INNOVATIVE ELECTRIC SMELTER SOLUTIONS OF THE SMS GROUP FOR THE FERROALLOYS AND SI-METAL INDUSTRY

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ABSTRACT

As long ago as in 1906, the SMS group delivered the first submerged arc furnaces. Meanwhile - over the last 100 years – we have supplied more than 700 submerged arc furnace plants and major components for our customers worldwide, which operates plants for the production of ferro alloys, Si-metal, non-ferrous metals and other applications.

The fact that recently Metix as well as Paul Wurth joins the SMS group increased the product folio of SMS for our clients significantly and SMS offers the full process lines for all metal production plants including the full range of upstream and downstream equipment.

This paper will emphasize SMS recent developments and projects regarding the electric smelters and submerged arc furnace technology especially for the production of ferro alloys. As a leader in DC and AC-based technology, we will present the various application areas.

The paper will present the recent technological trends in electric smelter technology on the basis of numerous plants, which are currently under execution or had been commissioned recently.

Most of these electric furnaces are considered to be highly energy intensive units. The high level of required electrical power is to a great extend defined by the process but can also be influenced by the equipment and the operation practice. SMS developed several measures, how to reduce the overall electrical energy consumption of these metal production lines. This also includes options to utilize the RHF for the pre-heating and pre-reduction of the ores.

KEYWORDS: *DC-Furnaces, AC-Furnaces, submerged arc furnaces, ferro alloys, FeNi, FeCr, FeSi, circular furnace, rectangular furnace, SMS Siemag, metix, Paul Wurth, rotary hearth furnace, RHF, energy saving.*

METIX AND PAUL WURTH JOIN THE SMS GROUP, BENEFITS FOR THE WORLD MARKET

Since 22 June 2011, the Metix company, which is based in Johannesburg, joined SMS Siemag AG as part of the SMS Group. Active in plant construction and equipment supplies for the ferroalloy industry for almost ten years, Metix is the market leader regarding electric smelter technology in the Southern Africa region. Combined with SMS Siemag it takes the group market share to more than 50% of the western world ferroalloys, non-ferrous and precious metals market.

SMS Siemag is part of the SMS group, which in 2012 attracted sales totaling some EUR 3 billion with more than 13,000 employees.

Whilst previously Metix concentrated mainly on supply of equipment and plants for the production of ferrochrome and ferromanganese, its merger with SMS Siemag expands its range into Platinum, Si-metal, ferrosilicon, ferronickel, calcium carbide and copper. In addition, Metix now have access to new technology equipment and processes related to DC furnaces, rectangular furnaces, gas cleaning and waste heat recovery, which should be also of great interest for the platinum industry in South Africa. SMS Siemag covers the remaining parts of the world.

Paul Wurth, Luxemburg is with its 1600 employees and 26 daughter companies worldwide the leading company for the supply of complete solutions for blast furnaces, coke ovens and environmental technology for iron making plants. For submerged arc furnace and electric smelters, Paul Wurth offers superior equipment such as drilling machine and mud guns (TMT) and is also the leading supplier for slag and metal granulation systems as well as hot metal casting machines.

The Paul Wurth range of coal based direct reduction technologies, which can be applied in the ferro alloy industry.

Especially the rotary hearth furnace (RHF) allows the reduction of the power consumption of the smelters by producing pre-reduced hot ore and reduces the overall production costs significantly.

With Paul Wurth the SMS group also supplies modern lining concepts for the smelters including the hearth area, side wall and roof.

RECENT ELECTRIC SMELTER REFERENCES OF THE SMS GROUP

The following picture provides an overview of recently installed AC- and DC- furnaces with the involvement of the SMS group.

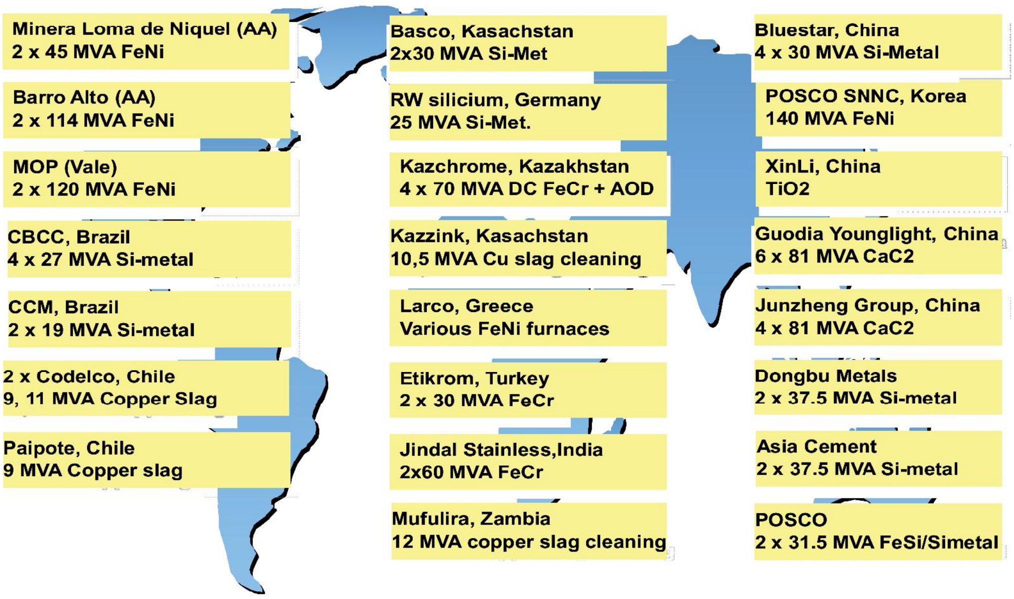

Figure 1: SMS Siemag milestones in SAF technology

The customers are distributed all over the world, pre-dominantly in countries with large raw material reserves and/or low energy costs.

ENERGY SITUATION

The overall energy consumption largely varies depending on the applied process. The chart gives an overview of some average energy consumption of various processes applied in the ferro alloy, Si-metal and CaC_2-industry [1]:

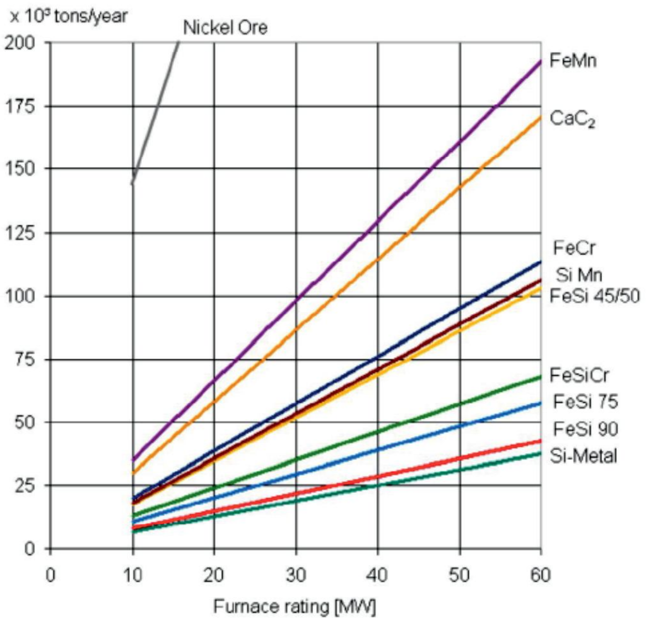

Figure 2: Production vs. furnace rating of various submerged arc furnaces

The production of Si-metal and FeSi requires the highest specific energy consumption. The electrical power required for a Si-metal furnace is in the magnitude of 11,000 – 13,000 KWh. FeNi units have an energy consumption between 5,500 – 8,000 KWh/ton. This strongly depends on the minerals and the Ni-level of the product. As an example the following graph (figure 3) shows the distribution of the energy of a FeNi-furnace.

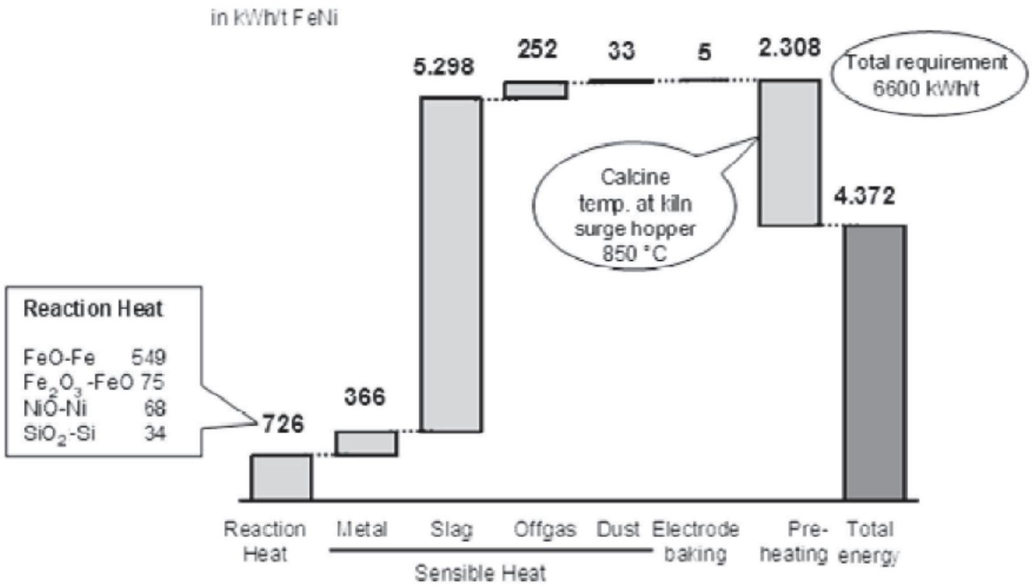

Figure 3: Energy consumption for FeNi processing [1]

It can be seen that the majority of the electrical energy is consumed by the metallurgical process. A large portion of the heat energy is later leaving the furnace via the slag. Only a smaller fraction of energy leaves the furnace via the off-gas. Additionally, when the process allows, a pre-heating and calcination of the raw materials can also significantly lower the power consumption of the smelter.

In the following, several examples are explained how over the last decades SMS Siemag worked on possibilities to reduce the overall energy consumption.

APPLICATION OF ENERGY RECOVERY SYSTEMS

Semi-open type furnaces: In Semi-open type electric smelters, the combustible components, which are generated during the process are fully burned in the freeboard area.The furnaces are either equipped with doors or openings in the roof, which allows the control of the off-gas temperature. Depending on the process the temperatures are between 550 to 750°C [1].

Such an energy recovery unit is being installed at Etikrom, the leading FeCr-producer in Turkey. The boiler produces 2 x 15 tons of steam, which will be converted in a generator to 2 x 2.5 MW electrical power. The client calculated an amortization period of approx. 3.5 years [2].

The feasibility of such systems gets even more economical for processes with a higher off-gas generation such as Si-metal furnaces. Internal calculation shows that more than 20% of the input electric power can be recovered.

Closed type furnaces: Due to environmental and ecological reasons, a larger portion of electric smelters are closed type furnaces, which produce larger quantities of CO-rich gas that can be utilized in various up-and downstream processes. SMS developed a “dirty-boiler-system”, which can take the hot dirty combustible gas and transform the chemical and sensible heat into steam (figure 4) [1]. The detailed principle is presented in a separate paper during this conference.

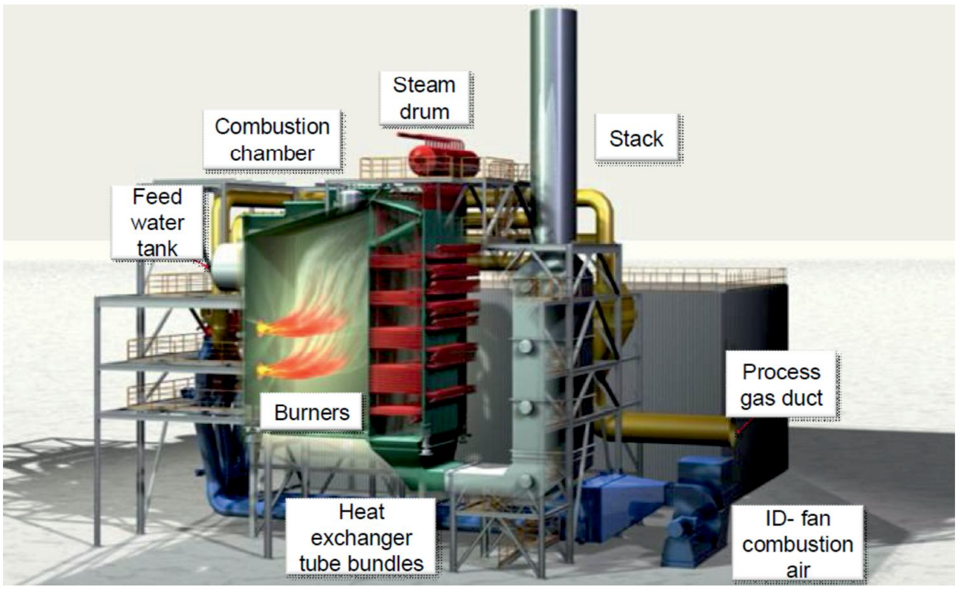

Figure 4: “Dirty Boiler” for recovery of energy of process gas

IMPROVEMENT OF THE OVERALL ELECTRICAL EFFICIENCY

Depending on the furnaces and the application, the electrical energy losses of poorly designed furnaces can contribute to almost 20% of the overall energy losses. The design and the chosen material for the high current line including the electrode column as well as for the roof can influence energy consumption greatly. SMS optimized the high current line system in this respect that we minimize the reactance of the system. The transformers are placed as close as possible to the electrode. Additionally, higher cross section in the high current line system as well as the use of a pressure ring, made of copper can reduce the overall electric consumption [3].

Figure 5: Lower part of the electrode column

Especially the use of copper pressure rings can contribute to a saving of up to 3% of the electrical losses for high-capacity furnaces. For this reason, SMS developed a patented lower part of the electrode column, which saves energy and is very easy in terms of maintenance [4].

ENERGY SAVINGS WITH ADVANCED COOLING CONCEPTS

Intensive cooling systems are necessary to prolong the lifetime of the furnace lining and the campaign period. It is SMS Siemags philosophy that the furnace needs to be cooled in a balanced way, avoiding that too much heat is removed from the process and the equipment. For the Kazchrome FeCr project, a new kind of cooling system had been developed to lower the overall energy consumption considerably. Each 72 MW furnace can save more than 3 MW in comparison to conventional DC-technology, as offered by other companies. Figure 6 shows an illustration of the furnaces [5].

The roof as well as the side wall is lined with high quality alumina based refractory. The closed type roof is air cooled as well as the bottom anode. The side wall is cooled by a channel cooling system.

Additionally we offer special cooling arrangements for FeNi furnaces based on inserted copper plates in the side wall [6]. This cooling system extracts less energy in comparison to available waffle coolers or copper staves, as supplied by others. This cooling arrangement is working successfully and reliable in the largest furnaces (figure 6).

Figure 6: Illustration of the DC-furnace as being built for Kazchrome/Kazakhstan [5]

Figure 7: Side wall copper cooling system [7]

OPTIMIZING UP-STREAM STEPS

One of the key items for a smooth and efficient operation of a submerged arc furnace is an accurate control of the input raw material being charged into the furnaces. An accurate control of the reductant in the mix as well as accurate physical and chemical properties can improve the overall furnace efficiency significantly [8].

Depending on the quality of the raw material for a Si-metal smelter, the energy savings, while using good raw materials can result in a magnitude of 2000 – 3000 KWh/ton of metal.

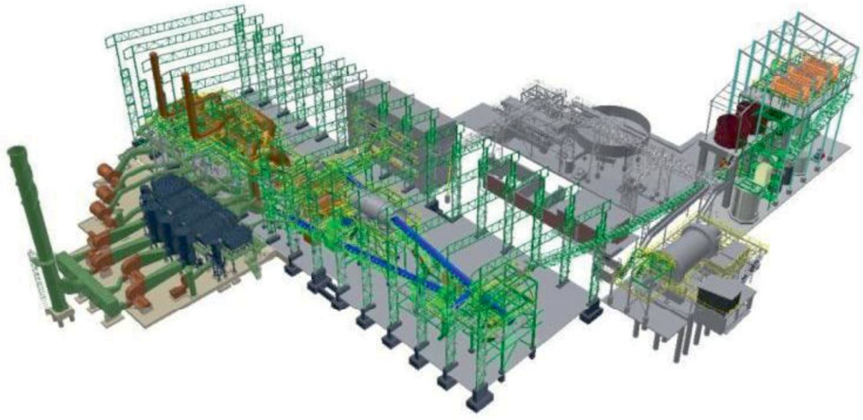

Figure 8: Cr-ore sinter plant as installed by Metix under the license of Outotec

For AC-based furnaces, especially for the FeMn and FeCr, it is important that the fraction of fines is kept to a minimum. Here SMS contributed to a large extend by installing sintering plants under the license of Outotec as well as briquetting lines for almost all plants in South Africa. Those projects were carried out under EPC- and EPCM responsibility by Metix [9].

For the FeNi furnaces, the quality of the calcine, in particular the chemical reduction degree greatly influences the specific power consumption of the smelters. Proper mining management, good carbon control and accurate kiln operation improves the overall plant performance [8].

MAXIMIZED POWER ON TIME AND AVOIDANCE OF INTERRUPTIONS

The heat losses and electrical losses are additionally reduced, when the furnaces are operating constantly at or above nominal load at a constant load, and when the furnace conditions, including the raw materials are kept constant. Especially furnace interruptions have a certain negative impact on the energy consumption due to the additional energy required for heating up the furnace and for stabilizing the process. SMS is well known for supplying reliable and efficient smelters all over the world. Our design assures highest availability levels.

For the DC-furnace, a new patented type electrode column system was developed allowing slipping and nippling under full power. This maximizes the power-on time and leads to fewer disturbances for the process and the off-gas system [3].

PRE-REDUCTION OF THE ORE

The SMS group is working on numerous processes regarding the pre-reduction of ore. Depending on the process, the chemical pre-reduction can reduce the power requirement of the smelter drastically. Usually coal based direct reduction processes such as rotary kiln and rotary hearth furnace technology can be used for this purpose. In this section we like to describe the potentials for the rotary hearth furnace technology.

The principle of this technology is rather simple and always similar independent on the raw material mix (figure 9).

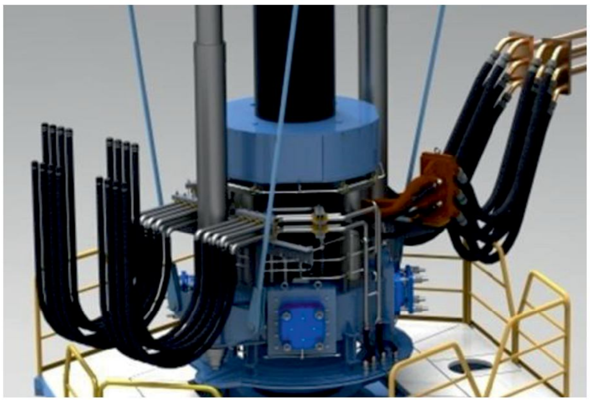

Figure 9: Patented electrode column for a DC-furnace [3]

The metal oxide containing ore together with a reductant (mostly coal) and a binder is agglomerated either with an extrusion or briquetting press or with a pelleting unit forming a "wet agglomerate", which is then charged to a rotary hearth furnace [10]. The Doughnut-shaped gas fired furnace quickly heats up the charge and partially chemically reduces the charge. The pre-reduced hot charge is then smelted in the submerged arc furnace [11].

Pig iron: The RHF was firstly applied in the 70ties for steel mill waste recycling and later for hot metal production out of iron ore. In 1999 SMS Siemag supplied a submerged arc furnace to "Iron Dynamics" (IDI), a daughter company of "Steel Dynamics" in Butler/Indiana. Today the unit produces approx. 300,000 tons of hot metal, which is send over the fence to the neighboring steel plant. IDI decided to close the submerged arc furnace to use the CO-gas from the smelter as a fuel in the rotary hearth furnace. According to IDI, the process only needs very little quantities of natural gas. SMS is investigating, if the same principle can also be applied for other metals. Numerous pilot and demonstration scale tests had been carried out to proof the technical feasibility of the RHF-SAF-process combination.

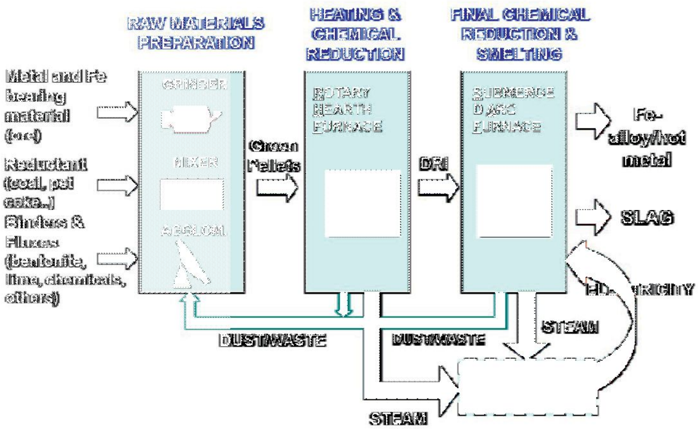

Figure 10: Basic principle of the RHF technology

FeNi: In one R+D-project a mix of Limonite and Saprolite (Transition Ore) was tested as the main raw material. The nature of this material is the main reason for developing this alternative process based on Rotary Hearth Furnace (RHF). In fact, due to its high fines content, it is challenging to directly charge the Limonitic to a calcination kiln, where it creates a high dust carryover. The RHF, thanks to its “gentle handling”, is the best option to treat cold-bonded agglomerates without risk of turning them back to dust.

Moreover, this furnace can take profit from the high Fe content of these kind of ores. In fact, when coal is added to the ore, the RHF is not only calcining, but also pre-reducing and partially metallizing the Fe and Ni oxides, thus considerably reducing the smelting power needed at the SAF.

Basically there are three application possibilities for the RHF:

- To substitute the ore treatment in rotary kilns with the pre-reduction in RHF, with a decrease of the electric energy consumption and the possibility to use fines as raw materials
- To substitute the route Sinter + BF with that RHF + SAF, decreasing the operating cost and increasing the production flexibility and product quality
- To treat in the RHF the fines produced in the RK + SAF route, obtaining a pre-reduced product, which can be easily charged in the smelting furnace

In 2010, Paul Wurth carried out industrial tests at Inmetco/USA in a RHF, where the reduction of NiO had been successfully tested.

The rotary kiln produces large amounts of dust. The quantity of dust is from 10 to 30 % of the total Ni ore charged, mainly coming from the rotary kilns for drying, calcining and pre-reduction. The dust has more or less the ore composition. The basic idea is to reduce the dust in a separate RHF and to charge the hot Ni-containing DRI to the existing smelter. This measure will boost the overall capacity of the FeNi-plant. Furthermore this kind of the dust treatment also greatly reduces the environmental pollution. Any kind of dust produced in the plant can be treated in the RHF: from drying and calcining RKs, from EFs and refining stage. Furthermore the RHF can treat also the dust of the existing stockpile, if any: this option has a very important economic and environmental impact. Depending on the location, the economical return of this solution presents, generally, a very short pay back time.

FeCr: SMS is also involved in the development of using the rotary hearth furnace for the pre-reduction of Cr-ore. In the 80ties, industrial tests were carried out, which basically demonstrated the feasibility of this technology. Today, SMS is collaborating with Midrex and Kazchrome, to confirm the past test results while using the Cr-ore concentrate as well as the coal of Kazchrome. The major target is a significant reduction of the specific electrical power consumption in the SAF.

So far fundamental tests as well as preliminary pilot tests had been conducted with promising results. Besides a significant electrical energy saving, SMS sees the following additional advantage compared to the kiln pre-reduction process principle:

- Ore agglomerates can be directly charged into the rotary hearth furnace because the charge rests on the hearth and are subject to minimal mechanical stresses.
- The carbon content in green pellets can be adjusted.
- There are no sticking problems expected in the RHF.
- The reduced pellets are ideal for hot charging into the smelting unit because of their uniform physical properties and adjustable carbon content.
- The RHF might achieve a higher metallization in the direct reduced chrome ore (DRC) and results in the lowest energy consumption for the subsequent smelting.
- Due to less fines generation, higher overall plant productivity.
- CO-gas from the SAF can be utilized.

The following picture 11 shows an illustration of such a plant concept.

To demonstrate the economic advantages the following case study can be assumed, based on raw materials from Kazakhstan.

When green pellets with the composition of 15.5 % C, 15.0 % Fe, 23.2 % Cr, 0.2 % S and 13.5 % H_2O is used the product of the smelter will contain approx. 5% of C, 19.5% of Fe (at a metallization of 95 %) and 29.9 % of Cr (at a metallization 50 - 85 %).

First recent test at the test center of Midrex in Charlotte/USA indicates a possible metallization of >50%. Additional tests need to confirm these figures. Based on these data SMS carried out a mass balance to indicate the potential electrical savings. Usually the practical energy consumption without pre-reduction is in the magnitude of 4000 kWh/t FeCr.

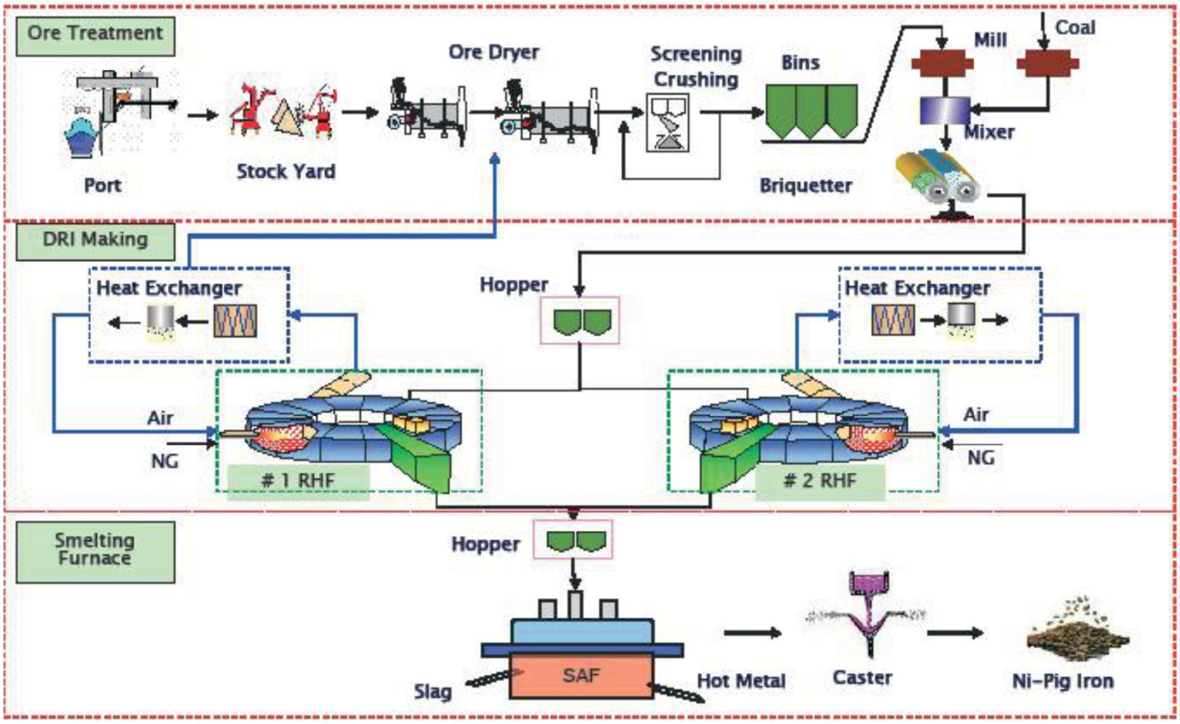

Figure 11: RHF-SAF concept for the production of FeNi/Ni-pig iron

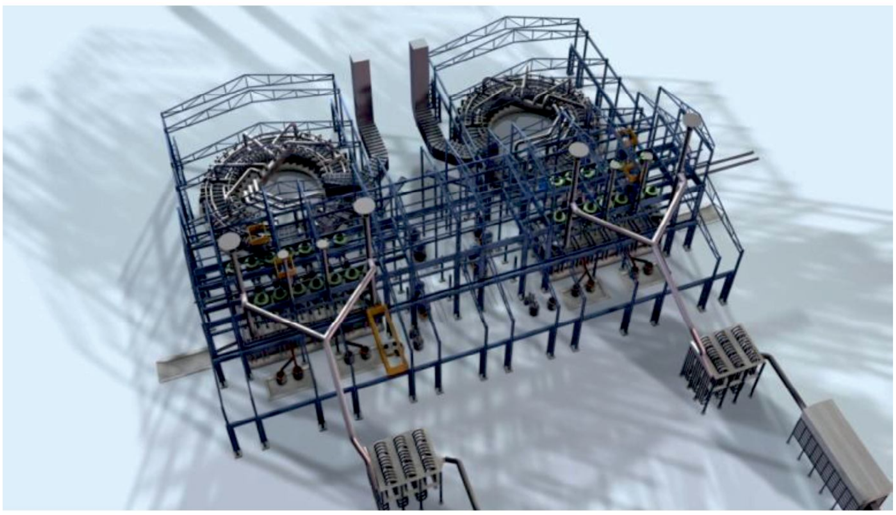

Figure 12: RHF-SAF plant for the production of H.C. FeCr

		DRC 50	DRC 80
theor. energy consumption	kWh/ t FeCr	1880	1400
production	t/h	66,6	66,6
total furnace load	MWh	125	93
load of one furnace	MWh	63	47
total losses	MWh	12	10
total furnace load	MW	75	57
practical energy consumption	kWh/ t FeCr	2240	1700

Figure 13: Power consumption of the electric smelter

ENERGY RECOVERY SYSTEM OUT OF LIQUID SLAG

From the technical point of view, it is most challenging, recovering the sensible heat out of liquid slag. Especially for a process, generating large amounts of slag (such as for FeNi-smelter plants), such a system could decrease the overall energy consumption significantly. Paul Wurth as part of SMS developed a system, which will be in operation within 2013. The dry slag granulation system injects steel ball into the liquid slag and the conductivity of the “slag cake” is improved, and it is possible that the sensible heat is transferred to a heat exchanger. The cooled down solidified slag is later crushed, the steel balls are screened out and send back into the energy recovery unit. Such a system is currently under construction on industrial scale at one of the leading steel producers in Germany. When the results are positive and the plant demonstrates its feasibility, such system will also be applied for the ferro alloy and non-ferrous industry.

GENERAL ASPECTS REGARDING THE APPLICATION OF SUBMERGED ARC FURNACES AND ELECTRIC SMELTERS

Today more than 99% of ferro alloy and TiO_2-production is carried out in AC furnaces. There is no application in the pyrometallurgy for DC furnaces that has not been carried out in AC furnaces before. A partial substitution of AC furnaces by DC furnaces was considered only by few customers (mainly for the application FeCr, FeNi, TiO_2, PGM) as it will be further described in the following chapters.

Ferro Nickel: Until today all of the pyro metallurgical FeNi is produced in conventional AC based submerged arc furnaces [12]. The strong competitiveness of submerged arc furnaces for ferroalloys has been mainly achieved by the installation of advanced high-power smelting units. During the last decade numerous improvements have been developed providing efficient and safe operation with large scale FeNi-furnaces. Modern ferro-nickel SAF's are characterized by high efficiency. In general, depending on the requested capacity, these may be round or rectangular-shaped furnaces (figure 9) [13]. The choice is mainly based on the anticipated power input. SMS SIEMAG has found that where more than 60-70 MW nominal furnace load is required, a rectangular furnace is the best solution from the technical, economical and operational point of view. Below this capacity the circular furnaces are the preferred solution [14].

This new demand led to the development of various sidewall cooling concepts as well as to the development of AC thyristor controls, which allow better operational control, higher and more efficient power input and less overall maintenance. Sidewall cooling and a thyristor control system are installed in the smelters for Eramet in New Caledonia as well as Anglo American and Vale in Brazil.

In December 2013, SMS Siemag received the order by POSCO SNNC, one of the internationally leading FeNi producers to deliver the world's largest submerged arc furnace for the production of FeNi. POSCO SNNC is a joint venture between the Korean company POSCO and the mining company SMSP, which is based in New Caledonia. The Ni-ore of SMSP's mine NMC is shipped to the plant in Gwanjang and converted to FeNi.

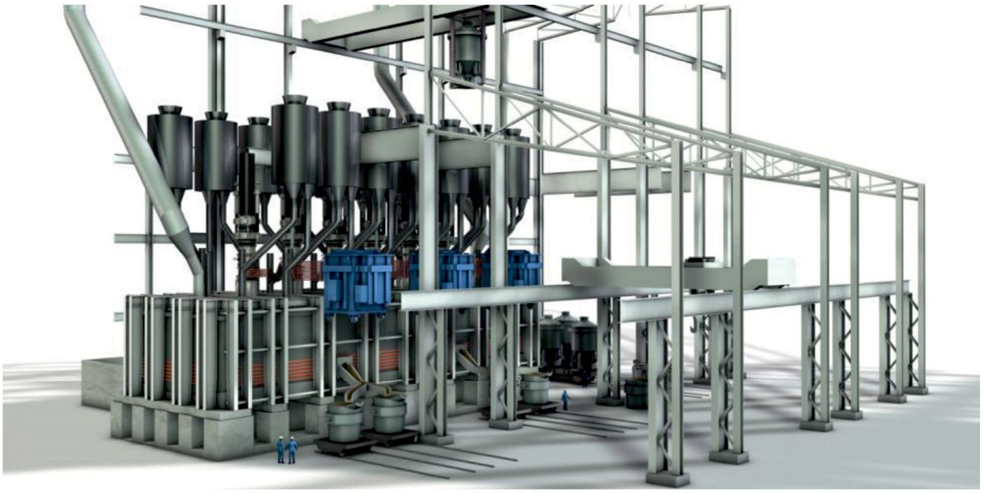

Figure 14: 3D Illustration of a modern rectangular FeNi plant

It is the target of POSCO SNNC to boost the annual capacity to approx. 54,000 tons of Ni. The expansion of POSCO SNNC includes the capacity increase of the New Caledonian mine as well as an expansion of the FeNi-plant. This requires, beside other units, an additional kiln for the production of calcine and the installment of a second submerged arc furnace.

The power rating of the rectangular shaped FeNi-smelter is approx. 140 MVA resulting a total nominal power input of approx. 100 MW. Such a large capacity furnace requires impressive furnace dimensions of approx. 40 x 15 m, which represents the world largest electric smelter.

Numerous innovations are incorporated in the smelter design. SMS Siemag will use a modern air cooling system for the lower shell of the furnace. Additionally certain modernizations of the patented sidewall-copper-cooling system for the slag line level will be applied. The cooling rate will be improved compared to the previous supplied systems.

Nevertheless the overall required cooling rate is moderate, which improves the thermal efficiency as well as the productivity of the furnace.

The applied binding system represents the best mechanical system for the controlled expansion of the furnace lining. It works with tile rods in the longitudinal direction and with a balcony shaped sidewall system in the transversal direction.

The scope includes the engineering and supervision services as well as the supply of complete furnace with the above described features including the electrics and automation.

Our client plans to commission the plant in the last quarter of 2014. The following picture shows the contract signing on December 17th of 2012 at the Gwanjang site together with POSCO SNNC, TongIl Boiler and SMS Siemag.

Ferro Chrome: Ferro-chrome production is carried out in either a DC or AC-based SAF. Until today almost all FeCr is produced in conventional AC furnaces which are charging cold lumpy material to the furnace [14].

Over the last years, Metix converted numerous former open-type furnace in South Africa to closed type furnaces. The modification requested also a replacement of the electrode columns. The main customers are Xstrata, Mogale, Hernic as well as IFM. All furnaces of these clients are equipped with the robust Metix type copper equipment that ensures availability, durability and stable furnace operation. Innovative design on the replacement is the main focus to minimize downtimes.

At the beginning of 2008, SMS Siemag received the order form ETI- Krom in Elaziğ, Eastern Turkey, for the revamp of two AC-based FeCr furnaces and both furnaces were started up in 2010. These furnaces are equipped with an energy recovery system allowing the recovery of approx. 12% as electrical power.

The increasing proportion of fine ore drove some ferrochrome producers to the decision to process the material directly as fines. The application of DC furnaces was investigated in the 1970s in South Africa due to the accumulation of huge chrome ore fines. A first pilot 16 MVA furnace was operating at Palmiet Ferrochrome in Krugersdorp in South Africa in 1983, five years later a 62 MVA furnace was commissioned at Middelburg Ferrochrome. Currently there are two furnaces in operation at Samancor (40 MW and 60 MW). SMS Siemag received the order for installing 4 x 72 MW furnaces for Kazchrome in Kazachstan. The units will produce approx. 440,000 annual tons of liquid H.C. ferro chrome. A layout of the plant is shown in figure 15.

These innovative furnaces represents a new DC-smelter generation. In particular the DC-electrode column design and the refractory/cooling concept will allow a higher productivity as well as higher power-on-time. It is planned that the furnaces will be commissioned within 2014. SMS is also responsible for the EPCM-service.

Ferro Manganese: Over recent decades, SMS has designed and supplied several ferromanganese/silico-manganese SAFs around the world. In France, the world's largest FeMn-SiMn furnace is operating very successfully, processing alumina-rich Carajas ore from Brazil. The major part of the ore is charged as sinter into the furnace, which is nearly 20 meters in diameter and has 102 MVA transformer capacity [15].

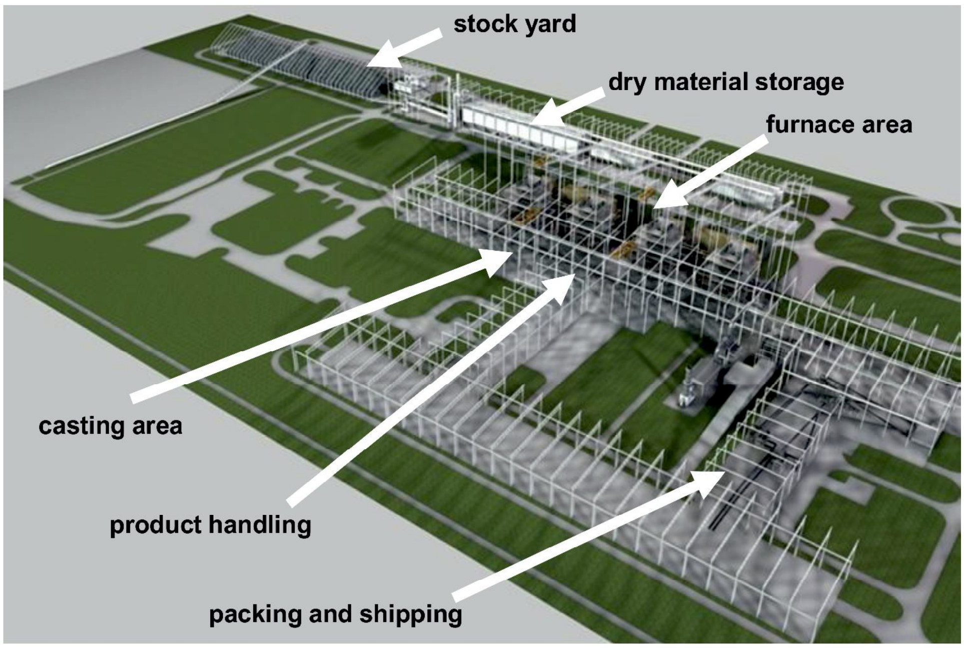

Figure 15: 3D Illustration of a modern DC-based FeCr plant

Furthermore Metix was also involved in the modification of numerous smelters for Mogale Alloys, Assmang Catoridge and BHP Metalloys in South Africa. Metix supplied the electrode columns including copper cooled roof for largest Chinese FeMn/SiMn furnace for Yunnan Metallurgical Group Co Ltd.

Today's Fe-alloy furnaces are designed with a compact high-current supply system, which minimizes the reactance of the furnace and maximizes the electrical efficiency.

Currently SMS carries out the engineering for a new FeMn/SiMn plant in Asia, which will operate two 75 MVA closed type furnaces. The plant will be equipped with a new scrubber system, allowing a dust content in the clean gas below 30 mg. This technology ensures a stable operation of the furnace and is compared to the disintegrator solution less cost intensive. This unit can be also connected with a SMS-ELEX-type electrostatic filter system to reach dust contents < 10mg in the clean gas.

Silicon metal and FeSi: SMS Siemag has supplied the majority of large-scale submerged arc furnaces for silicon production, which typically operate at 12-24 MW. The demand for high-grade silicon is growing, mainly due to increasing demand from aluminum, silicon and other industries. A large-scale modern Si-metal plant is shown in figure 17.

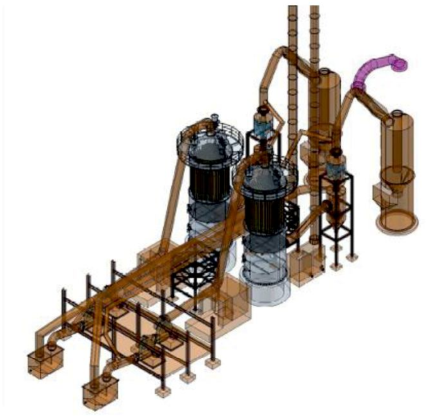

Figure 16: Wet scrubber gas cleaning plant for closed type submerged arc furnaces

The process requires an energy input of about 12 MWh per ton of silicon with high quality raw materials, such as high-quality quartz and low ash reductants. It is sometimes economically feasible to install energy recovery systems. The specially designed furnace hood allows an off-gas temperature of approx. 800°C [16]. Additionally, the fume exhaust gas is injected in the hood which eliminates the necessity for a bag house for the tapping fume dedusting system in this area [16].

At the moment several projects for FeSi and Si-metal plants are under execution. The clients Dongbu Metals and Asia Cement, both based in South Korea will built a two-furnace-based Si-metal plant in the Sarawak district in Malaysia. The technical data for both plants and the related furnaces are similar. Each furnaces has a power rating of 24 MW and the plants will produce > 30,000 annual tons of Si-metal. The client plans to commission the plants in 2014 and 2015. Additionally POSCO awarded SMS with the supply of two FeSi-furnaces with a power rating of 21 MW. The erection is almost completed and both furnaces will be commissioned this year. For the above mentioned projects SMS supplies the core equipment including the three electrode columns of its latest design and a new water-cooled gas hood.

In 2010 the SILIKAZ COMPANY commissioned the two-furnace plant, which was installed in Kazakhstan. Besides the furnaces themselves, the entire plant engineering from raw material handling to packing of the final product (four different grain sizes Si-metal) was done by SMS.

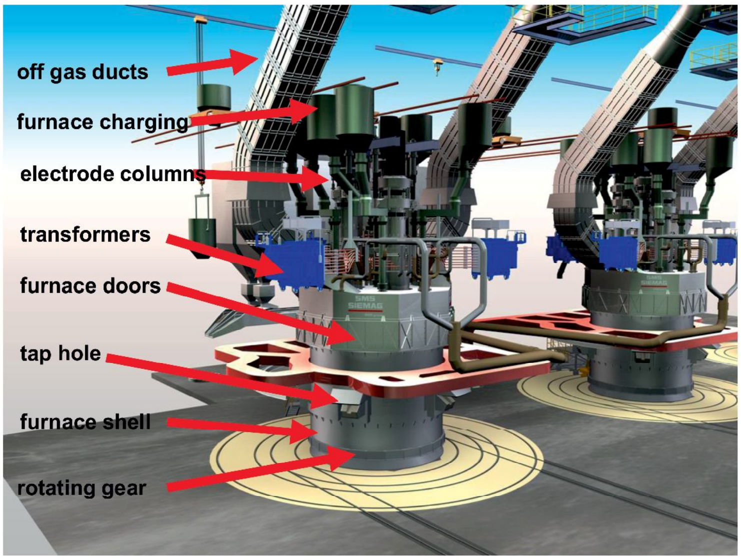

Figure 17: 3D illustration of a modern Si-metal plant

CONCLUSION

The first SAF was commissioned more than 100 years ago in Germany. Since then the remarkable development of this smelting tool has been recognized all over the world, and submerged arc furnaces are now operating in at least 20 different main industrial fields. With Metix and Paul Wurth the SMS group can offer a wide and complex product portfolio for AC- and DC-based smelter technology. This also includes intelligent solutions regarding energy recovery systems and coal based pre-reduction units. It is our goal to offer plant and equipment concepts, which are from the economic and ecological point the best solutions for our clients.

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