Overcoming Technical Barriers Related to Biomass Co-combustion in Large-Scale Power Plants

Sven Unterberger,
Jörg Maier, Klaus R.G. Hein

Institut fuer Verfahrenstechnik und Damfpkesselwesen (IVD)
Institute of Process Engineering and Power Plant Technology
Universitaet Stuttgart, Germany

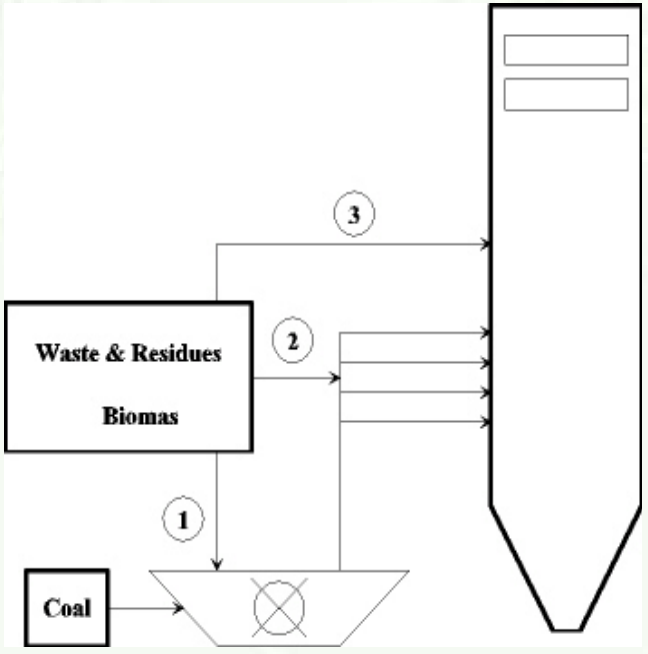
BIO-ENERGY
ENLARGED PERSPECTIVES

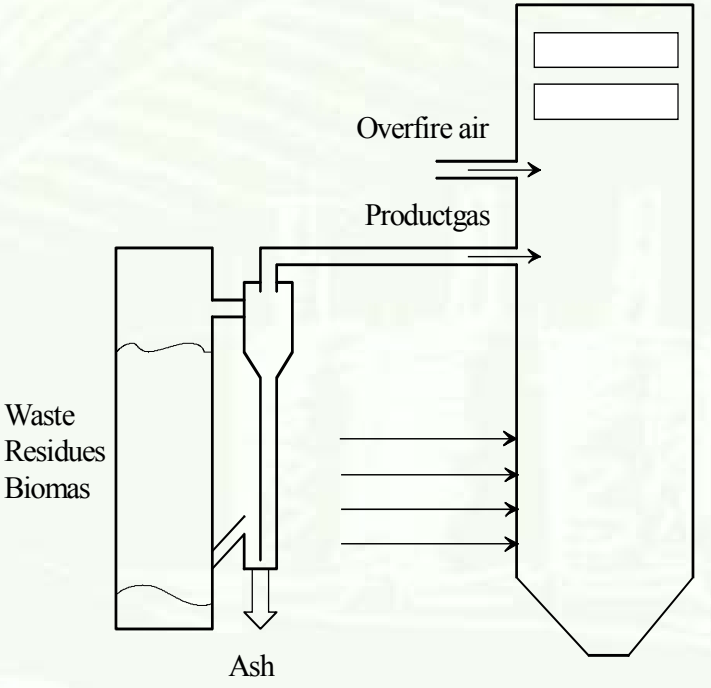
Budapest ,16-17 October 2003

Why Biomass Co-Combustion?

- Large, already existing capacities
- Comparable low investment costs
- High (electric) efficiency, low emissions
- Low operational effects at low biomass shares
- Seasonal fluctuations of biomass can be minimised
- Substitution of coal for CO_2 reduction

Co-Combustion Techniques



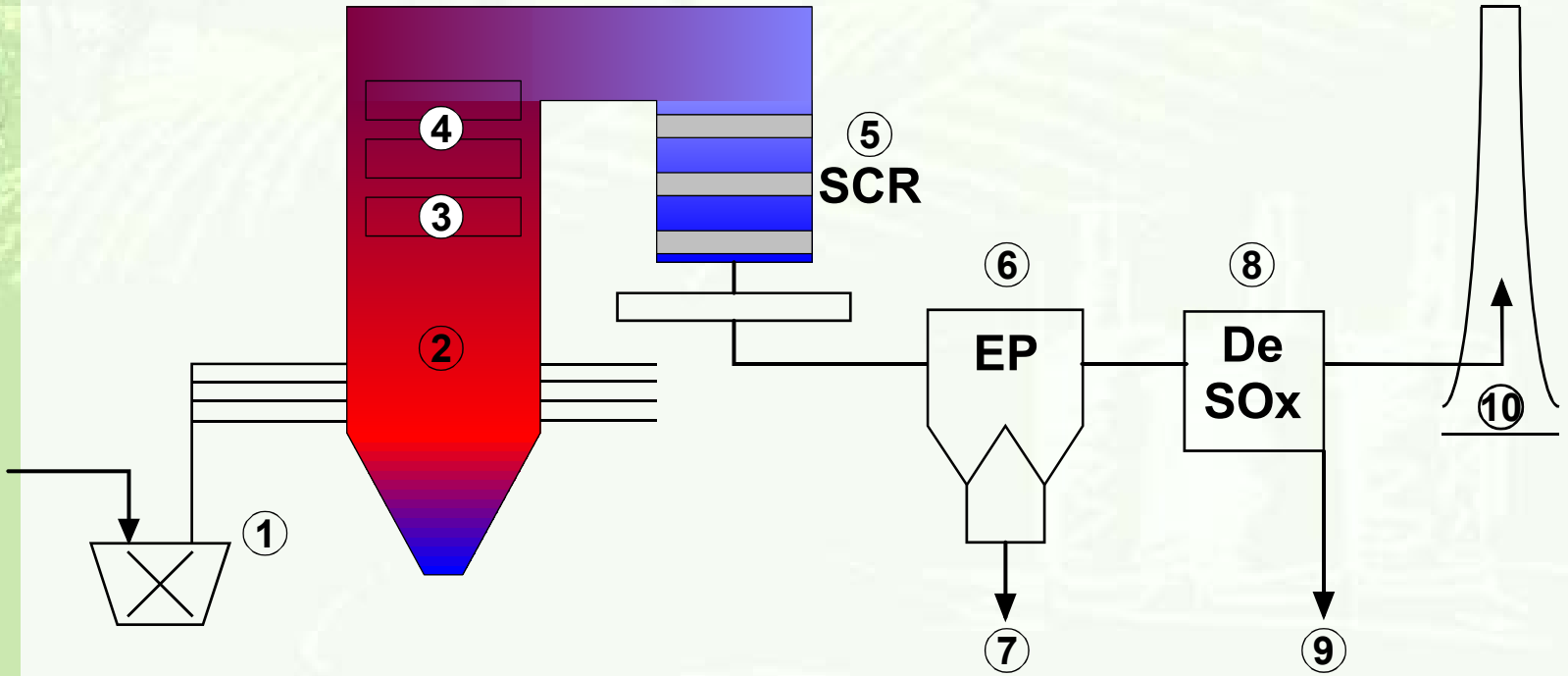


Direct co-combustion

Indirect Co-Combustion

- Pyrolysis
- Gasification
- Pre-Combustion

Areas of Concern



1 milling system: capacity, wear
2 furnace: slagging
3 super heater: corrosion
4 convective heat exchanger: fouling, erosion
5 DeNOx: deactivation, capacity, erosion
6 precipitator: capacity
7 ash: utilisation
8 DeSOx: capacity
9 DeSOx-residues: utilisaton
10 flue gas: emissions

Previous EC-Projects @ IVD

- Co-Utilisation of Coal, Biomass and Waste
  APAS, 1993 - 1994
- Operational Problems, Trace Emissions and By-Product Management of Industrial Biomass Co-Combustion
  OPTEB, 01.01.1996 - 31.12.1998
- Prediction of ash and deposit formation for biomass co-combustion
  DEPOSIT PREDICTION, 01.07.1998 - 30.06.2000
- Slagging and Fouling Prediction by Dynamic Boiler Modelling
  SLAGMOD, 01.06.2000 - 31.05.2002
- Quality of Secondary Fuels for Pulverised Fuel Combustion
  SEFCO, 01.08.2000 - 31.07.2002
- Utilisation of Residues from Biomass Co-Combustion
  UCOR, 01.10.2000 - 30.09.2003

Conclusions

- Biomass preparation and co-firing with coal technically feasible
- Limited operational problems at lower shares of biomass (< 10 $\%_{th}$)
- Effects of biomass constituents on
  - by-product quality (UCOR)
  - air pollution control devices (CATDEACT)
  - emissions of toxic metals (TOMERED)

  are not completely understood
- Co-utilisation of bio-wastes and refuse-derived-fuels (RDF) not investigated

Influence of Biofuel (Co-)Combustion on Catalytic Converters in Coal-Fired Power Plants

CATDEACT

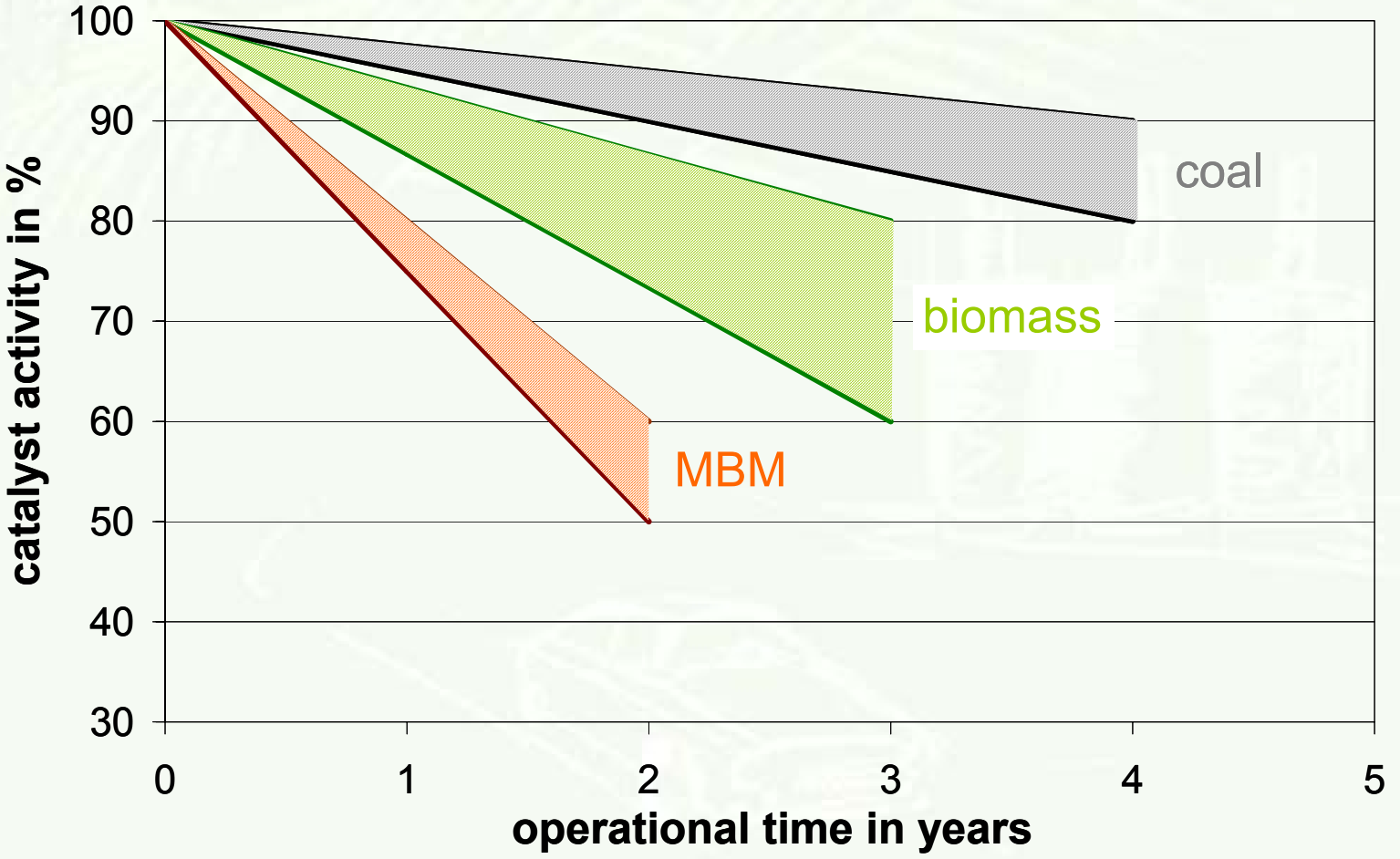
ENK5 - CT2001 - 559

01/11/2001 - 31/10/2004

BIO-ENERGY
ENLARGED PERSPECTIVES

Budapest ,16-17 October 2003

Background


100
90
80
70
60
50
40
30
catalyst activity in %
0
1
2
3
4
5
operational time in years
coal
biomass
MBM

Motivation

- Biomass contains catalyst poisons
  K, Na (wood, straw, ...)
  P (MBM, sewage sludge, ...)
- Costs for total replacement of a three layer SCR approx. 8 - 12 Mio.€
- Costs for regeneration about 4 - 6 Mio.€
- Higher operational costs due to NH_3 consumption and fly ash enrichment

Project Partners

1 Universität Stuttgart, IVD (co-ordinator)

2 Technical University of Denmark

3 Energy Solutions GmbH

4 Vattenfall AB

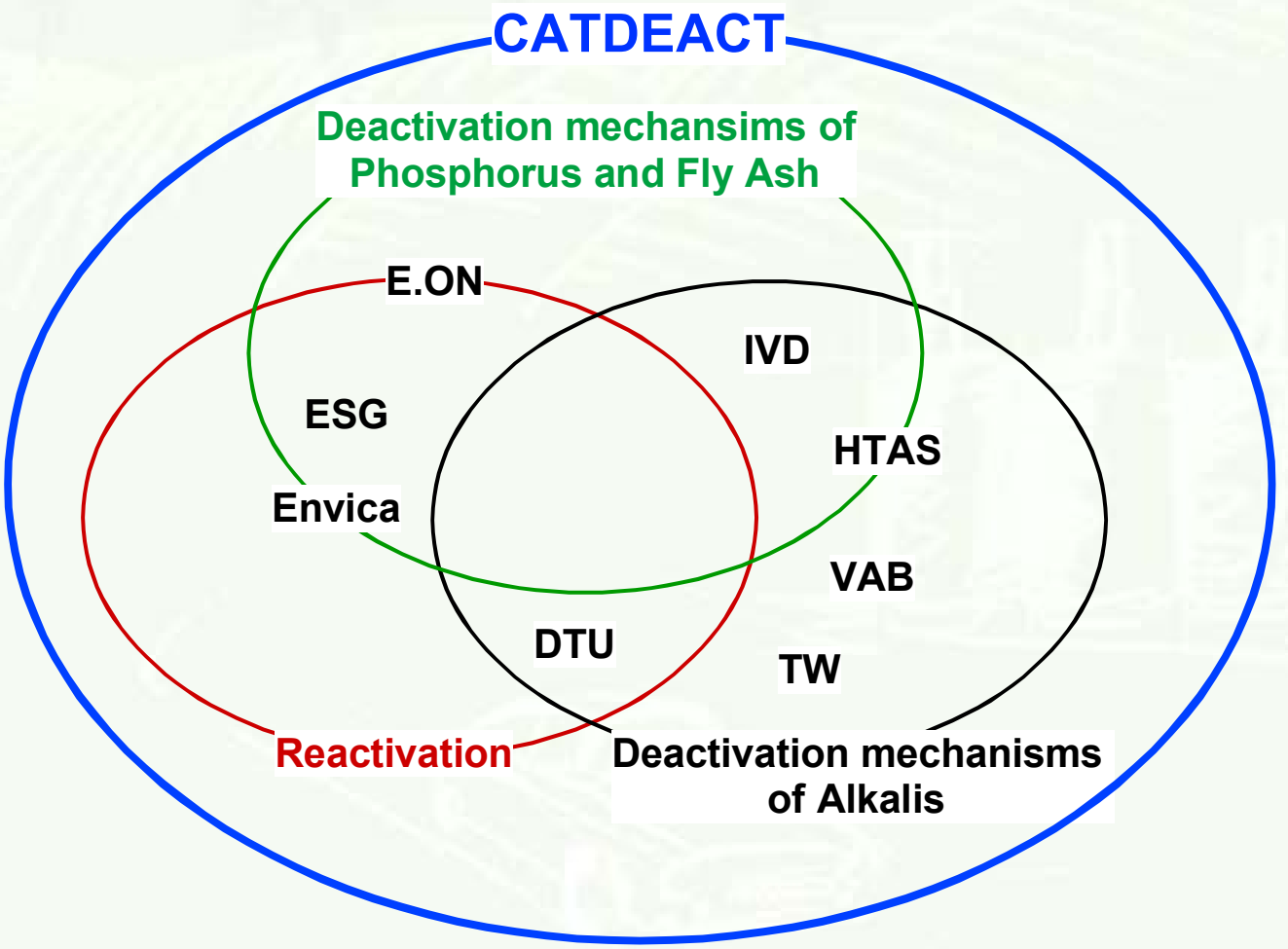
5 Haldor Topsoe A/S

6 E.ON Engineering GmbH

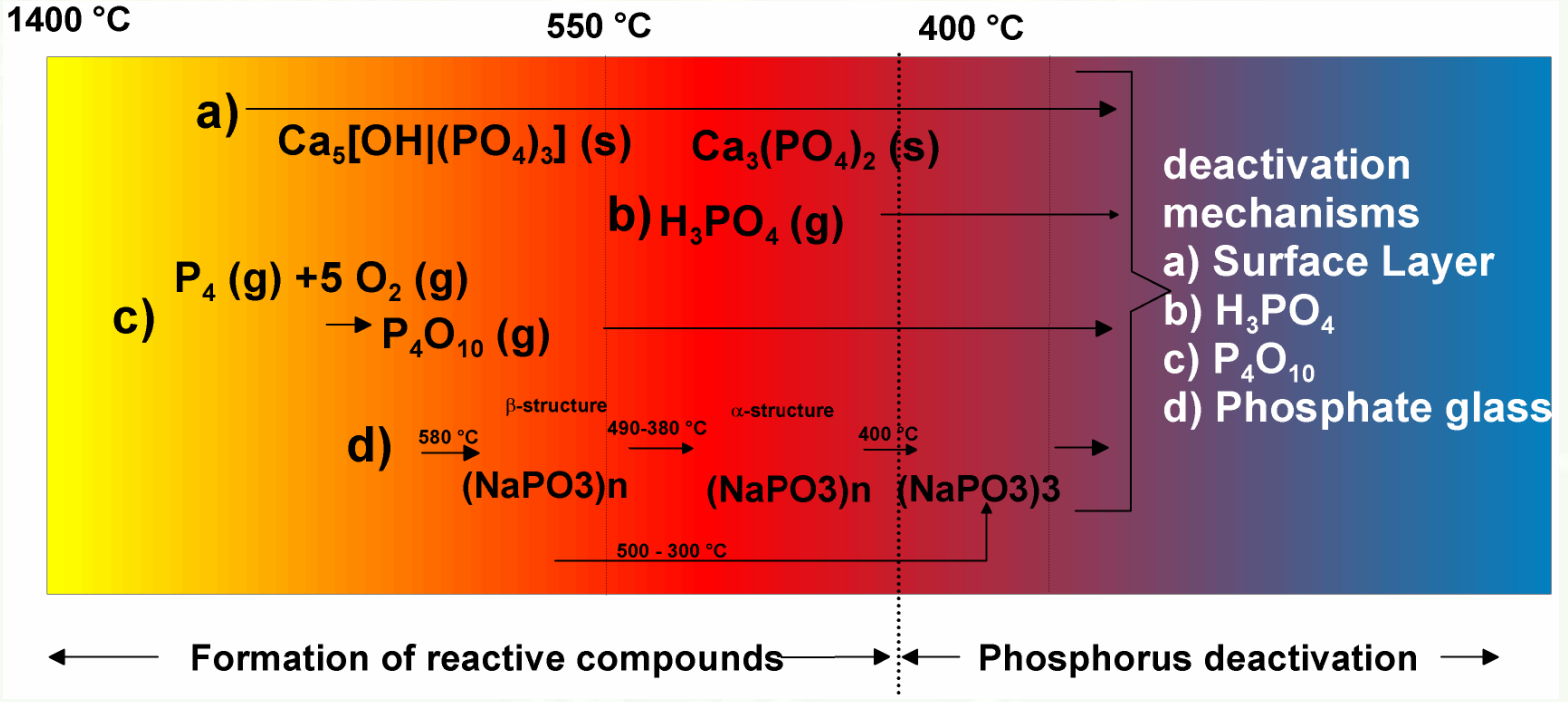
7 ENVICA GmbH

8 Techwise A/S

Work Content



Lab-Scale Tests



Full-scale Tests

- 4 slip stream reactors on identical 350 MW_{el} units (Techwise):
  - one 100% coal, one co-fired with up to 10 $\%_{th}$ straw
  - two high dust and two low dust reactors
  - exposure times: 2000, 3500 and 5000h
- analysis of deactivated catalysts by E.On and HTAS
- regeneration by ENVICA, ESG and DTU

=> deactivated catalyst samples available, analysis and regeneration still ongoing

Expected Results

- Advanced analysis methods
- Mechanisms leading to deactivation during co-combustion:
  - secondary fuel characteristics
  - operational parameters
- Countermeasures
  - regeneration
  - operational parameters
  - additives