Conclusion Report of THERMACT-B Performance Evaluation at

FS Bioenergia – Lucas, Brazil

in Boiler # 1 & 2 (100 TPH each)

Trial Objective:

- The objective of the Performance Evaluation was to **Reduce Biomass consumption by usage of Thermact-B.**
- The reduction in Biomass consumption was evaluated on the basis of improvement in Steam to Biomass ratio (SFR).
- The Steam to Biomass ratio was calculated by following formula Without & With Thermact-B usage.

$$\text{Steam to Biomass ratio (SFR)} = \frac{\text{Steam Generation}}{\text{Biomass Consumption}}$$

- The % Increase in Steam to Biomass ratio will be calculated as under:-

$$\text{\% Increase in SFR} = \frac{SFR_{Post} - SFR_{Pre}}{SFR_{Pre}} \times 100$$

Where, SFR_{Pre} = Steam to Biomass ratio without THERMACT-B usage

SFR_{Post} = Steam to Biomass ratio with THERMACT-B usage

- THERMACT-B was added at the ratio of 1:15,000 kg/kg basis i.e 1 kg Thermact-B was added with 15,000 kg of Biomass.

Procedure of Data Recording:

As discussed during the meeting between FS Bioenergia and Abhitech Energycon Limited representatives on 28/1/2020, the following procedure/methodology was agreed for Thermact-B performance evaluation in both Boiler.

The Performance Evaluation was conducted in two Phases as below:

Phases – I - During this phase Wood Chips, Saw Dust, Rice Husk, Bagasse were used almost at same ratio:

- Without Thermact-B – From 28th Jan 2020 to 3rd Feb 2020 (7 days)
- With Thermact-B - From 5th Feb 2020 to 16th Feb 2020 (12 days)
- Without Thermact-B - from 18th Feb to 24th Feb 2020 (7 days)

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- All the related operation parameters required for calculation and other observation were recorded on hourly basis from DCS history of both boilers.
- Daily Biomass Consumption was calculated through speed of Biomass feeders.
- The % mix of all biomass (Wood Chips: Sawdust: Rice Husk: Bagasse) was tried to keep same as far as possible during Phase –I trial.
- Daily one sample of each biomass was sent to FS Lab for its Ash% & Moisture% testing. On the bases of Moisture % & Ash%, its Calorific Value was calculated.
- Flue Gas analysis by gas analyser was done daily.

The Summary of Various Benefits is indicated below:

Parameters		Without Thermact-B	With Thermact-B		Remarks	Without Thermact-B	Remarks	
Trial -1		28-1-20 to 3-2-20	5-2-20 to 16-2-20			18-2-20 to 24-2-20		
Total Steam Generation	Tons	4047.0	3783.5			4003.8		
Biomass Consumption Total	Tons	1838.9	1668.8	170	MT Reduction	1883.4	215	MT Increase
Steam Boimass Ratio (SFR)	kg/kg	2.22	2.31	4.3%	Increase	2.14	-8%	Reduction
Biomass Average Moisture	%	41.4	46.2	4.8	Increase	43.9	-2.3	Reduction
Biomass Average GCV	Kcal/kg	2634	2205	428	Reduction	2491	286	Increase
Silo Biomass Feeder speed	%	27.2	27.6	-2%	Reduction	30.7	10%	Increase
Redler Biomass Feeder speed	%	37.3	30.2	19%	Reduction	34.6	13%	Increase
Boiler -1 Parameters								
Silo Biomass Feeder speed	%	24.3	25.4	-5%	Reduction	29.2	13%	Increase
Redler Biomass Feeder speed	%	34.2	31.0	10%	Reduction	34.3	10%	Increase
O2 %	%	4.6	3.9	15	%Reduction	3.8	3	%Reduction
Excess Air	%	28.3	23.0	19	%Reduction	22.1	4	%Reduction
CO	ppm	244.0	172.0	30	%Reduction	172.0	0	%Increase
FG temp Air heater O/L	°C	368.1	360.0	8.2	°C Reduction	365.7	-6	°C Increase
FG Temp Multicicione I/L	°C	333.6	324.6	8.9	°C Reduction	327.0	-2	°C Increase
FG temp Economizer O/L	°C	204.9	197.9	6.9	°C Reduction	199.2	-1	°C Increase
Boiler -2 Parameters								
Silo Biomass Feeder speed	%	30.1	29.8	1%	Reduction	32.2	7%	Increase
Redler Biomass Feeder speed	%	40.3	29.4	27%	Reduction	34.9	16%	Increase
O2 %	%	3.6	3.5	2.7	% Reduction	3.4	4	%Reduction
Excess Air	%	20.8	20.1	3.3	% Reduction	19.1	5	%Reduction
CO	ppm	425	247.0	178	%Reduction	355.0	-30	%Increase
FG Temp APH I/L	°C	390.9	385.0	5.9	°C Reduction	384.3	1	°C Reduction
FG Temp APH O/L	°C	333.6	324.8	8.9	°C Reduction	333.6	-9	°C Increase
FG Temp Multicicione I/L	°C	159.7	157.4	2.3	°C Reduction	158.0	-1	°C Increase

Remarks:

- The above results confirm that after usages of Thermact-B, the **Steam Biomass ratio** has **increased by 4.3 %.** However after discontinuation of Thermact-B the

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ratio has **decreased significantly.**

- As per our day to day observation & daily biomass analysis report from Lab, it was observed that during Thermact usages Moisture in biomass was increased by almost 4.8% and Calorific value if biomass has decreased by 428kcal/kg. Therefore it can be considered that the actual saving is more than 4.3%, however for reference we can agree minimum biomass saving of 4.3%. Here the correction for moisture changed has not been applied.
- During Thermact-B usages the CO level in Flue gas has **decreased by 72ppm & 178 ppm** in both boilers 1 & 2 respectively. However after discontinuation it has increased by 108 ppm in boiler 2.
- During Thermact-B usages the O2% level in Flue gas has **decreased by 15%** in boiler 1.
- During Thermact-B usages the Flue Gas exit temp has reduced by 7 °C & 2.3 °C in both boilers 1 & Boiler 2 respectively. However after discontinuation The Flue gas temp has started increasing in both boilers.
- FS Bioenergia will receive the tax credit of about 8% of the following taxes ICMS 4%,PIS 0.65%, and COFINS3%.

Phase-II Trial :

The phase II trial of Thermact -B was planned with only wood chips.

- Without Thermact-B - From 25th Feb 2020 to 28th Feb 2020 - (4 days)
- With Thermact-B - From 29th Feb 2020 to 2nd Mar 2020 - (3 days)

Note:

- As per our experience & trial -1 observation, Thermact-B needs minimum 3-4 days to clean-up and stabilization. Also after 3-4 days we can see the reduction in flue gas exit temp and reduction in biomass consumption.
- However due to unforeseen shutdown of process plant in 3rd March around 2:00 AM, the trial-2 with, single fuel got discontinued. Due to insufficient data of trial-2, conclusion of trial couldn't be arrived.

Conclusion:

- Based on data analysis it is concluded that the use of THERMACT-B has resulted in reduction in biomass consumption by 4.3%, apart from other benefits as enumerated above and hence has fulfilled the objective of the trial.

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