



EDITORIAL

Dear valued friends,

In April we could welcome many of you to our 6th International Mini-Mill Symposium, which has meanwhile established itself as a major event for the mini-mill community. The papers presented and the discussions showed that the mood in the market has become much more optimistic than it has been quite recently.

As a reliable partner to steelmakers worldwide, BSE offers products and services covering the market trends:

⊙ **Efficiency:** Tilttable VLB, Consulting

⊙ **Safety:** MultiROB, EBT Filling, NEW: Spray-Cooling Technology

⊙ **Education and Training**

All our projects are based on our long-standing experience with the background of our own steel plant – true to our motto “from steelmaker to steelmaker”.

You are cordially invited to see all these products in operation here in Kehl and to discuss with us about your ideas and which support we can give you for the long term and sustainable success of your operation.

With the best personal greetings,

Torsten Rummler
Managing Director

Welcoming Steelmakers from all over the World

Sixth International Mini-Mill Symposium by BSE Showing Increased Optimism in the Market

From 2nd to 5th of April 2017, BSE hosted the sixth issue of its renowned international mini-mill symposium, this time taking place in the famous spa town of Baden-Baden in Germany. Once again, the symposium proved as THE gathering of the mini-mill family combining information, networking and entertainment.

During the conference, around 200 participants from 36 different countries listened to interesting presentations from steel industry experts. In accordance with the event motto “Together to the TOP” the presentations focused on the areas Trends & Technology, Operation and People.

The symposium motto was not only reflected in the optimistic and cordial atmosphere during the conference sessions, but also in the memorable leisure programme, especially in the final evening event featuring an aeroplane hangar turned into a vivid party location.



We at BSE look forward to welcoming you to one of our next events. Kindly contact us if you are interested in participating in future BSE events.

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Multiple Functions – Multiple Applications – Multiple Locations

Current BSE MultiROB Installations at Customers in Europe and America – Introducing New Application of Billet Sample Cutting

The following overview of BSE's latest projects shows the diversity of applications and functions of the MultiROB – the robotic solution by BSE. Beside the single functions of temperature measuring and sample taking at the EAF or ladle station and billet sample cutting at the casting machine, the automatic tool exchanger, gives the customer the flexibility to use multiple functions with solely one robot today and in the future.

ArcelorMittal Lazaro Cardenas (Mexico)

In order to increase the safety for the EAF operators, ArcelorMittal decided to invest in an automated solution to perform the temperature measuring and sample taking through the EAF sidewall. Since the existing sidewall opening is very small (200x200 mm) and is not always at the same place (because different shells are used) and due to further space limitations, the MultiROB turned out as the most appropriate solution for this task. The start-up took place in November 2017.



MultiROB with TempSamp function going through an opening in the EAF sidewall
(Click picture to download simulation)

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Böhler Edelstahl (Austria)

Due to safety reasons, the operators at the Böhler meltshop in Kapfenberg are not allowed to enter the ladle station area. Therefore, Böhler was looking for a robotic solution for the temperature measuring and sample taking. Furthermore, Böhler is planning a new meltshop, where advanced robot technology will be applied. The concept of the MultiROB – conversion of a state-of-the-art industrial robot from the supplier Kuka for operation under the hot and rough conditions in a meltshop – the related BSE know-how and the good experience with the BSE TempSamp Manipulator at the EAF convinced Böhler to start another cooperation with BSE.

Beside the robot itself the project comprised also:

- ⊙ Automatic cartridge exchange rack
- ⊙ Tool exchanger (including integrated media connection)
- ⊙ Standard training at BSE
- ⊙ Extended training for robot technology department (after start-up)
- ⊙ 24/7 Kuka-BSE service for one year

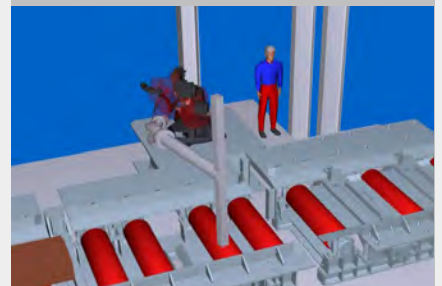
The start-up and training were successfully executed in March/April 2017, having provided Böhler with a reliable tool for today's needs and basic know-how for implementation of future robot applications.



Automatic sample taking at ladle station with cartridge rack and tool exchanger
(Click picture to download movie)

Billet Sample Cutting

A customer in Europe was looking for a safe, flexible and reliable tool to optimise the billet sample cutting. Together with the customer, BSE developed a system to use the MultiROB for this task. The new flexible system with the robot, supplied by BSE, and the torch cutter, supplied by the customer, will be able to cut sample slices even with different shape from different billet size.



Movement of the MultiROB into position for billet sample cutting ...
(Click picture to download simulation)



... realised by different flame modes for preheating and actual cutting process

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Increasing Operational Safety while Reducing Maintenance Effort

Installation of Furnace Roof and Elbow with Spray-Cooling Technology at Walsin Lihwa (Taiwan)

Walsin Lihwa operates a 65 ton stainless steel furnace at their meltshop in Tainan Hsien (Taiwan). The operation at the EAF created a lot of splashing, leading to formation of heavy skulls at the conventional roof design. Roof leakages and time-consuming cleaning were disturbing the production.

Project Approach

The installation of a new spray-cooled roof and elbow should increase the operational safety. Walsin Lihwa also expected an easier skull removal with the spray-cooled roof design. With the roof modification, the size of a new spray-cooled elbow should be increased to cope with the future fume emission at the EAF.

Walsin Lihwa delegates visited BSE/BSW in October 2015 to see the operation and maintenance of the spray-cooled roofs at BSW meltshop. The spray-cooling concept together with the impression of the visit at BSW convinced Walsin Lihwa to realise the project with BSE.

Scope of Supply

- ⊙ Detail engineering of one spray-cooled roof with spray-cooled delta
- ⊙ Hardware supply of one spray-cooled roof with refractory delta
- ⊙ Hardware supply of one spray-cooled elbow
- ⊙ Basic engineering of all necessary modification to the water supply and pump station
- ⊙ Supervision of erection and start-up including training for operation and maintenance staff

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Results / Benefits

In April 2017, the roof and elbow were installed successfully by Walsin Lihwa under the supervision of BSE. Starting from the very first heats, the operation of the new equipment was trouble-free, giving the team of Walsin Lihwa and BSE the time to test and determine the optimum water flow rate and pressure.



Open roof at BSE workshop displaying the collector ring and cooling elements



Roof and elbow ready for the first heat



Bottom view of the roof after several heats showing less skulls compared with previous roof design

Spray-Cooling Technology

The BSE spray-cooling technology provides **safe, simple and reliable cooling** of furnace components. The components are tested and proven at BSW, the steel plant of the Badische group, and at many customers' plants worldwide.



- ⊙ Cooling elements consisting of water header and spray bars providing a **pressure-less water flow**
- ⊙ Support structure with collector ring as an integral part used for water supply and return
- ⊙ Heat transfer through steel plate cooled by a thin water layer
- ⊙ Reliable operation and long lifetime due to proven design with well-balanced cooling performance



- ⊙ Lower consumption of cooling water compared with tubular design
- ⊙ Maximum safety in operation based on pressure-less function, thus **eliminating the risk of explosions** – in case of leakages the water droplets will just evaporate

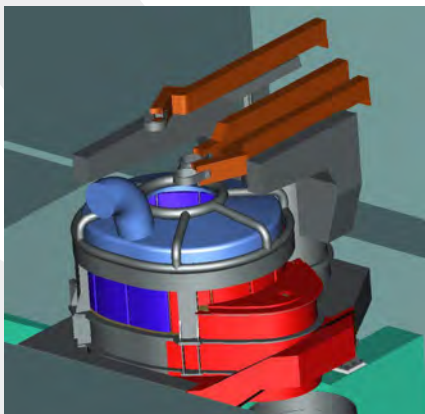
Increase of Tapping Weight hand-in-hand with Improvement of Safety, Operation and Process

EAF Modernisation with Automatic EBT Filling at Gerdau DIACO (Colombia)

In the course of a modernisation programme at its meltshop in Tuta (Colombia), Gerdau DIACO decided to modernise also the EAF. The main targets of the modernisation were to increase the tapping weight while improving also the safety conditions, operation and process. BSE was entrusted with this comprehensive EAF project based on the good experience of Gerdau with the BSE Virtual Lance Burner System and Lance Manipulator. The project consisted of engineering services and the supply of key components from BSE.

Project Approach

The concept, mutually developed by Gerdau and BSE, came to the conclusion to convert the existing EAF with OBT tapping system into an EAF with EBT system. With this concept, the existing roof design could be reused and the EAF volume slightly enlarged – at reasonable investment cost. The following sketch shows the areas of modification (in red colour).



Scope of Supply

The scope of supply comprised the key components upper and lower furnace shell, modification of tilting platform, furnace roof, TempSamp Manipulator and new Virtual Lance Burners including automation.

The modernised EAF was also equipped with a device for **automatic filling of the tapping hole** – a new development by BSE (more information on the right side).



Results / Benefits

The installation took place in late 2016. Gerdau was very satisfied with the project and impressed especially by the high manufacturing quality and the excellent cooperation during erection and start-up.

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Automatic EBT Filling

Also for the tap-hole filling, BSE developed a safe, simple and reliable method by using a conventional storage and dispensing system for the filling material combined with a mechanism for automatic opening / closing of the access hole in the EBT panel.

The mechanism consists of a water-cooled flap with copper cover for closing the access hole in the panel. By actuation of the water-cooled hydraulic cylinder, the flap opens and the sand from the bunker can be discharged for filling the tap-hole.



Flap mechanism device installed on the EBT panel for automatic opening / closing of the tapping access hole

For a visual check of the EBT tap-hole before and after the filling procedure, a camera system can be installed additionally. In order to protect the camera, the camera is placed in a water-cooled protection box. During activation of the camera, the lens is also protected by pressurised air or nitrogen blowing.

The complete system provides the customer with the benefits of:

- ⊙ Increased operational safety
- ⊙ Reduction of take-around time
- ⊙ Fully automated process control

Download Movie

Reaching New Productivity Levels for Stainless Steel Operation with BSE Oxygen Technology

Tiltable VLB System Installations at Outokumpu in Sweden and USA

Outokumpu is a global leader in stainless steel. The market is picking up and there is a demand to sell more volume. Thus the production facilities have to be equipped for the increased demand – in the case of Outokumpu by installation of state-of-the-art oxygen technology systems at the EAFs.

The excellent results achieved with the BSE Virtual Lance Burner (VLB) system at Outokumpu Tornio (Finland), the benefits of the unique tiltable design and the confidence of Outokumpu management in BSE/BSW were the main reasons to extend the cooperation with BSE by ordering two further VLB systems for Outokumpu's plants in Calvert (USA) and Avesta (Sweden).

Outokumpu Calvert (USA)

Since its installation in 2012, the 165 metric ton AC EAF at Outokumpu's Calvert facility had operated without a side-wall burner system, limiting the melting functionality to only its electrodes. With the installation of the Tiltable VLB by BSE the Outokumpu team expected to realise an increase in the furnace's productivity coupled with a reduction in conversion costs. The concept mutually developed by Outokumpu and BSE comprised the elimination of the existing cold spots within the EAF by installation of three VLBs and necessary auxiliaries. With these energy sources a more homogenous heat distribution around furnace should be achieved.

An investigation conducted by BSE prior to the project found out that parts of the equipment including the valve racks for oxygen and natural gas could be re-used (with minor modification) from the idle Outokumpu plant in Bochum (Germany).



Tiltable VLB panel complete with hydraulic cylinder and hoses



Visual check by BSE experts during installation and optimisation phase

The VLB system was commissioned and started up in July 2017, including process optimisation and training for operation and maintenance staff. The positive experience of the project and detailed results will be presented by Outokumpu at the **AISTech conference in May 2018 in Philadelphia (USA)**.

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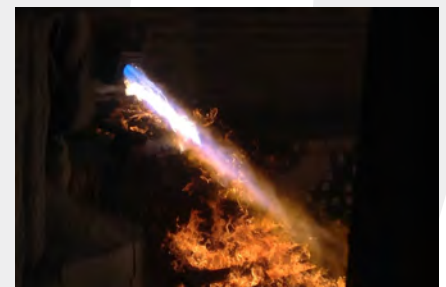
Outokumpu Avesta (Sweden)

Due to productivity increase at the AOD converter, the 90 ton EAF has become the bottleneck in the meltshop. In order to increase the productivity also at the EAF, Outokumpu decided to replace

the 20 year old burner system (3x3 MW) with a new tiltable VLB system from BSE. Beside the increase in burner power (up to 3x5 MW), the new system should also be more reliable and maintenance friendly, e.g. the old burners were often clogged due to inappropriate operation mode.



Furnace view with VLB in operation – burner mode with flat angle ...



... and lancing mode with steep angle

The first results after the start-up in August 2017 were promising: For the two reference steel grades, the **power-on time decreased by 11 % and 7 %**. **Electrical energy consumption decreased by 8 % and 5 %**. Due to the flexibility of the BSE VLB system and its variety of operation modes, Outokumpu is ready to achieve this new level of performance also for further steel grades.

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Boosting Today's Production and Securing Future Success of Rolling Mill Operation

Consulting Cooperation with SteelAsia for Productivity/ Efficiency Increase and Implementation of a Training Centre for Young Steelmakers

Since 2009, SteelAsia Manufacturing Corp. (Manila/ Philippines) and BSE have been cooperating for various technical and consulting projects. The long-term relationship was prolonged by signing of two further comprehensive consulting agreements in 2016 and 2017.

Boosting today's rolling mill production of around 2,0 million metric tons per year up to 4,5 million tons requires not only state-of-the-art technology. For reaching this ambitious target, it is also decisive to have a skilled and motivated workforce achieving highly efficient operation on a sustainable level. Therefore, beside a consulting study for productivity and efficiency increase, BSE was entrusted with the implementation of a customised training centre within the SteelAsia organisation.

Productivity and Efficiency Increase

Knowing BSE for a long time with its own steel plant Badische Stahlwerke (BSW) and its successful operational philosophy ("Badische Philosophy") was the key factor why SteelAsia decided for a know-how contract with BSE related to rolling mill operation. The contract comprises the systematic implementation of the "Badische Philosophy" with a three year know-how transfer and step-wise approach:

- ⊙ On-site investigation by BSE/BSW experts at SteelAsia
- ⊙ Mutual elaboration of a concept with defined road map and improvement projects
- ⊙ Management and operation / maintenance seminars at BSW
- ⊙ Operation / maintenance training at SteelAsia
- ⊙ Steering committee meetings

Implementation of Training Centre

Securing future success in steelmaking means the **right selection, education and training of young steelmakers.**

Based on observations made at BAG (the special company within the Badische Group dedicated to training of apprentices for different professions) and recommendations of BSE, SteelAsia is developing an own training centre in the Philippines.

In April 2017, the cooperation started with a kick-off meeting at the premises of SteelAsia, followed by the elaboration of a detailed report focusing on the three main fields/professions:

- ⊙ Operator (operator rolling mill: pulpit operator and adjuster)
- ⊙ Industrial mechanic (maintenance rolling mill)
- ⊙ Industrial electrician (maintenance rolling mill)

In July 2017, the report was discussed and the first train-the-trainer seminar conducted at the premises of BAG.

In 2018, BSE will further support SteelAsia with technical assistance at site.

Results / Benefits

SteelAsia and BSE are proud of having this long-term partnership, working hand in hand and being optimistic that the cooperation will pay off.

The on-site investigation, seminars at BSE/BSW and first on-site support have already effected a significant improvement of the rolling mill operation.

The implementation of the training centre together with BSE will be the next important step. Considering the excellent cooperation and success of the project so far, the course is set also for a successful start of the training centre scheduled for January 2019.



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Securing Future Success of Steelmaking by Comprehensive Training of Young Steelmakers

Tailor-Made Training Projects with Steel Producers in Middle East

There are many different ways to properly prepare young steelmakers for their jobs in a steel plant. One way is to run an own education/training centre dedicated to steelmaking theory and practice. BSE helps customers to establish such training centres (see article from the project at SteelAsia on page 6). For some customers (currently in Middle East region) BSE has developed another way: Comprehensive, tailor-made training programmes for a selection of persons with multiple-week seminars conducted at BSE/BSW in Germany or at customer site as key components.

Leaders Solutions (Rajhi Steel)

Leaders Solutions is a leading consulting & training company in Saudi Arabia. Among others, Leaders Solutions offers consulting services and training programmes to the steel industry. On behalf of one of its clients (Rajhi Steel) Leaders Solutions was looking for a competent partner to conduct process and equipment related seminars in Saudi Arabia.

The cooperation with BSE started in 2015 with training seminars for Rajhi Steel personnel at the production sites of Kharj and Jeddah. In 2016, Leaders Solutions and BSE agreed on a second training package covering safety & health, maintenance and steelmaking knowledge for nontechnical staff. The seminars of the second training package were conducted in 2016.

The main success factors for both training packages consisted of:

- ⊙ Increase of knowledge and skill level through holistic and customised training
- ⊙ Experience exchange with one of the most productive mini-mills and get to know best practice examples
- ⊙ Discussion of problems to develop solutions with experienced training instructors

Saudi Basic Industries Corporation

Saudi Basic Industries Corporation (SABIC) represents the leading steelmaker in Saudi Arabia operating iron making, steel making and steel rolling facilities. SABIC and the Badische Group have known each other for some decades already. In the course of a long-term strategy programme, SABIC aims to establish a multi-skilled knowledge in its organisation.

The latest cooperation with BSE, initiated in 2016, features a customised training programme for young steelmakers. BSE and SABIC developed a basic training plan featuring five main segments:

- ⊙ General topics and steelmaking fundamentals
- ⊙ Steel making at BSW (scrap to billet)
- ⊙ Rolling operations at BSW (billet to shipping of finished product)
- ⊙ Mechanical and electrical maintenance practice
- ⊙ Auxiliary topics: Quality, environment, safety, organisation, leading people and cost management

The content of all five parts was allocated to two main training sections, each with seminars at BSE/BSW lasting for 11 weeks in a row. This concept had the advantage, that all trainees followed the same training schedule as one team together, generating a positive learning atmosphere as well as creating a thorough understanding of the interdependency of tasks and functions required for successful steelmaking. At the end of each section, BSE conducted also a short written examination, which was provided to SABIC for internal review.

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"It was very good and we are happy about the new knowledge."

"Training was very good and people were all amazing, I appreciated everything and thank you very much."