Improved vapor Bleeding for steam economy, Considerations for installation of Economizer in boiler for energy efficiency.

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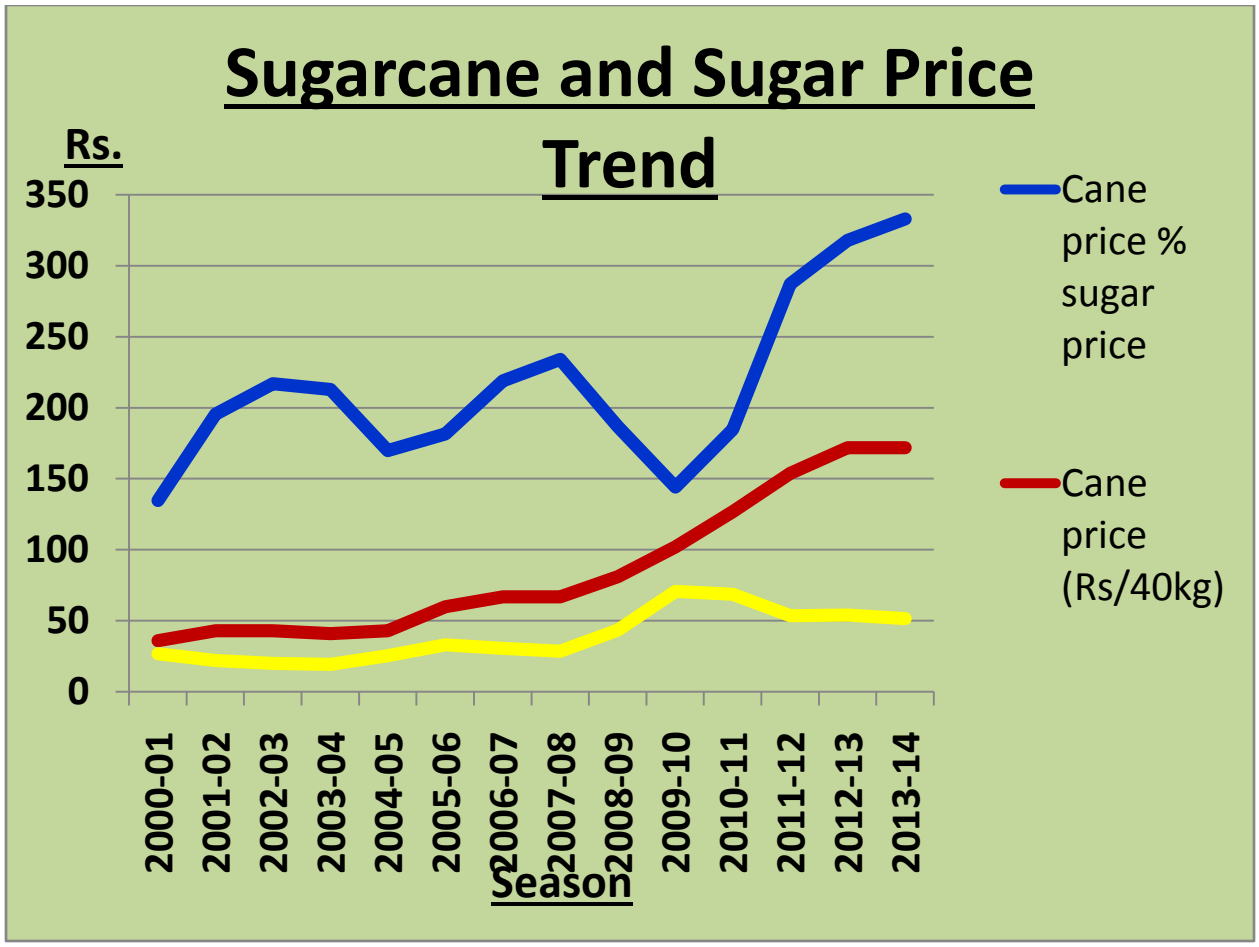
Introduction:

- Pakistan sugar industry is facing a very critical economic crisis and struggling hard for its survival.
- Sugar industry has become sandwich between two opposite desires; growers wish for higher cane prices and sugar customer crave for lowest sugar prices, further public government aim to satisfy both.
- The sugar prices has dropped below to the lowest price of 4 years before, where as cane price has escalated to the highest in the history.



Introduction:

- The only way of survival is to reduce manufacturing cost component.
- The best way is to increase plant energy efficiency and save more bagasse for sale or preferably for value added products, like Co-generation, particle board manufacture.
- There are many approaches for saving bagasse.
- By reducing plant steam requirement.
- By improving boiler efficiency.
- By improving bagasse quality through milling or by drying.
- By replacing bagasse with low cost alternative fuel, like cane field trash, cotton sticks.
- We will discuss in detail the first two options;
- By reducing plant steam requirement.

- By improving boiler efficiency.

Reducing plant steam requirement:

- Plant steam load is consisted on two simultaneous steam requirements;
  - Steam for power.
  - Steam for process. (we will discuss this topic only)
- A sugar plant is said to be balance when steam for power remains 90-95% of steam for process, to avoid any steam blow during minimum steam demand for process. (This is not the case for Co-generation sugar plant or for any allied plant)
- A balance plant does not mean efficient plant**.**

Reducing process steam requirement:

- There are many factors that determine steam requirement for process;
  - Cane juice composition.
  - Final product specification.
  - Process adopted for juice clarification, crystallization, refinery etc.
  - Extent of automation adopted.
  - Equipment design.
  - Skill of operator.
  - Direct steam losses.
  - Vapor bleeding arrangement. (we will discuss this topic only)

Typical vapor bleeding arrangement:

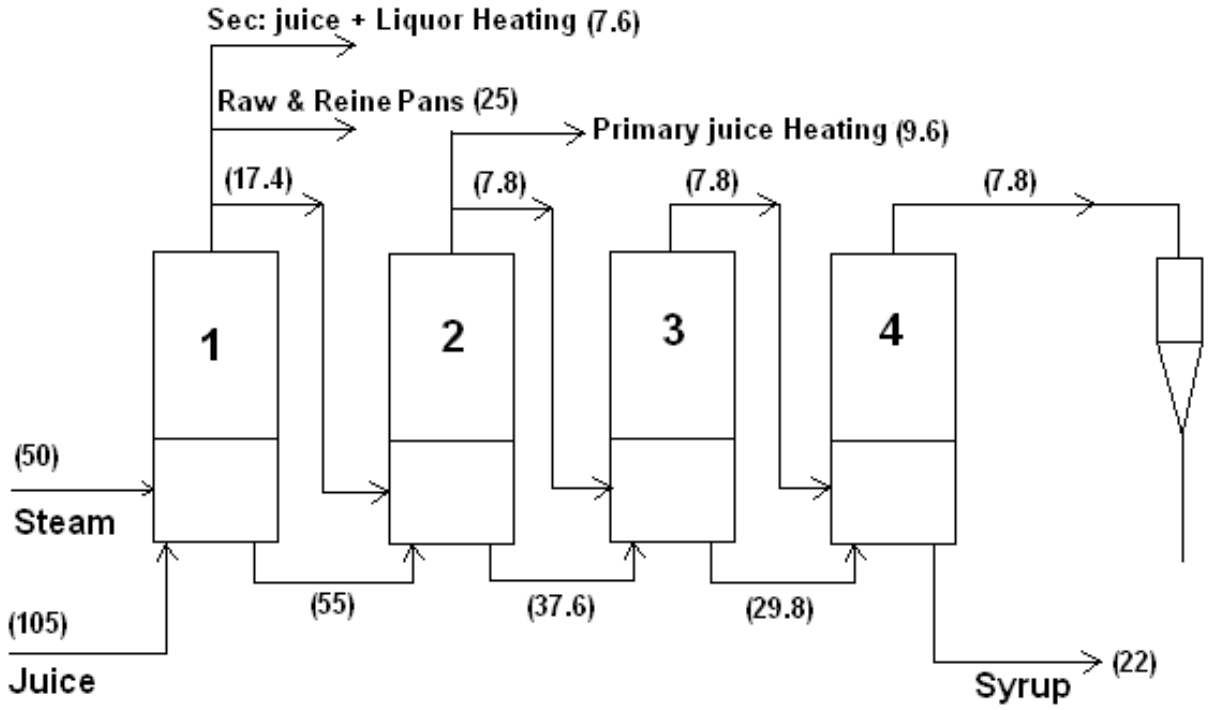
- Vapor bleeding is the most attractive option for reducing process steam demand.
- Steam for process is consisted on following typical consumptions for each 100 tons cane processed (with average cane juice composition, standard process scheme and 100 % mixed juice on cane);
  - Juice & liquor heating 17 tons

- Crystallization (Pans) 25 tons
- Evaporator condenser 08 tons

Total 50* tons

* (Steam losses & washing steam is not included)

Typical vapor bleeding arrangement:



Improved vapor bleeding arrangement:

- The ultimate limit of vapor bleeding is reducing evaporator condenser steam to ZERO.
- Steam for process could be reduced to 42 % cane.
  - Juice & liquor heating 17 tons
  - Crystallization (Pans) 25 tons
  - Evaporator condenser 00 tons

Total 42* tons

* (Steam losses & washing steam is not included)

- Further reduction in steam demand could be achieved by extending vapor bleeding from evaporator to pans. Primary juice heating could be partially done by pans vapor (A massecuite continuous pan vapor).
- Steam for process could be further reduced by replacing juice heating from steam to condensate.
- Elevated evaporators vapor temperature facilitates bleeding from following evaporators.
- Efficient milling could reduce water load from evaporators.
- Automation of pans will also reduce steam for pans.
- Juice heating/bleeding sequence:

➢ Raw juice 1st stage heating by A Conti pan vapors (25.0 – 50.0 °C) = 4.26 T/h

➢ Raw juice 2nd stage heating by condensate (50.0 – 63.5 °C)

➢ Raw juice 3rd stage heating by 4th effect vapors (63.5 – 72.0 °C) = 1.45 T/h

➢ Defecated juice 1st stage heating by 3rd vapors (70.0 – 92.0 °C) = 3.45 T/h

➢ Defecated juice 2nd stage heating by 2nd vapors (90.0 – 104 °C)= 2.00 T/h

➢ Clear juice heating by 1st vapors (97.0 – 112 °C)= 3.04 T/h

➢ Liquor heating by 2nd vapor = 0.6 T/h

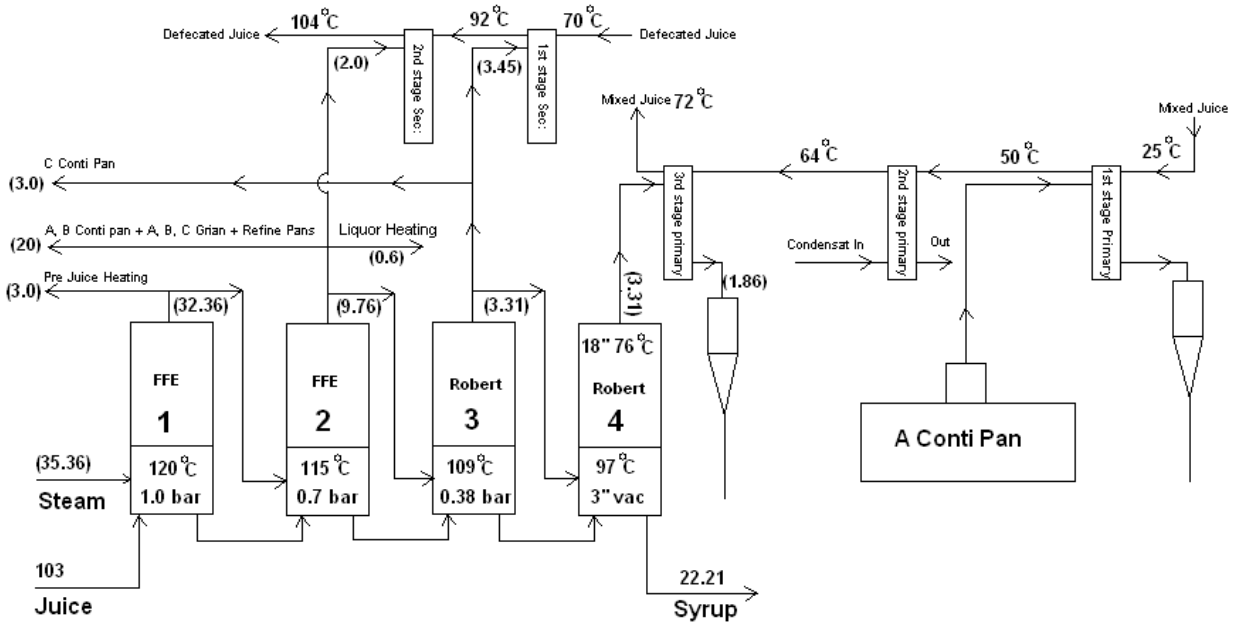
- Pan vapor bleeding sequence;

➢ A, B Conti pans + A, B & C Grain pans + Refine pans

by 2nd vapor = 20.0 T/h

➢ C Conti pan by 3rd vapor = 3.0 T/h

The process steam demand could be reduced to 35 % on cane by given vapor bleeding arrangement.



Improving Boiler Efficiency:

- Boiler consumes about 90 % of bagasse produced, when plant steam requirement is 54 % with typical boiler efficiency (giving 2.0 steam/bagasse ratio).
- Improving boiler efficiency by 1% reduces fuel consumption by 1%.
- For 1,000,000 tons cane 1 % saving in fuel corresponds to 9,000 tons bagasse.
- 10 °C reduction in flue gas temperature, increases boiler efficiency and steam/bagasse ratio by 1 % and saves 1 % fuel.
- Reducing excess air ratio from 1.40 to 1.32, Improves boiler efficiency and steam/bagasse ratio by 1% and saves 1 % fuel.
- 6 °C Increase in feed temperature, increases steam/bagasse ratio by 1 %, saves 1 % fuel and increases boiler capacity by 0.92%.
- Reducing feed water TDS from 80 to 40 ppm, improves steam/bagasse ratio by 0.6% and saves fuel by 0.6%. Whereas boiler efficiency remains same.

Effect of Economizer Addition:

- In Pakistan, to reduce flue gas temperature for improving boiler efficiency and saving bagasse, usually focus is given to add economizer only.

- If only economizer is added in the boiler, this will improve boiler efficiency but will deteriorate steam quality.

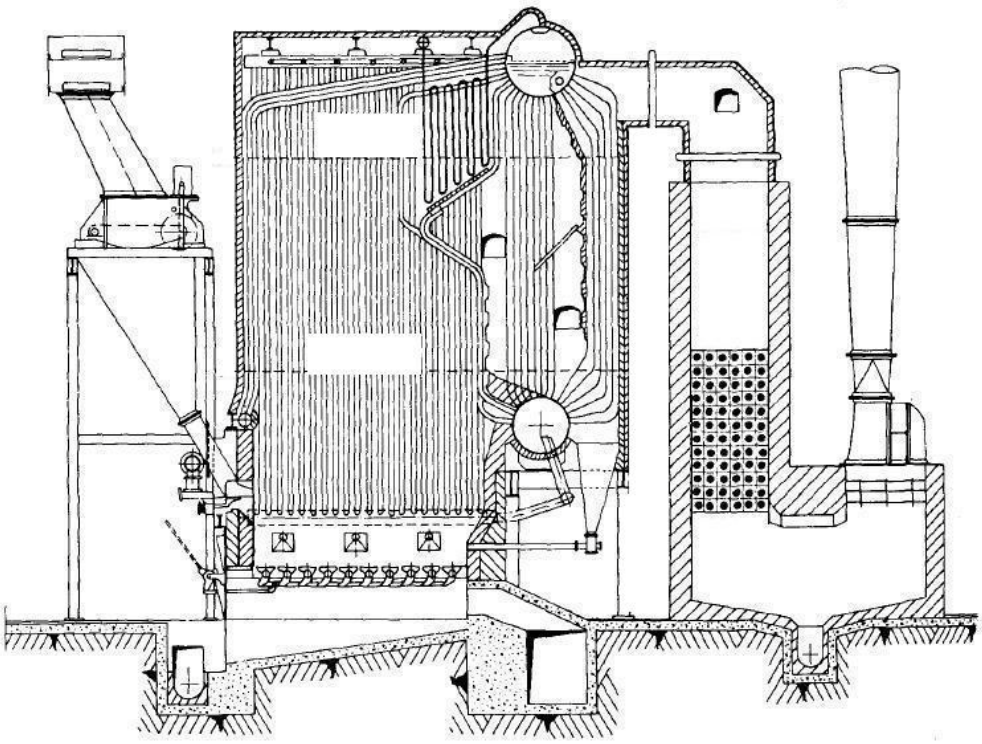


Fig. 41.15. Spreader-stoker furnace with rocking grate type BR1 (Fives Cail – Babcock).

Effect of Economizer Addition:

S.#	Description	Unit	Before	After

			Economizer	Economizer
1	Economizer inlet Gas temperature	°C	-	354
2	Economizer outlet Gas temperature	°C	-	311
3	Airheater inlet Gas temperature	°C	354	311
4	Airheater outlet Gas temperature	°C	260	230
5	Airheater inlet Air temperature	°C	27	27
6	Airheater outlet Air temperature	°C	160	141
7	Furnace Gas temperature	°C	976	965
8	Superheated steam temperature	°C	330	325
9	Increase in feed water temperature	°C	-	30
10	Boiler steam generation capacity	Tons/h	60	62.77

- 5°C decrease in boiler steam temperature, increases steam consumption of turbine (back pressure turbine) by 0.75% for same power load.
- A 10,000 tcd factory, operating with 50% steam on cane may lose its incidental Co-gen revenue by Rs. 3,000,000/- per season of 100 days.

Conclusion:-

- To maintain steam quality and smooth boiler operation, proportional increase in Airheater and Superheater heating surface is imperative, if economizer is added for improving boiler efficiency.