RealTime Control System
Case Study
Keokuk Steel Castings, Inc.
Keokuk, Iowa

Introduction

Keokuk Steel Castings has been in operation for thirty-eight years. This plant produces high integrity castings in carbon, stainless and high alloy steels. The Iowa facility can produce 85 tons of castings per day.

General Foundry Information	
Product Line:	Large variety of valves, rail and locomotive products, military and various other industrial castings
Casting Metal Type:	• Carbon Steel (to 5,000 lbs) • Stainless & Duplex Stainless (to 1,000 lbs) • High Alloy Steel (to 1,000 lbs)
Melting Facilities:	• AOD • Electric Arc Furnaces • Coreless Induction Furnaces
Sand Facilities:	• Core Processes Phenolic Urethane Shell • Molding Processes Phenolic No-Bake (70% Reclaim Sand)
Cleaning Facilities:	• Tableblast • Tumbleblast • Grinding Stations • Work Cell Cleaning Booths

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REALTIME

General Foundry Information

	• Casting Manipulator • Snag Grinding Stations
Heat Treating:	• Austentize • Normalize • Quench and Temper • Stress Relieve
Pattern Shop:	• Produce Wood, Metal, and Urethane Patterns

Project Objective

The objective was to introduce the Keokuk Steel Casting Foundry to the concept of computerized mixer controls utilizing statistical process control concepts. The primary end results expected were consistency and repeatability of the final product and reduced operating costs.

Original Problems

- Inconsistent chemical addition
- High maintenance cost of old chemical pump system
- Higher than required binder levels to compensate for fluctuations in pumping system
- No automatic catalyst adjustment based on sand temperature
- Inconsistent strip times from sand temperature fluctuations causing mold scrap

Solution

Installation of the MT Systems' REALTIME Computerized Binder Control System during July, 1992. Two mold line mixers were equipped with pump packages controlled by a centralized REALTIME System. The basis of the system was to provide repeatability and consistency over chemical additions to the sand mix while reducing overall binder usage.

To accomplish the above goals, each mixer was outfitted with the following hardware:

Solution

- Pump panel containing flowmeters, motor controller, motors, mag-drive pumps and diverter valves. (All devices are controlled by a central computer)
- Mixer electrical controls were designed and installed to accommodate the MT REALTIME System
- A remote monitor displaying process variables and parameters was mounted at each operator's station and in the Foundry Superintendent office.
- Temperature probes were installed after the sand heaters

Their production flow is as follows:

When the job is located under the mixer, the operator initiates the cycle by pressing a start button. The operator has a variety of sand mixes available to produce the mixes identified on the product Spec sheet. The choices are as follows:

New Sand Facing	1.15% Binder	2.7% FE_3O_4
Reclaim Facing	1.10% Binder	2.2% FE_3O_4
Blend Facing	1.15% Binder	2.4% FE_3O_4
Reclaim Backing	.85% Binder	NO FE_3O_4

During the making of the mold, the computer is monitoring sand temperature and controlling the catalyst to assure consistent strip times.

The system provides management with daily consumption reports. The consumption report documents total sand and chemicals consumed, total mixer run time and average resin and catalyst percents. This information is stored for future retrieval in month-to-date and year-to-date formats.

If some part of the system malfunctions, the computer will set off an alarm and shut down the system then provide diagnostics identifying the failed process.

The system is designed to compensate for line restrictions, chemical viscosity change pump wear and pressure change variation from varying binder levels in the surge tank.

Results and Benefits

- Reduced average binder usage from 1.4% to 1.1% with final potential with improved compaction to 1.0%
- Reduced sand and binder cost with major improvement in broken molds
- Significant reduction in downtime and maintenance costs
- Reduced iron oxide usage from 4% to 2.2%
- LOI's below .8% were easily achieved in the reclaim sand system due to less binder in the sand mix.
- More consistent tensile strengths resulted in consistently better casting appearance
- Catalyst usage reductions by varying the catalyst addition with the actual sand temperature
- Changes can be made in an instant without shutting the system down
- System is self-diagnostic for ease of operation and maintenance

Monetary Savings/Pay Back

Keokuk Steel Castings has two molding mixers equipped with the REALTIME System. The majority of the mixed sand used is through theses mixers. Comparing February 1992 and December 1992, which are two months of similar production levels, the binder usage was reduced 24% and iron oxide was reduced 32%. The total binder and iron oxide dollar savings per month was $25,128. **Pay back** on the system installed **was less than one year**.

Overall Evaluation

The computerized mixer control system has to be the single most important technology improvement in the foundry industry in recent years. Besides the cost reduction from binder reductions, there are significant cost reductions from improved and consistent sand quality resulting in reduced scrap and cleaning room labor hours. The documentation and information made available from the REALTIME System aids the area managers in better management of their areas.

The manufacturing managers are quite impressed with the system and plan to expand the capabilities to the remaining four mixers.