Study on ladle heating at Steel making shop

Vijay Kumar Singh
School of Mechanical Engineering, Lovely Professional University, Phagwara, 144411, India

Abstract:
Ladle is an important for transporting steel in any steel plant. The life of the refractories being used in ladle depends upon pre-heating of ladle. This paper elaborates on the arrangements required for ladle heating.

Introduction:
LD1 is a steel making shop. Ladle heating is one of the important activities in the process of steel making. Mixed CO gas is used as fuel for ladle heating. The project was taken up to optimize the use of gas.

Information Phase:
Ladle heating system comprised a 4” diameter individual burner connected to a common CO gas main header. Air supply to the combustion process is given through 8” diameter piping main. There is no control valves provided in the fuel line of individual burners resulting in continuous burning of fuel. Five ladle heating burners have been provided at pit side and one at mixer area.

Effective utilization of each pit side ladle is average 5 hrs / shift / heater. Therefore idle period of the heaters = 5 no. X 3 hrs X 3 shifts = 45 hrs / day. During idle period also fuel was burning at the same rate. The idle period of mixer side heater used for hot metal ladle heating was found to be 9 hrs / day.

The effect of continuous burning lead to
- Wastage of CO gas
- Pollution hazards

CV of mixed gas = 4000 m Cal / N m cub.

Total working hrs of 5 ladle heater = 43800 hrs

Idle period of 5 heaters @ 3 hrs per shift
Gas flow through each heater burner = 450 cubic meter / hr. @ 60 PSI

Total down time for maintenance / year = 4868 hrs.

Gas which could be saved =

6391250 Nm cub.

Effective working hours of ladle heater =

38932 hrs / yr

Total gas consumed =

23910650 Nm cub / hr

Potential of reducing idle hrs consumption of gas

= 16425hrs X 450 Nm cub/hr

= 6391250 Nm cub / yr

Potential energy savings due to stoppage of idle running

= 25565000000 Kcal

Potential savings = Rs 1.15 Crore / yr

Function Phase:

Function Analysis:

<table>
<thead>
<tr>
<th>Process / item</th>
<th>Verb</th>
<th>Noun</th>
<th>Basic / secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Heat</td>
<td>Ladle</td>
<td>Basic</td>
</tr>
</tbody>
</table>
Function Cost Worth Analysis:

<table>
<thead>
<tr>
<th>Function</th>
<th>Cost</th>
<th>Worth Basis of Worth</th>
<th>Value gap</th>
<th>Value Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Ladle</td>
<td>4.3 Cr</td>
<td>3.15 Cr</td>
<td>Stop gas during</td>
<td>1.15 Cr</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Idle time</td>
<td></td>
</tr>
</tbody>
</table>

Creative Phase:

Brain storming and Crawford slip writing technique were used to generate ideas to reduce gas consumption. Ten ideas were generated.

Evaluation Phase:

During evaluation only one idea was found to be implementable. The idea was to install individual valves in all five-pit side gas line burners for ladle heating.

Recommendation Phase:

Provide solenoid operated shutoff valve

Implementation Phase:

The above recommendation was implemented within a month and this saved fuel.

Savings:

Cost of gas saved = Rs 11500000 / Yr

Total cost of valves = Rs 417500

Net savings = Rs 1.11 Crore / Year