

Ethanol Production Plant Description

Summary

During COVID, a Perth Brewery decided to switch from beer production to Ethanol production, to be used as the main input to hand sanitizer. A commercial scale Ethanol plant was designed and built to distil Ethanol from a range of mash materials. The plant was predominantly designed to process a cleaner alcohol feedstock made with industrial yeast and liquid sugars. The feedstock has less residue, reducing scale buildup and resulting in a reduction of equipment cleaning. The plant will process any form of alcohol however, total production, process recovery and cleaning time will be determined by the process feedstock.



The plant consists of two 4000 litre kettles, fitted with 5M distilling towers. The plant can process up to 3500 litres of mash per batch run, extracting up to 400 litres of Ethanol, at an input alcohol level of 17%. Assuming a batch time of 4 hrs per kettle, operating for 24 hrs per day, 7 days per week, the theoretical production capacity is 1.35-1.5M litres per annum.

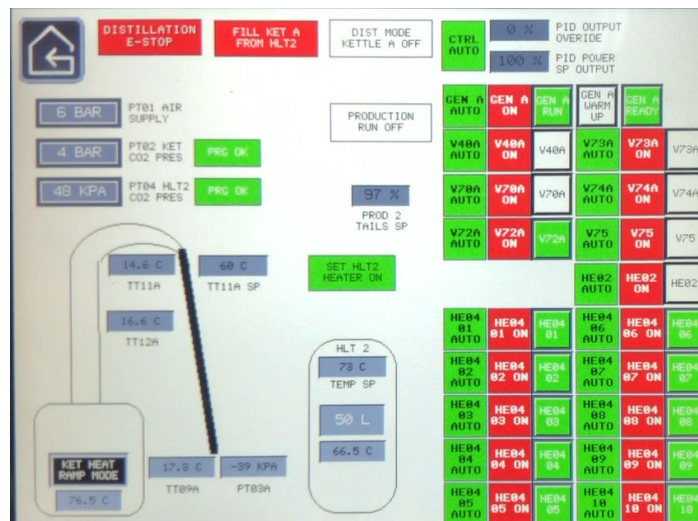


To reduce energy consumption, the plant is designed with a post run heat recovery circuit including a plate heat exchanger. The plate exchanger is used to recover heat from the kettle waste, being used to preheat the temperature of the next batch. The new batch is heated to approximately 45-50 degrees C when entering the pre heater, where it is further heated to 60-65 degrees C. All hot equipment and components are fully insulated for personnel protection and to reduce energy loss.

From the pre heater, the batch is pumped into one of the two kettles, where it is further heated to distilling temperature. Once the distilling temperature is reached, the distillation process commences to extract methanol, capture the ethanol and subsequently boil off the tails (final remaining alcohol) which is recycle into the next batch to increase the overall alcohol content. These three fractions are collected in the product tanks.

Equipment materials are dependent on duty. The kettle/distilling and product collection (hot circuits) are manufactured from stainless steel. The cooler, lower temperature feed, recirculation or cooling water circuits are fabricated from PVC.

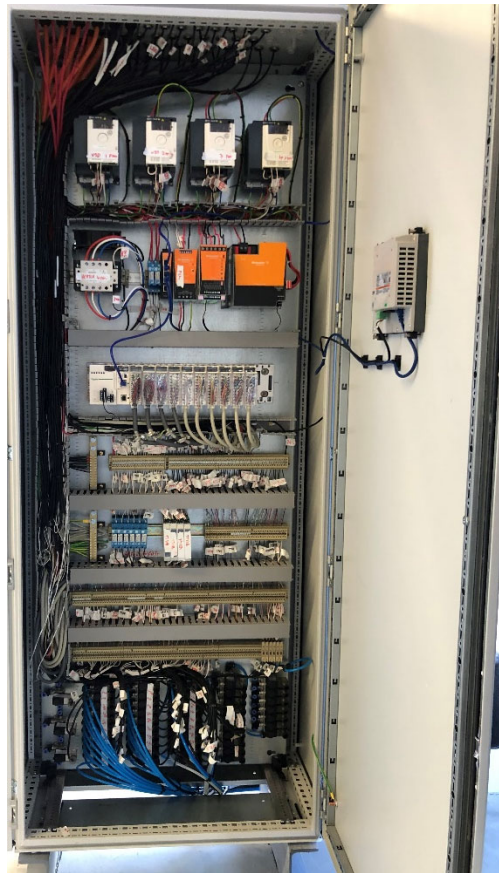
The production process is fully automated with all functions fully controlled through process instrumentation reporting to the PLC. Operators control the plant through a hand held HMI (iPad), with power supplied through external diesel generators (not included).



Each kettle is fitted with a total of 10 heating elements, totaling 175 kW of heating.



Each heater is controlled with Solid State relays, effectively controlling the heat input and resulting batch temperature rise.



Alcohol vapor is explosive at the correct air/fuel ratio. Where pumps and valves are located within an explosion zone, these items are pneumatic operated. All instrumentation and equipment is fire rated and suitable for explosive applications.



The plant could be further expanded with the installation of a third kettle. The existing piping arrangement has been configured to facilitate the third kettle without significant modification.

Plant Capacity

	Value	Comment
Estimated Availability pa	91 %	
Estimated Available Days pa	333 Days	24 hrs/day
Estimated Availability pa	88 %	
Estimated Operational Days pa	321 Days	24 hrs/day
Ethanol Recovery per batch - Max	400	
Ethanol Recovery per batch - Ave	350	
Estimated Annual Production – Max	1,500,000 l pa	
Estimated Annual Production – Ave	1,350,000 l pa	
Ethanol quality	95%	Dependent on feed stock and operational control parameters

Equipment Specification

Equipment	Number	Size	Specification
Kettles	2 off	1.5M Dia x 2.2 M high. Approx vol 4000 l	Super Duplex
Kettle heaters	10 per Kettle	175 kW total	
Still tower	1 per Kettle	300NB, 5M high	Stainless Steel
Cooling Tubes	3 per Tower	10NB	Copper
Condensers	1 per Tower	300NB, Length 1 M, 12NB Tubes	Stainless
Pre-heater tank	1 off	1.5M Dia x 2.2 M high. Approx vol 4000 l	Super Duplex
Plate Exchanger	1 off	Unkonwn	
Collection Tanks	3 off	1 M Dia x 1 M high. Approx vol 785 l	Stainless Steel