Clear*fl*eau™
Renewable Energy
From Liquid Residues

ON-SITE AD FOR DISTILLERY SITES – TECHNOLOGY OVERVIEW

Clear*fl*eau has developed an on-site digestion system that is suited to handling co-products from malt distillery sites and converting them into renewable energy. The liquid anaerobic digestion (AD) system can achieve a reduction in COD load of greater than 95%, for residual sewer discharge. Discharge of the cleansed digestate to watercourse (or to sea) will require further post-digestion aerobic treatment which Clear*fl*eau can also supply, as part of an AD project or in a second phase. In addition the AD plant will reduce the site's carbon footprint and by supplying heat and power to the site, reduce the cost of fossil fuel derived energy.

PROCESS DESCRIPTION

Based on the homogeneous supply of co-products from the distillery, one or more balance tanks are required prior to feeding the digester. The feedstock is pumped into the digester at a controlled rate with returned heated biomass and chemicals. An external macerator mixing pump will help to keep the solids in suspension in the balance tank.

The digester feed from the balance tanks is mixed with the returned sludge from solids separation, plus nutrients and other returned liquors. The feedstock temperature is assumed to be about 30degC and will require heating to achieve a 35°C temperature in the digester. It will always be useful to have some information on what waste heat may be available from the site to pre-heat the digester feed, should this be required, to help maximise RHI revenue.

Monitoring the reactor ensures that the correct temperature and pH is maintained. The pH correction is made on the effluent entering the reactor. To maintain the reactor temperature at 35degC, some of the sludge from the reactor is passed through a heat exchanger and fed back to the reactor. The heat can be produced by a biogas boiler or another source on site.

The treated effluent is pumped out of the AD reactor tank to a solids separation system. Polymer is added is to the effluent to assist the process. Un-degraded solids are returned to the reactor. Clear*fl*eau's solids separation unit will displace methane and other gases, prior to passing on cleansed effluent for further polishing. Additional treatment is applied to the residual waste water to polish it prior to discharge. We can also evaluate the processing of final effluent to allow this water to be re-used on site (e.g. for boiler feed) or discharged to a water course.

Biogas produced in the anaerobic digestion process is stored in the space above the reactor in a flexible bio-dome. The bio-dome comprises a two layer cover. The outer cover is inflated by blowers, with the inner one moving independently - depending upon the volume of biogas. The biogas produced should have a methane content of above 55% and can be fed to a Combined Heat and Power (CHP) unit, to produce power for use on site. Other options include combustion in a dedicated biogas boiler or upgrading to bio-methane for injection into the gas grid. Further discussion will be necessary to determine the energy system to be used on each specific site.

PROJECT REVENUE

The renewable energy generated can be used to replace fossil fuels that are consumed in the production processes. The project will provide a mix of power and heat that can be used on site and possibly by the adjacent retail site. It will reduce the site's carbon footprint, while providing increased treatment efficiency and providing significant energy cost savings.

In cases where biogas is to be fed to a CHP unit, it is recommended that this should be hired with a full maintenance contract. This provides flexibility to switch to a more efficient alternative energy conversion system (such as turbines or gas to grid) as they become more cost effective. Anaerobic digestion is eligible for renewable energy incentive payments. Companies that generate renewable energy from their processing residues will receive Government support payments - renewable electricity Feed in Tariff (FIT) and Renewable Heat Incentive (RHI).

The FIT incentive rates are revised annually (in April) and are index linked. Once a site is registered they are available for 20 years. Currently the rates are being reviewed and are subject to annual digression, as additional AD capacity is installed in the UK. Once the rate has been secured it will increase annually based on inflation over the 20 year period. The RHI was introduced in 2011 for gas (bio-methane) fed into the national gas grid, following upgrading as well as for surplus heat from a CHP or boiler heat for smaller AD projects. There has been some degression of the gas to grid rate and further reductions are expected.

The net financial benefit for the on-site digestion process depends on 3 factors: reduced treatment costs, reduced energy costs and the incentives revenue will be enhanced by savings on effluent treatment and reduced energy costs for the site. Overall there are a range of financial benefits for on-site AD compared to conventional aerobic treatment:

- Generation of renewable energy that can be used on site
- Lower carbon footprint than all aerobic treatment options
- Reduced treatment or disposal costs for process residues
- Lower costs for achievement of watercourse discharge
- Lower volume of residual sludge for off-site disposal

EQUIPMENT SUPPLY

The digester tank contains no internal moving parts and is mixed externally. The ancillary equipment will be installed and supplied on skids in a building (or containers for expedience in installation and to allow the units to be moved if required in the future). The proposed plant will comprise balancing tanks, digester vessel, solids separation and effluent polishing units, plus chemical dosing, heating system, flare, sludge storage and monitoring / control system.

Process design is based on a modular package for pumps and controls with balancing, the digester / gas storage vessel, external solids separation, chemical addition, sludge storage and gas handling. Included within the scope of works are the project management and the CDM requirements of the works, including the civil, mechanical and electrical site installation activities. Included in the scope is the execution of all the necessary final performance tests, client operator and management training and final handover of all the equipment supplied.

Clear*fl*eau has demonstrated the effectiveness of liquid AD technology in the distillery sector. The integrated bio-energy plant at Dailuaine distillery has been operating for over 3 years, treating co-products from the distillery and dark grains plant, while achieving water discharge to the river Spey. On-site AD plants should generate a return on investment of at least 20%.

Clear*fl*eau's on-site liquid digestion process is robust and cost effective, with minimal labour requirements and has a number of features suited to treatment of distillery co-products:

- The modular design fits into a confined footprint, with a low profile digester tank
- The system will generate at least 15% more biogas than other high-rate systems,
- Process effectiveness is due to highly effective mixing of liquors in the anaerobic reactor and sustained exposure of active biomass to the incoming load,
- It is better able to handle solid and load variations than other high-rate AD, due to its short liquid retention time combined with an extended solids retention period,

Output expectations for the on-site AD plants are based on experience with distillery feedstocks. Clear*fl*eau will work its clients to maximise energy output and optimise the return on investment.