The Advancement of Roll Cooling and Guide Shop Safety in Gerdau's Beaumont Mill

By: Abdul-Azziz Umaru

10/6/2016

GERDAU

Contents

- **Roll Cooling**
  - The Importance
  - The Status
  - The Theory
  - The Concept
  - The Expectations
- **Guide Shop**
  - Then
  - Now

The Importance of Roll Cooling

- Proper roll cooling is essential to lengthen the life of a pass/groove in a roll. With a two strand mill, ensuring the pass can make it to scheduled downtime without a changeover is a fundamental function of the Roll Shop.

- The main reasons for ensuring proper cooling to rolls consist of: maximizing roll life, maintaining proper product temperatures, avoiding the formation of cracks, plastic deformation and wear of the groove.

The Importance of Roll Cooling

Figure 1: Roughing Mill and Finishing Mill Rolls experiencing fire cracks.

GERDAU

The Current Status

- Roll Life
- Water Condition
- Water Pressure & Flow
- Water Headers

The Current Status – Roll Life

Stand	t/groove	Max removal mm	Min removal mm	Max t/mm	Min t/mm
1	15000	12,00	12,00	1250	1250
2	15000	12,00	12,00	1250	1250
3	15000	12,00	12,00	1250	1250
4	15000	12,00	12,00	1250	1250
5	15000	12,00	12,00	1250	1250
6	7200	20,00	12,00	360	600
7	7200	20,00	12,00	360	600
8	8200	4,00	4,00	2050	2050
9	8200	4,00	4,00	2050	2050
10	8200	4,00	4,00	2050	2050
11	8200	4,00	4,00	2050	2050
12	1800	8,00	8,00	1000	225
13	2500	8,00	8,00	1500	313
14	7600	4,00	4,00	1900	1900
15	6000	4,00	4,00	1500	1500

Table 1: Tons per groove circa 2011: Currently stand 12 is around 4000 tons/groove and stand 13 is at 6000.

GERDAU

The Current Status – Water Condition

ITEMS	REQUIRED
Temperature	77-86°F or 25-30°C
pH	8-8.5
Chloride ions in solution	<50ppm
Sulfate ions in solution	<100ppm
Water hardness	<250ppm
Suspended solids	<50ppm
Oil and grease	<10ppm
Largest particle	100µm

Table 2: Water Condition

The Current Status – Water Pressure & Flow

MILL	WATER FLOW m^3/h
Rougher	540
Intermediate	498
NTM	294
Necessary water flow - Rolls	**1334**
Necessary water flow - Guides (1334*20%)	266
TOTAL	**1590**
* Available flow	-1420
Difference	**170**

Table 4:3 Water Pressure

Table 4:3 Water Pressure

GERDAU

Water Header Designs

Stand 5

Stand 4

The Theory

- Firecracking
- Thermodynamics
- Water Header Design

- A goal of the cooling system is to remove all the heat from the groove right after the bar exits, so that the average temperature of the roll does not exceed ~122°F or 50°C;

The Theory - Firecracking

- There are 4 major ways of introducing firecracks:
  - Cyclical bar deformation stresses;
  - Cyclical thermal stresses;
  - Thermal shock
  - Mechanical shock (cold ends).

- Tension generated by cyclical thermal stresses (σ_T) is the main mechanism causing cracks.

- Due to this, removal of heat in the grooves are essential to reduce cracking. 10% of the heat is removed by evaporation and 90% by forced convection.

The Theory - Thermodynamics

Heat removed by convection:

$Q_C = h_{CN} \times A \times \Delta T_A$ (kcal/h)

$h_{CN} < 1000$ kcal/(h m² ºC)

h_{CN} = necessary HTC

A = cooling area per hour

GERDAU

The Theory – Water Header Design

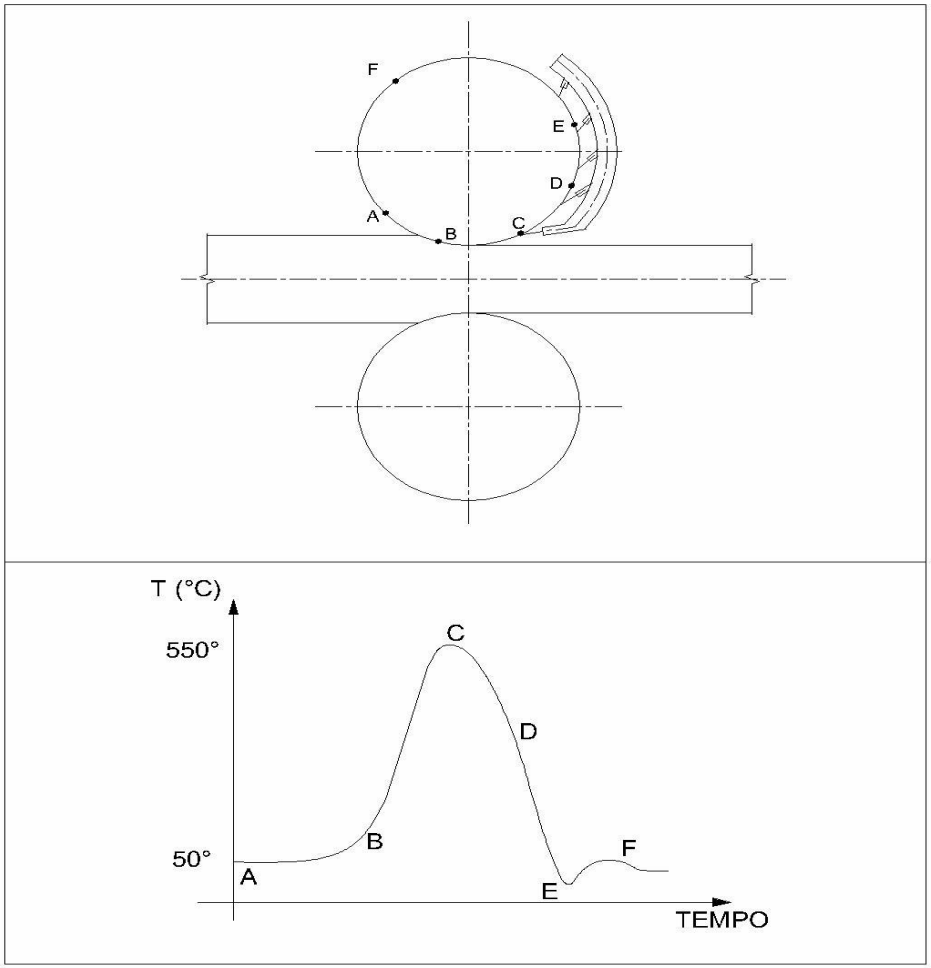


Figure 6: Roll Position vs. Temperature

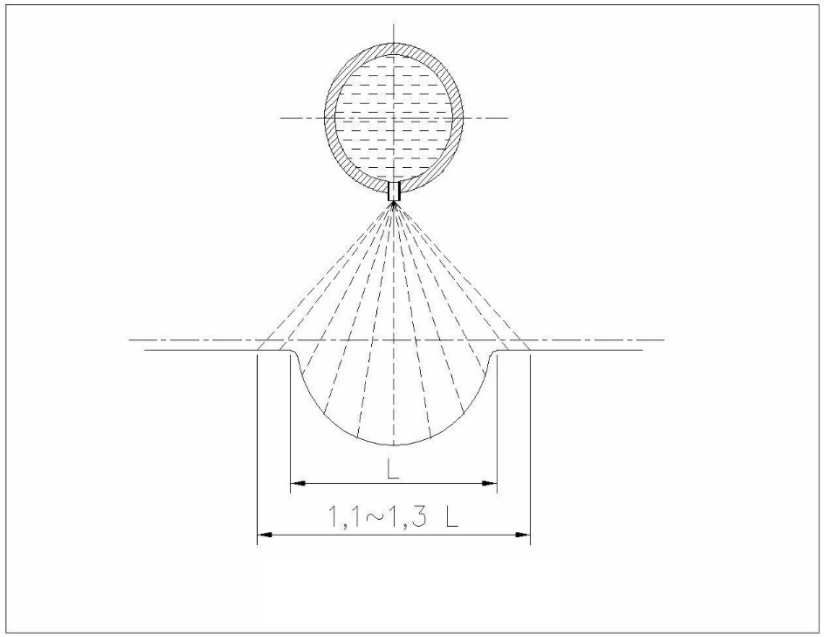


Figure 7: Proper Header Coverage

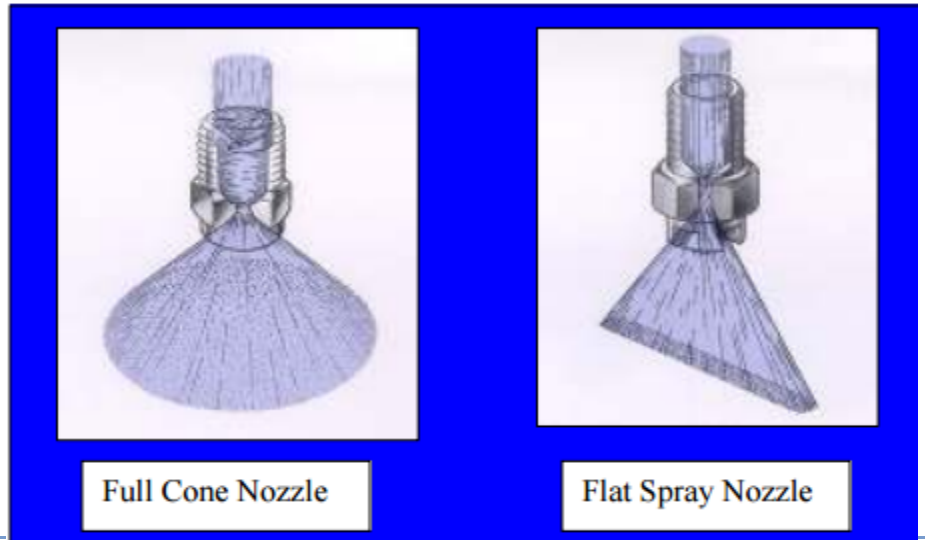
GERDAU

The Theory – Water Header Design (nozzles)

- Spray nozzles allow control over precise water flow and pressure.
- They allow you to direct the flow better.

Rules of Water Cooling

- Focus on the hottest points;
- Do not spray perpendicularly to the groove surface;
- Distance between the nozzle exit and the roll surface: 20 to 30mm;
- Beginning of cooling: 30 to 60mm from bar exit.

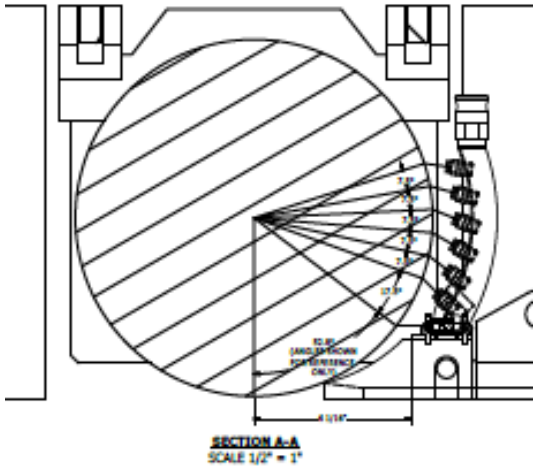


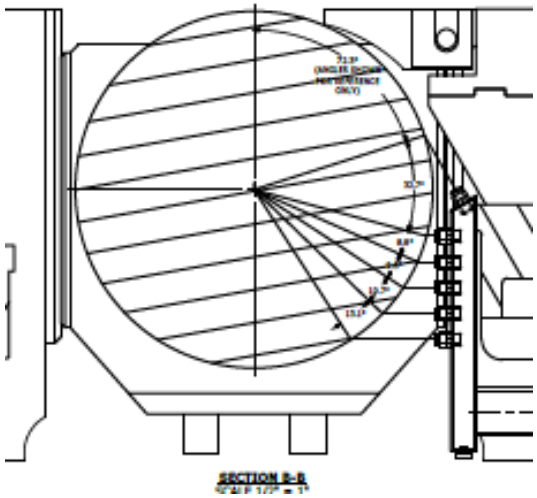
GERDAU

The Concept – Issues

- Spray is perpendicular to the roll surface (splash).
- Full cone spray (HTC 10x lower than FS).
- Interference between sprays.
- Water distribution not known.
- Header adjustment (exists only on NTM).
- The flow per stand is not known.

The Concept - Actual





The Expectations

- Tons per groove 50% increase on stand 12
- Tons per groove 25% increase on stands 6 & 7.
- Less downtime for pass changeovers.
- Increased product quality.

Improvements in

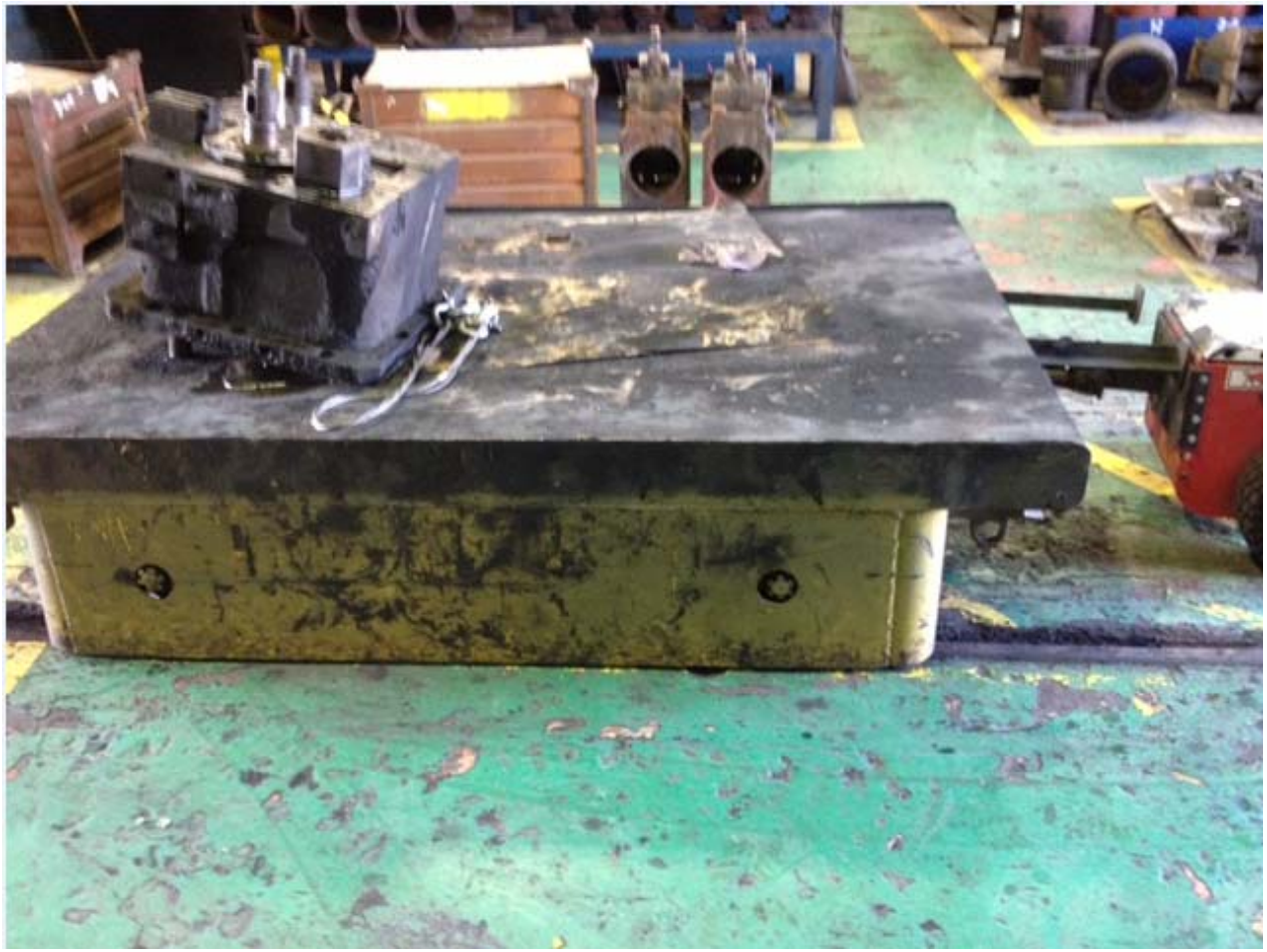
GUIDE SHOP SAFETY

GERDAU

Safety Improvement Projects

- Power Cart LTA
- Guide Shop Light Duty
  - Hydraulic Press
  - Cassette Flipper
  - Strongarm
- Trim & Inspection Station Air Conditioning

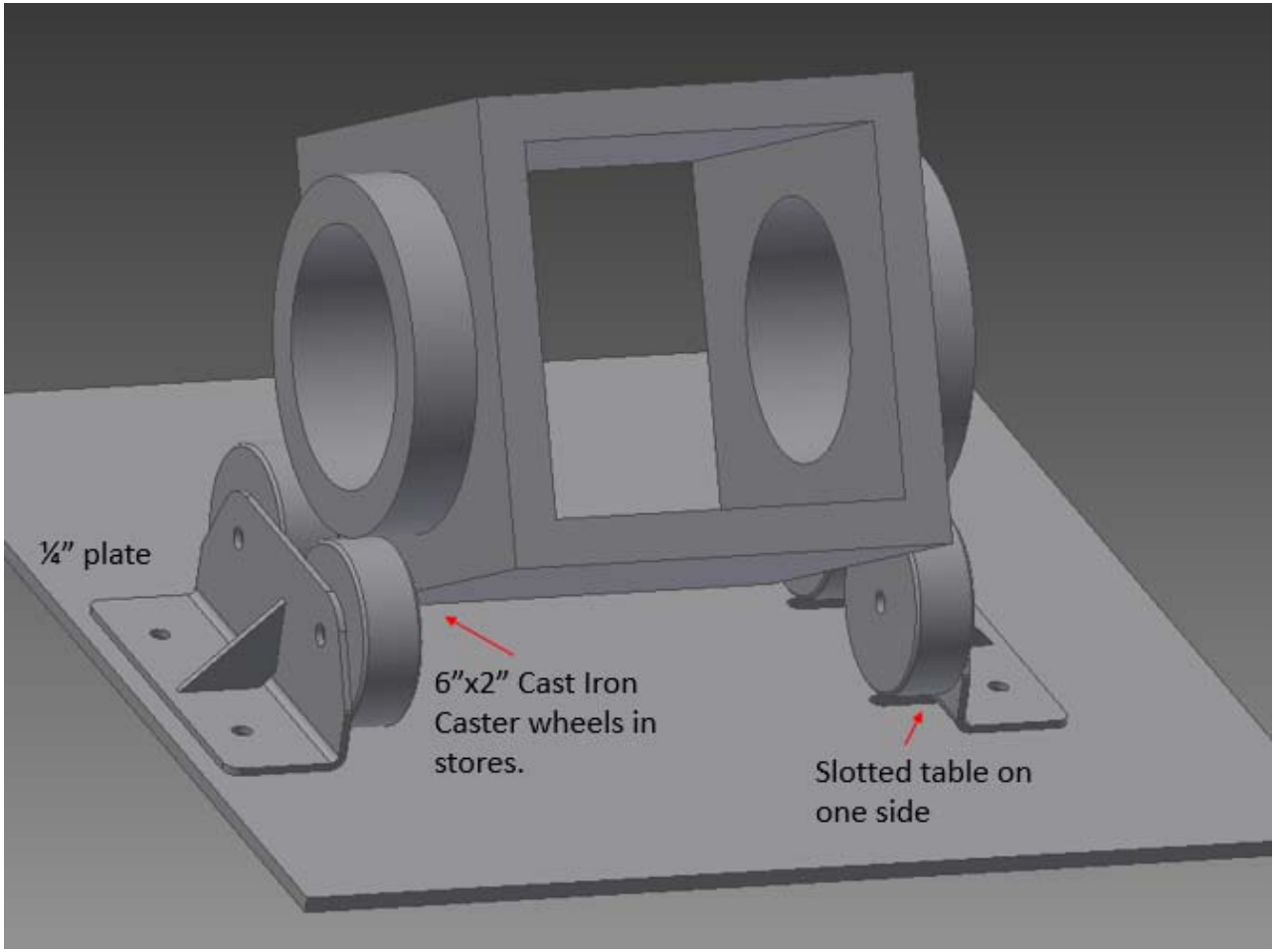
Power Cart LTA



Hydraulic Press

GERDAU

Cassette Flipper



GERDAU

Cassette Flipper

GERDAU

Strongarm

GERDAU

Inspection Station

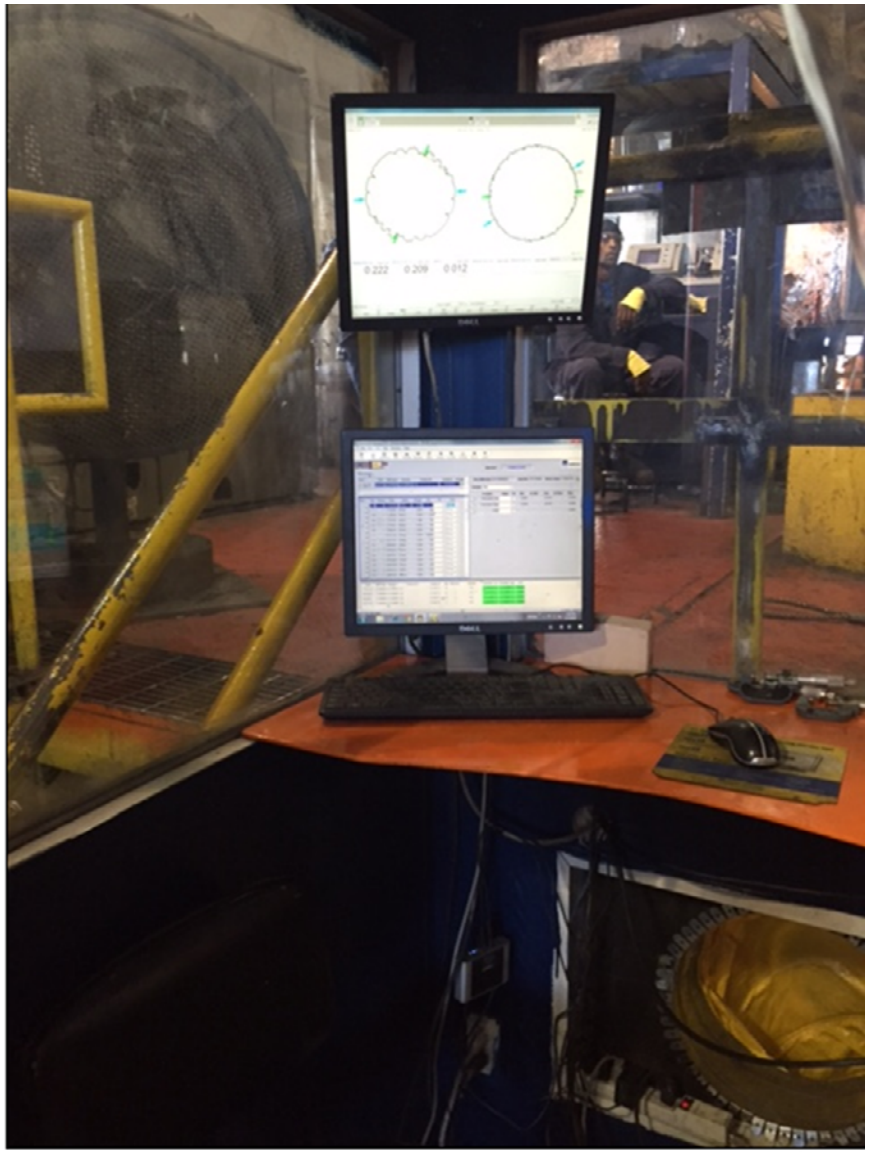
GERDAU

Trim Station

GERDAU

Inspection Station After

GERDAU



GERDAU

Trim Station After

GERDAU

Questions??