#1

ZR22G, ZR402G
Insitu Oxygen Measurement

#2

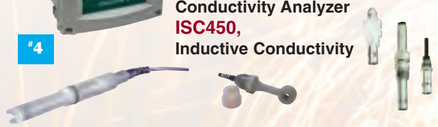
AXF Magnetic
Flowmeter

#3

GC1000 MARK II
Gas Chromatograph

PH450,
pH Analyzer
SC450,
Conductivity Analyzer
ISC450,
Inductive Conductivity

#4



#5

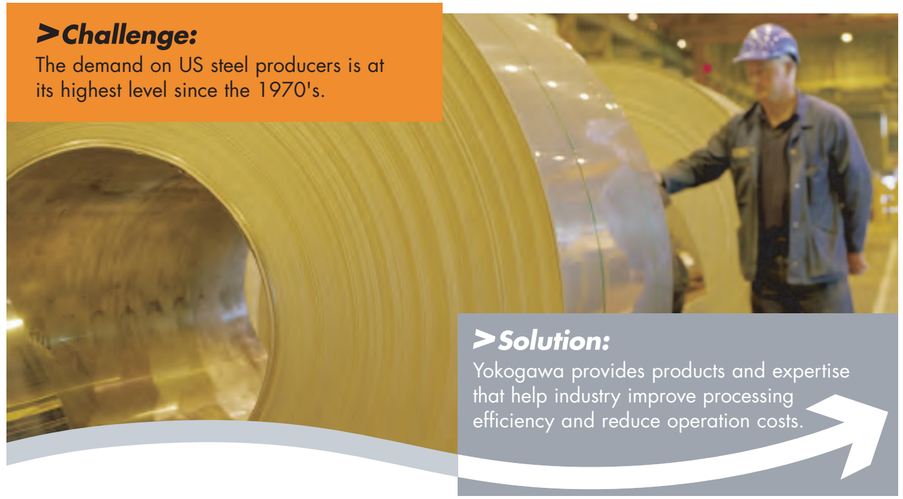
GD40/GD402
Gas Density Analyzer

#6

CX1000
Digital Recorder

>Challenge:

The demand on US steel producers is at its highest level since the 1970's.



>Solution:

Yokogawa provides products and expertise that help industry improve processing efficiency and reduce operation costs.

A Yokogawa Commitment to Industry

vigilance®

quality innovation foresight

What does **vigilance®** mean to Yokogawa? For starters, always, always making sure the products and solutions that leave our research and development labs are the best the world has seen - from day one throughout your business life cycle. Our innovative technologies and committed experts help design, install and manage your production systems efficiently and dynamically. In an ever-changing business environment, we help plan for the future to ensure continuity and flexibility in your automation strategies. Yokogawa goes the extra mile to do things right. Let us be vigilant about your business.

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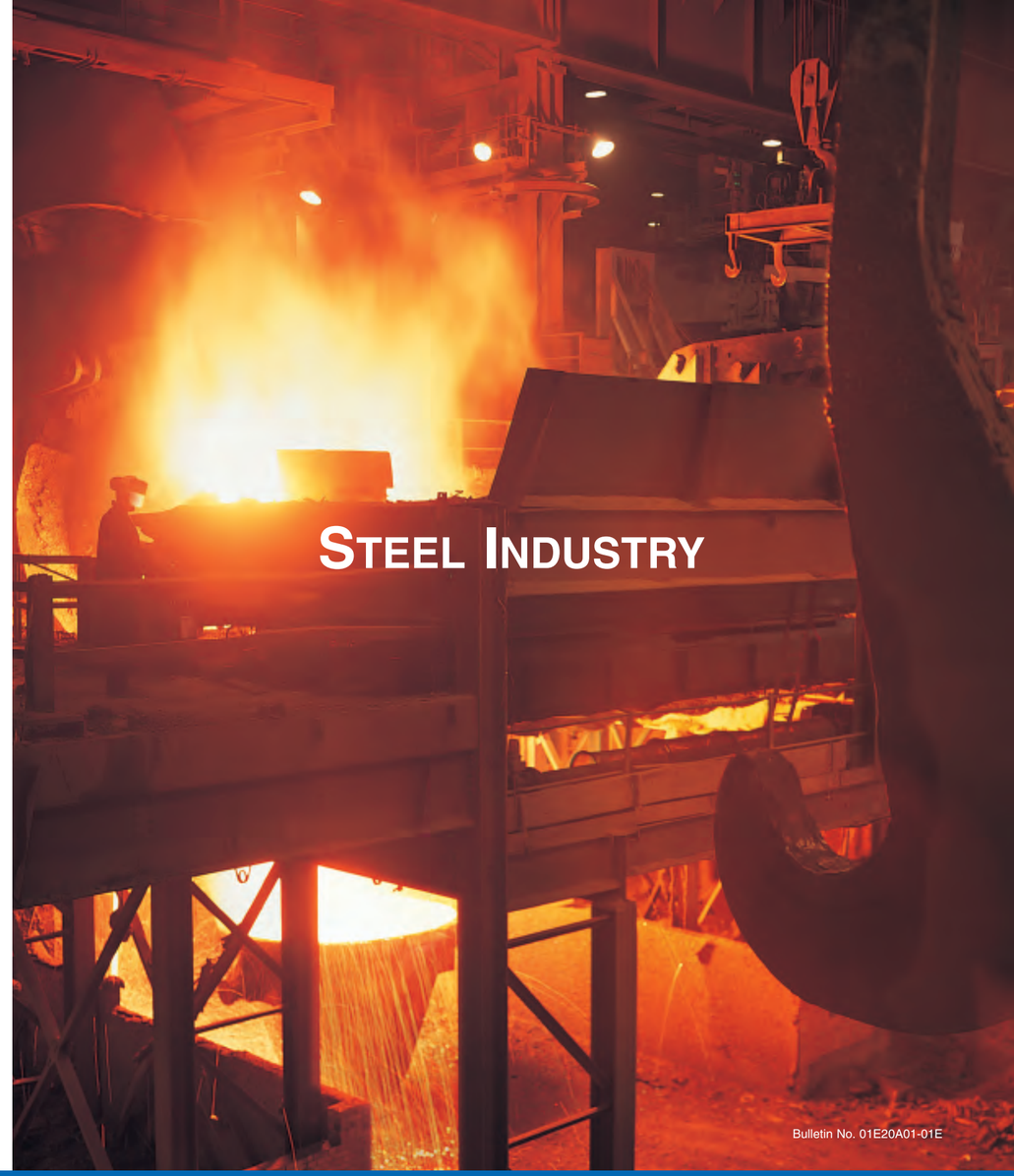

STEEL INDUSTRY

Bulletin No. 01E20A01-01E

A Yokogawa Commitment to Industry
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Coke Oven

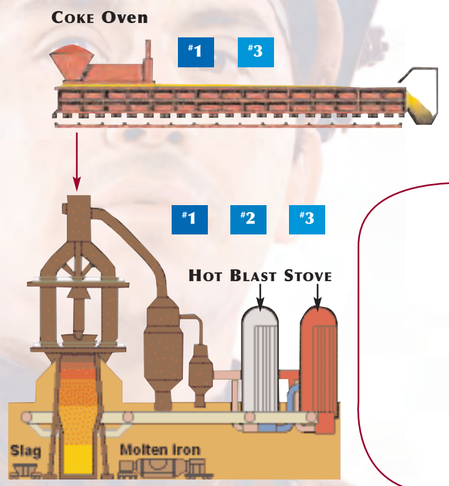
Coke is produced when coal is heated to drive off volatile matter contained within. Coal is indirectly heated in coke ovens by burning coke-oven off gas in heating flues in the coke oven's side walls.

An oxygen measurement is used to maintain the fuel / air ratio efficiency of the combustion in the heating flues. A 10% increase in excess air changes fuel usage by 1%.

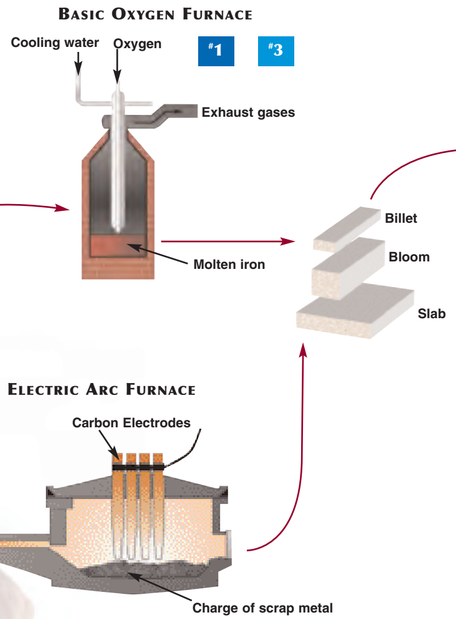
Temperatures: 400 - 600°F
Locations: Combustion gas flue duct
Recommended product: ZR22G, ZR402G

A gas chromatograph is used to measure the composition and BTU content of the coke oven gas. Coke gas is a good fuel that can be utilized in various combustion processes. The BTU value is used for oven burner control and for custody transfer accounting when the coke gas is sold to other locations.

Location: Coke oven off gas stream
Recommended product: GC1000 Mark II with sample system



Blast Furnace
Produces molten pig iron from iron ore.



Blast Furnace

The blast furnace is used to make pig iron from iron ore. An aggregate of iron ore, coke, limestone, sinter and fluxes are charged into the top of the furnace while preheated air is blasted into nozzles (tuyeres) at the bottom. The air reacts with the coke to make CO and tremendous heat that purifies and melts the aggregate charge. The molten iron collects in the bottom of the furnace. The exhaust gas (top gas) is captured, cleaned and used for fuel in other areas of the plant.

The oxygen measurement on the blast furnace ensures an adequate air flow rate through the tuyeres to maintain the process melt temperature and also for safety purposes to prevent hazardous conditions.

Temperatures: Various
Location: Blast furnace waste gas stream
Recommended product: ZR22G, ZR22P, ZR402G

A gas chromatograph is used to analyze the blast furnace top gas composition. The air / coke reaction results in a complex exhaust gas stream of CO, N_2, H_2 and CO_2. The CO concentration is a key measurement to determine the process efficiency.

Temperatures: 60°C
Location: Blast furnace top gas stream
Recommended product: GC1000 Mark II with sample system

Hot Blast Stove

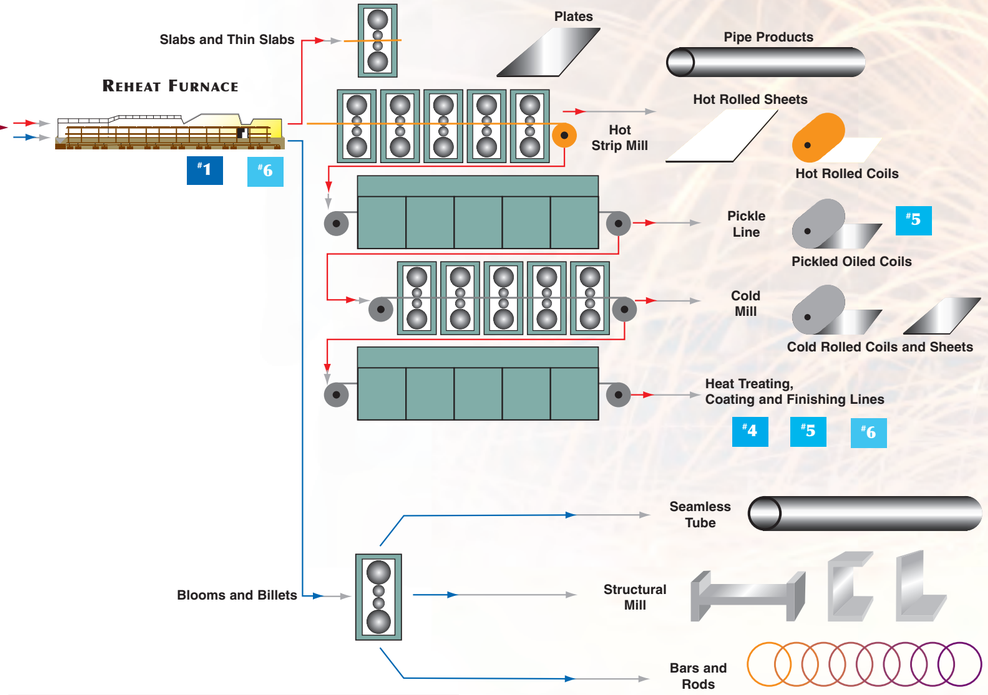
Blast furnace top gas has considerable energy value. It is burned in stoves that preheat the air for the hot blast into the blast furnace tuyeres. Any top gas not used is sent to the boiler house for use generating steam for various purposes. In both instances an oxygen measurement is used to improve fuel efficiency, lower emissions and for verification of safe process conditions.

Temperatures: 400 - 700°F
Location: Blast stove flue gas stream
Recommended product: ZR402G, ZR22G

Reheat Furnaces

Intermediate steel products such as slabs or billets are rolled to shape in a steel mill. The steel is heated in a reheat furnace to soften the steel for the rolling process. Natural gas or fuel oil burners create heat along the furnace length.
Oxygen concentration is measured at different locations within the furnace length to determine combustion efficiency, control process oxidation conditions and to help reduce furnace NOx emissions.

Temperatures: 1000 - 1300°F
Locations: Heat zone, soak zone, oxidation zone
Recommended product: ZR22G, ZR22P, ZR402G



Blast Furnace

A water cooling system is imbedded within the blast furnace walls to help keep the infrastructure cool during operation. Multiple water lines, typically 2" in size, are run through the column. The cooling water can contain scale, silt, sand, etc., which makes a magnetic flow meter the perfect choice to measure the cooling water flow rates. Inlet and outlet flow rates are measured to check for cooling system leaks.

Temperature: up to 150°F
Flow range: up to 150 GPM
Location: Inlet and outlet of blast furnace water cooling system
Recommended product: AXF Magnetic flow meter

Basic Oxygen Furnaces (BOF), Electric Arch Furnaces (EAF)

Pig iron, fluxes and scrap are reacted with pure oxygen to create steel. Carbon in the molten metal charge reacts with CO_2 to form CO which is either burned in the process or off gassed to a pollution control system.

Top gas from a BOF or EAF is similar to that of a BF.
The product applications are also similar.

Secondary Processes

Gas Nitriding

Gas nitriding is a hardening process performed on a variety of metals. The nitriding furnace is normally oxygen-free (<1% O_2) to prevent oxidation, which can compromise metal quality. Nitrogen is injected into the furnace to purge the environment of air followed by an ammonia purge; this establishes an oxygen free environment and acts as a blanket gas. The N_2 or H_2 content is measured at the furnace inlet or retort exhaust to gauge purity.

Temperatures: 930 – 1020°C
Location:
Furnace inlet, retort exhaust
Recommended product:
GD402/GD40

Gas Carburizing

Carburizing is a hardening process in which carbon is dissolved in the surface layers of a low-carbon steel. The result is a metal with hardness, producing a strong, wear-resistant surface layer on a material. A problem with gas carburizing is the control of the gas within the furnace to generate the correct amount of carbon monoxide (CO). If this is not controlled accurately, carbon dioxide (CO_2) can begin to form, which leads to scale formation and oxide formation on the surface of the metal.

The CX line of recorders have programmed capability to control the furnace' s atmosphere and temperature.

Recommended product:
CX1000 / CX2000 with carbon master sensor

Annealing

Annealing is the process of bringing the material to its softest possible point. The material is heated then slowly cooled to reduce its hardness and ductile properties. The annealing atmosphere can be either pure H_2 or an H_2/N_2 mixture. The H_2 helps to keep the surface of the product free of CO_2 at high temperatures. Product quality may be greatly compromised if oxidation occurs therefore accurate gas measurements are crucial.

Temperatures: 500 – 650°C
Location:
Furnace inlet
Recommended product:
GD402/GD40

Pickling

After steel has been heat treated, welded, etc, layers of colored oxides and scale are present. Some of these oxides can lower the corrosion resistance of the metal and, therefore, must be removed via the pickling process. The pickling process removes the contaminants from the metal's surface by using acids such as nitric, hydrofluoric, sulphuric, hydrochloric, etc, without damaging the metal's surface. The acid concentration is monitored to make certain it is sufficient for scale and oxide removal.

Temperatures: ~80°C
Location:
Process line
Recommended product:
EXA PH402/SC402/ISC402