Speciality Organic Chemicals Sector Guidance EPR 4.02 – BAT Assessment

Indicative BAT	*Response*
Plant Systems and Equipment	
1. Formally consider potential emissions from plant systems and equipment and have plans and timetables for improvements, where the potential for substance or noise pollution from plant systems and equipment has been identified.	As part of the management of change potential emissions including noise from plant systems and equipment are considered formally and within HAZOP studies where applicable. No further improvements have been identified as a result of this variation.
2. Carry out systematic HAZOP studies on all plant systems and equipment to identify and quantify risks to the environment.	HAZOP studies were carried out including measures at the design stage to mitigate identified environmental risks.
3. Choose vacuum systems that are designed for the load and keep them well maintained. Install sufficient instrumentation to detect reduced performance and to warn that remedial action should be taken.	Vacuum systems are maintained. Process monitoring is in place and reviewed regularly. A deterioration in performance is additionally flagged by product quality which is monitored constantly. No change to the vacuum systems is required as a result of this variation.
Over-pressure protection systems	
1. Carry out a systematic HAZOP study for all relief systems, to identify and quantify significant risks to the environment from the technique chosen.	HAZOP studies were carried out including measures to mitigate environmental risks. No change to the over pressure protection systems is required as a result of this variation.
2 Identify procedures to protect against overpressure of equipment. This requires the identification of all conceivable over-pressure situations, calculation of relief rates, selection of relief method, design of the vent system, discharge and disposal considerations, and dispersion calculations. In some cases careful design can provide intrinsic protection against all conceivable over-pressure scenarios, so relief systems and their consequential emissions can be avoided.	HAZOP studies were carried out including pressure relief and vacuum relief valves.
3. Maintain in a state of readiness all equipment installed in the venting system even though the system is rarely used.	No change in the venting arrangements and controls is proposed as a result of this variation.
Heat exchangers and cooling systems	
1. Consider leak detection, corrosion monitoring and materials of construction, preferably in a formal HAZOP study. Plans and timetables for improved procedures or replacement by higher integrity designs should be in place where the risks are identified as significant.	Corrosion is not likely. M&I use 316L and 304 grades of stainless steel. Only storage vessels would employ 304.
2. If corrosion is likely, ensure methods for rapid detection of leaks are in place and a regime of corrosion monitoring in operation at critical points. Alternatively, use materials of construction that are inert to the process and heating/cooling fluids under the conditions of operation.	Corrosion is not considered likely.
3. For cooling water systems, use techniques that compare favourably with relevant techniques described in the Industrial Cooling Systems BREF.	There is no change required to the cooling systems as a result of this variation. Systems will continue to comply with the regulations.
Purging facilities	
1. Assess the potential for the release to air of VOCs and other pollutants along with discharged purge gas and use abatement where necessary.	N/A
Reaction stage	
1. With a clear understanding of the physical chemistry, evaluate options for suitable reactor types using chemical engineering principles.	The chemistry used is suitable only for a batch process. Reactors and agitators have been designed in conjunction with external consultants to give optimal heat transfer and mixing.
2. Select the reactor system from a number of potentially suitable reactor designs - conventional STR, process-intensive or novel-technology - by formal comparison of costs and business risks against the assessment of raw	Alterative reactor processes have been considered: in particular sonochemistry and microwave heating. The former is not feasible as microbubbles caused by sound waves in the raw materials do not cavitate to produce

material efficiencies and environmental impacts for each of the options.	heat. The latter would require a change to the chemical route by employing transesterification methods and was not pursued.
3. Undertake studies to review reactor design options based on process-optimisation where the activity is an existing activity and achieved raw material efficiencies and waste generation suggest there is significant potential for improvement, The studies should formally compare the costs and business risks, and raw material efficiencies and environmental impacts of the alternative systems with those of the existing system. The scope and depth of the studies should be in proportion to the potential for environmental improvement over the existing reaction system.	Reactor designs have been improved to enhance heat transfer and mixing over the years.
4. Maximise process yields from the selected reactor design, and minimise losses and emissions, by the formalised use of optimised process control and management procedures (both manual and computerised where appropriate).	The reaction goes to > 99.8% completion based on hydroxyl value. The system is automated and SCADA controlled. Procedures and work instructions are documented and reviewed at least every two years.
5. Minimise the potential for the release of vapours to air from pressure relief systems and the potential for emissions of organic solvents into air or water, by formal consideration at the design stage - or formal review of the existing arrangements if that stage has passed.	No organic solvents are used in the process. Air emissions go through a scrubber tank to entrain vapours and allow for additional condensation prior to release. Emissions to sewer from the reactors go through a limestone bed to give a ten-fold reduction in acid value which is monitored regularly.
Minimisation of liquid losses from reaction systems	
Use the following features that contribute to a reduction in waste arisings from clean-outs: • low-inventory continuous throughput reactors with minimum surface area for cleaning • minimum internals such as baffles and coils in the reactor • smooth reactor walls, no crevices • flush bottom outlet on reaction vessels • all associated piping to slope back to the reactor or to a drain point • sufficient headroom under the reactor for collection of all concentrated drainings in drums or other suitable vessel, if necessary • minimal pipework, designed to eliminate hold-up and to assist drainage • pipework designed to allow air or nitrogen blowing • system kept warm during emptying to facilitate draining • HAZOP studies used to assess the potential for the choking of lines by high-melting point material • campaigns sequenced so that cleaning between batches is minimised • campaigns made as long as possible to reduce the number of product change-overs • where a complete clean is necessary, use cleaning methods that minimise the use of cleaning agents, (e.g. steam-cleaning, rotating spray jets or high-pressure cleaning) or use a solvent which can be re-used • carry out HAZOP studies to minimise the generation of wastes and to examine their treatment/disposal • consider use of disposable plastic pipe-liners • eliminate or minimise. locations for solids to settle-out • consider duplicate or dedicated equipment where it can reduce the need for cleaning that is difficult.	No reactor cleaning is necessary.

Minimisation of vapour losses	
1. Review your operating practices and review vent flows to see if improvements need to be made.	Operating practices and venting arrangements were reviewed as part of the HAZOP studies. No additional requirements were identified.
2. Consider opportunities to enhance the performance of abatement systems	The releases to air are not volatile and contain fatty acid vapour. The condenser system vents into a scrubber tank that is designed to ensure that releases are minimised.
Separation stages	
1. Choose your separation technique following a detailed process design and HAZOP study. Follow formal operating instructions to ensure effective separation and minimisation of losses. Adhere to design conditions such as heat input, reflux flows and ratios, etc.	HAZOPs were conducted at the project design stage. The separation techniques are automated. The changes proposed by this variation are described within the variation application supporting document.
2. Install instrumentation to warn of faults in the system, such as a temperature, pressure or low coolant-flow alarms.	There are no changes to the instrumentation as a result of this variation.
Liquid-liquid separations	
1. Use techniques which maximise physical separation of the phases (and also aim to minimise mutual solubility) where practicable.	The existing acid/water separator tank prior to the scrubber ensures good gravity separation of the immiscible streams.
2. When the phases are separated, use techniques which prevent (or minimise the probability and size of) breakthrough of the organics phase into a waste-water stream. This is particularly important where the environmental consequences of subsequent releases of organics to air or into controlled waters may be significant (eg. where the effluent is treated in a DAF unit or some of the organic components are resistant to biological treatment).	The condensate from the reactors (a mixture of fatty acid and water) goes into a separator tank where the water and acid separate under gravity. The interface in the separator tank is self-governing and has been demonstrated to be effective over many years. The water from the separator tank then enters an effluent tank for pre-treatment. This downstream effluent treatment tank has also been shown to be effective to reduce the acid value significantly prior to discharge to the wider site drainage.
3. When a separation is done by hand, use a "dead man's handle", backed-up by good management, to improve the chance of the flow being properly controlled as the phase boundary approaches.	N/A
4. Consider if automatic detection of the interface is practicable.	N/A
5. Where you are discharging to drain, consider whether there should be an intermediate holding or "guard" tank to protect against accidental losses from the organics phase	Not deemed necessary as the reactor design inhibits boil-over due to the presence of a relatively large headspace.
Solid-liquid separations	
1. Use techniques to minimise, re-use and/or recycle rinse water, and to prevent breakthrough of solids.	N/A
2. Install instrumentation or other means of detecting malfunction as all of the techniques are vulnerable to solids breakthrough.	N/A
3. Consider installing "guard" filters of smaller capacity downstream which, in the event of breakthrough, rapidly 'clog' and prevent further losses.	N/A
4. Have good management procedures to minimise loss of solids, escape of volatiles to air and excessive production of waste water.	N/A
Chemical process controls	
1. Monitor the relevant process controls and set with alarms to ensure they do not go out of the required range.	SCADA control means that constant process monitoring is possible.
Analysis	
1. Analyse the components and concentrations of by products and waste streams to ensure correct decisions are made regarding onward treatment or disposal. Keep detailed records of decisions based on this analysis in accordance with management systems.	Wastewater is monitored regularly at the point of discharge by the sewage undertaker. Stack emissions are monitored annually.
Point Source Emissions to Air	

1. Formally consider the information and recommendations in the BREF on Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector (see Reference 1) as part of the assessment of BAT for point-source releases to air, in addition to the information in this note.	The recommendations of the BREF on Common Waste Water and Waste Gas Treatment/ Management have been reviewed. The cumulative emissions for short and long term have been screened and further modelled to demonstrate acceptability of impact
2. Identify the main chemical constituents of the emissions, including VOC speciation where practicable.	This information has been established through the speciation of the type of fatty acid that makes up the release to atmosphere. This included acetic acid, heptanoic acid, isobutyric acid, isocaproic acid, isovaleric acid, n-butyric acid, n-caprioic acid, n-valeric acid and propionic acid. There are no changes in the range and type of emissions to atmosphere as a result of this variation however the additional cumulative emission for short and long term have been screened and further modelled to demonstrate acceptability of impact
3. Assess vent and chimney heights for dispersion capability and assess the fate of the substances emitted to the environment.	The cumulative emissions for short and long term have been screened and further modelled to demonstrate acceptability of impact
4. Use the following measures to minimise emissions to air: • recover emissions rich in organics by fractionation and then recycle • recover and reuse solvents • continuously monitor off-gas concentration from reaction vessels, dryers, condensers, evaporators	N/A
Point Source Emissions to Water	
1. Control all emissions to avoid a breach of water quality standards as a minimum. Where another technique can deliver better results at reasonable cost it will be considered BAT and should be used.	The operator does not discharge directly to surface water and is not aware of any breaches of the site's wider consent to discharge parameters. Furthermore, a surface water screening assessment has been undertaken to demonstrate acceptability of impact at the final receiving water. At maximum discharge the overall contribution from the entire site will less than 0.0001% of the outfall release to the local receiving water from the Davyhulme wastewater treatment works
2. Use the following measures to minimise water use and emissions to water: • where water is needed for cooling, minimize its use by maximising heat transfer between process streams • use water in recirculating systems with indirect heat exchangers and a cooling tower rather than a once through system. (A water make-up treatment plant and a concentrated purge stream from the system to avoid the build up of contaminants are likely to be necessary.) • leaks of process fluids into cooling water in heat exchangers are a frequent source of contamination. Monitoring of the cooling water at relevant points should be appropriate to the nature of the process fluids. In a recirculatory cooling system, leaks can be identified before significant emission to the environment has occurred. The potential for environmental impact is likely to be greater from a once through system. • Planned maintenance can help to avoid such occurrences • water used for cleaning can be reduced by a number of techniques, e.g. by spray cleaning rather than whole vessel filling • strip process liquor and treat if necessary, then recycle/reuse	The site employs small scale commercially available cooling towers and associated condenser attached to each of the reactors. This cooling system is also used on the evaporation process via a primary condenser, with a secondary condenser which provides additional cooling via a closed loop chiller. The cooling tower is serviced and cleaned in line with current L8 legislation, including one online, and one offline clean per year (approximately 6 months apart). The system is drained down annually. These services are completed by a specialist third party. The tower has an automatic monitoring and dosing system, which is checked monitored both internally and by a third party. Such systems are commonplace within the sector and operated in a manner that is consistent with the BAT statements. Water is not used for the routine cleaning of processing equipment such as the reactor vessels. Due to the nature and scale of the operation there is no need or viable opportunities to treat/recover wastewater for recycling/reuse. Emissions to sewer from the reactors go through a limestone bed to give a ten-fold reduction in acid value which is monitored regularly.

• use wet air oxidation for low volumes of aqueous effluent with high levels of organic content, such as waste streams from condensers and scrubbers • neutralise waste streams containing acids or alkalis to achieve the required pH for the receiving water • strip chlorinated hydrocarbons in waste streams with air or steam and recycle by returning to process where possible • recover co-products for re-use or sale • periodically regenerate ion exchange columns • pass waste water containing solids through settling tanks, prior to disposal • treat waste waters containing chlorinated hydrocarbons separately where possible to ensure proper control and treatment of the chlorinated compounds. Contain released volatile chlorinated hydrocarbons and vent to suitably designed incineration equipment • non-biodegradable organic material can be treated by thermal incineration. However, the thermal destruction of mixed liquids can be highly inefficient and the waste should be dewatered prior to incineration.	All other techniques have been screened and assessed as not applicable to the operations of the installation
Point Source Emissions to Ground	
1. Use the following measures to minimise emissions to land: • use settling ponds to separate out sludge (Note: Sludge can be disposed of to incinerator, encapsulation, land or lagoon depending upon its make up.) • chlorinated residues should be incinerated and not released to land. (Chlorinated hydrocarbons are not to be released to the environment due to their high global warming and ozone depletion potentials.) • either recycle off spec product into the process or blend to make lower grade products where possible • many catalysts are based on precious metals and these should be recovered, usually by return to the supplier	N/A – there are no emissions to ground from the installation. All waste is diverted from landfill.
Fugitive Emissions to Air	
1. Identify all potential sources and develop and maintain procedures for monitoring and eliminating or minimising leaks and releases of VOCs from all non-process stream sources. 2. Choose vent systems to minimise breathing emissions (for example pressure/ vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment. 3. Use the following techniques (together or in any combination) to reduce losses from storage tanks at atmospheric pressure: • maintenance of bulk storage temperatures as low as practicable, taking into account • changes due to solar heating etc. • tank paint with low solar absorbency • temperature control • tank insulation • inventory management • floating roof tanks • bladder roof tanks • pressure/vacuum valves, where tanks are designed to withstand pressure fluctuations	Due to the nature of the raw materials and process there is very limited potential for fugitive release to air. The techniques described within this section are all taken into consideration during design and HAZOP to optimise the production process and to minimise the potential for unintended losses. All relevant BAT considerations for bulk storage tanks were considered and presented as part of the previous permit application (2020).

• specific release treatment (such as adsorption condensation)	
Fugitive emissions to surface water, sewer and groundwater	
1. Provide hard surfacing in areas where accidental spillage or leakage may occur, e.g. beneath prime movers, pumps, in storage areas, and in handling, loading and unloading areas. The surfacing should be impermeable to process liquors.	The installation is entirely made of high integrity hard standing. All bulk tanks are secondary contained. All secondary containment on site have been designed and built encompassing chemical resistant epoxy coating where applicable.
2. Drain hard surfacing of areas subject to potential contamination so that potentially contaminated surface run-off does not discharge to ground.	The site has a 'whole site containment' approach in which potential releases off site are blocked off using the existing Envirovalve and the external hardstanding acts as the containment system. All yard drains are directed to sewer.
3. Hold stocks of suitable absorbents at appropriate locations for use in mopping up minor leaks and spills, and dispose of to leak-proof containers.	Spill kits containing a full inventory of response equipment are located at strategic points across the internal and external areas of the site. Relevant personnel are trained in spill response procedures and the procedures are periodically test. Spill, site drainage and pollution control measures are incorporated into site induction and the training requirements of relevant personnel.
4. Take particular care in areas of inherent sensitivity to groundwater pollution. Poorly maintained drainage systems are known to be the main cause of groundwater contamination and surface/above-ground drains are preferred to facilitate leak detection (and to reduce explosion risks).	Primary, secondary and tertiary containment measures, including site drains are subject to planned preventative measures including visual inspection by site engineering and facilities personnel and competent third party contractors. A rolling programme of inspection and repair is in place. There are no significant outstanding repair/remediation actions.
5. Additional measures could be justified in locations of particular environmental sensitivity. Decisions on the measures to be taken should take account of the risk to groundwater, taking into consideration the factors outlined in the Agency document, Policy and Practice for the Protection of Groundwater, including groundwater vulnerability and the presence of groundwater protection zones	The above programme of works is informed by consultation with the local EA inspector, relevant EA pollution prevention guidance for business. The Site is within a secondary A aquifer and principal aquifer) may be sensitive to contaminant release at surface. However, is not located within a designated groundwater Source Protection Zone (SPZ). Primary and secondary containment measures and controls are considered BAT. The presence of concrete hardstanding across the site will mitigate potential pathways.
6. Surveys of plant that may continue to contribute to leakage should also be considered, as part of an overall environmental management system. In particular, you should consider undertaking leakage tests and/or integrity surveys to confirm the containment of underground drains and tanks.	Regular checks and audits are made at the Site which includes inspections of the plant operations and storage of substances. CCTV surveys of drains are undertaken periodically. The site does not rely on sumps or underground storage vessels for the management of effluent other than rainwater.
Odour	
1. Manage the operations to prevent release of odour at all times.	Odour is not considered an issue at the site.
2. Where odour releases are expected to be acknowledged in the permit, (i.e. contained and treated prior to discharge or discharged for atmospheric dispersion): • for existing installations, the releases should be modelled to demonstrate the odour impact at sensitive receptors. The target should be to minimise the frequency of exposure to ground level concentrations that are likely to cause annoyance. • for new installations, or for significant changes, the releases should be modelled and it is expected that you will achieve the highest level of protection that is achievable with BAT from the outset.	N/A

• where there is no history of odour problems then modelling may not be required although it should be remembered that there can still be an underlying level of annoyance without complaints being made. • where, despite all reasonable steps in the design of the plant, extreme weather or other incidents are liable, in our view, to increase the odour impact at receptors, you should take appropriate and timely action, as agreed with us, to prevent further annoyance (these agreed actions will be defined either in the permit or in an odour management statement).	
3. Where odour generating activities take place in the open, or potentially odorous materials are stored outside, a high level of management control and use of best practice will be expected.	N/A
4. Where an installation releases odours but has a low environmental impact by virtue of its remoteness from sensitive receptors, it is expected that you will work towards achieving the standards described in this guidance note, but the timescales allowed to achieve this might be adjusted according to the perceived risk.	N/A
5. Where further guidance is needed to meet local needs, refer to Horizontal Guidance Note H4 Odour (see GTBR).	N/A
Noise	
1. Install particularly noisy machines such as compactors and pelletisers in a noise control booth or encapsulate the noise source.	All changes to the site introduced by this variation are to plant and equipment that are located internally in a purpose built facility.
2. Where possible without compromising safety, fit suitable silencers on safety valves.	No new safety valves have been fitted that are external to the installation.
3. Minimise the blow-off from boilers and air compressors, for example during start up, and provide silencers.	Existing control on boiler/compressors serving the wider site are considered adequate from a noise nuisance perspective.
Monitoring and reporting of emissions to air and water	
1. Carry out an analysis covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. The need to repeat such a test will depend upon the potential variability in the process and, for example, the potential for contamination of raw materials. Where there is such potential, tests may be appropriate.	The analysis of waste gas and wastewater streams has been undertaken. In respect of potential emissions to atmosphere the variability of the loading to the receiving environment by production campaign is understood. The emissions to sewer from the production process has been quantified and a further suite of analysis has been undertaken to facilitate the screening of emissions to sewer.
2. Monitor more regularly any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact. This would particularly apply to the common pesticides and heavy metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively.	The acid value of the wastewater release is monitored regularly as part of the process. The emissions to sewer from the production process has been quantified and a further suite of analysis has been undertaken to facilitate the screening of emissions to sewer. Whilst not required under the permit, stack emissions are monitored annually.
3. If there are releases of substances that are more difficult to measure and whose capacity for harm is uncertain, particularly when combined with other substances, then "whole effluent toxicity" monitoring techniques can be appropriate to provide direct measurements of harm, for example, direct toxicity assessment.	Not considered necessary.
Waste Emissions	
1. Monitor and record: • the physical and chemical composition of the waste • its hazard characteristics	This information is known from historical operational date for the process knowledge.

• • handling precautions and substances with which it cannot be mixed	
Environmental Monitoring	
1 Consider the following in drawing up proposals: • determinands to be monitored, standard reference methods, sampling protocols • monitoring strategy, selection of monitoring points, optimisation of monitoring approach • determination of background levels contributed by other sources • uncertainty for the employed methodologies and the resultant overall uncertainty of measurement • quality assurance (QA) and quality control (QC) protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail • reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information.	With respect to the operation of the process these points are covered by the day to day running of the installation to ensure product quality and the serviceability of the manufacturing equipment. No additional environmental monitoring beyond the monitoring of process controls is considered necessary.