

State of the art desulfurization technology arrives in North America

ALMAMET is a leading supplier of desulfurization reagents, technology and expertise, having recently acquired thyssenkrupp Industrial Solutions. Facilities around the world include both torpedo and open ladle desulfurization, but the open ladle version gives significant cost and efficiency benefits, both for desulfurization and blast furnace operations. Dynamic co-injection offers savings of up to 20% on reagents, as compared with standard co-injection. The company is applying this know-how in the provision of a new desulfurization facility for Jindal Steel & Power Ltd in India and will continue to develop this combined service offering for clients around the world.

Author: Stephan Steinacker
ALMAMET GmbH

INTRODUCTION TO ALMAMET USA

Over many decades, the ALMAMET International Group has implemented new technological enhancements to improve the efficiency and economics of desulfurization. Total cost of ownership is the central focus of the company and so, in addition to considering the simple reagent cost of desulfurization, other factors such as iron loss, refractory wear and slag disposal are taken into account, in a complete assessment of each individual steel plant. These improvements have been delivered on almost every continent, including many European countries, Russia, South Africa and India, among others, but less has previously been done in North America. Recognizing that there has been little improvement in iron and steel desulfurization in North America over many decades, the company has expanded its know-how and expertise in this region.

Operating through its subsidiary, ALMAMET USA, the company is bringing to North America 40 years of desulfurization experience and global reach, with the more recent introduction of equipment and facility engineering. This powerful combination is intended to provide steel makers with a very competitive, innovative and professional company, with high-quality products as well as equipment that takes desulfurization knowledge and improvements to a new level. Not only can tailor-made injection blends be supplied for the most effective desulfurization processes, the company also owns a long reference list of desulfurization facilities that have been built, run and serviced. The group has the discretion to call on its professionals worldwide to make recommendations on improvements and upgrades to customers, based on proven methods and references.

ALMAMET USA can rely on a manufacturing, warehousing and supply facility in Ontario, Canada, to supply the magnesium portion of the reagent as well as products for

the chemicals industry. Next steps include expansion into facilities in the United States for lime supply, allowing the company to be a much needed reliable and innovative supplier for the North American steel industry.

DESULFURIZATION EQUIPMENT

Tough price competition in the steel market generally leads to the favouring of technologies that are efficient and economical in operation. In times of overcapacity, the ability to offer a sophisticated portfolio of high-quality steel grades contributes towards stable profits. With desulfurization, the chemical process for the removal of sulfur from a material, it is known that the simultaneous injection, or co-injection, of pulverized burned lime and granulated magnesium provides high process flexibility. Through this method, manufacturers can better adapt to changing production requirements and achieve best performance, while also maintaining low operational expenses.

Understanding the importance of desulfurization, in 2018 the company entered the field of plant engineering and equipment supply by acquiring the know-how, experience and workforce of thyssenkrupp Industrial Solutions, formerly known as thyssenkrupp Polysius. The acquisition includes around 50 desulfurization stations for torpedo and open ladles throughout the world, with capacities ranging from less than 50t to more than 350t of hot metal. These facilities have been equipped with injection technology by thyssenkrupp over the last 50 years.

The resulting entity, ALMAMET Industrial Solutions, based in the Westphalia region of North West Germany, is well equipped to be a leader in iron and steel desulfurization. It is intended to maintain the same levels of sophistication and proven designs that were offered under thyssenkrupp, at even more competitive prices. The high quality of the

equipment will guarantee customers many decades of safe and reliable operation and low maintenance costs.

OPEN LADLES VERSUS TORPEDO LADLES

Desulfurization is performed mostly in the ladle, where an extremely low concentration of sulfur can be obtained. The basic method is to add elements, known as reagents, which readily combine with sulfur. Calcium carbide was formerly the reagent of choice, but the trend has since moved towards a safer and more environmentally friendly combination of magnesium (Mg) and lime (CaO). Additional desulfurization is achieved with the help of injected, or otherwise introduced, calcium, calcium alloys, or synthetic slags. Both processes require intensive bath agitation.

Of the 50 desulfurization installations mentioned, some are for torpedoes, as well as open ladles. While desulfurization in torpedo ladles was once regarded as being state of the art, open ladle treatment stations have become the leading technology since the 1990s. The advantages of desulfurization in open ladles versus torpedo ladles include:

- A more suitable ladle geometry, which leads to the uniform distribution of the reagents.
- A high reagent efficiency combined with a low reagent consumption.
- The high conformity of final sulfur in the melt.
- A clear 1:1 allocation of the desulfurized ladle to the basic oxygen furnace (BOF) with no hot metal blending.
- Efficient slag removal in integrated desulfurization stations for a higher yield.
- Easier ladle cleaning and refractory maintenance.
- The full utilization of the torpedo capacity with no freeboard provisions for reagent injection.
- Fewer torpedoes required for continuous operation.

At the heart of this desulfurization system are pneumatic injection conveyors. These are powered by a programmable logic control (PLC) based injection control system, MEPOL, as well as the accurate batchwise calculation of process parameters. In pursuit of overall efficiency, it may be beneficial to optimize process economy and reduce the cost of hot metal, by tolerating high sulfur raw materials and pulverized coal.

FLEXIBILITY FOR BETTER CONTROL AND ECONOMICS

One of the most important aspects of hot metal desulfurization lies in the combination of the used reagents, and in this, the flexibility of the co-injection process becomes an important factor. While mono-injection systems allow only limited flexibility of the desulfurization mixture, well established co-injection systems, as shown in *Figure 1*, can

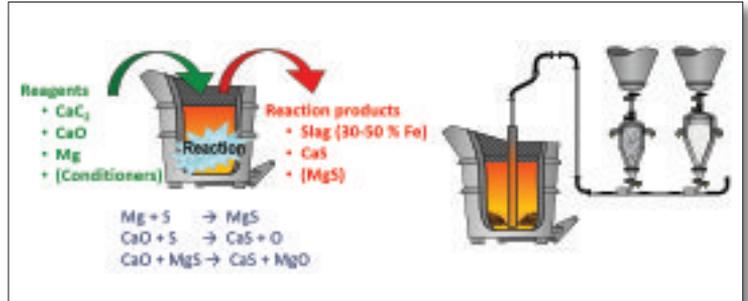


Fig 1 The co-injection process, as performed in open ladles

support an enhanced product portfolio.

The selective and sequenced injection of CaO and Mg leads to excellent process control and results in a positive effect on the economics of the process. The main advantages of the co-injection process for desulfurization in open ladles are:

- No upper limit on the sulfur start level, which can make the use of low-cost raw materials in the blast furnace possible.
- Very low final levels of sulfur are achievable in a reproducible manner.
- Various reagents and mixtures can be applied.
- No prior de-slagging of blast furnace slag, which reduces iron losses.
- A very low hot metal temperature loss during the treatment.
- Short processing times which lead to a high throughput.
- Low reagent consumption for a smaller amount of desulfurization slag and a higher yield.
- The opportunity to treat ladles with only a small freeboard.
- Comparably low space requirements and a flexible layout.

The dynamic co-injection process makes it possible to inject pure, fluidized CaO both in the beginning and at the end of the whole injection process. It also enables flexibility to vary the injection rates for varying periods of time, again depending on the process conditions. Pre-injection of CaO increases the basicity and reactivity of the slag. It also provides sufficient turbulence in the melt for the uniform distribution of Mg and CaO in the co-injection phase. This limits the injection of Mg, which is highly reactive and valuable, to the period when it will have greatest impact, resulting in optimized use of Mg.

CUSTOMIZED AND FULLY CONTROLLABLE DESULFURIZATION PROCESS

ALMAMET's dynamic co-injection capabilities are designed to provide the highest possible flexibility for a perfectly >

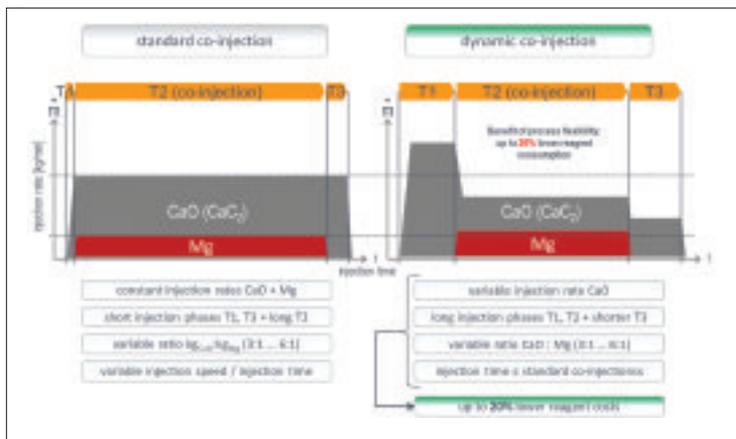


Fig 2 Comparison of standard with dynamic co-injection

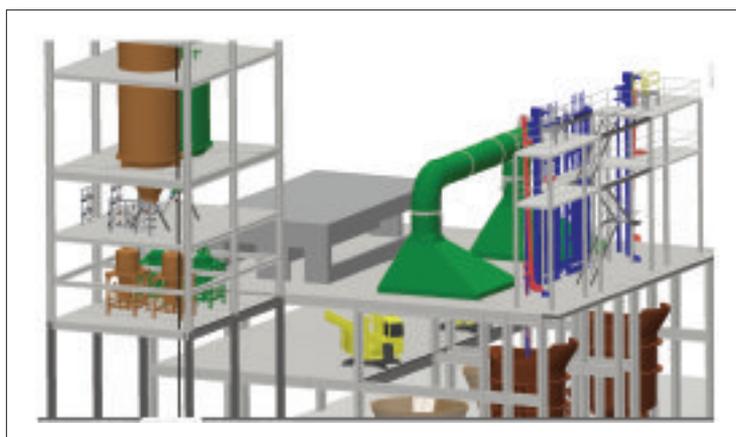


Fig 3 3D representation of desulfurization plant for JSPL, India



Fig 4 Global presence of the ALMAMET International Group

customized and fully controllable desulfurization process, as shown in Figure 2. The customization procedure considers all the relevant process and design conditions at the site. They include:

- Hot metal composition and temperature.
- Blast furnace slag basicity and characteristics.
- Ladle size, shape and freeboard.

- Required plant throughput and available treatment cycle time.
- Workshop space conditions and restrictions.

Based on this large matrix of influencing factors, the ideal reagent composition can be determined, with the most suitable plant layout and the most efficient injection process. These factors are agreed in close cooperation with the builder and operator. The company then aims to supply technology, reagents and services from a single source, for both key accounts and flexible business models, including services and spare parts.

NEW DESULFURIZATION PLANT IN INDIA

The first project of ALMAMET Industrial Solutions was for Jindal Steel & Power Ltd (JSPL), well known as a leading Indian company, with dominant interests in steel, power generation and mining. JSPL awarded the company with the construction of a new desulfurization plant at Angul in the state of Odisha, India, to include two fully equipped treatment stations. Alongside this is a service contract for the operation and maintenance of the newly built plant. A 3D representation of the plant is shown in Figure 3, including two stations, 260t ladles and transfer cars.

ALMAMET installed and now operates a facility for the preparation of first class fluidized CaO, using screened converter lime fines. This fully integrated desulfurization concept enables JSPL to count on reliable sulfur levels in all its steel grades, reinforced with the wider group's know-how.

MORE EFFICIENT AND ECONOMICAL TECHNOLOGIES

The combined factors of a customized plant layout, a flexible and reproducible injection process, as well as adapted reagents, have been shown to make a noticeable difference in plant performance and economics. Co-injection can play a key role in making metallurgical injection plants more economical and future-proof. In addition, this has opened new business opportunities and applications for the ALMAMET International Group with its co-injected desulfurization technology. The company intends to draw on its global presence (Figure 4) to augment its core business, supplying tailor-made desulfurization solutions, with a new expertise in plant engineering that helps its customers embrace more efficient and economical technologies. **MS**

Stephan Steinacker is Head of Business Development with ALMAMET, based in Bavaria, Germany. He also operates as Managing Director of ALMAMET SRL/Romania and Magnesium Solutions Europe/Germany.

CONTACT: steinacker@almamet.com