CASE STUDY-LOW TEMPERATURE EVAPORATOR MODULE (LTEM™)

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OBJECTIVES
♦ Reduction in steam consumption using waste vapors.
♦ Capacity enhancement of the plant.

SOLUTION
Low Temperature Evaporator Module (LTEM™) is the successful solution working between the Pan / Last Body Evaporator vapors and Condensers, retrieving waste heat of Spent Vapors.

BACKGROUND OF THE TECHNOLOGY
The vapors generated while evaporation of juice & massecuite at evaporator & pan sections in a sugar factory are dumped to condensers as waste heat. Since the inception these vapors were treated as waste for any process use. After the invention of SEDL’s LTEM™ these spent vapors have reduced 35-40% evaporation load of existing evaporators.

HIGHLIGHTS
♦ Use of single effect Low Temperature Evaporator Module (LTEM™) on Evaporator and Pan Vapors.
♦ Increase in imbibition percentage from 45% up to 60% on account of high evaporation & lowering sugar loss in bagasse.
♦ Overall ΔP in the LTEM™ is ~ 5 kPa
♦ Overall ΔT in the LTEM™ is ~ 5-7°C
♦ Low Retention Time.
  ▪ Reduces the Sucrose Inversion.
  ▪ Reduces Color Formation.
  ▪ Reduces Sugar losses.
♦ Higher Heating Surface Density.
♦ Wetting Rate: 3-5 L/cm h against 15-20 L/cm h for Tubular FFE.
♦ Modular Compact Design and low Capex & Opex.

PROJECT DETAILS
The proposed modifications are given below in the heat and mass balance diagram:
PLANT PERFORMANCE:
BEFORE & NOW

PROJECT PARAMETERS:
DESIGNED Vs. ACHIEVED

<table>
<thead>
<tr>
<th>S N.</th>
<th>PARAMETERS</th>
<th>DESIGNED PARAMETERS</th>
<th>ACHIEVED PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mix Juice Flow</td>
<td>130 Ton/hr</td>
<td>126 Ton/hr</td>
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<tr>
<td>2</td>
<td>Steam Consumption On Cane</td>
<td>41.00 %</td>
<td>41.00 %</td>
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<tr>
<td>3</td>
<td>Exhaust Steam</td>
<td>41.96 Ton/hr</td>
<td>40-42 Ton/hr</td>
</tr>
<tr>
<td>4</td>
<td>CJ, RJ Interchanger PHE</td>
<td>RJ In Temp. 32 °C</td>
<td>RJ In Temp. 26-28 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RJ Out Temp. 70 °C</td>
<td>RJ Out Temp. 65-70 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CJ In Temp. 77 °C</td>
<td>CJ In Temp. 74-76 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CJ Out Temp. 39.3 °C</td>
<td>CJ Out Temp. 38-42 °C</td>
</tr>
<tr>
<td>5</td>
<td>CJ-SJ Interchanger PHE</td>
<td>SJ In Temp. 68.8 °C</td>
<td>SJ In Temp. 65-70 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SJ Out Temp. 87 °C</td>
<td>SJ Out Temp. 80-85 °C</td>
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<td></td>
<td></td>
<td>CJ In Temp. 95 °C</td>
<td>CJ In Temp. 93-95 °C</td>
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<tr>
<td></td>
<td></td>
<td>CJ Out Temp. 77 °C</td>
<td>CJ Out Temp. 74-78 °C</td>
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<tr>
<td>6</td>
<td>CJ Flow</td>
<td>35 Ton/hr</td>
<td>27 Ton/hr</td>
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<tr>
<td>7</td>
<td>SJ Condensate PHE</td>
<td>SJ In Temp. 68.8 °C</td>
<td>SJ In Temp. 65-70 °C</td>
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<td></td>
<td></td>
<td>SJ Out Temp. 81.9 °C</td>
<td>SJ Out Temp. 78-83 °C</td>
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<td></td>
<td>Cond. In Temp. 93.4 °C</td>
<td>Cond. In Temp. 90-95 °C</td>
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<td>Cond. Out Temp. 75 °C</td>
<td>Cond. Out Temp. 70-74 °C</td>
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<td>8</td>
<td>LTEM™ Parameters</td>
<td>CJ In Temp. 39.3 °C</td>
<td>CJ In Temp. 38-45 °C</td>
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<tr>
<td></td>
<td></td>
<td>CJ Out Temp. 50 °C</td>
<td>CJ Out Temp. 50-54 °C</td>
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<td></td>
<td></td>
<td>CJ In Brix 10.61 %</td>
<td>CJ In Brix 10-11 %</td>
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<td></td>
<td></td>
<td>CJ Out Brix 34.97 %</td>
<td>CJ Out Brix 30-36 %</td>
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<td>Cond. Flow 24.94 m³/hr</td>
<td>Cond. Flow 23-26 m³/hr</td>
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</table>

The HTC observed during LTEM™ operation has been graphically represented above with respect to average values achieved on hourly basis since 6th December, 2014 to 1st January, 2015.

THE LIST OF PARAMETERS EXAMINED FOR CALCULATING HTC

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>UNITS</th>
<th>PLANT VALUES</th>
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<tbody>
<tr>
<td>Inlet Vapour Pressure</td>
<td>kPa A</td>
<td>16.5</td>
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<tr>
<td>Inlet Vapour Temperature</td>
<td>°C</td>
<td>56.0</td>
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<td>Inlet Vapour Enthalpy</td>
<td>kJ/kg</td>
<td>2367.54</td>
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<td>Pressure Drop Across the Pack</td>
<td>kPa A</td>
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<td>Outlet Vapour Pressure</td>
<td>k Pa A</td>
<td>11.6</td>
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<tr>
<td>Inlet Vapour Temperature</td>
<td>°C</td>
<td>49</td>
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<td>Heating surface</td>
<td>m²</td>
<td>1500</td>
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<tr>
<td>Condensate Out</td>
<td>T/h</td>
<td>25</td>
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<tr>
<td>Heat load</td>
<td>kJ</td>
<td>59188474.16</td>
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<tr>
<td>HTC</td>
<td>W/m²/K</td>
<td>1518.55</td>
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</table>

CONCLUSION

After the addition of SEDL’s LTEM™ the plant is operating at steam consumption of 39-41% on cane which was previously running on steam consumption of 50% on cane and is now crushing a maximum of 2620 TPD with an average of 2400 TPD, which was previously 2000 TPD.

There is further scope of capacity utilization up to 2800 TPD with improvement and balancing in downstream side machinery.