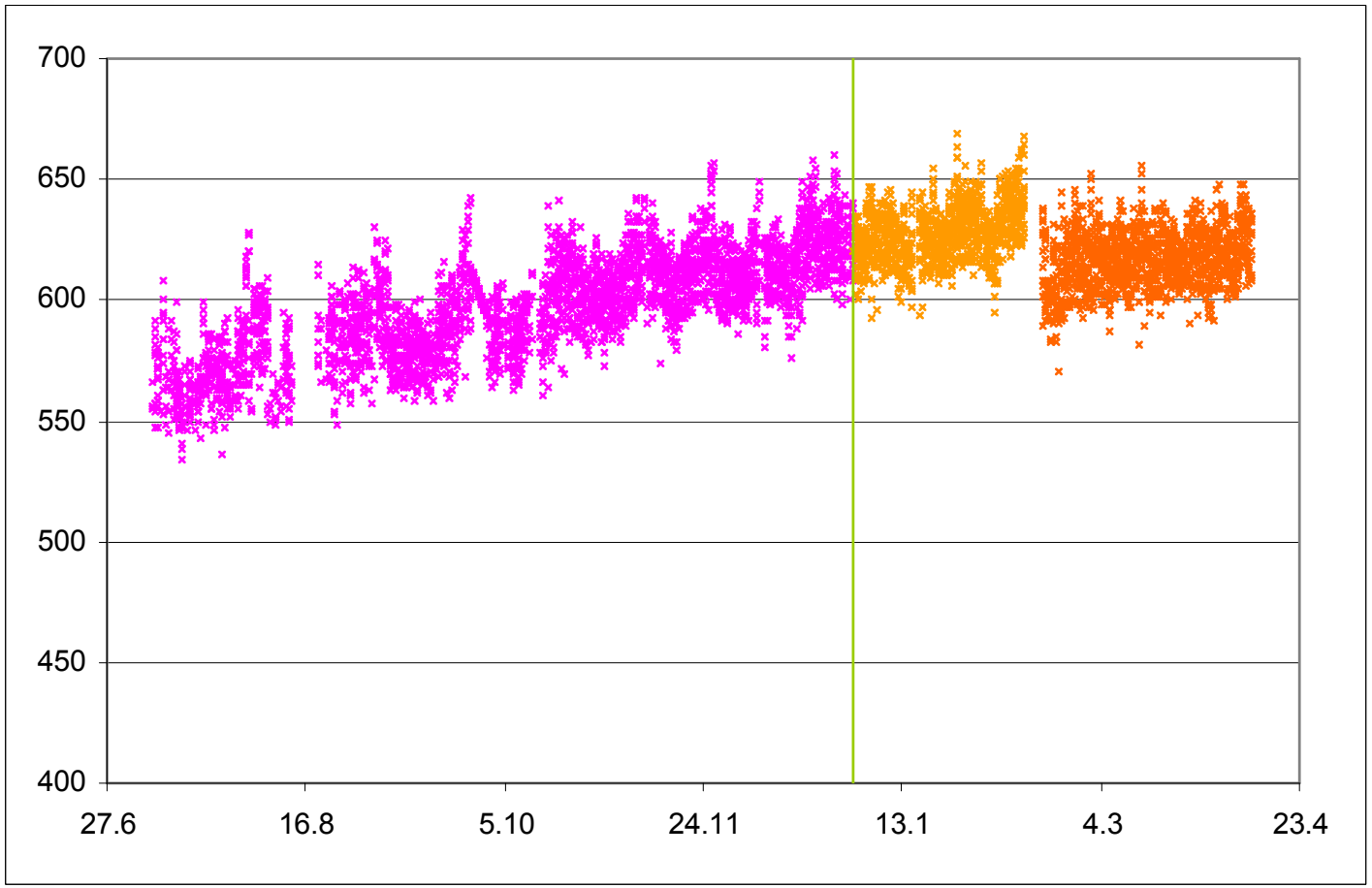
Flue gas temperature



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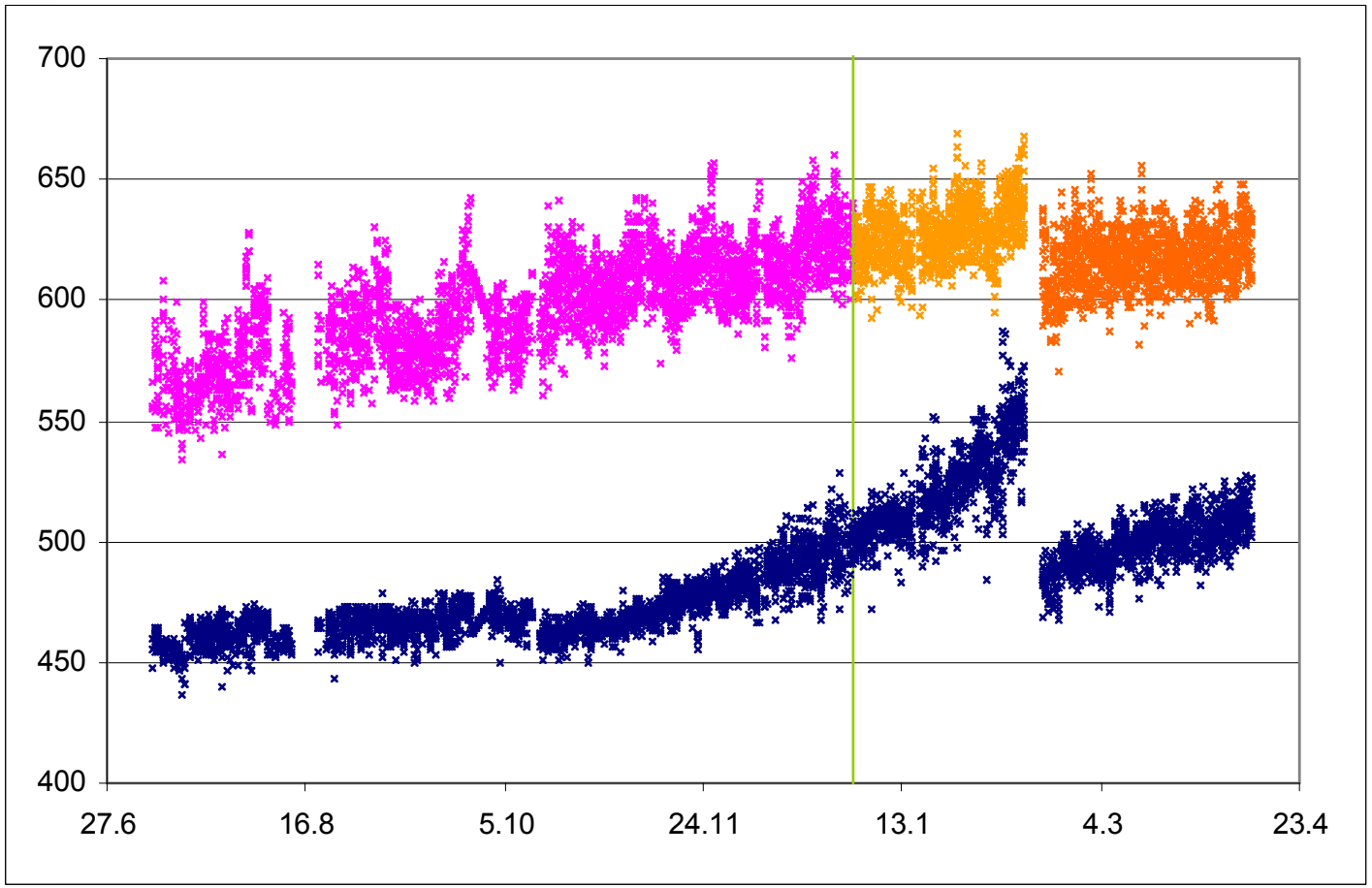
Flue gas temperature & pressure loss



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Idbäcken

- Removal of coal from fuel mix
- Increasing fouling and corrosion
- ChlorOut as S-additive
- SH replaced to E1250

Idbäcken, fuel distribution over bed

- With increasing share of recycled wood problems with deposit formation over fuel feed points
- Uneven temperature in bed – problems reaching high loads
- Mixing in freeboard

- Improved fuel feeding system - reduced deposit formation
  - Reduced amounts of fines and rapidly volatilized burning immediately above fuel feed points
  - More even heat release in bed

Idbäcken, fuel distribution table

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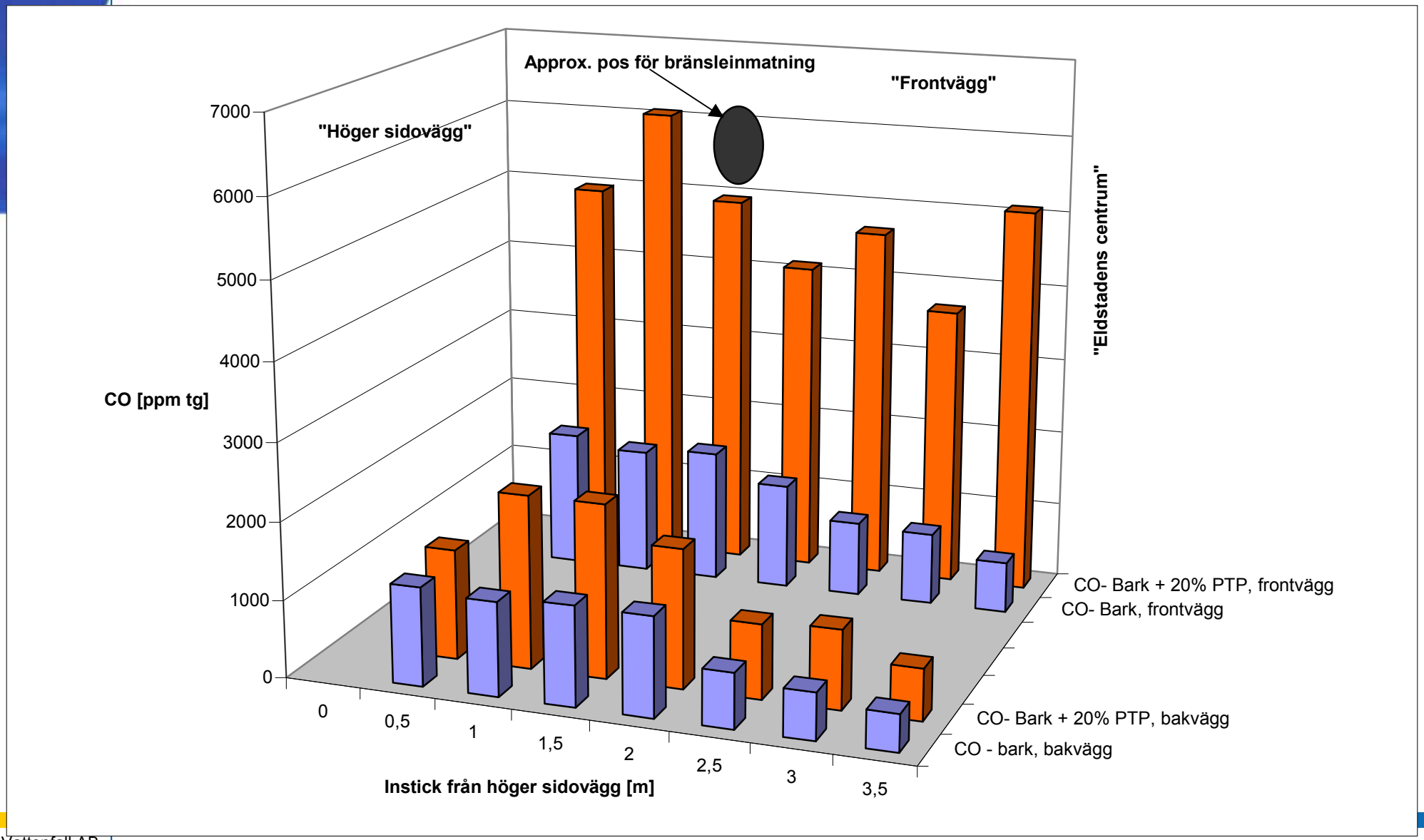
CO concentrations (Johannes BFB)



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Idbäcken, remaining issues

- Deposit formation in furnace wall
- Furnace wall corrosion

Bed fluidization issues –metal waste

- With recycled fuels in certain cases high amounts of incombustible matter, metal waste
- Nails in recycled wood
- Will not fluidize in the bed, decreased mixing
- Forming defluidized zones

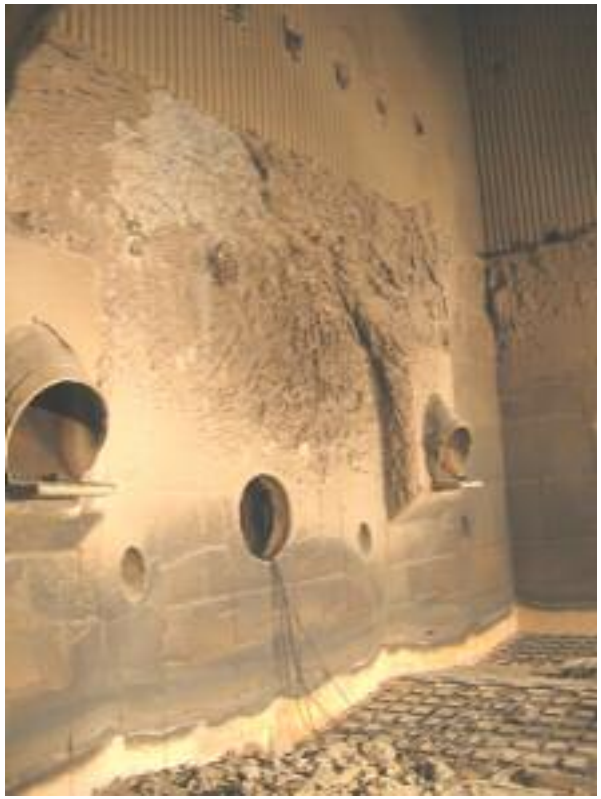
- Difficulties removing metal waste with bed bottoms not designed for the task

Removal of metal waste (Myllykoski)

- Nails forming tangled lumps
- Manually removed

“Rassausaukko”

- Bed bottom manually cleaned without need for shut-down
- Reduced load on natural gas



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Conclusions

- Waste fractions can be co-combusted with biofuels
- Feed arrangement must be looked over
- Spreading of fuel – especially in BFB:s

- Increased fouling & corrosion risk compared to “clean” fuels
- Increased amounts of chlorine, alkali, heavy metals

- Bed bottom capacity to deal with (metal) waste

Conclusions (2)

- Fuel quality can be monitored with IACM
- SH fouling rates correlating with measured alkali chloride levels
- Additives (ChlorOut) – reduction of alkali chlorides, fouling rate and corrosion risk