Intended for
Ball Beverage Packaging Europe Ltd

Date
September 2022

Project Number
1620011745-001

BALL BEVERAGE PACKAGING EUROPE LIMITED

SURFACE TREATMENT USING ORGANIC SOLVENTS BAT REVIEW

RAMBOLL

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Project No.	1620011745-001
Issue No.	1
Date	September 2022
Made by	Karen Hardy / Amelia Browne
Checked by	Richard Wood
Approved by	Richard Wood

Made by:

Checked/Approved by:

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Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
1	16/05/2022	KH / AB	RW	RW	First issue to client
1.1	12/09/2022	KH / AB	RW	RW	Minor revisions for duly making

Ramboll
8 Village Way
Tongwynlais
Cardiff
CF15 7NE
United Kingdom
T +44 2920 543 550
www.ramboll.co.uk

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1. INTRODUCTION

This document is prepared to support the Part A(2) Environmental Permit application by Ball Beverage Packaging UK Limited for the operation of a beverage can manufacturing facility, including the coating and printing of metal cans (solvent consumption >200tpa or >150kg/hr), located at Plot 4b, Segro Park, Kettering Gateway. The report assesses the proposed operations against the Best Available Techniques (BAT) Reference Document (BRef) for surface treatment using organic solvents (STS), published by the European Commission in December 2020.

1.1 Background

Ball Packaging is applying to operate a Part A(2) Environmental Permit for a Section 6.4 A(2)(a) Environmental Permit relating to the coating and printing of metal cans with a solvent consumption of >200tpa or >150kg/hr, which will be regulated by the local authority. Solvent emission limits will also apply under Schedule 14 of the Environmental Permitting Regulations.

In 2020, the Best Available Techniques (BAT) Reference Document for surface treatment using organic solvents (STS) was reviewed by the European Commission, with the final BRef document and associated BAT Conclusions published in December 2020.

This document identifies the sections of the BRef document relevant to Ball, and how the Installation is considered to be compliant with BAT.

2. BAT 1- ENVIRONMENTAL MANAGEMENT SYSTEMS

In order to improve the overall environmental performance, BAT is to elaborate and implement an Environmental Management System (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;

(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.

Specifically for surface treatment using organic solvents, BAT is also to incorporate the following features in the EMS:

(i) Interaction with quality control and assurance as well as health and safety considerations.

(ii) Planning to reduce the environmental footprint of an installation. In particular, this involves the following:

(a) assessing the overall environmental performance of the plant (see BAT 2);

(b) taking into account cross-media considerations, especially the maintenance of a proper balance between solvent emissions reduction and consumption of energy (see BAT 19), water (see BAT 20) and raw materials (see BAT 6);

(c) reducing VOC emissions from cleaning processes (see BAT 9).

(iii) The inclusion of:

(a) a plan for the prevention and control of leaks and spillages (see BAT 5 (a));

(b) a raw material evaluation system to use raw materials with low environmental impact and a plan to optimise the use of solvents in the process (see BAT 3);

(c) a solvent mass balance (see BAT 10);

(d) a maintenance programme to reduce the frequency and environmental consequences of OTNOC (see BAT 13);

(e) an energy efficiency plan (see BAT 19 (a));

(f) a water management plan (see BAT 20 (a));

(g) a waste management plan (see BAT 22 (a));

(h) an odour management plan (see BAT 23).

Ball has an effective Environmental Management System (EMS) and an Environmental Policy incorporated into the corporate management systems, to improve overall environmental performance of the Installation. The management system includes the elements listed in BAT 1.

3. BAT 2- OVERALL ENVIRONMENTAL PERFORMANCE

In order to improve the overall environmental performance of the plant, in particular concerning VOC emissions and energy consumption, BAT is to:

- identify the process areas/sections/steps that represent the greatest contribution to the VOC emissions and energy consumption and the greatest potential for improvement (see also BAT 1);
- identify and implement actions to minimise VOC emissions and energy consumption;
- regularly (at least once every year) update the situation and follow up the implementation of the identified actions.

The Installation implements all three aspects in the EMS.

4. BAT 3- SELECTION OF RAW MATERIALS

Table 4.1 below shows the techniques used by Ball to prevent or reduce the environmental impact of the raw materials, and whether or not BAT is applied. BAT is to use both of the techniques given below.

Table 4.1: Techniques to prevent or reduce the environmental impact of raw materials

Technique		Description	Does Ball meet BAT requirements?
(a)	Use of raw materials with a low environmental impact	As part of the EMS (see BAT 1), systematic evaluation of the adverse environmental impacts of the materials used (in particular substances that are carcinogenic, mutagenic and toxic to reproduction as well as substances of very high concern) and substitution by others with no or lower environmental and health impacts where possible, taking into consideration the product quality requirements or specifications.	Yes- included as part of the EMS
(b)	Optimisation of the use of solvents in the process	Optimisation of the use of solvents in the process by a management plan (as part of the EMS (see BAT 1)) that aims to identify and implement necessary actions (e.g. colour batching, optimising spray pulverisation).	Yes- included as part of the EMS

5. BAT 4- SOLVENT CONSUMPTION / VOC EMISSIONS

Table 5.1 below shows the techniques used to reduce solvent consumption, VOC emissions and the overall environmental impact of the raw materials in the Installation and identifies whether or not BAT is applied. BAT is to use one or a combination of the techniques given below.

Table 5.1: Techniques to reduce solvent consumption and VOC emissions

Technique		Description	Does Ball meet BAT requirements?
(a)	Use of high-solids solvent-based paints / coatings / varnishes / inks / adhesives.	Use of paints, coatings, liquid inks, varnishes and adhesives containing a low amount of solvents and an increased solids content.	Yes
(b)	Use of water-based paints / coatings / varnishes / inks / adhesives.	Use of paints, coatings, liquid inks, varnishes and adhesives where organic solvent is partially replaced by water.	Yes
(c)	Use of radiation-cured paints / coatings / varnishes / inks / adhesives.	Use of paints, coatings, liquid inks, varnishes and adhesives suitable to be cured by the activation of specific chemical groups by UV or IR radiation, or fast electrons, without heat and without emission of VOCs.	Yes
(d)	Use of solvent-free two-component adhesives	Use of solvent-free two-component adhesive materials consisting of a resin and a hardener.	Not currently used by Ball
(e)	Use of hot-melt adhesives	Use of coating with adhesives made from the hot extrusion of synthetic rubbers, hydrocarbon resins and various additives. No solvents are used.	Not currently used by Ball
(f)	Use of powder coatings	Use of solvent-free coating which is applied as a finely divided powder and cured in thermal ovens.	Not currently used by Ball
(g)	Use of laminate film for web or coil coatings	Use of polymer films applied onto a coil or web in order to give aesthetic or functional properties, which reduces the number of coating layers needed.	Not currently used by Ball
(h)	Use of substances which are not VOCs or are VOCs of a lower volatility.	Substitution of high-volatility VOC substances with others containing organic compounds that are non-VOCs or VOCs of a lower volatility (e.g. esters).	Yes

6. BAT 5- STORAGE AND HANDLING OF RAW MATERIALS

Table 6.1 below shows the techniques used for to prevent or reduce fugitive VOC emissions during storage and handling of solvent-containing materials and/or hazardous materials. The table also identifies whether or not BAT is applied. BAT is to apply the principles of good housekeeping by using all of the techniques given below.

Table 6.1: Techniques for storage and handling of raw materials

Technique		Description	Does Ball meet BAT requirements?
Management techniques			
(a)	Preparation and implementation of a plan for the prevention and control of leaks and spillages.	A plan for the prevention and control of leaks and spillages is part of the EMS (see BAT 1) and includes, but is not limited to: • site incident plans for small and large spillages; • identification of the roles and responsibilities of persons involved; • ensuring staff are environmentally aware and trained to prevent/deal with spillage incidents; • identification of areas at risk of spillage and/or leaks of hazardous materials and ranking them according to the risk; • in identified areas, ensuring suitable containment systems are in place, e.g. impervious floors; • identification of suitable spillage containment and clean-up equipment and regularly ensuring it is available, in good working order and close to points where these incidents may occur; • waste management guidelines for dealing with waste arising from spillage control; • regular (at least once every year) inspections of storage and operational areas, testing and calibration of leak detection equipment and prompt repair of leaks from valves, glands, flanges, etc. (see BAT 13).	Yes

Technique		Description	Does Ball meet BAT requirements?
Storage techniques			
(b)	Sealing or covering of containers and bunded storage area.	Storage of solvents, hazardous materials, waste solvents and waste cleaning materials in sealed or covered containers, suitable for the associated risk and designed to minimise emissions. The containers' storage area is bunded and of adequate capacity.	Yes
(c)	Minimisation of storage of hazardous materials in production areas.	Hazardous materials are present in production areas only in amounts that are necessary for production; larger quantities are stored separately.	Yes
Techniques for pumping and handling liquids			
(d)	Techniques to prevent leaks and spillages during pumping.	Leaks and spillages are prevented by using pumps and seals suitable for the material handled and which ensure proper tightness. This includes equipment such as canned motor pumps, magnetically coupled pumps, pumps with multiple mechanical seals and a quench or buffer system, pumps with multiple mechanical seals and seals dry to atmosphere, diaphragm pumps or bellow pumps.	Yes
(e)	Techniques to prevent overflows during pumping.	This includes ensuring for example that: • the pumping operation is supervised; • for larger quantities, bulk storage tanks are fitted with acoustic and/or optical high-level alarms, with shut-off systems if necessary.	Yes
(f)	Capture of VOC vapour during solvent-containing material delivery.	When delivering solvent-containing materials in bulk (e.g. loading or unloading of tanks), the vapour displaced from receiving tanks is captured, usually by back-venting.	Not applicable; As the materials used are primarily water-based, the solvent concentrations within the vapour space during delivery are expected to be minimal and as a consequence back-venting is not proposed.
(g)	Containment for spills and/or rapid take-up when handling solvent-containing materials.	When handling solvent-containing materials in containers, possible spills are avoided by providing containment, e.g. by using trolleys, pallets and/or stillages with built-in containment (e.g. 'catch pans') and/or rapid take-up by using absorbent materials.	Yes

7. BAT 6- DISTRIBUTION OF RAW MATERIALS

In order to reduce raw material consumption and VOC emissions, BAT is to use one or a combination of the techniques given below. Table 7.1 below identifies the techniques used by Ball to reduce raw material consumption and VOC emissions.

Table 7.1: Techniques to reduce raw material consumption and VOC emissions

Technique		Description of BAT	Does Ball meet BAT requirements?
(a)	Centralised supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents)	Supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents) to the application area by direct piping with ring lines, including system cleaning such as pig cleaning or air flushing.	Yes
(b)	Advanced mixing systems	Computer-controlled mixing equipment to achieve the desired paint/coating/ink/adhesive.	Yes
(c)	Supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents) at the point of application using a closed system	In the case of frequent changes of inks/paints/coatings/adhesives and solvents or for small-scale usage, supply of inks/paints/coatings/adhesives and solvents from small transport containers placed near the application area using a closed system.	Yes
(d)	Automation of colour change	Automated colour changing and ink/paint/coating line purging with solvent capture.	Not currently used by Ball
(e)	Colour grouping	Modification of the sequence of products to achieve large sequences with the same colour.	Yes
(f)	Soft purge in spraying	Refilling the spray gun with new paint without intermediate rinsing.	Yes

8. BAT 7- COATING APPLICATION

Table 8.1 below identifies the techniques used by Ball to reduce raw material consumption and the overall environmental impact of the coating application processes at the Installation. BAT is to use one or a combination of the techniques given below.

Table 8.1: Techniques to reduce raw material consumption and the overall environmental impact of the coating application processes

Technique		Description	Does Ball meet BAT requirements?
Techniques for non-spraying application			
(a)	Roller coating	Application where rollers are used to transfer or meter the liquid coating onto a moving strip.	Yes
(b)	Doctor blade over roller	The coating is applied to the substrate through a gap between a blade and a roller. As the coating and substrate pass, the excess is scraped off.	Yes
(c)	No-rinse (dry-in-place) application in the coating of coil	Application of conversion coatings which do not require a further water rinse using a roller coater (chemcoater) or squeegee rollers.	Not currently used by Ball
(d)	Curtain coating (casting)	Workpieces are passed through a laminar film of coating discharged from a header tank.	Not currently used by Ball
(e)	Electrocoating (e-coat)	Paint particles dispersed in a water-based solution are deposited on immersed substrates under the influence of an electric field (electrophoretic deposition).	Not currently used by Ball
(f)	Flooding	The workpieces are transported via conveyor systems into a closed channel, which is then flooded with the coating material via injection tubes. The excess material is collected and reused.	Not currently used by Ball

(g)	Co-extrusion	The printed substrate is coupled with a warm, liquefied plastic film and subsequently cooled down. This film replaces the necessary additional coating layer. It may be used between two different layers of different carriers acting as an adhesive.	Not currently used by Ball
Spraying atomisation techniques			
(h)	Air-assisted airless spraying	An airflow (shaping air) is used to modify the spray cone of an airless spray gun	Yes
(i)	Pneumatic atomisation with inert gases	Pneumatic paint application with pressurised inert gases (e.g. nitrogen, carbon dioxide).	Not currently used by Ball
(j)	High-volume low-pressure (HVLP) atomisation	Atomisation of paint in a spray nozzle by mixing paint with high volumes of air with a low pressure (max. 1.7 bar). HVLP guns have a paint transfer efficiency of > 50 %.	Not currently used by Ball
(k)	Electrostatic atomisation (fully automated)	Atomisation by high-speed rotational discs and bells and shaping the spray jet with electrostatic fields and shaping air.	Yes
(l)	Electrostatically assisted air or airless spraying	Shaping the spray jet of pneumatic or airless atomisation with an electrostatic field. Electrostatic paint guns have a transfer efficiency of > 60 %. Fixed electrostatic methods have a transfer efficiency of up to 75 %.	Not currently used by Ball
(m)	Hot spraying	Pneumatic atomisation with hot air or heated paint.	Yes
(n)	'Spray, squeegee and rinse' application in the coating of coil	Sprays are used for application of cleaners, pretreatments and for rinsing. After spraying,	Not currently used by Ball

		squeegees are used to minimise solution dragout, which is followed by rinsing.	
Automation of spray application			
(o)	Robot application	Robot application of coatings and sealants to internal and external surfaces.	Not currently used by Ball
(p)	Machine application	Use of paint machines for the handling of the sprayhead / spray gun / nozzle.	Yes

9. BAT 8- ENERGY REDUCTION - DRYING/CURING

Table 9.1 below identifies the techniques used by Ball to reduce energy consumption and the overall environmental impact from drying/curing processes at the Installation. BAT is to use one or a combination of the techniques given below.

Table 9.1: Techniques to reduce energy consumption and the overall environmental impact from drying/curing processes

Technique		Description	Does Ball meet BAT requirements?
(a)	Inert gas convection drying/curing	The inert gas (nitrogen) is heated in the oven, enabling solvent loading above the LEL. Solvent loads of > 1 200 g/m^3 nitrogen are possible.	Not currently used by Ball
(b)	Induction drying/curing	Online thermal curing or drying by electromagnetic inductors that generate heat inside the metallic workpiece by an oscillating magnetic field.	Not currently used by Ball
(c)	Microwave and high frequency drying	Drying using microwave or high-frequency radiation.	Not currently used by Ball
(d)	Radiation curing	Radiation curing is applied based on resins and reactive diluents (monomers) which react on exposure to radiation (infrared (IR), ultraviolet (UV)), or high-energy electron beams (EB).	Yes
(e)	Combined convection/IR radiation drying	Drying of a wet surface with a combination of circulating hot air (convection) and an infrared radiator.	Yes
(f)	Convection drying/curing combined with heat recovery	Heat from off-gases is recovered (see BAT 19 (e)) and used to preheat the input air of the convection dryer/curing oven.	Yes
Note: The selection of the drying/curing techniques may be restricted by the substrate type and shape, product quality requirements and the need to ensure that the materials used, coating application techniques, drying/curing techniques and off-gas treatment systems are mutually compatible.			

10. BAT 9- EMISSION REDUCTION - CLEANING

Table 10.1 below identifies the techniques used by Ball to reduce VOC emissions from cleaning processes. BAT is to minimise the use of solvent-based cleaning agents and to use a combination of the techniques given below.

Table 10.1: Techniques to reduce VOC emissions from the cleaning process

Technique		Description	Does Ball meet BAT requirements?
(a)	Protection of spraying areas and equipment	Application areas and equipment (e.g. spray booth walls and robots) susceptible to overspray and drips, etc. are covered with fabric covers or disposable foils where foils are not subject to tearing or wear.	Yes
(b)	Solids removal prior to complete cleaning	Solids are removed in a (dry) concentrated form, usually by hand, with or without the aid of small amounts of cleaning solvent. This reduces the amount of material to be removed by solvent and/or water in subsequent cleaning stages, and therefore the amount of solvent and/or water used.	Yes
(c)	Manual cleaning with pre-impregnated wipes	Wipes pre-impregnated with cleaning agents are used for manual cleaning. Cleaning agents may be solvent-based, low-volatility solvents or solvent-free.	Yes
(d)	Use of low-volatility cleaning agents	Application of low-volatility solvents as cleaning agents, for manual or automated cleaning, with high cleaning power.	Yes
(e)	Water-based cleaning	Water-based detergents or water-miscible solvents such as alcohols or glycols are used for cleaning.	Yes
(f)	Enclosed washing machines	Automatic batch cleaning/degreasing of press/machine parts in enclosed washing machines. This can be done using either: (a) organic solvents (with air extraction followed by VOC abatement and/or recovery of the used solvents) (see BAT 15); or (b) VOC-free solvents; or (c) alkaline cleaners (with external or internal waste water treatment).	Yes
(g)	Purging with solvent recovery	Collection, storage and, if possible, reuse of the solvents used to purge the	Not currently used by Ball

		guns/applicators and lines between colour changes.	
(h)	Cleaning with high-pressure water spray	High-pressure water spray and sodium bicarbonate systems or similar are used for automatic batch cleaning of press/machine parts.	Yes
(i)	Ultrasonic cleaning	Cleaning in a liquid using high-frequency vibrations to loosen the adhered contamination.	Yes
(j)	Dry ice (CO_2) cleaning	Cleaning of machinery parts and metallic or plastic substrates by blasting with CO_2 chips or snow.	Yes
(k)	Plastic shot-blast cleaning	Excess paint build-up is removed from panel jigs and body carriers by shot-blasting with plastic particles.	Not currently used by Ball

11. BAT 10- SOLVENT MASS BALANCE - MONITORING

Table 11.1 below identifies the techniques used by Ball to monitor total and fugitive VOC emissions. BAT is to monitor total and fugitive VOC emissions 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(2) of Annex VII to Directive 2010/75/EU and to minimise the uncertainty of the solvent mass balance data by using all of the techniques given below.

Table 11.1: Techniques to monitor / minimise uncertainty of total and fugitive VOC emissions

Technique		Description	Does Ball meet BAT requirements?
(a)	Full identification and quantification of the relevant solvent inputs and outputs, including the associated uncertainty	This includes: • identification and documentation of solvent inputs and outputs (e.g. emissions in waste gases, emissions from each fugitive emission source, solvent output in waste); • substantiated quantification of each relevant solvent input and output and recording of the methodology used (e.g. measurement, calculation 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.	Yes, the information collated within the solvent mass balance will include the inputs and outputs calculated based upon materials solvent content and control measures. This will include a consideration of uncertainty.
(b)	Implementation of a solvent tracking system	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).	Yes
(c)	Monitoring of changes that may influence the uncertainty of the solvent mass balance data	Any change that could influence the uncertainty of the solvent mass balance data is recorded, such as: • malfunctions of the off-gas treatment system: the date and duration are recorded; • changes that may influence air/gas flow rates, e.g. replacement of fans, drive pulleys, motors; the date and type of change are recorded.	Yes
Note: The level of detail of the solvent mass balance will be proportionate to the nature, scale and complexity of the installation, and the range of environmental impacts it may have, as well as to the type and quantity of materials used.			

12. BAT 11- EMISSIONS IN WASTE GASES - MONITORING

Table 12.1 below identifies the substances/parameters and their minimum monitoring frequencies associated with monitoring emissions in waste gases. BAT is to monitor these emissions 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.

Table 12.1: Techniques to monitor emissions in waste gases

Substance / Parameter	Sectors / Sources	Standard(s)	Minimum monitoring frequency	Monitoring associated with	Does Ball meet BAT requirements?
Dust	Coating and printing of metal packaging – Spray application	EN 13284-1	Once every year[a]	BAT 18	Not Applicable to Ball Kettering
TVOC	Any stack with a TVOC load < 10 kg C/h	EN 12619	Once every year[a b c]	BAT 14, BAT 15	Monitored as required
	Any stack with a TVOC load ≥ 10 kg C/h	Generic EN standards[d]	Continuous		Not Applicable to Ball Kettering
DMF	Coating of textiles, foils and paper[e]	No EN standard available[f]	Once every three months[a]	BAT 15	Not applicable to Ball Kettering
NO_X	Thermal treatment of off-gases	EN 14792	Once every year[g]	BAT 17	Monitored as required
CO	Thermal treatment of off-gases	EN 15058	Once every year[g]	BAT 17	Monitored as required

[a] To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.

[b] In the case of a TVOC load of less than 0,1 kg C/h, or in the case of an unabated and stable TVOC load of less than 0,3 kg C/h, the monitoring frequency may be reduced to once every 3 years or the measurement may be replaced by calculation provided that it ensures the provision of data of an equivalent scientific quality.

[c] For the thermal treatment of off-gases, the temperature in the combustion chamber is continuously measured. This is combined with an alarm system for temperatures falling outside the optimised temperature window.

[d] Generic EN standards for continuous measurements are EN15267-1, EN15267-2, EN15267-3 and EN 14181.
[e] The monitoring only applies if DMF is used in the processes.
[f] In the absence of an EN standard, the measurement includes the DMF contained in the condensed phase.
[g] In the case of a stack with a TVOC load of less than 0,1 kg C/h, the monitoring frequency may be reduced to once every 3 years.

13. BAT 12- EMISSIONS TO WATER - MONITORING

Table 13.1 below identifies the substances/parameters and their minimum monitoring frequencies associated with monitoring emissions in to water. 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.

Table 13.1: Techniques to monitor emissions to water for the coating and printing of metal packaging (DWI cans only)

Substance/Parameter	Standard(s)	Minimum monitoring frequency	Monitoring associated with
AOX[f]	EN ISO 9562	Once every month[b c]	BAT 21
F- [f h]	EN ISO 10304-1		
[a] The monitoring only applies in the case of direct discharge to a receiving water body.[*Removed from table as not relevant*]			
[b] The monitoring frequency may be reduced to once every 3 months if the emission levels are proven to be sufficiently stable.			
[c] In the case of batch discharge that is less frequent than the minimum monitoring frequency, monitoring is carried out once per batch.			
[d] TOC monitoring and COD monitoring are alternatives. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.			
[e] Monitoring of Cr(VI) only applies if chromium(VI) compounds are used in the processes.			
[f] In the case of indirect discharge to a receiving water body, the monitoring frequency may be reduced if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned.			
[g] Monitoring of Cr only applies if chromium compounds are used in the processes.			
[h] Monitoring of F- only applies if fluorine compounds are used in the processes.			

14. BAT 13- EMISSIONS DURING OTNOC

Table 14.1 below identifies the techniques used by Ball to reduce emissions during OTNOC. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to use both of the techniques given below.

Table 14.1: Techniques to reduce emissions to water

Technique		Description	Does Ball meet BAT requirements?
(a)	Identification of critical equipment	Equipment critical to the protection of the environment ('critical equipment') is identified on the basis of a risk assessment. In principle, this concerns all equipment and systems handling VOCs (e.g. off-gas treatment system, leak detection system).	Yes
(b)	Inspection, maintenance and monitoring	A structured programme to maximise critical equipment availability and performance which includes standard operating procedures, preventive maintenance, regular and unplanned maintenance. OTNOC periods, duration, causes and, if possible, emissions during their occurrence are monitored.	Yes

15. BAT 14- VOC EMISSIONS - REDUCTION

Table 15.1 below identifies the techniques used by Ball to reduce VOC emissions from the production and storage areas. BAT is to use technique (a) and an appropriate combination of the other techniques given below.

Table 15.1: Techniques to reduce VOC emissions

Technique		Description	Does Ball meet BAT requirements?
a	System selection, design and optimisation	An off-gas system is selected, designed and optimised taking into account parameters such as: • amount of extracted air; • type and concentration of solvents in extracted air; • type of treatment system (dedicated/centralised); • health and safety; • energy efficiency. • The following order of priority for the system selection may be considered: • segregation of off-gases with high and low VOC concentrations; • techniques to homogenise and increase the VOC concentration (see BAT 16 (b) and (c)); • techniques for the recovery of solvents in off-gases (see BAT 15); • VOC abatement techniques with heat recovery (see BAT 15); • VOC abatement techniques without heat recovery (see BAT 15).	Yes
b	Air extraction as close as possible to the point of application of VOC-containing materials	Air extraction as close as possible to the point of application with full or partial enclosure of solvent application areas (e.g. coaters, application machines, spray booths). Extracted air may be treated by an off-gas treatment system.	Yes
c	Air extraction as close as possible to the point of preparing	Air extraction as close as possible to the point of preparing paints/coatings/adhesives/inks	Yes

	paints/coatings/adhesives/inks	(e.g. mixing area). Extracted air may be treated by an off-gas treatment system.	
d	Extraction of air from the drying/curing processes	The curing ovens/dryers are equipped with an air extraction system. Extracted air may be treated by an off-gas treatment system.	Yes
e	Minimisation of fugitive emissions and heat losses from the ovens/dryers either by sealing the entrance and the exit of the curing ovens/dryers or by applying sub-atmospheric pressure in drying	The entrance to and the exit from curing ovens/dryers are sealed to minimise fugitive VOC emissions and heat losses. The sealing may be ensured by air jets or air knives, doors, plastic or metallic curtains, doctor blades, etc. Alternatively, ovens/dryers are kept under sub-atmospheric pressure.	Yes
f	Extraction of air from the cooling zone	When substrate cooling takes place after drying/curing, the air from the cooling zone is extracted and may be treated by an off-gas treatment system.	Yes
g	Extraction of air from storage of raw materials, solvents and solvent-containing wastes	Air from raw material stores and/or individual containers for raw materials, solvents and solvent-containing wastes is extracted and may be treated by an off-gas treatment system.	Not currently used by Ball
h	Extraction of air from cleaning areas	Air from the areas where machine parts and equipment are cleaned with organic solvents, either by hand or automatically, is extracted and may be treated by an off-gas treatment system.	Not currently used by Ball

16. BAT 15- EMISSIONS IN WASTE GASES

Table 16.1 below identifies the techniques used by Ball to reduce VOC emissions in waste gases and increase resource efficiency. BAT is to use one or a combination of the techniques given below.

Table 16.1: Techniques to reduce VOC emissions in waste gases

Technique		Description	Does Ball meet BAT requirements?
ii. Thermal treatment of solvents in off-gases with energy recovery			
(d)	Sending off-gases to a combustion plant	Part or all of the off-gases are sent as combustion air and supplementary fuel to a combustion plant (including CHP (combined heat and power) plants) used for steam and/or electricity production.	Not applicable
(e)	Recuperative thermal oxidation	Thermal oxidation using the heat of the waste gases, e.g. to preheat the incoming off-gases.	Not applicable
f)	Regenerative thermal oxidation with multiple beds or with a valveless rotating air distributor	An oxidiser with multiple beds (three or five) filled with ceramic packing. The beds are heat exchangers, alternately heated by flue-waste gases from oxidation, then the flow is reversed to heat the inlet air to the oxidiser. The flow is reversed on a regular basis. In the valveless rotating air distributor, the ceramic medium is held in a single rotating vessel divided into multiple wedges.	Yes
(g)	Catalytic oxidation	Oxidation of VOCs assisted by a catalyst to reduce the oxidation temperature and reduce the fuel consumption. Exhaust heat can be recovered with recuperative or regenerative types of heat exchangers. Higher oxidation temperatures (500–750 °C) are used for the treatment of off-gas from the manufacturing of winding wire.	Not applicable

17. BAT 16- VOC ABATEMENT SYSTEM

Table 17.1 below identifies the techniques used by Ball to reduce the energy consumption of the VOC abatement system. BAT is to use one or a combination of the techniques given below.

Table 17.1: Techniques to reduce energy consumption of VOC abatement system

Technique		Description	Does Ball meet BAT requirements?
(a)	Maintaining the VOC concentration sent to the off-gas treatment system by using variable-frequency drive fans	Use of a variable-frequency drive fan with centralised off-gas treatment systems to modulate the airflow to match the exhaust from the equipment that may be in operation.	Yes, applied within the RTO design
(b)	Internal concentration of solvents in the off-gases	Off-gases are recirculated within the process (internally) in the curing ovens/dryers and/or in spray booths, so the VOC concentration in the off-gases increases and the abatement efficiency of the off-gas treatment system increases.	Not currently used by Ball
(c)	External concentration of solvents in the off-gases through adsorption	The concentration of solvent in off-gases is increased by a continuous circular flow of the spray booth process air, possibly combined with curing oven/dryer off-gases, through adsorption equipment. This equipment can include: • fixed bed adsorber with activated carbon or zeolite; • fluidised bed adsorber with activated carbon; • rotor adsorber with activated carbon or zeolite; • molecular sieve.	Not currently used by Ball
(d)	Plenum technique to reduce waste gas volume	Off-gases from curing ovens/dryers are sent to a large chamber (plenum), and partly recirculated as inlet air in the curing ovens/dryers. The surplus air from the plenum is sent to the off-gas treatment system. This cycle increases the VOC content of the curing ovens/dryers' air and decreases the waste gas volume.	Not currently used by Ball

18. BAT 17- NOX REDUCTION

Table 18.1 below identifies the techniques used by Ball to reduce NOX emissions in waste gases while limiting CO emissions from the thermal treatment of solvents in off-gases. BAT is to use technique (a) or both of the techniques given below.

Table 18.1: Techniques to reduce NOx

Technique		Description	Does Ball meet BAT requirements?
(a)	Optimisation of thermal treatment conditions (design and operation)	Good design of the combustion chambers, burners and associated equipment/devices is combined with optimisation of combustion conditions (e.g. by controlling combustion parameters such as temperature and residence time) with or without the use of automatic systems and the regular planned maintenance of the combustion system according to suppliers' recommendations.	Yes, incorporated into RTO design
(b)	Use of low-NOX burners	The peak flame temperature in the combustion chamber is reduced, delaying but completing the combustion and increasing the heat transfer (increased emissivity of the flame). It is combined with increased residence time in order to achieve the desired VOC destruction.	The RTO is designed to a Guaranteed Emission Limit significantly below the BAT-AEL of 130 mg/Nm^3 NOx. This is achieved through avoidance of nitrogen bearing VOC's entering the RTO from the process, and use of a large combustion chamber with an overall residence time of >1 sec. As a consequence, the inclusion of a low-NOx burner is not required to achieve the BAT-AEL.

Table 18.2 below identifies the BAT-associated emission level (BAT-AEL) for NOX emissions in waste gases and indicative emission level for CO emissions in waste gases from the thermal treatment of off-gases.

Table 18.2: BAT-AEL for NOX emissions in waste gases and indicative emission level for CO emissions in waste gases from the thermal treatment of off-gases

Parameter	Unit	BAT-AEL[a](Daily average or average over the sampling period)	Indicative emission level[a](Daily average or average over the sampling period)
NOX	mg/Nm^3	20–130[b]	No indicative level

CO		No BAT-AEL	20–150
[a] The BAT-AEL and indicative level do not apply where off-gases are sent to a combustion plant.			
[b] The BAT-AEL may not apply if nitrogen-containing compounds (e.g. DMF or NMP (N-methylpyrrolidone)) are present in the off-gas.			

19. BAT 18- DUST EMISSIONS IN WASTE GASES

Table 19.1 below identifies the techniques used by Ball to reduce dust emissions in waste gases from substrate surface preparation, cutting, coating application and finishing processes. BAT is to use one or a combination of the techniques given below.

Table 19.1: Techniques to reduce dust emissions in waste gases

Technique		Description	Does Ball meet BAT requirements?
(a)	Wet separation spray booth (flushed impact panel)	A water curtain cascading vertically down the spray cabin rear panel captures paint particles from overspray. The water-paint mixture is captured in a reservoir and the water is recirculated.	Not currently used by Ball
(b)	Wet scrubbing	Paint particles and other dust in the off-gas are separated in scrubber systems by intensive mixing of the off-gas with water. (For VOC removal, see BAT 15 (c).)	Not currently used by Ball
(c)	Dry overspray separation with pre-coated material	A dry paint overspray separation process using membrane filters combined with limestone as pre-coating material to prevent fouling of the membranes.	Not currently used by Ball
(d)	Dry overspray separation using filters	Mechanical separation system, e.g. using cardboard, fabric or sinter.	Yes – following filtration, extracted air is directed to the RTO
(e)	Electrostatic precipitator	In electrostatic precipitators, particles are charged and separated under the influence of an electrical field. In a dry electrostatic precipitator (ESP), the collected material is mechanically removed (e.g. by shaking, vibration, compressed air). In a wet ESP, it is flushed with a suitable liquid, usually a water-based separation agent.	Not currently used by Ball

The BAT-associated emission level (BAT-AEL) for dust emissions in waste gases from spray coating is <1-3 mg/Nm^3. This is not considered to apply at the Ball Kettering site due to the extraction of the air to the RTO following filtration.

20. BAT 19- ENERGY EFFICIENCY

Table 20.1 below identifies the techniques used by Ball to use energy efficiently. BAT is to use techniques (a) and (b) and an appropriate combination of the techniques (c) to (h) given below.

Table 20.1: Techniques to use energy efficiently

Technique		Description	Does Ball meet BAT requirements?
Management techniques			
(a)	Energy efficiency plan	An energy efficiency plan is part of the EMS (see BAT 1) and entails defining and calculating the specific energy consumption of the activity, setting key performance indicators on an annual basis (e.g. MWh/tonne of product) and planning the periodic improvement targets and related actions. The plan is adapted to the specificities of the plant in terms of process(es) carried out, materials, products, etc.	Yes- an energy efficiency plan is used which entails the following: • Calculation of the specific energy consumption of the activity; • Setting key performance indicators on an annual basis (e.g. MWh/tonne of product); • Planning the periodic improvement targets and related actions.
(b)	Energy balance record	The drawing up once every year of an energy balance record which provides a breakdown of the energy consumption and generation (including energy export) by the type of source (e.g. electricity, fossil fuels, renewable energy, imported heat and/or cooling). This includes: (i) defining the energy boundary of the STS activity; (ii) information on energy consumption in terms of delivered energy; (iii) information on energy exported from the plant; (iv) energy flow information (e.g. Sankey diagrams or energy balances) showing how the energy is used throughout the process. (v) The energy balance record is adapted to the specificities of the plant in terms of process(es) carried out, materials, etc.	Yes- an energy balance record which entails the following: • An annual record providing a breakdown of the energy consumption and generation by the type of source; and • Information on energy consumption in terms of delivered energy.
Process-related techniques			

(c)	Thermal insulation of tanks and vats containing cooled or heated liquids, and of combustion and steam systems	This may be achieved for example by: • using double-skinned tanks; • using pre-insulated tanks; • applying insulation to combustion equipment, steam pipes and pipes containing cooled or heated liquids.	Yes
(d)	Heat recovery by cogeneration – CHP (combined heat and power) or CCHP (combined cooling, heat and power)	Recovery of heat (mainly from the steam system) for producing hot water/steam to be used in industrial processes/activities. CCHP (also called tri-generation) is a cogeneration system with an absorption chiller that uses low-grade heat to produce chilled water.	Not currently used by Ball
(e)	Heat recovery from hot gas streams	Energy recovery from hot gas streams (e.g. from dryers or cooling zones), e.g. by their recirculation as process air, through the use of heat exchangers, in processes, or externally.	Not currently used by Ball
(f)	Flow adjustment of process air and off-gases	Adjustment of the flow of process air and off-gases according to the need. This includes reduction of air ventilation during idle operation or maintenance.	Yes
(g)	Spray booth off-gas recirculation	Capture and recirculation of the off-gas from the spray booth in combination with efficient paint overspray separation. Energy consumption is less than in the case of fresh air use.	Not currently used by Ball
(h)	Optimised circulation of warm air in a large-volume curing booth using an air turbulator	Air is blown into a single part of the curing booth and distributed using an air turbulator which turns the laminar airflow into the desired turbulent flow.	Not currently used by Ball

BAT-AEPL for energy generation for coating and printing of metal packaging (all product types) is 0.3 – 1.5 kWh/m^2 of coated surface (annual average).

21. BAT 20- WATER USE AND WASTE WATER GENERATION

In order to reduce water consumption and waste water generation from aqueous processes (e.g. degreasing, cleaning, surface treatment, wet scrubbing), BAT is to use technique (a) and an appropriate combination of the other techniques given below.

Table 20.1: Techniques for reducing water consumption and waste water generation

Technique		Description	Does Ball meet BAT requirements?
(a)	Water management plan and water audits	A water management plan and water audits are part of the EMS (see BAT 1) and include: • flow diagrams and a water mass balance of the plant; • establishment of water efficiency objectives; • implementation of water optimisation techniques (e.g. control of water usage, water recycling, detection and repair of leaks). Water audits are carried out at least once every year.	Yes- a water management plan and water audits will be implemented.
(b)	Reverse cascade rinsing	Multiple stage rinsing in which the water flows in the opposite direction to the work-pieces/substrate. It allows a high degree of rinsing with a low water consumption.	Yes
(c)	Reuse and/or recycling of water	Water streams (e.g. spent rinse water, wet scrubber effluent) are reused and/or recycled, if necessary after treatment, using techniques such as ion exchange or filtration (see BAT 21). The degree of water reuse and/or recycling is limited by the water balance of the plant, the content of impurities and/or the characteristics of the water streams.	Yes

BAT-AEPL for specific water consumption for coating and printing of metal packaging (two-piece DWI beverage cans) is 90-110 l/1,000 cans (annual average).

22. BAT 21- EMISSIONS TO WATER

Table 22.1 below identifies the techniques used by Ball to reduce emissions to water and/or to facilitate water reuse and recycling from aqueous processes (e.g. degreasing, cleaning, surface treatment, wet scrubbing). BAT is to use a combination of the techniques given below.

Table 22.1: Techniques to reduce emissions to water from the treatment of waste water

Techniques		Description	Does Ball meet BAT requirements?
Preliminary, primary and general treatment			
(a)	Equalisation	Balancing of flows and pollutant loads by using tanks or other management techniques.	Yes
(b)	Neutralisation	The adjustment of the pH of waste water to a neutral value (approximately 7).	Yes
(c)	Physical separation, for example, by using screens, sieves, grit separators, primary settlement tanks and magnetic separation		Yes
Physico-chemical treatment			
(d)	Adsorption	The removal of soluble substances (solutes) from the waste water by transferring them to the surface of solid, highly porous particles (typically activated carbon).	Not currently used by Ball
(e)	Vacuum distillation	The removal of pollutants by thermal waste water treatment under reduced pressure.	Not currently used by Ball
(f)	Precipitation	The conversion of dissolved pollutants into insoluble compounds by adding precipitants. The solid precipitates formed are subsequently separated by sedimentation, flotation or filtration.	Not currently used by Ball
(g)	Chemical reduction	Chemical reduction is the conversion of pollutants by chemical reducing agents into similar but less harmful or hazardous compounds.	Not currently used by Ball
(h)	Ion exchange	The retention of ionic pollutants from waste water and their replacement by more acceptable ions using an ion exchange resin. The pollutants are temporarily retained and afterwards released into a regeneration or backwashing liquid.	Not currently used by Ball
(i)	Stripping	The removal of purgeable pollutants from the aqueous phase by a gaseous phase (e.g. steam, nitrogen or air) that is passed through the liquid. The removal efficiency may be enhanced by increasing the temperature or reducing the pressure.	Not currently used by Ball
Biological treatment			
(j)	Biological treatment	Use of microorganisms for waste water treatment (e.g. anaerobic treatment, aerobic treatment).	Not Applicable
Final solids removal			
(k)	Coagulation and flocculation	Coagulation and flocculation are used to separate suspended solids from waste water and are often carried out in successive steps. Coagulation is	Not Applicable

Techniques		Description	Does Ball meet BAT requirements?
		carried out by adding coagulants with charges opposite to those of the suspended solids. Flocculation is a gentle mixing stage so that collisions of microfloc particles cause them to bond to produce larger flocs. It may be assisted by adding polymers.	
(l)	Sedimentation	The separation of suspended particles by gravitational settling.	Not Applicable
(m)	Filtration	The separation of solids from waste water by passing them through a porous medium, e.g. sand filtration, nano-, micro- and ultrafiltration	Not Applicable
(n)	Flotation	The separation of solid or liquid particles from waste water by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers.	Not Applicable

The BAT-AEL for indirect discharges to a receiving water body for coating and printing of metal packaging (DWI cans only) is outlined in Table 22.2. The associated monitoring is given in BAT 12.

Table 22.2: BAT-AEL for indirect discharges to a receiving water body

Substance/Parameter	BAT-AEL[a, b]
Adsorbable organically bound halogens (AOX)	0,1–0,4 mg/l
Fluoride (F-)[c]	2–25 mg/l
[a] The BAT-AELs may not apply if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.	
[b] The averaging period is given in the general considerations.	
[c] The BAT-AEL only applies if fluorine compounds are used in the processes.	

23. BAT 22- WASTE MANAGEMENT

Table 22.1 below identifies the techniques used by Ball to reduce the quantity of waste sent for disposal. BAT is to use the techniques (a) and (b) and one or both of the techniques (c) and (d) given below.

Table 233.1: Techniques to reduce the quantity of waste sent for disposal

Technique		Description	Does Ball meet BAT requirements?
a	Waste management plan	A waste management plan is part of the EMS (see BAT 1) and is a set of measures aiming to: 1) minimise the generation of waste; 2) optimise the reuse, regeneration and/or recycling of waste and/or the recovery of energy from waste; and 3) ensure the proper disposal of waste.	Yes
b	Monitoring of waste quantities	Annual recording of waste quantities generated for each type of waste. The solvent content in the waste is determined periodically (at least once every year) by analysis or calculation.	Yes
c	Recovery/recycling of solvents	Techniques may include: • recovering/recycling solvents from liquid waste by filtration or distillation on site or off site; • recovering/recycling the solvent content of wipes by gravitational draining, wringing or centrifugation.	Not currently used by Ball
d	Waste-stream-specific techniques	Techniques may include: • reducing the water content of the waste, e.g. by using a filter press for the sludge treatment; • reducing the sludge and waste solvent generated, e.g. by reducing the number of cleaning cycles (see BAT 9); • using reusable containers, reusing the containers for other purposes, or recycling the container material; • sending the spent limestone generated from dry scrubbing to a lime or cement kiln.	Yes- all techniques listed are used except reducing the sludge and waste solvent generated.

24. BAT 23- ODOUR EMISSIONS

In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:

- a protocol containing actions and timelines;
- a protocol for response to identified odour incidents, e.g. complaints;
- an odour prevention and reduction programme designed to identify the source(s), to characterise the contributions of the source(s), and to implement prevention and/or reduction measures.

An odour management plan is not expected to be required at this site. The management of odour will be monitored and should odour issues arise, an odour management plan which includes the above elements will be prepared.

25. BAT CONCLUSIONS- COATING AND PRINTING OF METAL PACKAGING

The following Table 25.1 identifies the appropriate BAT-associated emission level (BAT-AEL) for emissions of VOCs from the coating and printing of metal packaging that will be applied at the Kettering installation.

Table 25.1: BAT-AELs for total and fugitive emissions of VOCs from the coating and printing of metal packaging

Parameter	Unit	BAT-AEL (Annual Average)	Does Ball meet BAT-AEL requirements?
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–12 (Associated monitoring is given in BAT 10)	Yes
TVOC	mg C/Nm3	1–20[a] (Associated monitoring is given in BAT 11)	Yes