Environmental Permit Variation – Supporting Documentation Appendix C - BAT Conclusion Compliance Assessment

Ellesmere Port Active Chemicals

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Basis of Report

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Appendices

1.0 Content of this Assessment

This document presents a demonstration of compliance with the specific BAT requirements of the sector guidance and applicable EU BAT Reference (BREF) Notes / and EU and UK BAT Conclusions.

Table 1 presents the details of the BREF Notes and BAT Conclusions that are applicable to the proposed process and the locations in which the BAT Compliance Assessments are presented.

Table 1: Applicable BREF Notes and BAT Conclusions

EU/ UK BAT Conclusions	Applicability to the Installation Activities	Comments	Location of Assessment
OFC - Manufacture of Organic Fine Chemicals August 2006	Applicable	Section 4.1 Part A activity. Assessed against Sector Guidance Note IPPC S4.02 - Guidance for the Speciality Organic Chemicals Sector	Appendix A Table A1
CWW Common Wastewater and Waste Gas Treatment / Management in the Chemical Sector May 2016	Applicable	Section 4.1 Part A activity	Appendix B Table B1
WGC Common Waste Gas Management and Treatment Systems in the Chemical Sector December 2022 UK Common Waste Gas Management and Treatment Systems in the Chemical Sector BAT Conclusions (UK WGC) – Formal Draft 2025	Applicable	Section 4.1 Part A activity Assessed against Draft UK WGC BAT Conclusions	Appendix C Table C1

2.0 Project Specific BAT

This assessment is focused solely on those changes that are proposed under this variation of the Environmental Permit. Review of all other activities against the requirements of BAT has been excluded from this document.

Appendix A Organic Chemicals Sector BATc / Production of Speciality Organic Chemicals Sector (EPR 4.02)

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Table A1: Assessment of Indicative BAT for Production of Speciality Organic Chemicals Sector (EPR 4.02)

The following table references and reviews compliance with the indicative BAT requirements contained within Environment Agency Guidance: 'How to Comply with your Environmental Permit Additional Guidance for the Speciality Organic Chemicals Sector (EPR 4.02) relative to the proposed new operations.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
1	**Managing your activities**		
1.1	**Environmental performance indicators** Monitor and benchmark your environmental performance and review this at least once a year. Your plans for minimising environmental impacts should be incorporated into on-going improvement programmes. Indicators can be derived using the Horizontal Guidance Note H1 Environmental Risk Assessment (see GTBR Annex 1). It is suggested that indicators are based on tonnes of organics produced (tOP) as they provide a good basis for measuring performance within an installation or a single company year on year.	Yes	Innospec's Ellesmere Port Integrated Management System (EPIMS) is in accordance with the requirements of ISO14001 and will include requirements to set key environmental performance targets and review performance at least annually. The performance of the new production plant will be benchmarked once commissioned.
1.2	**Accident management** In addition to the guidance in Getting the Basics Right, guidance prepared in support of the COMAH Regulations may help you in considering ways to reduce the risks and consequences of accidents, whether or not they are covered by the COMAH regime.	Yes	As part of the site operating systems, the site holds Accident Prevention, Management, and Emergency Response Plans to cover the site operations. The process design has included consideration of potential accident hazards and has included HAZOP assessments. Any changes or amendments to the processes will be subject to a Management of Change (MoC) process used alongside the HAZOP processes. Foreseeable accident and incident risks are identified within the HAZOP processes and where possible designed out, or if this is not possible suitable control measures are in place to reduce the risk to As Low As Reasonably Practicable.
1.3	**Energy efficiency:** Some large processes are major users of heat and power, and others produce energy from their exothermic reactions. For these there may be greater opportunities for optimising energy efficiency	Yes	The plant has been designed with due consideration of energy efficiency. Energy efficiency will be managed as part of the EMS and energy usage and reduction will be reviewed periodically.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
	in comparison to the smaller installation in the sector and to many industrial sectors. Assess the environmental impact of each process and choose the one with the lowest environmental impact. (We recognise that your choice may be constrained, for example, by the integration of processes on a complex site).		
1.4	**Efficient use of raw materials and water** As a general principle, you need to demonstrate the measures you take to: • reduce your use of all raw materials and intermediates; • substitute less harmful materials, or those which can be more readily abated and when abated lead to substances that are more readily dealt with; and • understand the fate of by-products and contaminants and their environmental impact. You should where appropriate: 1. Maximise heat transfer between process streams where water is needed for cooling. Use a recirculating system with indirect heat exchangers and a cooling tower in preference to a once-through cooling system. 2. Where water is used in direct contact with process materials, recirculate the water after stripping out the absorbed substances.	Yes	Innospec is committed to using less harmful solvents or methods of synthesis where possible. The plant has been designed to optimise raw materials usage and maximise yield. The pollution prevention measures applied to material storage e.g. containment measures and management procedures will be the same for all materials stored and used and will be used to prevent/minimise pollution risk. The main cooling duty is closed loop via the site cooling water system and a heat exchanger. Water use in the process is limited to ancillary systems only e.g. cooling The main cooling duty is closed loop via the existing site cooling water system and a heat exchanger and hence minimises cooling water use.
1.5	**Avoidance, recovery and disposal of wastes** Waste should be recovered unless it is technically or economically impractical to do so. You should list in detail the nature and source of the waste from each activity as the response to the emissions inventory requirement of the Application. Where there are a very large number of relatively small streams it may be appropriate to aggregate similar and comparatively insignificant waste streams. You should where appropriate: 1. Demonstrate that the chosen routes for recovery or disposal represent the best environmental option. Consider avenues for	Yes	The production chemistry and reaction systems and controls have been developed to optimise yield. Waste materials from the process will be collected into suitable containers e.g., drums/IBC's etc. All site waste will be sent offsite for recycling or disposal with the disposal route being selected in line with the waste hierarchy and existing site systems. Waste generation at the site is reviewed periodically as part of the overall site KPI targets.

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	recycling back into the process or reworking for another process wherever possible. 2. Provide a detailed assessment identifying the best environmental options for waste disposal where you cannot avoid disposing of waste.		
2	**Operations**		
2.1	**Design of a new process** During new project development environmental issues should be an integral part of discussion at every stage of the design, beginning with the initial concepts. At the initial stage of the development of the process there should be a formal and comprehensive study – the first stage in a formal HAZOP study – of the likely environmental consequences from: • The use of raw materials, and production of all intermediates and products • All routine emissions, discharges and solid/liquid waste streams and • Non-routine or unplanned releases and disposals. You should where appropriate: 1. Consider all potential environmental impacts from the outset in any new project for manufacturing chemicals. 2. Undertake the appropriate stages of a formal HAZOP study as the project progresses through the process design and plant design phases. The HAZOP studies should consider amongst other things the points noted above.	Yes	The design of the new process has been subject to full assessment of both safety and environmental risks through the use of HAZOP. Other Process Hazard Analysis (PHA) techniques have also been used as appropriate, e.g. SIL Assessments. And changes or amendments to the new production processes will be subject to a Management of Change (MoC) process which is applied alongside the HAZOP processes.
2.2	**Storage and handling of raw materials, products and wastes** You should where appropriate: 1. Store reactive chemicals in such a way that they remain stable, such as under a steady gas stream, for example. If chemical additions are necessary then tests should be carried out to ensure the required chemical composition is maintained. Inhibitors may also be added to prevent reactions. 2. Vent storage tanks to a safe location.	Yes	All raw materials, products and wastes will be stored and handled in accordance with the existing site systems and controls. All storage is assessed to ensure compliance with Control of Substances Hazardous to Health (COSHH). Material Safety Data Sheets (MSDS) for any potentially hazardous materials or chemicals will be kept on site together with the COSHH register. The MSDS

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	3. Use measures to reduce the risk of contamination from large storage tanks. In addition to sealed bunds, use double-walled tanks and leak detection channels. 4. Use HAZOP studies to identify risks to the environment for all operations involving the storage and handling of chemicals and wastes. Where the risks are identified as significant, plans and timetables for improvements should be in place.		provides information on how chemicals should be handled, stored and disposed of, and what to do in the event of an accident. All storage areas are designed to prevent uncontrolled releases, with no direct drainage to the environment. Materials stored will be grouped dependant in their compatibility, with a suitable separation being provided between non-compatible materials. The storage areas for liquids will be provided with secondary containment. These storage systems have been considered as part of HAZOP / PHR processes.
2.3	**Plant systems and equipment** A wide range of ancillary equipment is required throughout the process, which may include ventilation, pressure relief, vacuum raising, pumps, compressors, agitators, valves, purging and heating/cooling. Some of these systems give rise to a waste stream, for example wet vacuum systems or dust extraction equipment, and all of them have the potential to give rise to fugitive emissions. You should formally consider potential emissions from plant systems and equipment. You should where appropriate: 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. 2. Carry out systematic HAZOP studies on all plant systems and equipment to identify and quantify risks to the environment. 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.	Yes	The design of the new process has been subject to full assessment of both safety and environmental risks through the use of HAZOP etc. All potential emission from the process systems have been identified and appropriate venting systems designed to capture potential emissions. All key sources of VOC emission are abated using condensers followed by a wet chemical scrubber. Full details of the potential emission sources are included in the Main technical supporting document for the Environmental Permit application. Full details of the predicted emissions and emissions abatement systems are presented in Section 8.1 of the application documentation. Potential environmental impacts have been assessed within the AERA and demonstrated to be insignificant and hence no additional treatment of the emissions is required. A qualitative assessment of potential noise impacts has been undertaken within the Environmental Risk Assessment document which demonstrates that the proposed site activities will not lead to any significant impacts. A liquid ring vacuum pump system (P102) is linked to reactor R102, allowing a vacuum to be generated within the reactor. When this is operational, the air extracted from the reactor is drawn through the vacuum pump set before then being vented to the caustic scrubber. This system has been appropriately

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
			designed and will be correctly maintained. The systems have a local HMI interface with appropriate process condition monitoring and integrated alarms on potential excursions in processing conditions. There is also a DCS system feeding key data back to the main control room.
2.3	**Plant systems and equipment – over-pressure protection systems** You should where appropriate: 1. Carry out a systematic HAZOP study for all relief systems, to identify and quantify significant risks to the environment from the technique chosen. 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. 3. Maintain in a state of readiness all equipment installed in the venting system even though the system is rarely used.	Yes	The design of the new process activities has been subject to full assessment of both safety and environmental risks through the use of HAZOP etc. Overpressure safety systems (where required) have been appropriately sized and designed, although the plant has been designed to minimise the potential for such systems to need to operate.
2.3	**Plant systems and equipment – heat exchangers and cooling systems** You should where appropriate: 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. 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.	Yes	The design of the new process activities has been subject to full assessment of both safety and environmental risks through the use of HAZOP etc. The main cooling system is a closed loop system fed from the existing site cooling systems. Potential for corrosion has been considered in the design process. Given the scale of the site activities, the closed loop package cooling and heating systems proposed are considered appropriate.

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	3. For cooling water systems, use techniques that compare favourably with relevant techniques described in the Industrial Cooling Systems BREF.		
2.3	**Plant systems and equipment – purging facilities** Assess the potential for the release to air of VOCs and other pollutants along with discharged purge gas and use abatement where necessary.	Yes	The design of the new process has been subject to full assessment of both safety and environmental risks through the use of HAZOP etc. All potential emissions from the process systems have been identified and appropriate venting systems designed to capture potential emissions. All key sources of VOC emission are abated using condensers with a subsequent wet chemical scrubber. Full details of the potential emission sources are included in the Main technical supporting document for the Environmental Permit application.
2.4	**Reaction stage** It is important to consider how the chemistry and engineering options may contribute to releases to the environment from the reaction stage, both directly and as a consequence later in the process. It is also important that these considerations are made at the process design stage – before plant design and equipment selection is commenced. You should where appropriate: 1. With a clear understanding of the physical chemistry, evaluate options for suitable reactor types using chemical engineering principles. 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 material efficiencies and environmental impacts for each of the options. 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	Yes	All processing reactions will be undertaken as a single batch process in reactor R102 which is approximately 11m^3 in volume and is installed with a mixer and an external heating and cooling jacket which will be supplied from the site's existing LP steam or cooling water systems. Additional chilling can be supplied from a separate chiller package X110. The activities proposed to be undertaken at the multipurpose plant will utilise this production equipment in order to initially produce Arquad Nitrate and P13PA with other products potentially being produced in the future under the MPP. All proposed future production chemistries and reactions will be fully evaluated prior to commencement. Batch processing in stirred reactors is the preferred technology for this type of operation. Operation of the reactors will be subject to a defined process 'recipe' with a combination of manual procedural controls and automated control systems used to optimise the reaction activities. All emissions of VOC from the process will feed into designed systems for emission abatement and release to atmosphere. All process recipe's have been developed in order to ensure product quality and maximise yield.

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	studies should be in proportion to the potential for environmental improvement over the existing reaction system. 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). 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.		
2.4	**Minimisation of liquid losses from reaction systems** You should where appropriate: 1. 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	Yes	There will be minimal internals within the reactor – only the mixer. The reactor walls will be smooth, The reactor will have a flush bottom outlet, Pipework systems will be designed to facilitate minimisation or losses of material on product changeover, Cleaning of the reactor internals between batches will be optimised. The plant has been designed to optimise yield. The reactor is insulated to minimise heat loss.

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	• 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.		
2.4	**Reaction stage – minimisation of vapour losses** There are many techniques for minimising the potential for vapour losses and for collection and abatement of vapour displaced into vent lines. You should where appropriate: 1. Review your operating practices and review vent flows to see if improvements need to be made. 2. Consider opportunities to enhance the performance of abatement systems.	Yes	Reactor R102 (and the associated plant) also has a connection into the site nitrogen supply header which can be used to provide inertisation. The flow through these systems will be optimised to minimise the VOC emissions where possible.
2.5	**Separation stages – liquid-vapour separations** On completion of the reaction it is usually necessary to separate the desired product from the other components in the reaction system. You should where appropriate: 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. 2. Install instrumentation to warn of faults in the system, such as a temperature, pressure or low coolant-flow alarms.	Yes	All air extracted from the reactor passes through a shell and tube condenser (E102) for recovery of organic materials into the distillate received pot (T102) for return to the process. The condenser is cooled using the existing site cooling water system. This condenser loop can also be used for reflux operation of the reactor. The air from the condenser then flows through a knock-out pot and then to the caustic scrubber. These systems have been assessed by HAZOP. The reaction and condenser systems are installed with an automated control system which includes monitoring of key parameters.
2.5	**Separation stages– liquid-liquid separations**	N/A	A liquid/liquid separation is undertaken as part of the P13PA production process. An aqueous/organic separation is undertaken to remove the aqueous

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	You should where appropriate: 1. Use techniques which maximise physical separation of the phases (and also aim to minimise mutual solubility) where practicable. 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). 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. 4. Consider if automatic detection of the interface is practicable. 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.		phase. This is undertaken with an operator in attendance with a sightglass and a springloaded valve to control the cut. The separated material will be drained into IBC's for disposal. Prior to undertaking the separation the agitator is turned off and the material left to settle to maximise the separation.
2.5	**Separation stage – liquid-solid separations** Different separation techniques will be BAT for different applications, with factors like solubility, crystallisation rate and granular size being important. The main solid-liquid techniques are centrifuging, filtration, sedimentation, clarification, drying and ion exchange. You should where appropriate: 1. Use techniques to minimise, re-use and/or recycle rinse water, and to prevent breakthrough of solids. 2. Install instrumentation or other means of detecting malfunction as all of the techniques are vulnerable to solids breakthrough. 3. Consider installing "guard" filters of smaller capacity downstream which, in the event of breakthrough, rapidly 'clog' and prevent further losses. 4. Have good management procedures to minimise loss of solids, escape of volatiles to air and excessive production of wastewater.	Yes	Reaction and product materials can be filtered through bag filter (SF108) or inline filter (SF 107). Products can be recirculated through these filters until the desired product quality is achieved. The Arquad Nitrate production process involves the removal of salts via SF108, there is a pressure indication and a sightglass to allow operators to look for malfunction and SF107 filter is downstream which acts as a backup to remove any remaining salts.
2.6	**Purification stage**	N/A	Not applicable – no additional purification is undertaken

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	Waste associated with the purification stage may arise from: • impurities in the raw materials – so a change in the raw material specifications may reduce waste arisings • by-products generated by the process – so a change in reaction conditions, catalyst, solvent etc. may improve the selectivity of the reaction or eliminate by-product formation. Liquid products are usually refined by distillation, with filtration used to remove solid contaminants. Sources of loss are: • Gas entrainment. Gas or vapour flow will carry away volatile material either as vapour or as entrained droplets. Additional condenser heat-exchange area or colder heat-exchange fluid can improve the recovery rate, and coalescing demisters are relatively cheap and easy to install. • Ineffective separation. A better separation in the distillation column can be achieved by using more stages (theoretical plates) or more reflux. Modern types of packing or high-efficiency trays can often produce a marked improvement for a modest capital investment. • Filtration. Enclosed filtration is usually used and this is not normally a source of great vapour loss to air. Liquid discharged during cleaning or changing of filters should be returned to the process. Purification of solid products by washing and crystallisation. Washing and crystallising activities have the potential to produce large volumes of dilute liquors so counter-current systems of operation should be used wherever possible. During drying, the aim should be to produce the maximum concentration of solvent in the gas to allow recovery of the solvent. The use of vacuum during drying can improve both solvent recovery and energy efficiency.		
2.7	**Chemical process controls**	Yes	

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	Reaction conditions such as temperatures, pressures, rocking or stirring rates, catalyst age, input and output flow rates, addition of materials (and so on) are imperative to the efficient conversion of raw materials to product. You should where appropriate: 1. Monitor the relevant process controls and set with alarms to ensure they do not go out of the required range.		The plant control and monitoring system will have a local HMI control panel with associated local alarm systems. The plant will also be linked to a DCS control system linked back to the control room. The control system will monitor key parameters for each of the processing stages and will initiate alarms should parameters go out of predetermined ranges. The control systems also allow operators to take action to correct potential issues.
2.8	**Analysis** You should where appropriate: 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.	Yes	QA review of the product generated and the waste streams will be undertaken periodically. Periodic review of the process waste streams will be undertaken to ensure that they are being disposed of or sent for recovery appropriately, and that the waste hierarchy is being applied effectively in selecting the disposal route.
3	**Emissions and monitoring**		
3.1	**Point source emissions - air** You should where appropriate: 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. 2. Identify the main chemical constituents of the emissions, including VOC speciation where practicable. 3. Assess vent and chimney heights for dispersion capability and assess the fate of the substances emitted to the environment. 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 and scrubbers where off-gases are shown to be environmentally significant	Yes	A review of BAT against the CWW and WGC BREF has been undertaken (see tables B1 and C1 in this report). All process emissions to air have been identified and quantified. Appropriate channelled emissions systems have been provided to capture all key process emissions to air, and have been assessed as having insignificant emissions to the environment. Potential air quality and environmental impacts have been assessed as part of the application for Permit variation. Condensers are installed for VOC recovery from those vents to air where elevated levels of VOC could potentially be present. The recovered VOC will be collected for disposal as waste as it will not be suitable for immediate re-use in the process (Product Quality). Monitoring of process emission to air will be undertaken in line with the appropriate requirements of the WGC BREF.
3.1	**Point source emissions - water**	Yes	

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	You should where appropriate: 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. 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 leaning rather than whole vessel filling • strip process liquor and treat if necessary, then recycle/reuse • 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		Note that the changes proposed by this variation will not lead to any change in the methods used for the treatment of wastewater at the site. The new site process will lead to small volumes of water emissions from the vacuum pump liquid ring system, where trace amounts of VOCs may potentially be present in the water collected in the separator unit. This water will be discharged into the site process drainage system for treatment in the onsite effluent treatment plant before discharging to the Manchester Ship Canal (MSC). The quantities of water expected to be discharged from this system are very low (as the main cooling duty is closed loop via the site cooling water system and a heat exchanger) so it is not anticipated that the new plant will create any identifiable change in the flow or composition of the effluent discharged to the MSC or cause the site to exceed its current discharge emission limit. No amendment to the consented discharge to the MSC is required. There will be no process emissions to Sewer. All process effluent will be collected into IBC's for disposal offsite as waste or for recycling where possible.

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	• 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.		
3.1	**Point source emissions to land** Landfill of wastes should only be contemplated after all other alternatives have been thoroughly examined and rejected. 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	Not Applicable - There are no point source emissions to land.
3.2	**Fugitive emissions to air** You should where appropriate: 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.	Yes	There will be one new point source emission point to air from the proposed process activities. This will be emission point A14, from the caustic scrubber. All process stages are undertaken in processing systems that are designed to collect all releases of VOC into channelled emissions control systems with appropriate VOC abatement installed to minimise emissions. No bulk storage tanks will be used for the storage of raw materials for use in the process.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
	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 • specific release treatment (such as adsorption condensation).		
3.2	**Fugitive emissions to surface water, sewer and groundwater** You should where appropriate: 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. 2. Drain hard surfacing of areas subject to potential contamination so that potentially contaminated surface run-off does not discharge to ground. 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. 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).	Yes	All raw materials, products, and wastes are stored within dedicated storage areas with appropriate secondary containment measures. All liquids are stored on impermeable surfacing. All storage areas are designed to prevent uncontrolled releases with no direct drainage to the environment. Spill kits will be provided to control any losses that do occur. The main process activities will all be undertaken within the dedicated processing area which will be within an enclosed and walled area within the building. The building concrete flooring and the walls around the process area will act to provide containment for any spills within this area. Preventative maintenance and inspection will be carried out as detailed in the site EMS.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
	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. 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		A soil and groundwater pollution risk assessment has been undertaken as part of the Site Condition Report which includes further detail on the containment measures in place at the site (Section 9.5 in the Main Supporting Document).
3.3	**Odour** The requirements for odour control will be installation-specific and depend on the sources and nature of the potential odour. You should where appropriate: 1. Manage the operations to prevent release of odour at all times. 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. • 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	N/A	The proposed new process operations at the installation are not expected to handle or produce any particularly odorous materials. The most odorous material would be epichlorhydrin. However, emissions of epichlorhydrin will be abated by the scrubber to below the BAT AEL of 2mg/Nm³ and is not expected to lead to any offsite odour impacts given that the odour threshold is 0.93ppm.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
	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. 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. 5. Where further guidance is needed to meet local needs, refer to Horizontal Guidance Note H4 Odour (see GTBR).		
3.4	**Noise and vibration** You should where appropriate: 1. Install particularly noisy machines such as compactors and pelletisers in a noise control booth or encapsulate the noise source. 2. Where possible without compromising safety, fit suitable silencers on safety valves. 3. Minimise the blow-off from boilers and air compressors, for example during start up, and provide silencers.	Yes	The majority of process activities will be undertaken within the PC3 building, whilst the scrubber and the isotainer loading facilities will be external to the building. No significant impacts are expected as a result of the operation of the new plants (See Section 8.4 of the Main Supporting Document).
3.5	**Monitoring and reporting of emissions to air and water** You should where appropriate: 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. 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	Yes	Proposals for emission monitoring are included in Section 8.1.4 of the Permit Application technical documentation. The proposed monitoring of emissions from the plant will be undertaken in compliance with the requirements of: • EU BAT Reference Document – Monitoring of Emissions to Air and Water from Industrial Emissions Directive Installations (ROM)- July 2008. • Environment Agency Monitoring Stack Emissions: Environmental Permits (19 December 2019) (the formerly the EA’s M1 and M5 guidance notes). • BS EN 15259.

Guidance Section No.	Requirement	Operating to Guidance Requirement	Demonstration of BAT Compliance
	metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively. 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.		
3.5	**Monitoring and reporting of waste emissions** You should where appropriate: 1. Monitor and record: • the physical and chemical composition of the waste • its hazard characteristics • handling precautions and substances with which it cannot be mixed	Yes	All waste arisings from the site will be managed in accordance with the existing waste handling and management procedures at the site. This will include requirements to monitor and report waste arisings and to maintain appropriate documentation in relation to the nature of the waste and its characteristics, and maintaining records of all waste removed from site in line with the required Duty of Care.
3.5	**Environmental monitoring (beyond installation)** You should where environmental monitoring is needed: 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.	N/A	The air emissions impact assessment (AERA) undertaken in support of the Permit variation (Section 9.1) has identified that the impacts will be “insignificant”. Consequently, no monitoring (beyond the installation) is proposed.

Appendix B Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector BATc

Environmental Permit Variation – Supporting Documentation Appendix C - BAT Conclusion Compliance Assessment

Ellesmere Port Active Chemicals

Innospec Limited

SLR Project No.: 410.067515.00001

12 March 2026

Table B1: Assessment of BAT Compliance – Best Available Techniques Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector – published 9th June 2016

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
Scope	These BAT conclusions concern the activities specified in Sections 4 and 6.11 of Annex I to Directive 2010/75/EU, namely: — Section 4: Chemical industry; — Section 6.11: Independently operated treatment of waste water not covered by Council Directive 91/271/EEC and discharged by an installation undertaking activities covered under Section 4 of Annex I to Directive 2010/75/EU. These BAT conclusions also cover the combined treatment of waste water from different origins if the main pollutant load originates from the activities covered under Section 4 of Annex I to Directive 2010/75/EU. In particular, these BAT conclusions cover the following issues: — environmental management systems; — water saving; — waste water management, collection and treatment; — waste management; — treatment of waste water sludge with the exception of incineration; — waste gas management, collection and treatment; — flaring; — diffuse emissions of volatile organic compounds (VOC) to air; — odour emissions; — noise emissions.	-	The BRef document applies as the site activities is defined under Section 4.1 of Schedule 1 to the Environmental Permitting Regulations 2016 As is currently the case, there will be treatment of wastewater in the onsite effluent treatment plant (ETP) before discharge of it to the Manchester Ship Canal (MSC) (via emission point W1) the onsite ETP and discharge to the MSC are regulated under Environmental Permit BM0508IG) There will be no direct discharge to controlled waters There will be no direct discharge of process wastewater to sewer. Note that the changes proposed by this variation will not lead to any change in the methods used for the treatment of wastewater at the site. The new site process will lead to small volumes of water emissions from the vacuum pump liquid ring system, where trace amounts of VOCs may potentially be present in the water collected in the separator unit. This water will be discharged into the sitewide process drainage system for treatment in the onsite effluent treatment plant before discharging to the Manchester Ship Canal (MSC) (via emission point W1 in Environmental Permit BM0508IG). The Quantities of water expected to be discharged from this system are very low (as the main cooling duty is closed loop via the site cooling water system and a heat exchanger) so it is not anticipated that the new plant will create any identifiable change in the flow or composition of the effluent treated in the onsite ETP and discharged to the MSC or cause the site to exceed its current discharge emission limit. No amendment to the consented discharge to the MSC is required.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
			Hence review of the changes proposed by this variation against the requirements of the CWW BREF are not considered to be required.
1. Environmental Management Systems			
BATc 1	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features: (i) commitment of the management, including senior management; (ii) an environmental policy that includes the continuous improvement of the installation by the management; (iii) planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment; (iv) implementation of procedures paying particular attention to: (a) structure and responsibility; (b) recruitment, training, awareness and competence; (c) communication; (d) employee involvement; (e) documentation; (f) effective process control; (g) maintenance programmes; (h) emergency preparedness and response; (i) safeguarding compliance with environmental legislation. (v) checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the Reference Report on Monitoring of emissions to Air and Water from IED installations — ROM); (b) corrective and preventive action; (c) maintenance of records;	Yes	Innospec's Ellesmere Port Integrated Management System (EPIMS) is in accordance with the requirements of ISO14001 and will include requirements to set key environmental performance targets and review performance at least annually. The EPIMS fully implements the requirements of BATc 1.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	(d) independent (where practicable) internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained. (vi) review of the EMS and its continuing suitability, adequacy and effectiveness by senior management (vii) following the development of cleaner technologies; (viii) consideration for the environmental impacts from the eventual decommissioning of the plant at the design stage of a new plant, and throughout its operating life; (ix) application of sectoral benchmarking on a regular basis; (x) waste management plan (see BAT 13). Specifically for chemical sector activities, BAT is to incorporate the following features in the EMS: (xi) on multi-operator installations/sites, establishment of a convention that sets out the roles, responsibilities and coordination of operating procedures of each plant operator in order to enhance the cooperation between the various operators; (xii) establishment of inventories of waste water and waste gas streams (see BAT 2). In some cases, the following features are part of the EMS: (xiii) odour management plan (see BAT 20); (xiv) noise management plan (see BAT 22). *Applicability:* The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.		
BATc 2	In order to facilitate the reduction of emissions to water and air and the reduction of water usage, BAT is to establish and to maintain an inventory of waste water and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the following features: (i) information about the chemical production processes, including: (a) chemical reaction equations, also showing side products; (b) simplified process flow sheets that show the origin of the emissions;	Yes	The site will be compliant with the requirements of BAT 2. The site has a full understanding of all emissions to air and water and the inventory of emissions. i) A full process design has been undertaken and a full set of process design information will be available on site.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	(c) descriptions of process-integrated techniques and waste water/waste gas treatment at source including their performances; (ii) information, as comprehensive as is reasonably possible, about the characteristics of the waste water streams, such as: (a) average values and variability of flow, pH, temperature, and conductivity; (b) average concentration and load values of relevant pollutants/parameters and their variability (e.g. COD/TOC, nitrogen species, phosphorus, metals, salts, specific organic compounds); (c) data on bio eliminability (e.g. BOD, BOD/COD ratio, Zahn-Wellens test, biological inhibition potential (e.g. nitrification)); (iii) information, as comprehensive as is reasonably possible, about the characteristics of the waste gas streams, such as: (a) average values and variability of flow and temperature; (b) average concentration and load values of relevant pollutants/parameters and their variability (e.g. VOC, CO, NOX, SOX, chlorine, hydrogen chloride); (c) flammability, lower and higher explosive limits, reactivity; (d) presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, nitrogen, water vapour, dust).		ii) Details of the composition and volumes of wastewater streams have been included in the design. iii) Details of the composition and flowrates of waste gas streams have been included in the design and will be monitored periodically to confirm the emissions.
2. Monitoring			
BATc 3	For relevant emissions to water as identified by the inventory of waste water streams (see BAT 2), BAT is to monitor key process parameters (including continuous monitoring of waste water flow, pH and temperature) at key locations (e.g. influent to pre-treatment and influent to final treatment).	N/A	Not Applicable No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.
BATc 4	BAT is to monitor emissions to water in accordance with EN standards with at least the minimum frequency given below. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	N/A	Not Applicable No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th colspan="2">Substance / parameter</th><th>Standard(s)</th><th>Minimum Monitoring Frequency (1) (2)</th></tr>
<tr><td colspan="2">Total Organic Carbon (TOC) (3)</td><td>EN 1484</td><td rowspan="6">Daily</td></tr>
<tr><td colspan="2">Chemical Oxygen Demand (COD) (3)</td><td>No EN Standard available</td></tr>
<tr><td colspan="2">Total Suspended Solids (TSS)</td><td>EN 872</td></tr>
<tr><td colspan="2">Total Nitrogen (TN) (4)</td><td>EN 12260</td></tr>
<tr><td colspan="2">Total Inorganic Nitrogen (4) (N_{inorg})</td><td>Various EN Standards available</td></tr>
<tr><td colspan="2">Total Phosphorus</td><td>Various EN Standards</td></tr>
<tr><td colspan="2">Adsorbable organically bound halogens (AOX)</td><td>EN ISO 9562</td><td>Monthly</td></tr>
<tr><td rowspan="6">Metals</td><td>Cr</td><td rowspan="6">Various EN Standards available</td><td rowspan="6">Monthly</td></tr>
<tr><td>Cu</td></tr>
<tr><td>Ni</td></tr>
<tr><td>Pb</td></tr>
<tr><td>Zn</td></tr>
<tr><td>Other metals, if relevant</td></tr>
<tr><td rowspan="3">Toxicity (5)</td><td>Fish Eggs (<i>Danio rerio</i>)</td><td>EN ISO 15088</td><td rowspan="3">To be decided based on a risk assessment, after an initial characterisation</td></tr>
<tr><td>Daphnia (<i>Daphnia magna Straus</i>)</td><td>EN ISO 6341</td></tr>
<tr><td>Luminescent bacteria (<i>Vibrio fischeri</i>)</td><td>EN ISO 11348-1,
EN ISO 11348-2 or
EN ISO 11348-3</td></tr>
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<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td><table>
<tr><td></td><td>Duckweed (<i>Lemna minor</i>)</td><td>EN ISO 20079</td><td></td></tr>
<tr><td></td><td>Algae</td><td>EN ISO 8692,
EN ISO 10253 or
EN ISO 10710</td><td></td></tr>
</table>
Notes;
(1) Monitoring frequencies may be adapted if the data series clearly demonstrate a sufficient stability.
(2) The sampling point is located where the emission leaves the installation.
(3) TOC monitoring and COD monitoring are alternatives. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.
(4) TN and Ninorg monitoring are alternatives.
(5) An appropriate combination of these methods can be used.</td><td></td><td></td></tr>
<tr><td>BATc 5</td><td>Diffuse VOC’s
BAT is to periodically monitor diffuse VOC emissions to air from relevant sources by using an appropriate combination of the techniques I-III or, where large amounts of VOC are handled, all of the techniques I-III.
I. sniffing methods (e.g. with portable instruments according to EN 15446) associated with correlation curves for key equipment;
II. optical gas imaging methods;
III. Calculation of emissions based on emissions factors, periodically validated (e.g. once every two years) by measurements.
Where large amounts of VOCs are handled, the screening and quantification of emissions from the installation by periodic campaigns with optical absorption-based techniques, such as Differential absorption light detection and ranging (DIAL) or Solar occultation flux (SOF), is a useful complementary technique to the techniques I to III.</td><td>Yes</td><td>The new plant is not yet operational.
Proposals for calculating diffuse VOC emissions and associated monitoring will be reviewed as part of the implementation of such measures as required under the UK BATc for WGC. – See Appendix C.</td></tr>
<tr><td>BATc 6</td><td>Odour
BAT is to periodically monitor odour emissions from relevant sources in accordance with EN standards.
Emissions can be monitored by dynamic olfactometry according to EN 13725. Emission complemented by measurement/estimation of odour exposure or estimation of odour impact.</td><td>N/A</td><td>The proposed new process operations at the installation are not expected to handle or produce any particularly odorous materials. The most odorous material would be epichlorhydrin. However, emissions of epichlorhydrin will be abated by the scrubber to below the BAT AEL of 2mg/Nm³ and is not expected to lead to any offsite odour impacts given that the odour threshold is 0.93ppm.</td></tr>
</table>

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	The applicability is restricted to cases where odour nuisance can be expected or has been substantiated.		No additional monitoring is proposed.
Emissions to Water			
BATc 7	**Water Usage and Waste Water Generation** In order to reduce the usage of water and the generation of waste water, BAT is to reduce the volume and/or pollutant load of waste water streams, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.	N/A	Nor applicable. No direct use of Water in the process. Wastewater generated relates solely to water collected in the liquid ring vacuum pump separator which is not suitable for re-use. No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.
BATc 8	**Waste Water Collection and Segregation** In order to prevent the contamination of uncontaminated water and to reduce emissions to water, BAT is to segregate uncontaminated waste water streams from waste water streams that require treatment.	N/A	Not applicable. No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.
BATc 9	In order to prevent uncontrolled emissions to water, BAT is to provide an appropriate buffer storage capacity for waste water incurred during other than normal operating conditions based on a risk assessment (taking into account e.g. the nature of the pollutant, the effects on further treatment, and the receiving environment), and to take appropriate further measures (e.g. control, treat, reuse). The interim storage of contaminated rainwater requires segregation, which may not be applicable in the case of existing waste water collection systems.	N/A	Not Applicable No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.
BATc 10	**Waste Water Treatment** In order to reduce emissions to water, BAT is to use an integrated waste water management and treatment strategy that includes an appropriate combination of the techniques in the priority order given below.	N/A	Not Applicable No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
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<table>
<tr><th></th><th>Technique</th><th>Description</th></tr>
<tr><td>a</td><td>Process integrated techniques - prevent or reduce pollutants (1)</td><td>Techniques to prevent or reduce the generation of water pollutants.</td></tr>
<tr><td>b</td><td>Recovery of pollutants at source (1)</td><td>Techniques to recover pollutants prior to their discharge to the waste water collection system.</td></tr>
<tr><td>c</td><td>Waste water pre-treatment (1) (2)</td><td>Techniques to abate pollutants before the final waste water treatment. Pre-treatment can be carried out at the source or in combined streams.</td></tr>
<tr><td>d</td><td>Final waste water treatment (3)</td><td>Final waste water treatment by, for example, preliminary and primary treatment, biological treatment, nitrogen removal, phosphorus removal and/or final solids removal techniques before discharge to a receiving water body.</td></tr>
<tr><td colspan="3">(1) These techniques are further described and defined in other BAT conclusions for the chemical industry.
(2) See BAT 11.
(3) See BAT 12.</td></tr>
</table>
The integrated waste water management and treatment strategy is based on the inventory of waste water streams (see BAT 2).</td><td></td><td></td></tr>
<tr><td>BATc 11</td><td>In order to reduce emissions to water, BAT is to pre-treat waste water that contains pollutants that cannot be dealt with adequately during final waste water treatment by using appropriate techniques.
Description: Waste water pre-treatment is carried out as part of an integrated waste water management and treatment strategy (see BAT 10) and is generally necessary to:</td><td>N/A</td><td>Not Applicable
No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.</td></tr>
</table>

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<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>Protect the final waste water treatment plant (e.g. protection of a biological treatment plant against inhibitory or toxic compounds);
Remove compounds that are insufficiently abated during final treatment (e.g. toxic compounds, poorly/non- biodegradable organic compounds, organic compounds that are present in high concentrations, or metals during biological treatment);
Remove compounds that are otherwise stripped to air from the collection system or during final treatment (e.g. volatile halogenated organic compounds, benzene);
Remove compounds that have other negative effects (e.g. corrosion of equipment; unwanted reaction with other substances; contamination of waste water sludge).
In general, pre-treatment is carried out as close as possible to the source in order to avoid dilution, in particular for metals. Sometimes, wastewater streams with appropriate characteristics can be segregated and collected in order to undergo a dedicated combined pre-treatment.</td><td></td><td></td></tr>
<tr><td>BATc 12</td><td>In order to reduce emissions to water, BAT is to use an appropriate combination of final waste water treatment techniques.
Final waste water treatment is carried out as part of an integrated waste water management and treatment strategy (see BAT 10).
Appropriate final waste water treatment techniques, depending on the pollutant, include:
<table>
<tr><th></th><th>Technique (1)</th><th>Typical Pollutants Abated</th><th>Applicability</th></tr>
<tr><td colspan="2"><i>Preliminary and primary treatment</i></td><td></td><td></td></tr>
<tr><td>(a)</td><td>Equalisation</td><td>All pollutants</td><td rowspan="3">Generally applicable.</td></tr>
<tr><td>(b)</td><td>Neutralisation</td><td>Acids, alkalis</td></tr>
<tr><td>(c)</td><td>Physical separation, e.g. screens,</td><td>Suspended solids, oil/grease</td></tr>
</table></td><td>N/A</td><td>Not Applicable
No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.
No change to consented emissions to the MSC.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>sieves, grit separators, grease separators or primary settlement tanks</td><td></td><td></td></tr>
<tr><td colspan="3">Biological treatment (secondary treatment), e.g.</td><td></td></tr>
<tr><td>(d)</td><td>Activated sludge process</td><td rowspan="2">Biodegradable organic compounds</td><td rowspan="2">Generally applicable</td></tr>
<tr><td>(e)</td><td>Membrane bioreactor</td></tr>
<tr><td colspan="2">Nitrogen removal</td><td></td><td></td></tr>
<tr><td>(f)</td><td>Nitrification/denitrification</td><td>Total nitrogen, ammonia</td><td>Nitrification may not be applicable in case of high chloride concentrations (i.e. around 10 g/l) and provided that the reduction of the chloride concentration prior to nitrification would not be justified by the environmental benefits. Not applicable when the final treatment does not include a biological treatment.</td></tr>
<tr><td colspan="2">Phosphorus removal</td><td></td><td></td></tr>
<tr><td>(g)</td><td>Chemical precipitation</td><td>Phosphorus</td><td>Generally applicable.</td></tr>
<tr><td colspan="2">Final solids removal</td><td></td><td></td></tr>
<tr><td>(h)</td><td>Coagulation and flocculation</td><td rowspan="2">Suspended solids</td><td rowspan="2">Generally applicable.</td></tr>
<tr><td>(i)</td><td>Sedimentation</td></tr>
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<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
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<table>
<tr><td>(j)</td><td>Filtration (e.g. sand filtration, microfiltration, ultrafiltration)</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>(k)</td><td>Flotation</td></tr>
<tr><td colspan="4">(1) The descriptions of the techniques are given in Section 6.1</td></tr>
</table>
<p>The BAT-associated emission levels (BAT-AELs), for emissions to water given in Table 1, Table 2 and Table 3 apply to direct emissions to a receiving water body from:</p>
<p>(i) the activities specified in Section 4 of Annex I to Directive 2010/75/EU;</p>
<p>(ii) independently operated waste water treatment plants specified in Section 6.11 of Annex I to Directive 2010/75/EU provided that the main pollutant load originates from activities specified in Section 4 of Annex I to Directive 2010/75/EU;</p>
<p>(iii) the combined treatment of waste water from different origins provided that the main pollutant load originates from activities specified in Section 4 of Annex I to Directive 2010/75/EU. The BAT-AELs apply at the point where the emission leaves the installation.</p>
<p>Table 1 BAT-AELs for direct emissions of TOC, COD and TSS to a receiving water body</p>
<table>
<tr><th>Parameter</th><th>BAT-AEL’s (Yearly Average)</th><th>Conditions</th></tr>
<tr><td>Total Organic Carbon (TOC) (1)(2)</td><td>10 - 33 mg/l (3)(4)(5)(6)</td><td>The BAT-AEL applies if the emission exceeds 3.3 Te/yr</td></tr>
<tr><td>Chemical Oxygen Demand (COD) (1)(2)</td><td>30 - 100 mg/l (3)(4)(5)(6)</td><td>The BAT-AEL applies if the emission exceeds 10Te/yr</td></tr>
</table>
</td><td></td><td></td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>Total Suspended Solids (TSS)</td><td>5 - 35 mg/l⁽⁷⁾⁽⁸⁾</td><td>The BAT-AEL applies if the emission exceeds 3.5 Te/yr</td></tr>
</table>
(1) No BAT-AEL applies for BOD
(2) Either BAT-AEL for TOC or COD applies. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.
(3) The lower end of the range is typically achieved when few tributary waste water streams contain organic compounds and/or the waste water mostly contains easily biodegradable organic compounds.
(4) The upper end of the range may be up to 100 mg/l for TOC or up to 300 mg/l for COD, both as yearly averages, if both of the following conditions are fulfilled:

Condition A: Abatement efficiency ≥ 90 % as a yearly average (including both pre-treatment and final treatment).
Condition B: If a biological treatment is used, at least one of the following criteria is met:
A low-loaded biological treatment step is used (i.e. ≤ 0,25 kg COD/kg of organic dry matter of sludge). This implies that the BOD5 level in the effluent is ≤ 20 mg/l.
Nitrification is used.

(5) The upper end of the range may not apply if all of the following conditions are fulfilled:

Condition A: Abatement efficiency ≥ 95 % as a yearly average (including both pre-treatment and final treatment).
Condition B: same as Condition B in footnote (4).
Condition C: The influent to the final waste water treatment shows the following characteristics: TOC > 2 g/l (or COD > 6 g/l) as a yearly average and a high proportion of refractory organic compounds

(6) The upper end of the range may not apply when the main pollutant load originates from the production of methylcellulose.
(7) The lower end of the range is typically achieved when using filtration (e.g. sand filtration, microfiltration, ultrafiltration, membrane bioreactor), while the upper end of the range is typically achieved when using sedimentation only.
</td><td></td><td></td></tr>
</table>

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	(8) This BAT-AEL may not apply when the main pollutant load originates from the production of soda ash via the Solvay process or from the production of titanium dioxide.		

Table 2. BAT-AELs for direct emissions of nutrients to a receiving water body

Parameter	BAT-AEL's (Yearly Average)	Conditions
Total Nitrogen (1)	5-25 mg/l (2) (3)	The BAT-AEL applies if the emission exceeds 2.5 Te/yr
Total Inorganic Nitrogen (1)	5-20 mg/l (2) (3)	The BAT-AEL applies if the emission exceeds 2.0 Te/yr
Total Phosphorus	0.5-3.0 mg/l (4)	The BAT-AEL applies if the emission exceeds 300 kg/yr

(1) Either the BAT-AEL for total nitrogen or the BAT-AEL for total inorganic nitrogen applies.

(2) The BAT-AELs for TN and N_{inorg} do not apply to installations without biological waste water treatment. The lower end of the range is typically achieved when the influent to the biological waste water treatment plant contains low levels of nitrogen and/or when nitrification/denitrification can be operated under optimum conditions.

(3) The upper end of the range may be higher and up to 40 mg/l for TN or 35 mg/l for N_{inorg}, both as yearly averages, if the abatement efficiency is ≥ 70 % as a yearly average (including both pre-treatment and final treatment).

(4) The lower end of the range is typically achieved when phosphorus is added for the proper operation of the biological waste water treatment plant or when phosphorus mainly originates from heating or cooling systems. The upper end of the range is typically achieved when phosphorus-containing compounds are produced by the installation.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>

Table 3. BAT-AELs for direct emission of AOX and metals to a receiving water body

<table>
<tr><th>Parameter</th><th>BAT-AEL’s (Yearly Average)</th><th>Conditions</th></tr>
<tr><td>Adsorbable organically bound halogens (AOX)</td><td>0.2 - 1.0 mg/l (1) (2)</td><td>The BAT-AEL applies if the emission exceeds 100 kg/yr</td></tr>
<tr><td>Chromium (expressed as Cr)</td><td>5 - 25 µg/l (3) (4) (5) (6)</td><td>The BAT-AEL applies if the emission exceeds 2.5 kg/yr</td></tr>
<tr><td>Copper (expressed as Cu)</td><td>5 - 50 µg/l (3) (4) (5) (7)</td><td>The BAT-AEL applies if the emission exceeds 50 kg/yr</td></tr>
<tr><td>Nickel (expressed as Ni)</td><td>5 - 50 µg/l (3) (4) (5)</td><td>The BAT-AEL applies if the emission exceeds 5 kg/yr</td></tr>
<tr><td>Zinc (expressed as Zn)</td><td>20 - 300 µg/l (3) (4) (5) (8)</td><td>The BAT-AEL applies if the emission exceeds 30 kg/yr</td></tr>
<tr><td colspan="3">(1) The lower end of the range is typically achieved when few halogenated organic compounds are used or produced by the installation.
(2) This BAT-AEL may not apply when the main pollutant load originates from the production of iodinated X-ray contrast agents due to the high refractory loads. This BAT-AEL may also not apply when the main pollutant load originates from the production of propylene oxide or epichlorohydrin via the chlorohydrin process due to the high loads.
(3) The lower end of the range is typically achieved when few of the corresponding metal (compounds) are used or produced by the installation.
(4) This BAT-AEL may not apply to inorganic effluents when the main pollutant load originates from the production of inorganic heavy metal compounds.
(5) This BAT-AEL may not apply when the main pollutant load originates from the processing of large volumes of solid inorganic raw materials that</td></tr>
</table>

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</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td><table><tr><td>are contaminated with metals (e.g. soda ash from the Solvay process, titanium dioxide).
(6) This BAT-AEL may not apply when the main pollutant load originates from the production of chromium-organic compounds. (7) This BAT-AEL may not apply when the main pollutant load originates from the production of copper-organic compounds or the production of vinyl chloride monomer/ethylene dichloride via the oxychlorination process.
(8) This BAT-AEL may not apply when the main pollutant load originates from the production of viscose fibres.</td></tr></table>
The associated monitoring is in BAT 4.</td><td></td><td></td></tr>
<tr><td colspan="2">4. Waste</td><td></td><td></td></tr>
<tr><td>BATc 13</td><td>Waste
In order to prevent or, where this is not practicable, to reduce the quantity of waste being sent for disposal, BAT is to set up and implement a waste management plan as part of the environmental management system (see BAT 1) that, in order of priority, ensures that waste is prevented, prepared for reuse, recycled or otherwise recovered</td><td>Yes</td><td>All waste arisings from the site will be managed in accordance with the existing site waste handling and management procedures which are an integrated part of the site management systems.
This will include periodic review of the nature of the waste and its characteristics, and maintaining records of all waste removed from site in line with the required Duty of Care.
All site waste will be sent offsite for reuse, recycling or disposal with the disposal route being selected in line with the waste hierarchy.</td></tr>
<tr><td>BATc 14</td><td>In order to reduce the volume of waste water sludge requiring further treatment or disposal, and to reduce its potential environmental impact, BAT is to use one or a combination of the techniques given below.
<table><tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>(a)</td><td>Conditioning</td><td>Chemical conditioning (i.e. adding coagulants and/or flocculants) or thermal conditioning (i.e. heating) to improve the conditions during</td><td>Not applicable to inorganic sludges. The necessity for conditioning depends on the sludge properties and on the thickening/dewatering equipment used</td></tr></table></td><td>N/A</td><td>Not Applicable
No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td><table>
<tr><td></td><td></td><td>sludge thickening/dewatering.</td><td></td></tr>
<tr><td>(b)</td><td>Thickening/dewatering</td><td>Thickening can be carried out by sedimentation, centrifugation, flotation, gravity belts, or rotary drums. Dewatering can be carried out by belt filter presses or plate filter presses.</td><td>Generally applicable.</td></tr>
<tr><td>(c)</td><td>Stabilisation</td><td>Sludge stabilisation includes chemical treatment, thermal treatment, aerobic digestion, or anaerobic digestion.</td><td>Not applicable to inorganic sludges. Not applicable for short-term handling before final treatment.</td></tr>
<tr><td>(d)</td><td>Drying</td><td>Sludge is dried by direct or indirect contact with a heat source.</td><td>Not applicable to cases where waste heat is not available or cannot be used.</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table></td><td></td><td></td></tr>
<tr><td colspan="2">5. Emissions to Air</td><td></td><td></td></tr>
<tr><td>BATc 15</td><td>Waste Gas Collection
In order to facilitate the recovery of compounds and the reduction of emissions to air, BAT is to enclose the emission sources and to treat the emissions, where possible.
The applicability may be restricted by concerns on operability (access to equipment), safety (avoiding concentrations close to the lower explosive limit) and health (where operator access is required inside the enclosure).</td><td>Yes</td><td>All potential emissions to air from the new process have been identified and quantified.
The process emissions to air are directed to a single emission point with appropriate abatement systems
Condensers are installed for VOC abatement/recovery, with subsequent treatment in a wet chemical (caustic) scrubber.
Potential air quality and environmental impacts have been assessed as part of the application for Permit variation.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td>BATc 16</td><td>Waste Gas Treatment
In order to reduce emissions to air, BAT is to use an integrated waste gas management and treatment strategy that includes process-integrated and waste gas treatment techniques.
The integrated waste gas management and treatment strategy is based on the inventory of waste gas streams (see BAT 2) giving priority to process-integrated techniques.</td><td>Yes</td><td>Due to the nature of the site operations and the ability of each of the main site processes to be operated independently of each other, an integrated approach the waste gas treatment is not suitable.
See BAT 15 for details on the systems installed for the new process plant covered under this application for variation.</td></tr>
<tr><td>BATc 17</td><td>Flaring
In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or non-routine operational conditions (e.g. start-ups, shutdowns) by using one or both of the techniques given below.
<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>(a)</td><td>Correct plant design</td><td>This includes the provision of a gas recovery system with sufficient capacity and the use of high-integrity relief valves.</td><td>Generally applicable to new plants. Gas recovery systems may be retrofitted in existing plants.</td></tr>
<tr><td>(b)</td><td>Plant management</td><td>This includes balancing the fuel gas system and using advanced process control.</td><td>Generally applicable.</td></tr>
</table></td><td>N/A</td><td>Not applicable - no flaring is undertaken from the new process</td></tr>
<tr><td>BATc 18</td><td>Flaring
In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use one or both of the techniques given below.
<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>(a)</td><td>Correct design of flaring devices</td><td>Optimisation of height, pressure, assistance by steam, air or gas, type of flare tips (either enclosed or shielded), etc., aimed to enable smokeless and reliable operation and to ensure the efficient</td><td>Applicable to new flares. In existing plants, applicability may be restricted due to e.g. maintenance time availability during the turnaround of the plant.</td></tr>
</table></td><td>N/A</td><td>Not applicable - no flaring is undertaken from the new process</td></tr>
</table>

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	<table><tr><td></td><td></td><td>combustion of excess gases.</td><td></td></tr><tr><td>(b)</td><td>Monitoring and recording as part of flare management</td><td>Continuous monitoring of the gas sent to flaring, measurements of gas flow and estimations of other parameters (e.g. composition, heat content, ratio of assistance, velocity, purge gas flow rate, pollutant emissions (e.g. NOX, CO, hydrocarbons, noise)). The recording of flaring events usually includes the estimated/ measured flare gas composition, the estimated/measured flare gas quantity and the duration of operation. The recording allows for the quantification of emissions and the potential prevention of future flaring events.</td><td>Generally applicable.</td></tr></table>		
BATc 19	**Diffuse VOC Emissions** In order to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to use a combination of the techniques given below. The associated monitoring is in BAT 5. <table><tr><th></th><th>Technique</th><th>Applicability</th></tr><tr><td colspan="3">*Techniques related to plant design*</td></tr></table>	Yes	The processing plant has been designed to minimise diffuse VOC emissions where possible through the routing of emissions from the process reactor and associated systems into an emissions abatement system (condenser / scrubber). The following techniques have been applied to the process design: a) the number of potential emission sources has been limited. b) The process has been designed to capture all VOC into channelled emission control system where possible c) high integrity equipment has been specified for handling VOC materials where possible

BATc No.	BAT Justification			Operating to BAT	Demonstration of BAT Compliance
	(a)	Limit the number of potential emission sources	Applicability may be restricted in the case of existing plants due to operability requirements.		d) all process plant equipment has been designed to be readily accessible for maintenance e) plant assembly will be subject to pre-planned installation processes and acceptance testing to minimise potential for leaks. f) plant commissioning will be subject to pre-planned testing and processes to minimise potential for leaks. g) all VOC handling equipment will be subject to pre-planned inspection and maintenance / repair
	(b)	maximise process-inherent containment features			
	(c)	select high-integrity equipment			
	(d)	facilitate maintenance activities by ensuring access to potentially leaky equipment			
	Techniques related to plant/equipment construction, assembly and commissioning				
	(e)	Ensure well-defined and comprehensive procedures for plant/equipment construction and assembly. This includes using designed gasket stress for flanged joint assembly			
	(f)	ensure robust plant/equipment commissioning and handover procedures in line with the design requirements			
	Techniques related to plant operation				
	(g)	Ensure good maintenance and timely	Generally applicable.		

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td><table><tr><td></td><td>replacement of equipment</td><td></td></tr><tr><td>(h)</td><td>Use a risk based leak detection and repair programme</td><td></td></tr><tr><td>(i)</td><td>As far is it is reasonable, prevent diffuse VOC emissions, collect them at source and treat them</td><td></td></tr></table>The associated monitoring is in BAT5</td><td></td><td></td></tr>
<tr><td>BATc 20</td><td>Odour Emissions
In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:
(i) a protocol containing appropriate actions and timelines;
(ii) a protocol for conducting odour monitoring;
(iii) a protocol for response to identified odour incidents;
(iv) an odour prevention and reduction programme designed to identify the source(s); to measure/estimate odour exposure; to characterise the contributions of the sources; and to implement prevention and/or reduction measures.
The associated monitoring is in BAT 6.
The applicability is restricted to cases where odour nuisance can be expected or has been substantiated.</td><td>N/A</td><td>Not Applicable
The proposed new process operations at the installation are not expected to handle or produce any particularly odorous materials. The most odorous material would be epichlorhydrin. However, emissions of epichlorhydrin will be abated by the scrubber to below the BAT AEL of 2mg/Nm³ and is not expected to lead to any offsite odour impacts given that the odour threshold is 0.93ppm.

An odour management plan is therefore not required</td></tr>
<tr><td>BATc 21</td><td>Odour
In order to prevent or, where that is not practicable, to reduce odour emissions from waste water collection and treatment and from sludge treatment, BAT is to use one or a combination of the techniques given below.<table><tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>(a)</td><td>Minimise residence times</td><td>Minimise the residence time of waste water and sludge in collection and storage systems, in</td><td>Applicability may be restricted in the case of existing collection and storage systems.</td></tr></table></td><td>N/A</td><td>Not Applicable
No change to current site wastewater collection and treatment operations as a result of the changes proposed under this variation.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>particular under anaerobic conditions.</td><td></td></tr>
<tr><td>(b)</td><td>Chemical treatment</td><td>Use chemicals to destroy or to reduce the formation of odorous compounds (e.g. oxidation or precipitation of hydrogen sulphide).</td><td>Generally applicable.</td></tr>
<tr><td>(c)</td><td>Optimise aerobic treatment</td><td>This can include: (i) controlling the oxygen content; (ii) frequent maintenance of the aeration system; (iii) use of pure oxygen; (iv) removal of scum in tanks.</td><td>Generally applicable.</td></tr>
<tr><td>(d)</td><td>Enclosure</td><td>Cover or enclose facilities for collecting and treating waste water and sludge to collect the odorous waste gas for further treatment.</td><td>Generally applicable.</td></tr>
<tr><td>(e)</td><td>End-of-pipe treatment</td><td>This can include: (i) biological treatment; (ii) thermal oxidation.</td><td>Biological treatment is only applicable to compounds that are easily soluble in water and readily bio eliminable.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 22</td><td>Noise Emissions
In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to set up and implement a noise management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:
(i) a protocol containing appropriate actions and timelines;</td><td>Yes</td><td>The proposed new plant does not include any equipment likely to lead to any significant noise emissions.
The new process plant is expected to have relatively low noise levels which will have a similar noise profile to the existing activities undertaken at the installation and hence no particular change to the overall site noise profile is expected.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>(ii) a protocol for conducting noise monitoring;
(iii) a protocol for response to identified noise ;
(iv) a noise prevention and reduction programme designed to identify the source(s), to measure/estimate noise exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.</td><td></td><td>The new plant is located on an existing industrial site and in an area surrounded by other industrial sites and operations.
• The nearest residential property is located approximately 1.1km to the west of the site at Turing Avenue.
• The closest educational facility is Wolverham Primary & Nursery School which is approximately 1.3km to the southwest of the site.
• There are no hospitals within 2km of the site
The site has not received any historical noise complaints.
Given the nature of the new plant, the relatively low potential for significant noise generation and the surrounding land use, no significant noise impacts are expected as a result of the operation of the new plant.
A Noise Management Plan is therefore not considered to be required</td></tr>
<tr><td>BATc 23</td><td>**Noise Emissions**
In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>(a)</td><td>Appropriate location of equipment and buildings</td><td>Increasing the distance between the emitter and the receiver and using buildings as noise screens.</td><td>For existing plants, the relocation of equipment may be restricted by a lack of space or excessive costs.</td></tr>
<tr><td>(b)</td><td>Operational measures</td><td>This includes: (i)improved inspection and maintenance of equipment; (ii) closing of doors and windows of enclosed areas, if possible; (iii)equipment operation by experienced staff; (iv) avoidance of noisy activities at night, if possible; (v)provisions for</td><td>Generally applicable.</td></tr>
</table></td><td>Yes</td><td>See response to BAtc 22
Noise emissions from the installation will be minimised as follows:
a) The new processing systems are located a significant distance from potential receptors- see BATc 22
b) i) Process equipment will be subject to preplanned inspection and maintenance to minimise the potential for abnormal noise emissions.
iii) Site staff will be appropriately trained and competent and made aware of potential noise hazards and their management.
iv) Potential noisy activities will be minimised at night.
c) All process plant equipment has been specified to achieve a pre-determined maximum noise level to ensure operator protection within the building and correspondingly minimise offsite noise emissions.
d) The building will provide some acoustic attenuation of noise sources within the building.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th colspan="4">BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td></td><td></td><td>noise control during maintenance activities.</td><td></td><td></td><td>Potential for noise generation from the operation of pumps, fans, drivers, motors, and the caustic scrubber have been minimised through appropriate design and plant selection.</td></tr>
<tr><td></td><td>(c)</td><td>Low-noise equipment</td><td>This includes low-noise compressors, pumps and flares.</td><td>Applicable only when the equipment is new or replaced.</td><td></td><td></td></tr>
<tr><td></td><td>(d)</td><td>Noise-control equipment</td><td>This includes: (i) noise-reducers; (ii) equipment insulation; (iii) enclosure of noisy equipment; (iv) soundproofing of buildings.</td><td>Applicability may be restricted due to space requirements (for existing plants), health, and safety issues.</td><td></td><td></td></tr>
<tr><td></td><td>(e)</td><td>Noise abatement</td><td>Inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).</td><td>Applicable only to existing plants; since the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may be restricted by a lack of space.</td><td></td><td></td></tr>
</table>

Appendix C UK Common Waste Gas Management and Treatment Systems in the Chemical Sector BATc

Environmental Permit Variation – Supporting Documentation Appendix C - BAT Conclusion Compliance Assessment

Ellesmere Port Active Chemicals

Innospec Limited

SLR Project No.: 410.067515.00001

12 March 2026

Table C1: Assessment of BAT Compliance – UK Common Waste Gas Management and Treatment Systems in the Chemical Sector BAT Conclusions (UK WGC) – Formal Draft 2025

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
Scope	These BAT conclusions concern the activities specified in Schedule 1, Part 2, Chapter 4 of the Environmental Permitting (England and Wales) Regulations 2016 (as amended) – The chemical industry (i.e. all production processes included in the categories of activities listed in points 4.1 to 4.7). More specifically, these BAT conclusions focus on emissions to air from the aforementioned activity. **Relationship with other BAT conclusions for the chemicals sector** WGC BATC are applicable to the whole of the chemicals sector and is a companion document to the CWW BATC. The WGC BATC are complementary to the process specific BATC for the chemicals sector as listed in the examples below. • Emissions to air from the production of chlorine, hydrogen, and sodium/potassium hydroxide by the electrolysis of brine. This is covered by the BATC for the Production of Chlor-alkali (CAK). • Channelled emissions to air from the production of the following chemicals in continuous processes where the total production capacity of those chemicals exceeds 20 kt/yr: a. lower olefins using the steam cracking process; b. formaldehyde; c. ethylene oxide and ethylene glycols; d. phenol from cumene; e. dinitrotoluene from toluene, toluene diamine from dinitrotoluene, toluene diisocyanate from toluene diamine, methylene diphenyl diamine from aniline, methylene diphenyl diisocyanate from methylene diphenyl diamine; f. ethylene dichloride (EDC) and vinyl chloride monomer (VCM); g. hydrogen peroxide. These are covered by the BATC for the Production of Large Volume Organic Chemicals (LVOC). NOTE: Channelled emissions to air of nitrogen oxides and carbon monoxide from thermal treatment of waste gases originating from the above production processes are included in the scope of the WGC BATC. • Emissions to air from the production of the following inorganic chemicals.	-	The BRef document applies as the main site activities are defined under Section 4.1 of Schedule 1 to the Environmental Permitting Regulations 2016. **Note that the UK BAT Conclusions for the Common Waste Gas Management and Treatment Systems in the Chemical Sector have not yet been enacted in UK law.** **Innospec proposes to implement the requirements of the UK WGC BAT Conclusions once this is implemented in UK legislation.** **This will be undertaken on a sitewide basis.** **Compliance with the BATc will be implemented within 4 years of the formal publication of the BATc as a UK statutory instrument.**

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	a. ammonia; b. ammonium nitrate; c. calcium ammonium nitrate; d. calcium carbide; e. calcium chloride; f. calcium nitrate; g. carbon black; h. ferrous chloride; i. ferrous sulphate (i.e. copperas and related products, such as chlorosulphates); j. hydrofluoric acid; k. inorganic phosphates; l. nitric acid; m. nitrogen-, phosphorus- or potassium-based fertilisers (simple or compound fertilisers); n. phosphoric acid; o. precipitated calcium carbonate; p. sodium carbonate and sodium bicarbonate (i.e. soda ash manufacturing-processes); q. sodium chlorate; r. sodium silicate; s. sulphuric acid; t. synthetic amorphous silica; u. titanium dioxide and related products; v. urea; w. urea-ammonium nitrate. These production processes are likely to fall under the BATC for producing large volume inorganic chemicals (LVIC). • Emissions to air from steam reforming as well as from the physical purification and reconcentration of spent sulphuric acid, provided that these processes are directly associated with a production process listed under LVOC or LVIC. **Examples of emissions to air not within the scope of WGC UK BAT**		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	a. Combustion units other than process furnaces/heaters. This activity is likely to fall under requirements for large or medium combustion plants, or the BATC for refining mineral oil and gas. b. Process furnaces/heaters with a total rated thermal input below 1 MW. c. Emissions to air from waste incineration plants, which are likely to fall under the BATC for waste incineration. d. Emissions to air from the storage, transfer and handling of liquids, liquefied gases and solids, where these are not directly associated with the activity. e. Emissions to air from indirect cooling systems, which are likely to be covered by the BATC for industrial cooling system. **Other relevant BATC** Other EU BREF/BATC and reference documents which could be relevant for the activities covered by these BATC include the following: a. Common Wastewater and Waste Gas Treatment/Management Systems in the Chemical Sector (CWW); b. Production of Chlor-alkali (CAK); c. Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers (LVIC-AAF); d. Manufacture of Large Volume Inorganic Chemicals – Solids and Others Industry (LVIC-S); e. Production of Large Volume Organic Chemicals (LVOC); f. Manufacture of Organic Fine Chemicals (OFC); g. Production of Polymers (POL); h. Production of Specialty Inorganic Chemicals (SIC); i. Refining of Mineral Oil and Gas (REF); j. Economics and Cross-media Effects (ECM); k. Emissions from Storage (EFS); l. Energy Efficiency (ENE); m. Industrial Cooling Systems (ICS); n. Large Combustion Plants (LCP); o. Monitoring of Emissions to Air and Water from IED installations (ROM); p. Waste Incineration (WI); q. Waste Treatment (WT).		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
BAT conclusions – general			
BATc 1	To improve and maintain overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features: a. management commitment, leadership, and accountability, including senior management, for the implementation of an effective EMS; b. an analysis that includes the organisation's context, the needs and expectations of interested parties, and the characteristics of the installation that are associated with possible risks for the environment including human health; as well as the applicable legal requirements relating to the environment; c. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation; d. establishing objectives and performance indicators in relation to the significant environmental aspects, including safeguarding compliance with applicable legal requirements; e. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks; f. determination of structures, roles and responsibilities in relation to the environmental aspects and objectives including the provision of the financial and human resources needed; g. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training); h. internal and external communication; i. fostering employee involvement in good environmental management practices; j. establishing and maintaining a management manual, written procedures to control activities with significant environmental impact, and records that demonstrate compliance and record non-compliances; k. effective operational planning and process control; l. implementation of appropriate maintenance programmes;	Yes	Innospec's Ellesmere Port Integrated Management System (EPIMS) is in accordance with the requirements of ISO14001 and will include requirements to set key environmental performance targets and review performance at least annually. The EPIMS fully implements the requirements of BATc 1.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	m. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations; n. when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning; o. implementation of a monitoring and measurement programme; p. application of sectoral benchmarking on a regular basis; q. periodic internal auditing and independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; r. evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur; s. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness; t. following and considering the development of cleaner techniques. Specifically for the chemical sector, BAT is also to incorporate the following features in the EMS: u. an inventory of channelled and diffuse emissions to air (see BAT 2); v. an OTNOC management plan for emissions to air (see BAT 3); w. an integrated waste gas management and treatment strategy for channelled emissions to air (see BAT 4); x. a management system for diffuse VOC emissions to air (see BAT 19); y. provisions for the systematic management of chemicals (known as a chemicals management system [CMS]) that includes an inventory of the relevant hazardous substances and substances of very high concern used in the process(es); the potential for substitution of the substances that are listed in this inventory, focusing on those substances other than raw materials, is analysed periodically (e.g. annually) in order to identify possible new available and safer alternatives, with no or lower environmental impacts.		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
BATc 2	To facilitate the reduction of emissions to air, BAT is to establish, maintain and regularly review (including when a substantial change occurs) an inventory of channelled and diffuse emissions to air, as part of the environmental management system (see BAT 1), that incorporates all of the following features: a. information, as comprehensive as is reasonably possible, about the chemical production process(es), including: i. chemical reaction equations, also showing side products; ii. simplified process flow sheets that show the origin of the emissions; b. information, as comprehensive as is reasonably possible, about channelled emissions to air, such as: i. emission point(s); ii. average values and variability of flow and temperature; iii. average concentration and mass flow values of relevant substances/parameters and their variability (e.g., TVOC, CO, NO_X, SO_X, Cl_2, HCl); iv. presence of other substances that may affect the waste gas treatment system(s) or plant safety (e.g., oxygen, nitrogen, water vapour, dust); v. techniques used to prevent and/or reduce channelled emissions to air; vi. flammability, lower and higher explosive limits, reactivity; vii. monitoring methods (see BAT 8); viii. presence of substances classified as CMR 1A, CMR 1B or CMR 2; the presence of such substances may for example be assessed according to the criteria of Regulation (EC) 1272/2008 on classification, labelling and packaging (CLP). c. information, as comprehensive as is reasonably possible, about diffuse emissions to air, such as: i. identification of the emission source(s); ii. characteristics of each emission source (e.g., fugitive or non-fugitive; static or moving; accessibility of the emission source; included in an LDAR programme or not);	Yes	The site is compliant with the requirements of BATc 2. The site has comprehensive information and records in relation to the chemical reactions and process equipment used onsite. This includes process chemistry and process flow sheets. The site has a full understanding of emissions to air and the inventory of the emissions i) A full process design has been undertaken, and a full set of process design information will be available on site. ii) Details of the emission points and the expected composition and flow rates of the channelled emissions to air have been included in the design and data will be supplemented by monitoring as required under WGC BREF. Full details of the new process plant, its emissions and their potential impacts are included in Section 8.1 of the technical supporting document and the AERA.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	iii. the characteristics of the gas or liquid in contact with the emission source(s), including: 1. physical state; 2. vapour pressure of the substance(s) in the liquid, pressure of the gas; 3. temperature; 4. composition (by weight for liquids or by volume for gases); 5. hazardous properties of the substance(s) or mixtures, including substances or mixtures classified as CMR 1A, CMR 1B or CMR 2; iv. techniques used to prevent and/or reduce diffuse emissions to air; v. monitoring (see BAT 20, BAT 21 and BAT 22).		
BATc 3	To reduce the frequency of the occurrence of OTNOC and to reduce emissions to air during OTNOC, BAT is to set up and implement a risk based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the following features: a. identification of potential OTNOC (e.g., failure of equipment critical to the control of channelled emissions to air, or equipment critical to the prevention of accidents or incidents that could lead to emissions to air ('critical equipment')), of their root causes and of their potential consequences; b. appropriate design of critical equipment (e.g., equipment modularity and compartmentalisation, backup systems, techniques to obviate the need to bypass waste gas treatment during start-up and shutdown, high-integrity equipment, etc.); c. set-up and implementation of a preventive maintenance plan for critical equipment (see BAT 1, e); d. monitoring (i.e., estimating or, where this is possible, measuring) and recording of emissions and associated circumstances during OTNOC; e. periodic assessment of the emissions occurring during OTNOC (e.g., frequency of events, duration, amount of pollutants emitted as recorded in point d.) and implementation of corrective actions if necessary; f. regular review and update of the list of identified OTNOC under point a. following the periodic assessment of point e and.;	Yes	The site is an upper tier COMAH site and is operated subject to management systems. As part of these management systems, protocols have been introduced to manage OTNOC which are integrated into the site operational procedures. These include: • Plant standard operating procedures including monitoring of process operations and training in responding to OTNOC. • Basis of Safety requirements; • Identification of environmentally and safety critical plant; • Pre-planned inspection and maintenance schedules; • Reporting of inspection findings where defects have been identified; • Prioritisation of inspection and maintenance of critical plant items; • Loss of containment management and prevention procedures;

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	g. regular testing of backup systems.		• Flange and connection control procedures; • Accident /incident investigation procedures; • Emergency / incident response plan. OTNOC events would be investigated and corrective actions implemented where appropriate in line with the requirements of the EMS. Records of the OTNOC events would be maintained and inspected.
Channelled Emissions to Air			
BATc 4	To reduce channelled emissions to air, BAT is to use an integrated waste gas management and treatment strategy that includes, in order of priority, process integrated recovery and abatement techniques.	Yes	Due to the nature of the site operations and the ability of each of the main process units to be operated independently of each other, an integrated approach the waste gas treatment is not suitable. The new process plant has been designed to include a single emissions collection and abatement system (condenser / scrubber).
BATc 5	To facilitate the recovery of materials and the reduction of channelled emissions to air, as well as to increase energy efficiency, BAT is to combine waste gas streams with similar characteristics, thus minimising, where appropriate, the number of emission points	Yes	There is only one new emission point as a result of the proposed changes – see BATc 4 above.
BATc 6	To reduce channelled emissions to air, BAT is to ensure that the waste gas treatment systems are appropriately designed (e.g., considering the maximum flow rate and pollutant concentrations), operated within their design ranges, and maintained (through preventive, corrective, regular and unplanned maintenance) so as to ensure optimal availability, effectiveness and efficiency of the equipment.	Yes	All waste gas treatment systems have been appropriately designed.
BATc 7	BAT is to continuously monitor key process parameters (e.g., waste gas flow and temperature) for waste gas streams being sent to pre-treatment and/or final treatment.	Yes	There is no integrated waste gas treatment system. Hence there are no separate waste streams being sent for treatment.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td></td><td></td><td>The new process plant has been designed with dedicated emissions abatement (condenser / scrubber). The reaction process parameters are monitored as part of the process control and the control of the reaction process will determine the emission levels. Key parameters on the abatement systems e.g pH / Level are also monitored to ensure that they are operating correctly.</td></tr>
<tr><td>BATc 8</td><td>BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with BS EN standards. If BS EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Table 9: Monitoring of Channelled Emissions to Air

<table>
<tr><th>Substance / Parameter</th><th>Specific Process(es)</th><th>Emission Points</th><th>Standard(s) (1)</th><th>Minimum Monitoring Frequency (2)</th><th>Monitoring Associated With</th></tr>
<tr><td rowspan="2">Ammonia (NH_3)</td><td>Use of SCR/SNCR</td><td rowspan="2">Any stack</td><td rowspan="2">BS EN 21877</td><td rowspan="2">Once every 6 months (3) (4)</td><td>BAT 17</td></tr>
<tr><td>All other processes / sources</td><td>BAT 18</td></tr>
<tr><td>Benzene</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)(4)</td><td>BAT 11</td></tr>
<tr><td>1,3-Butadiene</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)(4)</td><td>BAT 11</td></tr>
<tr><td rowspan="3">Carbon monoxide (CO)</td><td rowspan="2">Thermal treatment</td><td>Any stack with a CO mass flow of ≥ 2 kg/h</td><td>Generic EN standards (5)</td><td>Continuous</td><td rowspan="2">BAT 16</td></tr>
<tr><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058</td><td>Once every 6 months (3)(4)</td></tr>
<tr><td>Process furnace/heaters</td><td>Any stack with a CO</td><td>Generic EN standards (5)</td><td>Continuous (6)</td><td>BAT 24</td></tr>
</table>
</td><td>Yes</td><td>Where required, monitoring of TVOC's will be in accordance with EN12619 or EN ISO 13199, with periodic monitoring to be undertaken at least once every 6 months for the first year of operation.

Mass flow of TVOC is <2kgC/h.

Details of the monitoring proposed are presented in Section 8.1.4 of the main technical supporting document.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>mass flow of ≥ 2 kg/h</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058</td><td>Once every 6 months (3)(4)</td><td></td></tr>
<tr><td></td><td>All other processes / sources</td><td>Any stack with a CO mass flow of ≥ 2 kg/h</td><td>Generic EN standards (5)</td><td>Continuous</td><td>BAT 18</td></tr>
<tr><td></td><td></td><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058</td><td>Once every 6 months (3)(7)</td><td></td></tr>
<tr><td>Chloromethane</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td>Substances other than CMR substances covered elsewhere in this table (8)</td><td>All other processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td>Dichloromethane</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td>Dust</td><td>All processes / sources</td><td>Any stack with dust mass flow ≥ 3 kg/h</td><td>Generic BS EN standards (5)</td><td>Continuous (9)</td><td>BAT 14</td></tr>
<tr><td></td><td></td><td>Any stack with dust mass flow < 3 kg/h</td><td>BS EN 13284-1</td><td>Once every year (3)(7)</td><td></td></tr>
<tr><td>Elemental chlorine (Cl_2)</td><td>All processes / sources</td><td>Any stack</td><td>US EPA 26A</td><td>Once every year (3) (7)</td><td>BAT 18</td></tr>
<tr><td>Ethylene dichloride (EDC)</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td>Ethylene oxide</td><td>All processes / sources</td><td>Any stack</td><td>BS EN/TS 13649</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
</table>
</td><td></td><td></td></tr>
</table>

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance

Formaldehyde	All processes / sources	Any stack	BS EN/TS 13649	Once every 6 months (3)	BAT 11
Gaseous chlorides	All processes / sources	Any stack	US EPA 26	Once every year (3)(7)	BAT 18
Gaseous fluorides	All processes / sources	Any stack	US EPA 26	Once every year (3)(7)	BAT 18
Hydrogen cyanide (HCN)	All processes / sources	Any stack	US EPA OTM29	Once every year (3)(7)	BAT 18
Lead and its compounds	All processes / sources	Any stack	BS EN 14385	Once every 6 months (3)(10)	BAT 14
Nickel and its compounds	All processes / sources	Any stack	BS EN 14385	Once every 6 months (3)(10)	BAT 14
Nitrous Oxide (N_2O)	All processes / sources	Any stack	BS EN ISO 21258	Once every year (3)(7)	Table 4 – Techniques to reduce channelled emissions to air
Nitrogen oxides (NO_x)	Thermal treatment	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous	BAT 16
		Any stack with a NO_x mass flow of <2.5 kg/h	BS EN 14792	Once every 6 months (3)(4)	
	Process furnace / heaters	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous (6)	BAT 24
		Any stack with a NO_x mass flow of <2.5 kg/h	EN 14792	Once every 6 months (3)(4)	
	All other processes / sources	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous	BAT 18
		Any stack with a NO_x mass flow of <2.5 kg/h	BS EN 14792	Once every 6 months (3)(4)	
PCDD/F	Thermal treatment	Any stack	BS EN 1948-1,	Once every 6 months (3)(10)	BAT 12

BATc No.	BAT Justification						Operating to BAT	Demonstration of BAT Compliance
				BS EN 1948-2, BS EN 1948-3				
	PM$_{2.5}$ and PM$_{10}$	All processes / sources	Any stack	BS EN ISO 23210	Once every year (3)(7)	BAT 14		
	Propylene oxide	All processes / sources	Any stack	BS EN/TS 13649	Once every 6 months (3)	BAT 11		
	Sulphur dioxide (SO_2)	Thermal treatment	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous	BAT 16		
			Any stack with a SO_2 mass flow of <2.5kg/h	BS EN 14791	Once every 6 months (3)(4)			
		Process furnaces / heaters	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous (6)	BAT 18, BAT 24		
			Any stack with a SO_2 mass flow of <2.5kg/h	BS EN 14791	Once every 6 months (3)(4)			
		All other processes / sources	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic BS EN standards (5)	Continuous	BAT 18		
			Any stack with a SO_2 mass flow of <2.5kg/h	BS EN 14791	Once every 6 months (3)(4)			
	Tetrachloro-methane	All processes / sources	Any stack	BS EN/Ts 13649	Once every 6 months (3)	BAT 11		
	Toluene	All processes / sources	Any stack	BS EN/TS 13649	Once every 6 months (3)	BAT 11		
	Trichloromethane	All processes / sources	Any stack	BS EN/TS 13649	Once every 6 months (3)	BAT 11		
	Total volatile organic carbon (TVOC)	Production of polyolefins (11)	Any stack with a TVOC mass flow of ≥ 2 kg C/h	Generic BS EN standards (5)	Continuous	BAT 11, BAT 26		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance

		Any stack with a TVOC mass flow of < 2 kg C/h	BS EN 12619	Once every 6 months (3)(4)	
	Production of synthetic rubber (12)	Any stack with a TVOC mass flow of ≥ 2 kg C/h	Generic BS EN standards (5)	Continuous	BAT 11, BAT 20
		Any stack with a TVOC mass flow of < 2 kg C/h	BS EN 12619	Once every 6 months (3)(4)	
	All other processes / sources	Any stack with a TVOC mass flow of ≥ 2 kg C/h	Generic BS EN standards (5)	Continuous	BAT 11
		Any stack with a TVOC mass flow of < 2 kg C/h	BS EN 12619	Once every 6 months (3)(4)	
Flow	As applicable	Any stack	BS EN ISO 16911-1 (periodic), BS EN ISO 16911-2 (continuous)	As applicable	As applicable

[1] Measurements are carried out according to BS EN 15259. This standard describes methods to determine mass-flow.
[2] The monitoring only applies when the substance/parameter concerned is identified as relevant in the waste gas stream based on the inventory given in BAT 6.
[3] To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.
[4] The minimum monitoring frequency may be reduced to once every year or once every 3 years if the emission levels are proven to be sufficiently stable.
[5] Generic BS EN standards for continuous measurements are BS EN 14181, BS EN 15267-1, BS EN 15267-2 and BS EN 15267-3.
[6] In the case of process furnaces/heaters with a total rated thermal input of less than 100 MW operated less than 500 hours per year, the minimum monitoring frequency may be reduced to once every year. The methods and standards in the above table still apply.
[7] The minimum monitoring frequency may be reduced to once every 3 years if the emission levels are proven to be sufficiently stable.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>[8] i.e. other than benzene, 1,3-butadiene, chloromethane, dichloromethane, ethylene dichloride, ethylene oxide, formaldehyde, propylene oxide, tetrachloromethane, toluene, trichloromethane. This means any other CMR chemicals included in the mixture of stack gas and classed as VOCs.
[9] The minimum monitoring frequency may be reduced to once every 6 months if the emission levels are proven to be sufficiently stable.
[10] The minimum monitoring frequency may be reduced to once every year if the emission levels are proven to be sufficiently stable.
[11] In the case of the production of polyolefins, the monitoring of TVOC emissions from finishing steps (e.g. drying, blending) and from polymer storage may be complemented by the monitoring in BAT 29 if it provides a better representation of the TVOC emissions.
BS EN 12619 measures emissions as total carbon, regardless of the type of VOCs measured in the stack-gas mixture. This includes any VOC CMR chemicals.
[12] In the case of the production of synthetic rubbers, the monitoring of TVOC emissions from finishing steps (e.g. extrusion, drying, blending) and from synthetic rubber storage may be complemented by the monitoring in BAT 36 if it provides a better representation of the TVOC emissions.</td><td></td><td></td></tr>
<tr><td colspan="2">BAT conclusions - efficiency</td><td></td><td></td></tr>
<tr><td>BATc 9</td><td>To increase resource efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to recover organic compounds from process off-gases by using one or a combination of the techniques given below and to reuse them.
Table 10: Raw Material Efficiency
<table>
<tr><th colspan="2">Techniques</th><th>Description</th></tr>
<tr><td>a.</td><td>Absorption (regenerative)</td><td>See Table 4</td></tr>
<tr><td>b.</td><td>Adsorption (regenerative)</td><td>See Table 4</td></tr>
<tr><td>c.</td><td>Condensation</td><td>See Table 4</td></tr>
</table></td><td>Yes</td><td>Emissions from A14 are abated using a water-cooled condenser for VOC recovery followed by the caustic scrubber.</td></tr>
<tr><td>BATc 10</td><td>To increase energy efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to send process off-gases with a sufficient calorific value to a combustion unit that is, if technically possible, combined with heat recovery. BAT 9 has priority over sending process off-gases to a combustion unit.</td><td>N/A</td><td>Not applicable – process off-gases are not sent to a combustion unit.</td></tr>
<tr><td colspan="4">BAT Conclusions - emissions</td></tr>
<tr><td>BATc 11</td><td>To reduce channelled emissions to air of organic compounds, BAT is to use one or a combination of the techniques given below.</td><td>Yes</td><td>Emissions from A14 are abated using a water-cooled condenser followed by the caustic scrubber.
The system has been designed to achieve epichlorohydrin emissions of below the IED Annex VII Emission Limit Value (ELV) of 2mg/Nm³ and to abate VOC's to below the</td></tr>
</table>

Table 11: Emissions of organic compounds

Technique		Description	Applicability
a.	Adsorption	See Table 4	Generally applicable.
b.	Absorption	See Table 4	Generally applicable.
c.	Catalytic oxidation	See Table 4	Applicability may be restricted by the presence of catalyst poisons in the waste gases.
d.	Condensation	See Table 4	Generally applicable.
e.	Thermal oxidation	See Table 4	Applicability of recuperative and regenerative thermal oxidation to existing plants may be restricted by design and/or operational constraints. Applicability may be restricted where the energy demand is excessive due to the low concentration of the compound(s) concerned in the process off-gases.
f.	Bioprocesses	See Table 4	Only applicable to the treatment of biodegradable compounds.

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of organic compounds.

Table 12: BAT associated emission levels (BAT-AELs) for channelled emissions to air of organic compounds

Substance / Parameter	BAT-AEL (mg/Nm^3) Daily average or average over the sampling period (1)
Total volatile organic carbon (TVOC)	< 1 – 20 (2)(3)(4)(5)
Sum of VOCs classified as CMR 1A or 1B	< 1 - 5 (6)
Sum of VOCs classified as CMR 2	< 1 - 10 (7)
Benzene	< 0.5 - 1 (8)

relevant BAT-AEL's. See Section 8.1.2 of the Main Technical Supporting Document.

Due to the low mass emission rates predicted, the BAT-AEL's for Total VOC and toluene are not expected to be applicable.

The BAT-AEL for 'Sum of VOCs classified as CMR 1A or 1B' of <1 – 5 mg/Nm^3 will apply as the calculated maximum mass emission of epichlorhydrin is 8.64 g/h.

The plant has been designed to comply with this BAT-AEL and achieve an emission concentration below 2mg/Nm^3.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance

1,3-Butadiene	< 0.5 - 1 (8)
Ethylene dichloride	< 0.5 - 1 (8)
Ethylene oxide	<0.5 – 1(8)
Propylene oxide	<0.5 – 1(8)
Formaldehyde	1 - 5 (8)
Chloromethane	< 0.5 - 1 (9)(10)
Dichloromethane	< 0.5 - 1 (9)(10)
Tetrachloromethane	< 0.5 - 1 (9)(10)
Toluene	< 0.5 - 1 (9)(11)
Trichloromethane	< 0.5 - 1 (9)(10)

[1] For activities listed under points 8 and 10, Part 1 of Annex VII of the IED, the BAT-AEL ranges apply to the extent that they lead to lower emission levels than the emission limit values in part 2 and 4 of Annex VII to the IED.

[2] TVOC is expressed in mg C/Nm^3.

[3] In the case of polymer production, the BAT-AEL may not apply to emissions from the finishing steps (e.g., extrusion, drying, blending) and from polymer storage.

[4] The BAT-AEL does not apply to minor emissions (i.e., when the TVOC mass flow is below e.g., 100 g C/h) if no CMR substances are identified as relevant in the waste gas stream based on the inventory given in BAT 2.

[5] The upper end of the BAT-AEL range may be higher and up to 30 mg C/Nm^3 when using techniques to recover materials (e.g., solvents, see BAT 9), if both of the following conditions are fulfilled:

- the presence of substances classified as CMR 1A/1B or CMR 2 is identified as not relevant (see BAT 2);
- the TVOC abatement efficiency of the waste gas treatment system is ≥ 95 %.

[6] The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the sum of the VOCs classified as CMR 1A or 1B is below e.g., 1 g/h).

[7] The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the sum of the VOCs classified as CMR 2 is below e.g., 50 g/h).

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>[8] The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 1 g/h).
[9] The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 50 g/h).
[10] The upper end of the BAT-AEL range may be higher and up to 15 mg/Nm^3 when using techniques to recover materials (e.g., solvents, see BAT 9), if the abatement efficiency of the waste gas treatment system is $\geq$ 95 %.
[11] The upper end of the BAT-AEL range may be higher and up to 20 mg/Nm^3 when using techniques to recover toluene (see BAT 9), if the abatement efficiency of the waste gas treatment system is $\geq$ 95 %.</td><td></td><td></td></tr>
<tr><td>BATc 12</td><td>To reduce channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds, BAT is to use techniques a. and b., and one or a combination of techniques c. to e. given below.
Table 13: Techniques to reduce PCDD/F emissions
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td colspan="4"><i>Specific techniques to reduce PCDD/F emissions</i></td></tr>
<tr><td>a.</td><td>Optimised catalytic or thermal oxidation</td><td>See Table 4</td><td>Generally applicable.</td></tr>
<tr><td>b.</td><td>Rapid waste-gas cooling</td><td>Rapid cooling of waste gases from temperatures above 400°C to below 250°C to prevent the de novo synthesis of PCDD/F.</td><td>Generally applicable.</td></tr>
<tr><td>c.</td><td>Adsorption using activated carbon.</td><td>See Table 4.</td><td>Generally applicable.</td></tr>
<tr><td>d.</td><td>Absorption</td><td>See Table 4</td><td>Generally applicable.</td></tr>
<tr><td>e.</td><td>Selective catalytic reduction (SCR) (1)</td><td>See Table 4
When SCR is used for NO_X abatement, an adequate catalyst surface of the SCR system also provides for the</td><td>Applicability to existing plants may be restricted by space availability and/or by the presence of catalyst</td></tr>
</table></td><td>N/A</td><td>Not applicable – there is no thermal treatment of waste gases associated with the new plant.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>partial reduction of the emissions of PCDD/F.</td><td>poisons in the waste gases.</td></tr>
<tr><td colspan="4">(1) SCR technique is not primarily used to reduce PCDD/F emissions.</td></tr>
</table>
<p>BAT-associated emission level (BAT-AEL) for channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds.</p>
<p>Table 14: BAT associated emission level (BAT-AEL) for channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds</p>
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (ng I-TEQ / Nm^3)
Average over the sampling period</th></tr>
<tr><td>PCDD/F</td><td>< 0.01 - 0.05</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td colspan="4">BAT Conclusions for dust and PM$_{10}$ – PM$_{2.5}$</td></tr>
<tr><td>BATc 13</td><td>To increase resource efficiency and to reduce the mass flow of dust and particulate-bound metals sent to the final waste gas treatment, BAT is to recover materials from process off-gases by using one or a combination of the dust reduction techniques given in Table 4.</td><td>N/A</td><td>Not applicable – there are no particularly dusty processes resulting from the proposed changes.</td></tr>
<tr><td>BATc 14</td><td>
<p>To reduce channelled emissions to air of dust and particulate-bound metals, BAT is to use one or a combination of the techniques given below.</p>
<p>Table 15: Emissions of dust and particulate-bound metals</p>
<table>
<tr><th colspan="2">Techniques</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Absolute filter</td><td>See Table 4</td><td>Applicability may be limited in the case of sticky dust or when the temperature of the waste gases is below the dew point.</td></tr>
<tr><td>b.</td><td>Absorption</td><td>See Table 4.</td><td>General applicable.</td></tr>
<tr><td>c.</td><td>Fabric filter</td><td>See Table 4</td><td>Applicability may be limited in the case of sticky dust or when the temperature of the waste gases is below the dew point.</td></tr>
<tr><td>d.</td><td>High-efficiency air filter (HEAF)</td><td>See Table 4</td><td>General applicable.</td></tr>
<tr><td>e.</td><td>Cyclone</td><td>See Table 4.</td><td>General applicable.</td></tr>
</table>
</td><td>N/A</td><td>See above</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>f.</td><td>Electrostatic precipitator</td><td>See Table 4</td><td>General applicable.</td></tr>
</table>
<p>BAT-associated emission levels (BAT-EALs) for channelled emissions to air of dust, lead, and nickel.</p>
<p>Table 16: BAT associated emission levels (BAT-AELs) for channelled emissions to air of dust, lead and nickel</p>
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm^3)
Daily average or average over the sampling period</th></tr>
<tr><td>Dust</td><td>< 1 - 5 (1)(2)(3)(4)</td></tr>
<tr><td>Lead and its compounds, expressed as Pb</td><td>< 0.01 - 0.1 (5)</td></tr>
<tr><td>Nickel and its compounds, expressed as Ni</td><td>< 0.02 - 0.1 (6)</td></tr>
<tr><td colspan="2">[1] The upper end of the range is 20 mg/Nm^3 when either an absolute or a fabric filter is not applicable.
[2] The BAT-AEL does not apply when the dust mass flow is below 50 g/h if no CMR substances are identified as relevant in the dust based on the inventory given in BAT 2.
[3] In the case of the production of complex inorganic pigments using direct heating, and in the case of the drying step in the production of E-PVC, the upper end of the BAT-AEL range may be higher and up to 10 mg/Nm^3.
[4] Dust emissions are expected to be towards the lower end of the BAT-AEL range (e.g., below 2.5 mg/Nm^3) when the presence of substances classified as CMR 1A or 1B, or CMR 2 in the dust is identified as relevant (see BAT 2).
[5] The BAT-AEL does not apply when the lead mass flow is below 0.1 g/h.
[6] The BAT-AEL does not apply when the Ni mass flow is below 0.15 g/h.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td colspan="4">BAT Conclusions for inorganic emissions</td></tr>
<tr><td>BATc 15</td><td>To increase resource efficiency and to reduce the mass flow of inorganic compounds sent to the final waste gas treatment, BAT is to recover inorganic compounds from process off-gases by using absorption and to reuse them.</td><td>N/A</td><td>Not applicable – there are no inorganic emissions resulting from the proposed changes.</td></tr>
<tr><td>BATc 16</td><td>To reduce channelled emissions to air of CO, NOx and SOx from thermal treatment, BAT is to use technique c. and one or a combination of the other techniques given below.</td><td>N/A</td><td>Not applicable – there are no inorganic emissions resulting from the proposed changes.</td></tr>
</table>

Table 17: Techniques to reduce emissions of inorganic compounds from thermal treatment

Technique		Description	Applicability
a.	Choice of fuel	See Table 4	Generally applicable.
b.	Low-NOx burner	See Table 4	Applicability to existing plants may be restricted by design and/or operational constraints.
c.	Optimisation of catalytic or thermal oxidation	See Table 4	Generally applicable.
d.	Removal of high levels of NOx precursors	Remove (if possible, for reuse) high levels of NOx precursors prior to thermal or catalytic oxidation, e.g., by absorption, adsorption or condensation.	Generally applicable.
e.	Absorption	See Table 4 In the case of regenerative absorption, the compounds may be recovered from the liquid.	Generally applicable.
f.	Selective catalytic reduction (SCR)	See Table 4.	Applicability to existing plants may be restricted by space availability.
g.	Selective non catalytic reduction (SNCR)	See Table 4	Applicability to existing plants may be restricted by the residence time needed for the reaction.

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of NOx and indicative level for channelled emissions to air of CO from thermal treatment

Table 18: BAT-AELs for channelled emissions to air of Nox and indicative emission level of CO from thermal treatment

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm³)
(Daily average or average over the sampling period)</th></tr>
<tr><td>Nitrogen oxides (NOx) from catalytic oxidation</td><td>5 - 30 (1)</td></tr>
<tr><td>Nitrogen oxides (NOx) from thermal oxidation</td><td>5 – 130 (2)</td></tr>
<tr><td>Carbon monoxide (CO)</td><td>No BAT-AEL (3)</td></tr>
<tr><td colspan="2">(1) The upper end of the BAT-AEL range may be higher and up to 80 mg/Nm³ if the process off-gas(es) contain(s) high levels of NOx precursors.
(2) The upper end of the BAT-AEL range may be higher and up to 200 mg/Nm³ if the process off-gas(es) contain(s) high levels of NOx precursors.
(3) As an indication, the emission levels for carbon monoxide are 4 - 50 mg/Nm³, as a daily average or average over the sampling period.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 17</td><td>In order to reduce channelled emissions to air of ammonia from the use of selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for the abatement of NOx emissions (ammonia slip), BAT is to optimise the design and/or operation of SCR or SNCR (e.g., optimised reagent to NOx ratio, homogeneous reagent distribution and optimum size of the reagent drops).

BAT-associated emission level (BAT-AEL) for channelled emissions to air of ammonia from the use of SCR or SNCR (ammonia slip)

Table 19: BAT-AELs for channelled emissions to air of ammonia from the use of SCR or SNCR (ammonia slip)
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm³)
(Average over the sampling period)</th></tr>
<tr><td>Ammonia (NH_3) from SCR/SNCR</td><td>< 0.5 - 8 (1)</td></tr>
<tr><td colspan="2">(1) The upper end of the BAT-AEL range may be higher and up to 40 mg/Nm³ in the case of process off-gases containing very high levels of NOx (e.g., above 5,000 mg/Nm³) prior to treatment with SCR or SNCR.</td></tr>
</table>
</td><td>N/A</td><td>Not applicable – there are no inorganic emissions resulting from the proposed changes.</td></tr>
<tr><td>BATc 18</td><td>To reduce channelled emissions to air of inorganic compounds other than channelled emissions to air of ammonia from the use of SCR or SNCR for the abatement of NOx emissions, channelled emissions to air of CO, NOx and SOx from the use of thermal treatment, and channelled emissions to air of NOx from process furnaces/heaters, BAT is to use one or a combination of the techniques given below.</td><td>N/A</td><td>Not applicable – there are no inorganic emissions resulting from the proposed changes.</td></tr>
</table>

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance

Technique		Description	Main Inorganic Compounds Targeted	Applicability
a.	Absorption	See Table 4	Cl_2, HCl, HCN, HF, NH_3, NOx, SOx	Generally applicable.
b.	Adsorption	See Table 4 For the removal of inorganic substances, the technique is often used in combination with a dust abatement technique (see BAT 14).	HCl, HF, NH_3 SOx	Generally applicable.
c.	Selective catalytic reduction (SCR)	See Table 4	NOx	Applicability to existing plants may be restricted by space availability.
d.	Selective non-catalytic reduction (SNCR)	See Table 4	NOx	Applicability to existing plants may be restricted by the residence time needed for the reaction
e.	Catalytic oxidation (1)	See Table 4	NH_3	Applicability may be restricted by the presence of catalyst poisons in the waste gases.
f.	Thermal oxidation (1)	See Table 4	NH_3, HCN	Applicability of recuperative and regenerative thermal oxidation to existing plants may be restricted by design and/or operational constraints. The applicability may be restricted where the energy demand is excessive due to the low concentration of the

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance

				compound(s) concerned in the process off-gases.

(1) These techniques are not primarily used to reduce emissions to air of organic compounds.

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of inorganic compounds

Table 21: BAT-AELs for channelled emissions to air of inorganic compounds

Substance/Parameter	BAT-AEL ($mg\text{-}Nm^3$) (Daily average or average over the sampling period)
Ammonia (NH_3)	2 - 10 (1) (2) (3)
Elemental chlorine (Cl_2)	<0.5 - 2 (4)(5)
Gaseous fluorides, expressed as HF	≤ 1 (4)
Hydrogen cyanide (HCN)	< 0.1 – 1 (4)
Gaseous chlorides, expressed as HCl	1-10 (6)
Nitrogen oxides (NOx)	10 - 150 (7) (8) (9) (10)
Sulphur oxides (SO_2)	< 3 - 150 (11)(9)

(1) The BAT-AEL does not apply to channelled emissions to air of ammonia from the use of SCR or SNCR (ammonia slip). This is covered by BAT 17.

(2) The BAT-AEL does not apply when the NH_3 mass flow is below approx. 50 g/h.

(3) In the case of the drying step in the production of E-PVC, the upper end of the BAT-AEL range may be higher and up to 20 mg/Nm^3, when the substitution of ammonium salts is not possible due to product quality specifications.

(4) The BAT-AEL does not apply when the mass flow of the substance concerned is below approx. 5 g/h).

(5) In the case of NOX concentrations above 100 mg/Nm^3, the upper end of the BAT-AEL range may be higher and up to 3 mg/Nm^3 due to analytical interference.

(6) The BAT-AEL does not apply when the HCl mass flow is below approx. 30 g/h).

(7) In the case of the production of explosives, the upper end of the BAT-AEL range may be higher and up to 220 mg/Nm^3 when regenerating or recovering nitric acid from the production process.

(8) The BAT-AEL does not apply to channelled emissions to air of NOx from the use of catalytic or thermal oxidation (see BAT 16) or from process furnaces/heaters (see BAT 36).

(9) The BAT-AEL does not apply when the mass flow of the substance concerned is below approx. 500 g/h.

(10) In the case of the production of caprolactam, the upper end of the BAT-AEL range may be higher and up to 200 mg/Nm^3 in the case of process off-gases containing very high levels of NOx (e.g., above

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	10,000 mg/Nm³) prior to treatment with SCR or SNCR, when the abatement efficiency of the SCR or SNCR is ≥ 99 %. (11) The BAT-AEL does not apply in the case of physical purification or reconcentration of spent sulphuric acid. The associated monitoring is given in BAT 8.		
Management systems for diffuse VOC Emissions			
BATc 19	To prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to elaborate and implement a management system for diffuse VOC emissions, as part of the environmental management system (see BAT 1), that includes all of the following features: a. Estimating the annual quantity of diffuse VOC emissions (see BAT 20). b. Monitoring diffuse VOC emissions from the use of solvents by compiling a solvent mass balance, if applicable (see BAT 21). c. Establishing and implementing a leak detection and repair (LDAR) programme for fugitive VOC emissions. The LDAR programme typically lasts from 1 to 5 years depending on the nature, scale and complexity of the plant (5 years may correspond to large plants with a high number of emission sources). The LDAR programme includes all of the following features: i. Listing of equipment identified as relevant fugitive VOC emission sources in the inventory of diffuse VOC emissions (see BAT 2). ii. Definition of criteria associated with the following: • Leaky equipment. Typical criteria could be a leak threshold, above which equipment is considered leaky, and/or the visualisation of a leak with OGI cameras. This depends on the characteristics of the emission source (e.g., accessibility) and the hazardous properties of the emitted substance(s). • Maintenance and/or repair actions to be carried out. A typical criterion could be a VOC concentration threshold triggering the maintenance or repair action (maintenance/repair threshold). The maintenance/repair threshold is generally equal to or higher than the leak threshold. This depends on the characteristics of the emission source (e.g.,	Not Yet	Innospec proposes to implement the required management controls for diffuse emissions as required under UK BAT for WGC once this is implemented in UK legislation. This will be undertaken on a sitewide basis. Compliance with the BATc will be implemented within 4 years of the formal publication of the BATc as a UK statutory instrument.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	accessibility) and the hazardous properties of the emitted substance(s). For the first LDAR programme, it is generally not higher than 5,000 ppmv for VOCs other than VOCs classified as CMR 1A or 1B, and 1,000 ppmv for VOCs classified as CMR 1A or 1B. For subsequent LDAR programmes, the maintenance/repair threshold is lowered (see point vi. a.) and not higher than 1,000 ppmv for VOCs other than VOCs classified as CMR 1A or 1B, and 500 ppmv for VOCs classified as CMR 1A or 1B, targeting 100 ppmv. Guidance and requirements for leak detection thresholds in BS EN 15446 and BS EN 17628. LDAR programmes may be risk based. iii. Measuring fugitive VOC emissions from equipment listed under point c. i. (see BAT 22). iv. Carrying out maintenance and/or repair actions (see BAT 23, techniques e. and f.), as soon as possible and where necessary according to the criteria defined in point c. ii. Maintenance and repair actions are prioritised according to the hazardous properties of the emitted substance(s), the significance of the emissions and/or operational constraints. The effectiveness of the maintenance and/or repair actions is verified according to point iii. C., leaving enough time after the intervention (e.g., 2 months). v. Filling in the database mentioned in point e. d. Establishing and implementing a detection and reduction programme for non-fugitive VOC emissions that includes all of the following features: i. Listing of equipment identified as relevant non-fugitive VOC emission sources in the inventory of diffuse VOC emissions (see BAT 2). ii. Monitoring non-fugitive VOC emissions from equipment listed under point d. i. (see BAT 24). iii. Planning and implementing techniques to reduce non-fugitive VOC emissions (see BAT 24, techniques a., c. and g. to j.). The planning and implementation of the techniques are prioritised according to the hazardous properties of the emitted substance(s), the significance of the emissions and/or operational constraints. iv. Filling in the database mentioned in point e. e. Establishing and maintaining a database, for diffuse VOC emissions sources that are identified in the inventory mentioned in BAT 2, for keeping record of:		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	i. equipment design specifications (including the date and description of any design changes); ii. the equipment maintenance, repair, upgrade, or replacement actions, performed or planned, and their date of implementation; iii. the equipment that could not be maintained, repaired, upgraded or replaced due to operational constraints; iv. the results of the measurements or monitoring, including the concentration(s) of the emitted substance(s), the calculated leak rate (as kg/year), the recording from OGI cameras (e.g., from the last LDAR programme) and the date of the measurements or monitoring; v. the annual quantity of diffuse VOC emissions (as fugitive and non-fugitive emissions), including information on non-accessible sources and accessible sources not monitored during the year. f. Reviewing and updating the LDAR programme periodically. This may include the following: i. lowering the leak and/or maintenance/repair thresholds (see point c. ii.); ii. reviewing the prioritisation of equipment to be monitored, giving higher priority to (the type of) equipment identified as leaky during the previous LDAR programme; iii. planning the maintenance, repair, upgrade or replacement of equipment that could not be performed during the previous LDAR programme due to operational constraints. g. Reviewing and updating the detection and reduction programme for non-fugitive VOC emissions. This may include the following: i. monitoring non-fugitive VOC emissions from equipment where maintenance, repair, upgrade or replacement actions were implemented, in order to determine if those actions were successful; ii. planning the maintenance, repair, upgrade or replacement actions that could not be performed due to operational constraints.		
BATc 20	BAT is to estimate fugitive and non-fugitive VOC emissions to air separately at least once every year by using one or a combination of the techniques given below, as well as to determine the uncertainty of this estimation. The estimation distinguishes between VOCs classified as CMR 1A	Not yet	See Response to BATc 19

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>or 1B and VOCs that are not classified as CMR 1A or 1B. The table below summarises the techniques for estimating VOC emissions.
Table 22: Techniques to estimate fugitive and non-fugitive VOC emissions to air
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Type of Emissions</th></tr>
<tr><td>a.</td><td>Use of emission factors</td><td>See Table 5</td><td rowspan="3">Fugitive and/or non-fugitive</td></tr>
<tr><td>b.</td><td>Use of a mass balance</td><td>Estimation based on the difference in the mass of the substance inputs to and outputs from the plant/production unit, considering the generation and destruction of the substance in the plant/production unit.
A mass balance may also consist of measuring the concentration of VOCs in the product (e.g., raw material or solvent).</td></tr>
<tr><td>c.</td><td>Use of thermodynamic models</td><td>Estimation using the laws of thermodynamics applied to equipment (e.g., tanks) or particular steps of a production process.
The following data are generally used as input for the model:
• chemical properties of the substance (e.g., vapour pressure, molecular mass);
• process operating data (e.g., operating time, product quantity, ventilation);
• characteristics of the emission source (e.g., tank diameter, colour, shape).</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>BATc 21</td><td>BAT is to monitor diffuse VOC emissions from the use of solvents by compiling, at least once every year, a solvent mass balance of the solvent inputs and outputs of the plant, as defined in Part 7 of Annex VII to Directive 2010/75/EU and to minimise the uncertainty of the solvent mass balance data by using all of the techniques given below.
Table 23: Techniques for mass-balance calculations of VOCs
<table>
<tr><th colspan="2">Techniques</th><th>Description</th></tr>
<tr><td>a.</td><td>Full identification and quantification of the relevant solvent inputs and outputs, including the associated uncertainty</td><td>This includes:
• identification and documentation of solvent inputs and outputs (e.g., channelled and</td></tr>
</table></td><td>Not Yet</td><td>See Response to BATc 19</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>diffuse emissions to air, emissions to water, solvent output in waste);
• substantiated quantification of each relevant solvent input and output and recording of the methodology used (e.g., measurement, estimation by using emission factors, estimation based on operational parameters);
• identification of the main sources of uncertainty of the aforementioned quantification, and implementation of corrective actions to reduce the uncertainty; and
• regular update of solvent input and output data.</td></tr>
<tr><td>b.</td><td>Implementation of a solvent tracking system</td><td>A solvent tracking system aims to keep control of both the used and unused quantities of solvents (e.g., by weighing unused quantities returned to storage from the application area).</td></tr>
<tr><td>c.</td><td>Monitoring of changes that may influence the uncertainty of the solvent mass balance data</td><td>Any change that could influence the uncertainty of the solvent mass balance data is recorded, such as:
• malfunctions of the waste gas treatment system: the date and period of time are recorded; and
• changes that may influence air/gas flow rates (e.g., replacement of fans): the date and type of change are recorded.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 22</td><td>
BAT is to monitor diffuse VOC emissions to air with at least the frequency given below and in accordance with BS EN standards. If BS EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Table 24: Monitoring methods for VOCs
<table>
<tr><th>Type of Sources of Diffuse VOC Emissions (1)(2)</th><th>Type of VOCs</th><th>Standard(s)</th><th>Minimum Monitoring Frequency</th></tr>
<tr><td>Sources of fugitive emissions</td><td>VOCs classified as CMR 1A or 1B</td><td>BS EN 17628 and BS EN 15446</td><td>Once every year (3)(4)(5)</td></tr>
</table>
</td><td>Not Yet</td><td>See Response to BATc 19</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>VOCs not classified as CMR 1A or 1B</td><td></td><td>Once during the period covered by each LDAR programme (see BAT 19 point c.) (6)</td></tr>
<tr><td rowspan="2">Sources of non-fugitive emissions</td><td>VOCs classified as CMR 1A or 1B</td><td rowspan="2">BS EN 17628</td><td>Once every year</td></tr>
<tr><td>VOCs not classified as CMR 1A or 1B</td><td>Once every year (7)</td></tr>
<tr><td colspan="4">(1) The monitoring only applies to emission sources that are identified as relevant in the inventory given in BAT 6.
(2) The monitoring does not apply to equipment operated under sub atmospheric pressure.
(3) In the case of inaccessible sources of fugitive VOC emissions (e.g., if the monitoring requires the removal of insulation or the use of scaffolding), the monitoring frequency may be reduced to once during the period covered by each LDAR programme (see BAT 19 point c.).
(4) For the production of PVC, the minimum monitoring frequency may be reduced to once every 5 years if the plant uses VCM gas detectors to continuously monitor VCM emissions in a way that allows an equivalent level of detection of VCM leaks.
(5) In the case of high-integrity equipment (see BAT 23) in contact with VOCs classified as CMR 1A or 1B, a lower minimum monitoring frequency may be adopted, but in any case, at least once every 5 years.
(6) In the case of high-integrity equipment (see BAT 23) in contact with VOCs other than VOCs classified as CMR 1A or 1B, a lower minimum monitoring frequency may be adopted, but in any case, at least once every 8 years.
(7) The minimum monitoring frequency may be reduced to once every 5 years if non-fugitive emissions are quantified by using measurements.

Note: Optical gas imaging (OGI) is a useful complementary technique to the method BS EN 15446 (‘sniffing’) in order to identify sources of fugitive VOC emissions and is particularly relevant in the case of inaccessible sources (see Table 5).
In the case of non-fugitive emissions, measurements may be complemented by the use of thermodynamic models.
Where large amounts (e.g., above 80 t/yr) of VOCs are used/consumed, the quantification of VOC emissions from the plant with tracer correlation (TC) or with optical absorption-based techniques, such as differential absorption light detection and ranging (DIAL) or solar occultation flux (SOF), is a useful complementary technique (see Table 5).</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 23</td><td>To prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to use a combination of the techniques given in the table below with the following order of priority.</td><td>Yes</td><td>See Response to BATc 19
And response to CWW BATc19 (Appendix B).</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>Note: The use of techniques to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air is prioritised according to the hazardous properties of the emitted substance(s) and/or the significance of the emissions.
Table 25: Techniques to prevent or reduce diffuse emissions
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Type of Emissions</th><th>Applicability</th></tr>
<tr><td colspan="5"><i>1. Prevention techniques</i></td></tr>
<tr><td>a.</td><td>Limiting the number of emission sources</td><td>This includes:
• minimising pipe lengths;
• reducing the number of pipe connectors (e.g., flanges) and valves;
• using welded fittings and connections;
• using compressed air or gravity for material transfer.</td><td>Fugitive and non-fugitive emissions</td><td>Applicability may be restricted by operational constraints in the case of existing plants.</td></tr>
<tr><td>b.</td><td>Use of high integrity equipment</td><td>High-integrity equipment includes, but is not limited to:
• valves with bellow or double packing seals or equally effective equipment;
• magnetically driven or canned pumps/compressors/agitators, or pumps/compressors/agitators using double seals and a liquid barrier;
• certified high-quality gaskets (e.g., according to BS EN 13555) that are tightened according to technique 2b;
• closed sampling system.
The use of high-integrity equipment is especially relevant to prevent or minimise:</td><td>Fugitive emissions</td><td>Applicability may be restricted by operational constraints in the case of existing plants.
Generally applicable to new plants and major plant upgrades.</td></tr>
</table></td><td></td><td></td></tr>
</table>

BATc No.	BAT Justification					Operating to BAT	Demonstration of BAT Compliance
			• emissions of CMR substances or substances with acute toxicity; and/or • emissions from equipment with high-leaking potential; and/or • leaks from processes operated at high pressures (e.g., between 300 and 2000 bar). High-integrity equipment is selected, installed, and maintained according to the type of process and the process operating conditions.				
	c.	Collecting diffuse emissions and treating off-gases	Collecting diffuse VOC emissions (e.g., from compressor seals, vents and purge lines) and sending them to recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11).	Fugitive and non-fugitive emissions	Applicability may be restricted: • for existing plants; and/or • by safety concerns (e.g., avoiding concentrations close to the lower explosive limit).		
	2. other techniques						
	d.	Facilitating access and/or monitoring activities	To ease maintenance and/or monitoring the access to potentially leaky equipment is facilitated, e.g., by activities, installing platforms, and/or drones are used for monitoring.	Fugitive emissions	Applicability may be restricted by operational constraints in the case of existing plants.		
	e.	Tightening	• tightening of gaskets by personnel that is qualified according to BS EN 1591-4 and using the designed gasket stress (e.g., calculated according to BS EN 1591-1);	Fugitive emissions	Generally applicable.		

BATc No.	BAT Justification					Operating to BAT	Demonstration of BAT Compliance
			• installing tight caps on open ends; and • using flanges selected assembled according to BS EN 13555.				
	f.	Replacement of leaky equipment and/or parts	This includes the replacement of: • gaskets; • sealing elements (e.g., tank lid); • packing material (e.g., valve stem packing material).	Fugitive emissions	Generally applicable.		
	g.	Reviewing and updating process design	This includes: • reducing the use of solvents and/or using solvents with lower volatility; • reducing the formation of side products containing VOCs; • lowering the operating temperature; • lowering the VOC content in the final product.	Non-fugitive emissions	Applicability may be restricted in the case of existing plants due to operational constraints.		
	h.	Reviewing and updating operating conditions	This includes: • reducing the frequency and duration of reactor and vessel openings; and • preventing corrosion by lining or coating of equipment, by painting pipes (for external corrosion) and by using corrosion inhibitors for materials in contact with equipment.	Non-fugitive emissions	Generally applicable. x		
	i.	Using closed systems	This includes: • vapour balancing (see Table 6);	Non-fugitive emissions	Applicability may be restricted by operational constraints in the case of existing		

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>closed systems for solid/liquid and liquid/liquid phase separations;
closed systems for cleaning operations;
closed sewers and/or wastewater treatment plants;
closed sampling systems;
closed storage areas. Off-gases from closed systems are sent to recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11).</td><td></td><td>plants and/or by safety concerns.</td></tr>
<tr><td>j.</td><td>Using techniques to minimise emissions from surfaces</td><td>This includes:
installing oil creaming systems on open surfaces;
periodically skimming open surfaces (e.g., removing floating matter);
installing anti-evaporation floating elements on open surfaces;
treating wastewater streams to remove VOCs and send the VOCs to recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11);
installing floating roofs on tanks;
using fixed-roof tanks connected to a waste gas treatment.</td><td>Non-fugitive emissions</td><td>Applicability may be restricted by operational constraints in the case of existing plants.</td></tr>
</table>
<p>BAT conclusions for the use of solvents or the reuse of recovered solvents</p>
<p>The emission levels for the use of solvents or the reuse of recovered solvents given below are associated with the general BAT conclusions given in Section 1.1 and Section 1.1.4.3.</p>
</td><td></td><td></td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>BAT-associated emission level (BAT-AEL) for diffuse VOC emissions to air from the use of solvents or the reuse of recovered solvents
Table 26: BAT-AEL for diffuse VOC emissions to air from the use of solvents or reuse of recovered solvents
<table>
<tr><th>Parameter</th><th>BAT-AEL (percentage of the solvent inputs) (Yearly Average) (1)</th></tr>
<tr><td>Diffuse VOC Emissions</td><td>≤ 5%</td></tr>
<tr><td colspan="2">(1) The BAT-AEL does not apply to plants whose annual consumption of solvents is lower than 50 tonnes.</td></tr>
</table>
The associated monitoring is given in BAT 20, BAT 21 and BAT 22.</td><td></td><td></td></tr>
<tr><td></td><td>Process Furnaces / Heaters – BATc 24</td><td>N/A</td><td>Not Applicable</td></tr>
<tr><td></td><td>Polymers and Synthetic Rubbers - BATc 25 - 36</td><td>N/A</td><td>Not Applicable</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

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