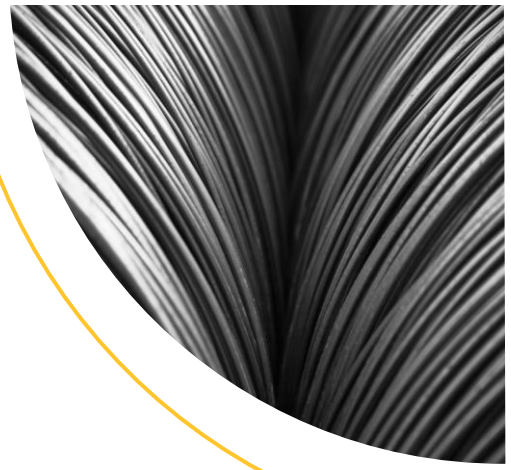
EAF Steelmaking Technologies for Enhanced Forging Performance

Forge Fair 5/24/2023

Charter Manufacturing Overview



Charter Manufacturing Portfolio Today

Established 1936 • Mequon, Wisconsin • Privately Held – 4th Generation Family-Owned

Iron Platform

Specialty Iron Bar
Established 1946

DB & DMS HQ
Woodstock, IL, USA

DMS-PA LLC
Salisbury, NC, USA

DMS-PA LLC
York, PA, USA

DMS-PA LLC
Fort Worth, TX, USA

Gray & Ductile Iron Castings
Established 1977

Aarowcast-Shawano
Wisconsin, USA

Steel Platform

Carbon & Alloy SBQ Rod, Wire, Bar
Established 1978

Saukville
Wisconsin, USA

Cleveland
Ohio, USA

Fostoria
Ohio, USA

Forming Platform

Engineered Steel Shaped Wire
Established 1936

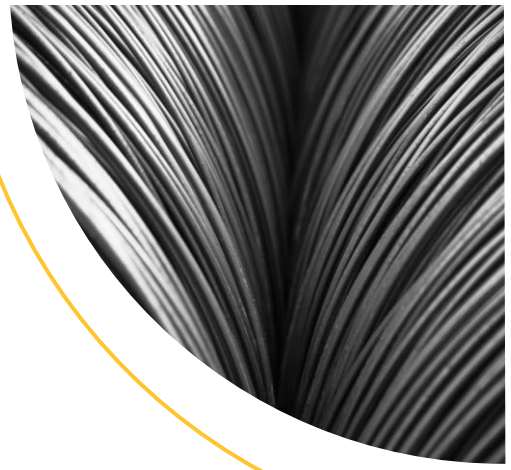
Milwaukee
Wisconsin, USA

Tier I & II Automotive Supplier
Established 1948

Milwaukee
Wisconsin, USA

3

Charter Steel Overview



Location Overview

Saukville, WI
Melt, Roll and Processing

Cleveland, OH
Melt and Roll

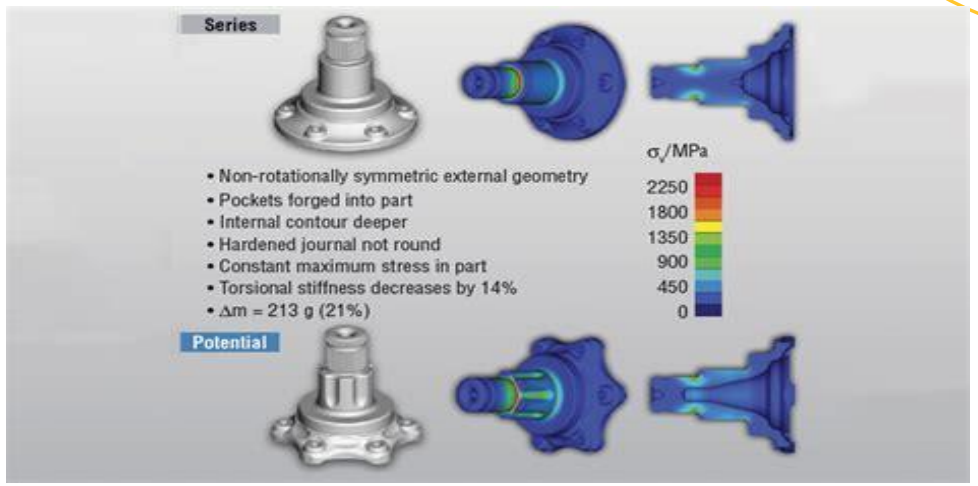
Fostoria, OH
Processing

CHARTER STEEL

Megatrends Affecting Steelmaking

Largest single site recycler in the state of Wisconsin.

- Lower Carbon Footprint
- Electric Vehicles
- AI
- Lightweighting
- Improved Performance for Same Applications
- Variation Reduction
- Clean Steel and Inclusion Control



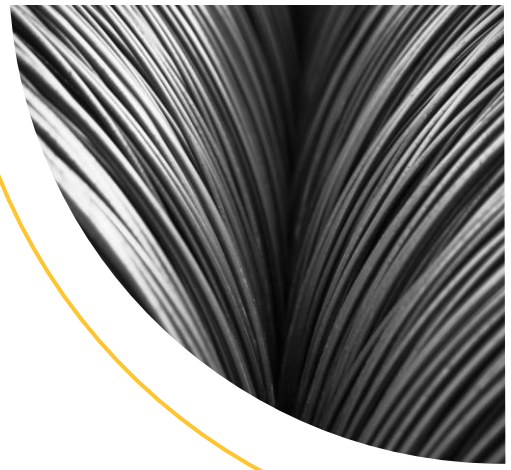
CHARTER STEEL

Changes Driving EAF Technology

Increasingly Difficult Product Applications

- New Cold Forming Applications
- Near Net Forming Applications
- Reduced Variation Requirements
  - Chemistry
  - Microstructure
- Heat Treat Response
- Inclusion Engineering
- Improved Cleanliness
- Dimensional Stability
- Higher Loads/Longer Life
- Grade/Alloy Proliferation

Steelmaking Process



EAF HISTORY

Initial Melt Shops Capable of Basic Product Application

- Limited Scrap and Melting
- Limited Refining
- No Vacuum Degassing
- Simple Continuous Casting
  - Ladle, Tundish, Slag, Stirring
- Not Competitive with BOF's
- Ladles not Optimized

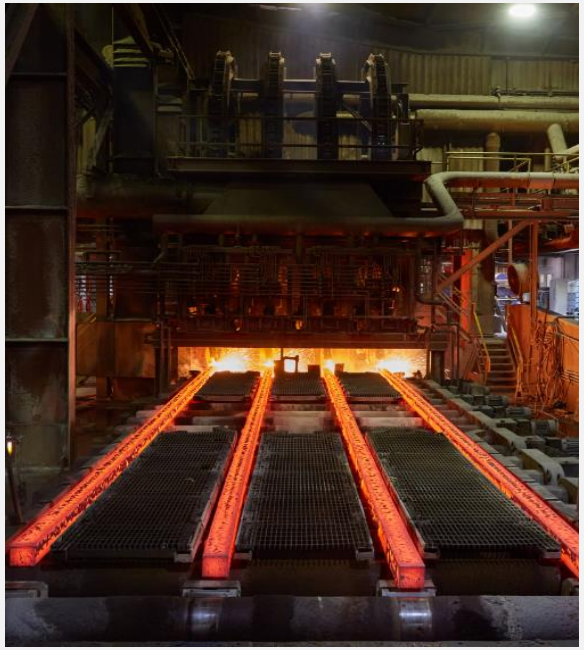
CHARTER STEEL

Melting, Refining, and Casting Process

Electric Arc Furnace
Initial Melt Composition

Ladle Refining Furnace
Produce Uniform
Chemistry and Temp.

Vacuum Oxygen Degasser
Remove Unwanted Gases & Inclusions
Produce Final Chemistry



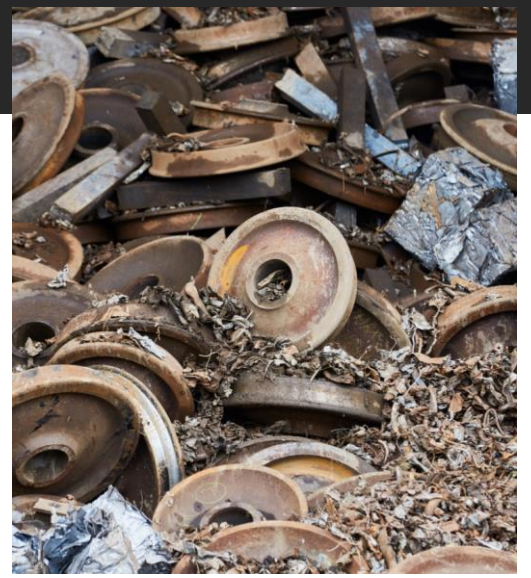
Continuous Billet Caster
Create Billets Ready for Rolling

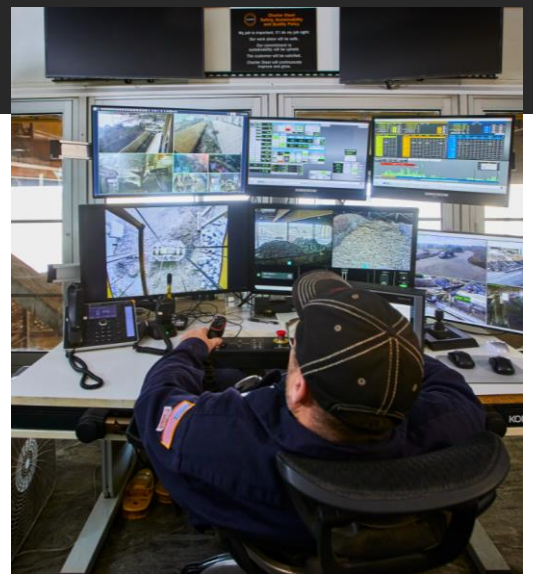
Process Flow Direction

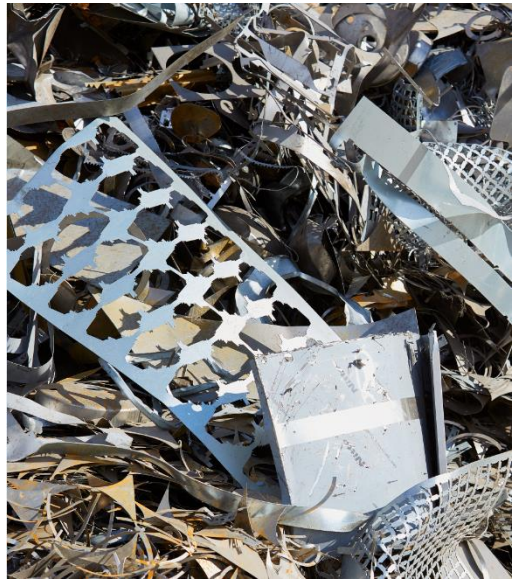
Raw Materials

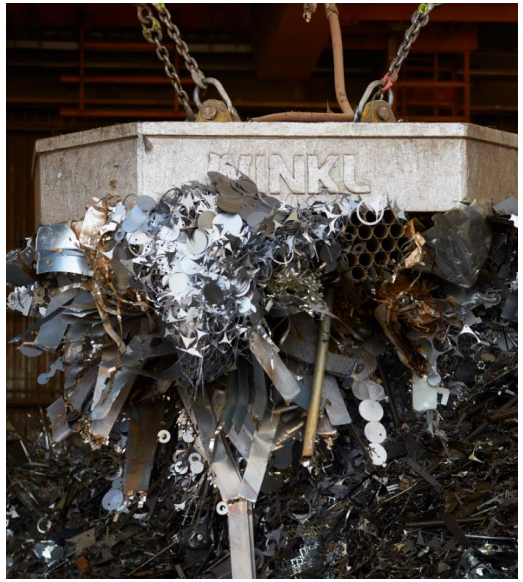
Recycled Scrap Material

- Initial scrap consists of:
  - Shredded Automobiles
  - Railroad Scrap
  - Busheling and other machine shop scrap
- Mix for each heat Tailored for Grade and Applications
- 90% - 100% Scrap Increases Sustainability Performance



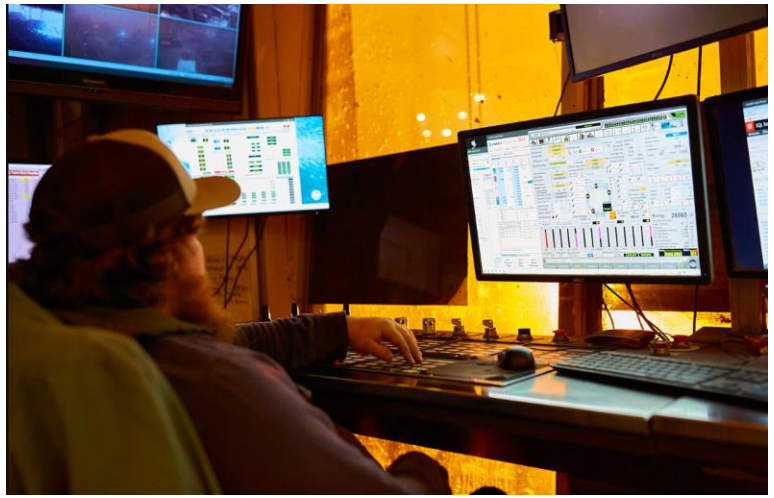






Melt Furnace Improvements

- Tailored Premium Scrap Recipes
- Optimized Slag Practices
- Optimized Tap Practices
- EBT
- Robotic Additions/Sampling
- Enhanced Sensors and Controls
- Optimized Energy Input
- Optimized Cooling and Refractory



CHARTER STEEL

LRF Technology Improvements

- Ladle Design
  - Refractory Design
  - Dimensions
  - Tap Design/Slag Detection
- Stirring Design and Control
  - Gas, Pressure, Location, Flow
  - Homogeneity
  - Sensor Improvements
  - Optimized Recipes
- Engineered Slag

Vacuum Degassing

Technology Improvements

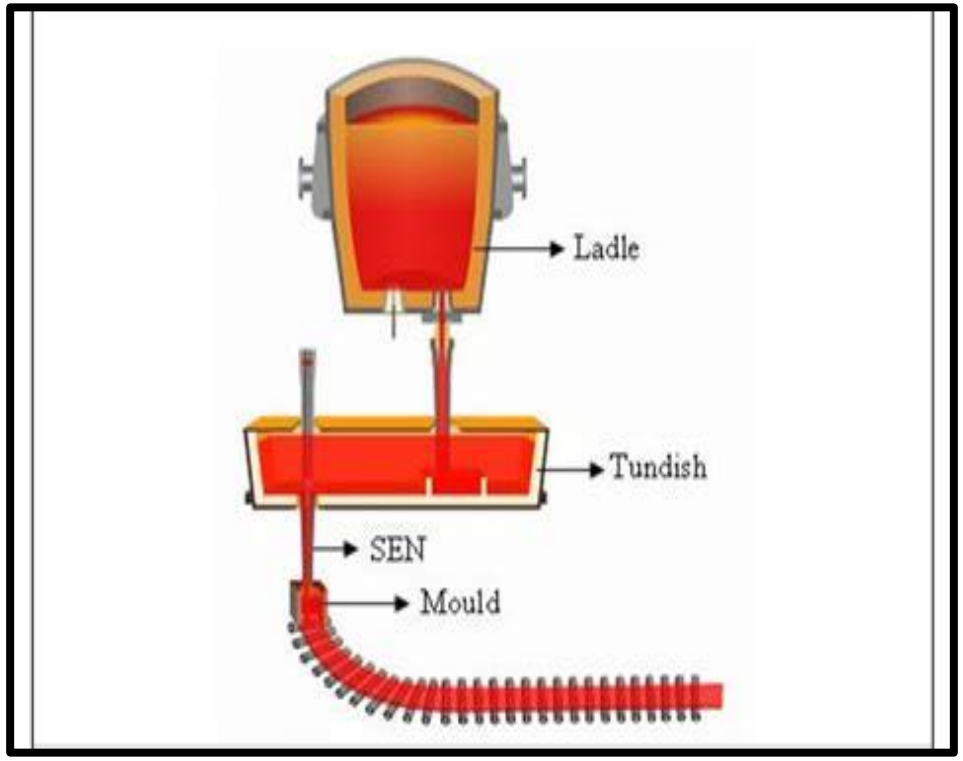
- Oxygen, Nitrogen, Sulfur, Phosphorous
- Inclusion Control
  - Uniformity
  - Temperature
- Chemistry
- Superheat
- Optimized Recipes
- Optimized Process Controls Technologies

CHARTER STEEL

Continuous Caster

Technology Improvements

- Speed, Oscillation, Primary Cooling, Secondary Cooling, Unbending
- Enhanced Quality Measures
- QCS
- Segregation/Solidification Development/Control
- Mold Powder
  - Chemistries
  - Application
  - Control
- Mold Shape and Size
- EMS Recipe Optimization
- Tundish Design
- Met. Length



CHARTER STEEL

Sustainability

- **ISO50001** Certification
- Produce steel out of **~90-100% recycled** material
- Leverage EAF vs. BOF – results in **75% fewer** CO2 emissions
- Greenhouse gas reduction
- Energy Conservation Program
- Implementation of Solar Fields to augment Current Grid
- By the Numbers
  - Carbon Footprint 2022 - **.62** Tonnes GHG/Good Ton Produced
  - Represents a **12.8%** reduction from 2016 in GHG/Good Ton Produced

CHARTER STEEL

YOUR TRUSTED STEEL PARTNER

We create steel. But at our core, we're committed to continuously investing in the people and technologies to better serve our customers.