

RIGHT: A view of Coors Shenandoah plant through the trees from the banks of the famous river.

Molson Coors new brew plant in Virginia, USA



Coors Brewing
Company

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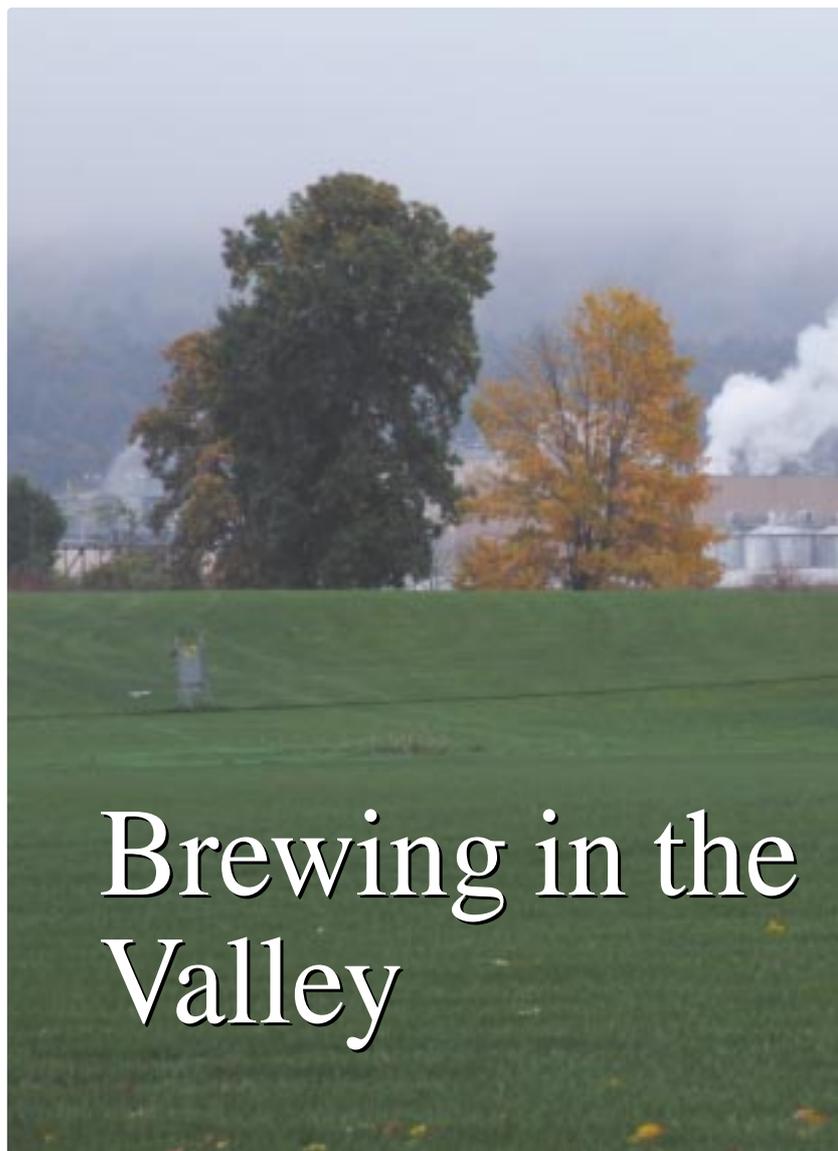
One thing which has always struck me whilst flying over the United States is how there can be miles and miles of 'not a lot' and then a concentration of steaming chimney stacks and then a lot more of 'not very much'. In Virginia's Shenandoah Valley I saw this industrial decentralisation in action again but this time at ground level in some beautiful countryside.

By Roger Putman

"Plans are in hand to test the feasibility of generating power from the biogas at the effluent plant or piping it all the way from the edge of the site to the boilers and whether the outflow water should be used by a nearby turf grower (sod man in the vernacular) or be exhaustively filtered for reuse by the brewery."

During the 1980s Bill Coors searched for a packaging plant location in the Eastern US and found land, labour, copious volumes of low-hardness water and a supportive local authority, in the form of Rockingham County officials, deep in the heart of Virginia. There was a rail link nearby so that the Norfolk and Southern Railroad could bring beer in from Coors plant in Golden, Colorado, some 1600 miles to the west. There was a natural gas pipeline already laid as Bill would have neighbours in this so called 'technology zone' in the form of pharma giant Merck, confectioners Hershey and Donnelly, a large printing works. He would however have to build his own effluent plant as Dupont managed to discharge mercury into the upstream Shenandoah River for decades before 1950 (even today a 125 miles stretch almost down to Washington DC remains contaminated) and the authorities are highly protective of this iconic stretch of water.

Battles of the American Civil War were fought along its length and a series of farmhouses are now preserved as the HQs of famous



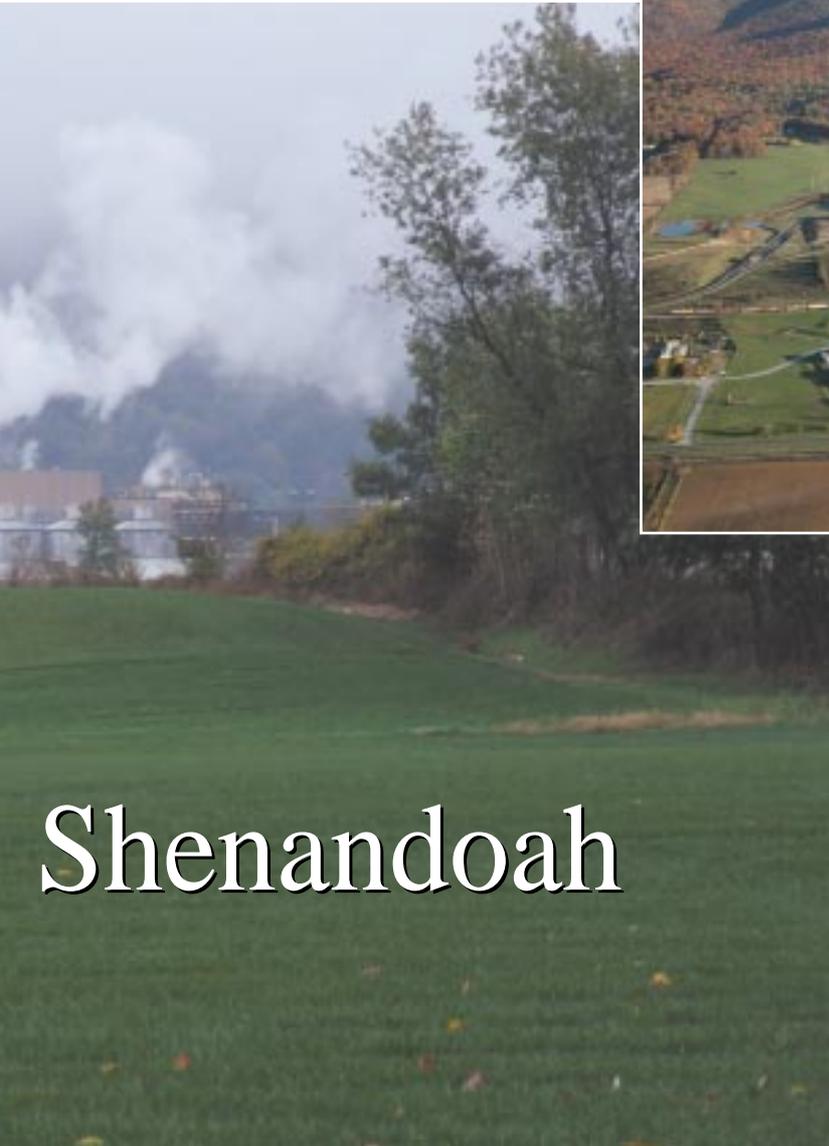
Brewing in the Valley

generals; this being Virginia, they are all Confederate ones! Mike Breedon who mows over 300 acres of grassland on behalf of Coors told me he had found cannon balls, bayonets and all sorts of other military artifacts over the years. Coors originally bought 2500 acres (some has since been sold off) which butted up against the tourist and hunter filled Shenandoah National Park with its famous Skyline Drive across the Blue Ridge Mountains of Virginia of lonesome pine fame. Towards the end of October, the trees were turning with some wonderful autumn colours but with two days of virtually continuous rain, I failed to see the full splendour of the hill tops and had to content myself with views of the road side through the spray.

From the comfort of VP and Shenandoah Plant Manager Tim

Williams' office, we discussed the recent expansion of the site, which started packaging operations in 1987 but now has America's newest big brewery added. But this remains a sensitive environmental area. With mysterious fish kill episodes still an ongoing problem, a Pure Water Forum has been formed – an assembly of industry and agriculture alongside community groups and the local James Madison University. The Forum operates a water monitoring system, advises farmers on pollution prevention and is fencing the river banks to keep cattle out of the water. Then there was a fun day last summer when everybody took to their boats and fished car tyres and other detritus out of the water. All this costs money and Coors currently provides around half of the funding.

The plant's anaerobic effluent



Shenandoah

facility currently uses the biogas to heat up the inflowing supply and the rest is flared off; wasteful but impressive in the darkness. Plans are in hand to test the feasibility of generating power from the biogas at the effluent plant or piping it all the way from the edge of the site to the boilers and whether the outflow water should be used by a nearby turf grower (sod man in the vernacular) or be exhaustively filtered for reuse by the brewery.

New brewery

Brewing started in March 2007 and Coors had just completed the biggest production week so far at just over 200,000hl or some 8mhl a year – not bad for less than eight months since the first mash and that is still only seven brews on each stream a day when the maximum possible might be 12 on each. Tim was looking at

the environmental impact of his increased operations. Over a huge aerial photo, he pointed out the scattered farmsteads and a lot of forest. He knew where the odd complaint had come from and precisely how to mitigate it. Traffic is an issue; for poor service and high costs now mean that less than 5% of output goes by rail when once it was over 20. Two enormous lorry parks with hundreds of trailers (refrigerated ones for the longer journeys) are testimony to these changes but the contractor has a lot of capital tied up in stationary kit! Truck movements have increased to around 1000 every week. Interstate 81 is a major north-south link in the US but plant traffic has to negotiate the 10-mile stretch from nearby Harrisonburg. Bottles come from O-I at Danville in Virginia about four hours away and also by road all the

way from the Rocky Mountain Bottle Co, a Coors JV back in Golden, cans come mainly from Ball at Walkill in New York State some five hours away as well as Rocky Mountain Metal Containers (another JV), crowns come from Fabrica in Mexico, labels from Golden and board from the many plants of Temple Inland. The plant is virtually wall to wall Coors Light with 40% liquid adjunct in the grist so Cargill deliver up to seven 25-tonne road tankers each day and the plant uses so much AMG that, it too comes in by road tanker. So rail is only used for a few beer tanks a month of Killian's Red, break bulk packaged goods from Golden and malt. This arrives from the 200,000 ton maltings in Golden in three-section 82.5-ton cars and there are 90 of them, all brand new. It takes three cars to fill a malt silo which lasts the brewery a day so present traffic is in the order of 20 wagons a week.

Rail tankers

While it might be Williams's mission to produce so much that the transfer of beer from Golden by rail becomes superfluous, Coors has a sophisticated method of achieving it. There is a 380-strong fleet of Coors-designed 660bbl (774hl) bogie tankers. The stainless shell is covered with 0.3m of insulation so that there is only 1°C temperature pick up on a journey which might take ten days (the fastest is six). They are cleaned at the Colorado end and after ten journeys they are passivated again such is the fear of iron pick-up on a delicately flavoured beer. The wagons are not badged for obvious reasons. These tanks were the lifeblood of the plant

An aerial view of the site showing the wooded National Park to the rear, next to the trailer park in the foreground is the packaging building, then maturation and utilities with the brewhouse to the rear before more trailer parks.

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Malt handling



ABOVE: The eight malt bins and three dust extraction streams.

RIGHT: I hope you will forgive your Editor for not climbing these steps in the pouring rain. At the landing by the top of the grey building on the right is a model of a hawk to keep pigeons at bay (inset).



LEFT: One of Coors' new 82.5 ton malt rail wagons in the unloading building

BELOW: Beneath the chisel bottomed grist cases.



when it was a blending, finishing, packaging and distribution site but with the recent announcement of the MillerCoors JV, I reckon that they may yet find a continuing role for end-to-end costing of the supply chain to the customer is essential in such a vast country with huge distances to cover and eight large US breweries to do it from.

Readers should remember that it is not too long ago that Coors broke out of its Colorado homeland to gain its current status as the nation's third biggest brewer. It picked up the old Schlitz Brewery in Memphis, Tennessee as recently as 1990 to add to its Shenandoah

packaging operation, a good deal closer to the east coast market than Colorado. The 5m-bbl Memphis plant was the first casualty of the 2005 formation of Molson Coors when the company looked to optimise brewing and packaging operations in the US and Canada and leverage the facilities' proximity to customers while reducing related distribution and overhead costs. It closed a few months before Shenandoah came on stream.

There are some 450 employees on site with another 50 seasonal part timers. Remarkably, the extra brewing added only 12 staff to the

payroll. All live within a 30 mile distance from work and both brewing and packaging operate 24/7 on a four-shift system. The brewhouse project cost in the region of \$300 million and that rises to \$400m if you include the new can and bottle lines installed a little earlier. There are two bottle lines, three for cans and a keg line.

Brewhouse by Briggs

Coors scoured the world for modern brewhouse installations, liked what Briggs had built for Fosters in Queensland and partnered with the Burton-based firm on the build the

In the bottom floor of the brewhouse



One of the mash vessels. Note the 18" diameter mash main to the lauter on the right.



ABOVE: Dosing calcium chloride from big bags...

BELOW: AMG is metered from bulk storage tanks and...



ABOVE: ...beta glucanase from transitanks.



Beneath one of the 42-ft diameter lauter tuns.



An Emerson Micromotion coriolis effect in line density meter checks gravity on the flow from the lauter tun.



The team control room beside the yeast area at the end of the brewhouse.

Shenandoah brewery. The project was sub-contracted via a US-based project management group who were responsible for dealing with the client. Many would not consider this the best approach as it adds complexity to the project and can expose interfaces like “who was supposed to arrange the CO₂ recovery line CIP?” yet it must be said that the strategy did result in the completion of one of the world’s most modern breweries. More and more these days Briggs is leading on the project implementation front rather than straight metal bashing. This venture was no different with Briggs being far from a straight installer of equipment. It designed the entire plant from the malt intake to the feed off the Profi filters into BBT, it designed all the automation (with a massive 3000 page functional design specification) and at the end of the job gave all the plant process guarantees to Coors on turnround, clarity, extract etc.

The vessel shells were made in Missouri by Mueller, while only the hydrocyclone premash The vessel shells were made in Missouri by Mueller, while only the hydrocyclone premashers, mash tun agitators, lauter gear, drives and false bottoms as well as the external thermosiphon wort boilers and trub removal devices came from the UK. The brewlength is 1000bbl (1170hl) collected at 16.8°P, there are twin streams with four vessels in each; a mash conversion vessel, 12.8m diameter lauter tun and two copper/whirlpools. These feed 40x3000bbl fermenters by Ziemann which then transfer beer to 12 existing 5500bbl sloping bottom maturation tanks and eight outside 5500bbl BBTs.

Planning begins

Planning started at the end of 2003, work on site commenced in April 2005 and peaked with over 1000 contractors. Coors has chosen to put the new brewhouse into an industrial building so there is no long view of the stainless vessels but it is impressive nonetheless for its sheer size and the complexity of the pipe routing. It is very like Fosters at Yatala (*Brewer & Distiller International*, Oct 2006) but without the ‘upstairs’. At Shenandoah access to the vessels is on open grid plate and the ceiling is not high enough to allow a good sightline from end to end across the tops of

the vessels.

There are 18 local operator terminals out on the new plant, some where lab instruments are situated, are cunningly protected by what looks like a hog roast barbecue cover. This arrangement allows the use of desk top equipment without the need for expensive waterproofing. Coors pondered whether to have the production team roving around the plant using only the local terminals but in the end decided that they would work more effectively from a base in the form of a large central control room with the lab attached. During my visit with the hardware operating satisfactorily, attention had moved to ironing out all the software issues, finalising routine maintenance, introducing 5S housekeeping standards and looking at how the two operators each on malt/brewing, FVs/yeast and maturation/filtration/ finishing could become more interchangeable and effective as eight months of intensive commissioning had built some ‘walls’ which had to come down! Operators are 90% self sufficient for lab analyses with QC staff in charge of calibration, auditing and the speciality stuff. The software in use is Emerson Delta V running the plant with some 18,000 I/O points in the brewery adding to 7,000 more already existing in the packaging department. Profibrew MES from Proficiency sits above that and SAP is running the whole enterprise. There are several ‘quality gates’ which require operator input before the automation takes over, these include – an iodine test before transfer from mash tun, yeast viability before pitching, VDK check before FV cooling on and a blending/taste acceptance in BBT before packaging. Full taste-training for operators to check beers before moving through the upstream process is underway. The self-led teams were recruited from existing blending staff so they need to learn the basics of brewing science quickly. To this end nine will sit the IBD General Certificate in May this year and the rest in November. Full support would then be given to anyone wanting to go on for the Diploma. Process Ops Director Andy Pickerell thought that once the quality technicians and his utility guys were put through the GCB as well that he would have the

Beside the vessels



Two of the copper/whirlpools from the working level.

Some evidence that the brewhouse is by Briggs and the shells by Mueller.



The hydro cyclone premasher swirls hot liquor into the grist to ensure good mixing.



High in the roof on the way to the top of the conical FVs gives you the best view of the plant layout. You can see three coppers, two lauter tuns but the mash vessels are hidden in the distance.



LEFT: Looking down on to one of the thermosiphon external wort boilers.

FAR LEFT: An operator's work station.

Fermentation at Shenandoah



A view down the lower fermenting room corridor; there are 20 3000bbl vessels outside on the left and 20 more on the right.



ABOVE: A very neat arrangement at the top of an FV contained in a small hinged housing.



ABOVE LEFT: The cones and mains are in the open.

LEFT: Conical FVs, a malt car and a cloud topped wooded hillside of the Blue Ridge Mountains.



BELOW: A view of the two stage propagator with 20 and 200 bbl working lengths.



“Although 72 brews a week for 50 weeks of the year will match existing packaging and FV capability, work on tuning times and temperatures was underway with a view to ensuring that brewhouse could reach the plant’s full designed potential of ten brews on each stream per day or 10 million barrels a year.”

best-qualified brew team anywhere in the world. This is good news for Coors and good news for the Institute.

No water treatment

The water source is on site and the 100-metre-deep bores reach two aquifers. One passing through limestone is slightly harder than the other. This is used for brewing and it receives no further treatment whatsoever with burtonising salts (CaCl_2) being added to the mash tun. Water for final rinsing is ozonated and dilution obviously deaerated but otherwise no liquor treatment is needed at all. Two 3000bbl cold liquor tanks sit outside with another two chilled to 4.5°C for wort cooling and two more at 85°C to receive the wort heat exchanger output.

Cargill drivers off-load liquid adjunct into four external 110-ton heated tanks as do bulk detergent deliverers and yeast/grain contractors fill their own trailers. The spent grain co-product is used by the local farmers but the yeast is used to soup up the protein content of pet food.

Pale malt is from a Coors proprietary two-row Moravian pedigree barley grown under contract. A malt car takes 90 minutes to unload the 82.5 tons with all three compartments open at once. The operator will sample the load from above and inspect it for

taints before starting the drag conveyor. Dust is aspirated as normal, magnets are in line just in case and the load is weighed into silo to cross check with dispatch figures. There are eight external 240 ton malt silos with conical bottoms hidden away inside bottom shrouds. On the way to the brewhouse, there is a Buhler combi cleaner, which Coors are particularly impressed with and a six roller Buhler dry mill on each stream. The chisel bottomed grist bins are on load cells to control the progress of milling.

The brewing process

Mashing in of 16.8 tonnes of malt takes just 10 minutes and starts at 50°C, is raised to 60°C for AMG addition and then 63°C for saccharification. The mash is then raised to 76°C for transfer to the lauter tun via 0.5m diameter mains for large volume but low velocity movement to two inlet points in the vessel floor. Transfer takes just 12 minutes followed by five minutes of recirculation. With four arms and only a 130kg/m² (12–14-inch bed) loading, run off takes 100 minutes. Extracts are upwards of 98%. Graining by opening two bomb doors to two dump tanks below each vessel takes another 15 minutes and the lauter is ready for reuse on a three hour cycle. Each copper/whirlpool turns around in four hours as there is no prerun tank. The thermosiphon external wort

boilers deliver wort back tangentially. The temperatures at the heating surface of the Briggs system means that fouling is reduced and a clean every 33 brews is sufficient to maintain effective heat transfer. Hop extract is pumped from a heated Decker cabinet where ‘Pike’ blend at 40% iso alpha acid is held at 56°C. The hops are added 15 minutes into the 75 minute boil. The syrup is added at the end of the boil with a tiny dose of ZnSO_4 . 15 minutes whirlpool stand is sufficient to control DMS at some 30ppb, a key flavour component in Coors Light, and matching with Golden where the brewery is 1700m above sea level has not been without its problems. Wort runs from three outlet points for cooling and the trub is scoured by jets from the slightly sloping vessel base and returned via two 30bbl trub tanks to the lauter just before graining. Each stream has a 1160bbl per hour wort chiller and three brews are collected at incrementing temperatures.

Although 72 brews a week for 50 weeks of the year will match existing packaging and FV capability, work on tuning times and temperatures was underway with a view to ensuring that brewhouse could reach the plant’s full designed potential of ten brews on each stream per day or 10 million barrels a year – but early work suggests that a two hour cycle and 24 brews a day would be entirely achievable with

more capacity downstream.

FVs from Ziemann

There are currently forty 3000bbl FVs from Ziemann in four lines of ten with two ring mains linking pairs of lines together. The vessel cones are not enclosed which means the ammonia valves are all open to the elements and the inlet/outlet lines need to be trace heated to prevent freezing up in winter. The two looped pipelines are housed in a central working corridor – “building the car around the driver” as described by Fermentation Manager Mike Ouderkirk seemed to sum up the design concept admirably. The saga of getting forty 6.5m diameter vessels to their final working point in Virginia was a considerable headache for the project team. The vessels were delivered in three lots up the James River to a place called Rappahannock some 109 miles from the brewery. With all 40 in a field by the river, movement of a convoy of three or four of them at a time with a police escort took almost five weeks to complete. The convoys had to avoid driving during school bus times and with a local maximum headroom of only just over five metres, it was easier to come across the top of the



The Pall Profi membrane filtration system with the inset showing a spare cartridge end on.

mountains rather than negotiate towns by going around them. An interesting logistical exercise which will have to be repeated when the plant expands further.

The FV cycle is 11 days. Yeast is cropped at the start of the VDK rest to one of four 140bbl collection tanks. Culture streams are managed for up to eight generations and excess is diverted to two 220bbl

waste tanks for disposal. Aber Instruments cell counters in the pitching lines were in the process of commissioning. A yeast propagation is undertaken every week with a slope arriving from Golden. A series of 100ml flasks is grown up for 24 hours and are then inoculated with 3 litres of cold wort direct from the heat exchanger into a large sterile plastic bag complete

Shenandoah People



Process Ops Director Andy Pickerell and a sample of high plains malted barley.



LEFT: Brewhouse Manager Walter Heeb demonstrates the water protection (inset) on a work station.



Fermenting Manager Mike Ouderkirk and the FV sampling ports in the fermenting lower corridor.



Process Engineer Monika Hayward checks the clarity off the Profi filter.



Microbiologist Brian Jackson prepares a 25-litre plastic bag for a lab yeast propagation stage.



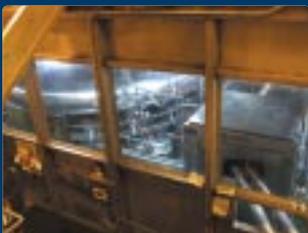
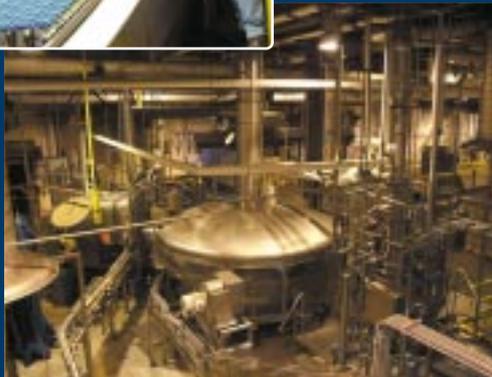
ABOVE: Warehouse Manager Walt Wright proudly shows off his copper kettle award which he received in 2000 for ‘outstanding leadership’.

Packaging at Shenandoah

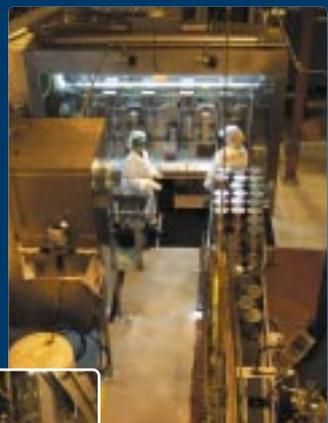


Cans coming in. Note the use of a blue lacquer to promote the claim of a 'frost brewed liner'

A 120 head H&K can filler with a shroud which looks like a brew kettle.



A cell containing a 160 head 2200cpm KHS filler.



ABOVE: Filling party cans.



LEFT: The original eight-lane keg racker dates from 1987.

RIGHT: A rotary Global Packer placing bottles into cases.



BELOW: The Rolco carton accumulator.

BELOW RIGHT: Bottles and bottles everywhere.



with injection and sampling tubes. The bag sits on a rocking tray and two of them are grown up together. After another day, the bag is topped up to 25 litres and a day later you have 50 litres at a cell count of 180×10^6 . This is pitched into 13bbl of wort at 25°C in a 20-bbl first-stage propagator for 24 hours and then moved to the 200bbl vessel with the balance of the volume. After only six days from the first slope, there is enough yeast to pitch 2000bbl at 10×10^6 cells per ml. This fermentation shoots off and there is no need to blend away the produce. The bag costs several hundred dollars but the assurance it gives to the operation is tremendous. That's the way to manage a yeast propagation!

Maturation is unremarkable except perhaps for the relatively small volume (66,000bbl) compared to the brewery upstream and packaging downstream. There is only time for three days at -1°C followed by rough centrifugation and into the 250bbl inlet buffer tank for GEA Westfalia Pall Profi kieselguhr free filtration. There are two 4800rpm centrifuges to feed two lines comprising four blocks of 20 membrane housings. Each line will handle 600bbl per hour and the trim chillers lie unused. Beer is diluted with deaerated liquor at almost one water to one volume of beer with DAL produced by a 10m tall ambient vacuum-packed column which gives liquor at below 40ppb O_2 . Most BBTs analyse at around 40ppb with a top spec of 100.

Beer is then sterile-filtered through 100cm sterilising sheets and is fed into one of the three 200mm ring-mains flowing at 1000bbl per hour which supply packaging with up to three fillers coupled up to each loop. Two ring-mains will be in use at any one time with the third being used in the blending area CIP sequences. Interestingly there was a three-head IDD keg machine in the filtration area crewed by temporary staff working for the process area. This fills 95 sixth-barrel (20litre) tall kegs an hour. Usually Killian's Red (from Colorado by rail tanker) in a marketing ploy for these tiny kegs will fit snugly between the usual half barrels in an under-bar refrigerated cabinet. Coors get another tap on the bar without having to provide its own space for it!

Packaging planning

The brewhouse only mashes Coors Light. Two percent of output is budget brand Keystone Light. Add a smidge of Killian's brewed at Golden and you would think that the planner at Shenandoah would have little to do. You would of course be wrong for there are 45 SKUs to manage. Coors prides itself on being responsive to changed orders and with on-site storage space for just over 5000 pallets, operations have to be slick with the six lines running simultaneously for 4.5 days or six at peak. Some 85% of output goes straight to the seven rail or 33 road vehicle docks. All finished beer used to be placed on metal slip sheets using special fork-lift trucks to pull the load on to a tray instead of forklifts and then push it off again but now Coors is moving to plastic pallets. However, beer destined for rail dispatch in low-headroom wagons will remain on slip sheets as a pallet beneath would rob each lift of a layer. This doubles the number of associated SKUs. So keeping a crew of 140 occupied and managing asset care as well as maintaining customer satisfaction can be taxing for the planners.

There is line sequencing to cope with the darker Killian's, a sterilise between Coors Light and Keystone, line cleaning depending on micro performance but normally keging every 96 hours and smallpack after 120 hours. Then there is export to Puerto Rico. This is a 'commonwealth' under US jurisdiction and the next island down the Greater Antilles close to Hispanola which is in turn next to Cuba.

There is large military presence with thirsty troops and a thriving tourist industry with cruise ships calling at the rate of several a day. This adds up to a 2 million barrel market for Coors through its largest beer distributor. With a small island mentality, things have got to be 'just right' so this beer is flash pasteurised before packaging and the containers pass through the warmed pasteuriser to ensure they are dry before packing; home sale products rely on air knives! Refrigerated ISO containers are taken to Jacksonville in Florida for the final 1100 miles to the Caribbean.

The packaging hall is as impressive as the brewhouse with the usual complex of conveyor

Into the warehouse



Each pallet is labelled after stretchwrapping.



Loads are placed on metal slip sheets...



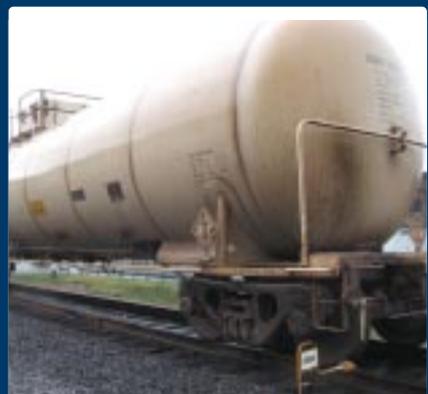
This truck attachment will drag the slip sheet on to the tray and push it off at the end of the journey.



The rather gloomy inside of rail car showing four pallets on slip sheets and a sturdy cardboard support spacer to prevent any movement.



Coors has its own locomotive for moving cars around the site.



660 bbl rail tankers which have brought beer all the way from Golden in Colorado, some 1600 miles away.

systems connecting materials in to finished packs out to the palletisers. Two 120 head H&K can fillers (1800cpm) have top shrouds which make them look like brew kettles and the third can filler, a 160 spout machine by KHS in an enclosed cell will fill up to 2200 12oz (355ml) cans a minute. Two can fillers remain on the 12oz size while the third has the changeovers for 10oz, 16oz and different-sized ends. Can collations are many – up to the monster 48-pack for the US Forces abroad.

The two bottling lines with KHS fillers operate at 1000–1200 bpm. There are two rotary Hartness ten station Global Packers on each line which can fill up to 65 cases a minute and a useful looking carton magazine from Rolco which hoists 280 erected boxes upwards until needed to provide buffer storage.

The original eight-lane keg racker will fill half- and quarter-barrels at 500 pieces per hour. Stuck in the middle of all this was a gang wearing white coats and hair nets filling five-litre Huber party cans which is a popular size for promotion of the National Football League.

Warehouse Manager Walt Wright reckoned that he had about a quarter of the space available compared to other distribution centres with similar throughput. The five smallpack lines feed a separate bank of eight Alvey palletisers close to the warehouse entry where all lifts are bar-coded for the warehouse management software as well as the final customer after stretchwrapping and a fleet of 48 trucks whisk the finished pallets away. ■



Many readers will recognise Shenandoah Plant Manager Tim Williams as he seems to have been just about everywhere! Australian born, he was due to study optometry at university but he was side tracked into the micro-brewing fraternity. He brewed at the Loaded Dog brewpub in Melbourne and then the 100hl Redback plant for Matilda Bay before it was part of Fosters. He qualified at Ballarat and took off for Bass in Burton on Trent for a six-month spell and then on to BRi in 1992 under Alistair McLay. With his AME and DME under his belt it was off to SAB in South Africa, Hungary, Russia and India. In between the last two he went back to college aged 32 and got an MBA. He joined Coors at Golden in 2004.

(Photo: Tommy Thompson)