Fluidized Bed Combustion as an Excellent Technology

Franz Winter

Institute of Chemical Engineering, Vienna University of Technology

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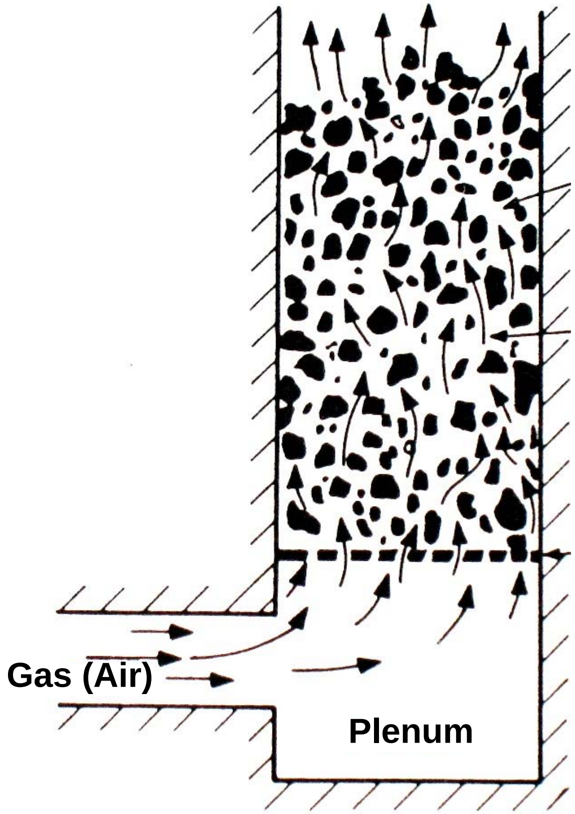

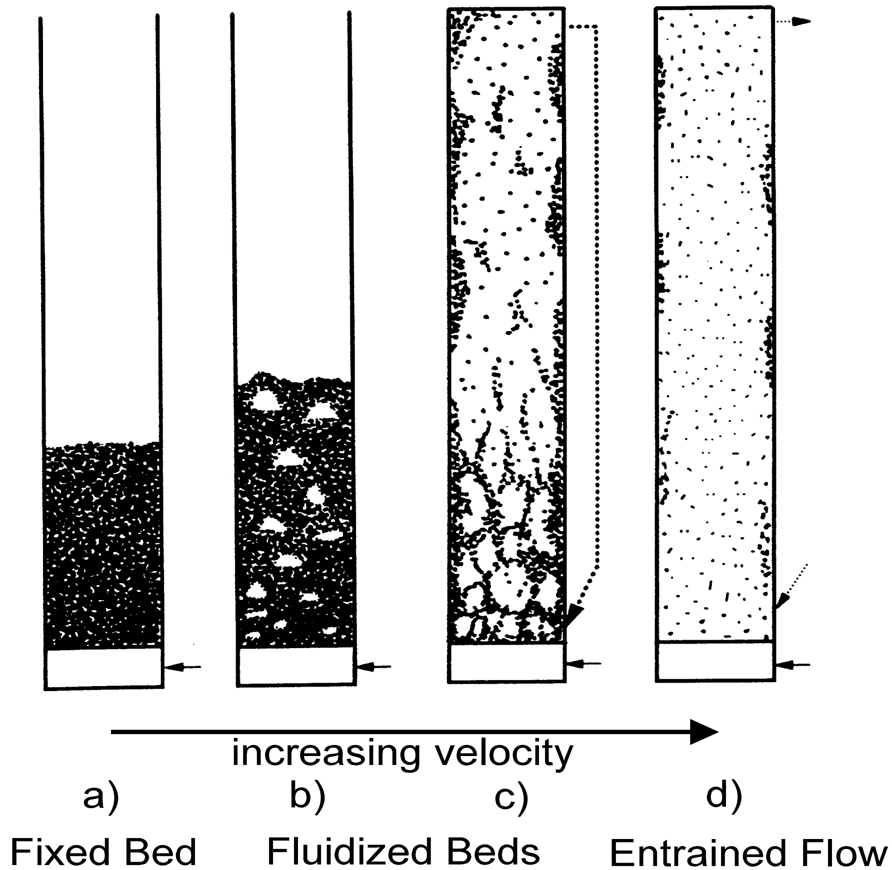

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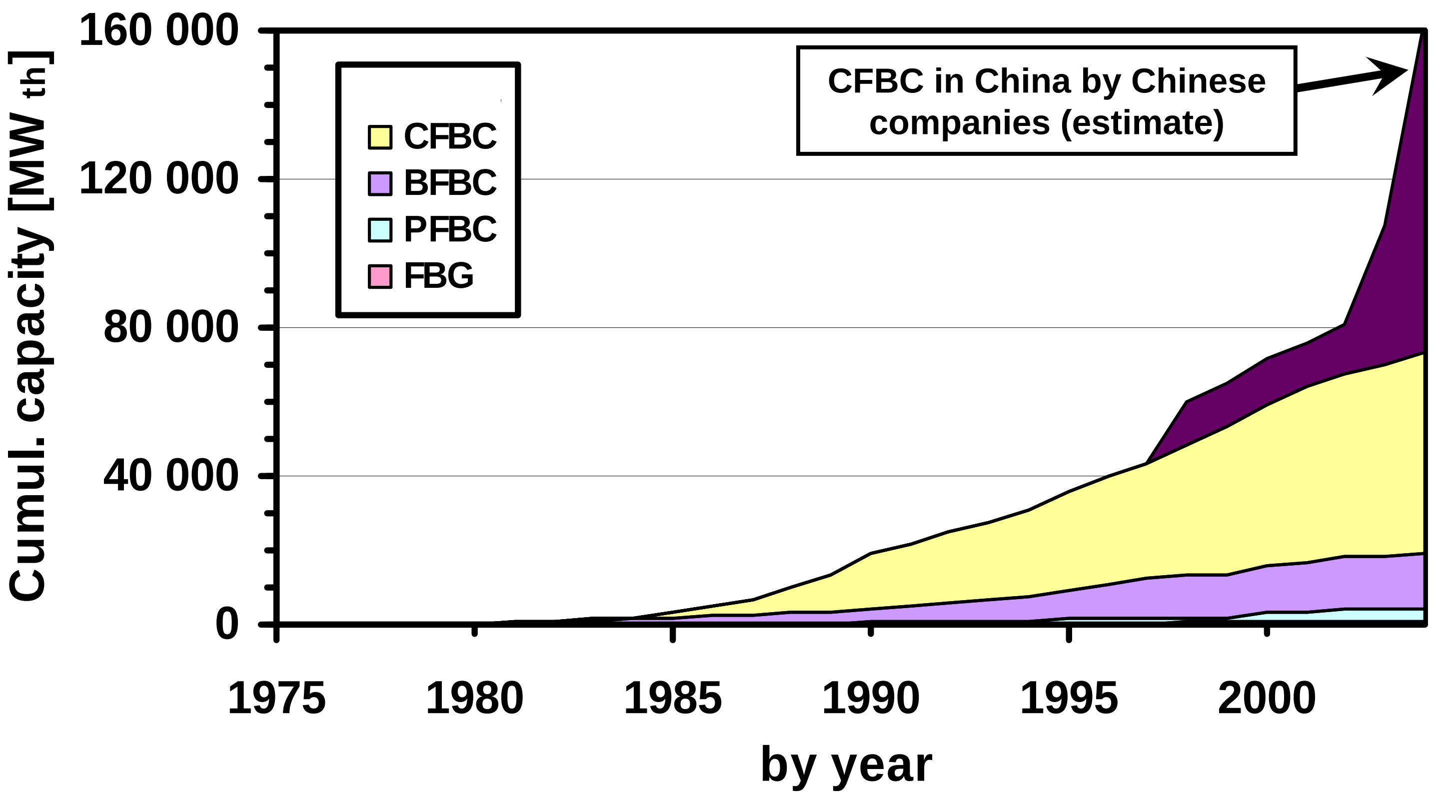
1. The Fluidized Bed Combustion technology

Capacity of FB devices worldwide (2004)



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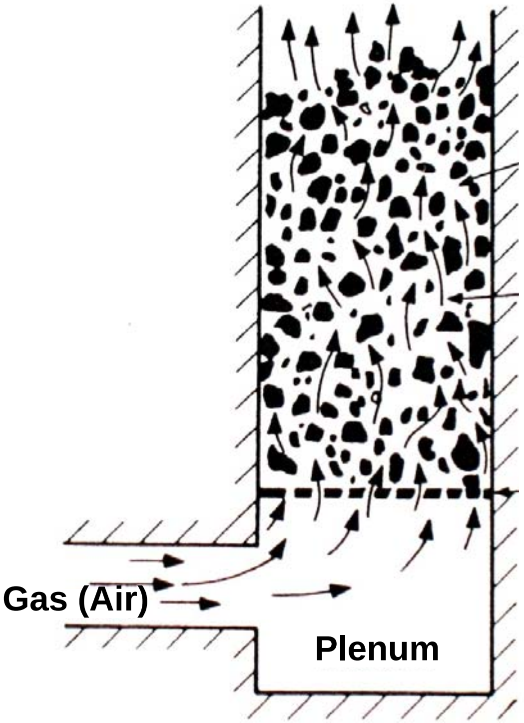
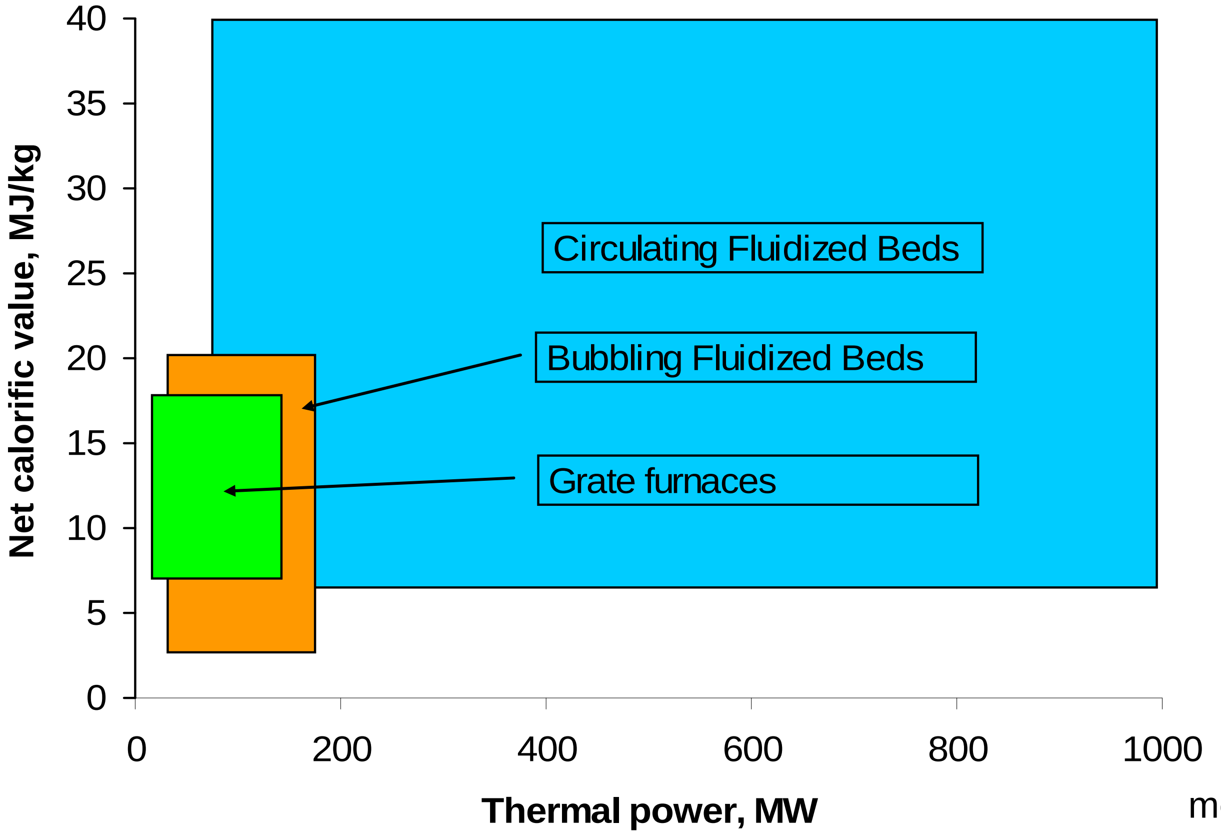
1. The Fluidized Bed Combustion technology

Advantages and Limitations of FBCs:



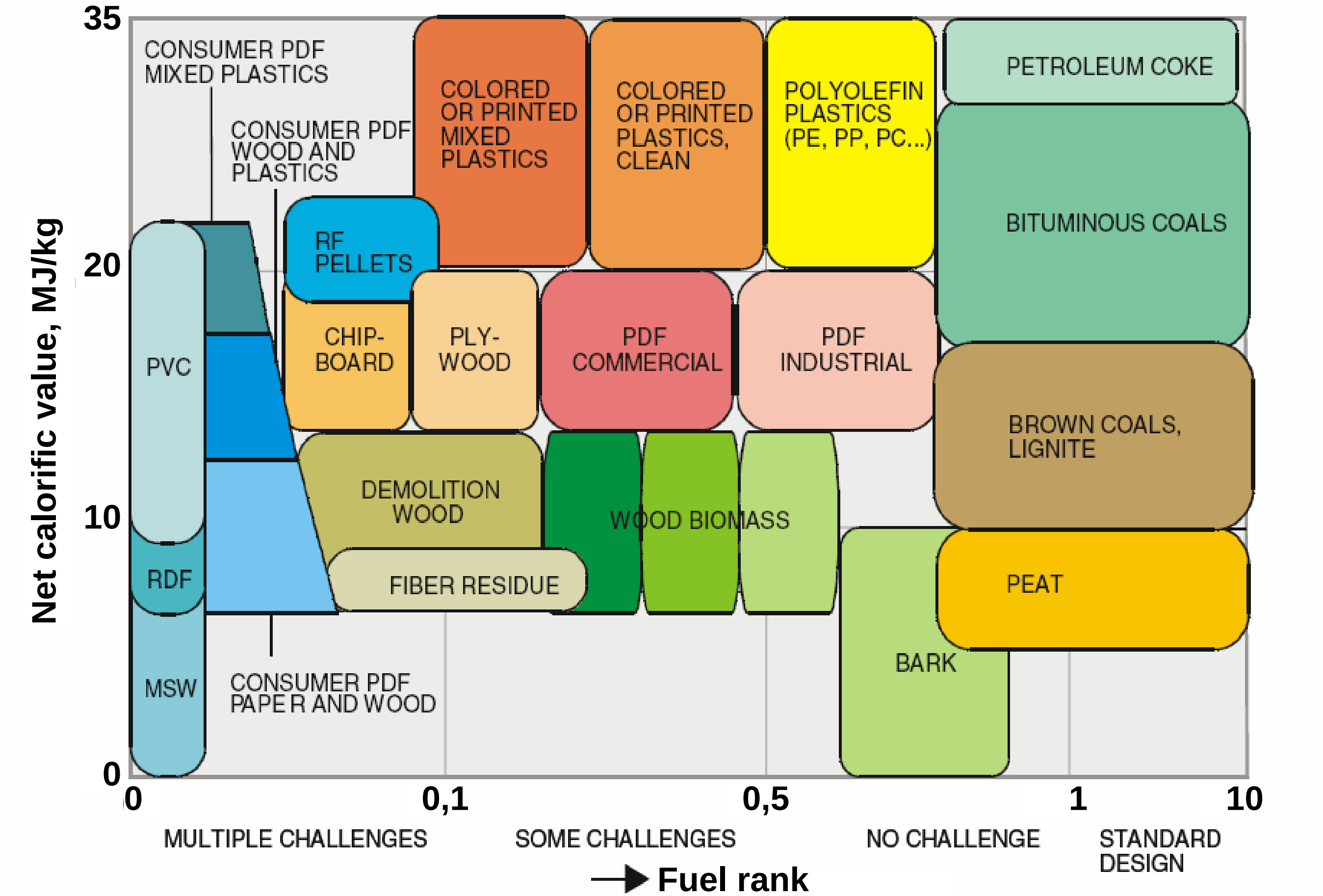
+ Excellent mixing & heat transfer
+ Flexibility against fuel quality
+ Low Emissions: SO_2, NO_X
+ High combustion efficiency
- Power demand for fluidization
- Fuel feeding: difficult

Operating ranges



modified from AE&E

2. Fuels for FBCs



Hämäläinen

2. Fuels for FBCs

Fuel	calorific value (MJ/kg) dry	moisture (%) as used
beech wood	17 - 19	10 - 30
spruce wood	19 - 21	10 - 30
grass	17 - 18	10 - 40
waste wood	16 - 17	10 - 30
paper	17 - 18	5 - 30
bark	15 - 16	10 - 30
sewage sludge	15 - 17	55 - 70
lignite	15 - 17	25 - 60
bituminous coal	29 - 33	3 - 5
Polyethylene (PE)	46	negligible
Polypropylene (PP)	44	negligible
Polystyrene (PS)	40	negligible
Polyamide (PA)	31	negligible

Industrial Fluidized Bed Combustors in Austria

Industrial Fluidized Bed Combustors in Austria

owner / location	year	type	capacity	fuels
Sappi Austria / Gratkorn	1981	CFBC	25 MW	Bark, sludge, biogas, natural gas
Sappi Austria / Gratkorn	1986	CFBC	133 MW	Coal, sludge, biogas, natural gas
Norske-Skog / Bruck a.d. Mur	1984	BFBC	15 MW	Bark, coal, sludge, biogas, natural gas
Verbund / Zeltweg*)	1998	CFBG	10 MW	Wood
ENAGES / Niklasdorf	2004	BFBC	40 MW	MSW, industrial waste, wooden residue, sewage sludge
Lenzing AG / Lenzing	1987	CFBC	108 MW	Bark, coal, sludge, wood residue, oil
RVL / Lenzing	1998	CFBC	110 MW	Plastics, waste, sludge, wood residue
Solvay / Ebensee	1987	CFBC	43 MW	Coal, wood waste
UPM Kymmene Austria / Steyrermuehl	1994	CFBC	48 MW	Bark, wood, wood residues, sludge
Energie AG Oberösterreich / Timelkam	2006	FBC	49 MW	Wood, wood residues, bark, sawdust
M-real Hallein AG / Hallein	2006	BFBC	30 MW	Wood chips

BFBC bubbling fluidized bed combustor
FICFBC fast internal circulating fluidized bed combustor
DFBG dual fluidized bed gasifier
CFBC circulating fluidized bed combustor
CFBG circulating fluidized bed gasifier
RFBC rotating fluidized bed combustor
*) not in operation

Industrial Fluidized Bed Combustors in Austria

owner / location	year	type	capacity	fuels
Mondi Packaging AG / Frantschach – St. Gertraud im Lavanttal	1984	CFBC	61 MW	Bark, coal, sewage sludge, heavy oil
Funder / St.Veit a.d. Glan	2007	BFBC	45 MW	Wood, wood residue, saw dust, process waste, sewage sludge
ABRG / Arnoldstein	2000	FBC	8 MW	oils, emulsions, wooden residue, sludges, plastics
Hamburger / Pitten	1984	BFBC	65 MW	Coal, biogas, sewage sludge
AWA Bad Vöslau / Bad Vöslau	2003	BFBC	1 MW	Sewage sludge
Fernwärme Wien / Vienna	1992	FBC	3 x 25 MW	Sewage sludge
Fernwärme Wien / Vienna	2003	RFBC	40 MW	Municipal Solid waste, sewage sludge
Wien Energie Bundesforste Biomasse Kraftwerk (WEBBK) / Wien-Simmering	2006	CFBC	66 MW	Forest Residue
Biomassekraftwerk-Heiligenkreuz Errichtungs-GmbH / Heiligenkreuz	2006	BFBC	43 MW	Forest Residue
BKG GmbH / Guessing	2001	FICFB	8 MW	Wood chips, wood residues
Energie Oberwart GmbH/ Oberwart	2008	FICFB	10 MW	Wood chips

BFBC bubbling fluidized bed combustor
FICFBC fast internal circulating fluidized bed combustor
DFBG dual fluidized bed gasifier
CFBC circulating fluidized bed combustor
CFBG circulating fluidized bed gasifier
RFBC rotating fluidized bed combustor

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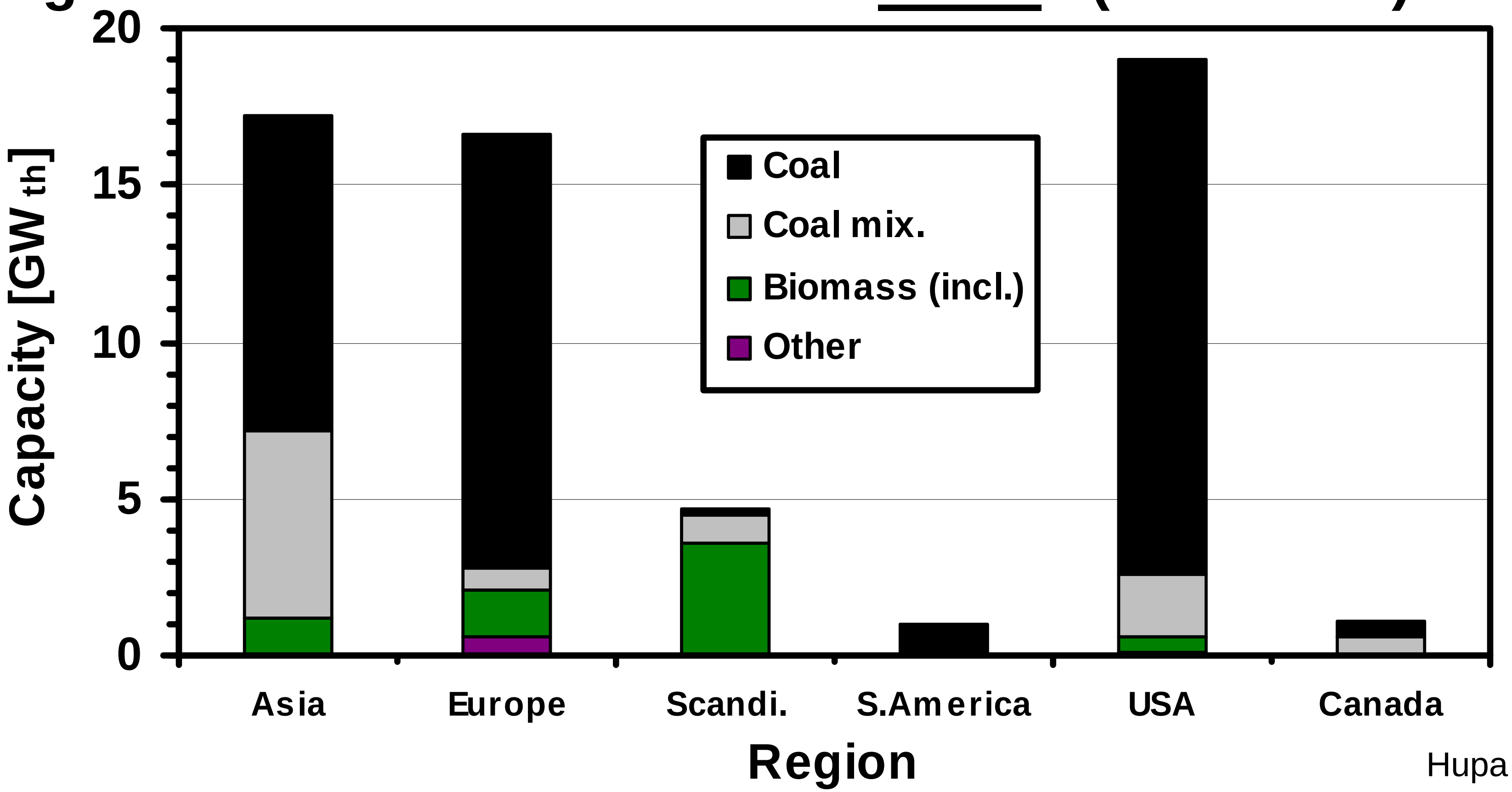
2. Fuels for FBCs

Regional differences in fuels for CFBCs (2005-2008)



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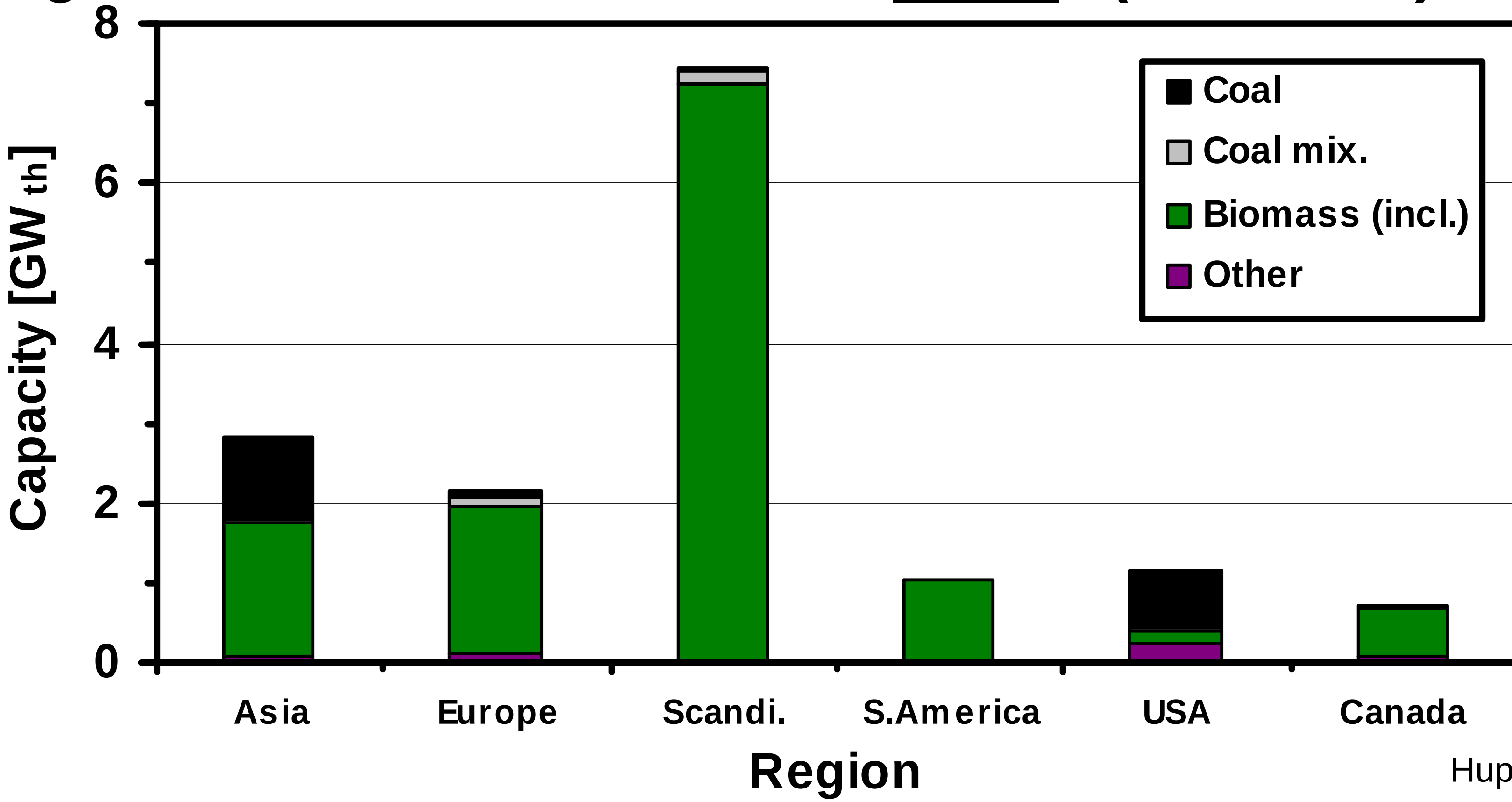
2. Fuels for FBCs

Regional differences in fuels for BFBCs (2005-2008)



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3. Co-combustion – definitions:

1. General definition:

Firing together
any fuels in the same plant.

2. Limited definition:

Firing together
low grade fuel with coal in the same plant.

3. Further limited definition – of greatest significance:

Firing together
biofuel with coal in in the same combustor.

3. Co-combustion – Impacts

Disadvantages due to the presence of biofuel – according to its share:

- Na, K → tendency to agglomeration
- Cl → corrosion
- high moisture → less energy

3. Co-combustion – Impacts

Neutral effects to be considered while operating – without any further negative consequences.

- Higher volatiles. To be considered while setting the combustion control parameters (temperature control, air distribution).

3. Co-combustion – Impacts

Advantages due to the presence of biofuel – according to its share:

- Better burnout. Measured data show Unburned Carbon Loss below 1%, several times also below 0.5%. [Abelha, Szentannai]
- CO_2-neutral production of heat and electricity.

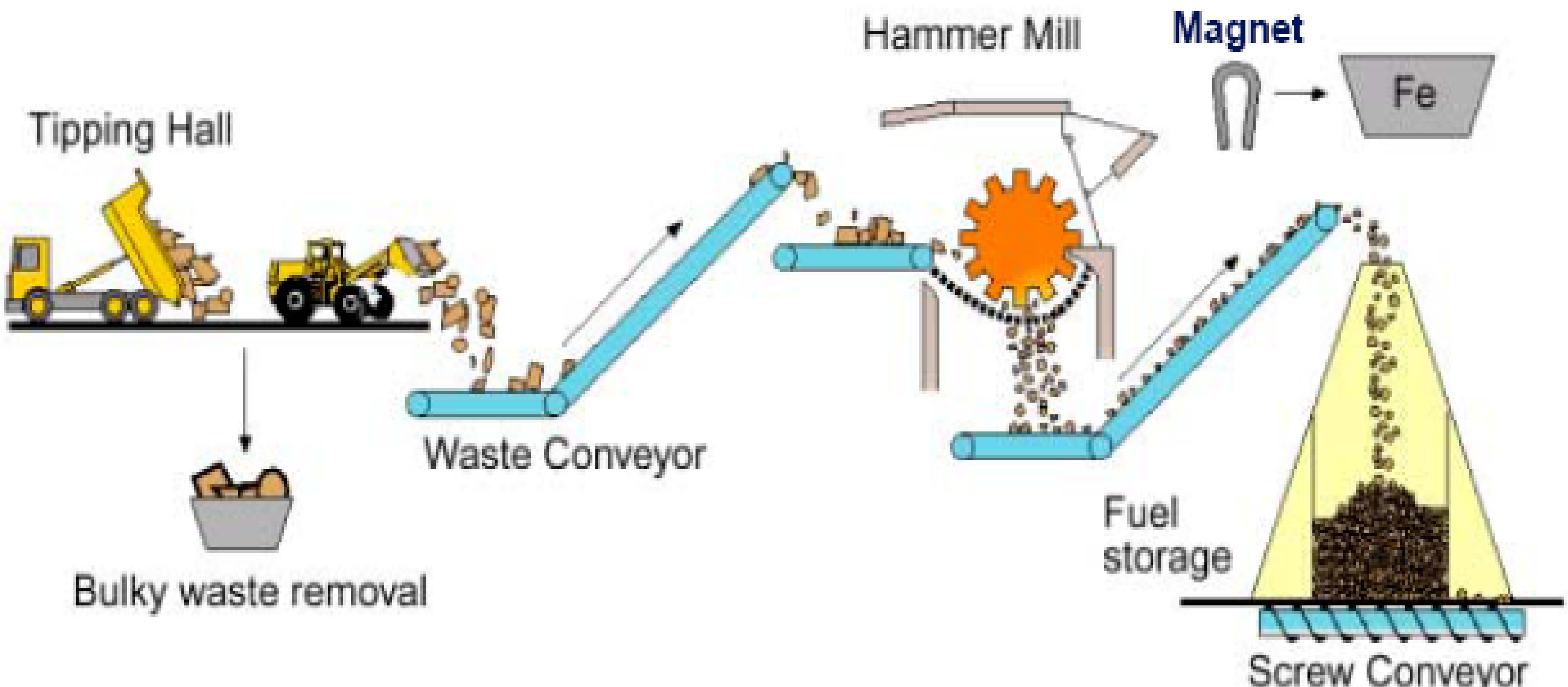
3. Co-combustion – Impacts

Synergy effects: when the resulted effect is more advantageous than the superposition of the two mono-combustions would be.

- NOx-Emission. Lower NOx-values measured, than at the mono-combustions of the same fuels. Reason: DeNOx-Reaction between NH_3 from biomass and NOx from coal. [Abelha]
- SO_2-Emission. When a biofuel contains more calcium than it would be necessary for the caption of the own sulphur, the co-combustion of a high sulphur coal is advantageous. [Szentannai]
- Aluminium-Silicates found in the ashes of coal and sewage sludge have shown to remove a great deal of alkali vapours that contribute to deposits on boiler tubes. [Amand]

4. Fuel preparation

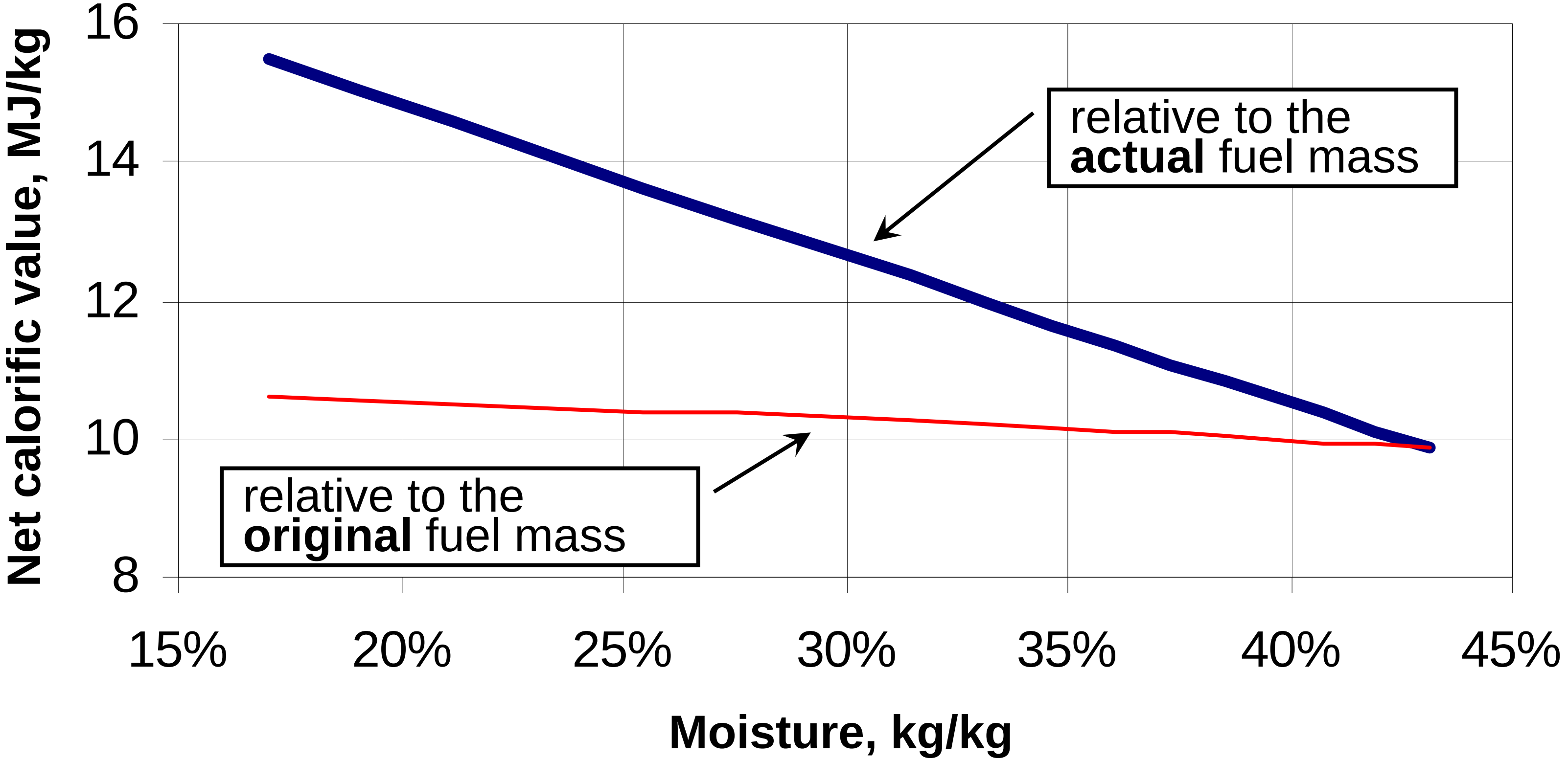
Example of a complex fuel preparation system.
Swedish concept.



Andersson

4. Fuel preparation

Effect of drying of a biomass fuel – decrease in fuel mass



5. Actual developments

+ The worldwide need for the FBC technology grows

+ Knowledge accumulated - dispersed

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- A tool for further advances is
  an innovative network: **iea-fbc.org**

  supported by IEA (www.iea.org)

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5. Actual developments   Main directions:

➔ Biomass – large FBCs – co-combustion

sew. sludge,... > 100 MW
example: Turow/PL

➔ Biomass – small FBCs – mono-/co- combustion

wood, waste,... 30 - 70 MW
example: Hallein/A

➔ Coal – large FBCs – monocombustion

> 100 MW
example: Lagisza/PL