Tackling A Burning Issue

Designing Control Valves for Oxygen Injection in Steel Mills

The iron ores are reduced in a blast furnace. The carbon-rich molten raw iron is converted into low-carbon steel in massive converter ladles

Where extreme temperatures, oxygen and high pressure come together, materials that seem fire–proof such as metals can easily burn. Therefore, applications like molten metals call for highly specialised process components - also in terms of control valves...

ZSOLT PEKKER

"Oxygen fires" are a nightmare scenario for steel mills and foundries. Technically speaking, oxygen itself does not burn, yet it plays a part in every combustion process, from the log fire warming our home to the fuel vapor combusted in the cylinder head to drive our cars. The wood as well as the fuel react with the oxygen gas and release energy. When speaking of an "oxygen fire", which is wrong in itself, we refer to burning things that are usually considered incombustible, such as metals. However, the risk of fire increases the higher the pressure, temperature and oxygen concentration in the environment are.

Take a steel mill, for example: Here, pure oxygen at high pressure is blown into a melt that is hotter than 1000 °C. This means that the piping and valves used must be resistant to oxygen fires. Samson manufactures tailor-made valves that work safely and reliably under such severe operating conditions. Recently, SMS Siemag AG had to face exact this challenge when equipping several steel mills in India. The Solution: Valves from control valve specialist Samson Controls.

India – The Asian Steel Giant Flexes its Muscles

Indian companies play an important role on the worldwide steel market: Arcelor Mittal, Jindal Steel, Tata Steel and Bhushan Steel figure among the top players in the industry. In 2011, India ranked fourth among the world's biggest crude steel producers, which makes it an important market for SMS Siemag. The company with over 11,000 employees specializes in plant and mechanical engineering for the steel, aluminum and nonferrous metal industry. The range of services provided includes turnkey production plants as well as plant expansions and upgrading.

Oxygen Injection Systems for Indian Steel Industry

SMS Siemag received several orders from India in 2010 and 2011. For example, the Rourkela mill, which belongs to the state-run

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SMS Siemag, a specialist in international plant engineering, recently equipped several steel mills in India with tailor-made control valves manufactured by Samson. India is one of the largest crude steel producers with an annual output of 72.2 megatonnes.

Steel Authority of India, as well as works operated by Bhushan Steel and Tata Steel were to be equipped with new converters. Converters are the massive ladles where molten raw iron, which is rich in carbon, is converted into low-carbon steel. The decisive step in this conversion is cleansing out impurities, such as carbon, silicon, manganese, sulfur and phosphorus, which are removed from the 1700-°C-hot molten raw iron by oxidation.

Igniting Impurities – It's all About the Oxygen

Burning the unwanted ingredients generates so much heat that the converters do not need to be heated from the outside to keep the raw iron molten. What is needed though is oxygen in abundance. This oxygen is blown into the converter from the top through a water-cooled pipe with a nozzle, called the "lance". The incoming gas creates a violent exothermic reaction that burns the impurities and creates a turbulence to mix the melt.

Frank Baltes of Samson, who coordinated the SMS Siemag order for India from the Samson office at Krefeld, Germany, knows what it comes down to: "The exact timing and dosage of the blown-in oxygen are crucial. In the process, pure oxygen at a high pressure is handled. Under such conditions, the impact of a small dirt particle can suffice to create a spark and ignite the metal equipment." This risk is particularly high in the valve, where the gas flow is deflected and subjected to mechanical influence.

Finding the Right Alloy for the Most Unfavorable Conditions

There is not one single metal that is resistant to oxygen fire. Nevertheless, different metals and alloys show varying degrees of ignition susceptibility. Mr. Baltes describes the challenge involved in material selection as follows: "We need to find the right material and wall thickness - taking into account a sufficient safety margin - to prevent an ignition even under the most unfavorable of conditions. We calculated several sizing alternatives to match the special requirements. Finally, the customer decided in favor of a Type 3241 Valve with a stainless steel body and a seat and plug trim made of Monel."

Monel is an alloy that contains approximately 65 % of nickel, 33 % of copper and 2 % of iron. It is characterized by a high tensile strength and, more importantly in this case, a very high resistance to oxygen. This resistance against corrosion has made it a sought after material for applications from aerospace to the chemical industry.

Cooperation of Steel Experts Ensures Smooth Transformation

Mr. Baltes recollects how information was exchanged back and forth with the customer during the planning stage: "We provided the plans as 3-D volume models so that everything would fit perfectly together once it was completed and the strict safety regulations could be met."

Despite the intense planning, a small accident involving a forklift happened when the valves were unloaded in India. The resulting damage, however, could be remedied immediately by Samson's Indian after-sales service staff. This minor incident has not stopped the valves from working as planned and specified by the customer ever since.

Expertise in Technical Gases Paves Way for Valve Technology

When working with plant engineering companies like SMS Siemag, which operate all across the world, it is a clear advantage if a supplier can also rely on a worldwide network of aftersales and service staff. This way, it can be assured that spare parts and personnel are readily available. "Our cooperation with SMS Siemag has been going on for years. Our expertise in special materials and exotic alloys is of great importance to this customer and we have been able to score points by showing great flexibility in handling quotations and orders," summarizes Mr. Baltes. And he states another factor that played into Samson's hands in this order: "our experience gained as a supplier to all major producers of technical gases." ●

SAMSON IN INDIA

Control Valve Specialist with Experience in Asia

Samson has been active in India for more than 25 years and opened a subsidiary there in 1999. In 2009, the company headquarters were moved from the metropolis of Mumbai to Ranjangaon in the state of Maharashtra. In 2011, Samson India opened a production site at Ranjangaon, where valves, positioners, self-operated regulators for pressure, differential pressure and temperature as well as differential pressure meters are manufactured. The investment made amounted to approximately € 3.5 million to serve the expanding Indian market. Apart from the Ranjangaon headquarters, Samson has branch offices in Bangalore, Baroda, Chennai, Delhi, Kolkata, Mumbai, Hyderabad and Pune.