



# Regulation 61(1) Response

Huntsman Polyurethanes (UK) Ltd.

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## Signature Page

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Huntsman Polyurethanes, Wilton

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### **APPENDIX A BAT CONCLUSION REVIEW TABLE – LVOC BREF**

### **APPENDIX B BAT CONCLUSION REVIEW TABLE – CWW BREF**

### **APPENDIX C SUMMARY OF PERMIT CONDITIONS FOR EMISSION POINTS A4-A9**

#### **Acronyms and Abbreviations**

Name	Description
BAT	Best Available Technique
BRef	BAT Reference Document
SPMP	Site Protection and Monitoring Plan
LVOC BRef	BAT Reference Document, and associated BAT Conclusions for the Large Volume Organic Chemicals
CWW BRef	Best Available Techniques Reference Document, and associated BAT Conclusions for the Common Waste Water / Waste Gas Treatment / Management Systems in the Chemical Sector

## 1. INTRODUCTION

Huntsman Polyurethanes (UK) Ltd (Huntsman) at the Wilton site received a Regulation 61(1) Notice dated 4<sup>th</sup> May 2018 from the Environment Agency (EA) regarding review and consolidation of the site's EPR permit and BAT review following the publication of the revised Large Volume Organic Chemicals (LVOC) BAT Reference Document (BRef), and associated BAT Conclusions for the Large Volume Organic Chemicals, (LVOC BATc).

Additional BRefs identified by the EA as relevant to the review are:

- The Best Available Techniques (BAT) Conclusions for Common Waste Water and Waste Gas treatment / Management Systems in the Chemical Sector, published on the 9th June 2016; and
- The Best Available Techniques (BAT) Conclusions for large combustion plants, published on 17<sup>th</sup> August 2017.

The EA has requested a written report stating whether compliance against each of the BAT Conclusions will be achieved by the compliance date of 7<sup>th</sup> December 2021.

This report has been compiled to meet this request as the response to the Regulation 61(1) Notice.

## 2. APPROACH

### 2.1 Task 1 – Screening

Following a conference call with Martin Swainston (Environment, Health and Safety Manager at the Wilton site) to discuss the site's processes and activities, Environmental Resources Management Ltd (ERM) pre-screened the BAT Conclusions in the three BRefs for potential applicability to the site. All BAT Conclusions from the BRefs were transferred into tables to be used in a subsequent workshop.

Following a discussion with the EA, details relating to the following areas have been reviewed and updated:

- Process emissions that are not channelled through the thermal oxidiser;
- Management of the nickel catalyst
- Details of abatement of emissions to sewer.

### 2.2 Task 2a – BAT Gap Analysis

ERM conducted a gap assessment workshop to discuss and record the site's compliance status against the BAT Conclusions. Each BAT Conclusion from each of the BRefs was assessed and a response was recorded. These tables are presented in *Appendices A & B*, with a summary of the findings presented in *Sections 3.1* and *3.2*.

### 2.3 Task 2b – Notice Items 4 and 5 Gap Analysis

ERM conducted a review of documents provided by the site, which included the extant Site Protection and Monitoring Plan (SPMP), Environmental Baseline Reference Data, results from historic and ongoing soil and groundwater monitoring programmes, and risk assessments, to assess whether further actions or information are required relating to items 4 and 5 of the Notice. A summary of this review is presented in *Sections 3.3* and *3.4*.

### 3. RESPONSE TO REGULATION 61(1) NOTICE

#### 3.1 Notice Items 1 and 2 – Review Compliance

1. *Confirm whether or not you currently comply with the standards described in the relevant BAT Conclusion reference document providing a description of how you meet the standard.*
2. *Where you do not currently comply with a standard as identified in paragraph 1, describe how and when you intend to comply with the standard to ensure that you are fully compliant with relevant BAT Conclusions by 7<sup>th</sup> December 2021, being the date which, hereafter in this Notice, is referred to as the ‘compliance date’.*

##### 3.1.2 LVOC BRef Review

Huntsman Polyurethanes Wilton has reviewed the BAT Conclusions in the LVOC BRef, and the review process table is provided in *Appendix A*.

The site is already in compliance with the BRef.

##### 3.1.3 CWW BRef Review

Huntsman Polyurethanes Wilton has reviewed the BAT Conclusions in the CWW BRef, and the review process table is provided in *Appendix B*.

The site is already in compliance with the BRef.

##### 3.1.4 LCP BRef Review

The Huntsman Polyurethanes Wilton site does not have any combustion sources that either individually or in aggregate exceed 50MWth thermal input. Consequently Huntsman Polyurethanes considers that the LCP BRef does not apply to this site.

#### 3.2 Notice Item 3 – Need for Cessation or Derogation

3. *Either:*
  - a. *if you intend to cease operating any activity which would not comply with the relevant new BAT Conclusion after the compliance date, confirm the date by which you intend to cease operation; or,*
  - b. *If you intend to continue operating any activity in a manner which would not comply with the relevant new BAT Conclusions after the compliance date, provide a justification for being allowed to do so; where such justification proposes future compliance but at a date after the compliance date, provide the date when you intend to come into full compliance. Where there is a BAT Associated Emission Level (BAT-AEL) described in the BAT Conclusion Document, you should provide sufficient technical and commercial information to demonstrate that achieving these emissions levels would lead to disproportionately higher costs compared to the environmental benefits, due to:*
    - i. *the geographical location of your installation;*
    - ii. *the local environmental conditions around your installation;*
    - iii. *The technical characteristics of your installation.*

*As well as explaining which of these criteria is relevant and why, you should refer to Defra’s published guidance on the subject.*

*Your justification should use a methodology equivalent to that outlined in the Environment Agency Guidance note EPRH1, for which a revised draft is available from the Environment Agency which includes details of how we will assess such justification proposals*

### Response to Notice Item 3

There are no BAT Conclusions in any of the relevant BRefs with which the site will not comply by the compliance date. Therefore, the site neither intends to cease operating any activity nor seek a derogation.

### 3.3 Notice Item 4 – Soil and Groundwater

*Where your activity involves the use, production or release of a relevant hazardous substance (as defined in Article 3(18) of the Industrial Emissions Directive), carry out a risk assessment considering the possibility of soil and groundwater contamination at the installation with such substances. Where any risk of such contamination is established, either:*

- *Prepare and submit a baseline report<sup>(1)</sup> containing information necessary to determine the current state of soil and groundwater contamination; or*
- *Provide a summary report referring to information previously submitted where you are satisfied that such information represents the current state of soil and groundwater contamination, so as to enable a quantified comparison to be made with the state of soil and groundwater contamination upon definitive cessation of the activity.*

### Response to Notice Item 4

A soil and groundwater baseline was submitted to the EA, dated 52178-001-734/DK/rc 26 February 2003. A total of 29 boreholes were drilled and 8 trial pits excavated. Generally low levels of contamination were encountered with the exception of a single aniline concentration detected in one borehole. Some limited evidence of hydrocarbons was detected in several boreholes, largely considered to have resulted from historic sources of contamination.

A review of the spillage register does indicate that several spills have occurred since the completion of the baseline in 2003 although the majority of the spills were either small volumes or contained within bunds.

It is considered likely that the condition of the soil and groundwater will not have significantly deteriorated although no recent monitoring has been completed to confirm this.

It is proposed to complete additional soil and groundwater monitoring to focus on those areas where there is an increased risk of contamination. Permanent groundwater monitoring wells will be installed to permit future groundwater monitoring. The details of the scope of work are yet to be agreed and the sampling strategy will be developed in consultation with the local Environment Agency officer. The site proposes to complete these works by the end of 2020.

### 3.4 Notice Item 5 – Water Framework Directive

*The Water Framework Directive requires that there is no deterioration in the quality of a water body, as a consequence of releases of hazardous pollutants. If your installation is a source of hazardous pollutants you must also provide information about these:*

- *Provide a summary report of the current hazardous pollutant releases referring to the series of screening tests, which are described in our H1 risk assessment guidance<sup>(2)</sup>, which will allow us to assess whether the emissions of hazardous pollutants from your installation are significant.*

### Response to Notice Item 5

There are no known direct releases to a natural water body from the Huntsman facility, therefore this notice item does not apply.

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(1) Baseline report - Defra Guidance - Industrial emissions Directive EPR Guidance on Part A installations (Section 5.10 – 5.15, pages 28-29)

(2) Environment Agency guidance on risk assessment process and the H1 software tool

## 4. SUMMARY AND ACTIONS

Huntsman Polyurethanes Wilton has conducted a review of the site's compliance with the BAT Conclusions contained within the LVOC, CWW and LCP BRefs as required by the Regulation 61(1) Notice from the Environment Agency.

The site is already in compliance with the BRefs. There are no BAT Conclusions in the BRefs with which the site will not comply by the compliance date. Therefore, the site neither intends to cease operating any activity nor seek a derogation.

Regarding soil and groundwater baseline, the existing site baseline was completed in 2003. It is proposed to complete additional soil and groundwater monitoring to focus on those areas where there is an increased risk of contamination. Permanent groundwater monitoring wells will be installed to permit future groundwater monitoring. The details of the scope of work are yet to be agreed and the sampling strategy will be developed in consultation with the local Environment Agency officer. The site proposes to complete these works by the end of 2020.

No Water Framework Directive response is required as the site does not have any releases to a water body.

## **APPENDIX A      BAT CONCLUSION REVIEW TABLE – LVOC BREF**

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Section	Section	BAT#	BAT Text	Requirements	Comments
General BAT Conclusions	Monitoring of emissions to air	BAT1	BAT is to monitor channelled emissions to air from process furnaces/heaters in accordance with EN standards and with at least the minimum frequency given in the table 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.	<p><b>CO</b> - ≥ 50 MWth - Continuous (Generic EN standards)/ 10 to 50 MLWth - Once every 3 months (EN 15058)</p> <p><b>Dust</b> - ≥ 50 MWth - Continuous (Generic EN standards and EN 13284-2)/ 10 to 50 MLWth - Once every 3 months (EN 13284-1)</p> <p><b>NH3</b> - ≥ 50 MWth - Continuous (Generic EN standards)/ 10 to 50 MLWth - Once every 3 months (No EN standard available)</p> <p><b>NOx</b> - ≥ 50 MWth - Continuous (Generic EN standards)/ 10 to 50 MLWth - Once every 3 months (EN 14792)</p> <p><b>SO2</b> - ≥ 50 MWth - Continuous (Generic EN standards) / 10 to 50 MLWth - Once every 3 months (EN 14791)</p>	<p>Nitrobenzene process: No process furnaces or heaters present. Heat for the nitration step is provided by exothermic addition of sulphuric acid.</p> <p>Aniline process: No process furnaces or heaters present. The reduction step is catalytic.</p> <p>Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. The Thox plant is monitored quarterly (NOx, , CO, O2, moisture, stack velocity and temperature &gt;850degC), with a report quarterly to the EA of NOx, , CO and minimum temperature when treating waste gases . There is also a requirement to notify the EA of annual up-time - requirement is &gt;95%.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>
		BAT2	BAT is to monitor channelled emissions to air other than from process furnaces/heaters in accordance with EN standards and with at least the minimum	<p><b>Substances/ Parameters</b></p> <p>Benzene</p> <p>Cl2</p> <p>CO</p> <p>Dust</p>	The only process vent gases not channelled through the Thox plant (described within BAT 1) are those emitted from point sources A4, A5, A6 and A7, all associated with the

Section	Section	BAT#	BAT Text	Requirements	Comments
			frequency given in the table 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.	EDC Ethylene Formaldehyde Gaseous chlorides, expressed NH3 NOX PCDD/F PCDD/F SO2 Tetrachloromethane TVOC VCM	Aniline process.  The existing agreed permit emission parameters and monitoring requirements are provided in summary in Appendix C  Footnote (2) to the BAT table states that <i>“the minimum monitoring frequency for periodic measurements may be reduced to once every year, if the emission levels are proven to be sufficiently stable.”</i>  Given that the permit monitoring parameters have been fixed and met for a number of years, Huntsman considers that no change is required.
	<b>Emissions to air</b> <b>Emissions to air from process furnaces/heaters</b>	<b>BAT3</b>	In order to reduce emissions to air of CO and unburnt substances from process furnaces/heaters, BAT is to ensure an optimised combustion.	Optimised combustion is achieved by good design and operation of the equipment which includes optimisation of the temperature and residence time in the combustion zone, efficient mixing of the fuel and combustion air, and combustion control. Combustion control is based on the continuous monitoring and automated control of appropriate combustion parameters (e.g. O2, CO, fuel to air ratio, and unburnt substances).	Nitrobenzene process: No process furnaces or heaters present. Heat for the nitration step is provided by exothermic addition of sulphuric acid.  Aniline process: No process furnaces or heaters present. The reduction step is catalytic.  Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process.  During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre

Section	Section	BAT#	BAT Text	Requirements	Comments
					(operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.
		<b>BAT4</b>	In order to reduce NOx emissions to air from process furnaces/heaters, BAT is to use one or a combination of the techniques given below.	<p><b>Technique</b></p> <ul style="list-style-type: none"> <li>a. Choice of fuel</li> <li>b. Staged combustion</li> <li>c. Flue-gas recirculation (external)</li> <li>d. Flue-gas recirculation (internal)</li> <li>e. Low-NOX burner (LNB) or ultra-low-NOX burner (ULNB)</li> <li>f. Use of inert diluents</li> <li>g. Selective catalytic reduction (SCR)</li> <li>h. Selective non-catalytic reduction (SNCR)</li> </ul>	<p>Nitrobenzene process: No process furnaces or heaters present. Heat for the nitration step is provided by exothermic addition of sulphuric acid.</p> <p>Aniline process: No process furnaces or heaters present. The reduction step is catalytic.</p> <p>Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. NOx levels are directly related to NH3 carry over from the hydrogenation step in the Aniline process. Typical emissions are 400-500 mg/Nm3 compared to a limit of 800 mg/Nm3.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>
		<b>BAT5</b>	In order to prevent or reduce dust emissions to air from process furnaces/heaters, BAT is to use	<p><b>Technique</b></p> <ul style="list-style-type: none"> <li>a. Choice of fuel</li> <li>b. Atomisation of liquid fuels</li> </ul>	Nitrobenzene process: No process furnaces or heaters present. Heat for the nitration step is provided by

Section	Section	BAT#	BAT Text	Requirements	Comments
			one or a combination of the techniques given below.	c. Fabric, ceramic or metal filter	<p>exothermic addition of sulphuric acid.</p> <p>Aniline process: No process furnaces or heaters present. The reduction step is catalytic.</p> <p>Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. There are no limits or monitoring requirements on the Thox plant for PM10.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>
		<b>BAT6</b>	In order to prevent or reduce SO <sub>2</sub> emissions to air from process furnaces/heaters, BAT is to use one or both of the techniques given below.	<p><b>Technique</b></p> <p>a. Choice of fuel</p> <p>b. Caustic scrubbing</p>	<p>Nitrobenzene process: No process furnaces or heaters present. Heat for the nitration step is provided by exothermic addition of sulphuric acid.</p> <p>Aniline process: No process furnaces or heaters present. The reduction step is catalytic.</p> <p>Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. The only source of sulphur in the process is</p>

Section	Section	BAT#	BAT Text	Requirements	Comments
					<p>H2SO4 in the nitrobenzene process, however carryover to the vent gases is very low.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>
	<p><b>Emissions to air</b> <b>Emissions to air from the use of SCR or SNCR</b></p>	<b>BAT7</b>	In order to reduce emissions to air of ammonia which is used in selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for the abatement of NOX emissions, 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 levels (BAT-AELs) for emissions from a lower olefins cracker furnace when SCR or SNCR is used: See Table 13.1.	Not applicable: There are no SCR or SNCR abatement systems present on site.
	<p><b>Emissions to air</b> <b>Emissions to air from other processes/sources</b> <b>Techniques to reduce emissions from other processes/sources</b></p>	<b>BAT8</b>	In order to reduce the load of pollutants sent to the final waste gas treatment, and to increase resource efficiency, BAT is to use an appropriate combination of the techniques given below for process off-gas streams.	<p><b>Techniques</b></p> <p>a. Recovery and use of excess generated hydrogen b. Recovery and use of organic solvents and unreacted organic raw materials c. Use of spent air d. Recovery of HCl by wet scrubbing for subsequent use e. Recovery of H2S by regenerative amine scrubbing for subsequent use f. Techniques to reduce solids and/or liquids entrainment</p>	<p>a) Hydrogen recovery has been optimised over the years of operation of the site, but further improvements are considered not currently available for the site due to contamination levels. b) Polisher (low level reactor) installed into the Aniline process in Q2/Q3 2017 to remove nitrobenzene from the crude aniline. c) Not applicable to the process d) Not applicable to the process e) Not applicable to the process f) Catalyst maintenance keeps entrained liquids/solids to a minimum</p>

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT9	In order to reduce the load of pollutants sent to the final waste gas treatment, and to increase energy efficiency, BAT is to send process off-gas streams with a sufficient calorific value to a combustion unit. BAT 8a. and BAT 8b. have priority over sending process off-gas streams to a combustion unit.	<b>Applicability</b> - Sending process off-gas streams to a combustion unit may be restricted due to the presence of contaminants or due to safety considerations.	The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished. The selection of the Energy Centre as a means of managing the waste gas streams from the Wilton site has been BAT reviewed and approved in its recent permit determination and issue.
		BAT10	In order to reduce channelled emissions of organic compounds to air, BAT is to use one or a combination of the techniques given below.	<b>Techniques</b> a. Condensation b. Adsorption c. Wet scrubbing d. Catalytic oxidiser e. Thermal oxidiser	Emission point A4 is abated by a water filled lute pot upstream of it.  Emission point A5 has no abatement, however there is not a continuous flow through this vent. The vent is contained by a pressure valve with a set point of 5" wg. The pressure valve only lifts and relieves to atmosphere when the vent header pressure increases above 5" wg.  Emission point A6 has a spray scrubber upstream of it. The vent gas is sprayed with Nitrobenzene in order to remove organics from it before it is released to atmosphere  Emission point A7 has a two stage wet scrubber, the first stage has

Section	Section	BAT#	BAT Text	Requirements	Comments
					<p>nitrobenzene as a liquor to capture organic compounds, the second stage has water to capture ammonia.</p> <p>The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished. The selection of the Energy Centre as a means of managing the waste gas streams from the Wilton site has been BAT reviewed and approved in its recent permit determination and issue.</p>
		<b>BAT11</b>	In order to reduce channelled dust emissions to air, BAT is to use one or a combination of the techniques given below.	<p><b>Techniques</b></p> <ul style="list-style-type: none"> <li>a. Cyclone</li> <li>b. Electrostatic precipitator</li> <li>c. Fabric filter</li> <li>d. Two-stage dust filter</li> <li>e. Ceramic/metal filter</li> <li>f. Wet dust scrubbing</li> </ul>	There are no sources of dust emissions from the Wilton site. There are no PM10 limits or requirements for monitoring for PM10 for the Thox plant.
		<b>BAT12</b>	In order to reduce emissions to air of sulphur dioxide and other acid gases (e.g. HCl), BAT is to use wet scrubbing.	<p><b>Description</b> - For the description of wet scrubbing, see Section 13.12.1.</p>	Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process. The only source of sulphur in the process is H2SO4 in the nitrobenzene process, however carryover to the

Section	Section	BAT#	BAT Text	Requirements	Comments
					<p>vent gases is very low.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>
	<p><b>Emissions to air - Emissions to air from other processes/sources - Techniques to reduce emissions from a thermal oxidiser</b></p>	<b>BAT13</b>	<p>In order to reduce emissions to air of NOX, CO, and SO2 from a thermal oxidiser, BAT is to use an appropriate combination of the techniques given below.</p>	<p><b>Techniques</b></p> <ul style="list-style-type: none"> <li>a. Removal of high levels of NOx precursors from the process off-gas streams</li> <li>b. Choice of support fuel</li> <li>c. Low NOx burner</li> <li>d. Regenerative thermal oxidiser</li> <li>e. Combustion optimisation</li> <li>f. Selective catalytic reduction</li> <li>g. Selective non-catalytic reduction</li> </ul>	<p>Thermal oxidiser: The thermal oxidiser (Thox) plant receives all vent gases from the Nitrobenzene process and some of the vent gases from the Aniline process.</p> <p>NOx levels are directly related to NH3 carry over from the hydrogenation step in the Aniline process. Typical emissions are 400-500 mg/Nm3 compared to a limit of 800 mg/Nm3.</p> <p>The only source of sulphur in the process is H2SO4 in the nitrobenzene process, however carryover to the vent gases is very low.</p> <p>During 2019, the vent gases currently channelled to the Thox plant will be diverted to the separately permitted Energy Centre (operated by Engie) and used for raising steam. Following a c. 6 month commissioning phase of the Energy Centre, it is expected that the Thox plant will be decommissioned and demolished.</p>

Section	Section	BAT#	BAT Text	Requirements	Comments
					The selection of the Energy Centre as a means of managing the waste gas streams from the Wilton site has been BAT reviewed and approved in its recent permit determination and issue.
	<b>Emissions to water</b>	<b>BAT14</b>	In order to reduce the waste water volume, the pollutant loads discharged to a suitable final treatment (typically biological treatment), and emissions to water, BAT is to use an integrated waste water management and treatment strategy that includes an appropriate combination of process-integrated techniques, techniques to recover pollutants at source, and pre-treatment techniques, based on the information provided by the inventory of waste water streams specified in the CWW BAT conclusions.		<p>Plant controls are used to manage the pollutant loading on the two effluent discharge streams.</p> <p>Nitrobenzene process:</p> <ul style="list-style-type: none"> <li>- Process strong effluent (from the 2<sup>nd</sup> wash) is diluted with process water from the aniline plant and then sent offsite to biological treatment through trade effluent consent with Northumbrian Water at Bran Sands. There is an inline monitor (pH, and turbidity ) on the discharge to sewer.</li> <li>- Process weak effluent (from the 1<sup>st</sup> wash) is adjusted for pH, steam stripped to remove organics and then sent to Sembcorp Utilities under a trade effluent consent. There are two inline monitors (pH and TOC) on the discharge. Sembcorp has a series of buffer vessels in the event of off-spec product being received to protect the discharge to estuary.</li> </ul> <p>Aniline process:</p> <ul style="list-style-type: none"> <li>- Process weak effluent (from the amine water steam stripping column ) is sent to Sembcorp Utilities as for the Nitrobenzene process. Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as</li> </ul>

Section	Section	BAT#	BAT Text	Requirements	Comments
					CEM fuel.
Resource Efficiency	Resource Efficiency	BAT15	In order to increase resource efficiency when using catalysts, BAT is to use a combination of the techniques given below.	<b>Techniques</b> a. Catalyst selection b. Catalyst protection c. Process optimisation d. Monitoring of catalyst performance	The Aniline process uses a solid Nickel catalyst in the reduction process step. Nickel is the most effective catalyst available (has been tested extensively over many years). Unreacted nitrobenzene in the crude aniline is tracked in the feed to the Aniline dehydration section and is an indicator of the performance of the Nickel catalyst. Changeout of the catalyst is triggered by performance reduction.
		BAT16	In order to increase resource efficiency, BAT is to recover and reuse organic solvents.	<b>Description</b> - Organic solvents used in processes (e.g. chemical reactions) or operations (e.g. extraction) are recovered using appropriate techniques (e.g. distillation or liquid phase separation), purified if necessary (e.g. using distillation, adsorption, stripping or filtration) and returned to the process or operation. The amount recovered and reused is process-specific.	Nitrobenzene process: Benzene is a raw material in the Nitrobenzene process. There is a recovery washing and purification process of the crude nitrobenzene which recirculates any recovered benzene back into the raw material input stream.  Aniline process: There is an aniline recovery step in the Aniline process through the Amine Water phase separator.
Residues	Residues	BAT17	In order to prevent or, where that is not practicable, to reduce the amount of waste being sent for disposal, BAT is to use an appropriate combination of the techniques given below.	<b>Techniques</b> <i>Techniques to prevent or reduce the generation of waste</i> a. Addition of inhibitors to distillation systems b. Minimisation of high-boiling residue formation in distillation systems <i>Techniques to recover materials for reuse or recycling</i> c. Material recovery (e.g. by distillation, cracking) d. Catalyst and adsorbent regeneration <i>Techniques to recover energy</i>	Aniline process: Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as CEM fuel.  The Nickel catalyst is sent for energy recovery as CEM fuel. Recovery of the catalyst is not economically viable as it is not possible to separate it effectively from the heavy aromatic tars from the aniline reactor  The site tracks closely all the

Section	Section	BAT#	BAT Text	Requirements	Comments
				e. Use of residues as a fuel	wastes generated. This is an annual report to the EA and also feeds back into the business and is used to identify waste minimisation opportunities going forward.
	Other than normal operating conditions	BAT18	In order to prevent or reduce emissions from equipment malfunctions, BAT is to use all of the techniques given below.	<b>Technique</b> a. Identification of critical equipment b. Asset reliability programme for critical equipment c. Back-up systems for critical equipment	a - The site has a register of critical equipment and a procedure for identifying/reviewing criticality b - The site operates a bulk storage asset integrity programme as part of the preventative maintenance regime. c - The site carries critical spares.  The site has undertaken a detailed review of the critical equipment from a safety and environmental stand point. This review has included human factors measures in addition to physical equipment reviews.
		BAT19	In order to prevent or reduce emissions to air and water occurring during other than normal operating conditions, BAT is to implement measures commensurate with the relevance of potential pollutant releases for: (i) start-up and shutdown operations; (ii) other circumstances (e.g. regular and extraordinary maintenance work and cleaning operations of the units and/or of the waste gas treatment system) including those that could affect the proper functioning of the installation.		There is a defined start-up procedure.  Waste gases cannot be sent to the Thox until the Thox is at a certain temperature due to interlocks.  Process interlocks include raw material (organics) feed loss, air loss,  Role play 'other than normal operating conditions' scenarios as a means of training of operational teams.
BAT conclusions for lower olefins production	Emissions to air	BAT20	In order to reduce emissions to air of dust and CO from the decoking of the cracker tubes, BAT is to use an appropriate combination of the	<b>Technique</b> <i>Techniques to reduce the frequency of decoking</i> a. Tube materials that retard coke	

Section	Section	BAT#	BAT Text	Requirements	Comments
			techniques to reduce the frequency of decoking given below and one or a combination of the abatement techniques given below	formation b. Doping of the raw material feed with sulphur compounds c. Optimisation of thermal decoking <i>Abatement techniques</i> d. Wet dust scrubbing e. Dry cyclone f. Combustion of decoking waste gas in process furnace/heater	
	<b>Emissions to water</b>	<b>BAT21</b>	In order to prevent or reduce the amount of organic compounds and waste water discharged to waste water treatment, BAT is to maximise the recovery of hydrocarbons from the quench water of the primary fractionation stage and reuse the quench water in the dilution steam generation system.	<b>Description</b> The technique consists of ensuring an effective separation of organic and aqueous phases. The recovered hydrocarbons are recycled to the cracker or used as raw materials in other chemical processes. Organic recovery can be enhanced, e.g. through the use of steam or gas stripping, or the use of a reboiler. Treated quench water is reused within the dilution steam generation system. A quench water purge stream is discharged to downstream final waste water treatment to prevent the build-up of salts in the system.	
		<b>BAT22</b>	In order to reduce the organic load discharged to waste water treatment from the spent caustic scrubber liquor originating from the removal of H <sub>2</sub> S from the cracked gases, BAT is to use stripping	<b>Description</b> For the description of stripping see Section 12.2. The stripping of scrubber liquors is carried out using a gaseous stream, which is then combusted (e.g. in the cracker furnace).	
		<b>BAT23</b>	In order to prevent or reduce the amount of sulphides discharged to waste water treatment from the spent caustic scrubber liquor originating from the removal of acid gases from the cracked gases, BAT is to use one or a combination of the techniques given below.	<b>Techniques</b> a. Use of low-sulphur raw materials in the cracker feed b. Maximisation of the use of amine scrubbing for the removal of acid gases c. Oxidation	

Section	Section	BAT#	BAT Text	Requirements	Comments
BAT conclusions for aromatics production	Emissions to air	BAT24	In order to reduce the organic load from process off-gases sent to the final waste gas treatment and to increase resource efficiency, BAT is to recover organic materials by using BAT 8b. or, where that is not practicable, to recover energy from these process off-gases (see also BAT 9).		
		BAT25	In order to reduce emissions to air of dust and organic compounds from the regeneration of hydrogenation catalyst, BAT is to send the process off-gas from catalyst regeneration to a suitable treatment system	<b>Description</b> The process off-gas is sent to wet or dry dust abatement devices to remove dust and then to a combustion unit or a thermal oxidiser to remove organic compounds in order to avoid direct emissions to air or flaring. The use of decoking drums alone is not sufficient	
	Emissions to water	BAT26	In order to reduce the amount of organic compounds and waste water discharged from aromatic extraction units to waste water treatment, BAT is either to use dry solvents or to use a closed system for the recovery and reuse of water when wet solvents are used.		
		BAT27	In order to reduce the waste water volume and the organic load discharged to waste water treatment, BAT is to use an appropriate combination of the techniques given.	<b>Techniques</b> a. Water-free vacuum generation b. Source segregation of aqueous effluents c. Liquid phase separation with recovery of hydrocarbons d. Stripping with recovery of hydrocarbons e. Reuse of water	

Section	Section	BAT#	BAT Text	Requirements	Comments
	Resource Efficiency	BAT28	In order to use resources efficiently, BAT is to maximise the use of co-produced hydrogen, e.g. from dealkylation reactions, as a chemical reagent or fuel by using BAT 8a. or, where that is not practicable, to recover energy from these process vents (see BAT 9).		
	Energy Efficiency	BAT29	In order to use energy efficiently when using distillation, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Distillation optimisation b. Recovery of heat from column overhead gaseous stream c. Single extractive distillation column d. Distillation column with a dividing wall e. Thermally coupled distillation	
	Residues	BAT30	In order to prevent or reduce the amount of spent clay being sent for disposal, BAT is to use one or both of the techniques given	<b>Techniques</b> a. Selective hydrogenation of reformate or pygas b. Clay material selection	
BAT conclusions for ethylbenzene and styrene monomer production	Process selection	BAT31	In order to prevent or reduce emissions to air of organic compounds and acid gases, the generation of waste water and the amount of waste being sent for disposal from the alkylation of benzene with ethylene, BAT for new plants and major plant upgrades is to use the zeolite catalyst process.		
	Emissions to air	BAT32	In order to reduce the load of HCl sent to the final waste gas treatment from the alkylation unit in the AlCl <sub>3</sub> -catalysed ethylbenzene production process, BAT is to use caustic scrubbing.	Only applicable to existing plants using the AlCl <sub>3</sub> catalysed ethylbenzene production process.	

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT33	In order to reduce the load of dust and HCl sent to the final waste gas treatment from catalyst replacement operations in the AlCl <sub>3</sub> -catalysed ethylbenzene production process, BAT is to use wet scrubbing and then use the spent scrubbing liquor as wash water in the post-alkylation reactor wash section		
		BAT34	In order to reduce the organic load sent to the final waste gas treatment from the oxidation unit in the SMPO production process, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Techniques to reduce liquids entrainment b. Condensation c. Adsorption d. Scrubbing	
		BAT35	In order to reduce emissions of organic compounds to air from the acetophenone hydrogenation unit in the SMPO production process, during other than normal operating conditions (such as start-up events), BAT is to send the process off-gas to a suitable treatment system		
	Emissions to water	BAT36	In order to reduce waste water generation from ethylbenzene dehydrogenation and to maximise the recovery of organic compounds, BAT is to use an appropriate combination of the techniques given	<b>Techniques</b> a. Optimised liquid phase separation b. Stream stripping c. Adsorption d. Reuse of water	

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT37	In order to reduce emissions to water of organic peroxides from the oxidation unit in the SMPO production process and to protect the downstream biological waste water treatment plant, BAT is to pretreat waste water containing organic peroxides using hydrolysis before it is combined with other waste water streams and discharged to the final biological treatment		
	Resource Efficiency	BAT38	In order to recover organic compounds from ethylbenzene dehydrogenation prior to the recovery of hydrogen (see BAT 39), BAT is to use one or both of the techniques given	<b>Techniques</b> a. Condensation b. Scrubbing	
		BAT39	In order to increase resource efficiency, BAT is to recover the co-produced hydrogen from ethylbenzene dehydrogenation, and to use it either as a chemical reagent or to combust the dehydrogenation off-gas as a fuel (e.g. in the steam superheater).		
		BAT40	In order to increase the resource efficiency of the acetophenone hydrogenation unit in the SMPO production process, BAT is to minimise excess hydrogen or to recycle hydrogen by using BAT 8a. If BAT 8a is not applicable, BAT is to recover energy (see BAT 9).		

Section	Section	BAT#	BAT Text	Requirements	Comments
	Residues	BAT41	In order to reduce the amount of waste being sent for disposal from spent catalyst neutralisation in the AlCl <sub>3</sub> -catalysed ethylbenzene production process, BAT is to recover residual organic compounds by stripping and then concentrate the aqueous phase to give a usable AlCl <sub>3</sub> by-product.	<b>Description</b> Steam stripping is first used to remove VOCs, then the spent catalyst solution is concentrated by evaporation to give a usable AlCl <sub>3</sub> by-product. The vapour phase is condensed to give a HCl solution that is recycled into the process.	
		BAT42	In order to prevent or reduce the amount of waste tar being sent for disposal from the distillation unit of ethylbenzene production, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Material recovery (e.g. by distillation, cracking) b. Use of tar as an absorbent for scrubbing c. Use of tar as a fuel	
		BAT43	In order to reduce the generation of coke (which is both a catalyst poison and a waste) from units producing styrene by ethylbenzene dehydrogenation, BAT is to operate at the lowest possible pressure that is safe and practicable.		
		BAT44	In order to reduce the amount of organic residues being sent for disposal from styrene monomer production including its co-production with propylene oxide, BAT is to use one or a combination of the techniques given below.	<b>Techniques</b> a. Addition of inhibitors to distillation systems b. Minimisation of high-boiling residue formation in distillation systems c. Use of residues as fuel	
BAT conclusions for formaldehyde production	Emissions to air	BAT45	In order to reduce emissions of organic compounds to air from formaldehyde production and to use energy efficiently, BAT is to use one of the techniques given	<b>Techniques</b> a. Send the waste gas stream to a combustion unit b. Catalytic oxidiser with energy recovery c. Thermal oxidiser with energy recovery	

Section	Section	BAT#	BAT Text	Requirements	Comments
	Emissions to water	BAT46	In order to prevent or reduce waste water generation (e.g. from cleaning, spills and condensates) and the organic load discharged to further waste water treatment, BAT is to use one or both of the techniques given	<b>Techniques</b> a. Reuse of water b. Chemical pre-treatment	
	Residues	BAT47	In order to reduce the amount of paraformaldehyde-containing waste being sent for disposal, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Minimisation of paraformaldehyde generation b. Material recovery c. Use of residues as a fuel	
BAT conclusions for ethylene oxide and ethylene glycols production	Process selection	BAT48	In order to reduce the consumption of ethylene and emissions to air of organic compounds and CO <sub>2</sub> , BAT for new plants and major plant upgrades is to use oxygen instead of air for the direct oxidation of ethylene to ethylene oxide.		
	Emissions to air	BAT49	In order to recover ethylene and energy and to reduce emissions of organic compounds to air from the EO plant, BAT is to use both of the techniques given	<b>Techniques</b> <b>Techniques to recover organic material for reuse or recycling</b> a. Use of pressure swing adsorption or membrane separation to recover ethylene from the inerts purge <i>Energy recovery techniques</i> b. Send the inerts purge stream to a combustion unit	
		BAT50	In order to reduce the consumption of ethylene and oxygen and to reduce CO <sub>2</sub> emissions to air from the EO unit, BAT is to use a combination of the techniques in BAT 15 and to use inhibitors	<b>Description</b> The addition of small amounts of an organochlorine inhibitor (such as ethylchloride or dichloroethane) to the reactor feed in order to reduce the proportion of ethylene that is fully oxidised to carbon dioxide. Suitable parameters for the monitoring of catalyst performance include the heat of reaction and the CO <sub>2</sub> formation per tonne of ethylene feed.	
		BAT51	In order to reduce emissions of organic compounds to air from the	<b>Techniques</b> <i>Process-integrated techniques</i>	

Section	Section	BAT#	BAT Text	Requirements	Comments
			desorption of CO2 from the scrubbing medium used in the EO plant, BAT is to use a combination of the techniques given	a. Staged CO2 desorption <i>Abatement techniques</i> b. Catalytic oxidiser c. Thermal oxidiser	
		BAT52	In order to reduce EO emissions to air, BAT is to use wet scrubbing for waste gas streams containing EO.	<b>Description</b> For the description of wet scrubbing, see Section 12.1 of BAT. Scrubbing with water to remove EO from waste gas streams before direct release or before further abatement of organic compounds.	
		BAT53	In order to prevent or reduce emissions of organic compounds to air from cooling of the EO absorbent in the EO recovery unit, BAT is to use one of the techniques given	<b>Techniques</b> a. Indirect cooling b. Complete EO removal by stripping	
	Emissions to water	BAT54	In order to reduce the waste water volume and to reduce the organic load discharged from the product purification to final waste water treatment, BAT is to use one or both of the techniques given	<b>Techniques</b> a. Use of the purge from the EO plant in the EG plant b. Distillation	
	Residues	BAT55	In order to reduce the amount of organic waste being sent for disposal from the EO and EG plant, BAT is to use a combination of the techniques given	<b>Techniques</b> a. Hydrolysis reaction optimisation b. Isolation of by-products at EO plants for use c. Isolation of by-products at EG plants for use	
BAT conclusions for phenol production	Emissions to air	BAT56	In order to recover raw materials and to reduce the organic load sent from the cumene oxidation unit to the final waste gas treatment, BAT is to use a combination of the techniques given below.	<b>Techniques</b> <i>Process-integrated techniques</i> a. Techniques to reduce liquids entrainment <i>Techniques to recover organic material for reuse</i> b. Condensation c. Adsorption (regenerative)	

Section	Section	BAT#	BAT Text	Requirements	Comments
		<b>BAT57</b>	In order to reduce emissions of organic compounds to air, BAT is to use technique d given below for waste gas from the cumene oxidation unit. For any other individual or combined waste gas streams, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Send the waste gas stream to a combustion unit b. Adsorption c. Thermal oxidiser d. Regenerative thermal oxidiser (RTO)	
	<b>Emissions to water</b>	<b>BAT58</b>	In order to reduce emissions to water of organic peroxides from the oxidation unit and, if necessary, to protect the downstream biological waste water treatment plant, BAT is to pretreat waste water containing organic peroxides using hydrolysis before it is combined with other waste water streams and discharged to the final biological treatment	<b>Description</b> For the description of hydrolysis, see Section 12.2. Waste water (mainly from the condensers and the adsorber regeneration, after phase separation) is treated thermally (at temperatures above 100 °C and a high pH) or catalytically to decompose organic peroxides to non-ecotoxic and more readily biodegradable compounds.	
		<b>BAT59</b>	In order to reduce the organic load discharged from the cleavage unit and the distillation unit to further waste water treatment, BAT is to recover phenol and other organic compounds (e.g. acetone) using extraction followed by stripping	<b>Description</b> Recovery of phenol from phenol-containing waste water streams by adjustment of the pH to < 7, followed by extraction with a suitable solvent and stripping of the waste water to remove residual solvent and other low-boiling compounds (e.g. acetone). For the description of the treatment techniques, see Section 12.2.	
	<b>Residues</b>	<b>BAT60</b>	In order to prevent or reduce the amount of tar being sent for disposal from phenol purification, BAT is to use one or both of the techniques given	<b>Techniques</b> a. Material recovery (e.g. by distillation, cracking) b. Use of tar as a fuel	

Section	Section	BAT#	BAT Text	Requirements	Comments
BAT conclusions for ethanolamines production	Emissions to air	BAT61	In order to reduce ammonia emissions to air and to reduce the consumption of ammonia from the aqueous ethanolamines production process, BAT is to use a multistage wet scrubbing system.	<b>Description</b> For the description of wet scrubbing, see Section 12.1. Unreacted ammonia is recovered from the off-gas of the ammonia stripper and also from the evaporation unit by wet scrubbing in at least two stages followed by ammonia recycling into the process	
	Emissions to water	BAT62	In order to prevent or reduce emissions of organic compounds to air and emissions to water of organic substances from the vacuum systems, BAT is to use one or a combination of the techniques given	<b>Techniques</b> a. Water-free vacuum generation b. Use of water ring vacuum pumps with recirculation of the ring water c. Reuse of aqueous streams from vacuum systems in the process d. Condensation of organic compounds (amines) upstream of vacuum systems	
	Raw material consumption	BAT63	In order to use ethylene oxide efficiently, BAT is to use a combination of the techniques given	<b>Techniques</b> a. Use of excess ammonia b. Optimisation of the water content in the reaction c. Optimise the process operating conditions	
BAT conclusions for toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI) production	Emissions to air	BAT64	In order to reduce the load of organic compounds, NOX, NOX precursors and SOX sent to the final waste gas treatment (see BAT 66) from DNT, TDA and MDA plants, BAT is to use a combination of the techniques given	<b>Techniques</b> a. Condensation b. Wet Scrubbing c. Thermal reduction d. Catalytic reduction	
		BAT65	In order to reduce the load of HCl and phosgene sent to the final waste gas treatment and to increase resource efficiency, BAT is to recover HCl and phosgene from the process off-gas streams of TDI and/or MDI plants by using an appropriate combination of the techniques given	<b>Techniques</b> a. Absorption of HCl by wet scrubbing b. Absorption of phosgene by scrubbing c. HCl/phosgene condensation	

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT66	In order to reduce emissions to air of organic compounds (including chlorinated hydrocarbons), HCl and chlorine, BAT is to treat combined waste gas streams using a thermal oxidiser followed by caustic scrubbing.	<b>Description</b> The individual waste gas streams from DNT, TDA, TDI, MDA and MDI plants are combined to one or several waste gas streams for treatment. (See Section 12.1 for the descriptions of thermal oxidiser and scrubbing.) Instead of a thermal oxidiser, an incinerator may be used for the combined treatment of liquid waste and the waste gas. Caustic scrubbing is wet scrubbing with caustic added to improve the HCl and chlorine removal efficiency.	
		BAT67	In order to reduce emissions to air of PCDD/F from a thermal oxidiser (see Section 12.1) treating process off-gas streams containing chlorine and/or chlorinated compounds, BAT is to use technique a, if necessary followed by technique b, given below.	<b>Techniques</b> a. Rapid quenching b. Activated carbon injection	
	Emissions to water	BAT68	BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. 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.	<b>Table - Substance/Parameter   Plant   Sampling Point   Standard(s)   Minimum monitoring frequency   Monitoring associated with</b>	

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT69	In order to reduce the load of nitrite, nitrate and organic compounds discharged from the DNT plant to waste water treatment, BAT is to recover raw materials, to reduce the waste water volume and to reuse water by using an appropriate combination of the techniques given	<b>Techniques</b> a. Use of highly concentrated nitric acid b. Optimised regeneration and recovery of spent acid c. Reuse of process water to wash DNT d. Reuse of water from the fire washing step in the process e. Multiple use and recirculation of water	
		BAT70	In order to reduce the load of poorly biodegradable organic compounds discharged from the DNT plant to further waste water treatment, BAT is to pretreat the waste water using one or both of the techniques given below	<b>Techniques</b> a. Extraction b. Chemical oxidation	
		BAT71	In order to reduce waste water generation and the organic load discharged from the TDA plant to waste water treatment, BAT is to use a combination of techniques a., b. and c. and then to use technique d. as given below.	<b>Techniques</b> a. Evaporation b. Stripping c. Extraction d. Reuse of water	
		BAT72	In order to prevent or reduce the organic load discharged from MDI and/or TDI plants to final waste water treatment, BAT is to recover solvents and reuse water by optimising the design and operation of the plant.		
		BAT73	In order to reduce the organic load discharged from a MDA plant to further waste water treatment, BAT is to recover organic material using one or a combination of the techniques given below.	<b>Techniques</b> a. Evaporation b. Extraction c. Steam stripping d. Distillation	

Section	Section	BAT#	BAT Text	Requirements	Comments
	<b>Residues</b>	<b>BAT74</b>	In order to reduce the amount of organic residues being sent for disposal from the TDI plant, BAT is to use a combination of the techniques given below.	<p><b>Techniques</b></p> <p><i>Techniques to prevent or reduce the generation of waste</i></p> <p>a. Minimisation of high-boiling residue formation in distillation systems</p> <p><i>Techniques to recover organic material for reuse or recycling</i></p> <p>b. Increased recovery of TDI by evaporation or further distillation</p> <p>c. Recovery of TDA by chemical reaction</p>	
<b>BAT conclusions for ethylene dichloride and vinyl chloride monomer production</b>	<b>Emissions to air -</b>		<b>BAT-AEL for emissions to air from an EDC cracker furnace</b>	The associated monitoring is in BAT 1.	
	<b>Emissions to air - Techniques and BAT-AEL for emissions to air from other sources</b>	<b>BAT75</b>	In order to reduce the organic load sent to the final waste gas treatment and to reduce raw material consumption, BAT is to use all of the techniques given below	<p><b>Techniques</b></p> <p><b><i>Process-integrated techniques</i></b></p> <p>a. Control of feed quality</p> <p>b. Use of oxygen instead of air for oxychlorination</p> <p><i>Techniques to recover organic material</i></p> <p>c. Condensation using chilled water or refrigerants</p>	
		<b>BAT76</b>	In order to reduce emissions to air of organic compounds (including halogenated compounds), HCl and Cl <sub>2</sub> , BAT is to treat the combined waste gas streams from EDC and/or VCM production by using a thermal oxidiser followed by two-stage wet scrubbing	<p><b>Description</b></p> <p>For the description of thermal oxidiser, wet and caustic scrubbing, see Section 12.1. Thermal oxidation can be carried out in a liquid waste incineration plant. In this case, the oxidation temperature exceeds 1 100 °C with a minimum residence time of 2 seconds, with subsequent rapid cooling of exhaust gases to prevent the de novo synthesis of PCDD/F. Scrubbing is carried out in two stages: Wet scrubbing with water and, typically, recovery of hydrochloric acid, followed by wet scrubbing with caustic.</p>	
		<b>BAT77</b>	In order to reduce emissions to air of PCDD/F from a thermal oxidiser (see Section 12.1) treating process	<p><b>Techniques</b></p> <p>a. Rapid quenching</p> <p>b. Activated carbon injection</p>	

Section	Section	BAT#	BAT Text	Requirements	Comments
			off-gas streams containing chlorine and/or chlorinated compounds, BAT is to use technique a, if necessary followed by technique b, given		
		<b>BAT78</b>	In order to reduce emissions to air of dust and CO from the decoking of the cracker tubes, BAT is to use one of the techniques to reduce the frequency of decoking given below and one or a combination of the abatement techniques given	<b>Techniques</b> <i>Techniques to reduce the frequency of decoking</i> a. Optimisation of thermal decoking b. Optimisation of mechanical decoking <i>Abatement techniques</i> c. Wet dust scrubbing d. Cyclone e. Fabric filter	
	<b>Emissions to water</b>	<b>BAT79</b>	BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. 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.	<b>Table - Substance/Parameter   Plant   Sampling Point   Standard(s)   Minimum monitoring frequency   Monitoring associated with</b>	

Section	Section	BAT#	BAT Text	Requirements	Comments
		BAT80	In order to reduce the load of chlorinated compounds discharged to further waste water treatment and to reduce emissions to air from the waste water collection and treatment system, BAT is to use hydrolysis and stripping as close as possible to the source.	<p><b>Description</b> For the description of hydrolysis and stripping, see Section 12.2. Hydrolysis is carried out at alkaline pH to decompose chloral hydrate from the oxychlorination process. This results in the formation of chloroform which is then removed by stripping, together with EDC and VCM. BAT-associated environmental performance levels (BAT-AEPLs): See Table 10.3. BAT-associated emission levels (BAT-AELs) for direct emissions to a receiving water body at the outlet of the final treatment: See Table 10.5.</p>	
		BAT81	In order to reduce emissions to water of PCDD/F and copper from the oxychlorination process, BAT is to use technique a. or, alternatively, technique b together with an appropriate combination of techniques c., d. and e. given below	<p><b>Description</b> <i>Process-integrated techniques</i> a. Fixed-bed design for oxychlorination b. Cyclone or dry catalyst filtration system <i>Waste water pre-treatment</i> c. Chemical precipitation d. Coagulation and flocculation e. Membrane filtration (micro- or ultrafiltration)</p>	
	Energy Efficiency	BAT82	In order to use energy efficiently, BAT is to use a boiling reactor for the direct chlorination of ethylene.	<p><b>Description</b> The reaction in the boiling reactor system for the direct chlorination of ethylene is typically carried out at a temperature between below 85 °C and 200 °C. In contrast to the low-temperature process, it allows for the effective recovery and reuse of the heat of reaction (e.g. for the distillation of EDC). Only applicable to new direct chlorination plants</p>	

Section	Section	BAT#	BAT Text	Requirements	Comments
	Residues	BAT83	In order to reduce the energy consumption of EDC cracker furnaces, BAT is to use promoters for the chemical conversion.	<b>Description</b> Promoters, such as chlorine or other radical-generating species, are used to enhance the cracking reaction and reduce the reaction temperature and therefore the required heat input. Promoters may be generated by the process itself or added.	
		BAT84	In order to reduce the amount of coke being sent for disposal from VCM plants, BAT is to use a combination of the techniques given	<b>Techniques</b> a. Use of promoters in cracking b. Rapid quenching of the gaseous stream from EDC cracking c. Pre-evaporation of EDC feed d. Flat flame burners	
		BAT85	In order to reduce the amount of hazardous waste being sent for disposal and to increase resource efficiency, BAT is to use all of the techniques give	<b>Techniques</b> a. Hydrogenation of acetylene b. Recovery and reuse of HCl from incineration of liquid waste c. Isolation of chlorinated compounds for use	
BAT conclusions for hydrogen peroxide production	Emissions to air	BAT86	In order to recover solvents and to reduce emissions of organic compounds to air from all units other than the hydrogenation unit, BAT is to use an appropriate combination of the techniques given. In the case of using air in the oxidation unit, this includes at least technique d. In the case of using pure oxygen in the oxidation unit, this includes at least technique b. using chilled water	<b>Techniques</b> <i>Process-integrated techniques</i> a. Optimisation of the oxidation process b. Techniques to reduce solids and/or liquids entrainment <i>Techniques to recover solvent for reuse</i> c. Condensation d. Adsorption (regenerative)	
		BAT87	In order to reduce emissions of organic compounds to air from the hydrogenation unit during start-up operations, BAT is to use condensation and/or adsorption	<b>Description</b> For the description of condensation and adsorption, see Section 12.1.	
		BAT88	In order to prevent benzene emissions to air and water, BAT is not to use benzene in the working solution.		

Section	Section	BAT#	BAT Text	Requirements	Comments
	Emissions to water	BAT89	In order to reduce the waste water volume and the organic load discharged to waste water treatment, BAT is to use both of the techniques given	<b>Techniques</b> a. Optimised liquid phase separation b. Reuse of water	
		BAT90	In order to prevent or reduce emissions to water of poorly bioeliminable organic compounds, BAT is to use one of the techniques given	<b>Techniques</b> a. Adsorption b. Waste water incineration Only applicable to waste water streams carrying the main organic load from the hydrogen peroxide plant and when the reduction of the TOC load from the hydrogen peroxide plant by means of biological treatment is lower than 90 %.	

## **APPENDIX B      BAT CONCLUSION REVIEW TABLE – CWW BREF**

01 March 2019

Section	Subsection	BAT#	BAT Text	Requirements	Comments
Environmental management systems	Environmental management systems	BAT1	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:	<p>I. commitment of the management, including senior management;</p> <p>II. an environmental policy that includes the continuous improvement for the installation by the management;</p> <p>III. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;</p> <p>IV. implementation of procedures paying particular attention to:</p> <ul style="list-style-type: none"> <li>(a) structure and responsibility</li> <li>(b) recruitment, training, awareness and competence</li> <li>(c) communication</li> <li>(d) employee involvement</li> <li>(e) documentation</li> <li>(f) effective process control</li> <li>(g) maintenance programmes</li> <li>(h) emergency preparedness and response</li> <li>(i) safeguarding compliance with environmental legislation</li> </ul> <p>V. checking performance and taking corrective action, paying particular attention to:</p> <ul style="list-style-type: none"> <li>(a) monitoring and measurement</li> <li>(b) corrective and preventive action</li> <li>(c) maintenance of records</li> <li>(d) independent internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; <p>VI. review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;</p> <p>VII. following the development of cleaner technologies;</p> <p>VIII. consideration for the environmental impacts from the eventual decommissioning of the plant at the design stage of a new</p> </li></ul>	<p>The site operates an EMS, embedded in the site's operating procedures.</p> <p>Huntsman has a series of trained internal audits and auditors. There are 3 yearly EHS audits and 3 year process safety audits (non-overlapping schedule).</p> <p>Section 3 of the site's COMAH report sets out the Management Measures to Prevent Major Accidents:</p> <ul style="list-style-type: none"> <li>3.1 Outline of the System for Preventing Major Accidents</li> <li>3.2 Major Accident Prevention Policy</li> <li>3.3 Planning and Organising</li> <li>3.4 Planning and Implementing</li> <li>3.5 Key Risk-control Systems</li> <li>3.6 Measuring Performance</li> <li>3.7 Review and Audit</li> </ul> <p>The following Huntsman Polyurethane Management Procedures (HPMP) are also relevant to the environmental management system.</p> <ul style="list-style-type: none"> <li>1701 G - Management of the Installations Drainage and Effluent Systems</li> <li>1702 N - Management of Waste Materials for Off-Site Disposal</li> <li>1703 B - Management of Packaging Wastes</li> <li>1716 F - Prevention of Noise Nuisance of the Public (requirement XIV)</li> <li>1740 F - Waste Minimisation</li> <li>1741 B - Management of Emissions to Air</li> </ul>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				<p>plant, and throughout its operating life.</p> <p>IX. Application of sectoral benchmarking on a regular basis; X. waste management plan.</p> <p>Specifically for chemical sector activities, BAT is to incorporate the following features in the EMS: XI. on multi-operator installation/sites, establishment of a convention that sets out 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.</p> <p>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).</p>	<p>1742 - Determination of Significant Releases and Assessment of Control Measures 1743 B - Management of Land and Site Protection including Past Operating and Waste Management Practices 1746 H - Compliance with IPPC Permit 1750 C - Leak Detection and Repair</p>
		<b>BAT2</b>	<p>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:</p>	<p><b>I.</b> 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; (c) descriptions of process-integrated techniques and water/waste gas treatment at source including their performances; <b>II.</b> information, as comprehensive as 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);</p>	<p>The following reports and procedures provide the required information.</p> <p><i>COMAH Report:</i> Section 2.2 - Dangerous Substances 2.2.1 Names and Maximum Quantities 2.2.2 Physical and Chemical Behaviours 2.2.3 Immediate and Delayed Harm to People and the Environment</p> <p>Huntsman Polyurethane Management Procedures (HPMP): 1701 G - Management of the Installations Drainage and Effluent Systems 1702 N - Management of Waste</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				<p>(c) data on bioeliminability (e.g. BOD, BOD/COD ratio, Zahn-Wellens test, biological inhibition potential (e.g. nitrification));</p> <p><b>III.</b> information, as comprehensive as is reasonably possible, about the characteristics of the waste gas streams, such as:</p> <p>(a) average values and variability of flow and temperature;</p> <p>(b) average concentration and load values of relevant pollutants/parameters and their variability (e.g. VOC, CO, NOx, SOX, chlorine, hydrogen chloride);</p> <p>(c) flammability, lower and higher explosive limits, reactivity;</p> <p>(d) presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, nitrogen, water vapour, dust).</p>	Materials for Off-Site Disposal 1741 B - Management of Emissions to Air
<b>Monitoring</b>		<b>BAT3</b>	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).		<p>There are no direct emissions to surface water, or river.</p> <p>Plant controls are used to manage the pollutant loading on the two effluent discharge streams.</p> <p>Nitrobenzene process:</p> <ul style="list-style-type: none"> <li>- Process strong effluent (from the 2<sup>nd</sup> wash) is diluted with process water from the aniline plant and then sent offsite to biological treatment through trade effluent consent with Northumbrian Water at Bran Sands. There is an inline monitor (pH and turbidity ) on the discharge to sewer.</li> <li>- Process weak effluent (from the 1<sup>st</sup> wash) is adjusted for pH, steam stripped to remove organics and then sent to Sembcorp Utilities</li> </ul>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
					<p>under a trade effluent consent. There are two inline monitors (pH and TOC) on the discharge. Sembcorp has a series of buffer vessels in the event of off-spec product being received to protect the discharge to estuary.</p> <p>Aniline process: - Process weak effluent (from the amine water steam stripping column) is sent to Sembcorp Utilities as for the Nitrobenzene process. Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as CEM fuel.</p>
		<b>BAT4</b>	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.	<p><b>Substance/parameter</b> Total organic carbon (TOC) Chemical oxygen demand (COD) Total suspended solids (TSS) Total nitrogen (TN) Total inorganic nitrogen (Ninorg) Total phosphorus (TP) Adsorbable organically bound halogens (AOX) <i>Metals</i> Cr Cu Ni Pb Zn Other metals, if relevant <i>Toxicity</i> Fish eggs (Danio rerio) Daphnia (Daphnia magna Straus) Luminescent bacteria (Vibrio fischeri) Duckweed (Lemna minor) Algae</p>	<p>There are no direct emissions to surface water, or river.</p> <p>Annual reporting to EA as per the requirements of the permit based on test reports from Northumbrian Water and Sembcorp.</p>
		<b>BAT5</b>	BAT is to periodically monitor diffuse VOC emissions to air from relevant	I. sniffing methods associated with correlation curves for key equipment;	Permit requirement for fugitive VOC emissions - submitted annually to

Section	Subsection	BAT#	BAT Text	Requirements	Comments
			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.	<p>II. optical gas imaging methods; III. calculations of emissions based on emissions factors periodically validated (e.g. once every two years) by measurements.</p> <p>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.</p> <p><b>Description</b> - See Section 4.6.2.</p>	<p>the EA.</p> <p>The site operates using option III. TVOCs are reported every 36 months annually based on calculations from previous monitoring results and annual sniff testing.</p>
		<b>BAT6</b>	BAT is to periodically monitor odour emissions from relevant sources in accordance with EN standards.	<p><b>Description</b> - Emissions can be monitored by dynamic olfactometry according to EN 13725. Emission monitoring may be complemented by measurement/estimation of odour exposure or estimation of odour impact.</p> <p><b>Applicability</b> - The applicability is restricted to cases where odour nuisance can be expected or has been substantiated.</p>	No odour emissions from site. No requirement for monitoring.
<b>Emissions to water</b>	<b>Water usage and waste water generation</b>	<b>BAT7</b>	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.		<p>Plant controls are used to manage the pollutant loading on the two effluent discharge streams.</p> <p>Nitrobenzene process: - Process strong effluent (from the 2<sup>nd</sup> wash) is diluted with process water from the aniline plant and then sent offsite to biological treatment through trade effluent consent with Northumbrian Water at Bran Sands. There is an inline monitor (pH and turbidity) on the discharge to sewer. - Process weak effluent (from the 1<sup>st</sup> wash) is adjusted for pH, steam stripped to remove organics and</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
					<p>then sent to Sembcorp Utilities under a trade effluent consent. There are two inline monitors (pH and TOC) on the discharge. Sembcorp has a series of buffer vessels in the event of off-spec product being received to protect the discharge to estuary.</p> <p>Aniline process: - Process weak effluent (from the amine water steam stripping column) is sent to Sembcorp Utilities as for the Nitrobenzene process. Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as CEM fuel.</p>
	Waste water collection and segregation	BAT8	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.	<b>Applicability</b> - The segregation of uncontaminated rainwater may not be applicable in the case of existing waste water collection systems	<p>The site has combined wastewater and stormwater drainage. Process areas are bunded. External bunds are periodically checked for presence of water - this is pumped to the Sembcorp drain following a test for contamination.</p> <p>The site's hazardous materials offloading area is self contained in respect of drainage - there is sufficient storage volume in this area to contain a spill during offloading.</p> <p>All other areas of site are hard surfaced with impermeable surfacing. Surface water drains to Sembcorp drain.</p>
		BAT9	In order to prevent uncontrolled emissions to water, BAT is to provide an appropriate buffer storage capacity for waste water incurred during other	<b>Applicability</b> - The interim storage of contaminated rainwater requires segregation, which may not be applicable in the case of existing waste water collection	Sembcorp has a series of buffer vessels in the event of off-spec product being received to protect the discharge to estuary.

Section	Subsection	BAT#	BAT Text	Requirements	Comments
			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).	systems.	<p><i>The site has carried out a bulk storage bunding review. This has confirmed that there is more than adequate capacity for failure and firewater (&gt;110%). See COMAH report sections:</i></p> <ul style="list-style-type: none"> <li>- Section 5.1.1 provides details of bulk storage and bunding for the Nitrobenzene plant</li> <li>- Section 5.1.2 provides details of bulk storage and bunding for the Aniline plant</li> <li>- Section 5.3.10 provides details of the bulk storage and bunding for the effluent storage</li> <li>- Section 4.3.2.5 Domino Assessment - Fire water run-off</li> <li>- Section 5.1.3.6 includes details of site drainage, including the management of firewater.</li> </ul>
	Waste water treatment	BAT10	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.	<p><b>Technique</b></p> <ul style="list-style-type: none"> <li>a. Process-integrated techniques</li> <li>b. Recovery of pollutants at source</li> <li>c. Waste water pre-treatment</li> <li>d. Final waste water treatment</li> </ul> <p><b>Description</b> - The integrated waste water management and treatment strategy is based on the inventory of waste water streams (see BAT 2). BAT-associated emission levels (BAT-AELs): See Section 4.3.4.</p>	<p>Water is not used as a raw material, it is a by-product of the process and is managed accordingly with phase separation and steam stripping used to strip product from the water.</p> <p>The response to BAT 3 provides details of waste water management for the site.</p>
		BAT11	In order to reduce emissions to water, BAT is to pretreat waste water that contains pollutants that cannot be dealt with adequately during final waste water treatment by using appropriate techniques.	<p><b>Description</b> - 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:</p> <ul style="list-style-type: none"> <li>-protect the final waste water treatment plant (e.g. protection of a biological</li> </ul>	<p>There is no final effluent treatment on site. The site discharges to both Northumbrian Water and to Sembcorp Utilities under trade effluent consents.</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				<p>treatment plant against inhibitory or toxic compounds);</p> <ul style="list-style-type: none"> <li>·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);</li> <li>·remove compounds that are otherwise stripped to air from the collection system or during final treatment (e.g. volatile halogenated organic compounds, benzene);</li> <li>·remove compounds that have other negative effects (e.g. corrosion of equipment; unwanted reaction with other substances; contamination of waste water sludge).</li> </ul> <p>In general, pre-treatment is carried out as close as possible to the source in order to avoid dilution, in particular for metals. Sometimes, waste water streams with appropriate characteristics can be segregated and collected in order to undergo a dedicated combined pre-treatment.</p>	<p>Plant controls are used to manage the pollutant loading on the two effluent discharge streams.</p> <p>Nitrobenzene process:</p> <ul style="list-style-type: none"> <li>- Process strong effluent (from the 2<sup>nd</sup> wash) is diluted with process water from the aniline plant and then sent offsite to biological treatment through trade effluent consent with Northumbrian Water at Bran Sands. There is an inline monitor (pH, and turbidity) on the discharge to sewer.</li> <li>- Process weak effluent (from the 1<sup>st</sup> wash) is adjusted for pH, steam stripped to remove organics and then sent to Sembcorp Utilities under a trade effluent consent. There are two inline monitors (pH and TOC) on the discharge. Sembcorp has a series of buffer vessels in the event of off-spec product being received to protect the discharge to estuary.</li> </ul> <p>Aniline process:</p> <ul style="list-style-type: none"> <li>- Process weak effluent (from the amine water steam stripping column ) is sent to Sembcorp Utilities as for the Nitrobenzene process. Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as CEM fuel.</li> </ul>
		<b>BAT12</b>	In order to reduce emissions to water, BAT is to use an appropriate combination of final waste water treatment techniques.	<p><b>Description</b> - 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,</p>	<p>'There is no final effluent treatment on site. The site discharges to both Northumbrian Water and to Sembcorp Utilities under trade effluent consents.</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				<p>include:</p> <p><b>Technique</b>  <i>Preliminary and primary treatment</i>                      a. Equalisation                      b. Neutralisation                      c. Physical separation, e.g. screens, sieves, grit separators, grease separators or primary settlement tanks  <i>Biological treatment (secondary treatment), e.g</i>                      d. Activated sludge process                      e. Membrane bioreactor  <i>Nitrogen removal</i>                      f. Nitrification/denitrification  <i>Phosphorus removal</i>                      g. Chemical precipitation  <i>Final solids removal</i>                      h. Coagulation and flocculation                      i. Sedimentation                      j. Filtration (e.g. sand filtration, microfiltration, ultrafiltration)                      k. Flotation</p>	
<b>Waste</b>		<b>BAT13</b>	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.		<p>Aniline process: Residues from the dehydration stills and refining stills purge processes are sent for energy recovery as CEM fuel.</p> <p>The Nickel catalyst is sent for energy recovery as CEM fuel. Recovery of the catalyst is not economically viable as it is not possible to separate it effectively from the heavy aromatic tars from the aniline reactor</p> <p>The site tracks closely all the wastes generated. This is an annual report to the EA and also feeds back into the business and is used to identify waste minimisation</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
					opportunities going forward.
		BAT14	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.	<b>Technique</b> a. Conditioning b. Thickening/dewatering c. Stabilisation d. Drying	There is no final effluent treatment on site. The site discharges to both Northumbrian Water and to Sembcorp Utilities under trade effluent consents.
Emissions to Air	Waste gas collection	BAT15	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.	<b>Applicability</b> - 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).	Site operates a fully enclosed process and emissions are discharged through the Thox plant or other permitted emission points. For more detail see the LVOC BREF review - BAT 3-8
	Waste gas treatment	BAT16	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.	<b>Description</b> - 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.	The process is designed to minimise waste gases and maximise production. Site operates a fully enclosed process and emissions discharged through the Thox plant or other permitted emission points.  For more detail see the LVOC BREF review - BAT 3-8
	Flaring	BAT17	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	Not applicable - no flaring on site
		BAT18	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	Not applicable - no flaring on site
	Diffuse VOC emissions	BAT19	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.	<b>Technique</b> <i>Techniques related to plant design</i> a. Limit the number of potential emission sources b. Maximise process-inherent containment features c. Select high-integrity equipment (see the description in Section 4.6.2)	Permit requirement for fugitive VOC emissions - submitted annually to the EA.  The site monitors using technique III - calculations of emissions based on emissions factors periodically validated (e.g. once every two

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				<p>d. Facilitate maintenance activities by ensuring access to potentially leaky equipment <i>Techniques related to plant/equipment construction, assembly and commissioning</i></p> <p>e. Ensure well-defined and comprehensive procedures for plant/equipment construction and assembly. This includes using the designed gasket stress for flanged joint assembly (see the description in Section 4.6.2)</p> <p>f. Ensure robust plant/equipment commissioning and handover procedures in line with the design requirements <i>Techniques related to plant operation</i></p> <p>g. Ensure good maintenance and timely replacement of equipment</p> <p>h. Use a risk-based leak detection and repair (LDAR) programme (see the description in Section 4.6.2)</p> <p>i. As far as it is reasonable, prevent diffuse VOC emissions, collect them at source, and treat them</p> <p>The associated monitoring is in BAT 5.</p>	<p>years) by measurements.</p> <p>TVOCs are reported annually based on calculations from previous monitoring results and annual sniff testing.</p>
	<b>Odour emissions</b>	<b>BAT20</b>	<p>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:</p>	<p>I.a protocol containing appropriate actions and timelines;</p> <p>II.a protocol for conducting odour monitoring;</p> <p>III.a protocol for response to identified odour incidents;</p> <p>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.</p> <p>The associated monitoring is in BAT 6.</p> <p><b>Applicability</b> - The applicability is restricted</p>	<p>No odour emissions from site. No requirement for monitoring in the permit.</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
				to cases where odour nuisance can be expected or has been substantiated.	
		BAT21	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.		Not applicable - no WWTP on site.
	Noise emissions	BAT22	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:	<p>I. a protocol containing appropriate actions and timelines;</p> <p>II.a protocol for conducting noise monitoring;</p> <p>III.a protocol for response to identified noise incidents;</p> <p>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.</p> <p><b>Applicability</b> - The applicability is restricted to cases where noise nuisance can be expected or has been substantiated</p>	<p>The site is located on a large industrial estate and has no proximate noise sensitive receptors.</p> <p>There is noise generating equipment on site (e.g. compressors, agitators, hydrogen let down valves), however these are contained within noise-insulated enclosures where practicable.</p> <p>Site operates a noise monitoring programme alongside the wider Wilton estate noise monitoring programme.</p> <p>No noise concerns have been raised by either the regulator or local residents. There are no permit requirements for noise monitoring.</p>
		BAT23	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.	<p><b>Technique</b></p> <p>a. Appropriate location of equipment and buildings</p> <p>b. Operational measures</p> <p>c. Low-noise equipment</p> <p>d. Noise-control equipment</p> <p>e. Noise abatement</p>	<p>The site is located on a large industrial estate and has no proximate noise sensitive receptors.</p> <p>There is noise generating equipment on site (e.g. compressors, agitators, hydrogen let down valves), however these are contained within noise-insulated enclosures where practicable.</p> <p>Site operates a noise monitoring programme alongside the wider</p>

Section	Subsection	BAT#	BAT Text	Requirements	Comments
					Wilton estate noise monitoring programme.  No noise concerns have been raised by either the regulator or local residents. There are no permit requirements for noise monitoring.

**APPENDIX C      SUMMARY OF PERMIT CONDITIONS FOR EMISSION  
POINTS A4-A9**

01 March 2019



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