

metals & mining

The magazine for the metals and mining industries

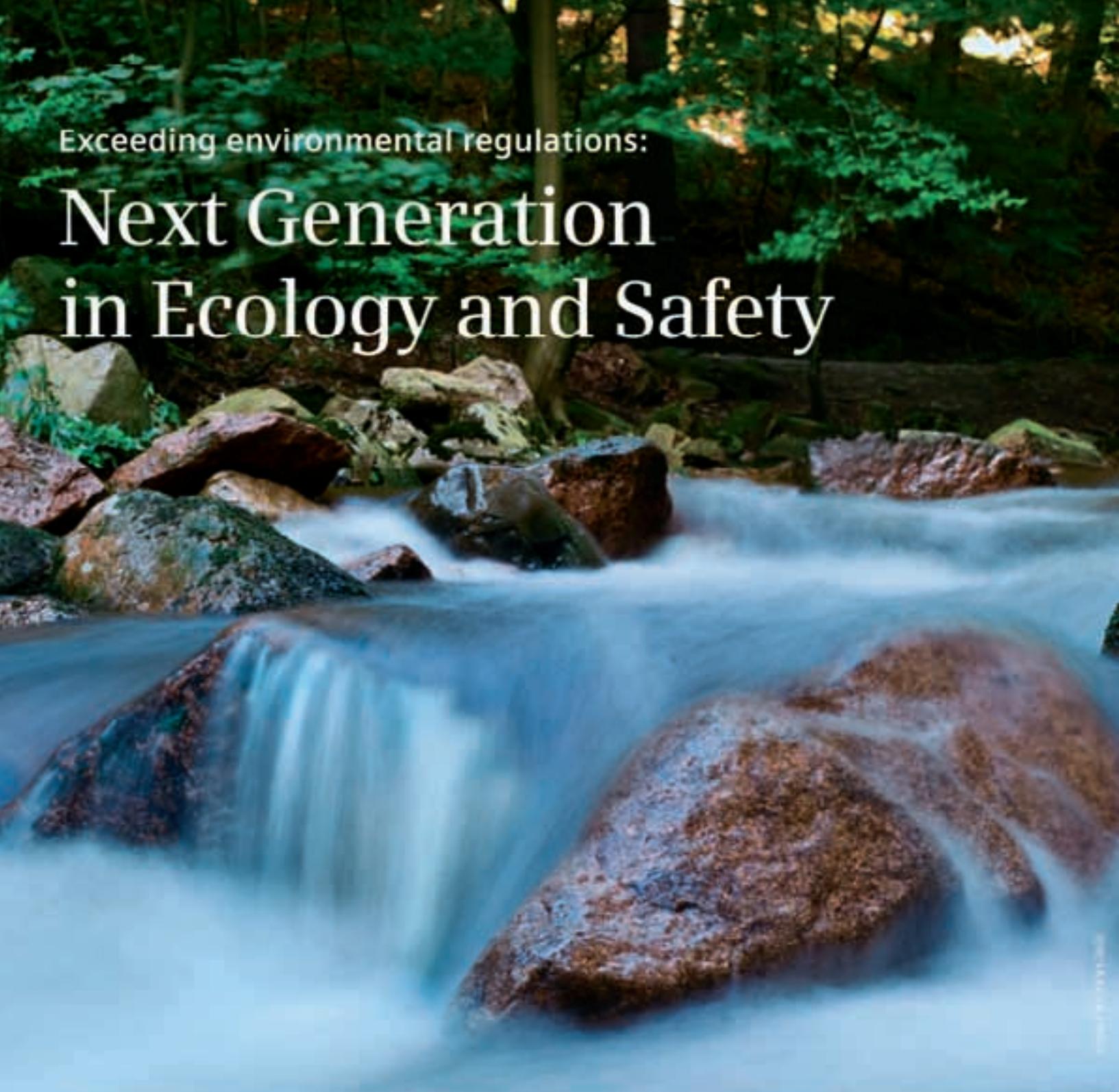
Issue 1|2009

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Energy and
Environmental
Care



Exceeding environmental regulations:

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Metals Technologies



EDITORIAL >

Dear Readers,

Energy and environmental care is becoming increasingly important in the metals business and therefore it is a cornerstone of Siemens VAI policy. This is reflected by the broad range of products and solutions offered by our company, many of which are presented in this special issue.

Up until recently, metal producers were confronted by galloping operating costs, which were primarily the result of increasing prices for metallic ores, scrap and, in particular, energy. Additionally, ever-stricter legislation has forced operators to implement environmental measures to limit dust, gaseous and liquid emissions. In particular, the CO₂ question will demand strong action by all companies to limit emissions of this greenhouse gas. Otherwise, production costs will certainly increase as a result of looming penalties in the form of CO₂ emission certificates.

In order to remain competitive, metals producers will be required to increase their energy efficiency. This can be achieved through the improvement of existing processes, through cross-process optimization as well as through the installation of advanced and innovative technologies. At the same time, this reduces emissions and overall specific operating costs.

Environmental matters must not be seen through the small prism of the current economic climate, but must be viewed from the medium- to long-term perspective. This topic is far too crucial to be subjected to short-term business cycles. Postponing effective action now means increasing the risk of not being ready for the inevitable market revival and the renewed demand for scarce raw materials. Even today, cost-efficient plants are distinguished by their energy efficiency and clean production operations.

For these reasons, Siemens VAI has established a new business subsegment called "Energy and Environmental Care," which works in close cooperation with the related company departments. Emphasis is placed on all aspects of environmental technology for the metals industry. These include innovative technologies (e.g., Corex, Finex), process-optimization solutions (e.g., VAiron ironmaking), primary and secondary dedusting systems (Meros and other advanced dry- and wet-type systems), plant-wide energy management, advanced water management, numerous "smart" technological packages and components, treatment of residual materials as well as cost-effective recycling solutions (converter CO gas recovery, by-product recovery, etc.).

Selected topics from our energy and environmental portfolio featured in this issue of metals & mining outline solutions for sustainable, competitive and profitable production.



Dr. Richard Pfeiffer

President and Chairman of the Board of Siemens VAI

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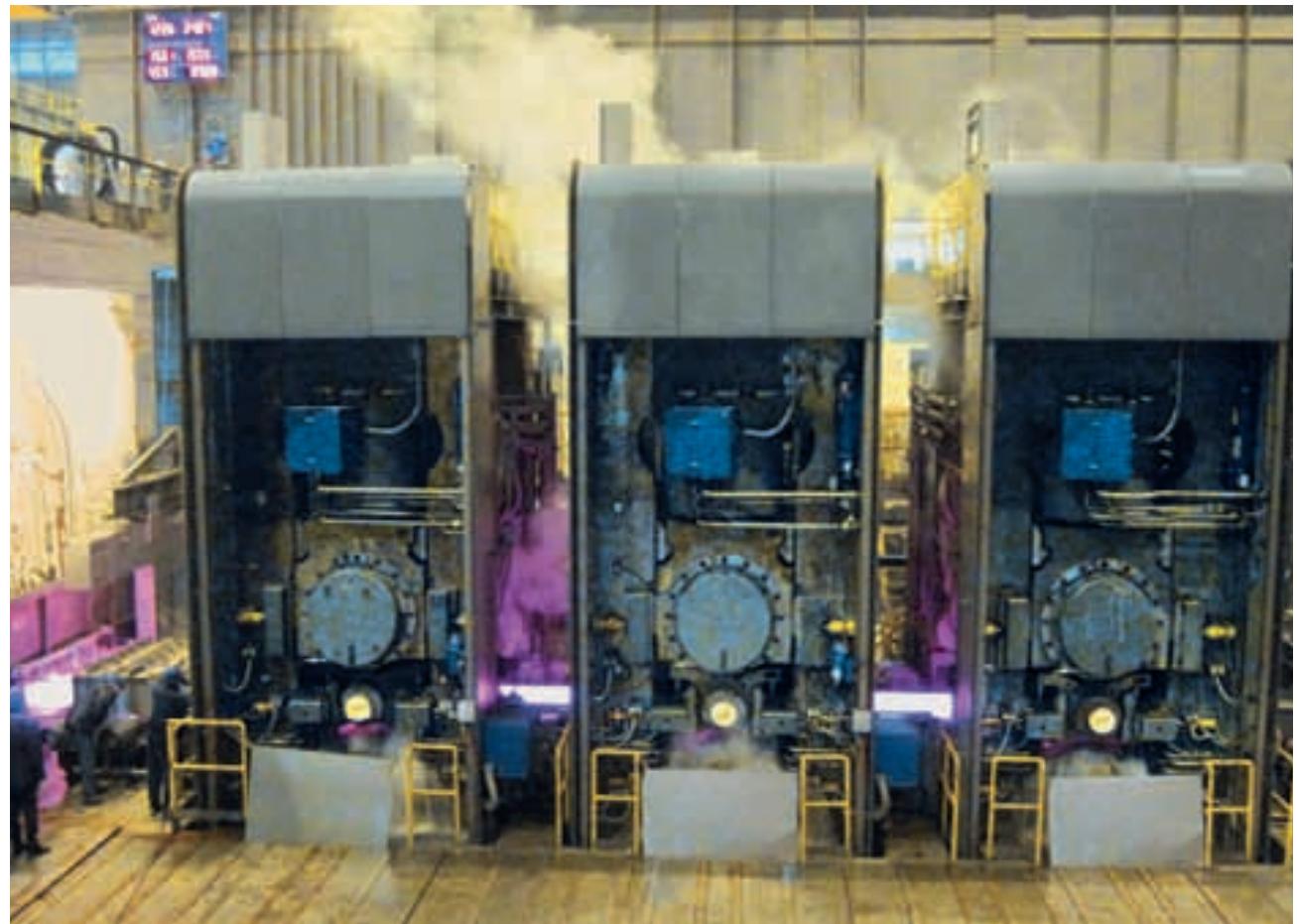
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In-line rolling stands at the end of the casting section

Start of Hot Commissioning of the Arvedi ESP Plant in Cremona, Italy

In December 2008, the first heat was cast on the new Arvedi ESP (Real Endless Strip Production) line at the Acciaieria Arvedi steelworks in the northern Italian city of Cremona. On December 22, 2008, a 229-ton heat was cast at a width of 1,300 millimeters. Stable casting conditions were quickly achieved at a constant casting speed of four meters per minute. In-line reduction during casting and roughing by the high-reduction mill were implemented successfully. The strand was

cut into plates by a pendulum shear and stacked by means of a pusher-piler unit.

Further casting and rolling tests were carried out in January 2009 at a speed of 4.5 meters per minute, obtaining a final gauge of 19 millimeters after rolling in the high-reduction mill. In accordance with the start-up schedule of the Arvedi ESP line, the further hot commissioning will follow a step-by-step approach for the subsequent production units. ■

Plant Start-ups and FACs (Sept. 1 to Dec. 31, 2008)

| Company | Country | Project |
|---|------------|--|
| Anshan Iron and Steel Group | China | Start-up of new 1-strand thick-slab caster and new 2-strand slab caster |
| Arcelor Mittal Dofasco | Canada | FAC for process optimization system for K-OBM, ladle furnace and vacuum degassing plant, including K-OBM quality model and stream-pacing system |
| Arcelor Mittal Eisenhüttenstadt | Germany | Start-up of revamped electrostatic precipitator for a 220-ton LD (BOF) converter; FAC for process optimization system for 2-strand slab caster and 6-strand bloom caster |
| Arcelor Mittal Temirtau | Kazakhstan | Start-up of 3-slit rolling operation |
| Asla | Spain | Start-up of a zinc casting-rolling plant, cold mill and finishing line |
| Baoshan Iron & Steel Ltd. | China | Start-up of new PLTCM (E/A supply) |
| Baosteel | China | Start-up of plate mill extension (E/A supply); start-up of PLTCM (E/A supply) |
| Baosteel Meishan | China | Start-up of wet-type dedusting system with annular gap technology (Simetal ^{CLIS} WDS Cone) for 150-ton LD (BOF) converter; start-up of upgraded 2-strand slab caster |
| Changcheng Special Steel Co., Ltd. | China | Start of hot trials on special-bar-quality mill |
| Ferriere Valsabbia | Italy | Start-up of phase 2 of project, including high-speed bar braking |
| Handan Iron and Steel Group Co., Ltd. | China | FAC for VAI-Con Link suspension system; start-up of new 300-ton twin-station ladle furnace |
| Laiwu Steel Group Ltd. | China | Start-up of new 1-strand slab caster |
| Minera Los Pelambres | Chile | Start-up of a hybrid flotation cell |
| Nanjing Iron & Steel Co., Ltd. | China | Start-up of Level 2 system, including expert system for Blast Furnace No. 2 |
| Nizhny Tagil Iron & Steel Works (NTMK) | Russia | Start-up of 160-ton Converter No. 3 and receipt of PAC (also for offgas-treatment system) |
| North American Stainless | U.S.A. | First heat successfully tapped on AOD Converter No. 2 |
| Pudong Iron & Steel Co., Ltd. | China | FAC for 4.2-m plate mill (E/A supply) |
| Qatar Steel Co. | Qatar | FAC received for turnkey 700,000 t/a rebar rolling mill |
| Rizhao Steel | China | Start-up of new 2,150-mm hot-strip mill (E/A supply) |
| Shougang Jingtang Iron&Steel Co., Ltd. | China | FAC for new PLTCM (E/A supply) |
| Shougang ShouQin | China | FAC received for Lomas Dynacon installation |
| Shougang Shunyi | China | Start-up of new continuous annealing line (E/A supply); start-up of new Continuous Galvanizing Lines Nos. 1 and 2 (E/A supply) |
| Siderúrgica de Guatemala SA (Sidegua) | Guatemala | Start-up of bar line, including 3-slit rolling section |
| Talleres y Aceros | Mexico | Start-up of bar mill |
| Tangshan Iron & Steel Co., Ltd. | China | Start-up of new AOD Converter and VOD plant |
| Tata Iron & Steel Co., Ltd. | India | Start-up of new 6-strand billet caster |
| Tianjin Tiantie Metallurgical Co., Ltd. | China | FAC for new PLTCM (E/A supply) |
| Tianjin Pipe (Group) Corporation | China | Start-up of upgraded 6-strand billet caster |
| Tifast | Italy | Start-up of super-alloy mill |
| U.S. Steel Kosice | Slovakia | Start-up of two upgraded 2-strand slab casters |
| Walsin Lihwa | Taiwan | Start-up of modernized long-product rolling mill |
| Wieland Werke Ulm | Germany | Start-up of a modernized reversing cold mill (E/A supply) |
| Xiangtan Iron & Steel Co., Ltd. | China | Start-up and FAC for 3.8-m-wide plate mill (E/A supply) |
| Xin Yu Steel | China | Start-up of new 1,580-mm-wide hot-strip mill (E/A supply) |



A pragmatic approach to economic and environmental sustainability

Energy and Environmental Care

The current financial crisis affecting the steel industry will inevitably result in a cutback in funds and expenditures for environmental protection. In the midst of a recession with swelling numbers of unemployed, management priority is a different one. However, even in times of economic downturn, the question is not whether we can afford to invest in green solutions. Much more, the crucial question is whether we can afford *not* to continue the momentum of efforts focusing on environmental protection. What is needed above all is a pragmatic strategy that addresses the needs of industrial viability and employment simultaneously with urgent ecological demands. It is shown in the following that by applying best-performance technologies in the steel industry – a major consumer of fossil fuels – not only can the energy consumption and environmental emissions be slashed, but producers can save a lot of money as well.

During the past years environmental awareness has increased dramatically on a global scale. The long-term consequences of pollution and emissions – in particular the probable link between global warming and rising concentrations of CO₂ – has resulted in far-reaching measures initiated by governments and international organizations to enforce sustainable and environmentally friendly economies and manufacturing processes. Stricter legislation that is still binding and the introduction of an emissions-trading system are examples of this. According to a study carried out for Siemens VAI by the Boston Consulting Group (BCG) and based on information of the International Energy Agency (IEA), the iron and steel industry consumes roughly 20 percent of industrial energy and is responsible for 30 percent of industrial CO₂ emissions. It is therefore understandable that this industrial sector has been a prime target of legislation to reduce CO₂ generation, in addition to other gaseous, particulate, liquid emissions and solid wastes.

Is global warming really taking place?
Global warming has been one of the most “hotly” discussed topics in recent years and the steel industry has been “fingered” as a primary perpetrator behind climatic change. But is global warming really taking place? On the basis of information published on the >>

>> Met Office Hadley Centre Website – the U.K.'s official center for climate-change research – worldwide temperature measurements show that the average global temperature of the earth's surface has not increased since the year 2000. This fact, in addition to conclusions deduced from ice-core analyses indicating naturally fluctuating climatic changes in the past (as a result of, for example, variations in the earth's orbit around the sun, volcanic activity or changes in solar radiation), is often quoted by the "naysayers" as evidence that global warming (or cooling) is a naturally occurring phenomena on the earth unrelated to anthropological (i.e., human) influence.

However, it is also a fact that the average worldwide temperature has increased by 0.2°C from 1875 to 1975, and that there was a dramatic increase of 0.5°C in the world's average temperature between 1975 and 2000. And ever since world-temperature data has been kept, it is undeniable that the up-and-down zigzag temperature trend clearly shows an overall upward development. The overwhelming majority of climate experts are convinced of the correlation between rising CO₂ levels in the atmosphere and global warming. Since the

beginning of the Industrial Revolution in the latter part of the 1800s, CO₂ concentrations have increased by around 30 percent due to human-induced emissions from fossil fuels. The 17 warmest years measured during the past 50 years up to 2007 all occurred during the last 20 years. Depending on the degree to which CO₂-reducing measures are implemented on a global scale, it is estimated by specialists in this field that average worldwide temperatures will increase by between 2°C and up to 7°C by the end of this century. It is also sobering to realize that CO₂ already present in the atmosphere will remain there for many years to come and will continue to affect the climate for some time, even if emissions were reduced to zero today.

Consequences of global warming

Worldwide temperature increases are likely to result in an increased frequency and severity of weather events such as heat spells, violent storms and flooding. Rising levels of greenhouse gases in the atmosphere could set in motion large-scale changes in the earth's natural systems, such as oceanic and atmospheric currents. Some of these changes may be irreversible – the melting of

polar ice sheets will result in the flooding of low-lying areas throughout the world and subsequent mass human migration. This danger is not to be underestimated considering that an estimated 38 percent of the world's population of 6.7 billion people (2008) now lives within 100 kilometers of the coast. It would be difficult – if not impossible – to adapt to rapid changes in the sea level. It is also increasingly being recognized that the roots of conflicts in Africa such as at Darfur in Sudan and in the Middle East are largely attributable to ecological reasons, in addition to ethничal and religious roots. The Sahara continues to spread and water supplies are dwindling in many regions of the earth. These are but minor side effects compared to what may be the consequences if global warming continues unabated in the future.

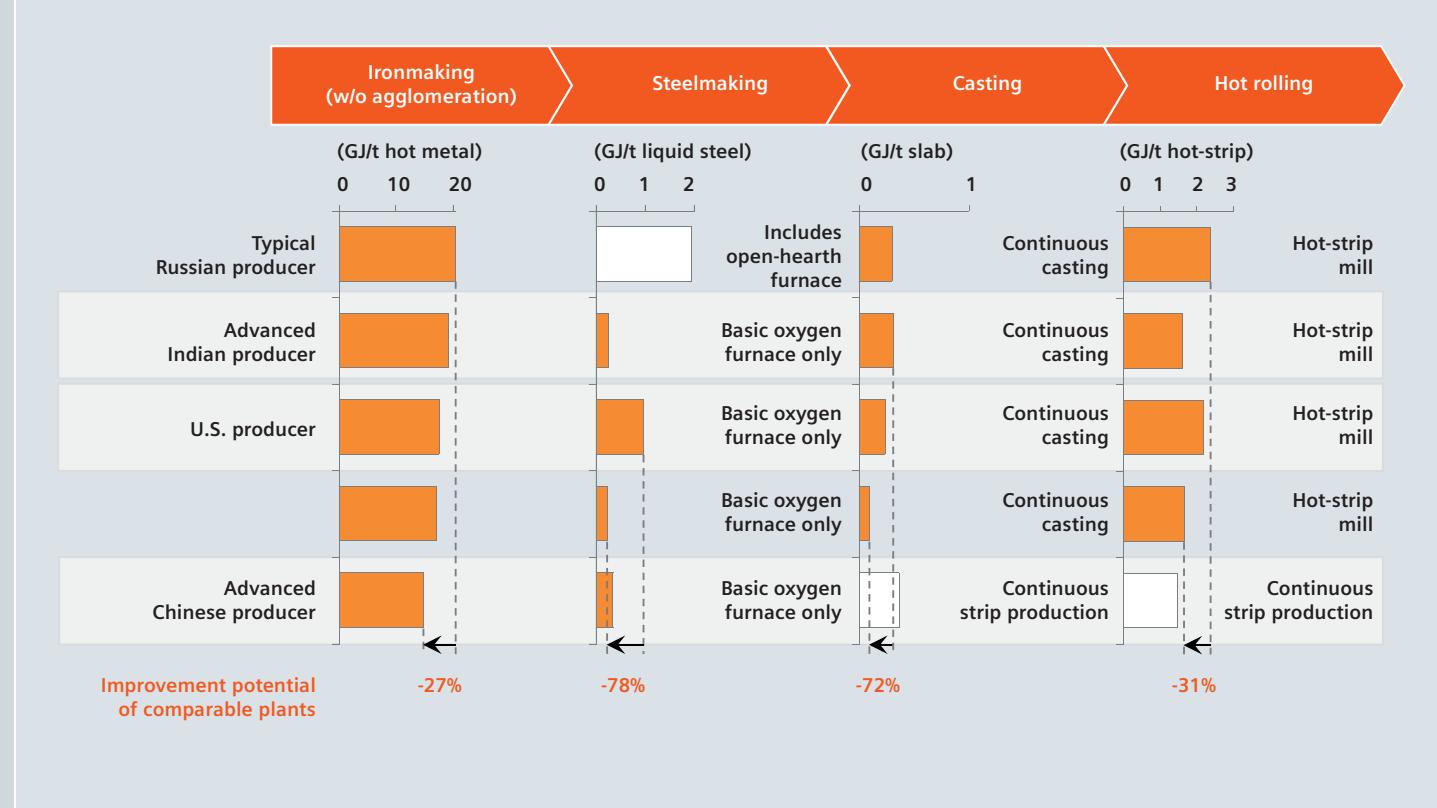
Potential for energy and cost savings

Approximately 20 gigajoules (GJ) of energy are required to produce a ton of crude steel. The production of one ton of steel in the blast furnace/oxygen steelmaking route releases an average of 1.8 tons of CO₂ to the atmosphere. Carbon dioxide emissions trade today at

about U.S.\$30 per ton, which therefore increases the price of each ton of steel by around U.S.\$60. Despite the downturn in steel prices as a result of the economic crisis and reduced demand, the CO₂ cost burden is likely to remain. Most international governments and producers have confirmed that they will uphold their environmental goals, regardless of whether or not they agree that there is a link between greenhouse-gas emissions and global warming. There is therefore a very clear link between energy efficiency, CO₂ reductions and lower costs. Raw materials are, of course, the main variable costs in steel production, and the costs for energy account for more than one-third of these costs. It is obvious that "The cheapest energy is the energy you don't use." Therefore, increased efficiency in the generation, transmission and use of energy is a decisive factor for reducing costs in steelmaking. And this is possible by applying "best-available" technologies to reduce the specific energy consumption.

A study was carried out for Siemens VAI that compared the energy consumed by integrated producers worldwide at each step along the iron and steel production chain, from ironmaking up to hot rolling. It >>

COVER STORY >



>> could be shown that there was an overall average difference of 20 percent in the total energy consumption between worst performers (CIS countries) and best performers (Europe and modern Chinese steel works). This difference varies at individual production steps; for example, 27 percent in ironmaking and 78 percent in steelmaking. The 20 percent energy difference between worst and best performers is equivalent to 600 million tons of CO₂ emissions per year. Or to put it in other words, if all producers had the energy efficiency of the best producers, this would mean a reduction in CO₂ emissions by this impressive figure. Application of best-available technologies can reduce the energy consumption in steel mills by two to three GJ per ton of steel. It "profits" to be energy efficient.

Growth linked to environmental compliance

In addition to energy aspects, the steel industry must also meet the continually increasing demands – and the related costs – governing pollution control. Permission to construct new production facilities is frequently linked to adherence to the strictest emission values, many of which were impossible to meet even ten years ago with the technology available at that time. This was true, for example, at the Linz-based Austrian steel producer voestalpine Stahl, where permission to expand the steel production output required trail-blazing investments in new and innovative environmental technologies. Siemens VAI was instrumental in implementing the eposint and Meros processes together with voestalpine, through which the lowest emissions from a European sinter plant are easily achieved. In fact, over the years Siemens VAI has been a close partner of voestalpine with the installation of many highly efficient pollution-control solutions, contributing to the company's outstanding reputation today as one of the world's most environmentally friendly steel producers. (See Panorama Article by voestalpine on p. 42.)

Examples of advanced environmental solutions

As a leading supplier of energy-saving and environmental technologies, Siemens VAI can provide the full scope of processes and solutions along the entire iron and steel production route that not only meet the strictest emission regulations, but also help producers to attain substantial cost savings. The company's supply portfolio not only includes the complete range of mechanical equipment, but also all systems and solutions for automation, drives, energy recovery, media supply, power generation, transmission and distribution. Nearly a quarter of the Siemens product portfolio today focuses on environmental business activities. In ongoing R&D programs, existing solutions are being continually improved and new solutions are under de-

velopment. Examples of various technological highlights in this field are briefly presented in the following.

As described in a separate article in this issue (see p. 24), during the cokemaking process the energy that would otherwise be lost during the wet quenching of hot coke can be used to produce steam in a dry-quenching process. The steam is then available for the generation of electrical energy in addition to various heating purposes. Furthermore, dust emissions are reduced as there are no dust-laden steam clouds released to the atmosphere during wet quenching.

Reducing environmental emissions from the sintering process is one of the most important steps for improving the environmental compatibility of an integrated iron and steel works. The offgas heat can, for example, be used to generate steam for subsequent applications

The cheapest energy is the energy you don't use.

within the steel plant. However, a much higher offgas-heat efficiency is achieved in the eposint process where a portion of the offgas from sintering is mixed with off-gas from the sinter cooler (for oxygen replenishment) and recirculated to the process. (See metals & mining 2|2008.) This results in a lower coke-fuel rate for the sintering process. Furthermore, the dust and noxious-gas (e.g., SO₂ and NO_x) content of the recycled offgas is reduced as it passes through the sinter bed, which acts



Reduction of flaring through cross-process optimization reduces dust, CO₂ emissions and energy costs.

as a type of prefilter. This allows the subsequent gas-cleaning unit to be dimensioned smaller, saving operational and investment costs.

When the sinter offgas is cleaned in a Meros plant before it is emitted to the environment, dust, metallic and organic components are reduced in a series of treatment steps to levels lower than 5 to 10 percent of those achieved in conventional offgas-treatment processes. (See metals & mining 2|2008.) Since the start-up in August 2007 of the world's first industrial Meros plant at voestalpine Stahl, this facility has been reliably and continually operating, exceeding the prescribed emission values by far.

As demonstrated in numerous blast furnace installations worldwide, the VAiron Automation and Expert System allows, for example, the iron ore burden to be cost-optimized with a simultaneous reduction in the coke rate. This results in substantial production savings and lower environmental emissions.

Corex is a well-known and proven hot-metal-production process based on the use of mainly non-coking coal as the energy source and reductant. Through the elimination of sintering and cokemaking facilities and thanks to its unique process features, dust and noxious-gas emissions are decreased by 90 to 95 percent in this process compared to the integrated blast furnace route. Environmental reasons played heavily in the decision by Baosteel (Baoshan Iron & Steel Co., Ltd., Medium & Heavy Plate Branch) to build a 1.5-million-ton-per-year Corex plant at Luojing (near Shanghai), which started up in 2007, and for the recent order placed by them for a second installation of a same-size plant to be built at the Luojing site.

Finex, a joint development with Posco, features the direct use of iron ore fines and non-coking coal to produce hot metal. Iron ore fines are reduced in a fluidized-bed reactor followed by melting in a separate Corex-type melter gasifier. As in the Corex process, coal is used as both the energy source for melting as well as for the generation of the reduction gas. An industrial 1.5-million-ton-per-year Finex plant was started up on April 11, 2007. The plant is now operating above its design capacity and the key consumption figures (e.g., specific coal rate and oxygen consumption) are far lower than expected. Similar to the Corex process, the elimination of the cokemaking and sintering processes for the production of hot metal leads to significant environmental and economical benefits.

As described separately in this issue (see p. 28), a comprehensive life-cycle assessment was conducted for the Corex and Finex ironmaking technologies, taking into account all relevant environmental parameters such as emissions, affect on global warming, and long-term availability of raw materials. This study,



Advanced water-treatment and recycling solutions minimize the environmental impact of industrial plants.

which was carried out in close cooperation with three universities, confirmed that the Corex and Finex processes score much higher in terms of environmental compatibility in comparison with the conventional blast furnace route.

In the field of electric steelmaking, the so-called Ultimate furnace developed by Siemens VAI has set new milestones for production performance. A high-shell design and optimized furnace geometry allow single-bucket charging to be carried out, thereby shortening tapping cycles. A higher power input with a greater control of the melting process is achieved with Simelt fur- >>

>> nace modules, reducing the power-on time. The use of advanced RCB (refining combined burner) technology and the application of post-combustion practice promote a high bath turbulence and, consequently, a high heat transfer and scrap-melting rate. With the direct charging of hot DRI (direct-reduced iron) into the EAF, as employed at Hadeed in Saudi Arabia, the sensible heat of the iron charge is efficiently utilized, increasing productivity by 15 to 30 percent compared to cold-charging of DRI. All of these factors contribute to higher output, significant energy savings and lower-cost steelmaking operations.

The application of well-proven offgas-treatment solutions for LD (BOF) steelmaking plants – Siemens VAI is the leader in this field – allows primary and secondary dust emissions to be reduced to levels previously unattained in oxygen steelmaking. CO-rich gas recovery from the converter process reduces flaring, dust and CO₂ emissions, and saves money as well. Comprehensive recycling and by-product utilization solutions not only benefit the environment, they are also profitable for producers. Waste-free steelmaking is no longer a dream, but a feasible option.

Plant-wide energy-management solutions drastically reduce the overall energy consumption, costs and environmental emissions within a steel works. For example, with the Simetals^{CIS} Energy Management system from Siemens VAI, comprehensive information of the energy and media network within a steel works is monitored in a central system. This allows consumption rates to be accurately predicted and serves as the basis for the implementation of effective optimization steps. The benefits include reduced peak-load tariffs, fully coordinated energy and media distribution, improved power-plant operation, and reduced flaring and far lower environmental emissions. Typical energy-cost savings can be in the range of three percent, and, when considering that approximately one-third of total production costs in an integrated steelmaking plant can be attributed to energy expenditures, this can mean immense savings indeed!

An endless strip production process known as Arvedi ESP, a joint development of the Italian steel producer Acciaieria Arvedi S.p.A. and Siemens VAI, is now in the start-up phase in Cremona, Italy. Hot commissioning of the new ESP line commenced in December 2008. ESP technology is distinguished by the direct coupling of thin-slab casting, in-line induction heating and hot rolling to produce high-quality strip in a continuous, uninterrupted production sequence. With this mode of operation, the energy required for the hot rolling of slabs down to thicknesses of one millimeter and below is significantly reduced in comparison with conventional hot-strip mills. Furthermore, the thin-gauge end



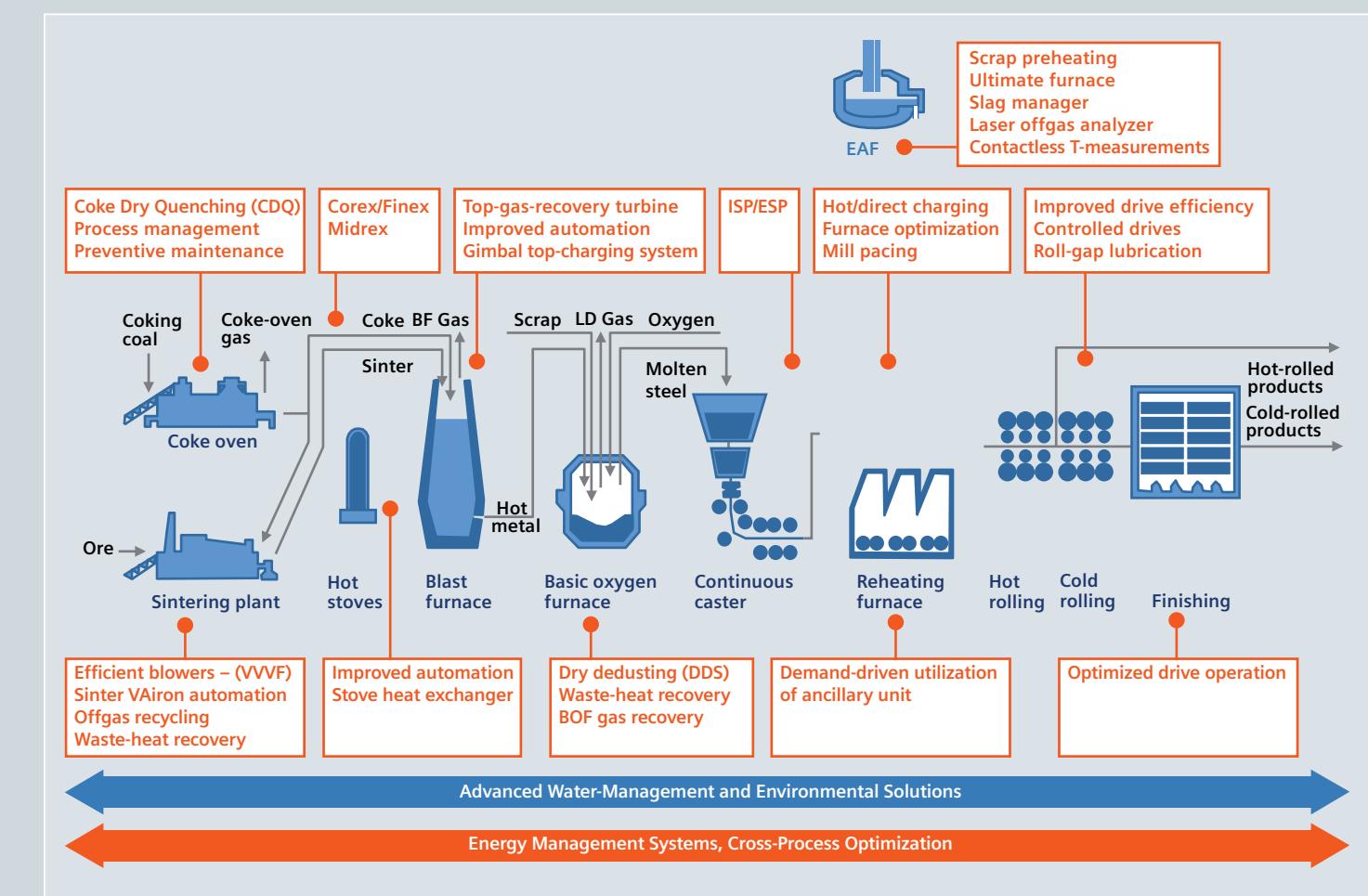
Roughly three-quarters of the energy required in an integrated steel works is consumed during ironmaking.



Advanced equipment and an optimized EAF process considerably reduce expensive electrical energy costs.

products can be directly used for numerous applications, such as in the automotive, machine, tube and pipe industries, eliminating the need for subsequent cold rolling. This again saves energy and substantially reduces production costs.

Water is increasingly seen as a valuable commodity that can no longer be taken for granted. In the words of Benjamin Franklin (1706–1790), American scientist, inventor, statesman and philosopher, "We will never know the true value of water until the well runs dry." According to Ban Ki-moon, U.N. Secretary-General, "There are 1.2 billion people who do not have access to safe drinking water." (Time, January 12, 2009) A reliable water supply for 21 of the 33 largest cities on our planet cannot be assured on a long-term basis. It is therefore vitally important that the sustainable and protective use of the raw material water be accorded the highest priority. For the steel industry, 100 percent waste-water recycling concepts are now available from Siemens VAI – particularly important for arid countries



– and contribute to minimizing the environmental burden of metals production. (See separate article in this issue on p. 38.)

To meet the electrical energy requirements of steel works, power stations supplied by Siemens, equipped with the world's most efficient turbines, can achieve a degree of efficiency approaching 50 percent in coal-fired and 60 percent in gas-fired power stations. This means huge fossil-fuel savings and the simultaneous reduction of CO₂ emissions to meet our energy demands.

Concluding remarks

The optimized consumption of energy and raw materials, the application of advanced technological processes and the maximum application of recovery/recycling solutions lead to major energy savings, reduced CO₂ emissions, increased environmental compatibility and higher profits. Even at highly efficient plants, there is still the potential to achieve significant improvements. Cross-process optimization measures and an increased

It pays to be energy and environmentally efficient.

integration and coordination of technological processes and plants can play a key role in tapping the additional energy and cost-saving potential in iron- and steelmaking. The implementation of advanced environmental solutions not only benefits our world, but also contributes to long-term economical viability in steel production.

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Mines require large amounts of electricity. Possibilities for saving energy are therefore very welcome. One way is to use variable frequency drives (VFD) for overland conveyors and bulk-material-handling applications. The energy consumption can be reduced by up to 20 percent depending on the material flow and compared with a conventional conveyor drive. Furthermore, slip starting is eliminated thanks to the use of frequency drives, which also control the conveyor speed. In the case of down-hill conveyor systems, electrical energy can be generated during normal operation as the following example shows: Los Pelambres is one of Chile's copper mines. The copper ore is mined and crushed at an altitude of 3,200 meters above sea level. A 13-kilometer-long conveyor belt system connects the mine with the processing plant, which is located at an altitude of 1,600 meters. Ten Siemens VFDs with closed-loop speed control allow a defined starting and stopping torque to be applied to the conveyor system at all operating conditions. During normal operation with a nominal load, the drives generate up to 17 MW of electrical power and thus save a good 50,000 tons of CO₂ emissions every year. Three years ago, the Los Pelambres mine received a prize for efficient power use from the Chilean Ministry of Economics.

Water is the critical factor when it comes to developing mining operations in Chile.

Using diesel electric truck drives saves energy, time and money compared with mechanical truck drives. Siemens equips these gigantic vehicles with highly efficient AC drives. The AC drive technology is the perfect choice for open-cast mining because it offers increased performance, low maintenance and can adapt to harsh conditions. Rising fuel prices and greater environmental awareness call for improvements in the operation of trucks in open-cast mines. The answer is the trolley-assist system developed by Siemens to supplement diesel electric drives. This system enables trucks to operate at a low cost and with electricity produced in an environmentally friendly manner. The trolley truck system provides the basis for cost-effective transport of heavy bulk materials and a minimum environmental impact by shortening the truck's turnaround time. The costs for trolley trucks and overhead lines amortize within three years. In the meantime, Siemens has more than 300 trucks in service worldwide.

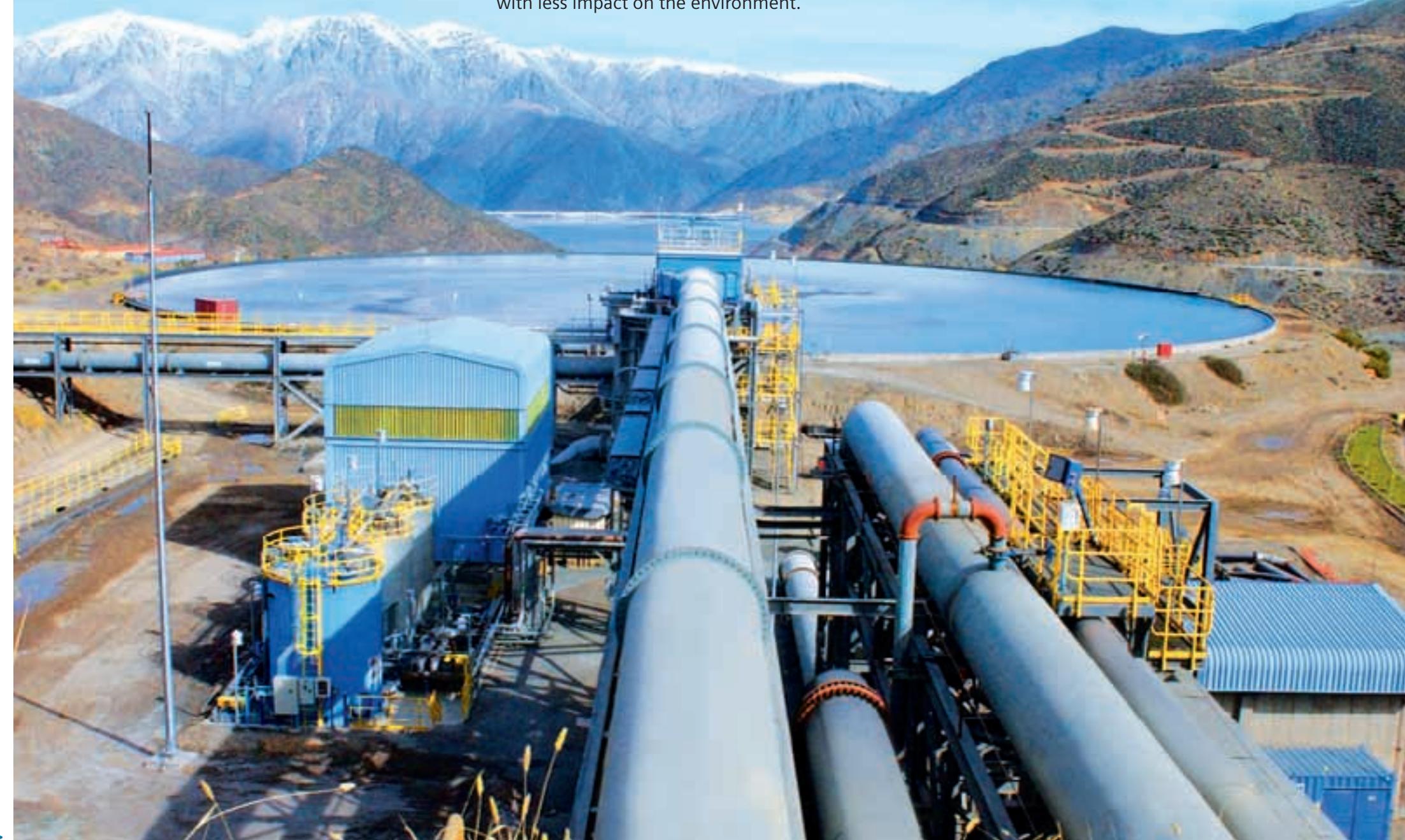
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Tailing water contains a high concentration of various heavy metals and chemicals, such as sulfates. Reuse of effluents from tailing dams is a challenge for all environmental engineers.

Saving water and electricity with Siemens technology

Reducing the Impact of Mining

Every sort of economic activity somehow affects nature and the environment. This is also the case for mining. This article outlines ways to mine raw materials with less impact on the environment.





Siemens solutions help to make the Los Pelambres open-cast copper mine one of Chile's show pieces for energy efficiency and resource protection.

Trolley truck system in operation.
Speed on the grade typically increases by up to 95 percent, while fuel and oil consumption are usually reduced by 85 percent.



>> Electricity can also be saved in the preparation of ore. For years, gearless mill-drive solutions from Siemens have been working almost without wear in more than 20 processing facilities. Without gears, these mill drives are subjected to extremely low wear and are up to 20 percent more efficient. With the control concept, the speed of the mill can easily be adapted to the hardness and other parameters of the ore. Gearless drives are available up to 28 MW. A recent contract covers the delivery of drives for two ore mills at Xstarta Copper Mines in South Africa.

Siemens is using the gearless drive technology also for cyclone pumps (Simine^{CIS} Pump GD), mine winders (Simine^{CIS} Winder) and draglines (Simine^{CIS} Drag). Using these drive systems, energy consumption can be reduced by 20 percent and more, and efficiency and availability can be increased dramatically. In the world's second largest dragline, in China's open-cast coal mine Zhungeer in Inner Mongolia, this technology was installed instead of a DC drive system and mechanical gears.

Optimizing the water cycle in mines saves money

A hot topic in mining is water. Especially in Chile, open-cast mines have difficulty keeping their full production capacity, since not enough fresh water is available for production. That is why pipelines are being considered to transport desalinated ocean water to the mines. Along with the necessary technology for conveyance, Siemens also offers high-capacity reverse osmosis (RO) systems to remove salt from sea water. Due to the use of highly efficient energy-recovery systems, modern RO systems provide energy savings of up to 40 percent.

The enormous amounts of water that accumulate as a result of ore processing pose another problem. Depending on the type of ore and the preparation process, the water can be contaminated with heavy metals, arsenic and sulfates. Also, water laced with the dust from dumping areas and conveying systems must be treated. To comply with the ever-stricter environmental legislation, water-treatment systems must be aligned to the toxic mix and individually modeled for open-cast mine operations. The goal should be to prepare only as much water as is needed and, as often as possible, to feed it back into the process water in suitable quality.

Siemens Mining Technologies, together with the Siemens Business Unit Water Technologies, delivers the necessary know-how with its products, systems and services. This includes conventional treatment lines all the way up to the newest membrane filter treatment systems. Siemens delivers all the technology – instrumentation and automation, process management systems, sludge processing, treatment of the water with active carbon powder, wet-air oxidation, chlorine dioxide disinfection and membrane filtration. In this way,



Gearless drives have a 20 percent higher efficiency compared to drives with gears.

Siemens Mining Technologies is able to offer tailored solutions for every customer need. In addition, Siemens is closely working on specific technical adaptations with the Freiberg Technical University for Mining and Technology. (See metals & mining 1|2008.)

When deposits have been depleted, a mine cannot simply be shut down. As a result of the mining process, ore is still exposed on the surface. Through constant contact with atmospheric oxygen, precipitation and/or groundwater, the bonded sulfides in the ore oxidize, producing large amounts of sulfuric acid. This mobilizes the heavy metals and rinses them out. The water contaminated with acid and heavy metals (ARD/AMD = Acid Rock/Mine Drainage) can negatively impact groundwater as well as the surrounding rivers and lakes. For decades, avoiding contamination has been the most important environmental topic in the mining industry. Siemens Mining Technologies has just developed the ARD/AMD treatment unit to process this water. It combines conventional chemical treatment processes with membrane technology. A chemical process first removes a part of the contaminates and raises the pH value before the membrane filter removes the rest of the contaminates. Through this combination, the heavily contaminated water can be cleaned so that it is potable. Since the water is often located in remote and dry areas, it can be used for agricultural irrigation.

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New flotation cell from Siemens

Higher Yield at Lower Costs

Flotation as a method for separation and enrichment has a long tradition, especially in ore preparation.

The physical separation process uses the different surface properties of material suspended in water in order to separate them using gas bubbles. Heavy metals in their sulfidic and oxidic deposits are mostly non-absorbent and can adhere to the surface of the injected gas bubbles after chemical conditioning. Silicate, oxygenic salts and minerals are wettable and sink to the bottom. The degree of separation (recovery) is – apart from other factors – a function of the amount of air or gas injected and the bubble sizes created in flotation machines.

Simine[®] Hybrid Flot

The Siemens solution combines a so-called pneumatic spray-in principle with a column method. The Siemens cell operates without an agitator, because the ore slurry is sprayed into the cell by high-pressure nozzles, along with nitrogen, which is often used as a substitute for atmospheric air in molybdenum extraction. Nitrogen is added to the ore slurry (pulp) in mixing chambers before it goes into the cell. This considerably improves the frequency of contact between the gas bubbles and very fine molybdenum

particles as well as the ability of the particles to stick to these bubbles. The resulting mixture is sprayed into the flotation cell. The nitrogen blown in through an internal column in the second stage ensures that the molybdenum particles which were not “captured” in the first stage stick to the gas bubbles and are transported to the surface. The foam concentrate thus produced is taken off over the edge of the flotation tank and drained off. Short retention times of the pulp in the machine and new, patented additional drain gutters reduce the risk of losing already captured particles. The Siemens system, which has a nominal capacity margin of 100 to 400 cubic meters per hour of pulp with a solids content of up to 48 percent, is operated with only three pumps and without an agitator. It therefore needs up to 70 percent less electrical power compared with conventional systems of comparable capacities. Around 60 to 100 cubic meters of nitrogen an hour are needed to operate the cell. This is considerably below the hourly consumption rate of 1,000 to 1,400 cubic meters associated with conventional systems. Water consumption in a flotation process generally depends among other things on the total solids content that can be processed.

The first pilot cell during the test phase: a 2 percent molybdenum recovery rate could be achieved with a considerably higher Mo content in the concentrate. This is achieved with a simultaneous reduction in the energy and gas consumption. Furthermore, the Siemens hybrid flotation cell is much more compact compared with conventional units.



The ease of ore separation directly affects yield and profit. Siemens recently installed two new flotation cells at the Chilean copper mine Los Pelambres, which separates molybdenum from copper in a highly efficient and defined process. The new flotation process increases yield significantly compared to the previous flotation process without the Siemens cells, with a minimum of energy and gas required and a lowered environmental impact.

The Siemens Hybrid Flot cells can be operated at solids contents of up to 50 percent, which is more than with other pneumatic cells. Water consumption can therefore be kept down with Siemens cells.

Two percent more molybdenum

The tests with the first pilot cell in the selective copper-molybdenum process showed an increase of molybdenum recovery of more than 2 percent of the total process. However, results depend on feed load and operation mode. The recovery increase is shown especially in the fine particle fractions (particle sizes < 10 µm and < 25 µm), but also in coarser particle size fractions (> 75 µm). The molybdenum concentration could be enriched from a typical concentration of less than 3 percent in the feed pulp to up to nearly 40 percent in the concentrate product of the Siemens cell using only one single cell. Dalibor Dragisevic, supervisor for the molybdenum plant in Los Pelambres: “Siemens sold us not only equipment, but a process as well. The excellent results of our strategic alliance with Siemens have improved our plant indicators, and we are even acquiring a second cell.”

Further flotation equipment

The actual installation of the two Siemens cells at Los Pelambres allows parallel operation of the cells, thus doubling capacity. A smaller Siemens cell in the same design (downscaled) for capacities of 10 to 50 m³/h was recently completed, and first tests with this cell are planned starting in March. A third model upscaled to process a capacity of approximately 800 to 1,400 m³/h is now the focus of current development activities. ■

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The second Siemens cell during commissioning in Los Pelambres: The two cells can be operated in parallel or sequential mode.



The entire open-cast mine Garzweiler II in Germany is monitored and controlled from the new control center, located close to the conveyor assembly point Jackerath.

Automation Control with Simine^{CIS} CC

Perfecting Processes

Transparency is crucial for optimizing processes in the mining industry. Materials and resources must be controlled to ensure that bottlenecks, disturbances or delays do not lead to unproductive time at any point in the process. The data generated during operations and that is necessary for the process as a whole must be routed to a central "control point," error-free and available to all parties involved. This is the only way to further streamline processes and take advantage of potential synergies, whether in plant operation or in maintenance and repair.

The end-to-end automation solution Simine^{CIS} CC places automation, communication and data management of the entire process chain – including excavation, transportation, processing and distribution of the mined raw material – onto a single, consistent platform. The plant equipment and control room are a unified system based on uniform integration of the automation components and communication processes.

Steps for innovation

One of Siemens' traditions is the continuous development of automation technology and ergonomics. As early as 1960, Siemens installed the first central control room for an open-cast mine. In 1977, process-computer, PLC and SCADA systems were introduced to a mining facility for the very first time. The 1990s

brought further optimization of PLC, data transfer systems and SCADA, almost completely replacing conventional control systems.

Since the turn of the millennium, in the mining industry Siemens has moved away from component-based systems towards fully integrated DCS structures based on the process-control system Simatic PCS7. Today, the combination of proven Simatic PCS7 standard modules with mining-specific modules from the automation solution Simine^{CIS} CC creates a modular, interface-optimized solution tailored to the requirements of the mining industry.

Always one step ahead

In the current decade, Siemens in Germany has either newly installed or modernized the control centers of both energy giants RWE Power and Vattenfall Europe

Mining – and has also taken on projects of this nature on an international level. For RWE Power, the control centers in the open-cast mines Fortuna, Hambach and Inden were modernized, and a completely new control center was installed for Garzweiler II. This project involved the complete control, monitoring, reporting and visualization of 25 conveying paths with up to 6 belt conveyors each, 16 large machines, and about 100 mine-drainage stations using modular-based automation technology with Simatic PCS7 standard components. The complete data transfer as well as the transfer of audio and video signals from the entire open-cast mine is carried out by an extended Open Transportation Network (OTN) with around 100 nodes. Therefore, Garzweiler II is one of the largest PCS7-based, Totally Integrated Automation (TIA) projects worldwide.

Since the exploration of the Spence copper mine in Chile, mine operator BHP Billiton also relies on the Simatic PCS7 system with hard- and software for 5,000

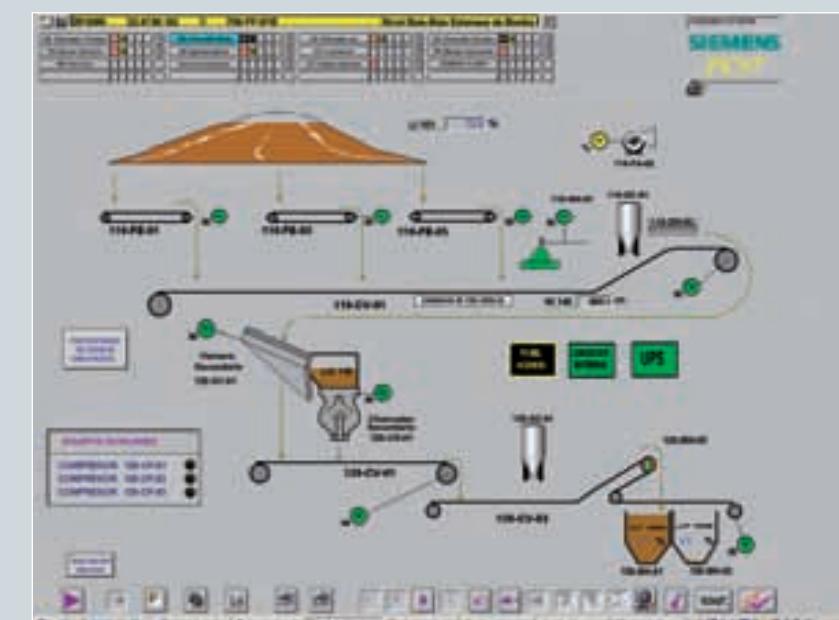


The control center from Vattenfall Europe Mining for the Nohchten/Reichwalde open-cast mines and the coal stockyard of power plant Boxberg

tags and around 150 displays. Siemens was involved in the entire project, from the beginning to completion, including the planning phase, the rollout workshop and after-sales service.

In 1997, Siemens built a new control center for Vattenfall Europe Mining's Nohchten open-cast mine. During the recommissioning of the Reichwalde open-cast mine, a completely new functional control center was constructed for the operation and observation of the technological lines of Reichwalde and Nohchten open-cast mines. The automatic operation of the coal stockyard for the Boxberg power plant, including stockpile and quality management, is also monitored from the Reichwalde/Nohchten control center.

The complete coal supply of Boxberg is carried out by the fully automated coal stockyard. The specified quality parameters of the coal are reached by an automated blending functionality with a variance of about five percent. After the migration of the operating func-



Visualization of the process-control system Simatic PCS7 of Spence copper mine in Chile. All the relevant information is clearly displayed and up to date.

tions from the existing control center at the Nohchten open-cast mine, the switchover to the newly built control center took only four days.

The next innovation in the area of automation technology is already on the advance: at the end of 2008, Siemens won a contract to deliver a control center and communication system for the Ciner Group's Collolar Lignite Mine in Turkey. In this project, a wireless LAN-based solution will be used for data transmission in the entire mining area for the first time. The PLCs will communicate with one another via Industrial Ethernet, while the entire voice communication will be transferred over IP telephony, and video signals will be transmitted in the mpeg4 standard over the same SCALANCE W system. Even the linkup of real-time systems like decentralized peripheral equipment is possible. In order to prevent reciprocal interference among the components, three V-LANs are connected along the transmission routes.

At a glance

With the Totally Integrated Automation approach combined with the industry-specific technological functions from the Simine CC toolbox, Siemens offers a platform for control centers that are always on the cutting edge of technology and, as a result, performance. The control centers also integrate the proven developments collected over the years in HMI (Human Machine Interface), especially for mining applications.

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Coke dry-quenching process supports environmentally friendly and economical coke production

Still Want to Blow Off Steam?

In conventional wet-type coke-quenching systems, the sensible heat of the hot coke from the cokemaking process is lost to the environment in the form of steam during quenching. This is not only a source of dust pollution to the surroundings, but is also a waste of energy. In coke dry-quenching plants, this heat is recovered and utilized to produce steam that can be used, for example, to generate electricity. The Finland-based coking-plant specialists of Siemens VAI explain why the coke dry-quenching solution is not only environmentally more compatible, but also saves money.

A typical coke dry-quenching (CDQ) plant from Siemens VAI consists of three dry-quenching chambers, the integrated coke bucket-lifter/transfer cars and waste-heat boilers. The hot coke enters the quenching chambers at a temperature of approximately 1,000°C. After a five-hour passage time, it is cooled to temperatures of 180 to 200°C by means of a circulation gas with a flow rate of 75,000 Nm³/h. This inert gas, which forms during the start-up phase of the cokemaking cycle when the oxygen present in the coking chamber has been depleted, is a mixture consisting mainly of nitrogen, and smaller amounts of CO₂, CO and H₂. The temperature of the cooling gas upon exiting the quenching chambers is in the range of 800°C, and 150°C after it is employed to produce steam in the boiler.

In a modern three-chamber CDQ plant, a nominal capacity of 50 t/h is achieved per unit. However, the actual output of quenched coke is about 105 t/h. Two units are in full operation and one is in "hot-stand-by" status. A dry-quenching plant is operated in such a way that two chambers and boilers work at full capacity, while one is being charged with about 10 percent of its actual quenching capacity. This hot-stand-by unit is thus ready to assume full operation should a problem arise with either of the other two units. At full capacity, a quenching unit typically produces about 25 t/h of high-pressure steam (93 bar) and the stand-by unit produces 2.5 t/h of low-pressure steam (8 bar) from the waste heat of coke. The cooled coke is transported by means of belt conveyors from the CDQ plant directly to the coke-screening station of the blast furnace. Coke is charged to the blast furnace in two

grain-size fractions (> 20 mm and 8–20 mm), and coke with grain sizes under 8 mm is used mainly as fuel in the sinter plant.

CDQ performance and operational benefits

In recent years, a number of developments have enhanced the performance of CDQ plants. Operation today is fully automatic with advanced process control and optimization systems. The average lifetime of the refractory linings in the quenching chambers could be increased from an average of seven to ten years. Operating and maintenance costs have been reduced, unplanned repairs are fewer, more time is available for preventive maintenance and overall operational safety has improved significantly. Rautaruukki's CDQ plant in Finland had an average degree of utilization exceeding 99.6 percent during the years 2000 to 2005.

The moisture content of coke dried in the CDQ process is approximately 0.2 percent compared to that of wet-quenched coke, which is about 2 to 5 percent. Other advantages that have been documented include a CSR (Coke Strength after Reaction) standard deviation of only 1.24 percent, a more uniform coke quality for improved blast furnace operations, a lower consumption of coke and heavy oil per ton of tapped hot metal, and facilitated handling and preparation with a dryer coke, particularly during winter conditions. The coke breeze that is used as a fuel in the sinter plant is drier than wet-quenched dust, thus more heat energy is generated during combustion. In the case of a total power failure of the integrated steel plant, steam generated at the CDQ plant is still available for many hours



CDQ plant in full operation at Ruukki Production, Raahe, Finland

to maintain safe and inert conditions of gas lines, and can be used for heating purposes during the winter as well.

Reference plants

Siemens VAI engineered and supplied coke dry-quenching systems at the cokemaking facilities of Raahe, Ruukki Production, Rautaruukki Oyj, Finland (partial supply, start-ups: 1987 and 1992); Koksownia Przyjazn, Poland (start-ups: 1997–1999); ArcelorMittal, Cracow, Poland (start-up: 2000); and Konark Met Coke Ltd., India (start-up: 2006). The latest CDQ projects (partial supply) are being implemented at SAIL's (Steel Authority of India Limited) steelmaking facilities at IISCO Steel Plant, Rourkela Steel Plant and at Bhilai Steel Plant, and are scheduled for start-up beginning 2011.

Concluding remarks

Reduced dust and CO₂ emissions from CDQ plants represent an important step for an improved environmental compatibility of cokemaking plants. A uniformly drier and thus more energy-efficient coke quality results in operational advantages in the sintering and blast-furnace processes. The broad engineering and plant-building experience of Siemens at every step in the iron and steel production chain, including electrical, automation and power-generation expertise, is available to assist producers to find the optimum solution for their cokemaking facilities. ■

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Improving the energy efficiency and environmental emissions of hot-blast stoves

More Than Hot Air

Like many steps in the blast furnace ironmaking route, hot-blast stoves are significant energy consumers. This is unavoidable as it is fundamental for the heating of the hot blast required for the smelting-reduction operations in the blast furnace. Historically, hot-blast stoves were characterized by their low efficiency and high emissions. Siemens VAI is at the forefront of development to improve this situation through enhanced stove performance and environmental compatibility.

A typical mid-range set of three stoves will generate about 300,000 Nm³/h of blast at a temperature of 1,200 °C. The energy being transferred to the blast is not insignificant and is of the order of 133 MW, 24 hours per day and seven days per week. Reducing the energy consumption is therefore a top priority. The expected overall efficiency for a stove system of this size is approximately 80 percent. The 20 percent energy loss can be roughly broken down into 3 percent shell losses, up to 4 percent from the hot-blast main, and between 0.05 and 0.5 percent during the combustion process with the remaining losses – by far the largest – attributable to the energy contained in the emitted flue gases.

Most of the new stoves that Siemens VAI builds today are installed with waste-heat-recovery systems based on a direct-contact heat-exchanger principle, which recovers heat from the flue gases for use in the preheating of combustion gas and air. Even many of the older plants with congested mains layouts, which for space reasons do not allow direct-contact systems to be installed, have implemented waste-heat recovery on the basis of oil systems. Each of these applications can improve overall stove efficiency by up to 4 or 5 percent under the right circumstances. These systems also reduce or eliminate the amount of high-calorific enrichment gases required to generate high hot-blast temperatures.

Another area where Siemens VAI has been particularly successful was in the development of a special ceramic burner in the internal combustion chamber. Energy loss due to unburned gases during the combustion process can be reduced to approximately 0.05 percent. However, and more importantly, CO emissions are lowered to a level of 200 to 300 ppm, which is significantly less than levels achieved with many other ceramic burner designs currently available on the market – and only a tenth of some of the traditional metallic burner designs still in use.

The extent of reduced emissions with the installation of large wall panels by Siemens VAI in the dividing wall between the combustion chamber and the chequer chamber is not easy to quantify. However, it is certainly superior to the traditional small brickwork construction and the metal membrane used by other stove suppliers, which tend to erode over time.

Outlook

Hot-blast stoves are a key product of the Siemens VAI blast furnace portfolio. Over the last few years, Siemens VAI has received orders for the design or supply of 85 new stoves or stove repairs in addition to 22 orders for stove studies and investigations. Currently, a new development plan is underway to further improve the ef-



Ceramic burner crown of an internal combustion chamber, SSAB Luleå, Sweden



Ceramic pre-cast wall panels in an internal combustion chamber stove, SSAB Luleå, Sweden

iciency of the ceramic burner by applying a better gas and air distribution and mixing arrangement. This will lead to even lower CO, SO₂ and NO_x emissions. Oxygen enrichment of the combustion air is also being investigated as a means to reduce enrichment fuels at high operating temperatures, and a more efficient chequer is also being developed. Other areas still requiring further attention are the stove shell and the hot-blast main where significant energy losses occur. Insulating the stove shell is one answer, but this is not entirely satisfactory, particularly on old stoves where regular shell inspections are important.

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Life-cycle assessment confirms environmental advantages of Corex and Finex processes

In Black and White... And Green

A Life Cycle Assessment study provides a holistic overview of the environmental impact of a technological process. Beginning with the mining of iron ore and coal up to the finished hot-metal product, it could be shown that the Corex and Finex ironmaking processes score much higher in an LCA rating when compared with the conventional blast furnace route.

Corex and Finex are innovative smelting-reduction processes in which non-coking coal is directly used as the energy source and reducing agent for the production of hot metal. But to what extent are they environmentally compatible and how can this be proved? Up until recently, this question has not been easy to answer. One approach had been to evaluate the results from mass balances or measurements, that is, the quantity of potentially harmful substances released to the environment such as dust, SO_2 , NO_x and CO_2 . These were then compared with emissions from the blast furnace route, including the sintering and coking plants. With a Life Cycle Assessment (LCA) evaluation, as defined per ISO 14040 and 14044, a standardized method for generating a comprehensive picture of environmental impacts could be applied.

Definition of environmental impact categories

In close cooperation with three universities – Technical University of Berlin (Germany), University of Mining and Metallurgy (Leoben, Austria) and Technical University of Denmark (Copenhagen) – an LCA study was conducted in 2007 and 2008 using the environmental software tool “GaBi.” Each step in the hot-metal production process, including the mining of iron ore and coal, the transportation to the plant site and the individual production steps, were modeled and analyzed. All by-products and their subsequent utilization were also taken into account. Five key impact categories were identified in this study, which considered most of the interfaces between the environment and the production process as a whole. The five categories are Acidification Potential, Abiotic Resource Depletion Potential, Global Warming Potential, Photochemical Ozone Creation Potential and Eutrophication Potential, as outlined in the following:

The Acidification Potential (AP) provides an overview of the acidic components that are released to the environment. The gaseous substances SO_2 and NO_x are transformed to sulfuric and nitric acid if they come into contact with water. Acid rain is a well-known consequence and forest dieback gained notoriety in the mid-1970s.

The Abiotic Resource Depletion Potential (ADP) considers natural resources which are subdivided into “non-renewable deposits” (e.g., fossil fuels), funds which are “renewable within a human lifetime” (e.g., groundwater) and “continually renewed flows” (e.g., wind). Processes are more sustainable if they are based on the use of coal, which is abundantly available worldwide, instead of non-coking coal, where resources are clearly limited.

Global Warming Potential (GWP): One of the most frequently discussed environmental topics today is

global warming, which most experts believe is caused by an increase of so-called greenhouse gases in the atmosphere. These gases, including water vapor, raise the atmospheric temperature by absorbing infrared radiation reflected from the surface of the earth.

Photochemical Ozone Creation Potential (POCP) describes the formation of ozone (O_3) in the presence of NO_x , hydrocarbons and sunlight (summer smog). Although the mechanisms behind this form of ozone creation are highly influenced by weather conditions, industry and traffic also play a major role.

Another important environmental impact factor is the Eutrophication Potential (EP), which determines the degree of over-fertilization. Needless to say, hot-metal production has not been a primary culprit in polluting the environment with nutrients, yet it is nevertheless a factor that has to be considered for a holistic overview of environmental impacts.

Evaluation tools and results

The relative importance and magnitude of the above-described impact categories were evaluated for the Corex, Finex and blast furnace ironmaking routes. This was performed by applying two different normalization methods: the CML (Centrum voor Milieuwetenschappen Leiden*, NL) and the EDIP routine (Environmental Development of Industrial Products). This approach allowed an enormous amount of complex and interrelated data to be illustrated in a single overview diagram. Specific customer-relevant parameters and energy sources have an influence on the overall picture. Different electricity mixes (country-specific ratio of hydroelectric-, atomic-, wind- or coal-based power generation) were also taken into consideration.



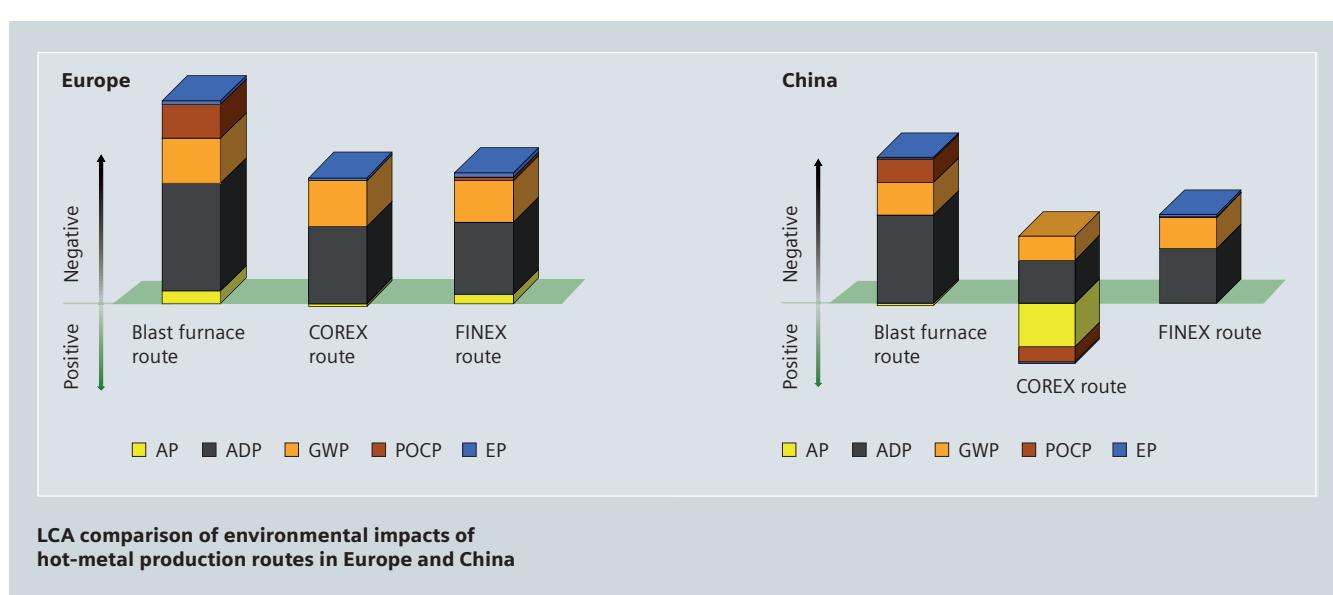
Export gas from Posco's Finex plant in Pohang, Korea, is used to generate electrical energy.

Under European conditions, it could be shown that all three ironmaking production routes are comparable with respect to global warming (GWP). Corex and Finex have a better LCA rating for all other categories when compared to the blast furnace route. For Chinese steel producers, the LCA for the Corex and Finex processes provides a much better outcome than the conventional blast furnace route. This is also valid for global warming, which is roughly 30 percent less due to the utilization of the export gas from the Corex and Finex plants for the generation of electricity. In fact, when considering the Acidification Potential, the inverted graph result indicates a “positive” impact on the environment.

Concluding remarks

The results of an independent LCA of the main hot-metal production processes have shown that the Corex and Finex processes are environmentally more compatible than the conventional blast furnace production route, especially at sites where coal is used as an energy source to generate electricity. As a supplier of Corex, Finex and blast furnace technology, Siemens VAI can ideally support iron and steel producers in the selection of the optimum hot-metal route, taking into account raw material factors, local site conditions, cost aspects and environmental requirements.

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Siemens VAI-supplied DDS plant at Tianjin Tiantie Metallurgical Group Steel Plate Ltd. Co., China
 (The picture shows round-type electrostatic precipitators, ID fans with silencers, gas-switchover station, gas cooler, waste-gas flare stacks and gasholder.)

Steelmaking in harmony with the environment using advanced offgas-cleaning systems for converter steelmaking plants

The Sky's the Limit!

Located at the birth site of the LD (BOF) steelmaking process and as the driving force behind the worldwide adoption of this technology, the Linz-based headquarters of Siemens VAI has a special obligation to provide integrated environmental solutions for oxygen steelmaking. This article describes the scope and benefits of advanced offgas-cooling and -cleaning systems, including CO gas recovery, from Siemens VAI – the market leader in this field. With these solutions, steel producers can fully meet all legal requirements in a cost- and energy-efficient manner.

The distinctive red dust cloud swirling into the atmosphere above an industrial site was the characteristic trademark of an oxygen steelmaking plant in the past. For every ton of liquid steel tapped, between 15 and 20 kilograms of dust are generated. Thanks to major advances in offgas treatment and dedusting processes, environmental emissions from steelworks can be reduced today to levels previously thought to be unattainable. Siemens VAI has made decisive contributions to the highly efficient dedusting of converter steelmaking plants and holds a leading position in this field today.

Since the year 2000, more than 60 primary and secondary dedusting projects, comprising both dry-type and wet-type systems (DDS, WDS) were received by Siemens VAI from steel producers located in Austria, Belgium, Brazil, China, Germany, Russia, Slovakia, South Africa, South Korea, Ukraine and elsewhere. These included the supply of both new dedusting systems as well as the upgrading and modernization of existing facilities for carbon- and stainless-steelmaking plants. Optimized systems and solutions were supplied that fully satisfied the individual process and environmental requirements of each plant.

How does a dry-type converter-offgas-cleaning plant work?

In the oxygen-steelmaking process, large quantities of gas at temperatures up to 1,700°C are emitted from the LD (BOF) converters. These contain high concentrations of dust and carbon monoxide. The thermal energy of the hot gas can be largely recovered in a boiler-

type cooling stack where steam is generated (approximately 70 kg/t of steel) for other applications. The converter offgas is cooled in this step to approximately 800–1,000°C. In a second step, the gas is cooled down further to around 200°C in an evaporation cooler where water and steam are sprayed into the gas stream using special dual-flow nozzles. The coarse-dust fraction is removed from the offgas at this stage. The evaporation cooler is designed in such a way that the route and the retention time of the offgas will result in a completely

For every ton of liquid steel tapped, between 15 and 20 kilograms of dust are generated.

dry dust discharge. The gas then passes through a round-type electrostatic precipitator (ESP) where the fine dust is electrically charged by means of discharge electrodes. It then migrates to oppositely charged collecting electrodes where it accumulates. At certain intervals, the dust is mechanically rapped from the collecting and discharge electrodes by a series of hammers. The fine dust accumulates at the bottom of the ESP from where it is removed by an extraction system.

Both the coarse dust from the evaporation cooler and fine dust from the ESP can then be briquetted at the briquetting plant followed by recycling to the >>

LD (BOF) DEDUSTING PLANTS

>> steelmaking converters. This substitutes iron ore and scrap. As an option, the quantity of zinc in the fine dust can be determined with the use of a special laser device and, when the concentration is above a certain threshold, the zinc-rich dust portion can be extracted for subsequent use by external customers. DDS are distinguished by their high dedusting efficiency with a clean-gas dust content down to 10 mg/Nm³.

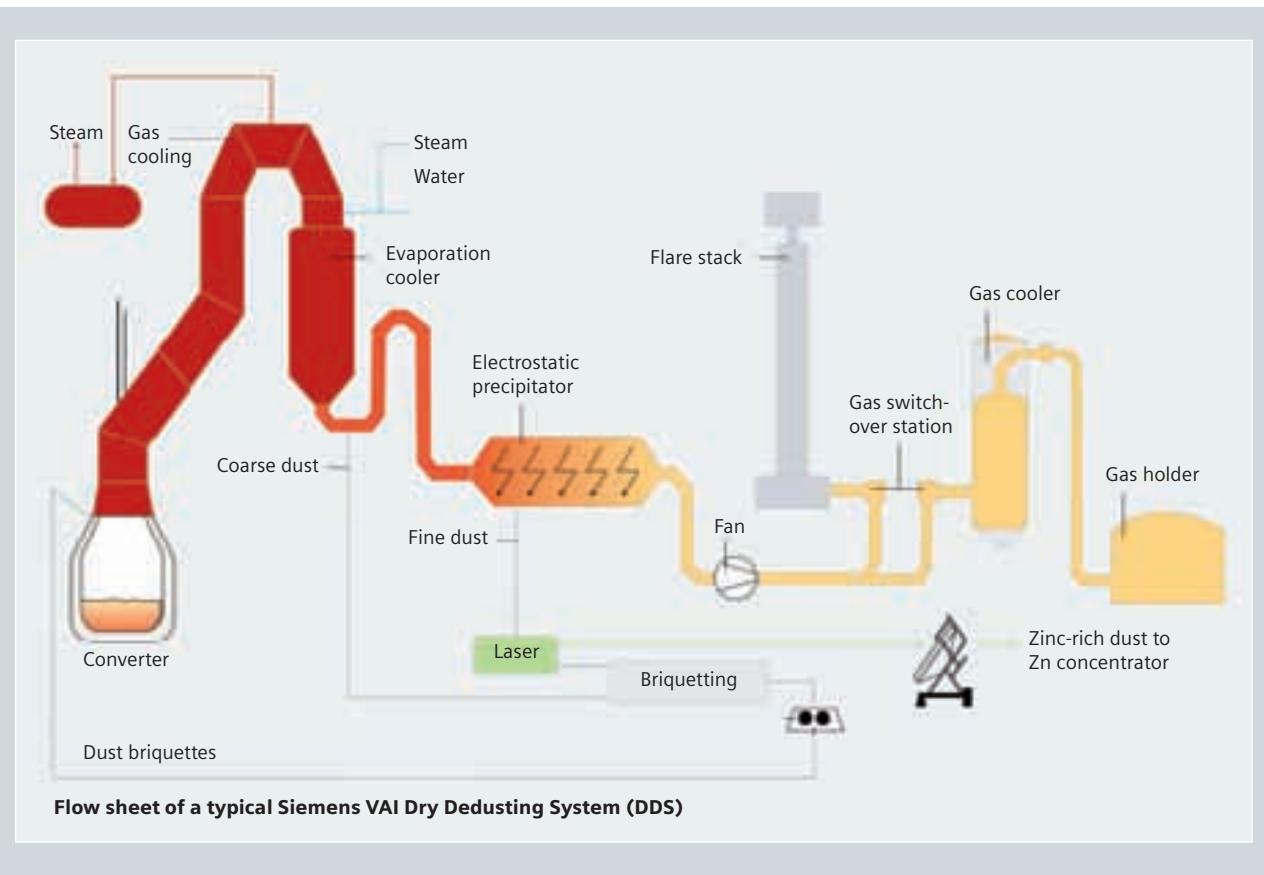
The efficient cleaning of converter offgas is the key factor for environmentally compatible and sustainable steelmaking operations.

The converter offgas is exhausted through the dedusting system with an axial induced-draft (ID) fan. If the CO content of the cleaned converter gas is above a certain concentration, as measured by the gas-analysis unit, it can be recovered. In the gas switchover station the CO-rich gas is routed to a multi-nozzle gas cooler where it is cooled down to below 70°C by means

of water injected in the counter-flow direction. The gas is then stored in a gas holder for subsequent use within a steel plant, such as for heating applications or for the generation of electricity. CO gas recovery is typically in the range of 70–100 Nm³ CO per ton of produced steel. This, of course, substitutes fossil fuels and significantly reduces energy costs and overall CO₂ emissions.

Wet-type dedusting systems

Offgas cleaning in oxygen steelmaking plants was performed for the first time applying wet-type dedusting systems. Many steel plants today still operate with wet-type systems. Coarse dust in the offgas stream is first precipitated in the quencher by water injections. In a second step, fine dust is removed in a specially designed scrubbing unit where a highly turbulent mixing of gas and scrubbing water takes place. Siemens VAI mainly supplies WDS Cone-type scrubbers with annular gap technology. These are characterized by their simple design, low investments costs, high dedusting efficiency (down to 30 mg dust/Nm³) and low energy requirements. If requested, a rectangular venturi scrubber can also be supplied. Otherwise, gas exhaustion through the system with an ID fan and CO gas recovery is performed as in DDS plants.



Comparison of dry- and wet-type primary dedusting systems

Investment costs for wet-type dedusting systems are only about 70 percent of those of DDS plants. However, because a high differential gas pressure must be maintained in wet-type systems to ensure efficient gas cleaning, this results in a higher electrical energy consumption of the ID fan. In comparison with WDS plants, no sludge arises in dry-type systems, which must be treated, dried or otherwise disposed of. This dispenses with the need for a slurry-water-treatment plant. The dust from DDS plants can be briquetted and recycled to the steelmaking process. These process-inherent features of DDS installations significantly reduce operational costs. Furthermore, the higher dedusting efficiency fully meets international legislation regarding converter emissions, even the stricter values anticipated for the future. For these and other reasons, dry-type systems with recycling solutions generally become more economical than wet-type systems within a period of about three years following plant start-up (European basis).

Secondary waste-gas treatment

In the steel production process, considerable quantities of dust and fumes are released to the surroundings primarily from hot-metal reladling stations, hot-metal desulfurization and deslagging stations, during the charging of hot metal and scrap into the converter, and during the tapping of liquid steel. Other sources of internal plant emissions include the secondary metallurgical facilities, such as ladle furnace or ladle-refining stations, as well as the material-handling systems for alloys, additives and fluxes. To combat this problem and to provide more acceptable working conditions for operating personnel, advanced solutions and systems are available that efficiently capture and clean secondary emissions arising within a steelmaking plant. Dust-laden fumes are collected directly at their emission source and are evacuated by powerful fans. From the various emission points, suction ducts convey the fumes to a central bag-filter station where the dust is filtered and precipitated before the cleaned gas with a dust content down to less than ten milligrams per standard cubic meter is released to the atmosphere. With pulse-jet cleaning, the filter cake that accumulates on the surface of the bag-filter is periodically dislodged by a reverse jet of air. The dust is removed from the system and conveyed to intermediate storage silos for subsequent recycling or disposal. Radial ID fans located downstream of the bag-filter provide the required draft to efficiently evacuate the fumes. The entire secondary dedusting system functions completely automatically and is coordinated with the converter charging and tapping cycles. The volume of the offgas emitted from the



Primary dedusting system (dry type) with gas and dust recycling for LD (BOF) steelmaking plant at Baoshan Iron & Steel Company Limited, China

stack as well as the dust content is measured at the stack exit to assure that the bag-filter system is working properly and that the prescribed dust emission levels are met.

Siemens VAI recently introduced an innovative static cooler system installed in the converter-charging suction ducts. During hot-metal charging, the high thermal power is absorbed by plates, thereby considerably reducing the required suction capacities. This also improves process safety and equipment lifetimes. Moreover, greater flexibility is provided with respect to the quality of charged scrap and hot-metal-pouring time. (Please see metals&mining 3|2007 for more information on this topic.)

Concluding remarks

Siemens VAI offers future-oriented technologies for the efficient extraction and cleaning of converter off-gas and secondary fume emissions that meet all environmental requirements. Furthermore, optimized systems are available for maximum utilization of the inherent heat of the offgas to generate steam – for cost-saving CO gas recovery as well as for profitable ferrous- and zinc-dust recycling. These solutions are key factors for environmentally compatible and sustainable steelmaking operations.

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Special design solutions combined with advanced process control is the key for sustainable and environmentally friendly electric steelmaking

Where Dust Has No Dominion



While EAF emission limits have never been so strict, the portion of metallic- and plastic-contaminated steels in the furnace charge continues to increase. This, compounded by the urgency to slash costs, does not make life easy for electric steelmakers. An experienced partner and proven solutions are called for to assist steel producers in meeting the production and environmental challenges of today.



Cathedral of the environment (example of a common EAF/AOD dedusting plant)

Environmental regulations governing EAF emissions of dust, volatile organic compounds (e.g., dioxins and furans), heavy metals and other hazardous materials are becoming progressively stricter. For example, at many production sites, legislation is already demanding that the dust content of the cleaned offgas be less than five mg/Nm³, and that dioxin concentrations be reduced to 0.1 nanograms (i.e., one ten-billionth or 1/10,000,000,000 of a gram) per Nm³. Furthermore, dust-disposal and -dumping costs are becoming prohibitive, calling for an improved optimization of the EAF process in addition to effective recycling solutions to minimize the generation and emission of dust.

Example of an EAF offgas-treatment and dedusting system from Siemens VAI

The evacuated primary offgas from EAF melting operations first passes through a drop-out box where the coarse dust is removed. If required, the offgas

can be post-combusted in a refractory-lined chamber to neutralize volatile gases. Cooling of the offgas down to less than 600°C then takes place in a water-cooled hot-gas line, which significantly reduces the volume of the offgas. As an option, the waste heat can be utilized to produce hot water and also saturated steam for various applications within the steel mill (e.g., for heating purposes or vacuum-degassing operations). In a second cooling step, the primary offgas is then rapidly lowered to between 200 and 250°C in a plate-type forced-draught cooler to minimize the reformation of harmful dioxins or furans (*de novo* synthesis). Spark arrestors installed upstream of the filter station is a further measure to protect the filter bags from sparks and smoldering dust.

Secondary offgas and dust emissions from the EAF area itself, from the hot-metal reladling station, canopy hood, slag-skimming station, secondary metallurgical facilities as well as from material

handling are then mixed with the primary offgas stream for common dedusting in pulse-jet-type bag filters. The offgas from the primary and secondary emission sources are exhausted through the entire system by means of powerful radial ID fans. The dust that is removed from the offgas stream is transported to storage silos by a conveying system. After pelletizing or briquetting, it can be recycled to the steel-making process. With repeated recycling sequences, especially when zinc-bearing scrap from cars and other coated steel products are charged to the furnace, the zinc content of the dust gradually increases, which may lead to possible metallurgical and system problems. When the zinc content of the dust exceeds a certain threshold level, as determined by an online, laser-based zinc-measuring system, this dust can be removed from the system and sold to the zinc industry. The dust content of the clean gas exiting the stack is typically below ten mg/Nm³, if required, less than five mg/Nm³.

A partner with experience

Siemens VAI has more than 30 years of experience in the supply of offgas treatment and dedusting projects for EAF steel mills. The latest orders (2006–2008) were received from renowned steel producers in China, Mexico, Ukraine and Russia. For these projects the furnace tapping weights varied between 120 and 160 tons and the fume-suction capacities between one and three million m³/h. On the basis of decades of experience in the field of EAF dedusting, Siemens VAI continues to help producers find the right solutions to meet their present and future requirements. ■

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Simetal^{CIS} Simelt – The reference for melting power

Melting Power At Its Best



Latest Simelt AC cabinet design

The first Simelt electrode controller with Simadyn C technology came into use in Germany in 1980. In 1993, the first Simelt based on the Simatic S5 PLC entered the market, featuring significant new functions in an improved automation landscape. Simelt AC, coupled with the Simatic S7 automation system, followed in 1995. Up until now, more than 240 Simelt controllers have been installed worldwide, with 54 units commissioned in 2007/2008. In China, for example, 18 new Simelt systems were supplied during this same time period. In the following it is shown why an increasing number of customers are turning to Simelt and its massive melting capability.

Simelt MDC (Melt Down Control), the third performance module, represents a major step towards fully automatic EAF operation. The MDC controls all furnace aggregates automatically, creating the conditions for a continuous, error-free melting process. This enables furnace operating staff to concentrate on other important tasks. The MDC can be adapted to any furnace and steel grade using precisely defined melting programs that ensure a high degree of reproducibility in the EAF process. Shorter power-on times by up to six minutes,

in the heat, thus reducing or avoiding overtime due to adjustments of the oxygen concentration. The FSM module achieves a more efficient furnace operation by stabilizing the arc, which improves the power input. Moreover, the module optimizes carbon injection, power-on times and thus the specific energy consumption. This solution is more reliable than the analysis of the harmonic distortion of the current, which cannot determine the height and alterations of the foaming slag in each area of the furnace.



Electric arc furnace during scrap meltdown

The challenge for electric steelmakers is to optimize production efficiency, energy consumption and environmental protection, while lowering the risks in EAF investments. Simelt modules were designed to ensure a precise furnace operation point and are highly compatible with every automation environment.

Modular performance with AC, NEC, MDC and FSM
Simelt modules have been adapted to the different tasks in furnace operation. The basic Simelt module, for instance, is the Simelt AC electrode controller, which takes into consideration all parameters relevant to the EAF melting process.

The AC module ensures high performance and safe operation under all working conditions at the optimal operation point by reducing the power-on time of the furnace and lowering electrode and energy consump-

tion as well as refractory wear. Once installed, the module enables swift access to operating data for evaluation and tuning, provides an improved transparency thanks to signal monitoring of all of the main parameters, and features a melting report system covering more than 100 electrical parameters.

A further module is Simelt NEC (Neuronal Energy Control), which distributes thermal energy more uniformly inside the furnace. In this way, the NEC significantly contributes to a prolonged lifetime of the furnace-wall elements. Other features include enhanced effective power, which is increased to the highest possible value; reduced specific melting energy; reduced power-on time; and lower overall power consumption. All in all, Simelt NEC achieves a higher power performance input with a dynamic control of the melting process, without any other changes to the power supply system down to the furnace transformer.

a reduced electrode consumption and a higher furnace yield have all been achieved with Simelt MDC.

Latest innovation – the Simelt FSM module

The latest addition to the family of Simelt modules is the Foaming Slag Manager (FSM). Simelt FSM provides a qualitative determination of the height of the slag and its distribution between the electric arc and the wall panels. With the goal of assessing the behavior of foaming slag in the electric arc furnace, a sensor system that operates on the basis of structure-borne sound measurements was developed and successfully tested by Siemens. This module is now successfully applied in several EAFs. With the help of a control algorithm, the FSM automatically regulates the injection of carbon into each area of the furnace. Additionally, Simelt FSM quickly reaches the target value for the oxygen content

Decisive cost and environmental benefits

Each of these powerful modules is the result of a continuous, ongoing research and development process aimed at improving production performance and energy efficiency. This not only lowers costs, it also means an improved environmental compatibility of the furnace with respect to, for example, raw-material savings and CO₂ emissions. All of the described features, aspects and benefits show why the Simelt electrode controller is perhaps the most successful product of its kind in the steelmaking industry today. ■

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Advanced water management to meet plant and environmental requirements

Water Is Life!

Water is one of the most important natural resources on our planet. And water is also vital for the operation of a steel mill. The preparation and industrial consumption of water for each plant site must go hand in hand with the protection and preservation of our water supplies. This is the task of the department of Advanced Water Management at Siemens VAI – to provide economical and ecological solutions for the sustainable use of water within the metallurgical industry.



Since the beginning of the industrial revolution the demand for cooling water has increased dramatically. Nearly every industry segment requires cooling-water applications. This was one of the main reasons – in addition to serving as a transportation media and energy source – that industrial plants were typically built along rivers and lakes. In the past, environmental protection was not a matter of priority and the industrial water employed mainly for cooling and cleaning in a “once-through” system was discharged back to its source without any treatment. As a result of environmental pollution and contamination, the industry was eventually forced to increasingly install closed-circuit water-recirculation systems and to apply effective treatment techniques for reused and discharged water. Although the consumption of make-up water could be dramatically reduced, the problem of contaminated waste-water effluents was not so easy to solve. Today, advanced water technologies allow plant systems to be designed in which the make-up water demand and quantity of water effluents are reduced to a minimum. Furthermore, effluents can now be treated in such a way as to avoid any detrimental impact to our environment. It is even theoretically possible with the application of current technology to design industrial plants with autarkic water systems that do not require any external make-up water at all. However, these solutions may not be feasible at the time. With so-called zero-liquid-discharge solutions waste water is treated for 100 percent reuse (Figure 1). As outlined in the following, the three determining factors that must be carefully considered for the proper and efficient design of water-treatment plants are 1) process requirements, 2) make-up water conditions and 3) legal aspects governing the recycling of water (if required) and disposal of wastes (Figure 2).

Process requirements

The parameters that must be taken into consideration to ensure optimized processes include the type and combination of cooling systems (open contact, open non-contact or closed systems), the ideal cooling temperature and water pressure for each plant unit, and the necessary water quantity and quality (i.e., allowable concentrations of dissolved solids). Furthermore, the right selection of equipment and piping material, automation systems and instrumentation integrated within an overall plant layout is the basis for long-term, reliable and efficient process operations.

Make-up water conditions

The starting point for each water-treatment system is an analysis of the raw-water quality and availability – taking into account possible legal restrictions – as well as the climatic conditions. This is the basis for defining the necessary treatment steps and an efficient cooling strategy. The goal is to optimize the water quality for the various foreseen uses such as potable water, service water and cooling-water applications (e.g., filtered water, softened water and desalinated water).

For autarkic water systems all possible water sources must be considered for use. This includes rainwater and also treated waste and sewage water. It is only through the utilization of alternative sources that steel plants could be operated without any additional, external make-up water. Certainly, the investment and operational costs are still rather high compared to straightforward water consumption savings, but the technologies are already available should they be required. It will be only a matter of time until the wasteful use of water will be increasingly restricted by the authorities and that the need for autarkic systems will increase.

Legal aspects

There are several sources of waste water in a steel plant. These include sewage water, stormwater and industrial waste water. The latter is comprised of blow-down water from open circulation systems, concentrates from reverse osmosis plants, eluates from desalting and softening plants as well as brine from evaporation plants. Slurry is generated through the backwashing of gravel filters or comes directly from clarifiers and thickeners of the various process steps. Slurry is dewatered to facilitate handling. The proper treatment of waste water and slurry depends on legal regulations, recycling opportunities and disposal possibilities. As mentioned above, waste-water flows can be treated for a 100 percent reuse. These zero-liquid-discharge solutions are the first step towards implementing autarkic water systems.

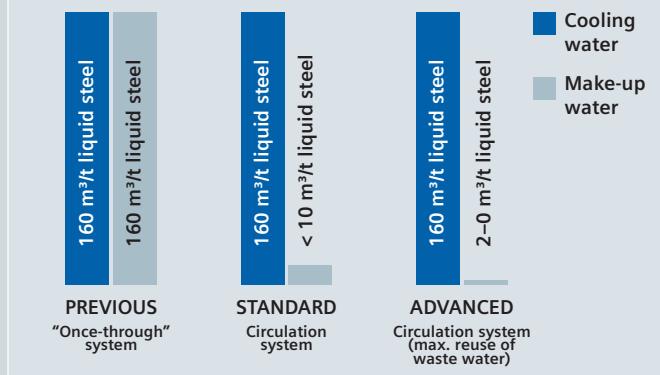


Figure 1: Water consumption in the iron and steel industry

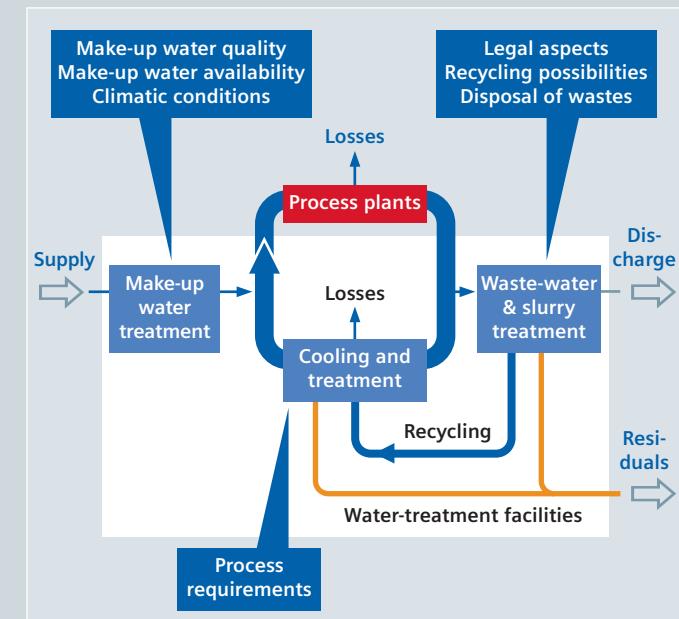


Figure 2: Design parameters for water-treatment plants

Concluding remarks

Efficient and sustainable water management is an obligation to our environment and future generations. It is only through the installation of completely integrated and proven solutions that long-term, responsible and sustainable water-treatment systems can be assured. With an experience record that extends back to more than 40 years and includes the implementation of some 170 projects in over 40 countries, Siemens VAI is one of the world's leading suppliers of water-management facilities for the iron and steel industry. On the basis of this experience and expertise, Siemens VAI can help producers design and implement the advanced water-management systems that satisfy both plant and environmental requirements. ■

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Josef Buchner (center), environmental protest on the Steyregg Bridge in Linz, Austria (December 6, 1989)

Josef Buchner, environmental activist

A Fighter for the Environment

Josef Buchner is the mayor of Steyregg, a small Austrian city downwind of the Linz industrial center. He was the organizer of numerous protests against air pollution from Linz in the past. Buchner eventually headed the "United Greens of Austria" political party from 1983 to 1994 and was a member of the Austrian parliament from 1986 to 1990. In the following interview Buchner spoke about his environmental activities and successes.

You are known as Austria's first "green mayor."

Josef Buchner: That's correct, but the word "green" is not quite accurate because I preside over a citizens' action group that is above party lines.

You once worked at Voest. Why wasn't there a greater environmental awareness earlier?

Josef Buchner: I was at Voest (now voestalpine Stahl) between 1960 and 1966. Voest and Chemie (Chemie Linz AG until 1990) were by far the largest employers at the time, even for Steyregg. Back then, no one really thought that far ahead. And no one dared to. The time just wasn't ripe. A lot of people were dependent on these companies for work.

What triggered the environmental movement in Steyregg? How was the situation back then, in the 1970s?

Josef Buchner: Steyregg lies directly downwind of the steel and chemical industries of Linz. It was the most polluted city in Austria. It was terrible. Just a few examples: The cows that were grazing in the fields had black heads, hooves and legs because the grass was so full of soot. The dust contained so much iron oxide that you could collect grape-sized clusters with a magnet from the outside windowsills. I recall days when balcony flowers and trees died overnight during the summer. The leaves turned yellow and fell off the trees, which remained barren until the following spring. The coniferous forests suffered the most. There were children whose spines didn't develop properly and a human geneticist said that there was no doubt that it was directly related to the environment. Many died of cancer in the greater Linz area, statistically far more than in other cities. We knew that we were dealing with a

frightening issue. People woke up in the morning in Linz and said, "Oh, the sun isn't shining today." But it was dirt clouding the sun. Many of them had no idea what they were breathing.

When did you start your environmental protests?

Josef Buchner: Politically it all began back in 1979. We founded a citizen action group and decided that if we wanted to take on Voest and Chemie, we couldn't do this as private persons. Industry was a powerful force. At the same time, the political situation was very delicate because we were often seen as job destroyers. There were secret studies and plans for the resettlement of Steyregg. That's when the discussions really got heated up. We received funds for air and environmental measurements. The results confirmed that the situation was very bad indeed. After a year of measurements, we went public with the results.

What kind of protests were organized?

Josef Buchner: Hundreds of articles were published in 15 years. What we did would not have been possible without the media. Voest took me to court in connection with the installation of a high-temperature gasification plant for the disposal of hazardous wastes. The last major protests were held back in 1988 and 1990. We once blocked the Steyregg Bridge in 1989. It was -10°C and mothers came with their children in strollers. It wasn't only against Voest, but also against Chemie Linz. Hundreds of people took part in the demonstration on the bridge. The police literally threw the banners into the Danube. It was a highly charged situation. We were ordered to leave the bridge. The police were naive enough to arrest my children, who were peacefully standing there as part of a human chain. The police pulled them out of the crowd, but no one else. My wife was horrified. She nearly had a nervous breakdown. The demonstration on the bridge was the final breakthrough, though. People realized that things couldn't go on as they were. The discussion was now out in the open – that only a clean industry could be an industry of the future.

What did you achieve with your protest campaigns?

Josef Buchner: We were able to sensitize the people about what was going on. Things started to change. The people of Linz began to acquire an environmental awareness, as well as the Linz authorities, politicians, Voest and Chemie. In the end, we managed to achieve our goals ten to fifteen years sooner. We have environ-

mental measurement results to prove this. Today, we have a good quality of life in Steyregg ... and we have air values that normally lie within the strict tolerances for climatic health resorts as defined by the Academy of Austrian Sciences.

How is your relationship with voestalpine today?

Josef Buchner: In fact, I'm very satisfied with voestalpine. An incredible amount has been done, which has had an extremely positive affect on Steyregg. Voestalpine – and you have to give them credit – has become a model plant. The conflict situation that we once had is a thing of the past. We now have polite and friendly communication with each other, which allows us to deal with issues in a professional and practical manner. We have very good air quality now. It's amazing. The forest is growing again. We are now very satisfied with our quality of life.

What plans and objectives do you have now?

Josef Buchner: We want the traffic problem in Linz to be solved, because this also affects us. Some 28,000 vehicles use the B3 [a major traffic route on the outskirts



Forcible disbanding of protest action

of Steyregg] every day – that's almost like the autobahn. Most of the pollution now no longer comes from the industry, but from traffic.

Do you have any regrets?

Josef Buchner: I regret nothing. We did our homework. That took us forward. And it wasn't always easy.

Interview with Dr. Lawrence Gould on Nov. 12, 2008. ■

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Continuous investments in environmental technology have transformed voestalpine into one of the greenest steel producers in the world today

We're Not Finished Yet

There was once a time when the people living in the Linz region of Austria would point with pride at the belching smokestacks and at a sky filled with smoke. This was the sign of prosperity and progress and, above all, a secure job. How the times have changed. Today, one points with pride at a world-class steel works and at chimneys without plumes. Over the past decades, voestalpine has made huge investments in environmentally friendly steel production, and counts today among the greenest steel companies worldwide.

Unacceptable environmental conditions of the past in the Linz region, which were partly caused by voestalpine Stahl, were not a result of the company being unconcerned about these matters. Effective pollution-control technologies simply did not exist at that time, contrary to today. The tremendous advances made in steelmaking, especially since the introduction of the revolutionary LD oxygen steelmaking process in Linz in 1952, proceeded at a much faster pace than the required environmental solutions. When it became clear in the 1970s and 1980s that there was indeed a correlation between pollution and health hazards, voestalpine increasingly became a pioneer in developing and implementing solutions to make steel a greener product.

Examples of applied environmental solutions

The major sources of emissions within a steel works are from the coking plant, sintering plant, blast furnace and the steelmaking plant. In all of these areas, as well as in the downstream rolling and processing facilities, voestalpine has either adopted the best available technologies or developed by itself, or together with partners, specialized solutions to combat emissions. Thanks to continuous modernization and pollution-control measures introduced during the past two decades, the company's cokemaking facilities still count among the cleanest plants of their type in Europe today. The eposint and Meros offgas-recycling and -treatment facilities at the Sinter Plant No. 5 are the latest in a series of installations that reduce the specific offgas volume, dust quan-

tity and other harmful emissions from the sintering process to levels previously unattained applying conventional technologies. Results of trials now being conducted on a DeNO_x pilot facility installed at the sinter plant will serve as the basis for the design of a future industrial-scale unit. Application of the VAiron optimization system in Blast Furnace A – developed jointly with Siemens VAI – in combination with an increased portion of injected plastics into the blast furnace, have been key factors for reducing the specific consumption of reductants (e.g., coke and heavy oil) in ironmaking to near the theoretical limit, thus saving raw materials and energy costs. With highly efficient primary and secondary offgas-cleaning systems in operation at the LD steel plant, dust emissions are reduced to well below prescribed limits. Collected dust is briquetted and recycled to the steelmaking process. The zinc-rich dust portion is separated and utilized externally. CO-rich gas is recovered for the generation of electrical energy in the company's own power station as well as for internal heating applications in industrial furnaces.

Plastics injection into the blast furnace

Voestalpine is one of only two companies in the world today that injects waste plastics into the blast furnace on a large scale. Currently, 60,000 tons of waste-plastic mixes from packaging collection and automotive shredder residue (ASR) are pelletized and injected into Blast Furnace A each year. This figure will be increased to 200,000 t/a – equivalent to more than one third of the entire annual quantity of waste plastics accumulating in Austria. This not only reduces CO₂ and SO₂ emissions, but also allows voestalpine Stahl to achieve the world's lowest dust emission values in the cleaned blast-furnace top gas.

CO₂ emissions

Regarding CO₂ emissions, the application of advanced technology, automation systems and energy-saving and -recovery solutions have lessened the specific energy consumption along the entire steelmaking route. For example, from 1990 to 2006 the total steel output by the voestalpine Group increased by 65 percent while specific CO₂ emissions per ton of crude steel could be reduced by 19 percent during the same time period. Furthermore, together with 40 other partners, the voestalpine Group is participating in the European-wide ULCOS (Ultra Low CO₂ Steelmaking) project to slash specific CO₂ emissions in steelmaking by 50 percent by the year 2050.

Investments that have paid off

A total of €49 million were invested in environmental technologies at voestalpine Stahl during the company's



voestalpine Stahl, Linz, Austria

financial year 2007/2008. This is in addition to approximately €600 million spent on environmental facilities during the past 20 years at the Linz site alone. The results are clearly visible. A dramatic reduction in dust emissions at voestalpine could be achieved between 1985 and the present. It is estimated that the annual quantity of coarse and fine dust (PM₁₀) emitted to the environment could be lowered by approximately 2,200 tons since 2001.

Concluding remarks and outlook

In addition to highest quality steel and personnel safety, environmentally compatible steelmaking is a key core value of voestalpine. Online measurements of all important emission values are continuously monitored and anyone at any time can check the current values. Each year since 1999, voestalpine Stahl has received an environmental compatibility certificate from Lloyd's Register Quality Assurance in confirmation of the company's conformance with the stipulations of the Eco-Management and Audit Scheme (EMAS). Over 140 individual measures are currently in progress to continuously reduce the environmental impact of steelmaking. These and many other projects such as those outlined above are examples of the commitment of voestalpine to maintain its reputation as a leading green-steel producer. ■

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Tree rings confirm improved air quality

An interesting indirect confirmation of the improved air quality in the Linz region over the decades can be seen in the growth pattern of tree rings. In a study conducted by Professor Dr. H. Sterba of the Viennese University of Agricultural Sciences in 1992, the tree rings of older spruce trees growing in the Linz area were compared with the sulfur dioxide emissions to the environment from voestalpine Stahl. Up until the year 1967, the SO₂ emissions were largely neutralized by the high portion of alkaline-rich dust emitted from the processing of Austrian siderite ore in the sintering and blast furnace plants. Following the installation of efficient dedusting filters in 1967, SO₂ emissions were no longer neutralized, resulting in a dramatic decrease in tree-ring growth between 1967 and 1980. After various measures to reduce SO₂ emissions were implemented, normal tree-ring growth resumed.

For more information about the environmental activities of voestalpine Stahl, readers are invited to visit the company's website (<http://www.voestalpine.com/>

[ag/en/press/publications/Download_Sonstige.html](http://en/press/publications/Download_Sonstige.html)) to download the environmental statement "How green is voestalpine."



Tree-ring growth pattern of a 90-year-old spruce tree from the Linz region

Review of the first Siemens VAI Rolling and Processing Conference

From Solutions To Value

On September 16 and 17, 2008, Siemens VAI held its first rolling-mill conference in Linz. Some 80 technical lectures and numerous displays gave the 450 participants from 40 countries an overview of the company's capability at the two-day event. The focus was on added value through higher productivity, better performance and quality as well as the lower life-cycle costs that Siemens solutions offer steel producers.

Already in his opening speech, Dr. Richard Pfeiffer, CEO of Siemens VAI, stressed close cooperation with customers in the development of improvement solutions. "Our main focus is to provide the highest value for our customers through completely integrated solutions," said Pfeiffer. "Value for our customers is created through the permanent emphasis on innovation in order to provide answers to specific and individual plant and market requirements. Value results from the combination of mechanical and electrical know-how, through the optimization of process steps and plant configuration, as well as from highest plant availability, which is the result of an excellent life-cycle service support." He repeatedly referred to the necessary standardization of tried-and-tested applications: "Siemens VAI began early with the standardization of the product family Siroll^{cis} – customized, cost-effective, flexible and reliable rolling mills and processing lines are the outcome."

For Pfeiffer, an excellent example for a "solution-to-value" facility based on highly innovative technology is endless strip production (ESP), in which liquid steel is cast and hot-rolled to thin-strip in a continuous, uninterrupted production process. The first facility of this type is now in the hot commissioning phase. Giovanni Arvedi, CEO of the Arvedi company, and Federico Mazzolari from Finarvedi in Cremona, Italy, spoke about this solution in their presentation, stressing the lower environmental impact and the better cost position in comparison to conventional process routes. "Clearly linked to low energy consumption are the ESP plant's lower direct and indirect emissions of greenhouse and noxious gases (CO₂ and NO_x), amounting to 40 to 50 percent on normal gauges and 65 to 70 percent on thin gauges," said Arvedi. "The new line concept will achieve the world's best energy balance for producing hot-

rolled coil from liquid steel, thanks to using the heat after casting for rolling operations and reducing the demand for deformation energy to a minimum, since the strip is still soft in the center."

Communicative exchange

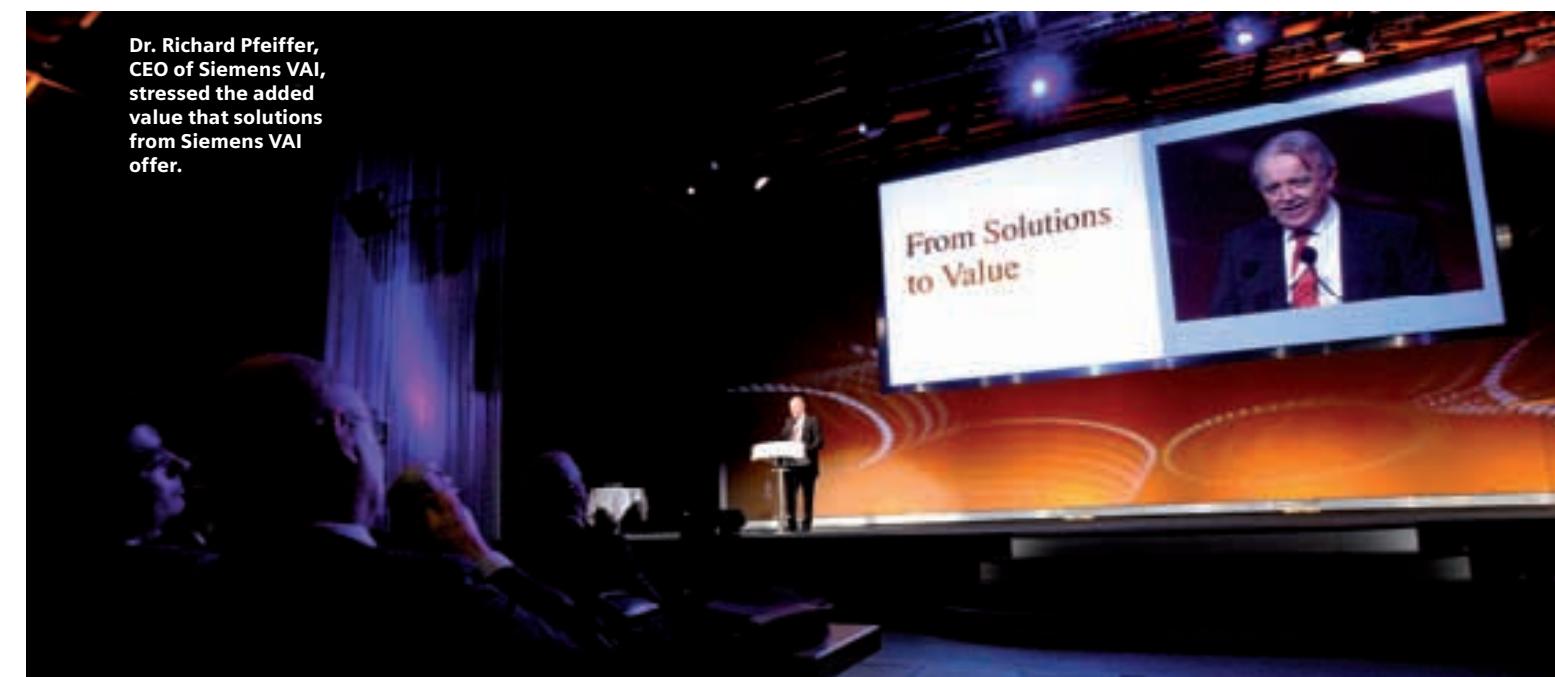
In his keynote speech, Dr. Carl-Dieter Wuppermann, Executive Member of the German Iron and Steel Institute (VDEh) management board, spoke about solutions competence. Particularly in the rolling and processing business, the challenge of the future will be to keep up with the worldwide growing demand for high-quality steel products, he said. Attaining defined product characteristics at low production costs will be the key factor to successfully take part in the globalized marketplace.

The presentation from the most recent Siemens acquisition – the Morgan Construction Company – with focus on the world-famous Morgoil bearings speaks for the ability of Siemens VAI to provide excellent solutions. In speeches from Siemens VAI employees from Austria, Germany, France and England it was made clear that innovation is fundamental to be able to offer tailor-made solutions for customer-specific requirements well into the future.

Examples of innovation in action include the Power-Coiler and its operation at ArcelorMittal in Fos-sur-Mer and Cracow as well as the advanced high-strength crop shear that was just installed in an ArcelorMittal hot-strip mill.

Advanced features such as dynamic work-roll cooling, L-block bending and shifting as well as Smart-Crown have already been extensively used, in particular for AHSS rolling. Innovative technologies like these are part of new hot-strip rolling mills – and they are extremely well suited for installation in existing >>

Dr. Richard Pfeiffer, CEO of Siemens VAI, stressed the added value that solutions from Siemens VAI offer.



Siemens VAI presented its rolling and processing portfolio at four stands integrated into the conference at the Linz Design Center.



Heavy metal at the RPC 2008: numerous displays in the outdoor area provided guests with an overview of production activities at Siemens.



The impressive displays at the conference exhibition attracted considerable attention and were the focal point of intense discussions.



The RPC 2008 served as a perfect platform for communicative exchange and keeping up with contacts.

>> facilities, which allow significant improvements to be achieved with respect to product quality and the product-mix range.

For the cold-band area, a laser welder for cutting and welding strips between 0.5 and 7.0 mm has just been introduced to the market. It was installed for the first time at Dunaferr in Hungary. The advanced mass-flow-control scheme for cold-rolling mills is a highlight in cold-mill automation. It was implemented at the new voestalpine and Corus tandem cold mills, where its full reliability and improved off-gauge length has been proven.

However, in this quick overview of rolling and processing innovation at least two extremely quality-related model-based process automation features deserve attention: profile and flatness control for hot, cold and plate mills, and microstructure target cooling for hot rolling. Both are gaining highest merits, assuring world-champion quality and yielding results at all production lines where installed and successfully commissioned. "At our first joint meeting, we were able to present our competence in the area of rolling and processing and thoroughly impress our customers," was how Kurt Rotert, responsible for the strip-rolling business at Siemens VAI, summed up the event's success.

Lecture highlights

Reports from steel manufacturers about their current projects served as an opportunity for an exchange of information. Corus project manager Theo de Visser spoke about the new tandem cold mill at the Corus site in IJmuiden, The Netherlands, which produced the first coil exactly 23 months after the contract was signed. Giovanni Monari from ArcelorMittal France shared his company's experience with the first application of a Siemens VAI Power Coiler in the hot-rolling mill at Sollac Fos-sur-Mer. Tian Xiliang from the Chinese firm Wuyang Iron and Steel Co. talked about the production of high-strength steels using Mulpic cooling technology. Peter Lukacs presented the new pickling line and reversing cold mill at ISD Dunaferr, Hungary.

In the lectures about plate mill technology, speakers from different institutes and universities gave an overview of the current trends and requirements. Thanks to the close cooperation with these organizations, Siemens VAI holds the leading market position.

Participants were especially interested in the speech given by voestalpine board member Dr. Wolfgang Lakata, who retraced the development of his company, one of world's most profitable steel producers today. At voestalpine Stahl in Linz, Siemens VAI installed a new 5-stand, 4-high tandem cold mill especially designed to produce AHSS grades. The mill was started in the summer of 2007, and since then has produced high-quality material. Due to pre-testing of mechanical equipment and automation solutions, already the very first strip produced on this mill was of sellable product quality. On the last day of the conference, participants were invited to tour the voestalpine facility.

There was plenty of opportunity for guests to get up close to Siemens technology. At four stands integrated into the conference at the Linz Design Center, Siemens VAI presented its rolling and processing portfolio: Strip Rolling, Strip Processing, Plate Rolling and Life Cycle Services. Electronics and automation were represented among others by a Sinamics SM150 medium-voltage converter. A demonstration model of Microstructure Target Cooling at the ThyssenKrupp Steel hot-rolling mill in Duisburg was also shown. In an outdoor exhibition tent, participants could get more information about the manufacturing facilities of Siemens VAI in Montbrison, France; Shanghai, China; and Worcester, U.S.A.

Opinions

Host Dr. Richard Pfeiffer: "I have to say that I was surprised this morning to see more than 400 customers present. We have shown our whole portfolio to our customers, and they were very impressed. I have received a lot of good feedback."

Douglas G. Stalheim, President DGS Metallurgical Solutions: "The event was very well attended and informative. It's good to have the different customers coming together to share. It was a great place to network and meet people, and a lot of good information was shared by the different speakers during the different sessions."

Niyazbek Kazakbev, head of the automation department of the plate rolling mill at United Metallurgical Company: "Interesting items for me are technologies, hot rolling and automation systems for plate mills. I hope I will be able to visit the next conference."

Dr. Mahmoud Galal, ESCO Business Consultancy, Managing Director: "Today, all steel producers are interested in improving quality and increasing quantity. Naturally these were very interesting topics for me, and I plan on contacting the experts to get more details on how we can proceed in our plants."

Guillaume Dupriez, Novelis Rolling and Process Group: "I was very impressed with the quality of the presentations, and it was a very good opportunity to attend high-quality lectures and to talk with experts from Siemens VAI. I also enjoyed some presentations about different packages that Siemens VAI has to offer to its customers, for example diagnostics tools to look at system efficiency."

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The event provided a chance to talk shop in the historical atmosphere of the Palais Kaufmännischer Verein, accompanied by a musical journey through time.



Continuous rolling of 120-meter-long rails in a unique combi-mill at Corus, U.K.

A Rail Achievement

Following the modernization and start-up of Corus' existing medium-section mill at Scunthorpe, U.K., in 2006 by Siemens VAI, the line was subsequently outfitted with rail-finishing facilities capable of producing up to 120-meter-long, tension-free rails in a continuous finishing mill – a world first for the steel industry. Rail production commenced in 2007.



Corus selected Siemens VAI as the principal contractor for this milestone project, which now enables the British steel producer to concentrate its entire production of rails within the U.K. at its Scunthorpe plant. Scores of companies from a dozen countries worked closely together in a monumental task that involved nearly 700,000 man-hours to master the engineering and technical challenges.

With a crude steel production of approximately 20 million tons per year, Corus Group Plc, a subsidiary company of Tata Steel, is the largest steel producer within Europe. As part of a £130 million investment plan for long products at the Scunthorpe site, Corus commissioned Siemens VAI in May 2005 to design, manufacture and install equipment that would enable rail rolling alongside the production of medium sections in the company's existing mill. The mechanical equipment supply included new descaling units, a continuous 7-stand universal-rolling train, state-of-the-art marking, hot-sawing, pre-cambering and cooling facilities in addition to dispatch and handling systems. The previous rolling capacity of approximately 650,000 t/a was to remain unchanged, however, roughly 40 percent of the product mix of the modernized mill was foreseen for the production of rails, depending on market requirements.

Equipment description

Two descaling pump units were provided to supply four descaling locations, two before the roughing stands, one before the continuous train and one before the last rolling stand.

Seven new universal RedRing rolling stands of the type RU480 were installed and eleven standby units were also supplied. Well proven in numerous installations worldwide, these universal stands can also be operated in a 2-high horizontal configuration for rolling other products. The time required for changing the operating mode is approximately 45 minutes, however, with an online quick-stand change system, this would be under 120 seconds. Roll change is done offline with a dedicated hydraulic robot. A changing cycle time is typically less than 30 minutes. RedRing stand assemblies are characterized by their simplicity, highly compact design, long lifetime and extreme rigidity, which is decisive for best product tolerance. Utilities are connected by an automatic self-centering device, reducing downtime.

The rail-stamping machine consists of a stamping head driven by an AC servo motor. It stamps every five meters at the same speed as the rail. Nose and tail cropping, as well as sample cutting, is carried out by a hot abrasive saw complete with a dust-collection system.

During cooling, a non-uniform mass distribution in the cross-section tends to bend the rail inwards on the

head side. If not corrected, this would make straightening very difficult. To compensate for bending, the rails are pre-cambered before being deposited onto the cooling bank. Pre-camber geometries are calculated according to cooling models. Rail parameters such as grade, shape, specific mass, length and temperature are taken into consideration. All lifting and clamping movements of the pre-cambering units are hydraulically controlled and traveling movements are driven by gear motors.

The new walking-beam-type cooling bank is 125 meters long and 25.4 meters wide. At the exit side, a rail-extracting system with skid transfer cars moves the rails individually onto the exit roller table. Following the rail exit from the cooling bed, it is turned for the straightener by a special manipulator. After straightening, the rails are individually lifted from the roller table and deposited onto the chains of a discharge bank. This provides temporary storage for the rails before they are moved to storage pens or into wagons.

Benefits

In addition to the mill capability to roll rails and medium sections for a wide range of applications, its continuous operating mode contributes to enhanced product output, consistent product quality and lower costs. The universal rolling stands can be quickly exchanged and flexibly adapted to the 2-high mode according to the production scheduling requirements, thus supporting a broad and varied product mix of different lot sizes. Furthermore, additional benefits resulting from continuous rolling include improved temperature control, more uniform descaling operations, simpler roll management and easier and quicker stand and roll exchange.

Concluding remarks

For the adaption of the existing medium-section rolling mill to a high-performance rail mill, a shut-down period of only 14 days was required for the necessary installations. Rails can be produced in weights varying from 30 to 75 kg/m, in lengths from 72 to 120 meters (seamless) and at a nominal production rate of 22 to 33 rails per hour. Not only could the operational costs be significantly decreased, but tolerances and finishing quality could also be improved, including for the other rolled sections. For this challenging project Siemens VAI provided a technically innovative solution that fully met the production and quality targets.

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Two new coil-handling systems at ISD Dunafer, Hungary

Fast and Powerful

Hungarian steel producer ISD Dunafer Zrt., in Dunaújváros, makes a wide range of hot- and cold-rolled products as well as treated strips and plates of various widths for the domestic appliance and automotive industry. Siemens VAI erected the Hot Coil Handling System 1, a reversing cold-rolling mill and a pickling line, which has been in operation since June 2008. Another new coil-handling system is planned to enter operation in April 2010.



Fully loaded >
step conveyor
of the Hot
Coil Handling
System 1



▲ Detail of walking-beam conveyor

▲ The whole coil-handling system is controlled
from one single control pulpit.

The group's majority owner – Industrial Union of Donbass – is currently upgrading the Dunaújváros plant to be a center for flat-steel production. ISD Dunafer plans to increase the hot-strip mill's production capacity from 1.8 million to 3 million tons per year and has installed a new pickling line. With an intended coil-to-coil time of 120 seconds, the existing coil-transport system that supports coils of up to 25 tons was insufficient. It was replaced by a new mechanism capable of carrying hot coils with a weight of up to 35 tons.

A new type of coil-handling system featuring a shorter coil-to-coil time and a higher coil weight had to be developed. Furthermore, the new system had to overcome extended transportation distances, split the production into two bays for coil storage, and be able to tilt coils from a vertical to horizontal position.

Siemens VAI took on the challenge and erected a new coil-handling system for ISD Dunafer. This plant has been in operation since June 2008. The requirements called for an innovative system with electro-mechanic drives that delivers high speed and extended conveying steps. Siemens VAI met the demands by designing a set of transport elements consisting of transfer beams, a tilting station, shuttle cars, step conveyors and walking beam conveyors, all capable of 120-second cycle times and coil weights of up to 35 tons.

Due to the smooth start-up phase, Siemens VAI won an order from ISD Dunafer to supply another integrated coil-handling system. The new second coil-handling system will replace an existing line, connect the down-coiler with coil storage and ultimately the new pickling line, and complete the planned hot-rolling mill capacity increase to three million tons per year.

In addition to construction and equipment and parts delivery, Siemens VAI also delivers a broad range of services. These range from technical project management, line setup to commissioning supervision and training for operators, and help to limit any possible uncertainties in the process. ■

Plant data

Strip dimensions

Thickness: 1.2–18 mm

Width: 800–1,550 mm

Coil data

Coil diameter: 1,200–2,250 mm

Max. coil weight: 35 t

Max. coil temperature: 650°C

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Hidden potential in most every plant

Saving Energy with Modern Drive Solutions

In many auxiliary processes in the steel and rolling mills, electrical drives for compressors, fans and conveyors often run at full power. The processes are regulated mechanically via chokes, valves and filters. It pays to switch to speed-controlled drives, which save energy and cut operating costs in half.



A Siemens study determined that if every electrical drive worldwide were to be brought up to the latest stand of technology, a yearly savings potential of 130 TWh or €9 billion would be possible. This would be good for the environment, since with the current energy mix every year about 57 million tons less carbon dioxide would be emitted into the atmosphere. "It's worth investing in environmental protection," says Harald Wiechmann, a Siemens VAI expert for drive technology in rolling mills, "since often electricity costs make up 90 percent of a drive's entire lifecycle costs. The procurement price is far below 10 percent." In the meantime, different countries like the United States, China, Canada and Australia have recognized the potential and have required producers and operators to introduce energy-saving motors that adhere to E.U. efficiency classes EEF1 and 2 or the American EPAct norm. Compared to standard motors, loss is reduced by over 40 percent. Their use pays off already with 2,000 operation hours per year.

Frequency converters cut energy use in half

Variable-speed motors and intelligent, energy-saving controls for AC motors offer a by far higher energy-saving potential. "Today's machines and facilities are typically configured for full load, although they normally run at 50 to 70 percent of capacity," explains Wiechmann. "For many standard applications involving pumps, condensers, conveyors and refrigeration, the excess energy is simply released through valves and chokes and effectively wasted." Wiechmann explains that it makes more sense to use a frequency converter to adjust the engine speed to the momentarily needed values. In the end, depending on the resistance curve, energy savings of up to 50 percent are possible with speed-variable operation. In cases with steep resistance curves, for which saving potential is especially high, up to 70 percent is not unheard of.

The magnitude of savings potential is illustrated in the following example: The fan drive and controller needed to be replaced in a plant with an exhaust filter for aluminum furnaces. Up until this point, the air flow had been regulated with a mechanical choke. When the metal is being melted the complete fan capacity is needed, while the air flow can be reduced when the facility is on standby. During production pauses and on weekends, only the minimum is required. If the throttle position were to be maintained and the old 45-kW motor replaced with an EEF1 motor, the energy savings would amount to 2 percent. Replacing the mechanical throttle with a frequency converter increased the savings potential to 66 percent in comparison to the original energy requirements. With this solution, a significantly smaller motor is needed. Over the time period of one

year, the energy costs in this facility sunk from €24,000 to €8,200.

Regenerative braking system

Not only in applications with electrical machines does it pay to carefully select a suitable frequency converter. Also in applications in which large loads are moved, or in which a great deal of braking energy is needed for hoisting devices, rolling routes, conveyor belts and shears, further savings potential can be exploited using frequency converters with regeneration capability, such as the Sinamics S120 or S150. The energy fed back into the system can be consumed by other users, which, depending on the application, results in savings of between two and four percent. "Experience has shown that variable-speed operation is technically feasible and sensible for a third of the drives," says Wiechmann. Further advantages of the four-quadrant operation are minimal system perturbation and less warmth in the control cabinet. For example, using the feed-out function the energy costs for a lift drive with an output of 22 kW and an average runtime of eight hours per day are reduced by €1,100 per year compared to a converter without the feed-out capability. In this case, this means a 40 percent reduction in energy costs. A further positive side effect is that the drive solution requires 77 percent less space.

"When motors and drives are adjusted for the actual load, all process steps are optimized, and the use of a variable-speed drive can already pay for itself within two years," says Wiechmann based on his own experience. If the investment is seen in relation to the lifespan, he says, the savings are enormous. The transition to energy-saving drive technology is worth it from day one. ■



Sinamics frequency converter and H-compact induction motor

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Yield improvement – the key to energy savings

Sustainability in Steel – A Plate Mill Perspective

The steel industry has experienced stunning growth in recent years. The importance of steel for the global economy and in our daily lives is huge, which is the bright side of our sector. But there is also a darker side, and one that provokes the question of how long growth can continue. The question is more fundamental than one of economics and world banking confidence; it concerns the depletion of earth's resources and the sustainability of modern civilization.

The global steel industry's carbon footprint is daunting: every year, it is producing nearly 2,000 megatons of carbon dioxide, a quarter of global industry's total burden and close to 5 percent of the world's overall artificial CO₂ output.

In plate rolling, just reheating a slab before actual milling from cold to process temperature takes enough energy to – expressed as potential energy – raise a plate four times the height of Mount Everest. And as basic reheat furnaces have a typical maximum efficiency of 60 percent, almost one more phantom plate could accompany the real plate on its ascent.

The electrical energy consumed in rolling depends on product dimensions, but it will likely be at least as much as is needed for reheating. The peak rolling power of a typical wide-plate mill is about 40 MW – about the same amount needed for a city of some 50,000 people.

These figures just describe the power used by the main mill stand motors for steel deformation. Considering all additional line processes like cooling, leveling shearing and line transport, the energy consumption of a typical modern plate mill adds up to approximately 1,200 kWh/ton. So, making just one single plate consumes as much energy as running a three-bedroom semi-detached house for a full year. But, a typical mill starts a new plate every two or three minutes, and does so almost 24/7.

Yet rolling mills are not the plant's biggest energy consumers. In fact, 75 percent of the energy in the integrated steelmaking process, from ore preparation to semi-finished rolled product, is consumed before the

steel solidifies. Primary rolling processes can even claim to be greener than the downstream finishing lines. In emission terms, spent liquors from pickling and coating processes have serious pollution potential. In comparison, traces of nitrogen oxides escaping from the hot mill's reheat furnace stack seem almost innocent by comparison.

But in spite of this context, just how clean could a hot mill and specifically a plate mill be?*

Power consumption ratio as a lever for improvement

There are several technologies to improve the energy efficiency of a rolling plant such as recuperative burners for reheating, using variable frequency drives, and recirculating cooling systems. Most helpful of all are near-net shape processing and hot connection (using residual heat from the mill's casting process).

Plate grades, though, rely on high strains and long alloying solution times for property development, and so plate mills offer much less potential for these techniques than strip mills.

In the end, energy savings of up to 25 percent over present levels are foreseeable in technical and economical terms. It is an undeniable fact that we use steel mainly because of its high yield strength, and because of this very property we need great amounts of energy to shape it.

Although the potential for direct energy savings in plate making is insignificant compared with the upstream consumption, it's precisely this ratio that holds the key. Yield improvements in the plate mill are geared up by this energy consumption ratio. In environmental



Energy savings of up to 25 percent in a plate mill are foreseeable in technical and economic terms.



terms, the best way to improve the plate mill is to maximize its yield – in order to avoid having to make more plates using processes that adversely affect our environment.

Optimization potential

Maximizing yield in rolling requires a combination of machine design and process control excellence, applied at the process concept level. To achieve this, Siemens VAI is researching and redesigning the shearing process. Further potential lies in longitudinal thermal plate profiling, and in new techniques to roll clearly defined square cross sections with better, straighter edges.

In a drive to advance these trends, Siemens is funding two PhD positions at the University of Sheffield during the current tenure of the IMMPETUS microstructural research program, with the goal of sustainability in plate and structural steelmaking. In addition, the entire third year of the mechanical engineering undergraduate course at the university will work for a term on "green"

plate-making projects. Once completed, to reinforce our environmental engineering reputation, the findings will be published in academic journals.

The duty parameters of the plate mill itself are mind-blowing, but the most powerful machines and the most extreme processing conditions are precisely the ones with the greatest potential for process improvement.

Sustainability brings a new way of thinking for us all, along with new opportunities. The technological revolution in the plate mill has just begun. ■

*Note that cleanliness in this context is a wide-ranging concept that goes far beyond the freedom from discharges into the environment. It also includes consumption of energy and extends to the impact on other resources as well as people.

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Reduced generation of waste materials and lower energy consumption

Greening Strip Processing

Solutions to reduce waste and energy consumption are not only applicable to new lines, but also older ones. When equipped with the right enhancement equipment, the performance and productivity of older lines can be increased while simultaneously lowering operating costs. Wherever viable, the goal is to reuse as much existing equipment as possible. The following examples show what can be done to achieve these targets.

Tank replacement in pickling lines

As opposed to the traditional brick-lined steel tanks, today almost all new process sections are outfitted with polypropylene tanks. Siemens VAI was a forerunner in providing this solution, which boasts excellent longevity, easy repair, lower costs and a perfect lining. The full water seal around each cover perfectly seals the tank, limiting exhaust to the areas where the wringer rolls (inter-tank and rinsing) are located. This energy-saving technology is also enhanced by the high pickling efficiency of these tanks, and full acid concentration management leads to lower acid temperatures and consumption.

Weld online heat treatment

Existing lines with a conventional steel product mix that have a yield stress of less than 500 MPa are moving towards much higher strengths. The processing of ultra-high-strength steels requires an annealing device at the welder. This treatment removes or reduces the thermal stresses that appear during weld cooling, and improves material ductility around the weld. The required annealing temperature varies with steel grades, but is normally between 550 and 750°C.

Siemens VAI offers two configurations for post-welding operations that don't require purchasing a new welder. For the first solution, enough space must be available next to the welding head so that an inducting unit can be installed inside the welder. This solution is especially suitable for performing a true annealing cycle

or post heating when capacity restrictions are placed on the entry looper.

If the welder does not permit on-machine installation, the second solution is applied: the weld is shifted to a stand-alone induction unit with a moveable clamp system for perfect positioning. This allows true annealing cycles but adds roughly 30 to 40 seconds to the overall cycle time.

High-pressure water cleaning

Over the years, several methods have been adopted by galvanizers – from brushes to portable high-pressure water units – to prevent zinc pick-up on skin-pass mill-work rolls and backup rolls. These solutions were typically dedicated to automotive and zinc aluminum coating lines. With environmental regulations calling for reduced use of detergents, there is a trend towards pure water in the wet systems, and more and more mills require efficient built-in systems.

Siemens VAI offers a built-in solution with one or two movable cars that shift along the length of the roll barrel by means of a pinion chain and electrical gear motor. Each movable car is equipped with two high-pressure nozzles – one for the work roll and one for the backup roll – that are fixed to a movable support actuated by two pneumatic cylinders. These high-pressure nozzles, which spray the rolls with water or water and detergent at 100 bars have three positions: one for roll-change operation, one for operation with a large-diameter work roll and one for a small-diameter work roll. The unit can operate continuously back and forth on the roll length, either in automatic or in manual operation.

Post-treatment sections

Until recently, most lines were equipped with spray systems to apply protective coatings on galvanized strip. However, most products such as hexavalent chromium cause health problems for the workers and increase their risk of developing lung cancer. This prompted steel suppliers to use other products

Investments in our industry have traditionally been based on price and final product performance. Operating costs and environmental regulations are now also becoming an important decision factor. Siemens VAI developed solutions that can handle extended product mixes, including high-strength steels for a "greener" production.



High-pressure water-cleaning system reduces the use of detergents in a skin-pass mill.

– and at the same time look for ways to increase productivity.

Roll coaters are an excellent alternative that offer the same or better coating performance, but at lower consumption rates and with less effect on the environment. Typically, some five times less coating product is consumed than with conventional spray systems. In addition, the coater solution eliminates the need for collecting and reprocessing the chemicals.

Many steel producers go further and are looking at inserting completely new sections in their existing lines, including passivation coaters and anti-fingerprint coaters as well as a prime paint-coating pass. Siemens VAI has developed the complete range of coaters to address all possible designs, maximize synergy potential and lower operating costs.

Process control

Steel producers want constant and optimized performance in their lines. Siemens VAI developed Faplac (23 references already), for full acid-concentration management on pickling lines. In addition to the prevention of under- or over-pickling, this management tool runs the line with minimal operational costs. The same applies to the TCOptimizer model, which – installed on galvanizing or continuous annealing lines – links all available line signals and product parameters to achieve the highest results at the lowest cost. ■

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Improving the ecological footprint of aluminum rolling mills

Green Solutions For Aluminum Rolling

A closer look at peripheral processes can help to optimize the environmental balance for aluminum rolling mills.

In a world of increasing population density and dwindling energy supplies, green technology and environmental concerns have gained prime importance for a business that used to rely on virtually unlimited energy resources and a seemingly forgiving environment. The aluminum industry is under constant pressure to achieve faster rolling speeds, thinner gauges, wider strip and larger coil sizes. These demands drive continuous process development and offer the opportunity to improve the ecological footprint of aluminum rolling. Consequently, energy-efficient technologies such as variable speed pumps and high-efficiency AC drives are introduced wherever possible to take advantage of the operating cost benefits and to reduce environmental impact.

But beyond these common solutions, there are many other opportunities to increase rolling efficiency, quality and yield, while reducing the amount of material and energy wasted. An in-depth analysis of the aluminum rolling process shows that the addition of various peripheral solutions provides energy savings and a reduction in waste, while increasing efficiency and yield.

Rolling oil recovery system

The exhaust airflow of aluminum cold- and foil-rolling mills can contain up to 1,000 mgC₁₂/Nm³ of rolling oil. Releasing these oil vapors into the atmosphere has a detrimental impact on the environment and is a waste of valuable resources.

Vapor-fume-recovery systems can improve this situation by reducing the residual content of rolling coolant (total hydrocarbon) in the cleaned exhaust air, helping to meet current legislation on environmental emissions. These systems not only reduce the amount of rolling coolant emitted with the exhaust air, but also recover rolling oil and recycle it directly back into the roll coolant circuit.

The Siroll Alu Vapor Shield fume-recovery system can recover up to 95 percent of the oil contained in the exhaust airflow.

The corresponding cleaning and recovery process is based on a closed washing-liquid circuit. The washing liquid absorbs the rolling coolant from the exhaust gas flow passing through the absorber column in a counter-flow exchange. Using a recuperator to cool the hot regenerated washing liquid, the energy contained in the liquid is transferred to the cold, enriched washing liquid, thereby reducing the need for additional heating and lowering energy consumption.

The oil-recovery rate of such a system depends on the actual extraction rate (m³/h) and inlet concentration (mgC₁₂/Nm³). Typically, an aluminum cold mill with an exhaust airflow of 140,000 m³/h can have a fume concentration in the order of 400 mgC₁₂/Nm³. Based on these figures, the system can recover up to 95 percent of the oil contained in the exhaust airflow.

Siemens VAI developed the Siroll Alu Vapor Shield fume-recovery system, which generates 50 kg/h of reusable rolling oil under these conditions. The system features include an optimized design of all plant components (column, pumps, heat exchanger, etc.), allowing the plant to run at the most economic conditions with maximized oil recovery. Over a year, this equates >>

>> to very significant cost savings and added protection for the environment, since the need for fresh oil is reduced.

Tightly controlled cooling

Efficient roll cooling and lubrication is another crucial feature in aluminum rolling. Tightly controlled cooling can yield better strip flatness and has a direct effect on process energy consumption and costs.

A new coolant spray offers better control over this process step. Employing an array of pulse-width-modulated integrated solenoid valves (ISV), the system implements zone cooling that is capable of controlling and correcting strip flatness. Based on a 10:1 flow modulation capability and coupled with advanced thermal modeling for spray-pattern optimization, the system achieves optimal thermal performance with minimized flow rates. Since tank heater and pump sizes are directly dependent on flow rates, this translates into clear energy and cost savings.

Yet, this system, developed and marketed by Siemens VAI as Siroll ISV Spray System, offers another function that further improves strip-edge flatness: the optional hot-edge spray system enables a modification



Siroll Edgewipe – for effective dryness at the strip edge

of the work-roll thermal profile. Spraying hot coolant onto the work rolls outside the strip width gives improved control of the strip-edge flatness, helping to reduce strip breaks, boosting yield and productivity.

Optimized strip drying and cleaning

After leaving the work-roll bite, the rolled aluminum strip must remain dry. This is crucial not only for downstream processes, but also to minimize the environmental impact from the annealing of coolant contaminated strip. Excess coolant in the exit coil causes strip staining, coil telescoping and yield losses. This also seriously affects the annealing process, leading to longer cycle times and increased energy consumption. What's more, coolant oil lost on exit coils needs to be replaced to replenish the system.

Siroll^{CIS} Edgewipe provides a faster annealing process with shorter cycle times and lower energy consumption.

Studies of coolant migration from the entry to the exit side of cold mills showed that strip top and bottom surfaces are effectively dry when they leave the mill bite. At this point, the residual coolant level is only a fraction of what is generally accepted at the coiler. A potential problem, however, exists at the strip edges. While conventional blow-off systems work well on the top and bottom surfaces, they form coolant beads on the edges, especially on thicker strip. If not addressed, this coolant bead migrates between the individual coil laps and causes the issues described above.

This is where an innovative expansion of the conventional strip-drying equipment sets in. The Siroll Edge Wipe system specifically addresses the coolant-edge bead problem, and is installed below the pass line on the mill's exit side, close to the mill bite. Controlled by an automatic edge-detection system, it uses a combination of focused air-sweeper jets and knock-off jets to blow the coolant bead off the strip edge. Each set of knock-off jets is associated with a local spray hood that collects the resulting coolant plume and directs it into the mill sump using an air-mover system.

This system – Siroll^{CIS} Edgewipe by Siemens VAI – achieves several benefits for aluminum strip mills. Although actual performance increases depend on the process used, the technique provides a faster annealing process with shorter cycle times and lower energy consumption. But being green also means being efficient: Siroll^{CIS} Edgewipe installations have been proven to offer

higher productivity and less coil telescoping, and higher yield due to reduced staining-related coil rejects.

Improved coolant filtration

Coolant filtration is an essential element in all metal rolling and forming. The conventional filtration media used for aluminum rolling is a combination of diatomaceous and fuller's earth. Since these substances are carcinogenic, disposing of spent filtration cake presents an ongoing health risk to the operators using the media and is associated with significant costs.

Recently, an alternative filtration technology was developed using cellulose-based media and thus avoiding the use of traditional, hazardous diatomaceous and fuller's earth. Utilizing this media, the system provides a higher level of filtration and extends the lifetime of the coolant. As a result, process performance is increased and the frequency of coolant dumps and operating costs can be reduced.

This system – the new Schneider[®] Acti-Cel R Coolant Filtration System – is under exclusive license to Siemens VAI. It is suitable for aluminum hot and cold mills, stainless steel, steel, copper/brass mills and for two-piece canmaking plants. On average, the system yields an 80 percent savings in waste-stream weight, and 80 percent in used filtration paper. Since the filter's operating life is four times longer than with the conventional technique, the system needs to be stopped less frequently for routine filter changes, and oil loss during filter change is reduced accordingly.

The system offers substantial energy and cost savings as well as environmental improvements: the cellulose media in its waste form has a very high calorific value and is a valuable energy source, so that disposal costs can be reduced by up to 95 percent.

Relevant results

Taking a holistic look pays off in the search for environmental process improvements. All consumable materials and all steps that perform some kind of energy transfer are candidates for environmental optimization. The solutions described above not only reduce the environmental impact of the aluminum rolling process, but also provide savings in operating and material costs.

These latest technologies from Siemens VAI are available as stand-alone products or in a bundle, helping plant operators to protect the environment while at the same time minimizing their operating costs. ■



On average, the new Schneider[®] Acti-Cel R Coolant Filtration System yields an 80 percent savings in waste-stream weight, and 80 percent in used filtration paper.

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New cold band production facility for ISD Dunaferr

Siemens VAI Erects New Mill in Hungary

ISD Dunaferr expanded the capacity of its integrated steel-production facility with the installation of a hot-coil transport system, a pickling line and a reversing cold mill.

In June 2008, Hungarian steel producer ISD Dunaferr started production in its new pickling line and cold mill at the company's facilities at Dunaújvaros. The plant was built by Siemens VAI. The project is part of a strategic development plan that Industrial Union of Donbass (IUD) had set up for ISD Dunaferr with the goal of converting the plant into a pivotal flat production center by increasing the capacity and quality of the finished products. To this end, Siemens VAI installed production lines that use the latest in production machinery and automation.

Linking old with new

A new coil transport system was needed to link the existing sections of the plant with the new pickling line. Since the project not only meant a capability upgrade but also a capacity increase, the new transport system had to be both faster and support higher payloads. (See p. 63 for further details.)

High throughput at low operating costs

Core requirements for the pickling line were high pickling rates at low operating costs. The actual pickling line consists of six sections: (1) an entry section with a heavy laser welder, (2) a pickling section with three pickling tanks, (3) a scale breaker, (4) a preheating section, (5) a drying section and (6) an exit section with a turret-type side trimmer, oiler, tension reel and automatic coil strapping. The pickling section contains a turbulent pickling-acid injection unit that ensures high process efficiency. An additional acid regeneration plant using a fluidized bed process was installed to meet environmental regulations. The line's annual design capacity is 1.6 million tons, which is achieved by building up coils of up to 50 tons at process output.

Sophisticated acid control

To minimize acid consumption, the pickling section contains an acid-control system. Using mathematical pickling process models, the Siroll^{CIS} Faplac® system con-

trols acid concentration and used acid liquids. It automatically calculates and controls acid concentration, acid temperature and acid flow process parameters, thus ensuring minimized acid consumption.

High quality and flexibility

The reversing cold mill is capable of processing 50-ton coils, and is designed for an annual capacity of 534,000 tons. It consists of a pay-off reel, a reversing mill stand and two tension reels. Additionally, Siemens VAI supplied all ancillary equipment, hydraulics and lubrication control systems, including automatic gauge and flatness control systems. The mill contains a strip dividing shear so that it can also produce smaller coils. An additional direct application is used for the first passes of very thin strip. When using the direct application, adjustable wipers ensure the correct operation of the multi-zone cooling headers. The tension reels of the mill are equipped with gripper slots and belt wrappers to support a very wide strip thickness range of 0.3 mm to more than 3 mm.

Sophisticated process control automation

The integrated automation system of the cold mill guarantees that a number of core criteria for safe and efficient line operation are met. Using process models, it ensures a high level of productivity by generating setup data and optimizing operating speed. Based on acquired process information, the system assists the operator with sophisticated automation functions and re-ports, and provides decision support, handles alarms and provides equipment diagnostics. Building on equipment status data, it ensures high line availability by employing easy maintenance-control schemes. All of these requirements are met by the installed Simatic-based integrated automation system.

Comprehensive safety system

Developed in a joint effort by engineers at Siemens VAI and ISD Dunaferr, the safety system complies with the

Pickling Line and Cold



Pickling line: plant and production data

Pickling line plant data

| | |
|-----------------------|-----------------|
| Annual capacity | 1,600,000 tons |
| Pickling acid | HCl |
| Entry-section speed | 600 m/min. max. |
| Process-section speed | 210 m/min. max. |
| Exit-section speed | 450 m/min. max. |

Pickling line production data

| | |
|-----------------------|------------------|
| Entry material | hot-rolled strip |
| Entry-strip thickness | 1.0–6.5 mm |
| Strip width | 750–1,600 mm |
| Process-section speed | 210 m/min. max. |
| Coil weight at exit | 50 tons max. |



Reversing cold mill: plant and production data

Reversing cold-mill plant data

| | |
|-------------------------|-------------------------|
| Mill type | single-stand, 4-high |
| Annual capacity | 534,000 tons |
| Rolling speed | 1,200 m/min. |
| Main drive power | 2x3,000 kW |
| Roll force | 25,000 kN |
| Work-roll bending force | +650/-350 kN (per neck) |

Reversing cold mill production data

| | |
|-----------------------|--------------------------------|
| Entry material | hot rolled and pickled |
| Entry-strip thickness | 1.5–5.0 mm |
| Exit-strip thickness | 0.25–3.0 mm |
| Strip width | 750–1,550 mm |
| Coil weight | 50 tons max. |
| Inside coil diameter | 610 mm |
| Outside coil diameter | 1,000 mm min. 2,650 mm max. |

latest European safety standards and is optimized to ensure high mill availability. For this purpose, the mill is split into several safety areas, and specific instrumentation and control systems issue alarms and/or prevent dangerous situations.

A strong and reliable partner

IUD and Siemens VAI have a long history of partnership through numerous successful plant design projects, with special focus on reliable start-up of new installations and efficient investment protection. Based

on its proven competence, for this project Siemens VAI supplied all engineering services, all mechanical, electrical and automation systems, and supervised construction and commissioning.

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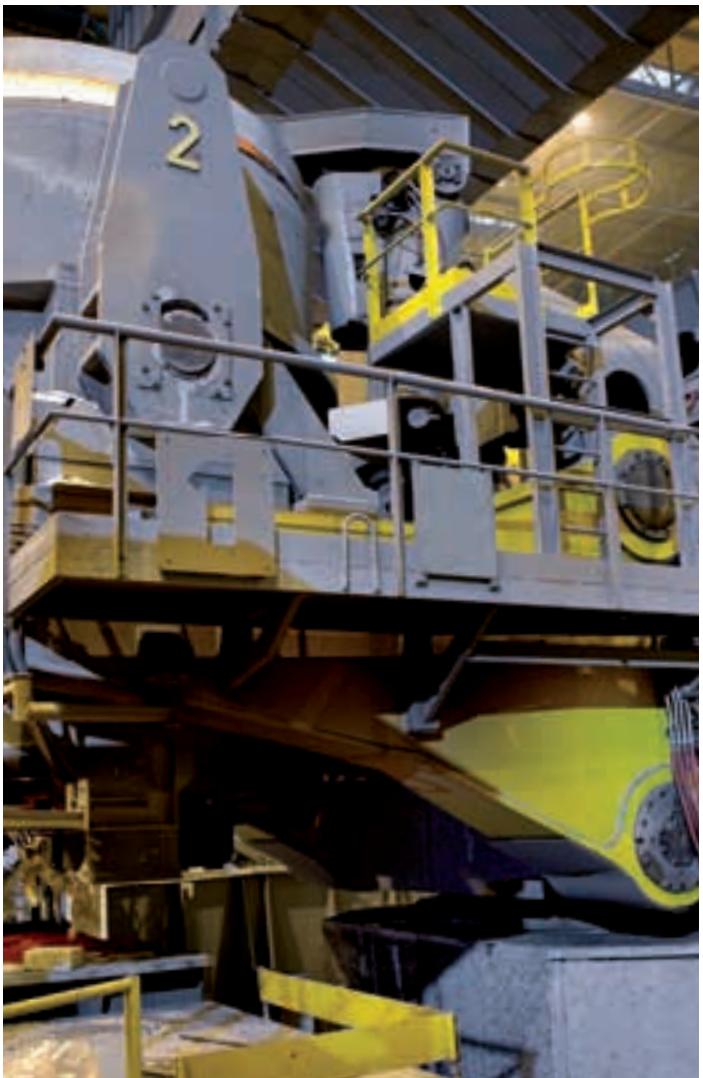
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Interview with Willibald Kloibhofer, Siemens VAI

Life Cycle Services In Saudi Arabia – A Success Story

Vendor/client cooperation does not end with plant acceptance – Siemens VAI Metals Services accompanies its clients through the life cycle of their entire investment. Willibald Kloibhofer, responsible for service and maintenance, coordinates a wide range of operation-related services for Saudi Iron & Steel Company (Hadeed), and explains the concept and its benefits.



Continuous casting machine, ladle turret

What are life-cycle services?

Kloibhofer: Siemens VAI provides services throughout the entire life cycle of a plant – from planning to construction and commissioning, during the entire production phase, and all the way to disassembly and disposal – from greenfield to greenfield. These services comprise operator training, consulting, maintenance and equipment upgrading, and cover the process flow from order processing to invoicing, from warehousing to parts export/import handling, as well as the coordination of third-party buy-out services.

Please tell us more about Hadeed and its operations.

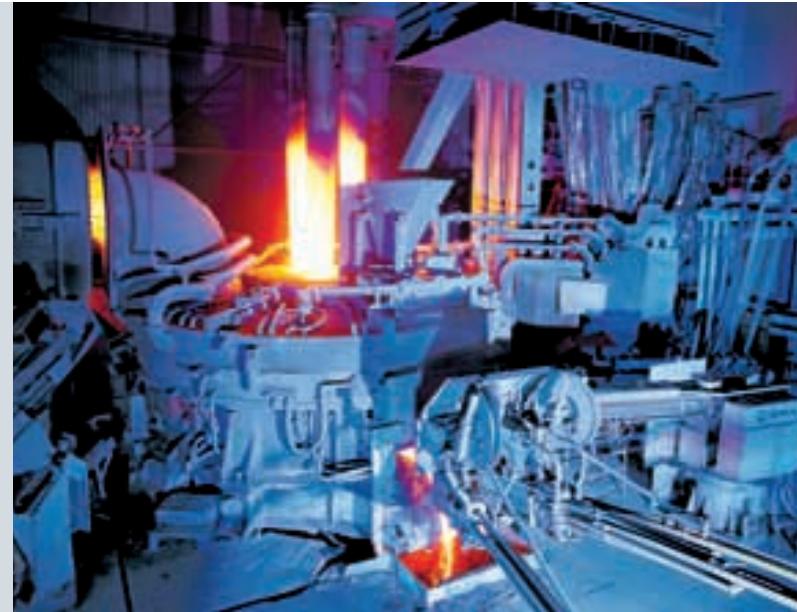
Kloibhofer: Hadeed, a Saudi Basic Industries Corporation (SABIC) company and one of the largest steel producers in the Middle East, runs a metallurgical facility with two electrical steel works. Established in 1983 as a structural steel supplier, it has an annual production capacity of about seven million tons, including a growing share of cold- and hot-rolled long and flat products. The plant is located in Al Jubail, Saudi Arabia, and was erected by Siemens VAI on a turnkey basis.

What kind of services is Siemens VAI Metals Services providing?

Kloibhofer: We provide feasibility studies, operator and maintenance training, maintenance services and supply equipment for plant upgrading, spare parts and technical assistance during shutdowns.

What has been the key factor for success?

Kloibhofer: I see key account management as the secret to our success. Customers like Hadeed often suffer from



Electric arc furnace at Hadeed with a capacity of 150 tons of liquid steel

coordination problems with their parts suppliers. So what they really appreciate is having one single, central contact who is responsible for managing all activities for every plant and technical area, and who focuses on providing solutions instead of just delivering parts.

Siemens VAI, for example, conducted a feasibility study to improve dedusting processes at Hadeed. Together with Hadeed management, we then entered into budget planning for an equipment upgrade, and subsequently managed the entire procurement, delivery and installation process. Building on established relationships with parts vendors and subcontractors, we leveraged framework contracts to obtain lower prices and faster delivery times.

As a result, we estimate that we can achieve an approximate savings of 10 to 15 percent in service cost over a plant's lifetime, and manage to cut plant maintenance and upgrading downtime.

What do you see as the most important accomplishments with this project?

Kloibhofer: Our long-term achievements include the trustful, close cooperation with our customers and the common administrative processes that we established. As part of this project, we managed to quadruple our order levels in the service area in just three years.

Please tell us more about the common administrative processes.

Kloibhofer: Working on common interests requires efficiency and speed – excessive bureaucracy must be avoided. Previously, we used a closed SAP system. We recently replaced it with the Internet-based Supplier

"Our customers are much more than just buyers of our solutions and products – they are our partners."



Willibald Kloibhofer,
responsible for service
and maintenance at
Siemens VAI

Portal, and now receive purchase orders, send out order confirmations and issue invoices electronically. The long-term goal of Hadeed is a paperless workflow, and we will probably come close to it.

What needs to be in place for a cooperation like this to work?

Kloibhofer: Accessibility is vital for efficient services, so a cell phone and a laptop must always be within reach. And since production downtimes are costly, reaction times are crucial. Our technicians always have a valid visa for their deployment areas, which helps us in our aim to react to customer calls within 24 hours.

Expert technical knowledge is indispensable when working with operating and maintenance staff. I gained this knowledge in my many years of work as a construction engineer, an engineering and project manager at Siemens VAI, and in several commissioning deployments.

How would you summarize the key elements of this success story?

Kloibhofer: Fast and targeted work, including the customer in the problem-solving process, and especially a fair and respectful cooperation, which helps to achieve optimum results for everyone involved. Our customers are much more than just buyers of our solutions and products – they are our partners. ■

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Saudi Arabia:
construction in progress

Intelligent turnkey service solutions help optimize investment costs

Turnkey Services: Limiting Risks, Saving Costs

Innovative turnkey services can limit the risks affecting schedules and investment volume during the construction and upgrading of steel plants.

To ensure long-term competitiveness, steel plant operators need strong expertise in the construction of new and the modification of existing plants. Building plants involves risks that impact financing, scheduling and overall plant performance. Purchasing of equipment and services require tendering negotiations and supervision of subcontractors. Expert personnel and subcontractor services have to

be scheduled and coordinated for timely completion. And as most projects are driven by investors, financing and milestone-based payments must be set up and managed.

Prospective plant customers may not have suitable resources for all these tasks, and as a result they can incur risks of compromised completion dates, budget overruns, plant performance and efficiency. All of these

can bottom out on financing costs and conditions. As an answer to these needs, Siemens VAI offers a customizable turnkey concept to limit investors' risks and total investment costs.

Turnkey services at a glance

The Turnkey Service Model of Siemens VAI is a new project contract concept with intelligent task distribution between both parties.

Optimizing customer investment costs is driven by two factors: in commercial terms, Siemens VAI offers tailor-made Turnkey Service Models, featuring an innovative way of sharing risk and engineering and project execution manpower with the central goal of minimizing the customer's investment costs. From a technical perspective, the Turnkey Service Model builds on our in-depth process know-how, enabling better consideration of metallurgical requirements and their best integration into turnkey solutions.

On top of the existing Full Turnkey and Process Turnkey Models, Siemens VAI now offers the Turnkey Service Model to better account for each customer's specific project execution needs and strengths.

Turnkey Service vs. Full Turnkey Model

The classic Full Turnkey Model features Siemens VAI as a main expert contractor that provides all supply and

turnkey work. The partnership is executed either as a consortium, on a cost-plus-fee or on a lump-sum basis. Customer involvement in the project is minimal, as the customer neither bears commercial risks nor is involved in organizing the manpower for project execution. This comes at a price: the customer pays a risk premium plus mark-up to cover the risk carried by Siemens VAI. However, the customer's competence and risk-reducing capabilities are insufficiently considered.

Local markets are a source of high risk and offer a lever for the Turnkey Service Model. Because customers are usually well versed with local market peculiarities, they can best deal with related risks. Assuming these risks, customers can benefit from significant mark-up and risk premium savings.

Because customers are usually well versed with local market peculiarities, they can best deal with related risks.

Siemens VAI contributes its engineering and project management experience and competence in handling the various interfaces to project subcontractors. >>

TURNKEY SOLUTIONS

>> Siemens VAI also handles overall scheduling and site management to ensure coordinated and aligned project execution. Thus, all partners contribute their core strengths to project execution so that the customer can benefit from substantial cost savings with the new Turnkey Service Model.

All partners contribute their core strengths to project execution so that the customer can benefit from substantial cost savings.

Process Turnkey Model

The Process Turnkey Model gives customers more influence on project execution than the Full Turnkey Model. While Siemens VAI is the main contractor for the process part, the customer manages all turnkey issues including any interfacing with subcontractors.

In contrast, the Turnkey Service Model complements the process equipment part with an integrated turnkey

part, offering a customized package of additional services: Siemens VAI handles all interfaces with the various engineering partners involved, securing successful project execution. Customers can choose from further flexible tools for almost any situation, such as engineering, procurement support, order management, and advisory and site management services.

Economical benefits

Assuming a 50/50 cost distribution of technological content (machinery and production equipment) vs. infrastructure (construction of bays and buildings, media supplies and water treatment, etc.), the new Turnkey Service Model achieves the following savings: through engineering optimization of production infrastructure, the customer can save up to 5 percent of the corresponding value (up to 2.5 percent of total project value). The infrastructure part roughly consists of 85 percent auxiliary equipment and construction, which is procured from third party suppliers and subcontractors. Up to 20 percent of this value can be cut through direct purchase by the customer, savings of up to 17 percent of the infrastructure or 8.5 percent of total in-

vestment value are possible. Hence, the Turnkey Service Model offers up to maximum savings of 11 percent of the original total investment value.

The Turnkey Service Model offers up to maximum savings of 11 percent of the original total investment value.

Other, less tangible but highly relevant benefits are controlled plant quality and performance, and tightly managed schedules, all of which can favorably influence financing terms and conditions for the project and, in the long run, return on your investment. ■

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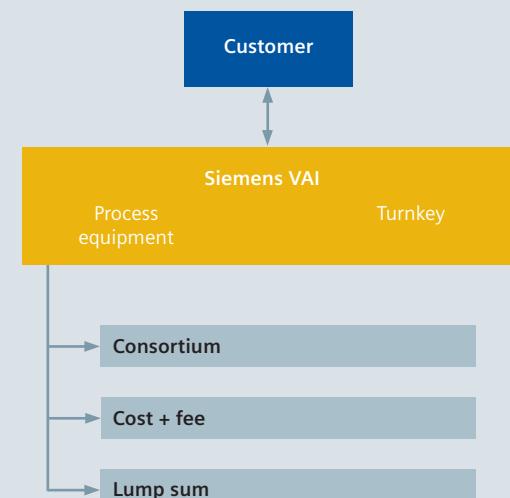


Comprehensive support for commissioning as well as operator and maintenance training help to ensure fast line start-up. Further services such as maintenance contracts and spare-parts supplies guarantee continuously high production quality and uptime.

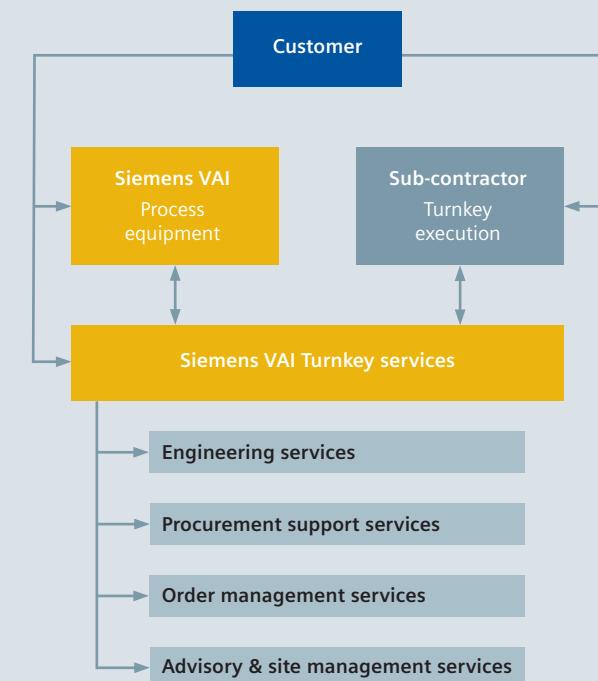


Leveraging client's strengths and innovative service concepts provide an optimized balance between risk management and investment costs.

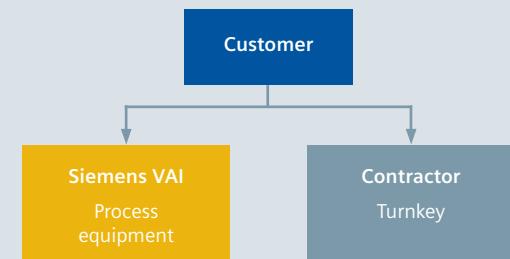
Full Turnkey Model



Turnkey Service Model



Process Turnkey Model



Wide spectrum of services helps manage operating risks

Full Services For Welders

A comprehensive service package can help ensure good welder availability and high weld quality.

Strip-joining welders have a critical impact on the continuous operation of strip-processing lines for flat carbon steel and stainless steel applications. Any limitations on equipment availability invariably create a bottleneck for all downstream processes. Unscheduled downtime is costly. A systematic service and maintenance program ensures continued efficiency for the entire line, and only a few hours of unscheduled strip downtime are necessary.

Siemens VAI complements its product scope with a full spectrum of services that help customers obtain the highest equipment performance and safely manage their plant operating risks.

Criteria for service and maintenance

Since the welder is a crucial line element, downtime due to component failure is not acceptable. Beyond that, the welder also has to deliver consistently high weld quality. During any standstill, downtimes have to be kept to an

absolute minimum. This is only possible if a company's personnel is trained to troubleshoot, with competent external backup available at short notice.

For rapid and reliable reaction, any external service and maintenance support has to cover all required fields of expertise from one single source. To compensate wear and tear, and to increase the service life of heavily used components, there must be a repair and refurbishment service for core machine parts. For maximum equipment service life, advances both in machine and process technology need to be integrated continuously into existing systems and processes.

A description of the typical components of a service and maintenance program is outlined in the following:

Spare-parts supply

Since a welder often operates 24/7, an on-site spares stock is mandatory to ensure quick emergency reaction. Typical items include welding heads and wheels,

bearings, a shear blade, a chiller unit and sub-components, electrical components (automation modules, boards, switches, sensors), seals, and hydraulic and pneumatic components.

Siemens VAI can recommend and deliver genuine, certified spares at short notice and attractive prices thanks to our network of preferential relationships with best-in-class suppliers.

Periodic maintenance visits

Through maintenance visits performed in regular intervals, Siemens VAI experts can detect and anticipate decreases in welder efficiency and help ensure trouble-free, continuous operation. On average, maintenance visits comprise five on-site man-days and include a thorough machine test.

During a visit, machine mechanics, electrical and automation components, as well as weld quality undergo comprehensive status checks. All irregularities and misalignments are corrected, and a debriefing session is held where suggestions for future handling optimization are made. After a visit, a detailed report is generated, including an action plan with recommendations for troubleshooting and future improvements.

On-call assistance and on-site intervention

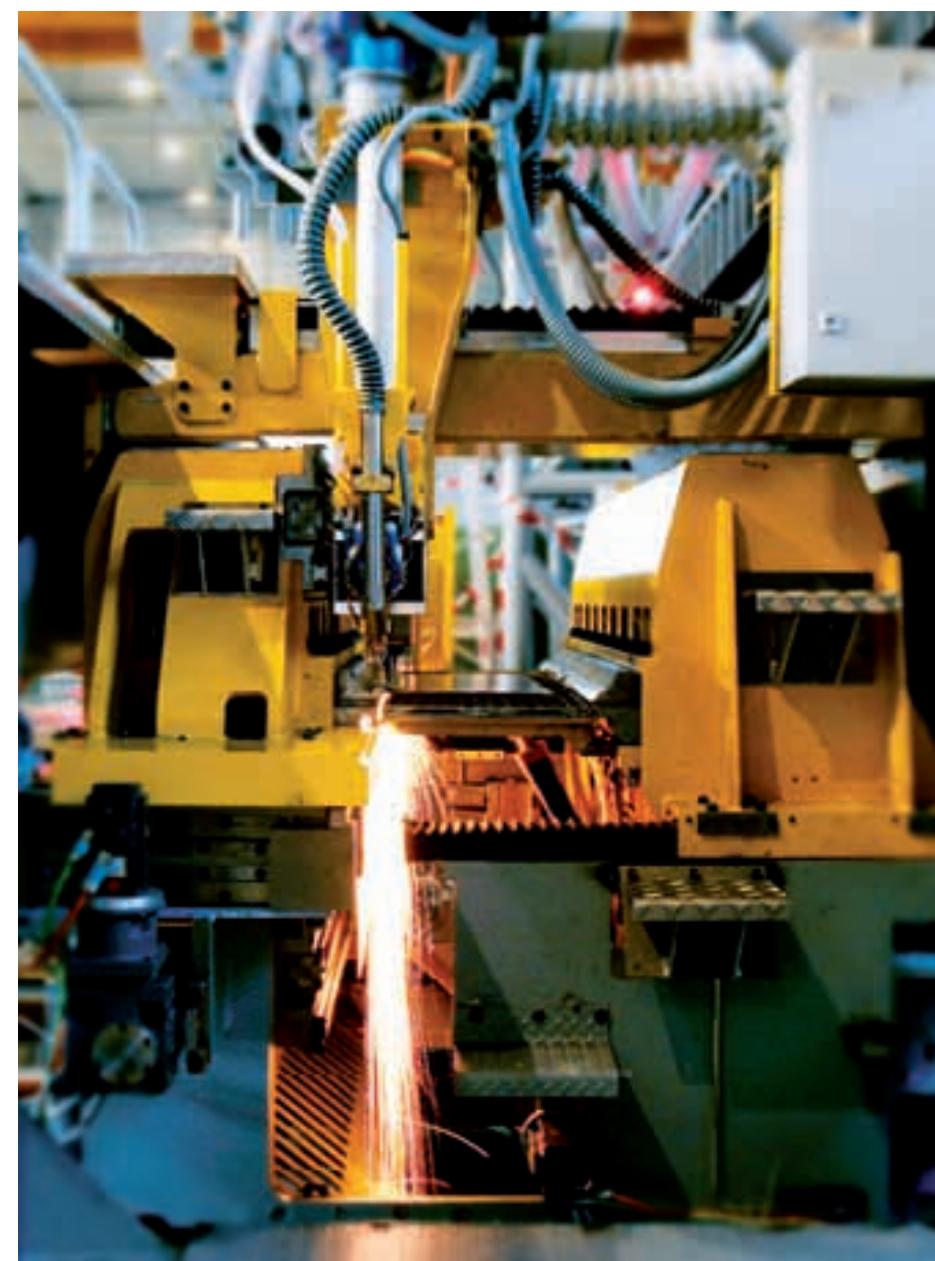
Designated Siemens VAI experts can be contacted in an emergency situation. After listening to a description of the problem, they are usually able to provide rapid diagnosis with detailed instructions for corrective action. If necessary, the customer can request at short notice an on-site visit from a Siemens VAI expert to ensure minimum equipment downtime.

Product life-cycle services

Complementing on-demand emergency support, further services ensure optimum welder system utilization:

Offline maintenance services can extend the welder's life cycle. At a Siemens VAI manufacturing site, welding head assemblies are reworked, first by disassembling the head into its components and then analyzing it in detail. Based on the status of a component, a report is drafted that details the necessary steps for reconditioning and for the inclusion of possible improvements. Upon customer approval, these operations are performed and the heads are submitted to a final test before being shipped back to the client.

Training services can help improve the welder's operating efficiency and extend its service life. Siemens VAI offers welder operations and maintenance training both for theoretical background and hands-on operation of the customer's own equipment, including troubleshooting, system diagnosis and various levels of maintenance.



Laser welder for strip processing line in operation

Service contracts help manage operating risks

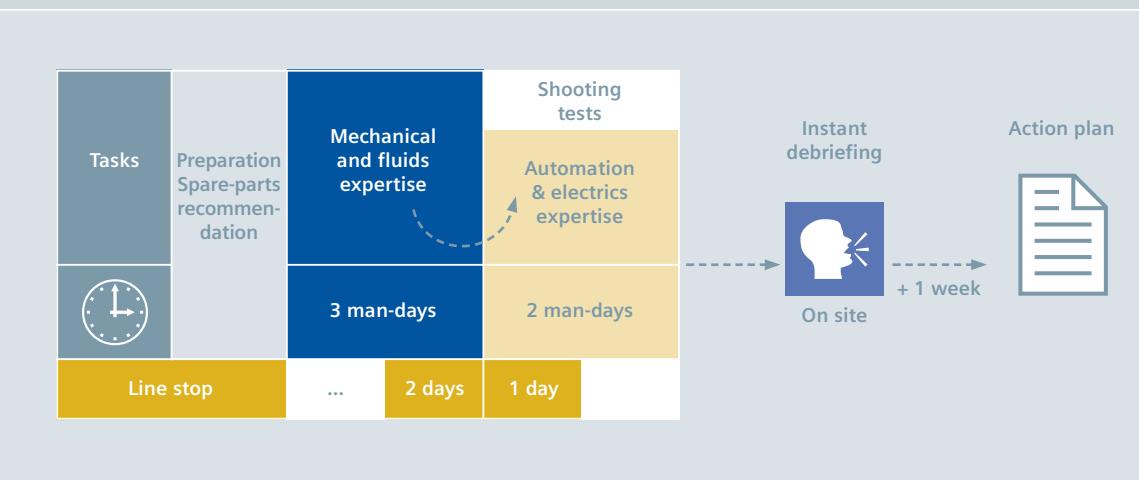
Leveraging its competence as an original equipment manufacturer, commissioning service provider and automation equipment manufacturer, Siemens VAI offers a full spectrum of services to help customers obtain the highest equipment performance and safely manage the operating risks of their plant.

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High-tech cleaning solutions for electrotechnical facilities

Timely Cleaning Keeps Facilities Running

Electronic and electrotechnical equipment is often exposed to a number of harming factors – such as fire damage and aggressive environmental conditions – without breaking down immediately. Siemens offers professional refurbishing and cleaning services, which add to a facility's lifetime.

Especially in the case of fire damage, deposits from smoke and soot and the resulting hydrochloric acid gases cause lasting damage – if they aren't removed by an expert within due time. Hydrochloric acid as a result of burning PVC causes corrosion in many metals and the corrosive reaction doesn't stop until the material is entirely disintegrated. The results of this type of contamination include leakage current, disruptions and damage to components through heat accumulation. All of these factors can interfere with a facility's operation; if left untreated they can cause lasting damage to the systems and facility. The contaminated equipment increases the risk of malfunctions and unplanned standstills with every year of operation, as the end of the familiar bathtub curve continues its upward shift (see diagram, p. 74).

Aggressive environmental factors such as sulfur dioxide, hydrosulfide, nitrous gases, salts and high humidity can also systematically damage equipment.

Especially in recent years, Siemens experts have experienced a rising number of cases in which new plants and systems are contaminated by construction activities such as drilling, grinding and beveling, etc. This often leads to partial or complete contamination of new systems – which are just barely ready for commissioning – through conductive or corrosive substances.

Time is money

For refurbishment, the deciding factor is time, since the higher the corrosion, the higher the refurbishing costs. In order to find a lasting remedy and to avoid renewed contamination, extensive causal research is often called for. In these cases, availability of civil drawings and documentation regarding the air-conditioning system is extremely important.

For a decision on suitable methods for cleaning electrical and electronic components, it is important to know the extent of the actual contamination. The ex-



As a competent and experienced service provider, Siemens VAI not only provides cleaning/restoration services, but also completely restores the functionality of the damaged electrical and electronic installations.

perts from Siemens can perform a visual survey, for example with an endoscopic device, and chemical on-site analyses to locate the presence of polycyclic aromatic hydrocarbons and other toxic substances, as well as pH-value, chlorides, nitrates, sulfates, salts, acids, and

The deciding factor is time, since the higher the corrosion, the higher the refurbishing costs.

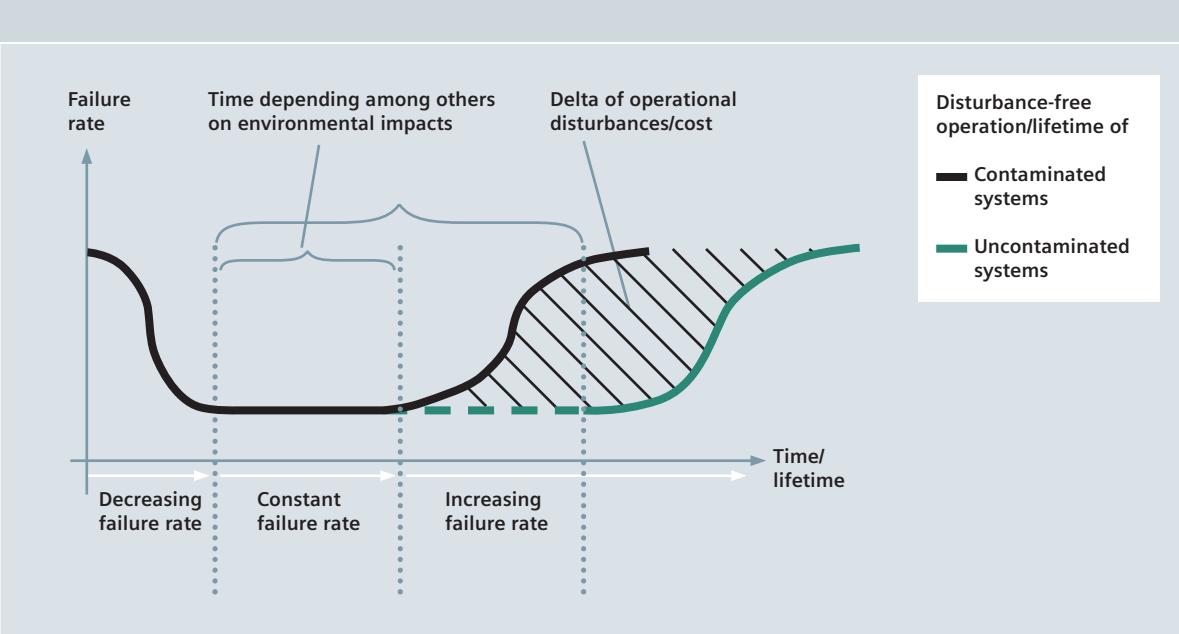
coarse and fine metallic substances. If these tests do not render clear results, Siemens experts take a wipe sample of the contaminated components as well as air ducts and rooms otherwise exposed to contamination. These samples are quantitatively evaluated in a chemical lab and the contents of ionogenic (conductive)

substances in the form of chloride, sulfate and nitrate salts, and other substances are determined and recorded. This type of on-site analysis also extends to risk assessment in accordance with worker-safety regulations and, when necessary, the initiation of first-aid measures.

Another important feature of the Siemens portfolio is environmental care. Experts carry out repetitive or long-term operational-safety studies to identify potential risk caused by prevailing environmental conditions. All results are generally documented in an analysis report.

Siemens offers tailor-made solutions

Whether a small electrical panel in a remote location, a ship in Dubai or a complete plant in Argentina, all services are offered by Siemens worldwide, 24 hours a day. The advantages of these services are obvious: tailor-made solutions with straight-forward implementation >>



The damage caused by the Elbe floods also affected electrotechnical installations. The images illustrate how equipment that was submerged in water and completely contaminated with mud and other harmful substances could be restored by Siemens specialists.



>> on short notice, increased operational safety and plant availability, reduction of sporadic disturbance and the minimization of maintenance, not to mention increased long-term conservation of asset value.

Proper and competent evaluation of analyses helps to identify and eliminate sources of pollution.

Further important advantages to be considered:

- Avoiding fire hazards due to flash-over or short circuit as well as the unplanned stoppages and ensuing loss of production;
- reduction of disturbances by unwanted conductive links and overheating; and
- preventive measures help avoid weak points and ultimately increase plant utilization.

Last but not least, disturbance-free plant operation also conserves energy, thus benefiting the environment. Proper and competent evaluation of analyses helps to identify and eliminate sources of pollution. ■

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Siemens at MINExpo International 2008

An estimated 38,500 people from around the world attended the recent MINExpo International, the mining industry's premier showcase for companies specializing in every facet of mining – open cast, underground, processing and preparation, mine site development, exploration and surveying, smelting and refining, and reclamation.

Held for three days in Las Vegas, Nevada, MINExpo displayed the latest technology, equipment, parts and services used for exploration, extraction, safety, environmental remediation and preparation of metallic ores, coal and other minerals. With 1,200 exhibitors whose displays covered more than 600,000 square feet of exhibit space, MINExpo is the largest show of its kind in the world.

Visitors to the show had the chance to learn about the industry's latest trends covering all aspects: equipment ranging from hand tools right up to the largest machinery; automation and robotics; safety and communications equipment; longwall mining equipment; engines and parts; materials handling and processing equipment and services; pollution control equipment;

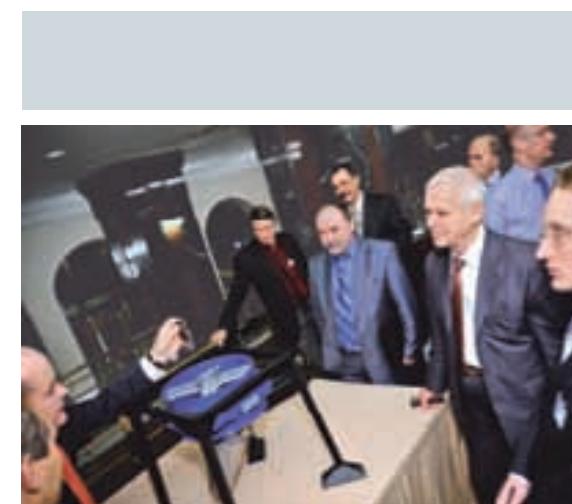


Visitors to the fair had a chance to operate a simulated shovel at the Siemens booth.

reclamation equipment and services; computer applications; consulting and financial services, and more.

The Siemens stand featured displays from several businesses including Mobile and Continuous Mining/Beneficiation, Water Technologies, Industrial Services, Process Instrumentation, Large Drives, and Mechanical Drives (Flender). Siemens also participated in several press opportunities, including interviews with the ARC Advisory Group, the Engineering & Mining Journal, and Coal Age magazine. ■

Symposium Debut in Moscow



Russian steelmakers examining the Simetal^{CIS} Gimbal Top model

On November 12, 2008, more than 40 customers and experts from Russia, the U.K. and Austria came together for the first blast furnace symposium of Siemens VAI in Moscow. "With our broad basis of mechanical solutions as well as comprehensive knowledge of metallurgical processes, we can optimize our investment projects in the Russian steel industry and maintain the competitiveness of the companies we serve there," said Geoff Wingrove, who is responsible for the worldwide blast furnace business of Siemens VAI.

Guest speaker Günter Brunnbauer, Managing Director for Ironmaking at voestalpine Stahl AG in Linz, Austria, spoke about his company's experience with blast furnace operations. Participants were also able to share their concerns and future expectations with Siemens VAI experts for blast furnaces. The technical sessions focused on the latest trends and developments, automation and control systems, environmental issues and cost efficiency right up to the local and international services abilities of Siemens VAI and its excellence in worldwide project execution. ■

European Rolling Conference Set for June



The ERC5 will take place in London: www.iom3.org/erc5

Siemens Employees Honored by Baosteel

In December 2008, Tommaso Di Paolo and Wolfgang Sterrer – both Siemens employees – were awarded the Baosteel Cooperation Contribution Prize 2008. Baosteel presents this prize at the end of each year to ten outstanding foreign supervisors and joint-venture employees for their contributions in the areas of construction, production, technical renovation, and research and development, among others.

Di Paolo and Sterrer were chosen based on their hard work and outstanding performance in Baosteel's No. 5 Cold Rolling Mill Project and the Corex C-3000 Project. "On behalf of Baosteel, I would like to extend my sincere thanks to Siemens for assigning such excellent employees to support us," said He Wenbo, President of the Baosteel Group Corporation. The dedication and commitment of the two Siemens winners have strengthened and enhanced the cooperation with this renowned Chinese steel producer. ■



Highest honors: Huang Ping from Siemens China (center) accompanied Wolfgang Sterrer (left) and Tommaso Di Paolo (right) as they received the "Baosteel Cooperation Contribution Prize 2008."

The 5th European Rolling Conference (ERC5), sponsored by Siemens VAI and hosted by the Institute of Materials, Minerals and Mining (IoM3), will take place in London from June 23 to 25. ERC5 targets the whole metals rolling community from flat and long products rolling, hot and cold rolling up to ferrous and non-ferrous rolling. The conference will also review the latest developments in rolled-product properties, quality and applications as well as the design, control and management of mill assets. Visit the Siemens VAI stand – and make sure to take time to listen to the high-carat speakers at the plenary sessions. ■

Inventor Honored At Siemens



Dr. Gerald Hohenbichler – recipient of the Siemens "Inventors of the Year" award

Once a year, Siemens honors its exceptional inventors in its "Inventors of the Year" award ceremony at company headquarters in Munich. In fact, the 12 award winners in 2008 have submitted altogether around 800 patents. The activities by these winning inventors cover the full range of the company's business activities, including medical technology, power generation and metals production.

Among the 2008 winners is Dr. Gerald Hohenbichler, 44. He has worked for Siemens VAI in Linz for the past 16 years and can already refer to 40 inventions and 276 submitted patents. His extraordinary activities in connection with the development of the ESP process will enable slabs to be rolled to strip in an endless production line. "By processing the steel in a continuous line we can get the same work done, but with 45 percent less energy," he explains. At the heart of the solution are implemented layout concepts and technological procedures as well as process monitoring tools that enable process control in real time. Additional inventions from Hohenbichler and patents for which he applied for together with others include active-vibration-damping control in cold-rolling mills as well as sensors and control systems that detect and clean dirty mill rolls. ■

More information

You can find further information and company press releases at our online portal www.siemens-vai.com.

Events: Upcoming Conferences and Fairs

| | | | |
|---------------|---|-----------|---|
| MAR 04–05 | STAHLMARKT 2009, Düsseldorf http://www.euroforum.de | APR 19–21 | 15 th WORLD STEEL CONFERENCE, Vienna, Imperial Riding School – Renaissance Hotel http://www.crugroup.com/Events/CRUEvents/WorldSteel/Pages/worldsteel.aspx |
| MAR 08–10 | 15 th WORLD STEEL CONFERENCE, New Delhi, Taj Palace Hotel http://www.crugroup.com/Events/CRUEvents/WorldSteel/Pages/worldsteel.aspx | APR 20–24 | HANNOVER MESSE 2009, Hannover http://www.messe.de |
| MAR 10–13 | ALUMBUILD 2009, Moscow, Crocus Expo http://www.entre.fi | APR 22–23 | 3 rd ANNUAL ACQUISITION LEVERAGED FINANCE CONFERENCE, Prague, Marriot Hotel http://www.euromoneyseminars.com/EventDetails/0819/3rd-Annual-Acquisition-Leveraged-Finance-CEE.html?LS=208263403-208LEOIE1ATA |
| MAR 11–13 | CIS Coal, Crimea, Ukraine http://www.cissteel.com/web/busf.nsf/StWeb/calendarE.html | APR 22–23 | 1 st IRAN INT. ALUMINUM CONFERENCE & EXPOSITION, Tehran http://www.iiac2009.ir |
| MAR 11–13 | 15 th INT. BAUXITE & ALUMINIA SEMINAR, Montego Bay, Jamaica, The Ritz-Carlton Golf & Spa Resort http://www.metalbulletin.com/events/baux | APR 28–29 | FAR EAST STEEL CONFERENCE & CHINA IRON ORE CONFERENCE, Beijing, Sofitel Wanda http://www.metalbulletin.com/events/Details/Intro.aspx?EventID=812&LS= |
| MAR 16–18 | ASIAN METALLURGY 2009, Mumbai, India, Bombay Exhibition Centre; http://www.steelworld.com | MAY 04–07 | AISTech 2009, St. Louis, Missouri, America's Center http://www.aist.org/aistech/09aistech.htm |
| MAR 17–18 | MASCHINENBAUFORUM, Pforzheim, Germany | MAY 06–08 | 3 rd ANNUAL PAYMENT CHINA CONFERENCE, Beijing, Intercontinental http://www.paymentchina.com |
| MAR 17–19 | CARBON MARKET INSIGHTS, Copenhagen, Bella Center; http://www.pointcarbon.com | MAY 10–12 | MAGMIN 2009, Amsterdam, Hotel Okura http://www1.metalbulletin.com/events/Details/Intro.aspx?eventId=714&LS= |
| MAR 23–27 | ASIA MINING CONGRESS 2009, Singapore http://www.terrapinn.com/2009/asiamining | MAY 10–12 | 14 th WORLD ALUMINIUM CONFERENCE, Dubai, Grand Hyatt Hotel http://www.crugroup.com |
| MAR 25–27 | ASIAN FERRO-ALLOYS CONFERENCE, Hong Kong, Kowloon Shangri-La http://www.metalbulletin.com/events/afa | MAY 11 | ACHEMA 2009 – 29 th International Exhibition-Congress on Chemical Engineering, Environmental Protection and Biotechnology Frankfurt am Main, Messe Frankfurt |
| MAR 25–28 | Energy Efficiency and CO ₂ Reduction in the steel industry, Budapest http://www.eecrsteel.com | MAY 12–15 | METALLURGY LITMASH 2009, Moscow http://www.metallurgy-tube-russia.com/cipp/mr/custom/pub/content/lang,2/oid,307/ticket,g_a_s_t |
| MAR 28–30 | 157 th ISIJ MEETING, Tokyo; http://www.isij.or.jp | MAY 13–15 | 2009 International Symposium on Thin Slab Casting and Rolling (TSCR 2009), Nanjing, China |
| MAR 29–31 | ALUMINIUM DUBAI, Dubai http://www.aluminium-dubai.com | MAY 18–20 | SEAISI 2009, Malaysia http://www.seaisi.org |
| MAR 30–31 | AUSTMINE 2009, South Australia, Adelaide Convention Centre http://isg-dev.informa.com/informaocz/austmine/home/ | MAY 20–22 | 7 th INT. EXHIBITION OF EQUIPMENT & TECHNOLOGIES OF MINERAL, METALLURGY & COAL-MINING INDUSTRIES "MINTECH-2009", Ust-Kamenogorsk, Kazakhstan http://www.kazexpo.kz |
| MAR–APR 29–03 | HOT FLAT ROLLING FUNDAMENTALS – A Practical Training Seminar, Ypsilanti, Marriott Ann Arbor Ypsilanti at Eagle Crest http://www.aist.org | MAY 24–27 | ASIA STEEL 2009, Busan, Korea http://www.asiateel2009.org |
| MAR–APR 31–01 | SERVICE IM MASCHINEN- UND ANLAGENBAU, Munich, Holiday Inn Munich-Schwabing http://www.euroforum.de/p1103632 | MAY 24–28 | ABM STEELMAKING SEMINAR, Sao Paulo, Brazil, Estação Embratel Convention Center http://www.abmbrasil.com.br/seminarios |
| APR 01–03 | 2 nd . INT. CONF. & EXHIBITION ALUMINIUM CASTING, Moscow, President Hotel http://www.alusil.ru | | |
| APR 02–04 | METALRICICLO 2009, Montichiari http://www.metalriciclo.com | | |
| APR 07–09 | STAINLESS 2009, Brno, Czech Republic http://www.messe-duesseldorf.de | | |
| APR 15–17 | MINING WORLD RUSSIA 2009, Moscow, Crocus Expo http://www.miningworld-russia.com | | |

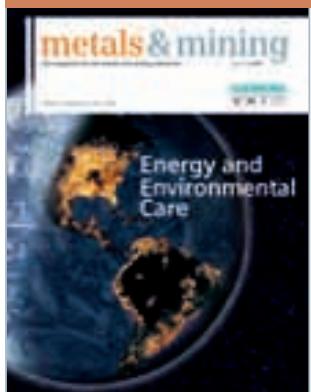


The next issue of **metals & mining** ...

Cost Savings in the Metals and Mining World

The past several years of continuous growth in the steel industry are now being interrupted by the worldwide financial crisis. The time is ripe to start thinking about cost-saving solutions, process improvements and upgrading possibilities. Even smaller investments can help to create added value through increased plant efficiency and enhanced product quality – while at the same time saving a lot of money for producers as well. Despite the up- and downturns in business cycles, steel will continue to play an important role in finding answers to the perplexing questions of the future, such as globalization, population explosion, urbanization and climate change. Because no matter what, steel stands for endurance, economic prosperity and growth. Improvement solutions of today will set the standards for tomorrow's performance.

Using selected examples, we will show in the next issue of **metals & mining** how smaller, targeted investments can boost your plant's competitiveness and viability in an increasingly harsh economic climate. Enough to spike your curiosity? The next issue is coming soon.



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metals@siemens.com.

The new Siemens VAI Website is now online

Next Generation Internet

The newly designed Siemens VAI Website can be viewed under www.siemens-vai.com. Approximately 500 pages were updated, structural improvements were made, and new features and functions were added. The topics "Metals" and "Mining" can now be directly accessed using separate tabs. The new navigation structure makes it possible for users to easily navigate through the site according to each process step in the mining to steel production chain. This is complemented by additional links to the related topics of Electrics & Automation, Metallurgical Services, Balance of Plant and Energy & Environmental Portfolio. May we invite you to explore the new Siemens VAI Website? We look forward to your comments and suggestions, which you can send to us by clicking on "Contact" in the Website.



www.siemens-vai.com

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