EDITORIAL

Dear valued friends,

50 years of BSW – this is almost the same time span as our combined personal experience within the Badische Group.

Starting as commercial manager and deputy steel plant manager in the 1990s, we have been working in various leading positions within the Badische Group since.

During our time within the Badische group, we have been learning, living and further developing the “Badische Philosophy” on a daily basis. BSE is an integral part of this philosophy enabling an expertise connection for permanent exchange of ideas, development of new technology and optimisation of processes.

BSE customers from all over the world have been benefitting from the expertise connection, too, as shown in the following selection of recent projects.

Be the next to benefit from the expertise connection and contact us. Badische experts are ready to increase also your productivity and efficiency – from steelmaker to steelmaker.

With the best personal greetings,
Andreas Volkert and Florian Glück, Managing Directors

Celebrating 50 Years of Steel Production at Badische Group

50th Anniversary of BSW and 35th Anniversary of Expertise Connection between BSW and BSE

In 1968, BSW started to produce reinforcement steel in Kehl (Germany) with an installed capacity of 0.3 million tons per year. Nowadays, 50 years later, BSW produces more than 2.2 million tons per year with virtually the same basic conditions, thus being a benchmark for high productive and successful steelmaking.

But how is it possible to reach this overall increase of productivity and efficiency on a peninsula with an area of only 130,000 m²?

BSW consequently applies the so-called “Badische Philosophy” (a special version of the infamous mini-mill culture) comprising the following principles:

- Simple and reliable equipment
- Focus on consistency of efficiency
- The human factor: “Steel is made by people!”
- Continuous improvement and investment in people
- Environmental friendly production
- Optimum logistics and material flow
- Clear and integrated investment programme

The “Badische Philosophy” can be employed for any kind of manufacturing business. That is why BSE came into play few years later, when BSE was founded in 1983: One of the most efficiently operating EAF steel plants turned its technology development and management culture into a profit centre of its own.

For 35 years, BSE has been offering its consulting and technology know-how to steel producers all around the world. BSE and BSW are located closely from each other in terms of distance, and the experts of both companies work closely together on all hierarchy levels. Therefore, the bridge over the river Kinzig is not only a mere information highway, but a true “expertise connection”.

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CONTENT

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Anniversary of BSW and BSE 1
Application of Badische Philosophy for Plants in South America / Middle East 2
The “Human Factor” at Badische – Safety and Education Concept 3
Equipment Strategy at Badische / EAF Modernisation Project in Asia 4
Environmental Strategy at Badische 5
Offgas System at BSW / Fluid Dynamic Model 6
Successful Application of Badische Philosophy for Plants in South America and Middle East

Consulting Projects with ArcelorMittal Brazil, Gerdau Sao Paulo (Brazil) and Jindal Shadeed (Oman)

Cooperation with BSE means optimisation of productivity and efficiency by smart adaptation of selected method and technology from mini-mills – also recently for three customers in South America and Middle East.

ArcelorMittal Brazil
After a benchmarking study and a visit of an ArcelorMittal delegation at BSW, BSE was awarded with an expertise assistance project for two ArcelorMittal steel plants in Brazil (Juiz de Fora, Piracicaba) with the following main targets:

- Improve efficiency
- Improve availability and productivity
- Improve costs and competitiveness
- Improve skills and qualification of staff

The project consisted of an on-site investigation of all plants, a common workshop and the implementation phase including seminars at BSW.

Gerdau Sao Paulo
Gerdau Group Brazil entrusted BSE also with an expertise assistance project for the Gerdau plant in Sao Paulo focusing on the scrap supply and EAF operation and the rolling mill process with the target to improve equipment operations.

The project consisted of an on-site investigation in Brazil as well as a workshop and seminars at BSW in Germany.

Jindal Shadeed
At the steel plant at Sohar (Sultanate of Oman) Jindal Shadeed operates a 200 ton EAF. Beside the target of improving the overall plant productivity, further targets were to improve the reliability and consistency of the complete melting and casting processes.

The BSE consultants and the responsible persons of Jindal Shadeed investigated on site and mutually developed a project plan with concrete measures in technical, process-related and organisational areas. The implementation phase is yet to be concluded, featuring one management seminar, operational seminars, technical assistance and steering committee meetings.

BSE Consulting for Mini-Mill Culture
BSE has been implementing successfully the mini-mill culture to steel plants and rolling mills all over the world with comprehensive so-called know-how agreements. These long-term know-how agreements typically comprise diverse consulting and training services at customer site as well as at BSW, serving as the main platform for know-how exchange and inspiration:

- On-site investigation at customer
- Concept development
- Improvement projects
- Seminars at BSW
- Implementation support

The implementation of the mini-mill culture is not limited to EAF and carbon steelmaking. Also steel plants using other raw material and metallurgical processes for different steel grades, including integrated mills, have been receiving consulting services from BSE. Furthermore, BSE provides these services also for wire processing plants utilising the experience of the downstream facilities’ network of the Badische Group.

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Steel Is Made by People!
The “Human Factor” at Badische Group: Safety, Education and Training

Technology and equipment are important to reach high performance and to remain competitive, and, of course, methodology is important to analyse the situation, identify potentials and utilise them, but BSW considers the people working in the company as the most important asset. This is why BSW put in a lot of effort and investment into its workforce.

Safety Culture
At a very early stage, BSW started to take care of its personnel. Driven by tough German safety regulations, the management recognised that health and safety lead to well-motivated employees and a long commitment to the company. Nevertheless, for decades, BSW’s strategy still had been dominated by values such as:
- Production first.
- Everybody is responsible for themselves.
- Safety costs money and wastes time. But today the environment has changed, e.g. different expectations and attitude of employees, new legal obligations. So BSW had to change its mind-set about health and safety first. The goal was for all BSW directors, managers and supervisors to talk about safety in order to find out what happens under the “water surface” of the “problem iceberg”.

After changing the mind-set and identifying causes for accidents, BSW has managed to reduce the risk of accidents over the past few years by using the “TOP” principle:

T – Technical improvement
For example, to get people to a safe distance from hazards, in 2012, BSW and BSE developed the MultiROB for temperature measurement, sampling and camera control of refractory.

O – Organisational measures
Setting clear safety standards, described and fixed in standard operating procedures (e.g. safe ways in production areas).

P – Person-related measures
Mandatory wearing of personal protective equipment, behavioural audits, instructions accompanied with continuous training.

Using the “TOP” principle means that one must always look for a technical improvement before using organisational or – at the very end – person-related safety measures. BSW uses this clear hierarchy for safety improvement and always aims for a technical solution first.

But still, more than 80 % of all accidents happen because people behave in an unsafe manner, either by error or by violation of safety guidelines. Therefore, the company has to learn from each reported near miss, unsafe act or unsafe condition in order to prevent accidents.

Education and Training
At the beginning of the 1980s, only 35 % of BSW’s workforce had been skilled, and only a little training had been offered to the workforce. As a consequence, BSW’s productivity had been on a fairly low level. Therefore, the owners of the Badische Group decided to launch an extensive training programme:
- First, in 1979, a training department was set up (as a sub-department of Human Resources).
- Second, in 1983, a critical mass of its workforce was sent to a Japanese steel maker (Kimitsu Works/Nippon Steel Corporation; regarded as “benchmark” at that time) for a detailed know-how and technology exchange.
- Third, in 1989, the Badische Group established the BAG Training Centre, an independent company responsible for the training of the group’s newcomers. The training centre trains apprentices for own purposes as well as for external customers.

Nowadays, 93 % of BSW’s workforce consists of skilled workers. Furthermore, it is essential to qualify young people not only to meet the skill demand, but also to overcome the aging of the workforce.

Skilled and motivated workers are the main success factor for safe and highly productive steelmaking.
Smart Investment Programme for Step-By-Step Increase of Furnace Productivity

EAF Modernisation Project at Fujian Fuxin Special Steel (China)

Fujian Fuxin Special Steel (hereafter called Fuxin) operates one 160 ton EAF at Zhangzhou (China). Fuxin produces two main grades of stainless steel in different operating modes. The target of Fuxin is to improve its furnace productivity. The cooperation of Fuxin and BSE started with a technical assistance for active power input optimisation. The expertise of BSE and the results of the technical assistance convinced Fuxin to intensify the cooperation with a comprehensive productivity increase package for the EAF.

Technical Assistance

In April 2017, BSE conducted an electrical investigation to assess the electrical operation and to define possibilities to increase the average power input in view of a power-on time reduction. The assessment consisted of measurements at site followed by the exact calculation of the entire high current system from the transformer wall to the electrodes with the Finite Network Method (FNM), uniquely applied by BSE. The outcome of the FNM calculation were recommendations on the power programme and the new high current system design to solve challenges such as:

- Cable twisting and reduction of magnetic forces on cables
- Symmetric impedances
- Symmetric current setpoints
- No hot spot in furnace

Beside the hands-on recommendations, BSE proposed a productivity increase package (including some new/upgraded equipment) to Fuxin with the target to substantially reduce power-on time and energy consumption.

FNM calculation of high-current system giving precise and valuable information for improvement measures

Productivity Increase Package

The productivity increase package features components for electrical and chemical energy input and engineering/modification of the EAF itself:

- New electrode arms
- New electrode regulation system
- Electrode mast positioning
- Tiltlable Virtual Lance Burner system
- New design of furnace spout
- Upgrade of existing Lance Manipulator

The Installation of the new/upgraded equipment is expected for March 2019.

Equipment Strategy at Badische

Beside continuous investment in people and process optimisation, Badische has been following a clear and integrated investment programme for hardware. Each investment step resulted in an immediate or subsequent boost of annual production. The diagram below shows as an example the development from 1981 to 2008. After 2008, due to global overcapacity, the focus was shifted to high productivity and efficiency.

Annual production [tgb] at BSW from 1981 to 2008 with major milestones of hardware investment (EAF, LF, CCM)

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**You Better Act Voluntarily Before You Must Act!**

Pro-Active Environmental Strategy at Badische Group

A steel plant always has an impact on its environment. Environmental challenges cannot be avoided; it’s just a matter of time when one has to face them. As a consequence, BSW follows a pro-active environmental strategy, finding solutions to environmental challenges before BSW is forced to do so. In the long run, this strategy saves money and the environment.

### Basic Concept

The environmental regulations for BSW are even more stringent than the already stringent German regulations. BSW elaborated over the years many concepts for the reduction of environmental impact by a steel plant. These concepts deal with the reduction of emissions to air water and soil, but also with the recycling of all by-products from steel making like slag, dust, scale and some others. The success of these concepts can be seen by the very low emission values of BSW and also the profit derived from the recycling of by-products. Other ideas have been worked out to minimise noise emissions and to detect radioactive sources that are coming together with the scrap into the steel making process. Backed by this extensive practical experience in environmental protection in the steel industry, BSE can offer these concepts and solutions to other mini-mills to shorten implementation time of environmental protection and to avoid expensive mistakes.

### Emission Control

Beside continuous reduction of CO₂ emissions, dust and inorganic gas, the development and installation of technology that significantly reduces the generation of dioxins and furans during scrap melting is one of BSW’s prime achievements. In order to avoid regeneration during normal cooling down (de novo synthesis) the offgas is shock-cooled by a high-temperature quenching system.

### Noise reduction

For many years BSW have been devoting special attention to noise protection and achieved an important reduction of noise pollution by taking extensive measures: In 1976, the first noise measurements were carried out in the vicinity of BSW, followed by noise barriers for different outdoor facilities in the 1980s and 1990s. As a next step, the furnace/casting building was insulated in 2002. The most recent measure in 2014 was the erection of a big noise protection park close to the neighbouring village. In addition, many small-scale measures are implemented continuously, in order to reach new levels of noise protection.

### Slag Recycling

BSW and its subsidiary BSW Stahl-Nebenprodukte GmbH (BSN) have been operating a slag treatment plant for about 20 years. The plant mainly consists of crushing and screening equipment to produce different slag products, differing mainly in grain size. Depending on its grain size the processed slag can be used for various purposes:
- Road construction
- Hydraulic engineering
- Construction of parking lots
- Rail construction

Selling the slag products and using the magnetic parts results in a net profit, which makes slag treatment interesting not only for environmental but also for economic reasons.

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Turning “problems” into profits – Recycling of slag into building material

Noise level before (left) and after (right) erection of noise protection park
Due to its location on the river Rhine and the close proximity to the Black Forest, BSW attracts close attention from local environmental authorities. Beside the governmental regulations the offgas system has to meet the specific requirements of BSW, considering high production rate and cost efficiency. Therefore, the Fluid Dynamic Model (FDM) was chosen to optimise the offgas system and meltshop ventilation.

**Offgas System at BSW**

Since its establishment in 1968 and even more since the participation in the Eco-Audit according to European Union regulation in 1997, BSW assures an eco-friendly and ecological coexistence with its environment. In parallel, the substantial increase in production over the years shows that highly productive steelmaking and environmental compliance are not a contradiction but continuous adaptation and optimisation of the offgas system as a precondition.

Along with the approved production permit for 2.8 million tons, Bender Corporation, the subsidiary of BSE, investigated in detail the performance of the emission control system in order to optimise the utilisation of the baghouse, ductwork, cooling system and building evacuation capacity.

Among other conventional methods a Fluid Dynamic Model study was executed in order to determine the necessary modification to the building and the required flow rates for proper building ventilation, followed by a Conceptual Engineering project. The revamped offgas system was commissioned in January 2014 and continuously provides satisfactory evacuation for two EAFs’ primary emission control systems, the meltshop building, two ladle furnaces, the ladle preparation stands, and the casting aisle without major delays or errors.

The first task of the FDM was to simulate the existing situation. From this basis, it was possible to optimise the geometry of the canopy hood, determine the necessary flow rates, identify locations for separating walls and show the necessity of local exhaust hoods above the furnaces for the future production of 2.8 million tons. Eleven tests were executed to determine the optimum system configuration and operation parameters, giving valuable results e.g. for modification of the roof exhaust and installation of a partition wall between the furnaces.

**Fluid Dynamic Model**

The ventilation of an EAF meltshop, where several heat and dust sources contribute to the in-plant environment, is complex and makes it difficult to predict the required exhaust capacity. The ventilation in the BSW meltshop bay is influenced by various parameters that are partly interdependent.

As for the new production permit, the roof ventilators above the casters were closed and seven separate tests with the focus on the casting aisle were executed, giving further information about optimum flow rates.