

THE SWAN BREWERY: WATER AND ENERGY EFFICIENCY

The Swan Brewery has a long-standing commitment to environmental responsibility. As a major user of water and energy, and producer of waste and wastewater, it has implemented a number of cleaner production and other initiatives to improve its environmental and business performance. These have resulted in significant savings.

Background

The Swan Brewery has been in operation at its Canning Vale site in Western Australia, since 1979. The company was originally founded in 1857 and became part of the Lion-Nathan Group in 1992. Swan's strategy is to continue producing high quality beers for the Western Australian markets. The brewery's commitment to quality includes the use of premium local ingredients such as Stirling variety barley, speciality yeast strains and Australian hops.

The brewery is a major producer in WA with a capacity of 300 million litres per year in packaged and bulk form. The equivalent of 750,000 cans leaves the brewery every day. Brewing is an important industry in Western Australia, supporting over 15,000 jobs. 200 people are employed at the Swan Brewery itself.

Swan has a long-standing commitment to environmental responsibility and has implemented an environmental management system. It has also signed up to the Greenhouse Challenge.



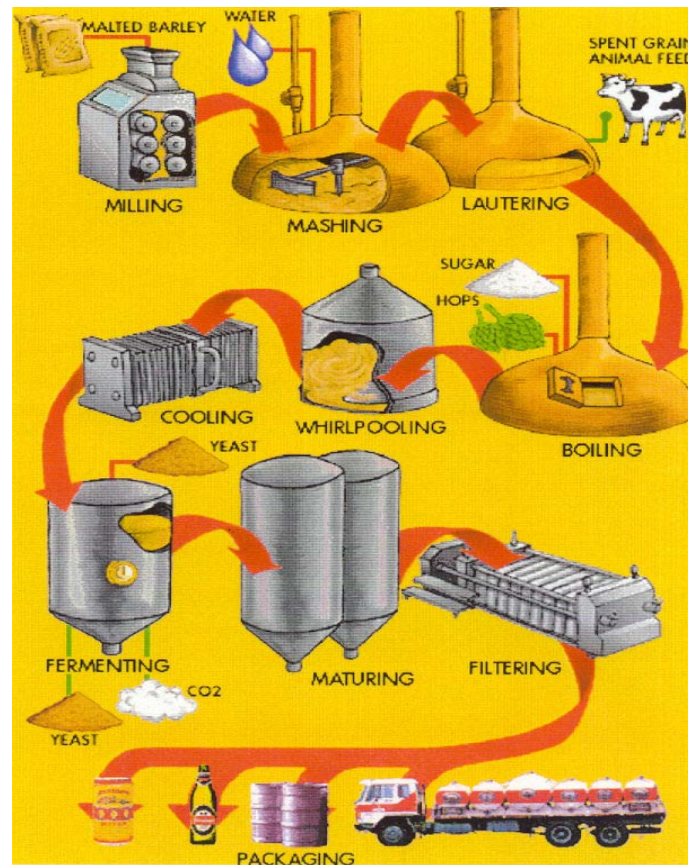
General view of the Swan Brewery site

The Process

The brewing process is shown in the flow chart below:

- *Milling*: Malted barley is stored in silos prior to being conveyed to the brewhouse, where it is weighed according to the recipe required and then lightly crushed into 'grist'.

- *Mashing:* The grist is mixed with water to form a mash which is carefully heated and agitated in the mash tun. Under controlled temperatures the natural enzymes begin converting the insoluble starches and proteins into soluble malt extract known as the wort, which contains fermentable sugars including maltose.
- *Filtering:* The mash filter is a large plate and frame filter where the dissolved sugars of the wort are separated from the spent grain, which mainly consists of the malt husks. After filtering, the grain is sparged, or rinsed, with hot water to wash out the residual wort. The Swan Brewery sells the spent grain from filtering to farmers as animal feed (mostly for dairy and pig farms), together with the protein-rich trub from the boiling process.



Source: Lion Nathan

Process flow chart

- *Boiling:* Once the wort is separated from the husks, it is transferred to the wort kettle to be boiled. This process develops colour and flavour. Boiling helps extract the bitter and aroma substances from the hops, which are introduced at this stage together with the sugar. The boiling also sterilises the wort and inactivates the malt enzymes, prior to the introduction of the yeast in the next stage. Cane sugar is added in syrup form during the boiling stage to provide a ready source of fermentable sugars for the yeast to turn into alcohol. This sugar supplements the maltose (malt sugar) produced during the mashing stage.
- *Whirlpooling:* After boiling, the wort is transferred to the whirlpool to remove solids known as trub. This includes the hop residues and some protein material from the malt.

- *Cooling:* After whirlpooling the wort is cooled to about 10°C, ready for fermentation.
- *Fermentation:* In the fermentation process yeasts (microscopic single-celled organisms) convert sugar into alcohol and carbon dioxide. At the Swan Brewery only lager yeasts are used. These are heavier than the surrounding beer, and so sink to the bottom of the fermenting vessel when fermentation is complete (as compared to ale yeasts which rise to the top). Strict quality control is used to ensure strain purity and freedom from wild yeasts which can gain entry to beer by contact with unclean equipment, and impair the flavour of the product. This is why good hygiene is necessary in brewing and dispensing.

Air and yeast are added to the cooled wort in the fermenting vessel. The air provides oxygen to the yeast to ensure a vigorous start to fermentation - a process which converts the dissolved sugars into alcohol and carbon dioxide. Once the fermentable sugars have been converted, the process stops by itself - it has 'run out of fuel'. This process usually takes about 4 or 5 days. Once fermentation is complete, most of the yeast sinks to the bottom of the fermenting vessel and it is removed by pumping it away from the bottom of the cone at the base of the vessel.

- *Maturation:* This stage involves the raw beer, sometimes referred to as green beer, being stored in 'lagering' tanks at or slightly below 0°C for 6 to 10 days. This allows the flavours produced during fermentation to harmonise to produce a balanced flavour profile. It enhances shelf life by precipitation, or settling, of protein material. The cold temperatures also lock in the carbon dioxide that gives the effervescence.
- *Filtration:* The hazy storage beer from the lagering tanks is filtered through a fine (diatomaceous) earth filter to remove yeast residue and haze particles. At this stage, the carbonation is also fine-tuned, using the carbon dioxide saved from the fermenting stage. The level of carbonation must meet strict specifications which vary from beer to beer, and whether the product is to be packaged or kegged. The beer that comes out of the filtration process is called bright beer, because this sparkling clear beer can now be seen through.
- *Packaging:* Packaging is a critical quality control point. Bright beer is held until all the final quality control and flavour checks have been made. Oxygen contact is minimised during filling to help ensure a fresh taste and long shelf life. Pasteurisation can then occur to ensure the microbiological integrity of the package. Using advanced technology, the beer is kegged, bottled or canned, labelled and then packed. Cans and stubby bottles are shrink-wrapped or basket-packed into six-packs prior to being put into cartons. Cartons are then stacked onto pallets, ready for the trucks to transport them.

Cleaner Production Initiatives

Cleaner production and other environmental initiatives include the following:

Water use and recycling

Brewing is a heavy user of water – about 7 litres are required for every litre of beer. Water conservation is therefore a priority, especially in view of the drought situation in Western Australia.

Process water is treated by reverse osmosis to remove impurities and ensure a consistent quality.



Reverse osmosis treatment plant

Use is controlled through process control, preventative maintenance programs to minimise leaks and housekeeping practices to avoid unnecessary use eg minimum hosing.

A new water recycling system has been installed and was commissioned in August 2001. In this system water is recovered from various processes or units, stored and distributed to non-product services.

Water is presently recovered from the following sources: the gravity can rinser, refrigerative coolers defrost water and carbon dioxide purifiers cooling water. The main reuse is in the evaporative condensers and in cooling tower make-up water.

About 300kL a year of rainwater is also collected from certain roofs.



Condenser units



Water collection from roofs

Energy use

Various energy saving initiatives have been implemented, including:

- Basic housekeeping measures such as turning off lights and equipment where not needed. An energy management system has been installed for controlling lighting and temperature.
- Insulating pipes and equipment.
- Preventative maintenance eg checking for compressed air leaks.
- Ongoing review of the energy efficiency of processes and equipment.

Following a recent energy review the following initiatives will be implemented:

- Installing a variable speed drive to the motor at the wastewater treatment plant.
- Running a smaller air compressor at weekends to cater for times of low demand.

Process waste

Process and other waste is recycled wherever possible:

- Spent grain from lautering is sold to farmers for cattle feed.
- CO₂ is collected from the finished beer (ready for packaging) tanks to prevent CO₂ venting to atmosphere.
- Spent yeast is sold to farmers as pig feed.
- All canning and glass waste is recycled.

Waste water

All process wastewater is treated at an on-site effluent treatment plant. The water is re-used for watering the site's lawns and gardens and the solid waste is sold for fertiliser.



Wastewater treatment plant

Benefits

Water recycling is saving approximately 60,000 kL a year. Besides savings in water costs this is expected to achieve a 10% saving in wastewater treatment amounting to the equivalent of 500 tonnes per annum in CO₂ emissions.

Approximately 83 tonnes a year of CO₂ are expected to be collected from the finished beer tanks.

The variable speed drive motors are expected to reduce annual electricity demand by 220,000 kw hrs, equivalent to 230 tonnes of CO₂ per annum.

The use of a smaller air compressor at periods of low demand is expected to reduce annual electricity demand by 150,000 kwh, equivalent to 165 tonnes of CO₂ per annum.

Further developments

Cleaner production options continue to be considered as part Swan's commitment to continual improvement.

Options being considered include:

- Recovering waste heat from compressors via heat exchangers.
- Sand filtration to allow water from the effluent treatment plant to be used for non-product purposes.
- Co-generation of electricity and steam.
- Power factor alterations.
- Use of solar energy (to keep water hot rather than for steam).

Contact

Trisha Nelson
Brewing Engineer
The Swan Brewery Company Pty Limited
25 Baile Rd
Canning Vale
WA 6155
Tel: 08 9350 0222
Fax 08 9455 1138
Email trisha.nelson@lion-nathan.com.au

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