Steel Foundry Assessment with Emphasis on the Integration of ITP Software and Technology Solutions into the Assessment

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L'Enfant Plaza Hotel
Washington DC
February 7, 2008

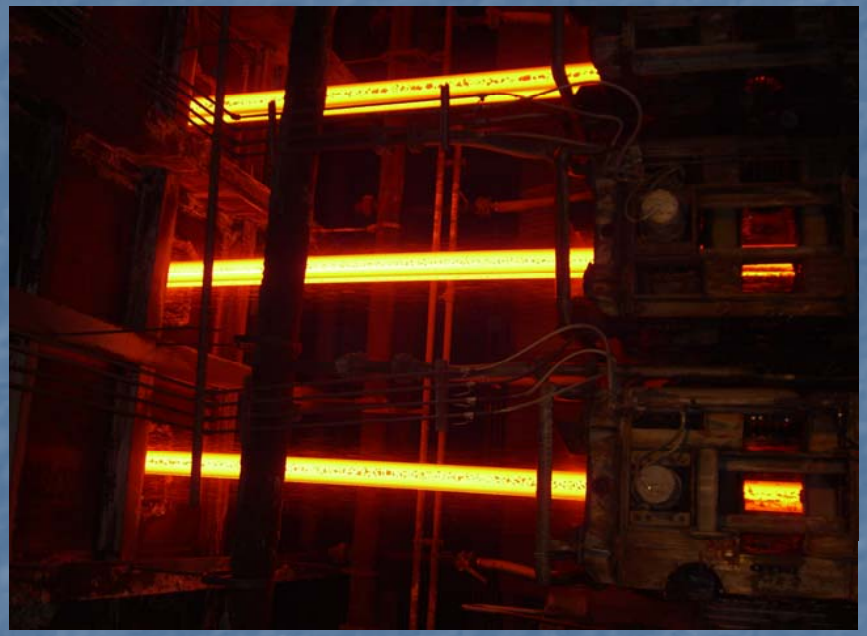
University of Illinois at Chicago IAC

- 8 years old
- 136 assessments
- Over 1,200 recommendations
- 59% implementation rate

- Currently 12 students
  - 7 Mechanical Engineers
  - 2 Industrial Engineers
  - 2 Chemical Engineers
  - 1 Electrical Engineer

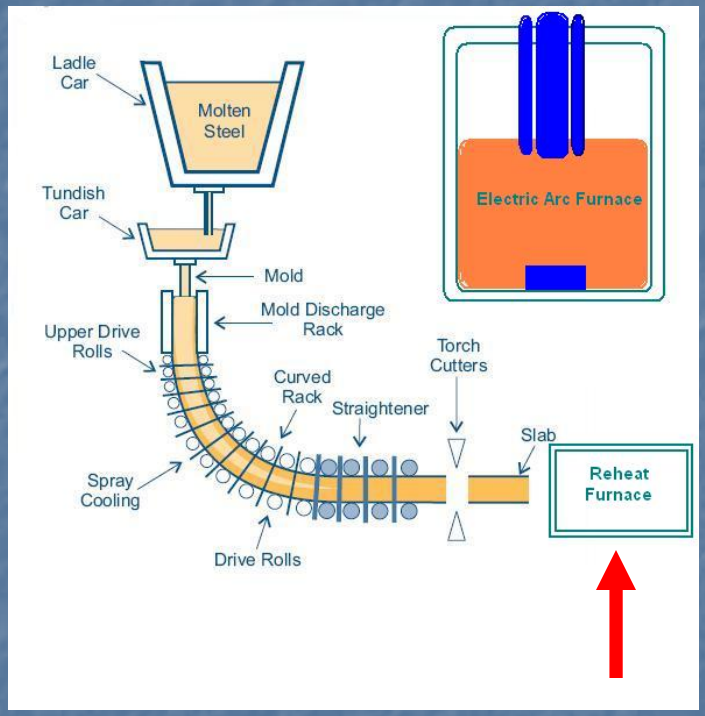
Alton Steel Background

- Secondary steel plant
- Produces 360,000 tons of steel billets per year
- $100 million in annual sales
- BIG place – spans 28 acres
- HUGE energy budget
  - Over $9 million/yr
  - 136 million kWh/yr of electricity ($1.9 million)
  - 630,000 kW/yr of demand ($2.9 million)
  - 480,000 MMBtu/yr of natural gas ($3.9 million)
  - 154 million gallons/yr of water ($400,000)



Continuous Casting Operation

- Most efficient way to solidify large volumes of metal into simple shapes for subsequent processing
- After the steel leaves the caster, it is reheated to a uniform temperature and rolled into sheet, bars, rails, and other shapes



Assessment Background

- UIC-IAC contacted by the Environmental Protection Agency
  - Asked to conduct an assessment at a plant with “difficulties”
  - Newly reopened plant had to post $1 million bond for environmental remediation
- Contacted the plant management
  - Turned out to be friendly
  - Extremely cooperative
  - Showed significant interest
- Asked for standard pre-assessment materials
- Designated teams

  Expected to conduct a standard assessment

The Story

- Four hour drive to the facility
- Visited in mid-August
- Met CEO of company for the first time on the 1st day
  - Came in with a small scrap of paper
  - He had four ideas

Four Ideas

- Recuperate Heat from Electric Arc Furnace
- Recover Heat from 14” Mill Reheat Furnace
- Recover Waste Water
- Use Excess Heat to Make Ethanol

The Decision

- Continue?
- Do a hybrid assessment, combining some of the plant ideas with a standard assessment?
- Focus entirely on those four ideas?

Plan of Action

- Reorganized the team into three subteams
  - Waste Water Team
  - 14” Mill Team
  - Electric Arc Furnace Team

Assessment Day 1

- Cooling tower is HUGE
- Waste water is GREEN
- Ash for the furnaces is 400°F

- At the end of Day 1
  - We had little date
  - We had no information
  - Plant staff were knowledgeable
  - We had no idea if this approach would work

Day 1 – After the Assessment

- We were all very tired
- Did some brief sight-seeing
- Had dinner with the CEO of the company

Assessment Day 2

- Just as hot as the day before
- Returned with 18 gallons of water
- Continued to work in reassigned teams

- By the middle of the day
  - A little bit more data and information
  - Still supported by the facility staff
  - We realized that the new approach might work

Continued work through the afternoon

Day 2 – After the Assessment

- Held a conference in the breakfast room at the hotel
- Shared ideas between teams
- Started to click

And Finally, Day 3

- Met nearly everyone at the plant
- Debriefed plant staff
  - Everyone, from maintenance to the CEO, was there
  - Goal of saving 10% of the energy budget $900,000/yr
  - "We think it is going to work"

Recommendation List

- Plant's original ideas
- Our ideas

- Install Recuperator on the 14" Mill Reheat Furnace
- Reuse Wastewater as 14" Mill Makeup Water
- Generate and Sell Steam for Ethanol Production
- Replace 14" Mill Reheat Furnace with More Efficient Furnace
- Upgrade Burners on the 14" Mill Reheat Furnace
- Replace Control System on the 14" Mill Reheat Furnace
- Trade Carbon Credits on the Chicago Carbon Exchange

Upgrade Burners on the 14” Mill Reheat Furnace

- UIC-IAC idea
- Cost Savings: $76,000/yr
- Implementation Cost: $252,000
- Simple Payback: 3.3 years

- Emissions Reductions
  - 1.3 tons NO_X/yr
  - 0.4 tons CO/yr
  - 547 tons CO_2/yr

Replace 14” Mill Reheat Furnace with a More Efficient Furnace

- Plant and UIC-IAC idea
- Cost Savings: $1.5 million/yr
- Implementation Cost: $6.8 million
- Simple Payback: 4.5 years

- Emissions Reductions
  - 26 tons NO_X/yr
  - 7.8 tons CO/yr
  - 10,803 tons CO_2/yr

Install Recuperator on the 14” Mill Reheat Furnace

- Plant idea
- Cost Savings: $860,000/yr
- Implementation Cost: $2.4 million
- Simple Payback: 2.8 years

- Emissions Reductions
  - 15 tons NO_X/yr
  - 4.5 tons CO/yr
  - 6,217 tons CO_2/yr

Reuse Wastewater as 14” Mill Makeup Water

- Plant idea
- Potential savings of 600,000 gal/day
- Large capital investment
- Short payback period
- Savings could not be quantified
  - Quantities of well water and city water cannot be distinguished

Replace Control System on the 14" Mill Reheat Furnace

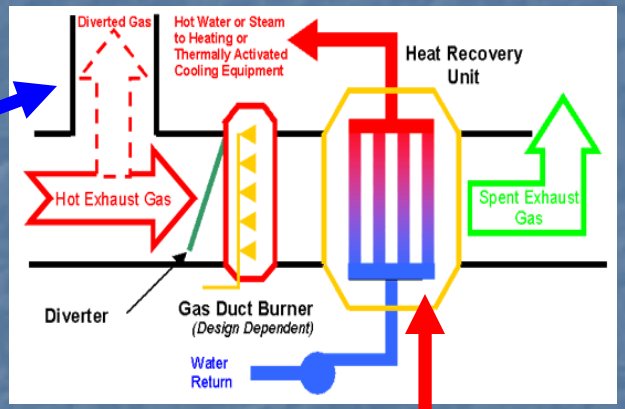
- UIC-IAC idea
- Each 1% increase in throughput results in savings of $10,000/yr
- Savings could not be quantified
  - Lack of information from manufacturer on current system
  - Variety of products run through the mill

Trade Carbon Credits on the Chicago Carbon Exchange

- UIC-IAC idea
- Increased Revenue: $54,000/yr
- Implementation Cost: $5,000
- Simple Payback: 2 months

CCX Chicago Climate Exchange

Generate and Sell Steam for Ethanol Production



- Enormous amount of waste heat
- Divert to heat recovery steam generator

Generate and Sell Steam for Ethanol Production (cont.)

- Plant idea
- Increased Revenue: $2.6 million/yr
- Implementation Cost: $12.6 million
- Simple Payback: 4.8 years

- Emissions Reductions
  - 135 tons NO_X/yr
  - 40.6 tons CO/yr
  - 56,200 tons CO_2/yr

Results – Alton Steel

- 7 recommendations
- Delivered the report on time
  - Final energy savings of $2.5 million
  - Increased revenue of $2.6 million
  - Payback period of 4.3 years
  - 63,000 ton/yr reduction in greenhouse gas emissions

Results – Engineering Students

- Still maintain contact with the plant
- Developed into a Senior Design Project
  - Initial HRSG design
  - Plant staff is excited – free engineering!
  - Dr. Worek is the technical advisor
  - Team to use DOE Best Practices software
    - PHAST and SSAT

Results – UIC-IAC

- All team members received EIT
- Project Coordinator became Qualified Steam and Pumping Specialist
  - Current Lead Students scheduled for Qualified Steam Specialist training
- Remaining team members are all Lead Students and working on other engineering projects
- Now looking at Miller Brewing Company
  - Three plants in Wisconsin (trying to work with MEP)
  - Each plant is comparable to Alton Steel

What Did We Learn?

- Really listen to the client
- Conservative option is not always the best option
- IACs capable of conducting large-scale assessments in 1-2 assessment days
- Possible to recommend and implement leading- edge technologies (ethanol) and concepts (carbon trading)

Thank You

- ORNL – Michaela Martin
  - Helping to create and maintain strong Lead Students
  - Being here today (welcome back from China – lunch is dim sum)
  - Giving us the opportunity to share our experiences
- Rutgers – Dr. Muller
  - Believing in us (we think)
  - Giving us the assessment days to conduct the visit
- Golden Office – Bill Prymak and Kristin McDaniel
  - Fighting the funding battle
  - Writing the checks
  - Reading our (long) quarterly reports

Questions?

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