Electric Arc Furnace Productivity
A Never Ending Story

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Badische Stahlwerke GmbH (BSW) was established in 1968 as the first steel mill of the emerging Korf Group. Our steel making facilities utilize the so-called "mini mill" concept. In 1968, the mini mill concept was to establish steel plants near scrap sources and the end user's location. The main objective was to compete with the long carbon steel products produced by the integrated mills.

Our plant is located alongside a river in order to facilitate and to minimize the costs for transportation. The mill was initially designed for an annual capacity of 350,000 tons.

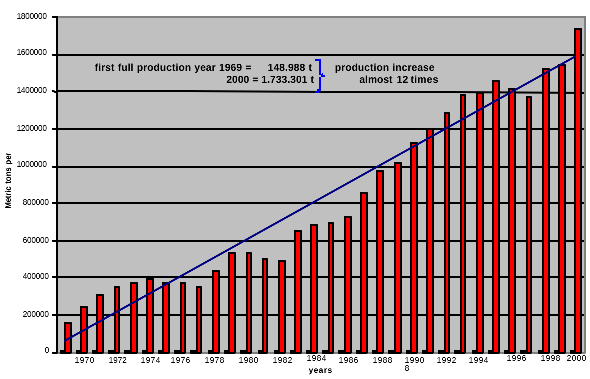

Fig. 1 — BSW steel plant - 32 years experience of increase in productivity

Our history is rich since we have successfully survived three great crises:
-The worldwide recession for the steel industry which started in 1975
-The European steel crisis in 1980 resulting in a quota regulation
-The bankruptcy of the Korf group in 1983

Also our history has forced us to continuously look at the future. We know that to deal with the reinforcing steel industry in the European market is a constant struggle for success. A struggle in order to achieve the lowest possible cost to our sales forces even in a high cost country like Germany, which is well known for it's high labor cost. Cost per man-year for example is about 30% higher than in other European countries. The border between France and Germany is about 300 m away from our plant. Over the past two decades, our experience confirms that the highest possible productivity has the biggest impact on lowering conversion cost.

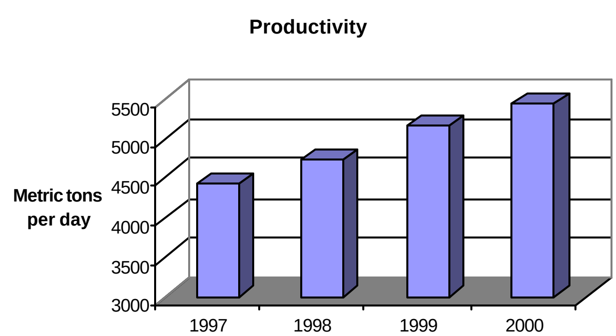

Fig. 2 – Development of productivity at BSW melt shop

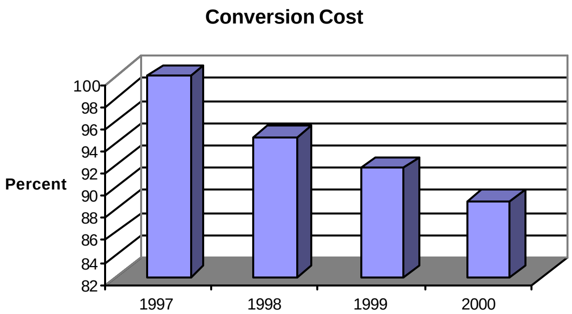

Fig. 3 — Development of conversion cost at BSW melt shop

We regard ourselves as experts in steel making but do not hesitate to call for external expertise as soon as the field does not pertain to steel making directly (for example Bender Corporation for off-gas problems)

Our present interpretation of the "mini mill" concept focuses in the achievement of extraordinary high productivity based on the following main topics:

- Everyone's will to progress from the operator to the president and CEO
- A constant investment program which enables a permanent rejuvenation of the plant by implementing "state of the art" new equipment
- A personnel philosophy which enables empowerment of our employees
- Full control of all environmental issues
- A clear and aggressive vision for the future

The technical equipment and what we have achieved to date can be seen in the following tables:

BSW data

Scrap Yard

Storage capacity:	40.000 Metric tons
Daily scrap consumption:	6.400 Metric tons
Scrap Mix:	
Shredded	28%
Turnings	13%
Bushlings	13%
HMS #1, #2	44%

BSW data

Melt Shop equipment

Electric Arc Furnaces	No. 1	No. 2
Tapping weight	80 Metric tons	80 Metric tons
Transformer capacity	57 MVA	82 MVA
Active power input	52 MW	66 MW
Secondary voltage	660 V	850 V
Secondary current	56 kA	54 kA
Shell dimensions	5,8m x 6,8m (19ft x 22ft)	6,2m (20ft)
Electrode diameter	550mm (22 inch)	550mm (22 inch)
Lancing	2 oxygen lances	2 oxygen lances
	1 carbon lance	1 carbon lance
Burners	1 x 2,5 MW	2 x 3,8 MW
		1 x 2,5 MW
	3 CoJet lances	1 CoJet lance
Electrode holders	Aluminum Arms	Aluminum Arms
Roof	Water spray	Water spray
Temperature & Sampling	Manipulator	Manipulator

BSW data

Melt Shop performance data 2001 ytd

Average productivity	5.590 metric tons billets/day
Annual production 2000	1.733.000 metric tons billets

	EAF #1	EAF #2
Heats in 2000	10.361	11.212
Electricity in kWh/metric tons billet	325	355
Electricity in kWh/ton scrap	260	284
Oxygen in Nm^3/metric ton billet	48	40
Oxygen in SCFT/ton scrap	1.360	1.140
Electrode in kg/metric ton billet	1,8	1,8
Electrode in lbs/ton scrap	3,2	3,2
Yield (billet/scrap)	88,5 %	88,8%

BSW data

Ladle Furnace and Caster

Ladle Furnace	No. 1	No. 2
Active power input	10 MW	10 MW
Electrode diameter	350 mm (14 inch)	350 mm (14 inch)
Treatment time	20 min	20 min
Electricity	20 kWh/t billet	20 kWh/t billet
Electrode consumption	0,2 kg/ t billet	0,2 kg/t billet
CCM		
Number of strands	5	5
Radius	6,2 m	6,2 m
Mould length	1000 mm	1000 mm
Mould cooling	spray cooling	spray cooling
Mould design	Parabolic taper	Parabolic taper
Billet cutting	4 shears, 1 torch	5 torches

The following performance figures provide proof that our approach is successful:

- More than 10,000 heats per year at #1 furnace
- More than 11,000 heats per year at #2 furnace
- A production record with 51 taps in one day
- Electrical consumption of less than 330 kWh per metric ton of good billet (260 kWh/ton scrap)
- Productivity increase of 20% with conversion cost decrease of 10% in two years

Some of our benchmarks for the future are as follows:

- 1.9 Mio. metric tons of billet in 2003 (1.5 Mio. tons were achieved in 1998 and 1.7 Mio. in 2000)
- 6,000 metric tons of billet per day in 2003 (it was 4,436 in 1997, 4,730 in 1998, 5,162 in 1999)

Our records in productivity define our benchmarks for the future

- 40 taps in one day with one furnace on April 19th, 1999
- 46 taps in one day with one furnace on October 21st, 1999
- 51 taps in one day with one furnace on February 22nd, 2001

A clear and aggressive vision for the future
Bench mark of 6000 t/day in 2003

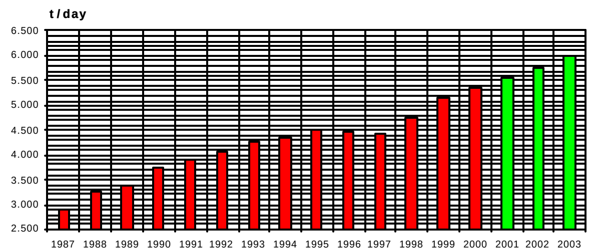

Fig 3 – BSW Benchmark for 2003

- The basis of our success is maintaining as well as increasing a highly dedicated work force. In this way we create a positive impact on our environment. Environmental protection does not only mean for us to fulfill official regulations, but to also be a benchmark regarding such aspect of steel making. Consequently, BSW is the first steel maker to obtain the European environmental management system. The following table shows examples of our clean gas emissions that we reached thus far as a milestone in the development of our environmental protection program.

TABLE I Example of one of the environmental issues

Clean gas emissions at BSW						
Parameter	**Unit**	**Federal general limits**	**BSW approval of August 1998**		BSW emissions measured in March 01	
			Source 1	**Source 2**	Source 1	**Source 2**
Dust	**Mg/Nm^3**	**20**	**4**	**1,5**	0,6	**0,07**
	Lb/h	**79,4**	**10,6**	**2,0**	1,6	**0,1**
Carbon monoxide	**Mg/Nm^3**	**To minimize**	**600**	**-**	**284**	
	Lb/h		**1587**	**-**	**1136**	
Nitrogen oxides	**Mg/Nm^3**	**500**	**25**	**15**	20	**5**
	Lb/h	**1984**	**66,1**	**19,8**	53,3	**6,7**
Sulfur oxide	**Mg/Nm^3**	**500**	**---**		12	**1**
	Lb/h	**1984**			32,0	**1,3**
Dioxines / furanes	**$NgTE/Nm^3$**	**0,100**	**0,100**		0,065	**0,006**

We are prepared for the future because we have clear visions. We want to become better because we believe that only the best will survive on the European reinforcing steel market. We enjoy the competition.