

Berlin breweries, 1990

Paul Ambler

The Berlin Wall was breached on 9th November 1989. A party from the UK Brewers' Guild visited Berlin in April 1990. The party was led by Lieutenant Colonel Bill Carling, General Secretary of the Guild. Bill has a detailed knowledge of Berlin, having previously been based there with the Army Air Corps. We stayed in West Berlin and visited breweries in both the east and west. We entered the eastern sector via Checkpoint Charlie; members of the East German Volkspolizei were still on duty and spent some considerable time inspecting our passports. However our coach's return to the west was described by Bill as 'by another way' so there is no official record of our return. Perhaps there is still a Stasi document suggesting Paul Ambler and 20 colleagues are still in East Berlin!

A detailed account of the visit was published in *The Brewer* of June 1990. A copy of the article is included with my photographs. At that time the contrast between the West Berlin Breweries (Schultheiß of Kreuzberg and Berliner Kindl of Neukölln) and those in the east (Berliner Bürgerbräu in Köpenick and Kindl II in Potsdam) was marked. The breweries in the west were modern and using good-quality materials whilst those

in the east were worn-out and using poor-quality materials. In the circumstances, it was of great credit to the East Berlin brewers that their beer tasted so good. I was particularly impressed by Herr Schmidt, Technical Director of Berliner Bürgerbräu. Before the fall of the Berlin Wall, all East German breweries were part of the VEB and owned by the state. In early 1990, Herr Schmidt declared independence on the state organisation and started to forge partnerships with western customers. As a consequence, he was summarily removed from his post just before our visit. However, he had the support of his workers, who went on strike to ensure that he was reinstated. As it happened, this was just in time for us to meet him. His vision was to make the brewery, the oldest in Berlin, 'the green brewery by the lake.' He had a long way to go as in 1990 the brewery boilers were still fired with brown coal, but I did find his vision appealing. It has recently been confirmed that 1990 annual output was 400,000 hectolitres, 80% of which were exported to 12 countries.¹

All four breweries that we visited are now closed. The magnificent brewhouse at Berliner Kindl of Neukölln survives as an

Arts Centre, but now looks dusty and unloved.² In 1999 work started on the superb Viktoria Quarter in Kreuzberg which incorporated Schultheiß historic buildings.³

So how did these closures come about?

In 1990, Schultheiß in Kreuzberg was owned by Brau und Brunnen. Following reunification, Brau und Brunnen bought the eastern Kindl breweries (Potsdam and Radeberger). So in 1993 both Schultheiß in Kreuzberg and a sister plant in Spandau were closed and production transferred to the east.⁴

The majority shareholding in Berliner Kindl had been purchased by the Oetker Gruppe in 1988. The remaining shares were acquired in 2002. Following the purchase of Radeberger Exportbierbrauerei in 1990, the beer division of the Oetker Gruppe was renamed the Radeberger Gruppe in 2002. In 2004 the Radeberger Gruppe acquired a majority shareholding in Brau und Brunnen; later minor shareholders were bought out and the Neukölln brewery ceased production in 2005.⁵

Kindl II in Potsdam, originally bought by Brau und Brunnen, was later sold to Oetker and closed on 31st December 2002 and production transferred to the former East Berlin Schultheiß brewery in Weißensee⁶ (which, of course, we had not visited) now part of the Radeberger Gruppe and renamed the Berliner-Kindl-Schultheiß-Brauerei.

After unification, the Treuhandanstalt was responsible for selling businesses previously owned by the VEB This trust sold Berliner Bürgerbräu to the Bavarian brewing family Häring in 1992. The Häring family owned Hofmark brewery in Cham, Bavaria. Production declined at Berliner Bürgerbräu Brauerei; eventually the bottling plant was closed and only the core brand, Berliner Bürgerbräu, was produced. In 2008 the Köpenick brewery was closed, and Bürgerbräu beer was contract brewed and bottled by Bauhaus Hartman in Saxony. Then, in early 2010, the trademark rights were bought by the Radeberger Gruppe. So some Bürgerbräu brands are now brewed alongside Kindl and Schultheiß ones at the Berliner-Kindl-Schultheiß-Brauerei. However, the Häring family, represented by Martina Häring, retained the Bürgerbräu site and buildings.⁷ A gastropub, Restaurant Bräustübl - Gastronauten mbH was opened on the site on 14th January 2011. The gastropub serves beer from its own microbrewery⁸ as well as Rotkehlchen (Robin beer), a Bürgerbräu brand now brewed at the Berliner-Kindl-Schultheiß-Brauerei.

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Acknowledgements

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Guild forges links with Berlin brewers

Introduction

The Guild visit to Berlin was the second foreign tour to take place since 1988. The twenty-one strong party consisted of eighteen brewers from a cross section of companies, two Allied Traders and the General Secretary. The visit took place over the period 23rd to 27th April, and although based in West Berlin, an equal amount of time was spent in both the West and the East.

The initial planning started in late 1988 when of course the Eastern bloc situation was very different. By the time the group had arrived, an amazing and unforeseen change had taken place. The Berlin Wall was virtually in pieces, travel between East and West was easier and most

important of all, the East Berliners were more relaxed and talkative. The last point proved to be very apparent during the visits.

The programme was designed to give an insight into the technical aspects of German brewing, their education and training, and a comparison between East and West. With this aim in mind, the General Secretary arranged visits to two breweries and the brewing university on each side of the border. This proved to be a good balance, the results of which are fully covered in the main part of this article.

As always with this type of visit, the hosts were extremely generous and ensured that the group were fed and refreshed at

frequent intervals. Each visit either ended with a tasting, started with a tasting, or as in most cases. started and ended with a tasting! The Berlin Braumeisters entertained the party on the second evening with a most enjoyable informal dinner. It provided the ideal relaxed forum for the exchange of views and ideas. In concluding this short introduction therefore, the President, Mr BB Awford, who lead the visit, would like to thank all our hosts in Berlin, members of the group and all the companies who supported the visit. It was a most successful, interesting and worthwhile visit, and greatly enjoyed by all who participated.

**Schultheiss Brewery, West Germany
23th April 1990**

Our first brewery visit, after arriving in Berlin on Monday morning was to Schultheiss, Kreuzberg brewery on Monday afternoon.

Schultheiss brewery was established in 1857 and is run as a cooperative with smaller breweries including Kreuzberg, Spandau and Heidelberg. The maltings are situated at Schonberg.

The specific plants concentrate production on particular products. Kreuzberg brews Pils, Premium beers, and soft drinks, Spandau Mainstream brands and



Figure 1. The yeast room at West Berlin's Schultheiss brewery.



Figure 2. Schultheiss brewery bottling plant.

Berliner Weisse, Heidelberg produces Weizen.

The capacity of Kreuzberg is 800,000 hls per annum, however expansion will increase this to 1.1 million hls pa.

Can sales are considered important in the Berlin market, 50 cl, 33 cl are produced with 51 at Kreuzberg.

The brewhouse was built by Steinecker in 1980 and modernised by Huppmann in 1989. Control is by two Siemens S32 computers which are due for replacement next year by Siemens S5. An infusion mash system is in operation using temperatures of 50, 64 and 72 degrees C. 13,000 kg malt produces 800 hl cold wort, currently six brews per day are pro-

duced, this will be increased to seven by tuning the brewing operation.

Liquor supply is from local borehole which is hard and contains high levels of Iron. Treatment is performed centrally to remove 50% of hardness and locally, according to need.

Wort boiling uses a low pressure system with heat recovery from the vapour to pre-heat sweet wort Savings of 50% of primary energy costs are claimed. Only German hops are used as extract, Premium beers use CO₂ extract.

A single stage chilled liquor wort cooler transfers the wort to the fermenting block which consists of 11,000 hls in open squares and 11,000 hls in conical vessels.



Figure 3. The brand new Till keg washer/racker at the Schultheiss brewery.

The beer is fermented with a flocculating strain of yeast and Krausened, at a ratio of 75:25, with a nonflocculating strain, CO₂ is collected from all conicals at a rate of 400 litres per hour. Conditioning time is approximately 4 weeks.

Filtration is via two 100 cm Seitz Orion filters running at 250 hls per hour. Oxygen, haze and CO₂ are measured in-line.

Weisse beer production is carried out in a completely separate area.

All pipework from conicals and to BBT's is solid, polished and with automated valves.

The existing bottling line has a capacity

of 80,000 bph and is run at 60,000 bph as this is the rating of the single bottle inspector. There is a new line capable of packaging a variety of bottle sizes and labels with H & K filler with direct modern link to H & K Dortmund for real time fault diagnosis, and a Krones inspector and labeller. Glideliners are used for pressure free combining, the noise level is extremely low.

Most qualities are tunnel pasteurised, Pils is flash pasteurised using micro-processor control to achieve +/- 2 pu's.

A Till rotary keg filler is being commissioned producing 300 x 50 litre kegs per hour with the capability of 600 kegs per hour of different sizes.

Gamma ray level detection system is used and labelling is done by ink jet, this is removed with 0.5% caustic.

After the tour of the brewery we were treated to some generous German hospitality consisting of product tasting and a 'traditional snack' of Ham shank (a whole one each!), Sauerkraut and Pease pudding. This really was welcome to Berlin!

Berliner Kindl Brauerei **24th April 1990**

Tuesday dawned, a grey day. The team assembled, on time, except for the General Secretary who had cleverly ensured a prompt start by instructing everyone to be in the hotel foyer half an hour before they needed to be.

The bus was loaded, groaning Brewers complaining that they did not want to see food again for three days. There followed what Bill Carling might describe as a 'pleasant' tour through Berlin suburbs until the Brewery suddenly appeared, with the Technical Director Herr Shrobbel waiting to greet the party.

Berliner Kindl was founded in 1872 and had initially been a cooperative of three breweries. Only one remains which now trades as a joint stock company. It was, for a time, the fourth largest brewery in Germany, producing 1,000,000 hls per annum, but difficult trading conditions saw this fall to 750,000 hls as the population emigrated and because the other German companies use Berlin as a test market causing intense competition for sales.

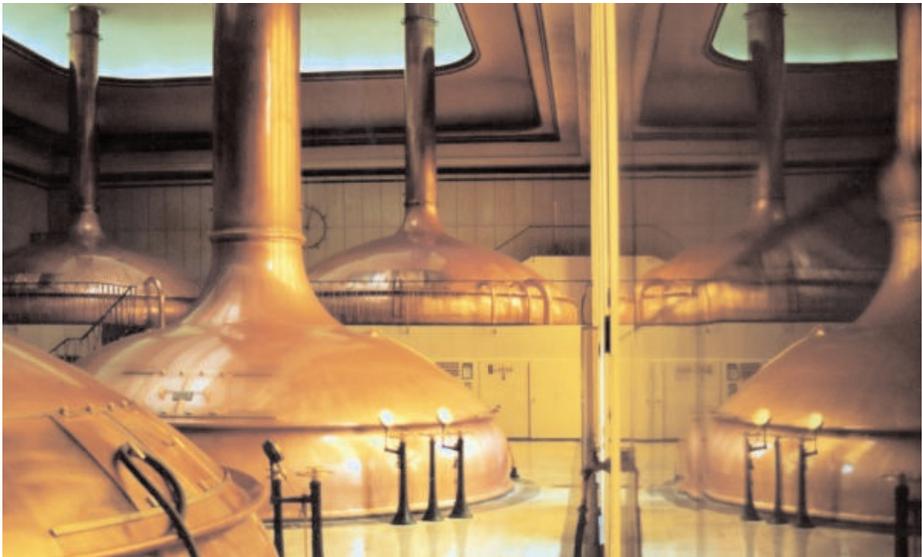


Figure 4. Berliner Kindl's extremely attractive and modernised brewhouse.



Figure 5. Cylindro-conical fermenting vessels at Berliner Kindl.

The Kindl trademark was adopted from Munich as the original intention was to produce a pilsner beer. Today there is a range of 9 products, the three of most significance being Pils (11.5°, 27 EBU); Premium (12.3°, 33 EBU) and Weisse (7.5°, 8 EBU) which is a lactic product. All are brewed to conform to the Reinheitsgebot regulations (naturally).

In 1945, the Russians removed the brewing plant as part of their War Reparations,

so in the early 1950's Steinecker installed one of the most attractive copper brew-houses I have seen. This was modernised by Huppmann in 1989 but the original vessel shells were retained maintaining the character of the plant. The effect is superb!

On average, 10 tonnes of malt are infusion mashed every 3 hours to give 600 hl of wort. It is a twin stream system so two lauter tuns are employed, the cop-

pers being low pressure units. A heat exchanger uses the vapour energy for raising the temperature of the worts during run off, 50% energy savings being claimed.

Liquor treatment takes place before mashing, strong anion/strong cation exchange being used. Iron is also quoted as a problem. Most cooling duties are performed by direct ammonia expansion except for the fermenters which are glycol jacketed. The boilers are coal fired, using a local equivalent of anthracite.

Fermentation vessels are either cylindrical or square and are a variety of ages and capacities. The yeast is

replaced after 5 re-plantings, primary fermentation lasting for 7 days at 14°C. One day is permitted for diacetyl reduction before Krausening at a 75:25 ratio. Weisse beer is fermented using a mixture of yeast strains and cultured lactobacillus. Separate pipework has been installed to prevent contamination of normal brewery worts. We were assured that great care was taken to ensure procedures in this area are followed.

Maturation takes place over a time span of 2-4 weeks, with stabilisation being achieved by storage at -1.5°C. The filter room is extremely modern, with block Kieselguhr and pvpp filtration equipment supplied by Filtrix. Deaerated liquor is



Figure 6. Berliner Kindl's bottling plant.



Figure 7. The Head Brewer of West Berlin's Kindl Brewery describes his brand new filler room.

used to purge the lines before and after beer transfer to prevent oxygen pick up, the standard for the polished lager being an impressive 0.1 ppm. Design standards are high, every pump in the filter stream having its inlet pressure controlled by plc to prevent unwanted fluctuations within the system.

The CIP set servicing this area is also brand new, using 1.5% acid at 65°C. It was commented that the high detergent temperature caused problems at commissioning because the vessels being washed went over pressure owing to gas expansion.

Two small pack lines are squeezed into the original bottling hall, producing a combined output of 60,000 bottles per hour of either beer or soft drinks. Flash pasteurisation and aseptic filling is employed. H & K fillers are installed with computer links direct to the manufacturers for fault finding. The lines are completed by Krones inspection and labelling equipment and Kaiser conveyors. Package sizes are 37 cl, 50 cl and a special 5l can, which is filled on a miniature cask racking line.

The Berlin Market is showing growth in the Keg beer segment, so the Brewery

has purchased a quantity of new 501 Stainless Steel Kegs These are filled at 360 kegs/hour by an Enzinger combined washing and racking system, which has six heads per lane. Container contents are 50.5 Kg. 8,000 m³ of warehouse storage is available to accommodate a total of 60 product lines.

Manning levels are 15 operatives from raw materials to BBT, 10 people on each of the small pack lines and 5 on each keg line. There are 18 maintenance personnel. The overall impression created is of an efficient mature brewery being given a new lease of life by the opportunity to expand into East Germany. Investment is very obvious and the local management team have a very positive approach to the opportunities which German Unification will create.

The finale of this visit was a trip to the sample room for some more excellent hospitality. Visitors are made to feel extremely welcome and I observed that most of the party had recovered sufficiently to enjoy the thoroughly excellent snack provided to compliment the equally excellent lager! The President impressed the assembly by making his thank you presentation in German, the sentiment being heartily endorsed by the Guild members.

**Versuchs und Lehranstalt für Brauerei in Berlin (VLB)
24th April 1990**

The VLB is primarily involved in teaching and research in the fields of brewing and fermentation. In addition, it had an expanding role in consultancy, analytical services and information database provi-

sion. The institution which was founded by brewery companies in 1883, retains such corporate membership as was possible after the partition of Germany, and hopes to re-establish links with breweries in the east in the coming months.

Three extended courses are held at VLB, leading to Diploma Engineer status in four and a half years, Diploma Brewmaster in two years or Brewmaster in 10 months. In each case, practical experience is part of the entry qualifications for the course.

There is an annual meeting in Berlin for several hundred delegates, on current scientific and technology issues. Other seminars and courses are organised throughout Germany on a regular basis.

Research activities range from raw materials through the brewing process to packaging materials and dispense. Professor Schildbach spent some time discussing the activities of VLB in new barley variety development, agricultural improvements geared towards environmentally friendly farming, research into the steeping process and showed the service available for testing of purity of barley varieties in a sample by gel electrophoresis and typing against a database of fingerprints.

As low pressure boiling and the use of hop extracts seemed so prevalent in Berlin brewhouses, it was no surprise to find research using a mass spectrometer to investigate wort and beer volatiles.

Much effort had been put into research geared towards defence of the Reinheitsgebot, by developing analytical techniques for the detection of colouring

agents, preservatives, head stabilisers and haze stabilisers, and immunological tests to detect the presence of non-barley cereals in grist.

Extensive equipment, either developed by VLB or brought in (often from the US) was in use for assessing packaging materials.

Three microbreweries from 6 litre to 100 litre batch sizes are operated.

An extensive library has been assembled in the years since the last war, when all previous publications were removed and disappeared. Electronic information database services are available, as well as the more usual books and journals.

VLB were complimentary about the international standing of the institutions at Weihenstephan and Nutfield, and see these three as centres of excellence co-operating and competing in service to the brewing industry worldwide.

Bürgerbräu, Frederikshagen **25th April 1990**

The fortuitous timing of this visit to an East German brewery emphasised the tremendous difficulties facing East German industry. The planned economy has historically led to a stagnation in technical development severe capital and maintenance cost restrictions, over-manning and problems with quality raw material availability. The determination of the technical director and his staff to overcome these difficulties and to see the November '89 changes as an opportunity to be grasped was clear in all aspects of the visit.

The Berliner Bürgerbräu itself is 126 years old and is the oldest established brewery in Berlin. It is idyllically situated by a lake and is located in a town first founded by Frederick the Great. The brewery started life as a privately owned company which later became owned by a cooperative of innkeepers in the Kopenick area of SE Berlin. In 1900 it produced 150K hl per year, today 450K hl per year. Ownership later transferred to the state and in 1959 as part of the planned economy, Bürgerbräu was 'federated' with Kindlbrauerei, Schulthelsbrauerei, Brauerei Boranquell and Engehardbrauerei to form the VEB. Three



Figure 8. Berliner Bürgerbräu.

months ago as a result of the November 1989 changes, Herr Schmidt, the Technical Director unilaterally declared independence from the VEB and has looked to forge partnerships in the West - he was immediately removed from his post but reinstated and allowed to follow this policy following a popular demonstration of support by the entire brewery.

Problems abound: environmental issues are well understood but capital to action changes is not available - black smoke pours from the boilerhouse chimney. Overmanning is appreciated as giving very low productivity and pay (average 850 DM/month - East German, currently equivalent to around £15.00/week). A five year plan to reduce headcount, as

far as possible by natural wastage, is under way and pay parity with the West is looked for within three years. Health and Safety standards and general site hygiene will be upgraded as the culture changes. Public relations requirements are being addressed with a super new reception room being built. Technical training of the brewing staff is thorough and to high standard with 4½ years being spent at the Humboldt University studying Brewing and Engineering e.g. Cornelia Borchers one of our hosts and Quality Assurance Manager for the brewery passed her Brewing Diploma and also spoke Russian, French and English as well as her native German.

Of the 450K hl per annum produced, 180 hls is draught, 180 hls bulk, sent out



Figure 9. Berliner Bürgerbräu process corridor.



Figure 10. Berliner Bürgerbräu cask racking cellar.

for packaging and 90K hls is bottled on site. (A significant volume of Brandenburger Pilsner for export to Tesco in the UK!).

Water for brewing is derived from their own wells but requires treatment for high iron content and hardness. A historical shortage of malt has led to the use of up to 60% barley in home beers, although Export beers are produced according to the Reinheitsgebot. 15% maize and 10% sugar was typically used in an East German produced Steinecker type brew-house, comprising 2 mash vessels, 2 lauters and one copper.

The hops used were East German, all pelletised but only aroma hops were inert gas flushed, none were vacuum packed. Although blending to give standardised addition occurred, there seemed little doubt that quality control of materials and aroma hop availability was a concern.

Primary fermentation (6°C pitching to 12°C maximum) was carried out in a mixture of open squares and conicals lasting for one week. Secondary fermentation at 1-2°C took place for 2-5 weeks dependent on product. The diacetyl level was typically reduced to a maximum of 150 ppb at commencement of lagering.



Figure 11. View of Lake Müggelsee from Berliner Bürgerbräu.

The casks used were fairly old and dented but had what appeared to be extremely effective rubber rolling rings.

The small bottling line (90K hls/annum) was a mixture of old and new, the filler being new (18,000 bph for 50 cl bottles) and a Krones Prontomatic being used to give the high quality dress needed for Export beers. It was clearly appreciated that package appearance in general needed to be upgraded to meet the needs of a free market-place.

In summary, this was a fascinating visit, seeing how brewery staff were rising to the challenge of financial constraints, raw material supply concerns and an impending market-place which will be much

more open. We must thank Herr Schmidt, Herr Kiechle and their Team for the open and honest debate of their problems and for giving such an insight into these rapidly changing times between East and West Europe.

The Humboldt University, East Berlin 25th April 1990

On Wednesday afternoon, the party visited the Humboldt University in East Berlin and was conducted round the Fermentation Section of the Faculty of Natural Sciences.

In cramped conditions below ground level, an enthusiastic team of researchers

operate a mini-brewery, producing about 20 litre batches. In an adjoining room they evaluate the products by drinking them!

We were invited to sample and discuss three of their beers ranging in alcohol content 1-5%. Maize adjuncts were used and authentic mini-lautering equipment was employed.

The beers were unpasteurised and drank cleanly and very easily.

An active discussion took place with continued sampling and a great deal of 'entente' was created with cards being exchanged. Our visit was very much appreciated.

Kindl Brewery 26th April 1990

Before November, beer production in East Berlin was owned by a co-operative operating from five breweries; Burgerbrau, Barenquell in South Berlin, Englehurst beside the Spree river, Schulthies the oldest and Kindl Brewery. Recently the Burgerbrau and Barenquell have decided to leave this organisation and look after their own affairs.

The co-operative are now anxious to improve their Breweries to enable them to compete with their Western competitors. They are hoping for a large amount of brand loyalty to see them through the difficult times ahead. They fear the



Figure 12. CIP at East Berlin's Kindl Brewery.

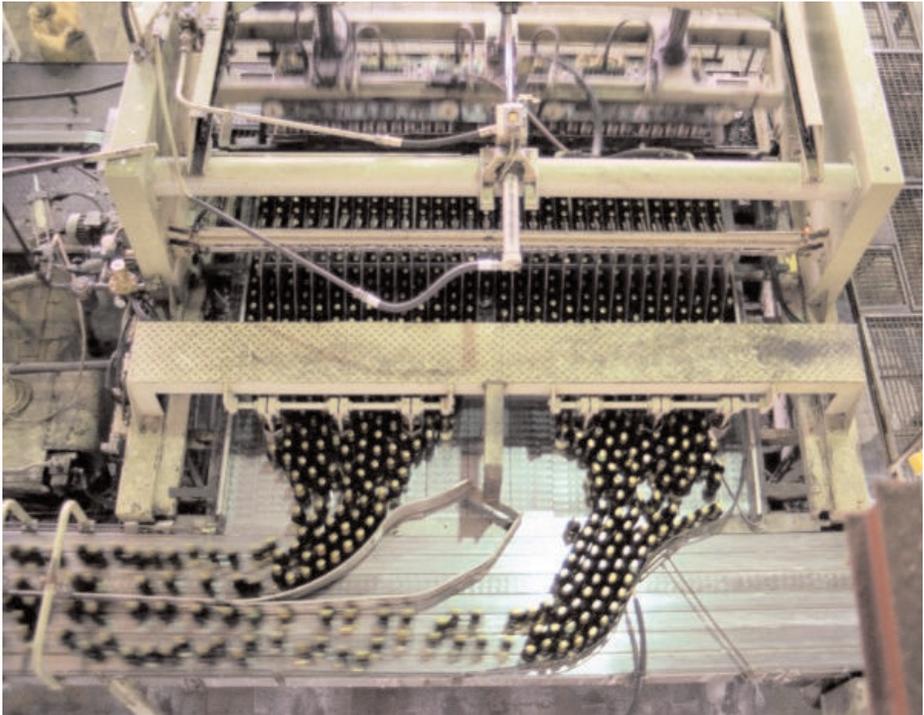


Figure 13. East Berlin Kindl bottling line.

resources and advertising expertise of West Germany, quality of product, presentation and incentive promotions enticing local business. In comparison, the presentation of their own products is poor, with low cost labelling of poor quality and scuffed mixed returnable bottles.

Similarly Kindl own the only soft drinks facility in East Berlin producing 1.5m hl pa The quality is poor by their own admission but significantly are entering negotiations with the Coca Cola Company.

Kindl Brewery is the largest in East Berlin employing 1000 people. They expect to

significantly reduce this number in the future. It has its own maltings producing 34,000 tonnes p.a. a part of which until now, had to be sent to other breweries.

Beer production in East Benin is 2 7m hl p.a. of which Kindl produces 1.2m hl, 1.0m bottle and 0.2m hl in tank.

There are 10 different qualities varying in strength from 8-16°P.

Deutches Pilsner is the mainstream beer for local trade and Berliner Pilsner (12°P) is the export quality, pasteurised in bottle for a 90 day shelf life. Other products

include. a light beer (8°P) named Hell, a diet beer and a Book beer (16°P) which is available as a light or dark brew.

One of the major problems concerns the availability of raw materials which is largely cost dependent. A normal grist would contain up to 60% barley but at present 75% malt, 25% maize is used due to a shortage of barley. (Current prices for barley - 900 EDM to 1400 EDM). There is a desire to move toward Rheinheitsgebot brewing in the future.

The water is supplied by their own bore-hole and contains 36° German hardness and high iron. The iron is removed and the water softened to 4° German hardness via anion and cation exchangers.

The Brewhouse was installed in 1974 by Ziemann, to produce 1000 hls per 3½ hrs, (7 brews/day). It consists of two mash vessels, one lauter tun, two under-backs, one copper and two whirlpools. Malt is wet milled there also being a dry mill for barley. The malt is mashed separately from the adjunct; and combined in later stages as shown in the mash programme (see below).

Mashing Programme

Maize	50°		
	v		
	64°		
	v	Malt	35°
	74°		v
	v		50°
	85° -----	> -----	v
			65° 80 mins
			v
			74° 70 mins
			v
			78° 15 mins
Tranfer to Lauter Tun		< -----	



Figure 14. Ad hoc brewery transport, East Berlin Kindl.

Enzymes are added to the mash to promote the conversion.

The target fermentability is 81-85%, and a mash pH 5.4. The mash programme would be reduced should raw materials improve.

The hops used are East European, pelletised and of poor visual quality. These are mixed with a proportion of methanol hop extract, slurried and pumped to the copper at the start of boil. The atmospheric copper is boiled for 90 minutes and hop utilisation in 25-30% to achieve target EBU of 26 in Pilsner, 30-33 in special beers. Copper fining is not used. Some vacuum packed hop pellets of superior quality are sometimes added to the Whirlpool for special beers.

There are two paraflows, one on-line whilst the other is being cleaned, Both are two stage units, using Brewing Liquor to cool to 20°C followed by brine to achieve 6-8°C. The wort is aerated man-

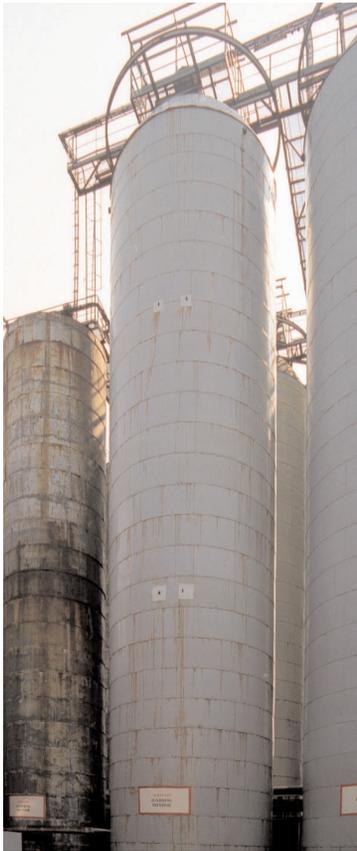


Figure 15. Reactors (dual purpose tanks), East Berlin Kindl.

usually during transfer to outdoor fermenting vessels, described as Reactors.

In all there are 30 Reactors (22 x 2,500 hl, 8 x 5,500 hl) giving a total capacity of 100,000 hl.

Typical dimensions of the smaller vessels are 3.6m Dia x 19m with a 60° cone angle.

The yeast is stored as a thick slurry, washed with phosphoric acid and used up to 100 generations. The wort is pitched at a rate of 1 l/hl. The primary fermentation takes 7 days, with a top heat of 12°C.

The Reactors are held under one atmosphere pressure and the carbon dioxide is collected for use at the soft drinks plant.

There follows a diacyl rest until the level falls below 0.2 ppm (target 0.1) and CO₂ is measured to meet the specification. The fermenter is then chilled through an external heat exchanger to 0-1°C over a period of 34 days. The yeast is allowed to sediment for a further 2 days before being skimmed. After a further 24 hours the beer is then filtered ready for packing.

The filtration area consists of plate and frame filters plus polishing filter, although this area was not shown. In all, the total process time is 14-21 days. The Reactors are given a vigorous clean as below:

Hot Caustic 80°C
Cold Nitric Acid
Rinse
Peracetic acid - final rinse

The bottling hall houses two lines, installed in 1971 by Holstein and Kappert, rated at 60,000 bph Each line has depalletising, decrating, bottle washing, two filters, several body labellers, recrating and palletising. There is a tunnel pasteuriser on the export line and a flash pasteuriser for local products on the other line. Bottle inspection is by manual sight screen. Generally the plant was in a poor state of repair and required close attendance as possibly indicated by the number of operators present.