PT. KRAKATAU STEEL

Recovering Waste Heat through Billet Transportation System Modification

SUMMARY OF THE OPTION

PT. Krakatau Steel is a large government-owned integrated steel plant in Indonesia and produces hot rolled coils, plates and sheets; cold rolled coils and sheets and wire rods with capacity 2 million, 650.000, dan 20.000 ton per year.

The Billet Steel Plant (BSP) is one plant in PT. Krakatau Steel that produces billets for the production of wire rods in the Wire Rod Mill (WRM) plant. The average billet temperature exiting the roller caster system at BSP is 900^{o}C. In BSP cooling system, the billet heat is reduced from 900^{o}C to 450^{o}C, and then while waiting for transferring to WRM and charging to Reheating Furnace the billet temperature naturally goes down to 130 ^{o} C. The cooling bed contributes significantly to the billet heat loss, and this heat was not utilized. The option proposed was a modification of the billet transportation system between the BSP and the WRM plants, whereby the billet temperature is kept as high as possible, before charging to reheating furnace in WRM. Three alternative systems were evaluated and the tunnel/underground transportation system was the preferred system.

Potential energy savings at the WRM reheating furnace are 1176 ton natural gas per year resulting in greenhouse gas emission reductions of 3445 ton CO_2/yr. Investment costs are US$ 820,333 and costs savings are US$ 152,222 per year with a payback period of 5 years. Due to the high investment costs and long payback period, this option was found to be unfeasible at present.

KEYWORDS

Indonesia, Iron & Steel, Waste Heat Recovery, Billets

OBSERVATIONS

The Billet Steel Plant (BSP) produces billets that are used for the production of wire rods as shown in Figure 1. Liquid steel is poured into casts in a roller casting system and produce billets at a temperature of 900^{o}C. In BSP cooling system, the billet temperature is reduced to 450^{o}C and then to 130^{o}C on two cooling beds in one hour. It was observed that heat is lost in two ways:

- Cooling by convection of air
- Conduction to the cooling beds

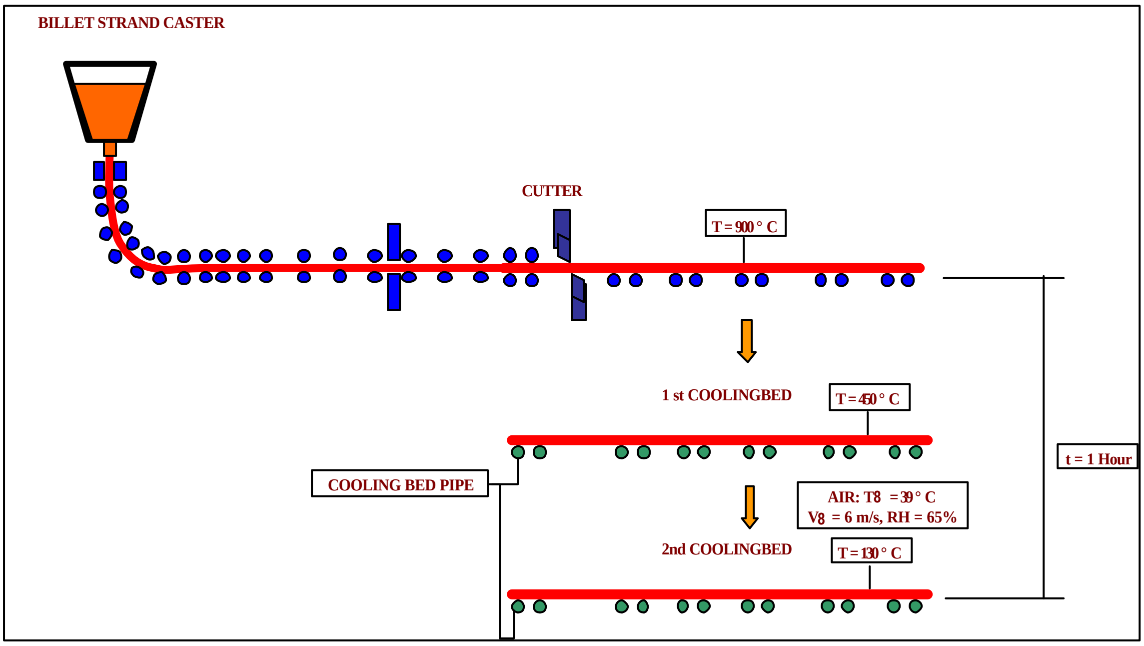


Figure 1 – Billet Production Process

OPTIONS

To minimize billet heat loss in the cooling system, it was recommended to install a different billet transportation system to keep billet remain hot before charging to reheating furnace at the WRM (Wire Rod Manufacturing) plant. Three alternative billet transportation systems were considered:

- Movable box storage/furnace
- High temperature conveyor
- Tunnel/underground transport system

Aspects considered for the choice and design of the billet transportation system were

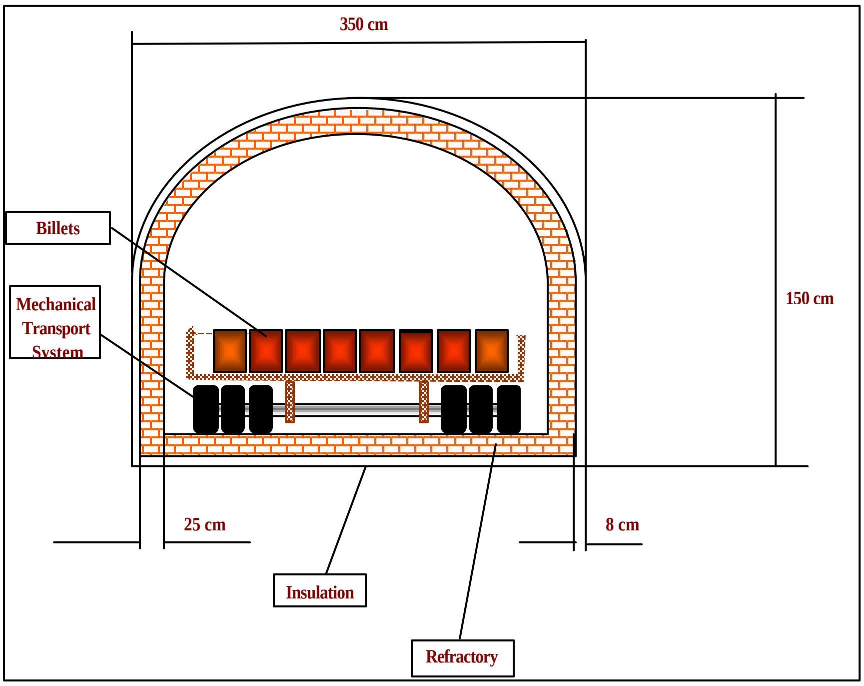
- Low heat loss by keeping the billet temperature at 500 °C or capturing heat loss from billets. In reality not all waste heat can be recovered as part of the heat will be lost due to radiation, conduction and convection during transportation from the BSP to the WRM reheating furnace over a 500 m distance
- Low operation and maintenance cost, high transport capacity, capability to transport billets at higher speeds, easy handling and control, high safety levels and strong construction.

The tunnel or underground transport system was the preferred option. To recover billets heat during billet transportation, the tunnel wall is insulated to minimize heat loss through radiation, conduction, and convection from billets to the tunnel wall. The characteristics of the refractory are given in table 1. The cross-sectional design proposed for the tunnel/underground transportation is shown in figure 2.

Table 1: Refractory characteristics

No	Item	Unit	Result
1	Name: Fire Clay, burnt 16 K		
2	Maximum working temperature	^{o}C	1373
3	Density, p	Kg/m^{3}	2050
4	Thermal conductivity, k	W/m * ^{o}K	1
5	Specific heat, c_p	J/kg * ^{o}K	960
6	Thickness	cm	25
7	Refractory brick volume	cm^{3}	648

Figure 2: Cross Section of Tunnel for billet transport system



RESULTS

The implementation of this option was technically feasible. The financial and environmental benefits are as follows:

Financial benefits

- Investment: US$ 820,333
- Annual cost savings: US$ 152,222
- Payback period: 5 years

Due to the high investment costs and long payback period, this option was found to be unfeasible at present.

Environmental benefits

- Annual energy savings: 1176 ton natural gas (6221.84 Nm^3/day x 300 days 0.00068 tons/Nm^3). This is based on 236.43 GJ/day, calculated as follows:
  - TBB/day X c_p X (485.6 – T_8)
  - = 1204 ton/day X 434 kJ/kg.°K X (485.6 - 33)°C
  - Heat from billets released from the tunnel at 485.6°C
- Annual GHG emission reduction: 3445 ton CO_2/yr (1176 ton natural gas X 2,93 CO_2/ton natural gas)

FOR MORE INFORMATION

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