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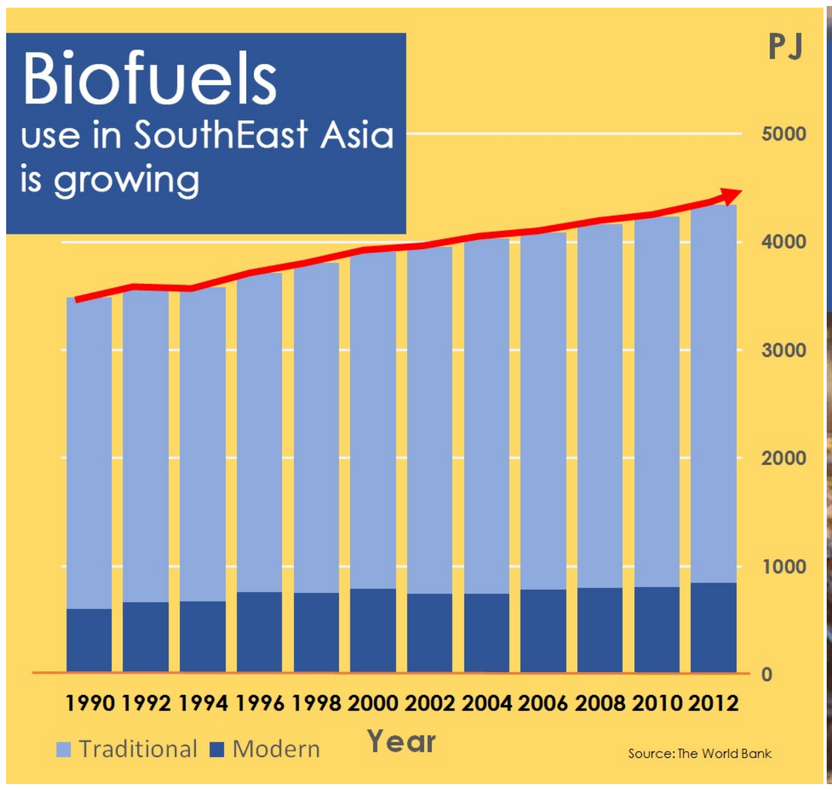
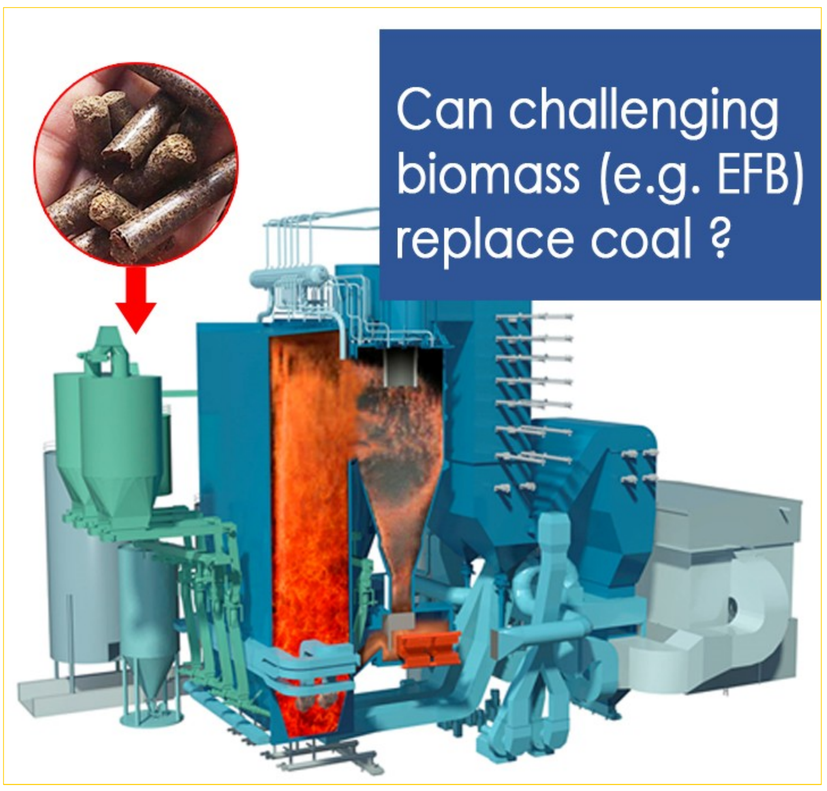




Combustibility of Empty Fruit Bunch (EFB) Pellets in Circulating Fluidized Bed Combustion

Cyril Bajamundi [1], Timo Leino [1], Martti Aho [1],Jouni Hämälainen[1], Merja Hedman[2], Juha Roppo[2]
[1] VTT Technical Research Centre of Finland Ltd. ; [2] Valmet Technologies Oy

Background

This research aims to assess the suitability of EFB pellets for energy production. Valmet Technologies Oy provided the EFB pellets from South East Asia. VTT Ltd. and Valmet planned and performed the combustion experiments. Output of this work can be the basis of design for large power plants utilizing challenging biomass residues.

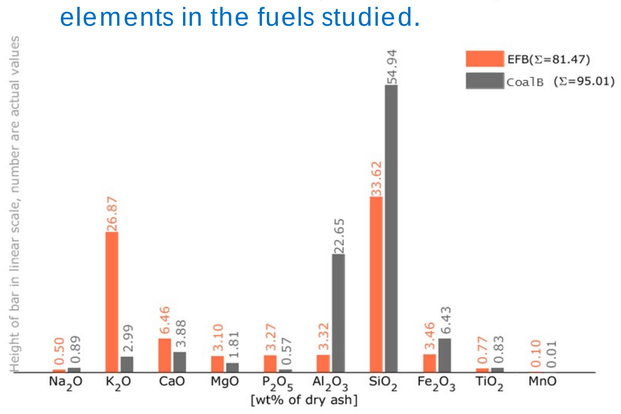
EFB Pellet as a Fuel

- Heating value of EFB is lower compared to coal. For the same energy input, more EFB is required.
- Compared to Coal, EFB has more Cl and K.
- Possible risk for corrosion and challenges related to ash melting.

Ultimate and proximate analyses for the selected project fuels

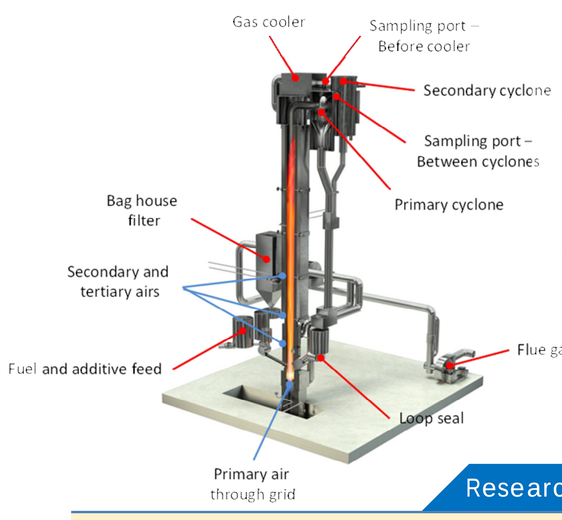
Property	unit	EFB pellet	Coal B
Moisture content	wt.%	7.5	6.6
HHV	MJ/kg d.s.	20.4	28.4
LHV	MJ/kg d.s.	19.1	27.4
Ash (815°C)	wt.% d.s.	8	16.2
Ash (550°C)	wt.% d.s.	9.1	16.8
Volatiles	wt.% d.s.	72.3	32.8
Carbon	wt.% d.s.	48.5	68.3
Hydrogen	wt.% d.s.	5.8	4.6
Nitrogen	wt.% d.s.	1.14	2.22
Sulphur	wt.% d.s.	0.12	0.36
Chlorine	wt.% d.s.	0.53	0.005

Concentration of major ash forming elements in the fuels studied.

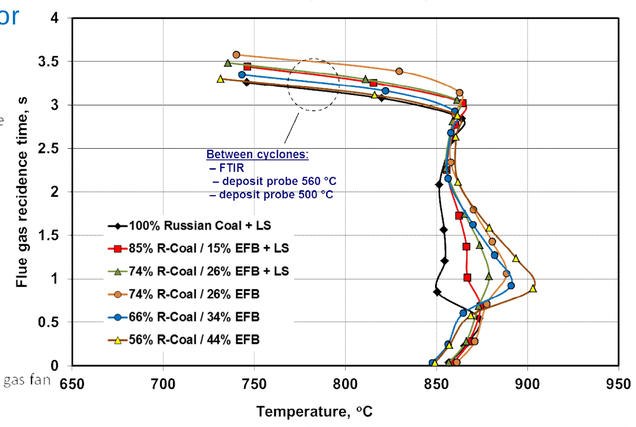


Combustion Experiments/Conditions

Schematic diagram of the pilot scale circulating fluidized bed combustor



Test Matrix and temperature profile



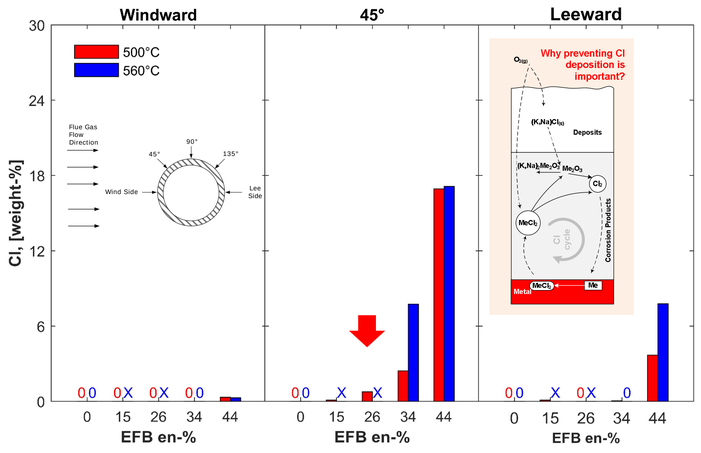
Test #	Duration, hr.	Coal B, en-%	EFB, en-%	Limestone added
1	11	100%	0%	Ca/S=2.6
2	5	85%	15%	Ca/S=2.0
3	4	74%	26%	Ca/S=1.0
3B	1	74%	26%	no
4	39	66%	34%	no
5	26	56%	44%	no

Research Questions ???

Will EFB combustion lead to corrosion?
What are the levels of gaseous emissions?

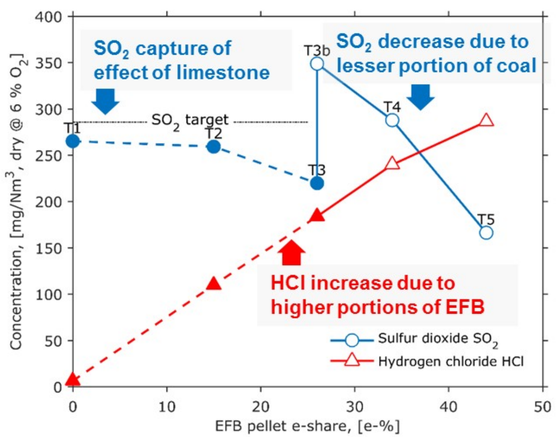
Results

Concentration of chlorine in deposits collected on probes maintained at 500°C and 560°C metal temperature. 0 = zero weight %, X = no data.

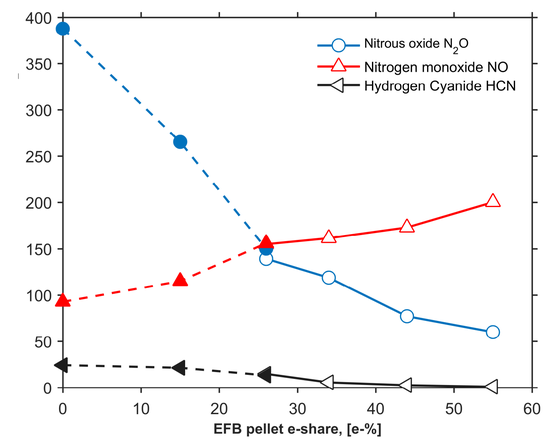


- Depending on superheater design, material temperature and grade the risk of corrosion may start in the range of 25 en-% to 35 en-% EFB.

Concentration of the SO_2 and HCl in the flue gas at different EFB share.
Filled points represent test points with limestone addition



Concentration of nitrogen compounds in the flue gas at different EFB share.
Filled points represent test points with limestone addition.



- Different blends (and Ca addition) affected SO_2 and HCl concentration in the flue gas.
- 80% decrease in N_2O with EFB energy portion increased from 0 to 45%.

Conclusion/ Recommendation

- Below 25 en-% EFB with the coal tested, the boiler is safe from Cl induced high temperature corrosion risk.
- Larger EFB shares can be used depending on the boiler type and concept.
- Long duration test with higher EFB en-% shares are recommended to be made to assess applicability of the biofuel in large-scale combustion set-up.