Roll Manufacturing Processing

*Material grades for your mill*

Fall 2018 IRD
Conventional - Common Methods of Roll Making

Cast Iron
- Static Cast
- Centrifugal Cast
- Or
- Single Pour
- Or
- Double Pour
(All With same Alloy)

Cast Steel
- Static Cast
- Centrifugal Cast
- Or
- Double Pour

(Outer Shell
Alloy – Higher Ni-Cr-Mo
Inner Core – Promote Better Machinability; Less Expensive Alloy)

Roll Design Has To Select The Best Method To Use In Supplying Mill Rolls. ★★

Considerations
- Stands Where Used – Rougher – Intermediate – Finisher
- Pass Depths – Type
- New to Scrap Size (Especially if Centrifugally Cast is Used)
Importance of Microstructure in Cast Rolls
Increasing Alloy – Changed Microstructures

Examples
• Lower All – Pearlite – Range Hardness 620-700 Ld
• Alloy – Rougher – Intermediate 52-65 HSc

Fig 1 Surface Layer  SG-P 2%Ni  Magnification 200x
Fig 2 Beneath Barrel  SG-P 2%Ni  Magnification 200x
Fig 3 Surface Layer  SG-P 3%Ni  Magnification 200x
Fig 4 Beneath Barrel  SG-P 3%Ni  Magnification 200x
Importance of Microstructure in Cast Rolls
Higher Alloy – Changes the Microstructures

Examples
• Pearlite / Beanite / Martensite (Needle Like)
Importance of Microstructure in Cast Rolls
Normalized – Heat Treated

- Good Application: Recommended Where Both Strength and Ability to Withstand Thermal Shocks are Paramount
- Exceptionally Good Mechanical Properties
- Higher Cost Due to Added Heat Treating

![Surface Layer Lower Alloy Heat Treated](image1)  (Mag. 200x)

![Beneath Barrel Lower Alloy Heat Treated](image2)  (Mag. 500x)

![Surface Layer Higher Alloy Heat Treated](image3)  (Mag. 500x)

![Beneath Barrel Higher Alloy Heat Treated](image4)  (Mag. 500x)
Coreless Induction Furnace used in Cast Roll Melting
Tapping & Pouring
Centrifugally Cast
Cast Rolls Cooling After Pour
When Demand Exceeds Conventional Cast Rolls
Composite Bonded Powder Metal Rolls Take Over

**Application:**
- Intermediates to Finishers

**Advantages:**
- Greater Pass Life In Multiples
- Holds Shape Longer
- Many Alloy Options - 1V - 3V - 9V - 10V - High Speed Bridge Alloy
- Improved Surface Quality Due to Fine Grain Size and Uniform Carbide Distribution
- U.S.A. Made
Two piece construction
• Outer Surface Roll is Powder Metal High Speed Steel
• Inner Roll is a Medium Grade 4140 Alloy Steel or Carbon Steel
• Metallurgically Bonded at Bond Line Composite Steels
• Applications :
  ➢ Hot Rolling
  ➢ Cold Rolling
  ➢ Form Straightener

Composite Bonded Roll (CPM 9V)

High Performance Tool Steel 9% Vanadium Or High Speed Steel

Bond Line

Steel
Composite Bonded Roll (CPM 9V)
Hot Isostatic Pressing
Composite Bonded Roll (CPM 9V)

**CBR™ Tool Steel Microstructure**

- 9% Vanadium
- 2% Carbon

**Powder Metal Characteristics:**
- Uniform Fine Grain
- Rounded Carbides in Microstructure
- Excellent Wear Resistance and Toughness
- Resistant to Mechanical Abrasion
Microphotographs

PM 9V

Heat Treated High Chrome

Nodular Iron

Bi-metal ForMax
Cooling System

Factors to Consider

- Volume
- Pressure
- Quantity
- Temperature
Temperature Effects

Overheating Rolls Can Degrade The Microstructure And Have Harmful Effects
Investigation of Roll Damage During Rolling
Investigation of Roll Damage
New Developments – Forged High Performance Roll

- Micrograph shows extremely fine-grained structure of tempered martensite
- Fine carbide dispersion approximately 25% carbide
- Structure is completely wrought
- No evidence of residual dendritic structure or porosity as would be present in a cast roll
- Surface hardness 63 HRc to provide roll wear resistance

- Core microstructure shows fine-grained structure of tempered martensite
- Structure is completely wrought
- No evidence of residual dendritic structure or porosity as would be present in a cast roll
- Core hardness of 30 HRc to provide roll toughness
Alloy Price Curve
Questions

Engineered Solutions