



NEW APPROACHES IN ENVIRONMENTAL TECHNOLOGIES FOR GREEN PLANTS¹

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Abstract

Energy and environmental technologies do not only gain public awareness, but represent a steadily growing major market of the steel industry – especially against the background of increasing energy costs and stricter environmental legislation. Both have been leading to rapid technological advancement and further improvements of the processes in the steel industry since many years. The presentation sums up these developments in regard to optimized technologies as well as to the necessary investments which were made in order to enhance the processes. In addition, the most important fields of energy and environmental technologies are presented. To make it more demonstrative, examples of state-of-the-art energy and environmental technologies like water treatment plants and converter gas recovery for BOF steelmaking plants are presented. Furthermore, trendsetting technologies are introduced, such as an innovative energy recovery system for electric arc furnaces (EAF), two types of next-generation electrostatic precipitators (ESP) for BOF gas cleaning, novel hydrothermal acid regeneration plants and the pioneering foamy slag briquettes to establish an effective foamy slag practice in EAFs for stainless steel production.

Key words: Energy efficiency; Environmental technology; Gas cleaning.

NOVOS DESENVOLVIMENTOS EM TECNOLOGIAS AMBIENTAIS PARA PLANTAS “VERDES”

Resumo

Tecnologias energéticas e ambientais não somente ganham conhecimento público, mas representam um crescente Mercado da Indústria do Aço – especialmente em um ambiente de aumento de custos com energia e maiores exigências regulatórias ambientais. Ambos os fatores acarretaram em um rápido avanço tecnológico e respectivas melhorias na Indústria do Aço há alguns anos. Esta apresentação resume os desenvolvimentos tecnológicos, bem como os investimentos necessários que foram realizados na melhoria dos processos. Adicionalmente são apresentados os mais importantes campos das tecnologias energéticas e ambientais. Para ilustrar, a apresentação inclui exemplos de tais tecnologias no seu estado da arte, como plantas de tratamento de água e sistemas de recuperação de gases de convertedores para aciarias integradas. Além disso, tendências tecnológicas são apresentadas, como o inovador sistema de recuperação de energia para fornos elétricos a arco (FEA); precipitadores eletrostáticos de última geração para limpeza de gases de convertedores; novas plantas hidro-térmicas de regeneração de ácido e a pioneiro sistema de quebra de escória para estabelecer prática eficiente de escória espumante em FEAs para produção de aços inoxidáveis.

Palavras-chave: Eficiência energética; Tecnologia ambiental; Limpeza de gases.

¹ Technical contribution to the 41th Steelmaking Seminar – International, May, 23^h-26th 2010, Resende, RJ, Brazil.

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SMS Siemag goes for networked environmental engineering

The plantmaker SMS Siemag expects the future to hold great potential for the field of energy and environmental technology. The company has further reinforced its already traditional dedication to energy-efficient and environment-friendly plant and equipment. The list of proven but especially also of new technologies is long and continues to grow. It ranges from the novel thermal recovery system in electric steelmaking shops to converter gas recovery, innovative dry and wet-type electrostatic precipitators for converters, filter systems for rolling oils and emulsions, complete plant and equipment for water treatment, and includes the newly developed hydrothermal regeneration of acids for pickling systems. These new technologies also reflect a new way thinking with regard to the efficiency of resources, energy recovery and environmental protection.

In view of the ever increasing cost of energy and raw materials, resource-saving production methods and modern recovery technologies will pay off quickly. The economic effects are particularly significant where environmental and recovery techniques are not looked at individually, e.g., for each plant or for each process step, but as an integrated system. For the question here is: How can thermal energy or residues obtained in a process be used directly for other processes in a facility, by the shortest route and without any costly conversion? It is precisely these questions that the Energy and Environmental Technology specialist department of SMS Siemag is dealing with. It acts as a counterpart to the environmental engineering departments of our customers who have also set up company-wide centres of competence and coordination to meet the growing requirements.

New metals – optimised and tailor-made

Thanks to new or optimised plants and processes, metals today can be produced with tailor-made and improved properties. Their contribution to the reduction of CO₂ emissions has in recent years been enormous. For example, lighter and also safer high-strength steels make it possible to produce lighter automobile chassis. For example: If the Eiffel tower were to be built again using today's steel grades, two-thirds less steel would be needed. Yet despite all these the positive factors, the challenge still remains of reducing the energy input and emissions in the production and processing of steel even further.

Environmental protection and energy savings must also make sense economically. Only then will technologies become marketable and be used by the industry. As a motto for the future, SMS Siemag's Energy and Environmental Technology department has coined the brand name x-e², with e² standing for ecology and economy.

The portfolio of SMS Siemag in the field of energy and environmental technology covers five basic areas. These are:

- Energy
- Air
- Water
- Liquids and residues
- Service

Intelligent use of energy

A new SMS Siemag system for energy recovery downstream of the electric arc



furnace is a good example of networked thinking with regard to energy and environmental technology systems. In this new system, the furnace off-gas, which has a temperature of 1,250°C, is routed through a boiler system which, on the one hand, brings about the necessary cooling of the gas and, on the other hand, converts a large portion of the thermal energy into steam. This can be used in ways that depend on the individual configuration of the steelmaking plant. For example, it can be fed into the steelmaking plant's steam network, power a turbine with generator or even an air separation plant that generates the gases needed for melting the steel, such as nitrogen and oxygen. In addition, the steam may be used for treating contaminated water or for the desalination of ocean water. A particularly efficient application: The steam produced from the EAF's waste heat can power the vacuum ejector pumps of a vacuum degasser and thus render the otherwise necessary steam generators superfluous. The new process from SMS Siemag converts up to 1,000°C hot waste gas into useful energy. In a current project, this process is being used to generate around 60 tons of saturated steam, which corresponds to a power of around 7 MW. The effect: Around 50,000 tons of CO₂ emissions are saved per year. SMS Siemag's CSP® plants also have a huge savings potential. The Compact Strip Production (CSP®) technology, which was made ready for launching on the market 20 years ago, uses a continuous process route to roll cast, hot steel directly into steel strip. Reheating of the steel slabs as in conventional hot strip production is no longer necessary, resulting in energy savings of up to 42 per cent. Since then SMS Siemag has continuously further developed CSP® plants so that today, for example, thinner strand dimensions can be attained by applying the new Liquid Core Reduction (LCR) technology. These dimensions require less rolling force and energy in the subsequent rolling process.

An established process is the SMS Siemag system for the recovery of converter gas. In this process the combustible CO gas is cleaned, stored in X-Melt gas holders and made available, for example, for the generation of electricity in a power station. Around 80 cubic meters of CO gas per ton of steel are recovered. Therefore, in an integrated metallurgical complex (blast furnace plus steelmaking plant) with an annual production of 5.2 million tons of steel this results in a recovery of around 420 million cubic meters of gas. The amount of gas recovered would be enough to furnish around 35,000 four-person households with heating and hot water for one year.

Not quantified so far are energy savings resulting from new automation and optimised process technologies, for example in secondary metallurgy which account for shorter treatment times, increased utilisation of energy and fewer alloying additives. They too are part of the environmental balance of a modern steelmaking plant.

Cost efficiency in air pollution control

Fifteen to twenty kilograms of dust arise in every ton of steel produced. With an annual production of 1.2 million tons of steel this amounts to around 20,000 tons of dust. SMS Elex has developed a new filter unit that optimally supplements the gas cleaning process which is most commonly used in converter meltshops today, namely the wet-type scrubber. This refers to the hydro-hybrid electrostatic precipitators which in addition to the dry-type electrostatic filters represent an innovative product. This new concept makes it possible to revamp existing filter units to meet stricter EU pollution limits at a low cost. The combination of, for example, a Venturi scrubber and a hydro-hybrid filter produces pollution levels of less than 20



milligrams per cubic meter of off-gas.

In aluminium cold rolling mills, special low-viscosity rolling oils are used for cooling and lubrication, of which a part evaporates during the rolling process. These vapours are exhausted and routed into the Airwash™ system of SMS Siemag. There they are directed through a sort of generously dimensioned sponge in which the oil vapours are washed out with the help of washing oil. In an average plant this allows around 100 litres of rolling oil to be filtered out of the off-gas in one hour. In a distillation process the rolling oil/washing oil mixture is then decomposed again into its constituents. The result being clean air, recovered rolling oil for the rolling process and treated washing oil for repeated cleaning of the exhaust air. To optimise the cleaning capacity, SMS Siemag's affiliate SMS Lubrication has developed a new washing oil which is tailored to the specific requirements of the Airwash™ cleaning process.

Keeping water in a circuit

As a provider of integrated plant solutions, SMS Siemag's portfolio, of course, also includes the entire range of water supply and treatment systems. These include pump stations, filter systems, cooling basins and much more. SMS Siemag designs and builds the complete systems, starting with the cooling circuit and extending to treatment systems, including the return of water into the production process. In the process, the water supply and treatment system is designed specifically to meet the plant or customer requirements. An example of the dimensions: In a current project for a US customer, around 32,000 cubic meters of water per hour from a hot rolling mill are cooled, cleaned and returned to the process.

Treating liquids and residues

In a rolling mill, special emphasis is placed on capacity and product quality. Termed "ancillary systems", filter and treatment systems have so far led a shadowy existence. However, awareness and emphasis have changed. For example, for rolling mills alone, SMS Siemag offers eight different filter systems to enable customer-tailored solutions. Special mention must be made here of the multi-plate filters, which on account of their modular design and high filter capacity have since become part of the standard equipment of a cold rolling mill for aluminium sheets. In a Chinese facility which is about to be commissioned, three of these filters will in the future treat around 14,000 litres of rolling oil per minute. In addition, rolling oils specially developed by SMS Lubrication will make the rolling process more efficient. This will minimise friction forces in the roll gap and also the energy input, while ensuring improved surface finish.

Another example of economical recycling technologies from SMS Siemag are acid regeneration systems in pickling plants. Technologies such as the eddy-current and spray roasting processes recover 99.8 percent of the acid for re-use. In an average pickling facility, 10 to 20 cubic meters of spent acid are obtained per hour. This corresponds to around 20 to 40 tons. To dispose of such a quantity, one to two tank trucks per hour would be needed. The savings and environmental protection effect thus goes far beyond the idea of economic recycling. SMS Siemag is one step ahead here: Hydrothermal regeneration is a new acid regeneration method whose chemical processes take place at a maximum of 170°C. Methods used so far require a process temperature of 700 to 900°C.

With the so-called foamy-slag briquettes, SMS Siemag has developed another new



patented process for the production of stainless steel. It recycles a huge amount of dust, improves the metallic yield and results in a longer service life of the refractory lining as well as of the electrodes in an EAF. For this purpose, newly developed briquettes are added to the molten metal. A large portion of these briquettes consists of residues such as EAF dust, as well as carbon, binding agents and other fluxes. With the effect that they produce a foamy slag similar to the foam on a cup of cappuccino. For carbon steel this effect is produced by the injection of carbon and oxygen. However, this method cannot be used for stainless steel. In the form of foamy-slag briquettes, the benefits of a foamy slag are now also available in the production of stainless steel – a major technology leap.

Summary

SMS Siemag does not only offer the equipment and technological solutions described above. Beyond that, SMS Siemag offers environmental and energy audits, and is also currently developing a comprehensive environmental monitoring system for all the equipment used in a steelmaking plant. It ensures that all energy and environmentally relevant data converge in a central control room. Customers benefit from the fact that they immediately receive an on-line overview of the current situation and can on the basis of these data check their production processes and work continuously on improvements.