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feature:

FUTURE PROOFING THE "SPIRIT OF SPEYSIDE"

Photo Andrew Wood

April 2013 saw the accrediation of a landmark bioenergy project in the Scotch whisky world when "The Duke of Rothesay", aka HRH Prince of Wales, officially opened the £60.5 million Helius CoRDe plant. Located in Rothes in the heart of Speyside, this "blended biomass" combined heat and power plant co-located with a new Pot Ale Syrup facility, embodies the true "Spirit of Speyside".

ANYONE WHO HAS TRAVELLED IN SCOTLAND will have noted how there are distilleries scattered throughout. According to the Scottish Whisky Association (SWA) there are 108 distilleries licensed to produce Scotch. Speyside, a small region in the north-eastern part of the Highlands, is perhaps the world's most distillery dense region with around 50 whisky distilleries.

Scotch is big business. Figures from the SWA show that the industry generates over £4 billion in export earnings, accounting for 25 percent of the UK's food and drink exports. Furthermore about £1 billion is invested annually across the supply chain by the industry.

In June 2009 the SWA launched its Environmental Strategy for whisky distillers. It was hailed as the "most ambitious voluntary, environmental sustainability strategy of any single UK manufacturing sector." It applies specifically whisky distilleries and targets energy, water and materials use. Collectively the industry is committed to sourcing 20 percent of its primary energy needs from non-fossil sources by 2020 and 80 percent by 2050.

In 2008 only 3 percent of its primary energy supply came from non-fossil sources. This is good news for project developers like Helius Energy plc since process heat accounts for almost 80 percent of the industry's primary energy demand. The latest SWE report with 2012 figures showed that non-fossil primary energy sources had increased over fivefold to 16 percent.

Valuable by-products

Whisky production generates two important by-products, draff and pot ale, often used to produce a finished animal feed product known as Distillers Dark Grains (DDG). The Combination of Rothes Distillers Limited, CoRD, minority shareholders in Helius CoRDe, has been processing by-products from the Speyside whisky industry for over 100 years. Set up as a joint venture in 1904 to serve the five distilleries then operating in Rothes, CoRD specialised in the drying and processing of excess pot ale into fertiliser cake.

In 1970 CoRD opened its first joint processing plant in Rothes to produce DDG pellets and a second plant was added in 1974. The site could process up to 90 000 tonnes of draff and 300 000 tonnes of pot ale per annum. The remaining effluent from the processing plant was treated at a CoRD owned wastewater treatment plant (WWTP) on a nearby site. CoRD also provides effluent treatment service on behalf of local distilleries at the WWTP.

Central figure

–Helius CoRDe is a joint venture created by Helius Energy plc, Rabo Project Equity BV (equity investment arm of Rabobank) and CoRD to develop, build, own and operate a biomass combined heat and power plant and a new processing plant to produce pot ale syrup, a high protein liquid animal feed product, here Rothes, said Andrew Wood, plant manager for Helius CoRDe.

Andrew Wood is a central figure in the project. Previously he was with project developers Helius Energy plc and was Project Manager for the original planning design, contract negotiation and subsequently construction of the plant.

–Like a well aged whisky, the project goes back to 2005 when Helius Energy approached

CoRD with an idea about using draff as a biomass fuel.

Long-term cost control

–The key issue for CoRD was to get long-term cost control over its by-products processing and improve its environmental footprint, said Wood.

The old steam evaporators used gas and rising fuel costs were a major concern. The plant was also at full capacity and a bottleneck for whisky production.

–We looked as far as membrane technology instead of a steam evaporator to separate the solids, told Wood, but the finances didn't stack up.

With an extra half Renewable Obligation Certificate (ROC) for combined heat and power (CHP) in the balance, it was back to steam evaporation. With only a 1.2 ha space available it was decided to reassess the whole premise of the project to come up with what you see today, a woodchip and draff fuelled CHP and new evaporator process plant, explained Wood.

Danish turn-key supplier

A new tender was issued and the technology supply contract for the CHP was awarded to the Danish company Aalborg Energie Technik (AET), an independent engineering and contracting company that supply biomass-fired boiler plants in the 25 to 170 MW thermal size range. It AET's first biomass project in Scotland. As turnkey supplier, AET designed, supplied, constructed and commissioned essentially the entire combined heat and power plant exclusive the on-site civil works, a deal worth approximately £30 million or roughly half the entire Helius CoRDe project.

One project, two components

The new pot ale process plant is a conventional sextuple effect pot ale steam evaporator plant from Wellman Process Engineering. It can process up to 66.5 tonnes per hour of incoming pot ale and pressed draff liquor (PDL) mix. Four distilleries supply the pot ale via pipeline the rest arrives by tanker truck. Using the steam from the CHP to heat and evaporate the water from the mix, a concentrated Pot Ale Syrup is produced.

The evaporated water is condensed using cold water from the CHP cooling towers and the process condensate effluent is piped to the WWTP. The condensate from the steam used in the initial heating is recirculated back to the CHP. On an annual basis 430 000 tonnes of pot ale and PDL gives 44 000 tonnes of Pot Ale Syrup.

Local fuel supply

The warm wet draff comes by truck that passes a weighbridge before unloading into a receiver bunker. From here the draff is conveyed to a 400 m^3 intermediary storage silo. From the silo the draff is dewatered by a screw press provided by Haarslev, as a sub-supplier to AET. The PDL is pumped to the pot ale processing.

The pressed draff goes through a rotary steam dryer, again provided by Haarslev as a sub-supplier to AET to bring the moisture content down to around 3 percent before going into the draff dosing bin for the boiler. The dryer uses some of the extraction steam from the low pressure end of the turbine as a heat source.

A compact plant, a view of the draff receiving bunker as seen from the side and the rotary steam dryer.

A pail of Pot Ale Syrup an animal protein supplement, the product from pot ale processing facility. Using steam and power from the CHP it can turn 430 000 tonnes pot ale into 44 000 tonnes "Spey Syrup" per year. It doesn't taste half bad either.

-A practical feature I like are the visual control points, like here on these pneumatic conveyors. It's a simple but great complement to computer screens, easy for anyone walking around the plant to spot a potential hitch, said Andrew Wood.

–Draff is SEPA classed as a by-product and the plant was finally permitted as a class B using clean wood and draff. This means it is not under the waste incineration directive (WID). During the entire technical design planning we had to keep in mind that the plant may have to be class A compliant, explained Wood.

The woodchips are sourced from two main suppliers and delivered by truck. There is no on-site chipping or regrinding facilities. On arrival the woodchips are unloaded into a woodchip bunker conveyed past a sizing screen and magnetic separator before going into storage in one of two 350 m^3 concrete silos, one for fresh woodchips the other for drier material. The supplied chips are a 15:85 mix of clean, uncontaminated recycled wood and seasoned roundwood. From the storage silos the chips are fed together into the woodchip dosing bin thereby mixing the chips. In total the plant uses about 40 000 tonnes of woodchips a year.

–Though the boiler can handle a varied range of moisture content, drying the draff and mixing the woodchips to an even 50 percent moisture content keeps the overall efficiency up and emissions down, said Wood.

Chips and dust combustion

The heart of the CHP is the AET 34 MWth »

"The key issue for CoRD was to get long-term cost control over its by-products processing and improve its environmental footprint"

Andrew Wood
Plant Manager Helius CoRDe

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(fuel input) moving-grate steam cycle boiler. The fuel is pneumatically transported from each respective dosing bin into the furnace using spreader stokers for the woodchips and a dust firing system for the draff. An extra prototype dust noozle has also been installed by AET for performance test purposes. The lighter particles are burnt in suspension whilst heavier particles fall evenly onto the grate forming a rapid-burning mat of fuel. The continuously-moving grate, the speed of which can be adjusted to compensate fuel variations and ash content, moves the burning mat towards the boiler front where the bottom ash falls into the ash pit. Primary air is induced through nozzles in the grate bars. Secondary air and recirculated flue-gas with larger particles is introduced into the combustion zone. The boiler is fitted with a gas burner which is used for start-ups, auxiliary and emergency back-up.

Flue-gas cleaning consists of an AET urea based Selective Non-Catalytic Reduction (SNCR) system, bicarbonate injection for acid neutralization and a series of bag filters for fly ash and particulates removal.

–Our NOx reduction is in fact class A compliant on account of our "in someone's backyard" location inside the town. Besides we wanted to future proof it now against any coming requirements, said Wood.

The bottom ash is used on site as an aggregate material and the nutrient rich fly ash is being used as fertilizer.

–Nothing goes to landfill both materials are SEPA approved, he said without giving away how the fly ash was applied in practice.

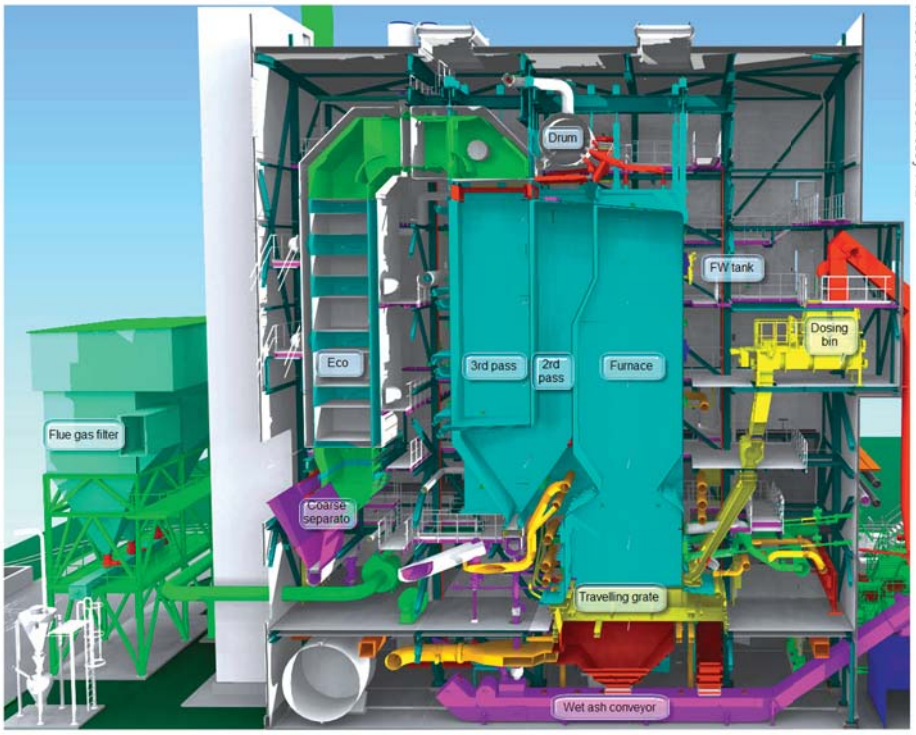

Illustration courtesy AET

–I can say we have a project and have found we what believe is an ideal solution.

On time and within budget

The plant went into commercial operation in July 2013. It is accredited under the CHPQA and qualifies as a "Good Quality" CHP plant. The entire project was built on time and within budget, a result Andrew Wood attributes to three factors; having direct control of the three construction contractors, using prompt and regular payment as an incentive to follow agreed installation milestones, and, being on-site and able to make on the spot decisions.

Being in the rare position of having managed the design, build and now operation of the plant begs the question if a year or so of operational experience has given any "what was I thinking" moments.

–In retrospect the placement of the cooling towers on the roof was an oversight, it makes service access a bit more difficult. The control room could have been on the other side of the building taking in the panoramic view of the River Spey instead, though I'm not so sure, it might just be a distraction, ended Andrew Wood.

Text & photos: Alan Sherrard
BI72/4390/AS

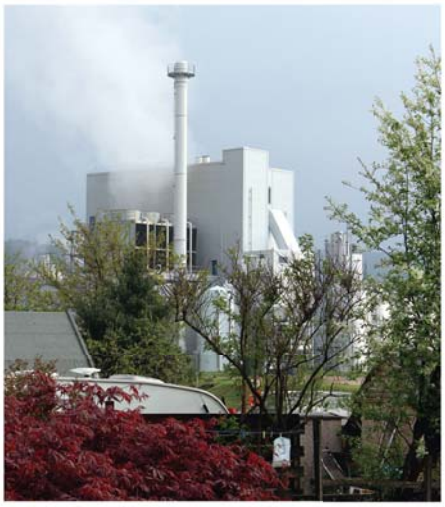

Photo Andrew Wood

HELIUS CORDE PLANT SPECIFICATIONS

POT ALE PROCESS PLANT

Evaporator: Wellman Process Engineering sextupel sequential falling film & final forced
Energy: Steam c. 12 t/h @ 3.35 Bar(a), Power 240 kW
Capacity: Total 66.5 t/h of which Pot ale c. 58 t/h & Pressed Draff Liquor (PDL) c. 8 t/h
Products: Pot Ale Syrup c. 6 t/h, weak condensate c. 60.5 t/h

COMBINED HEAT & POWER PLANT

Boiler: Steam cycle, 34 MWth AET moving-grate & dust injectio
Steam out: c. 42 MW / 42 t/h @452°C & 82 bar (a)
Turbine: TGM Kanis 2 stage condensing
Power out: Gross c. 8.3 MWe, Net c. 6.9 MWe, Parasitic c.1.4 MWe
Fuel need: Woodchips c. 40 000 t/yr, Wet draff c. 130 000 t/yr
Burn rate: Wood c. 7 t/h (@ 50% mc) & Dry draff (@ 3% mc) c. 4 t/h
Treatment: NOx reduction - AET SNCR urea, Dust - bag filters, pH adjustment - $NaHCO_3$ injection