Appendix H – Common Waste Gas Management and Treatment Systems in the Chemical Sector BRef BATc Assessment

Agilent Environmental Permit Application: Redacted for the Public Register

Best Available Techniques & Operating Techniques

Agilent Technologies LDA UK Limited

SLR Project No.: 410.064951.00001

23 September 2024

Assessment of Indicative BAT for Common Waste Gas Management and Treatment Systems in the Chemical Sector

The following table provides an assessment of the operation techniques carried out by Agilent against the BAT requirements contained within the Common Waste Gas Management and Treatment Systems in the Chemical Sector BRef.

Table H1 Best Available Techniques – Common Waste Gas Management and Treatment Systems in the Chemical Sector

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
Scope	These BAT conclusions concern the following activity specified in Annex I to Directive 2010/75/EU: 4. Chemical industry (i.e., all production processes included in the categories of activities listed in points 4.1 to 4.6 of Annex I, unless specified otherwise). More specifically, these BAT conclusions focus on emissions to air from the aforementioned activity. These BAT conclusions do not address the following: 1. Emissions to air from the production of chlorine, hydrogen, and sodium/potassium hydroxide by the electrolysis of brine. This is covered by the BAT conclusions for the Production of Chlor-alkali (CAK). 2. Channelled emissions to air from the production of the following chemicals in continuous processes where the total production capacity of those chemicals exceeds 20 kt/yr: ▪ Lower olefins using the steam cracking process. ▪ Formaldehyde. ▪ Ethylene oxide and ethylene glycols. ▪ Phenol from cumene. ▪ Dinitrotoluene from toluene, toluene diamine from dinitrotoluene, toluene diisocyanate from toluene diamine, methylene diphenyl diamine from aniline, methylene diphenyl diisocyanate from methylene diphenyl diamine. ▪ Ethylene dichloride (EDC) and vinyl chloride monomer (VCM). ▪ Hydrogen peroxide. This is covered by the BAT conclusions for the Production of Large Volume Organic Chemicals (LVOC). However, channelled emissions to air of nitrogen oxides (NO_X) and carbon monoxide (CO) from thermal treatment of waste gases originating from the aforementioned production processes are included in the scope of these BAT conclusions. 3. Emissions to air from the production of the following inorganic chemicals: • Ammonia. • Ammonium nitrate. • Calcium ammonium nitrate.	Yes	The BRef document applies as the main site activities are defined under Section 4.1 Part A(1)(a)(viii) activity, i.e., producing organic chemicals such as plastic materials (for example polymers, synthetic fibres and cellulose based fibres); of Schedule 1 to the Environmental Permitting Regulations 2016.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	• Calcium carbide. • Calcium chloride. • Calcium nitrate. • Carbon black. • Ferrous chloride. • Ferrous sulphate (i.e., copperas and related products, such as chloro-sulphates). • Hydrofluoric acid. • Inorganic phosphates. • Nitric acid. • Nitrogen-, phosphorus- or potassium-based fertilisers (simple or compound fertilisers). • Phosphoric acid. • Precipitated calcium carbonate. • Sodium carbonate (i.e., soda ash). • Sodium chlorate. • Sodium silicate. • Sulphuric acid. • Synthetic amorphous silica. • Titanium dioxide and related products. • Urea. • Urea-ammonium nitrate. This may be covered by the BAT conclusions for the Production of Large Volume Inorganic Chemicals (LVIC). 4. Emissions to air from steam reforming as well as from the physical purification and reconcentration of spent sulphuric acid, provided that these processes are directly associated with a production process listed under the aforementioned points 2 or 3. 5. Emissions to air from the production of magnesium oxide using the dry process route. This may be covered by the BAT conclusions for the Production of Cement, Lime and Magnesium Oxide (CLM). 6. Emissions to air from the following: • Combustion units other than process furnaces/heaters. This may be covered by the BAT conclusions for Large Combustion Plants (LCP), the BAT conclusions for the Refining of Mineral Oil and Gas (REF) and/or by Directive. • Process furnaces/heaters with a total rated thermal input below 1 MW. • Process furnaces/heaters used in lower olefins, ethylene dichloride and/or vinyl chloride monomer production referred to in point 2 above. This is covered by the BAT conclusions for the production of Large Volume Organic Chemicals (LVOC).		

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	7. Emissions to air from waste incineration plants. This may be covered by the BAT conclusions for Waste Incineration (WI). 8. Emissions to air from the storage, transfer and handling of liquids, liquefied gases and solids, where these are not directly associated with the activity specified in Annex I to Directive 2010/75/EU:4. Chemical industry. This may be covered by the BAT conclusions for Emissions from Storage (EFS). However, emissions to air from the storage, transfer and handling of liquids, liquefied gases and solids are included in the scope of these BAT conclusions provided that these processes are directly associated with the chemical production process specified in the scope of these BAT conclusions. 9. Emissions to air from indirect cooling systems. This may be covered by the BAT conclusions for Industrial Cooling Systems (ICS).		
	Summary of applicability of the BAT Conclusions to the proposed activities proposed under this application for Variation. 1.1 General BAT Conclusions - BATc 1 – 23 1.2 Polymers (Polyolefins) BAT 24 - 25 1.3 Synthetic Rubbers - BATc 26 - 35 1.4 Process Furnaces / Heaters – BATc 36	-	 Applicable Not Applicable Not Applicable Not Applicable
Environmental Management Systems (EMS)			
BATc 1	In order to improve the overall environmental performance, BAT is to elaborate and implement an EMS that incorporates all of the following features: i. commitment, leadership, and accountability of the management, including senior management, for the implementation of an effective EMS; ii. an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment; iii. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation; iv. establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;	Yes	Agilent will operate the site under an Environmental, Health and Safety Management System which conforms with all the requirements of BAT1. The company wide EHS Management System is certified to ISO 14001. The Site operates an Integrated Management System that is in accordance with ISO 14001. Agilent publishes an annual ESG (Environmental, Social and Governance) report. The decommissioning of new plant is considered at the design stage to ensure that all potential risks to the environment are mitigated during decommissioning and demolition.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	v. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks; vi. determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed; vii. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g., by providing information and training); viii. internal and external communication; ix. fostering employee involvement in good environmental management practices; x. establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records; xi. effective operational planning and process control; xii. implementation of appropriate maintenance programmes; xiii. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations; xiv. when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning; xv. implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations; xvi. application of sectoral benchmarking on a regular basis; xvii. periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; xviii. evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur; xix. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness; xx. following and taking into account the development of cleaner techniques.		Use of cleaner, more efficient technology is considered when replacing equipment. A programme of internal auditing is in place, with audits scheduled every 18 months. Benchmarking occurs against other Agilent sites. Regarding the requirements in BAT 1 specific to the chemicals sector: • The site has established inventories of waste liquid and waste gas streams; • The site has a procedure for operating under potentially abnormal conditions; • The site has an integrated waste gas management strategy for channelled emissions to air; and • The site operates a chemicals management system.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	Specifically for the chemical sector, BAT is also to incorporate the following features in the EMS: xxi. an inventory of channelled and diffuse emissions to air (see BAT 2); xxii. an OTNOC management plan for emissions to air (see BAT 3); xxiii. an integrated waste gas management and treatment strategy for channelled emissions to air (see BAT 4); xxiv. a management system for diffuse VOC emissions to air (see BAT 19); xxv. a chemicals management system that includes an inventory of the hazardous substances and substances of very high concern used in the process(es); the potential for substitution of the substances that are listed in this inventory, focusing on those substances other than raw materials, is analysed periodically (e.g., annually) in order to identify possible new available and safer alternatives, with no or lower environmental impacts.		
BATc 2	In order to facilitate the reduction of emissions to air, BAT is to establish, maintain and regularly review (including when a substantial change occurs) an inventory of channelled and diffuse emissions to air, as part of the environmental management system (see BAT 1), that incorporates all of the following features: i. information, as comprehensive as is reasonably possible, about the chemical production process(es), including: a. chemical reaction equations, also showing side products; b. simplified process flow sheets that show the origin of the emissions; ii. information, as comprehensive as is reasonably possible, about channelled emissions to air, such as: a. emission point(s); b. average values and variability of flow and temperature; c. average concentration and mass flow values of relevant substances/parameters and their variability (e.g., TVOC, CO, NOX, SOX, Cl2, HCl); d. presence of other substances that may affect the waste gas treatment system(s) or plant safety (e.g., oxygen, nitrogen, water vapour, dust); e. techniques used to prevent and/or reduce channelled emissions to air;	Yes	Agilent has established an inventory of channelled and diffuse emissions to air. The location of channelled emission points to air are presented in Drawing 002. The inventory fully complies with the requirements of BATc 2. A recent review of the inventory has resulted in further assessment, including a BAT options appraisal and technology selection for waste gas abatement (refer Section 11.1.2 of the main BATOT report). The site is committed to installing the BAT option to ensure compliance with the BAT-AEL's and BAT operating techniques. A temporary scrubber will be used to reduce concentrations of compounds further whilst the new abatement system is being designed, commissioned and installed. Agilent intends that the upgraded waste gas abatement system should be operational by approximately Q2 2025.

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	f. flammability, lower and higher explosive limits, reactivity; g. monitoring methods (see BAT 8); h. presence of substances classified as CMR 1A, CMR 1B or CMR 2; the presence of such substances may for example be assessed according to the criteria of Regulation (EC) 1272/2008 on classification, labelling and packaging (CLP). iii. information, as comprehensive as is reasonably possible, about diffuse emissions to air, such as: a. identification of the emission source(s); b. characteristics of each emission source (e.g., fugitive or non-fugitive; static or moving; accessibility of the emission source; included in an LDAR programme or not); c. the characteristics of the gas or liquid in contact with the emission source(s), including: 1) physical state; 2) vapour pressure of the substance(s) in the liquid, pressure of the gas; 3) temperature; 4) composition (by weight for liquids or by volume for gases); 5) hazardous properties of the substance(s) or mixtures, including substances or mixtures classified as CMR 1A, CMR 1B or CMR 2; d. techniques used to prevent and/or reduce diffuse emissions to air; e. monitoring (see BAT 20, BAT 21 and BAT 22).		As a result of the design of the channelled emissions collection and abatement systems, no significant fugitive emission sources are anticipated. The AERA provided with this permit application (410.064951.00001AERA) has formally considered the potential environmental impacts associated with all potential emissions from plant systems to offsite receptors. The AERA concluded that the emissions process contribution can be considered 'insignificant' against relevant long-term and short-term standards for the protection of human health.
Other Than Normal Operating Conditions (OTNOC)			
BATc 3	In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions to air during OTNOC, BAT is to set up and implement a risk based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the following features: i. identification of potential OTNOC (e.g., failure of equipment critical to the control of channelled emissions to air, or equipment critical to the prevention of accidents or incidents that could lead to emissions to air (critical equipment)), of their root causes and of their potential consequences; ii. appropriate design of critical equipment (e.g., equipment modularity and compartmentalisation, backup systems, techniques to obviate the need to bypass waste gas treatment during start-up and shutdown, high-integrity equipment, etc.);	Yes – Once OTNOC plan prepared for the site.	Agilent have prepared procedures on how to manage incidents that relate to abnormal conditions. These procedures are currently being collated into one OTNOC management plan. The plan will include: • Identification of environmentally critical plant;

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	iii. set-up and implementation of a preventive maintenance plan for critical equipment (see BAT 1 xii.); iv. monitoring (i.e., estimating or, where this is possible, measuring) and recording of emissions and associated circumstances during OTNOC; v. periodic assessment of the emissions occurring during OTNOC (e.g., frequency of events, duration, amount of pollutants emitted as recorded in point iv.) and implementation of corrective actions if necessary; vi. regular review and update of the list of identified OTNOC under point i. following the periodic assessment of point v.; vii. regular testing of backup systems.		• Measures to be used to identify and prevent potential OTNOC; and • Actions to be taken in the event of OTNOC to minimise emissions to the environment and ensure the plant is returned to normal operating parameters safely. Following OTNOC events, these would be investigated, and corrective actions implemented where appropriate in line with the requirements of the EMS. Records of OTNOC events will be maintained and inspected. The site operates planned preventative maintenance for critical equipment.
Channelled Emissions To Air			
BATc 4	In order to reduce channelled emissions to air, BAT is to use an integrated waste gas management and treatment strategy that includes, in order of priority, process integrated recovery and abatement techniques. The integrated waste gas management and treatment strategy is based on the inventory in BAT 2. It takes into account factors such as greenhouse gas emissions and the consumption or reuse of energy, water and materials associated with the use of the different techniques.	Yes	A recent review of the inventory has resulted in further assessment, including a BAT options appraisal and technology selection for waste gas abatement (refer Section 11.1.2 of the main BATOT report). The site is committed to installing the BAT option to ensure compliance with the BAT-AEL's and BAT operating techniques. A temporary scrubber will be used to reduce concentrations of compounds further whilst the new abatement system is being designed, commissioned and installed. Agilent intends that the upgraded waste gas abatement system should be operational by approximately Q2 2025

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
BATc 5	In order to facilitate the recovery of materials and the reduction of channelled emissions to air, as well as to increase energy efficiency, BAT is to combine waste gas streams with similar characteristics, thus minimising the number of emission points	Yes	As part of the waste gas abatement options appraisal, combination of waste streams will be considered where practicable. Several waste gas streams current vent to the wet scrubber for treatment of exhaust gases before venting to atmosphere. Smaller laboratory-scale processes are contained in fume cupboards and exhaust gases are vented locally. This approach is considered appropriate given the small-scale nature of the production at this site.
BATc 6	In order to reduce channelled emissions to air, BAT is to ensure that the waste gas treatment systems are appropriately designed (e.g., considering the maximum flow rate and pollutant concentrations), operated within their design ranges, and maintained (through preventive, corrective, regular and unplanned maintenance) so as to ensure optimal availability, effectiveness and efficiency of the equipment.	Yes	The BAT options appraisal and technology selection for waste gas abatement will ensure that equipment selected will be appropriately designed for the sites' waste gas composition. Waste gas abatement at the site is included within the planned preventative maintained schedule to ensure that the equipment is maintained and operated in line with manufacturer specifications.
Monitoring			
BATc 7	BAT is to continuously monitor key process parameters (e.g., waste gas flow and temperature) of waste gas streams being sent to pre-treatment and/or final treatment.	N/A	Due to the batched nature of the process, it is not practicable to continuously monitor key process parameters for emissions to air. The process operates on a batched basis with intermittent discharges to air. The overall mass emission levels are predicted to be low. As such, continuous monitoring of flow and temperature is not considered to be warranted.
BATc 8	BAT is to monitor channelled emissions to air 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.	Yes	Section 14 of the BAT-OT sets out the BAT AEL's that apply to the exhaust gases and also

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th>Substance / Parameter (1)</th><th>Process(es) / Source(s)</th><th>Emission Points</th><th>Standard(s) (2)</th><th>Minimum Monitoring Frequency</th><th>Monitoring Associated With</th></tr>
<tr><td rowspan="2">Ammonia (NH_3)</td><td>Use of SCR/SNCR</td><td rowspan="2">Any stack</td><td rowspan="2">EN 21877</td><td rowspan="2">Once every 6 months (3) (4)</td><td>BAT 17</td></tr>
<tr><td>All other processes / sources</td><td>BAT 18</td></tr>
<tr><td>Benzene</td><td>All processes / sources</td><td>Any stack</td><td>No EN standard available</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td>1,3-Butadiene</td><td>All processes / sources</td><td>Any stack</td><td>No EN standard available</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
<tr><td rowspan="6">Carbon monoxide (CO)</td><td rowspan="2">Thermal treatment</td><td>Any stack with a CO mass flow of ≥ 2 kg/h</td><td>Generic EN standards (5)</td><td>Continuous</td><td rowspan="2">BAT 16</td></tr>
<tr><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058</td><td>Once every 6 months (3)(4)</td></tr>
<tr><td rowspan="2">Process furnace/heaters</td><td>Any stack with a CO mass flow of ≥ 2 kg/h</td><td>Generic EN standards (5)</td><td>Continuous (6)</td><td rowspan="2">BAT 36</td></tr>
<tr><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058</td><td>Once every 6 months (3)(4)</td></tr>
<tr><td rowspan="2">All other processes / sources</td><td>Any stack with a CO mass flow of ≥ 2 kg/h</td><td>Generic EN standards (5)</td><td>Continuous</td><td rowspan="2">BAT 18</td></tr>
<tr><td>Any stack with a CO mass flow of < 2 kg/h</td><td>EN 15058 X</td><td>Once every 6 months (3)(7)</td></tr>
<tr><td>Chloromethane</td><td>All processes / sources</td><td>Any stack</td><td>No EN standard available</td><td>Once every 6 months (3)</td><td>BAT 11</td></tr>
</table>
</td><td></td><td>sets out the monitoring schedule which will be in place.
Where required for demonstration of compliance with BAT-AEL's, monitoring will be undertaken in compliance with the standards stated, or using alternatives previously agreed with the EA.</td></tr>
</table>

BATc No.	BAT Justification						Operating to BAT	Demonstration of BAT Compliance
	CMR substances other than CMR substances covered elsewhere in this table ([12])	All other processes / sources	Any stack	No EN standard available	Once every 6 months [3]	BAT 11		
	Dichloromethane	All processes / sources	Any stack	No EN standard available	Once every 6 months [3]	BAT 11		
	Dust	All processes / sources	Any stack with dust mass flow ≥ 3 kg/h	Generic EN standards [5], EN 13284-1 and EN 13284-2	Continuous [8]	BAT 14		
			Any stack with dust mass flow < 3 kg/h	EN 13284-1	Once every year [3][7]			
	Elemental chlorine (Cl_2)	All other processes / sources	Any stack	No EN standard available	Once every year [3] [7]	BAT 18		
	Ethylene dichloride (EDC)	All other processes / sources	Any stack	No EN standard available	Once every 6 months [3]	BAT 11		
	Ethylene oxide	All other processes / sources	Any stack	No EN standard available	Once every 6 months [3]	BAT 11		
	Formaldehyde	All other processes / sources	Any stack	EN standard under development	Once every 6 months [3]	BAT 11		
	Gaseous chlorides	All other processes / sources	Any stack	EN 1911	Once every year [3][7]	BAT 18		
	Gaseous fluorides	All other processes / sources	Any stack	No EN standard available	Once every year [3][7]	BAT 18		

BATc No.	BAT Justification						Operating to BAT	Demonstration of BAT Compliance
	Hydrogen cyanide (HCN)	All other processes / sources	Any stack	No EN standard available	Once every year (3)(7)	BAT 18		
	Lead and its compounds	All other processes / sources	Any stack	EN 14385	Once every 6 months (3)(9)	BAT 14		
	Nickel and its compounds	All other processes / sources	Any stack	EN 14385	Once every 6 months (3)(9)	BAT 14		
	Nitrous Oxide (N_2O)	All other processes / sources	Any stack	EN ISO 21258	Once every year (3)(7)	-		
	Nitrogen oxides (NO_x)	Thermal treatment	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic EN standards (5)	Continuous	BAT 16		
			Any stack with a NO_x mass flow of <2.5 kg/h	EN 14792	Once every 6 months (3)(4)			
		Process furnace / heaters	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic EN standards (5)	Continuous (6)	BAT 36		
			Any stack with a NO_x mass flow of <2.5 kg/h	EN 14792	Once every 6 months (3)(4)			
		All other processes / sources	Any stack with a NO_x mass flow of ≥ 2.5 kg/h	Generic EN standards (5)	Continuous	BAT 18		
			Any stack with a NO_x mass flow of <2.5 kg/h	EN 14792	Once every 6 months (3)(4)			
	PCDD/F	Thermal treatment	Any stack	EN 1948-1, XEN 1948-2, EN 1948-3	Once every 6 months (3)(9)	BAT 12		
	$PM_{2.5}$ and PM_{10}	All processes / sources	Any stack	EN ISO 23210	Once every year (3)(7)	BAT 14		
	Propylene oxide	All processes / sources	Any stack	No EN standards available	Once every 6 months (3)	BAT 11		

BATc No.	BAT Justification						Operating to BAT	Demonstration of BAT Compliance
	Sulphur dioxide (SO_2)	Thermal treatment	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic EN standards [5]	Continuous	BAT 16		
			Any stack with a SO_2 mass flow of <2.5kg/h	EN 14791	Once every 6 months [3][4]			
		Process furnaces / heaters	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic EN standards [5]	Continuous [6]	BAT 18, BAT 36		
			Any stack with a SO_2 mass flow of <2.5kg/h	EN 14791	Once every 6 months [3][4]			
		All other processes / sources	Any stack with a SO_2 mass flow of ≥ 2.5 kg/h	Generic EN standards [5]	Continuous	BAT 18		
			Any stack with a SO_2 mass flow of <2.5kg/h	EN 14791 X	Once every 6 months [3][4]			
	Tetrachloromethane	All processes / sources	Any stack	No EN standards available	Once every 6 months [3]	BAT 11		
	Toluene	All processes / sources	Any stack	No EN standards available	Once every 6 months [3]	BAT 11		
	Trichloromethane	All processes / sources	Any stack	No EN standards available	Once every 6 months [3]	BAT 11		
	Total volatile organic carbon (TVOC)	Production of polyolefins [10]	Any stack with a TVOC mass flow of ≥ 2 kg C/h	Generic EN standards [5]	Continuous	BAT 11, BAT 25		
			Any stack with a TVOC mass flow of < 2 kg C/h	EN 12619	Once every 6 months [3][4]			
			Any stack with a	Generic EN standards [5]	Continuous	BAT 11, BAT 32		

BATc No.	BAT Justification						Operating to BAT	Demonstration of BAT Compliance
		Production of synthetic rubber (11)	TVOC mass flow of ≥ 2 kg C/h					
			Any stack with a TVOC mass flow of < 2 kg C/h	EN 12619	Once every 6 months (3)(4)			
		All other processes / sources	Any stack with a TVOC mass flow of ≥ 2 kg C/h	Generic EN standards (5)	Continuous	BAT 11		
			Any stack with a TVOC mass flow of < 2 kg C/h	EN 12619	Once every 6 months (3)(4)			
	(1) The monitoring only applies when the substance/parameter concerned is identified as relevant in the waste gas stream based on the inventory given in BAT 2. (2) Measurements are carried out according to EN 15259. (3) To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions. (4) The minimum monitoring frequency may be reduced to once every year or once every 3 years if the emission levels are proven to be sufficiently stable. (5) Generic EN standards for continuous measurements are EN 14181, EN 15267-1, EN 15267-2 and EN 15267-3. (6) In the case of process furnaces/heaters with a total rated thermal input of less than 100 MW operated less than 500 hours per year, the minimum monitoring frequency may be reduced to once every year. (7) The minimum monitoring frequency may be reduced to once every 3 years if the emission levels are proven to be sufficiently stable. (8) The minimum monitoring frequency may be reduced to once every 6 months if the emission levels are proven to be sufficiently stable. (9) The minimum monitoring frequency may be reduced to once every year if the emission levels are proven to be sufficiently stable. (10) In the case of the production of polyolefins, the monitoring of TVOC emissions from finishing steps (e.g., drying, blending) and from polymer storage may be complemented by the monitoring in BAT 24 if it provides a better representation of the TVOC emissions. (11) In the case of the production of synthetic rubbers, the monitoring of TVOC emissions from finishing steps (e.g., extrusion, drying, blending) and from synthetic rubber storage may be complemented by the monitoring in BAT 31 if it provides a better representation of the TVOC emissions. (12) i.e., other than benzene, 1,3-butadiene, chloromethane, dichloromethane, ethylene dichloride, ethylene oxide, formaldehyde, propylene oxide, tetrachloromethane, toluene, trichloromethane.							
Organic Compounds								

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td>BATc 9</td><td>In order to increase resource efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to recover organic compounds from process off-gases by using one or a combination of the techniques given below and to reuse them.
<table>
<tr><th colspan="2">Techniques</th><th>Description</th></tr>
<tr><td>a.</td><td>Absorption (regenerative)</td><td>See Section 1.4.1.</td></tr>
<tr><td>b.</td><td>Adsorption (regenerative)</td><td>See Section 1.4.1.</td></tr>
<tr><td>c.</td><td>Condensation</td><td>See Section 1.4.1.</td></tr>
</table></td><td>Yes – once the options appraisal has been completed.</td><td>The air emissions abatement system is described in section 4.7 of the BAT-OT.

Key reaction processes are installed wit guard condensers, and the emissions from the main production area (emission point A1) are currently treated using a wet scrubber system.

A recent review of the inventory has resulted in further assessment, including a BAT options appraisal and technology selection for waste gas abatement (refer Section 11.1.2 of the main BATOT report). The site is committed to installing the BAT option to ensure compliance with the BAT-AEL’s and BAT operating techniques. A temporary scrubber will be used to reduce concentrations of compounds further whilst the new abatement system is being designed, commissioned and installed. Agilent intends that the upgraded waste gas abatement system should be operational by approximately Q2 2025.</td></tr>
<tr><td>BATc 10</td><td>In order to increase energy efficiency and to reduce the mass flow of organic compounds sent to the final waste gas treatment, BAT is to send process off-gases with a sufficient calorific value to a combustion unit that is, if technically possible, combined with heat recovery. BAT 9 has priority over sending process off-gases to a combustion unit.</td><td>N/A</td><td>The small scale of production at the site means that on-site energy recovery is not practicable.</td></tr>
<tr><td>BATc 11</td><td>In order to reduce channelled emissions to air of organic compounds, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Adsorption</td><td>See Section 1.4.1.</td><td>Generally applicable.</td></tr>
<tr><td>b.</td><td>Absorption</td><td>See Section 1.4.1.</td><td>Generally applicable.</td></tr>
</table></td><td>Yes</td><td>Refer BAT 9 above.
Comparison of the current monitored site emissions against the BAT- AEL’s is presented in section 11.1.2 of the BAT-OT document.
This review identified that the following emission sources are not currently compliant with the relevant BAT-AEL’s:</td></tr>
</table>

BATc No.	BAT Justification				Operating to BAT	Demonstration of BAT Compliance
	c.	Catalytic oxidation	See Section 1.4.1.	Applicability may be restricted by the presence of catalyst poisons in the waste gases.		• A1. Unit 3 -Impingement Scrubber Exhaust -Total VOC and CMR2 Limit for chemical 2; • A3. Unit 3 - Main Production Lab FCs (Stack 2) – Total VOC; and • A4. Unit 3 - Main Production Area FCs & SAX hood (Stack 3) – Total VOC (although this is a very slight exceedance). A recent review of the inventory has resulted in further assessment, including a BAT options appraisal and technology selection for waste gas abatement (refer Section 11.1.2 of the main BATOT report). The site is committed to installing the BAT option to ensure compliance with the BAT-AEL's and BAT operating techniques. A temporary scrubber will be used to reduce concentrations of compounds further whilst the new abatement system is being designed commissioned and installed. Agilent intends that the upgraded waste gas abatement system should be operational by approximately Q2 2025.
	d.	Condensation	See Section 1.1.1.	Generally applicable.		
	e.	Thermal oxidation	See Section 1.1.1.	Applicability of recuperative and regenerative thermal oxidation to existing plants may be restricted by design and/or operational constraints. Applicability may be restricted where the energy demand is excessive due to the low concentration of the compound(s) concerned in the process off-gases.		
	f.	Bioprocesses	See Section 1.4.1	Only applicable to the treatment of biodegradable compounds.		

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

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

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

Propylene oxide	<0.5 – 1[8]
Formaldehyde	1 – 5 [8]
Chloromethane	< 0.5 – 1 [9][10]
Dichloromethane	< 0.5 – 1 [9][10]
Tetrachloromethane	< 0.5 – 1 [9][10]
Toluene	< 0.5 – 1 [9][11]
Trichloromethane	< 0.5 – 1 [9][10]

(1) For activities listed under points 8 and 10, Part 1 of Annex VII of the IED, the BAT-AEL ranges apply to the extent that they lead to lower emission levels than the emission limit values in part 2 and 4 of Annex VII to the IED.
(2) TVOC is expressed in mg C/Nm^3.
(3) In the case of polymer production, the BAT-AEL may not apply to emissions from the finishing steps (e.g., extrusion, drying, blending) and from polymer storage.
(4) The BAT-AEL does not apply to minor emissions (i.e., when the TVOC mass flow is below e.g., 100 g C/h) if no CMR substances are identified as relevant in the waste gas stream based on the inventory given in BAT 2.
(5) The upper end of the BAT-AEL range may be higher and up to 30 mg C/Nm^3 when using techniques to recover materials (e.g., solvents, see BAT 9), if both of the following conditions are fulfilled:
- the presence of substances classified as CMR 1A/1B or CMR 2 is identified as not relevant (see BAT 2);
- the TVOC abatement efficiency of the waste gas treatment system is ≥ 95 %.

(6) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the sum of the VOCs classified as CMR 1A or 1B is below e.g., 1 g/h).
(7) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the sum of the VOCs classified as CMR 2 is below e.g., 50 g/h).
(8) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 1 g/h).
(9) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 50 g/h).
(10) The upper end of the BAT-AEL range may be higher and up to 15 mg/Nm^3 when using techniques to recover materials (e.g., solvents, see BAT 9), if the abatement efficiency of the waste gas treatment system is ≥ 95 %.
(11) The upper end of the BAT-AEL range may be higher and up to 20 mg/Nm^3 when using techniques to recover toluene (see BAT 9), if the abatement efficiency of the waste gas treatment system is ≥ 95 %.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td>BATc 12</td><td>In order to reduce channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds, BAT is to use techniques a. and b., and one or a combination of techniques c. to e., given below.

<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td colspan="4">Specific techniques to reduce PCDD/F emissions</td></tr>
<tr><td>a.</td><td>Optimised catalytic or thermal oxidation</td><td>See Section 1.4.1</td><td>Generally applicable.</td></tr>
<tr><td>b.</td><td>Rapid waste-gas cooling</td><td>Rapid cooling of waste gases from temperatures above 400 ^{O}C to below 250 ^{O}C to prevent the de novo synthesis of PCDD/F.</td><td>Generally applicable.</td></tr>
<tr><td>c.</td><td>Adsorption using activated carbon.</td><td>See Section 1.4.1.</td><td>Generally applicable.</td></tr>
<tr><td>d.</td><td>Absorption</td><td>See Section 1.4.1.</td><td>Generally applicable.</td></tr>
<tr><td colspan="4">Other techniques not primarily used to reduce PCDD/F emissions</td></tr>
<tr><td>e.</td><td>Selective catalytic reduction (SCR)</td><td>See Section 1.4.1.
When SCR is used for NOX abatement, an adequate catalyst surface of the SCR system also provides for the partial reduction of the emissions of PCDD/F.</td><td>Applicability to existing plants may be restricted by space availability and/or by the presence of catalyst poisons in the waste gases.</td></tr>
</table>

BAT-associated emission level (BAT-AEL) for channelled emissions to air of PCDD/F from thermal treatment of waste gases containing chlorine and/or chlorinated compounds.</td><td>N/A</td><td>No thermal treatment of waste gases occurs.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (ng I-TEQ / Nm^3)
Average over the sampling period</th></tr>
<tr><td>PCDD/F</td><td>< 0.01 – 0.05</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 13</td><td>In order to increase resource efficiency and to reduce the mass flow of dust and particulate-bound metals sent to the final waste gas treatment, BAT is to recover materials from process off-gases by using one or a combination of the techniques given below and to reuse them.
<table>
<tr><th colspan="2">Techniques</th><th>Description</th></tr>
<tr><td>a.</td><td>Cyclone</td><td>See Section 1.4.1.</td></tr>
<tr><td>b.</td><td>Fabric filter</td><td>See Section 1.4.1.</td></tr>
<tr><td>c.</td><td>Absorption</td><td>See Section 1.4.1.</td></tr>
</table>
</td><td>Yes</td><td>Due to the moderate flow of nitrogen used in the polymerisation stage there is no significant entrainment of solids in the exhaust stream treated by the scrubber.
No significant emissions of dust or particulate bound metals to air are anticipated.</td></tr>
<tr><td>BATc 14</td><td>In order to reduce channelled emissions to air of dust and particulate-bound metals, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th colspan="2">Techniques</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Absolute filter</td><td>See Section 1.4.1.</td><td>Applicability may be limited in the case of sticky dust or when the temperature of the waste gases is below the dew point.</td></tr>
<tr><td>b.</td><td>Absorption</td><td>See Section 1.4.1.</td><td>General applicable.</td></tr>
<tr><td>c.</td><td>Fabric filter</td><td>See Section 1.4.1.</td><td>Applicability may be limited in the case of sticky dust or when the temperature of the waste gases is below the dew point.</td></tr>
<tr><td>d.</td><td>High-efficiency air filter</td><td>See Section 1.4.1.</td><td>General applicable.</td></tr>
<tr><td>e.</td><td>Cyclone</td><td>See Section 1.4.1.</td><td>General applicable.</td></tr>
<tr><td>f.</td><td>Electrostatic precipitator</td><td>See Section 1.4.1.</td><td>General applicable.</td></tr>
</table>
BAT-associated emission levels (BAT-EALs) for channelled emissions to air of dust, lead, and nickel.</td><td>Yes</td><td>No significant emissions of dust or particulate bound metals to air are anticipated.
Dust is not a significant concern as most of the processing is wet.
The final drying stages of the product are carried out in a sealed system, which includes the use of filters.
Dust is not emitted to air as a channelled emission.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm^3)
Daily average or average over the sampling period</th></tr>
<tr><td>Dust</td><td>< 1 – 5 (1)(2)(3)(4)</td></tr>
<tr><td>Lead and its compounds, expressed as Pb</td><td>< 0.01 – 0.1 (5)</td></tr>
<tr><td>Nickel and its compounds, expressed as Ni</td><td>< 0.02 – 0.1 (6)</td></tr>
<tr><td colspan="2">(1) The upper end of the range is 20 mg/Nm^3 when either an absolute or a fabric filter is not applicable.
(2) The BAT-AEL does not apply to minor emissions (i.e., when the dust mass flow is below e.g., 50 g/h) if no CMR substances are identified as relevant in the dust based on the inventory given in BAT 2.
(3) In the case of the production of complex inorganic pigments using direct heating, and in the case of the drying step in the production of E-PVC, the upper end of the BAT-AEL range may be higher and up to 10 mg/Nm^3.
(4) Dust emissions are expected to be towards the lower end of the BAT-AEL range (e.g., below 2.5 mg/Nm^3) when the presence of substances classified as CMR 1A or 1B, or CMR 2 in the dust is identified as relevant (see BAT 2).
(5) The BAT-AEL does not apply to minor emissions (i.e., when the lead mass flow is below e.g., 0.1 g/h).
(6) The BAT-AEL does not apply to minor emissions (i.e., when the Ni mass flow is below e.g., 0.15 g/h).</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td colspan="2">Inorganic Compounds</td><td></td><td></td></tr>
<tr><td>BATc 15</td><td>In order to increase resource efficiency and to reduce the mass flow of inorganic compounds sent to the final waste gas treatment, BAT is to recover inorganic compounds from process off-gases by using absorption and to reuse them.</td><td>N/A</td><td>The site processes do not involve inorganic chemistry.</td></tr>
<tr><td>BATc 16</td><td>In order to reduce channelled emissions to air of CO, NOx and SOx from thermal treatment, BAT is to use technique c. and one or a combination of the other techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Main Inorganic Compounds Targeted</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Choice of fuel</td><td>See Section 1.4.1.</td><td>NOx, Sox</td><td>Generally applicable.</td></tr>
<tr><td>b.</td><td>Low-NOx burner</td><td>See Section 1.4.1.</td><td>NOx</td><td>Applicability to existing plants may be restricted by design and/or operational constraints.</td></tr>
<tr><td>c.</td><td>Optimisation of catalytic or thermal oxidation</td><td>See Section 1.4.1.</td><td>CO, NOx</td><td>Generally applicable.</td></tr>
</table>
</td><td>N/A</td><td>Not applicable: no thermal treatment takes place at the site.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><td>d.</td><td>Removal of high levels of NOx precursors</td><td>Remove (if possible, for reuse) high levels of NOx precursors prior to thermal or catalytic oxidation, e.g., by absorption, adsorption or condensation.</td><td>NOx</td><td>Generally applicable.</td></tr>
<tr><td>e.</td><td>Absorption</td><td>See Section 1.4.1.</td><td>Sox</td><td>Generally applicable.</td></tr>
<tr><td>f.</td><td>Selective catalytic reduction (SCR)</td><td>See Section 1.4.1.</td><td>NOx</td><td>Applicability to existing plants may be restricted by space availability.</td></tr>
<tr><td>g.</td><td>Selective non catalytic reduction (SNCR)</td><td>See Section 1.4.1.</td><td>NOx</td><td>Applicability to existing plants may be restricted by the residence time needed for the reaction.</td></tr>
</table>
BAT-associated emission levels (BAT-AELs) for channelled emissions to air of NOx and indicative level for channelled emissions to air of CO from thermal treatment.
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm³)
(Daily average or average over the sampling period)</th></tr>
<tr><td>Nitrogen oxides (NOx) from catalytic oxidation</td><td>5 – 30 (1)</td></tr>
<tr><td>Nitrogen oxides (NOx) from thermal oxidation</td><td>5 – 130 (2)</td></tr>
<tr><td>Carbon monoxide (CO)</td><td>No BAT-AEL (3)</td></tr>
<tr><td colspan="2">(1) The upper end of the BAT-AEL range may be higher and up to 80 mg/Nm³ if the process off-gas(es) contain(s) high levels of NOx precursors.
(2) The upper end of the BAT-AEL range may be higher and up to 200 mg/Nm³ if the process off-gas(es) contain(s) high levels of NOx precursors.
(3) As an indication, the emission levels for carbon monoxide are 4 – 50 mg/Nm³, as a daily average or average over the sampling period.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 17</td><td>In order to reduce channelled emissions to air of ammonia from the use of selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for the abatement of NOx emissions (ammonia slip), BAT is to optimise the design and/or operation of SCR or SNCR (e.g., optimised reagent to NOx ratio, homogeneous reagent distribution and optimum size of the reagent drops).</td><td>N/A</td><td>SCR and SNCR systems are not utilised on site.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>BAT-associated emission level (BAT-AEL) for channelled emissions to air of ammonia from the use of SCR or SNCR (ammonia slip)
<table>
<tr><th>Substance / Parameter</th><th>BAT-AEL (mg/Nm^3)
(Average over the sampling period)</th></tr>
<tr><td>Ammonia (NH_3) from SCR/SNCR</td><td>< 0.5 – 8 (1)</td></tr>
<tr><td colspan="2">(1) The upper end of the BAT-AEL range may be higher and up to 40 mg/Nm^3 in the case of process off-gases containing very high levels of NOX (e.g., above 5,000 mg/Nm^3) prior to treatment with SCR or SNCR.</td></tr>
<tr><td colspan="2"></td></tr>
</table></td><td></td><td></td></tr>
<tr><td>BATc 18</td><td>In order to reduce channelled emissions to air of inorganic compounds other than channelled emissions to air of ammonia from the use of selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) for the abatement of NOx emissions), channelled emissions to air of CO, NOx and Sox from the use of thermal treatment, and channelled emissions to air of NOx from process furnaces/heaters, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Main Inorganic Compounds Targeted</th><th>Applicability</th></tr>
<tr><td colspan="5">Specific techniques to reduce emissions to air of inorganic compounds</td></tr>
<tr><td>a.</td><td>Absorption</td><td>Section 1.4.1.</td><td>Cl_2, HCl, HCN, HF, NH_3, NOx, Sox</td><td>Generally applicable.</td></tr>
<tr><td>b.</td><td>Adsorption</td><td>Section 1.4.1. For the removal of inorganic substances, the technique is often used in combination with a dust abatement technique (see BAT 14).</td><td>HCI, HF, NH. Sox</td><td>Generally applicable.</td></tr>
<tr><td>c.</td><td>Selective catalytic reduction (SCR)</td><td>Section 1.4.1.</td><td>NOx</td><td>Applicability to existing plants may be restricted by space availability.</td></tr>
<tr><td>D.</td><td>Selective non-catalytic reduction (SNCR)</td><td>Section 1.4.1.</td><td>NOx</td><td>Applicability to existing plants may be restricted by the residence time needed for the reaction</td></tr>
</table></td><td>N/A</td><td>SCR and SNCR systems are not utilised on site.
There is no thermal treatment of waste gases on site.
There are no direct fired process furnaces or heaters on site.

Waste gas emissions predominantly comprise VOCs.
NOx, CO and SOx are not emitted to air as part of the production process.

The reaction vessels are heated via electrical heating systems. General heating and other processes are heated via the low temperature hot water system which is powered by several small gas fired boilers (<1MWth rated thermal input).
An emergency diesel generator (<1MWth rated thermal input) is also located onsite which backs up critical electrical supplies.
This equipment has not been included as emission points or considered within the AERA as they each fall below 1MWth rated thermal input and therefore the medium combustion plant and specified generator requirements as outlined in Environmental Permitting (England</td></tr>
</table>

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

Other techniques not primarily used to reduce emissions to air of inorganic compounds

e.	Catalytic oxidation	Section 1.4.1.	NH_3	Applicability may be restricted by the presence of catalyst poisons in the waste gases.
f.	Thermal oxidation	Section 1.4.1.	NH_3, HCN	Applicability of recuperative and regenerative thermal oxidation to existing plants may be restricted by design and/or operational constraints. The applicability may be restricted where the energy demand is excessive due to the low concentration of the compound(s) concerned in the process off-gases.

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

Substance/Parameter	**BAT-AEL (mg-Nm³) (Daily average or average over the sampling period)**
Ammonia (NH_3)	2 – 10 (1) (2) (3)
Elemental chlorine (Cl_2)	<0.5 – 2 (4)(5)
Gaseous fluorides, expressed as HF	≤ 1 (4)
Hydrogen cyanide (HCN)	< 0.1 – 1 (4)
Gaseous chlorides, expressed as HCl	1-10 (6)
Nitrogen oxides (NOx)	10 – 150 (7) (8) (9) (10)
Sulphur oxides (SO_2)	< 3 – 150 (11)(9)
(1) The BAT-AEL does not apply to channelled emissions to air of ammonia from the use of SCR or SNCR (ammonia slip). This is covered by BAT 17.	

and Wales) (Amendment) Regulations 2018 do not apply.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	(2) The BAT-AEL does not apply to minor emissions (i.e., when the NH_3 mass flow is below e.g., 50 g/h). (3) In the case of the drying step in the production of E-PVC, the upper end of the BAT-AEL range may be higher and up to 20 mg/Nm3, when the substitution of ammonium salts is not possible due to product quality specifications. (4) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 5 g/h). (5) In the case of NOX concentrations above 100 mg/Nm³ , the upper end of the BAT-AEL range may be higher and up to 3 mg/Nm³ due to analytical interference. (6) The BAT-AEL does not apply to minor emissions (i.e., when the HCl mass flow is below e.g., 30 g/h). (7) In the case of the production of explosives, the upper end of the BAT-AEL range may be higher and up to 220 mg/Nm³ when regenerating or recovering nitric acid from the production process. (8) The BAT-AEL does not apply to channelled emissions to air of NOx from the use of catalytic or thermal oxidation (see BAT 16) or from process furnaces/heaters (see BAT 36). (9) The BAT-AEL does not apply to minor emissions (i.e., when the mass flow of the substance concerned is below e.g., 500 g/h. (10) In the case of the production of caprolactam, the upper end of the BAT-AEL range may be higher and up to 200 mg/Nm³ in the case of process off-gases containing very high levels of NOx (e.g., above 10 000 mg/Nm³) prior to treatment with SCR or SNCR, when the abatement efficiency of the SCR or SNCR is ≥ 99 %. (11) The BAT-AEL does not apply in the case of physical purification or reconcentration of spent sulphuric acid. The associated monitoring is given in BAT 8.		
Diffuse VOC Emissions to Air			
BATc 19	In order to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to elaborate and implement a management system for diffuse VOC emissions, as part of the environmental management system (see BAT 1), that includes all of the following features: i. Estimating the annual quantity of diffuse VOC emissions (see BAT 20). ii. Monitoring diffuse VOC emissions from the use of solvents by compiling a solvent mass balance, if applicable (see BAT 21). iii. Establishing and implementing a leak detection and repair (LDAR) programme for fugitive VOC emissions. The LDAR programme typically lasts from 1 to 5 years depending on the nature, scale and complexity of the plant (5 years may correspond to large plants with a high number of emission sources). The LDAR programme includes all of the following features: a. Listing of equipment identified as relevant fugitive VOC emission sources in the inventory of diffuse VOC emissions (see BAT 2). b. Definition of criteria associated with the following:	Yes	Agilent will review the need and options for management of diffuse VOC emissions. The potential for fugitive emissions to be generated is low. No significant fugitive VOC emission sources are anticipated as: • The amount of raw materials input to the process is low at 185.09 tonnes per year. • Pipework is located indoors and is minimal. • Pipework is maintained under a planned preventative maintenance system.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	▪ Leaky equipment. Typical criteria could be a leak threshold, above which equipment is considered leaky, and/or the visualisation of a leak with OGI cameras. This depends on the characteristics of the emission source (e.g., accessibility) and the hazardous properties of the emitted substance(s). ▪ Maintenance and/or repair actions to be carried out. A typical criterion could be a VOC concentration threshold triggering the maintenance or repair action (maintenance/repair threshold). The maintenance/repair threshold is generally equal to or higher than the leak threshold. This depends on the characteristics of the emission source (e.g., accessibility) and the hazardous properties of the emitted substance(s). For the first LDAR programme, it is generally not higher than 5,000 ppmv for VOCs other than VOCs classified as CMR 1A or 1B, and 1,000 ppmv for VOCs classified as CMR 1A or 1B. For subsequent LDAR programmes, the maintenance/repair threshold is lowered (see point vi. A.) and not higher than 1,000 ppmv for VOCs other than VOCs classified as CMR 1A or 1B, and 500 ppmv for VOCs classified as CMR 1A or 1B, targeting 100 ppmv. c. Measuring fugitive VOC emissions from equipment listed under point iii. A. (see BAT 22). d. Carrying out maintenance and/or repair actions (see BAT 23, techniques e. and f.), as soon as possible and where necessary according to the criteria defined in point iii. B. Maintenance and repair actions are prioritised according to the hazardous properties of the emitted substance(s), the significance of the emissions and/or operational constraints. The effectiveness of the maintenance and/or repair actions is verified according to point iii. C., leaving enough time after the intervention (e.g., 2 months). e. Filling in the database mentioned in point v. iv. Establishing and implementing a detection and reduction programme for non-fugitive VOC emissions that includes all of the following features: a. Listing of equipment identified as relevant non-fugitive VOC emission sources in the inventory of diffuse VOC emissions (see BAT 2). b. Monitoring non-fugitive VOC emissions from equipment listed under point iv. A. (see BAT 22). c. Planning and implementing techniques to reduce non-fugitive VOC emissions (see BAT 23, techniques a., c. and g. to j.). The planning and implementation of the techniques are prioritised according to the hazardous properties of the emitted substance(s), the significance of the emissions and/or operational constraints. d. Filling in the database mentioned in point v.		• Controls are in place where chemicals are transferred. • Chemical 2, chemical 3 and chemical 4 are all transferred to process via a Diaphragm pump from a DENIOS unit. These chemicals are delivered in sealed containers, transferred via minimal sealed indoor pipework into a sealed process that vents to a channelled emission point to air. • Smaller volumes of chemicals (205 L) are transferred into smaller containers within the drum store utilising pumps. • Chemicals stored in 205 L drums are transferred into smaller containers within the drum store utilising air pumps. • The proposed process will operate under a preventative maintenance programme to manage equipment that could potentially result in diffuse emissions to air. • The processes use high integrity equipment. • The process is sealed with the exception of the vent system which directs VOCs to channelled emission points.

BATc No.	BAT Justification	Operating to BAT	Demonstration of BAT Compliance
	v. Establishing and maintaining a database, for diffuse VOC emissions sources that are identified in the inventory mentioned in BAT 2, for keeping record of: a. equipment design specifications (including the date and description of any design changes); b. the equipment maintenance, repair, upgrade, or replacement actions, performed or planned, and their date of implementation; c. the equipment that could not be maintained, repaired, upgraded or replaced due to operational constraints; d. the results of the measurements or monitoring, including the concentration(s) of the emitted substance(s), the calculated leak rate (as kg/year), the recording from OGI cameras (e.g., from the last LDAR programme) and the date of the measurements or monitoring; e. the annual quantity of diffuse VOC emissions (as fugitive and non-fugitive emissions), including information on non-accessible sources and accessible sources not monitored during the year. vi. Reviewing and updating the LDAR programme periodically. This may include the following: a. lowering the leak and/or maintenance/repair thresholds (see point iii. B.); b. reviewing the prioritisation of equipment to be monitored, giving higher priority to (the type of) equipment identified as leaky during the previous LDAR programme; c. planning the maintenance, repair, upgrade or replacement of equipment that could not be performed during the previous LDAR programme due to operational constraints. vii. Reviewing and updating the detection and reduction programme for non-fugitive VOC emissions. This may include the following: a. monitoring non-fugitive VOC emissions from equipment where maintenance, repair, upgrade or replacement actions were implemented, in order to determine if those actions were successful; b. planning the maintenance, repair, upgrade or replacement actions that could not be performed due to operational constraints.		
BATc 20	BAT is to estimate fugitive and non-fugitive VOC emissions to air separately at least once every year by using one or a combination of the techniques given below, as well as to determine the uncertainty	Yes	Agilent will review the need and options for management of diffuse VOC emissions.

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>of this estimation. The estimation distinguishes between VOCs classified as CMR 1A or 1B and VOCs that are not classified as CMR 1A or 1B.

<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Type of Emissions</th></tr>
<tr><td>a.</td><td>Use of emission factors</td><td>See Section 1.4.2</td><td rowspan="3">Fugitive and/or non-fugitive</td></tr>
<tr><td>b.</td><td>Use of a mass balance</td><td>Estimation based on the difference in the mass of the substance inputs to and outputs from the plant/production unit, taking into account the generation and destruction of the substance in the plant/production unit. A mass balance may also consist of measuring the concentration of VOCs in the product (e.g., raw material or solvent).</td></tr>
<tr><td>c.</td><td>Use of thermodynamic models</td><td>Estimation using the laws of thermodynamics applied to equipment (e.g., tanks) or particular steps of a production process. The following data are generally used as input for the model:
• Chemical properties of the substance (e.g., vapour pressure, molecular mass).
• Process operating data (e.g., operating time, product quantity, ventilation).
• Characteristics of the emission source (e.g., tank diameter, colour, shape).</td></tr>
</table></td><td></td><td>As above</td></tr>
<tr><td>BATc 21</td><td>BAT is to monitor diffuse VOC emissions from the use of solvents by compiling, at least once every year, a solvent mass balance of the solvent inputs and outputs of the plant, as defined in Part 7 of Annex VII to Directive 2010/75/EU and to minimise the uncertainty of the solvent mass balance data by using all of the techniques given below.</td><td>Yes</td><td>Agilent will review the need and options for management of diffuse VOC emissions, in line with BAT 21.
Agilent has a solvent tracking system for solvents received and utilised on site.</td></tr>
</table>

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td></td><td>
<table>
<tr><th colspan="2">Techniques</th><th>Description</th></tr>
<tr><td>a.</td><td>Full identification and quantification of the relevant solvent inputs and outputs, including the associated uncertainty</td><td>This includes:
Identification and documentation of solvent inputs and outputs (e.g., channelled and diffuse emissions to air, emissions to water, solvent output in waste).
Substantiated quantification of each relevant solvent input and output and recording of the methodology used (e.g., measurement, estimation by using emission factors, estimation based on operational parameters).
Identification of the main sources of uncertainty of the aforementioned quantification, and implementation of corrective actions to reduce the uncertainty.
Regular update of solvent input and output data.</td></tr>
<tr><td>b.</td><td>Implementation of a solvent tracking system</td><td>A solvent tracking system aims to keep control of both the used and unused quantities of solvents (e.g., by weighing unused quantities returned to storage from the application area).</td></tr>
<tr><td>c.</td><td>Monitoring of changes that may influence the uncertainty of the solvent mass balance data</td><td>Any change that could influence the uncertainty of the solvent mass balance data is recorded, such as:
Malfunctions of the waste gas treatment system: the date and period of time are recorded.
Changes that may influence air/gas flow rates (e.g., replacement of fans): the date and type of change are recorded.</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>BATc 22</td><td>BAT is to monitor diffuse VOC emissions to air with at least the frequency given below and in accordance with 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.</td><td>Yes</td><td>Agilent will review the need and options for management and monitoring of diffuse VOC emissions, in accordance with BAT 22.</td></tr>
</table>

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

Type of Sources of Diffuse VOC Emissions [1][2]	Type of VOCs	Standard(s)	Minimum Monitoring Frequency
Sources of fugitive emissions	VOCs classified as CMR 1A or 1B	EN 15446 [8]	Once every year [3][4][5]
	VOCs not classified as CMR 1A or 1B		Once during the period covered by each LDAR programme (see BAT 19 point iii.) [6]
Sources of non-fugitive emissions	VOCs classified as CMR 1A or 1B	EN 17628	Once every year
	VOCs not classified as CMR 1A or 1B		Once every year [7]

(1) The monitoring only applies to emission sources that are identified as relevant in the inventory given in BAT 2.
(2) The monitoring does not apply to equipment operated under sub atmospheric pressure.
(3) In the case of inaccessible sources of fugitive VOC emissions (e.g., if the monitoring requires the removal of insulation or the use of scaffolding), the monitoring frequency may be reduced to once during the period covered by each LDAR programme (see BAT 19 point iii.).
(4) For the production of PVC, the minimum monitoring frequency may be reduced to once every 5 years if the plant uses VCM gas detectors to continuously monitor VCM emissions in a way that allows an equivalent level of detection of VCM leaks.
(5) In the case of high-integrity equipment (see BAT 23 b.) in contact with VOCs classified as CMR 1A or 1B, a lower minimum monitoring frequency may be adopted, but in any case, at least once every 5 years.
(6) In the case of high-integrity equipment (see BAT 23 b.) in contact with VOCs other than VOCs classified as CMR 1A or 1B, a lower minimum monitoring frequency may be adopted, but in any case, at least once every 8 years.
(7) The minimum monitoring frequency may be reduced to once every 5 years if non-fugitive emissions are quantified by using measurements.
(8) This standard may be completed by EN 17628.

Note:
Optical gas imaging (OGI) is a useful complementary technique to the method EN 15446 ('sniffing') in order to identify sources of fugitive VOC emissions and is particularly relevant in the case of inaccessible sources (see Section 1.4.2.) This technique is described in EN 17628.
In the case of non-fugitive emissions, measurements may be complemented by the use of thermodynamic models. Where large amounts (e.g., above 80 t/yr) of VOCs are used/consumed, the quantification of VOC emissions from the plant with tracer correlation (TC) or with optical absorption-based techniques, such as differential absorption light detection and ranging (DIAL) or solar occultation flux (SOF), is a useful complementary technique (see Section 1.4.2).

<table>
<tr><th>BATc No.</th><th>BAT Justification</th><th>Operating to BAT</th><th>Demonstration of BAT Compliance</th></tr>
<tr><td>BATc 23</td><td>
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 with the following order of priority.

Note: The use of techniques to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air is prioritised according to the hazardous properties of the emitted substance(s) and/or the significance of the emissions.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Type of Emissions</th><th>Applicability</th></tr>
<tr><td colspan="5">1. Prevention techniques</td></tr>
<tr><td>a.</td><td>Limiting the number of emission sources</td><td>This includes:
• Minimising pipe lengths.
• Reducing the number of pipe connectors (e.g., flanges) and valves.
• Using welded fittings and connections.
• Using compressed air or gravity for material transfer.</td><td>Fugitive and non-fugitive emissions</td><td>Applicability may be restricted by operational constraints in the case of existing plants.</td></tr>
<tr><td>b.</td><td>Use of high integrity equipment</td><td>High-integrity equipment includes, but is not limited to:
• Bellow valves or double packing seals or equally effective equipment.
• Magnetically driven or canned pumps/compressors/agitators, or pumps/compressors/agitators using double seals and a liquid barrier.
• Certified high-quality gaskets (e.g., according to EN 13555) that are tightened according to technique.
• Closed sampling system.

The use of high-integrity equipment is especially relevant to prevent or minimise:
• Emissions of CMR substances or substances with acute toxicity.
• Emissions from equipment with high-leaking potential</td><td>Fugitive emissions</td><td>Applicability may be restricted by operational constraints in the case of existing plants. Generally applicable to new plants and major plant upgrades.</td></tr>
</table>
</td><td>Yes</td><td>
The potential for diffuse VOCs to be generated is low. No significant diffuse VOC emission sources are anticipated.
• The amount of raw materials inputted into the process is low at 185.09 tonnes per year.
• Pipework is located indoors and is minimal. Pipework is maintained under a planned preventative maintenance system.
• Controls are in place where chemicals are transferred.
Chemical 2, chemical 3 and chemical 4 are all transferred to process via a Diaphragm pump from a DENIOS unit. These chemicals are delivered in sealed containers, transferred via minimal sealed indoor pipework into a sealed process that vents to a channelled emission point to air.
• Smaller volumes of chemicals (205 L) are transferred into smaller containers within the drum store utilising pumps.
• Chemicals stored in 205 L drums are transferred into smaller containers within the drum store utilising air pumps.
• The proposed process will operate under a preventative maintenance programme to manage equipment that could potentially result in diffuse emissions to air.
• The processes use high integrity equipment.
• The process is sealed with the exception of the vent system which directs VOCs to channelled emission points.

The site utilises more than 50 tonnes per annum of solvent. As such, the BAT AEL present in BATc 23 applies.
</td></tr>
</table>

BATc No.	BAT Justification					Operating to BAT	Demonstration of BAT Compliance
			• Leaks from processes operated at high pressures (e.g., between 300 bar and 2 000 bar). High-integrity equipment is selected, installed, and maintained according to the type of process and the process operating conditions.				Agilent will review the need and options for monitoring of diffuse VOC emissions.
	c.	Collecting diffuse emissions and treating off-gases	Collecting diffuse VOC emissions (e.g., from compressor seals, vents and purge lines) and sending them to recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11).	Fugitive and non-fugitive emissions	Applicability may be restricted: ▪ For existing plants ▪ By safety concerns (e.g., avoiding concentrations close to the lower explosive limit).		
	2. other techniques						
	d.	Facilitating access and/or monitoring activities	To ease maintenance and/or monitoring the access to potentially leaky equipment is facilitated, e.g., by activities, installing platforms, and/or drones are used for monitoring.	Fugitive emissions x	Applicability may be restricted by operational constraints in the case of existing plants.		
	e.	Tightening	This includes: • Tightening of gaskets by personnel that is qualified according to EN 1591-4x and using the designed gasket stress (e.g., calculated according to EN 1591-1). • Installing tight caps on open ends. • Using flanges selected assembled according to EN 13555.	Fugitive emissions	Generally applicable.		
	f.	Replacement of leaky equipment and/or parts	This includes the replacement of: • Gaskets. • Sealing elements (e.g., tank lid). • Packing material (e.g., valve stem packing material).	Fugitive emissions	Generally applicable.		

BATc No.	BAT Justification					Operating to BAT	Demonstration of BAT Compliance
	g.	Reviewing and updating process design	This includes: • Reducing the use of solvents and/or using solvents with lower volatility. • Reducing the formation of side products containing VOCs. • Lowering the operating temperature. • Lowering the VOC content in the final product.	Non-fugitive emissions	Applicability may be restricted in the case of existing plants due to operational constraints.		
	h.	Reviewing and updating operating conditions	This includes: • Reducing the frequency and duration of reactor and vessel openings. • Preventing corrosion by lining or coating of equipment, by painting pipes (for external corrosion) and by using corrosion inhibitors for materials in contact with equipment.	Non-fugitive emissions	Generally applicable.		
	i.	Using closed systems	This includes: • Vapour balancing (see Section 1.4.3). • Closed systems for solid/liquid and liquid/liquid phase separations. • Closed systems for cleaning operations. • Closed sewers and/or wastewater treatment plants. • Closed sampling systems. • Closed storage areas. • Off-gases from closed systems are sent to recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11).	Non-fugitive emissions	Applicability may be restricted by operational constraints in the case of existing plants and/or by safety concerns.		
	j.	Using techniques to minimise emissions from surfaces	This includes: • Installing oil creaming systems on open surfaces. • Periodically skimming open surfaces (e.g., removing floating matter). • Installing anti-evaporation floating elements on open surfaces. • Treating wastewater streams to remove VOCs and send the VOCs to	Non-fugitive emissions	Applicability may be restricted by operational constraints in the case of existing plants.		

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

		recovery (see BAT 9 and BAT 10) and/or abatement (see BAT 11). • Installing floating roofs on tanks. • Using fixed-roof tanks connected to a waste gas treatment.		

BAT conclusions for the use of solvents or the reuse of recovered solvents.

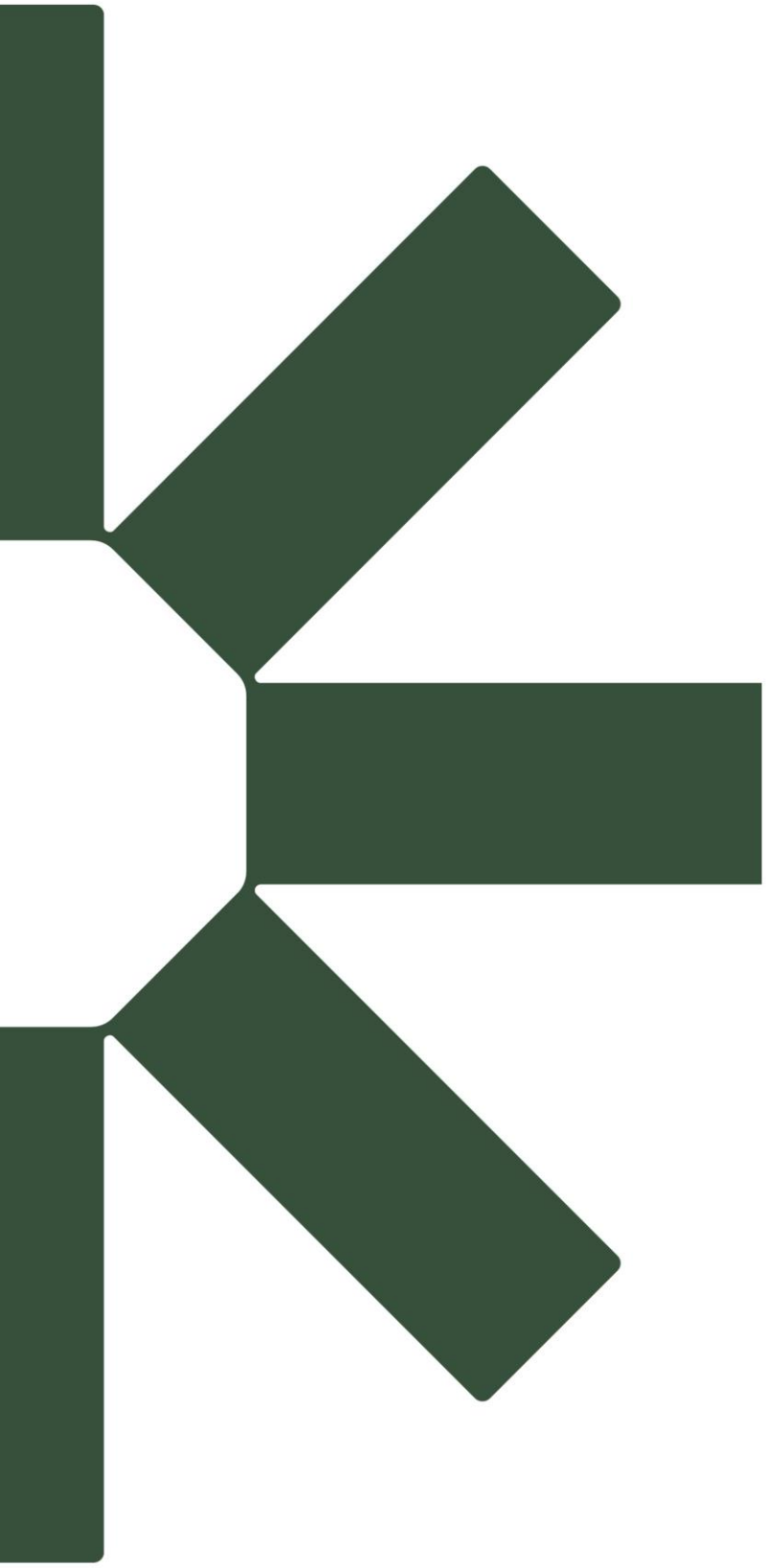
The emission levels for the use of solvents or the reuse of recovered solvents given below are associated with the general BAT conclusions given in Section 1.1 and Section 1.1.4.3.

BAT-associated emission level (BAT-AEL) for diffuse VOC emissions to air from the use of solvents or the reuse of recovered solvents.

Parameter	BAT-AEL (percentage of the solvent inputs) (Yearly Average) (1)
Diffuse VOC Emissions	≤ 5%

(1) The BAT-AEL does not apply to plants whose annual consumption of solvents is lower than 50 tonnes.

The associated monitoring is given in BAT 20, BAT 21 and BAT 22.



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