



UK Best Available Techniques Kick-off Meeting Summary for the Ceramics Sector

Kick-off meeting date: 26 – 28 November 2024

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Executive Summary

The Ceramics (CER) Technical Working Group (TWG) have initiated the review of Best Available Techniques (BAT) in the UK with the aim of establishing BAT Conclusions (BATC) for the sector.

Comments from the initial engagement concerning the scope and other elements of the BAT review were discussed by the TWG at a Kick-off meeting. The TWG discussions and subsequent consensus agreements are summarised in this document.

The TWG reviewed and agreed by consensus, a detailed scope of the BAT review based on the appropriate UK regulations. This agreed scope expanded upon a commission from the Standards Council based on relevant activities within the Industrial Emissions Directive (IED). The full details of the scope are presented in Appendix 2.

The TWG also discussed and agreed further details of the BAT review. This included details of how the review will be undertaken and identifying key environmental issues (KEIs) for the sector. The review identified which environmental impacts require the TWG's focus, i.e. emissions to air from ceramics activities. The TWG also ensured the review is specific to operations undertaken within the UK. The TWG noted that many ceramic installations may not have emissions to water from manufacturing activities, and details of these needed clarification. It also identified areas where more information and understanding of environmental impacts is required.

The techniques which enable emissions to be prevented or minimised, relevant to the listed and directly associated activities based on the scope, and KEIs, were discussed. The TWG agreed the appropriate techniques which require the collection of evidence. This will enable the TWG, along with international benchmarking, to determine the BATC and BAT associated emission limit values (BAT-AELs) for permitted activities, within the scope of the review of BAT. The KEIs and techniques agreed for inclusion and exclusion are found in the appropriate sections of this paper.

The TWG agreed several actions which are recorded in Appendix 3 and confirmed that there were no other substantive issues requiring their discussion and agreement, before the collection of evidence by the TWG.

Overview

This paper summarises the main outputs and decisions made by the Ceramics TWG for the review of Best Available Techniques (BAT) in the Ceramics sector at the Kick-off meeting held 26th-28th November 2024.

The paper begins with a short summary of the background and legal context to the UK process for reviewing BAT. It then summarises the TWG's agreed positions on the scope and other elements which establish the basis of the review.

This process forms an important part of the transparent approach. Which is aimed at ensuring the UK continues to be at the forefront of improving environmental performance, whilst supporting sustainable industry development.

Background and UK legal context

Best Available Techniques (BAT) are the economically and technically viable techniques which are the best for preventing or minimising emissions and impacts on the environment. Industrial installations undertaking specific types of activity are required to use BAT to reduce emissions to air, water and land.

The Environment and Wildlife (Legislative Functions) (EU Exit) Regulations 2019 defined in the European Union (Withdrawal) Act 2018, allows for an appropriate authority to specify BAT Conclusions for the purposes of provisions that have transposed Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) into domestic law.

The development of future BATC separately from the EU, will be based on the common origin of the legislation, to ensure BAT continues to be based on the same principles. The definition of BAT in UK law remains unchanged following EU exit. It forms part of our retained EU law, alongside all existing BATC that were developed at the EU level (largely on a sector-by-sector basis).

This function now rests independently with the UK Government, Scottish Government, Welsh Government, and the Department for Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA) who have executive power to adopt BATC.

The BAT process operates using a transparent, collaborative, flexible, data and evidence led process that safeguards and builds on the high levels of environmental protection already in place across the UK.

Technical Working Groups (TWGs) are formed for each sector under review. They work in a collaborative forum to discuss and develop BATC for the sector in the United Kingdom. The BATC are based on the collected evidence for the UK sector and through benchmarking of the techniques and associated emission limit values (BAT-AELs) against internationally sourced evidence.

The BATC will comprise of a short description of each best available technique identified, its applicability and where appropriate, an associated emission, consumption or performance level.

A formal draft UK BATC will be published for comment and public consultation. When approved they will be published as a Statutory Instrument and used as a basis for setting environmental permit conditions.

Sector Overview

Ceramics are usually described in terms of manufacturing products from clay using various techniques. Every ceramic installation follows relatively common process stages with minor differences. Extracted clay (in various forms, including powdered) is formed into the correct shape. It is then dried to reduce the moisture content before surface finishing may be added, e.g. glaze, patterns or colour. The prepared green (unfired) materials are then fired in a kiln.

As a result, the main environmental issues associated with regulated ceramics installations include emissions to air from combustion processes, with temperatures ranging from 600°C to 1800°C depending on the product. Energy efficiency should also be considered due to the substantial energy requirement for firing products. The firing process has the potential to cause odour issues, and heavy plant has the potential to cause noise pollution.

Clay by itself is inert and clay products do not require many, if any, additives to make the products. Most residues from manufacturing clay products can be used back within the process and ceramic wastes can be used in other sectors, e.g., construction.

As well as the main activities permitted installations will also include directly associated activities (DAA) which have a direct technical connection with the main activities. These activities may influence emissions and pollution. They include activities such as storage and handling of raw materials, shaping/forming of product, drying of product, surface treatment and decoration, storage and handling of waste materials, and packaging and storage of ceramic products.

Regulated installations in the UK

At the time of commission, the Ceramics BAT review there are 61 permitted ceramic installations in the UK affected by this review of BATC. However, the number of active installations may be lower because several installations are currently non-operational and are either undergoing a permit surrender or have been mothballed. The number of installations may change based on clarifications regarding installation activities, and whether they are within scope.

Initial engagement

Before the TWG began its work to review BAT for the Ceramics sector, engagement was undertaken through Citizen Space and via a detailed industrial questionnaire. The aim of the engagement was to seek feedback on the environmental impacts of the sector within the UK. This information was essential to support the development of appropriate BATC. Both methods of engagement focussed on 3 key themes to help begin the review of BAT. These were the scope of the review based on UK legislation, the key environmental issues for the sector, and the techniques which are used in the sector to prevent, or where this is not possible, to minimise pollution.

The Citizen Space survey undertaken between 15 May 2024 and 10 of June 2024 received views from 2 responses across a range of issues. The responses agreed

with the proposals regarding the scope and structure of the review being undertaken.

The industry specific questionnaire received 26 responses. The responses covered the full range of questions and proposals outlined in the survey. Most of the respondents agreed with the proposals outlined in the questionnaire for the Ceramics BATC review.

The anonymised responses were summarised and discussed by the TWG, at the appropriate parts of the KO meeting. The responses and discussions formed an important part of establishing the review. Detailed discussions by the TWG regarding the responses, are summarised in the relevant sections of this note. Where the discussions resulted in an action, the actions are logged in Appendix 3.

Scope of Review

The TWG discussed the scope of the BAT review for the sector. Comments received from the initial engagement through Citizen Space and with those directly involved in the sector, were discussed. The high-level scope comprises the following industrial sectors described in the Industrial Emissions Directive Annex I of Directive 2010/75/EU and are incorporated into UK Law:

3.5 Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain with a production capacity exceeding 75 tonnes per day and/or with a kiln capacity exceeding 4m³ and with a setting density per kiln exceeding 300kg/m³.

6.11 Independently operated treatment of wastewater not covered by Directive 91/271/EEC and discharged by an installation covered by Chapter II [of the IED], provided that the main pollutant load originates from the activities covered by these BAT Conclusions.

The IED activities described above were agreed by the TWG as an appropriate scope for the review. 6.11 activities were discussed by the TWG. They agreed to seek confirmation, in the evidence gathering stage, on whether any installations have effluent treatment capabilities. Activities excluded are also listed below.

Engagement responses asked for unregulated sectors to be included in the scope. The TWG discussed and agreed that unregulated ceramic manufacturing operations cannot be part of the scope, as they do not require an environmental permit, and the BATC only apply to regulated installations.

Associated in scope activities not specified in the IED

In addition to the main activities identified above, the scope for the BATC review also recognises intrinsically linked activities. These are activities intrinsically linked to the process, that may also be fundamental to the main activities. Where present these activities need to be considered as part of this review. The

TWG discussed, and agreed the inclusion of the following intrinsically linked activities:

- Onsite combustion exceeding 50MW that is not covered by the Large Combustion Plant BREF;
- Onsite combustion between 1MW – 50MW that is not a Medium Combustion Plant.

The TWG discussed the practical implementation of combustion activities at installations and the existing regulatory requirements, to clarify if the additional activities should be included in the scope.

An integrated environmental permit must include all activities that are directly associated with the primary activity, if they could influence emissions. This means that all combustion activities on the installation, e.g. kilns and dryers of any size, must be included as part of the environmental permit, and would therefore be included in the UK BAT review scope. For example, combustion processes where the gaseous products of combustion are put into direct contact with material being processed. Combustion plants that directly heat ceramic products using gaseous products of combustion, are excluded from the requirements of the Medium Combustion Plant Directive (MCPD). This means that they must form part of the ceramic installation permit and consequently the BAT review.

The MCPD requires operators of combustion plants (which generate electricity and/or heat, with a rated thermal input equal to or greater than 1 megawatt but less than 50 megawatts), to apply and obtain an environmental permit. These environmental permits must include emission limit values set under the provisions of the MCPD. These permits are required regardless of whether an installation has a permit for a primary activity, as defined in the scope above. This means if there is an in-scope medium combustion plant on a local authority regulated installation, it will need a separate environmental permit for the MCP.

Combustion over 50MW thermal is usually regulated as a Section 1.1 Part A activity and should be regulated against the IED Chapter III and the Large Combustion Plant BAT conclusions. Ceramic kilns are exempt from the requirements of IED Chapter III and the Large Combustion Plant BAT conclusions.

UK legislation: Activities proposed for inclusion

The responses from the initial engagement generally agreed with the proposed scope. Responses received informed the discussions below and subsequent agreement from the TWG.

The TWG discussed the scope of the review as laid out in the relevant regulations which cover the UK devolved governments. They agreed the details of the listed activities for the scope, based on the specifics of each set of regulations.

The detailed scope based on UK legislation can be seen in Appendix 2 at the end of this Summary Note.

Directly Associated Activities

The TWG discussed and agreed the inclusion of several directly associated activities. A directly associated activity is defined as an operation which — (a) has a technical connection with the activity, (b) is carried out on the same site as the activity, and (c) could have an effect on pollution. These included:

- storage and handling of raw materials;
- preparation/mixing of raw materials;
- shaping/forming of products;
- drying of products, irrespective of size;
- surface treatment and decoration of products;
- firing of products irrespective of size;
- subsequent treatment (ceramic product finishing);
- addition of auxiliary materials to the ceramic products;
- storage and handling of waste materials, and;
- sorting, packaging and storage of ceramic products.

The TWG also discussed and agreed that ceramic products can be split into different product types, with different manufacturing practices. As a result, evidence on product type will be gathered and used to develop product specific BATC, if the evidence supports it. The product types are:

- Clay construction products
 - Bricks
 - Roof tiles
 - Drainage pipes
- Abrasives ceramics
- Technical ceramics
- Refractory ceramics
- Expanded aggregates

The TWG discussed and agreed by consensus what further contextual information is needed to determine UK BATC. This will be obtained through the evidence collection process and will include information on:

- Energy use
- Impact of high/low sulphur clay on emissions;
- Level of aggregation of consumption data;
- Operational conditions;
- Plant configuration;
- Product type;
- Raw materials;
- System boundaries;
- Type of dyers;
- Type of kilns and;
- Type of fuel.

Activities proposed for exclusions within the final draft scope

The TWG discussed and agreed by consensus that the following activities should be excluded:

- Whiteware goods, that include gift & tableware, sanitaryware, and wall & floor tiles.

The TWG agreed by consensus that there are no installations in the UK exceeding the threshold and the industry experts do not anticipate any being constructed in the future.

- Standalone calcined clay installations.

Calcined clay, was discussed by the TWG. The TWG agreed by consensus that it is not a ceramic product, but is used as part of many other products, e.g. pharmaceuticals and paints. As the review of BAT covers "ceramic products" it would not be appropriate to include this element with the review scope.

- Quarrying of clay.

The TWG agree by consensus that clay is vital for ceramic installations. However, clay can be sourced from any suitable quarry and does not need to be part of an installation. Clay extraction is not a directly associated activity.

- Combustion processes when they are already covered by the Large Combustion Plant (LCP) BREF or the UK Medium Combustion Plant (MCP) Regulations. The TWG agree by consensus that these already have relevant emission limit values and BAT requirements.
- Surface treatment processes covered by the Surface Treatment with Organic Solvents BREF. This is relevant to the production of whiteware products and the use of glazes. The TWG agree by consensus that these already have relevant emission limit values and BAT requirements.
- Solvent emissions covered by the Solvent Emissions Activities described in the IED. This is relevant to the production of whiteware products and the use of glazes. The TWG agree by consensus that these already have relevant emission limit values.

Key environmental issues

Key environmental issues included in the BATC review

Emissions to air

The TWG discussed the key environmental issues (KEIs) for emissions to air. The initial engagement responses generally agreed with the proposed scope but informed the discussions of the TWG. The TWG agreed by consensus to include the following pollutants listed below as KEIs:

KEI	TWG agreed position	Additional notes
Carbon Dioxide (CO ₂)	To include as KEI	Collection emissions data from point sources.
Carbon Monoxide (CO)	To include as KEI	Collection information on releases to atmosphere from point sources. CO is key for combustion efficiency.
Hydrogen Chloride (HCL)	To include as KEI	Collection information on releases to atmosphere from point sources
Hydrogen Fluoride (HF)	To include as KEI	Collection information on releases to atmosphere from point sources
Nitrogen Dioxide (NO _x)	To include as KEI	Collection information on releases to atmosphere from point sources
Noise	To include as KEI	None
Odour	To include as KEI	None
PM10	To include as KEI	Collection information on releases to atmosphere from point sources
PM2.5	To include as KEI	Collection information on releases to atmosphere from point sources
Sulphur Oxides (SO ₂)	To include as KEI	Collection information on releases to atmosphere from point sources
Total Particulate Matter	To include as KEI	Collect information on releases to atmosphere from point sources

The TWG discussed emissions of carbon dioxide. Larger ceramic installations (within the sector) have trading agreements for emissions of carbon dioxide via the UK Emissions Trading Scheme (ETS) or Small Emitter Opt-out Scheme, Small Emitter Opt-out scheme must adhere to simplified monitoring and annual emission targets.

The TWG were unable to confirm how many ceramic installations in the UK have such agreements and agreed that further investigation into UK ETS, the impact

on the sector was required and evidence collection is to identify where CO₂ comes from in the process and how operating techniques impact on the scale.

The TWG also discussed emissions of particulates, their sources and the different size ranges associated with this. The different measures of particulates are included in the KEIs. These include Total Particulate Matter (TPM), Particulate Matter with a diameter of less than 10 microns (PM₁₀) and Particulate Matter with a diameter of less than 2.5 microns (PM_{2.5}). TWG members confirmed that current environmental permits have total particulate matter monitoring requirements. The TWG agreed TPM, PM₁₀ and PM_{2.5} should be included as KEIs and evidence collected on the emissions where available. The TWG discussed and agreed that the other pollutants should be included in the BAT review as they are already covered by the existing BAT conclusions.

The TWG then discussed and agreed the following pollutants as being considered Potential Pollutants of Concern and should be included in the evidence gathering stage to determine if they are KEIs.

KEI	TWG agreed position	Additional notes
Benzene (C ₆ H ₆)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Chromium (Cr)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Copper (Cu)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Harmful or persistent low-volume potential polluting substances. E.g. per-and poly fluoroalkyl substances (PFAS) or Perfluorooctane sulfonic acid (PFOS) chemicals	Collect data for evidence and assessment for inclusion as KEIs.	Potential substance that may be released from the wider installation.
Lead (Pb)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Mercury (Hg)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Methane (CH ₄)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.

Nickel (Ni)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Non-Methane Volatile Organic Compounds (NMVOC)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Polycyclic Aromatic Hydrocarbons (PAH)	Collect data for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Total Volatile Organic Compounds (TVOC)	To include in data collection	Further information is required.

The TWG discussed and agreed by consensus to collect information on the above pollutants. They agreed that harmful or persistent low-volume potential polluting substances, e.g. PFAS and PFOS chemicals are unlikely to be used within ceramic manufacturing, but confirmation of this will be sought in the evidence gathering stage.

The TWG discussed and agreed by consensus to collect information on the use of binding agents, drying aids, adhesives, body fuels, burnout additives and inks used within the ceramic process. When used these have the potential to release Total Volatile Organic Compounds. The evidence may confirm that no UK installation uses these.

The TWG discussed Non-Methane Volatile Organic Compounds (NMVOC). They discussed the use of NMVOC in the UK Pollutant Release and Transfer Register (PRTR) as a substitute for TVOC. The TWG agreed that confirmation of the release of NMVOC was required in the evidence gathering stage.

The TWG consider Polycyclic Aromatic Hydrocarbons (PAH) are not generally used in ceramic manufacturing in the UK and the TWG agreed that confirmation of this will be sought in the evidence gathering stage.

The TWG were unable to make a decision regarding other pollutants listed above, which have been entered into information sources such as the PRTR data sets. The TWG discussed whether a) their inclusion is a result of emissions from whiteware ceramics production (which there are no longer any above the regulation threshold in the UK), b) were erroneous submissions, or c) were from specific installations using additives. The TWG therefore agreed to gather further evidence to determine if the pollutants should remain as pollutants of concern for the sector.

Emissions to water

The TWG discussed emissions to water relevant to installations within the scope of the review. Emissions to water from an installation can either be process water, i.e. water that is used in the manufacturing process, or surface water, i.e. rainwater that has fallen on the site. Contaminated water from both process and surface water has to be suitably treated before leaving the installation.

Wastewater can be released by direct releases, e.g. straight to a receiving water body without further downstream treatment or indirect releases via a sewer. Wastewater that is from municipal use, e.g. kitchens, are excluded from the scope of BAT reviews.

The TWG agree that water use in ceramic installations is minimal. Water is only added to clay to enhance its plasticity, enabling it to be shaped appropriately. The TWG agree that only whiteware production needs to introduce significant amounts of water. However, as whiteware products are not produced in the UK in sufficient quantities to require an environmental permit, they are excluded from the review.

Where emissions of water do occur, the TWG discussed and agreed by consensus to include the following parameters as KEIs, or to collect further evidence to determine if they should remain as a KEI.

KEI	TWG agreed position	Additional notes
Adsorbable organically bound halogens (AOX)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Biochemical Oxygen Demand (BOD)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Harmful or persistent low-volume potential polluting substances. E.g. per-and poly fluoroalkyl substances (PFAS) or Perfluorooctane sulfonic acid (PFOS) chemicals	Collect data for evidence and assessment for inclusion as KEIs.	Potential substance that may be released from the wider installation.
Hydrocarbon Oil Index (HOI) and Oils/Total hydrocarbons	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
pH	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Phosphorus (P)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI	Further information is required to determine if pollutant is widely released in sector.

KEI	TWG agreed position	Additional notes
Temperature	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Total Nitrogen (TN)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI	Further information is required to determine if pollutant is widely released in sector.
Total Organic Carbon (COD)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.
Total Suspended Solids (TSS)	Collect data on process and surface water emissions for contextual information to determine if appropriate as a KEI.	Further information is required to determine if pollutant is widely released in sector.

The TWG acknowledged that there are several environmental permits with water discharge conditions, and some installations reported releases of some of these pollutants to water. On the basis that the processes should not require the use of water and subsequent emissions the TWG agreed by consensus that water emissions should be investigated further. This will confirm what the emissions are and where they originate.

The TWG discussed the potential for emissions of harmful or persistent low-volume potential polluting substances, e.g. PFAS and PFOS chemicals, to water. As with emissions to air, they considered this to be unlikely but agreed that confirmation needs to be sought in the evidence gathering stage.

Resource efficiency, climate change, circular economy and amenity issues

The TWG discussed resource efficiency, climate change, circular economy and amenity issues, and agreed by consensus to include the following pollutants listed below as KEIs.

KEI	TWG agreed position	Additional notes
Circular Economy	To include as KEI	Ceramics can generally be reused/recycled.
Climate Change Adaptation	To include as KEI	Dependent on installation type and more suited to narrative BAT approach, and part of the management techniques.

KEI	TWG agreed position	Additional notes
Consumption of important raw materials	To include as KEI	To develop narrative BAT Techniques.
Decarbonisation around dryers and furnaces	To include as KEI	There are other legislation and national drivers that impact decarbonisation.
Energy efficiency around dryers and furnaces	To include as KEI	There are other legislation and national drivers that impact on energy efficiency.
Fugitive emissions of dust	To include as KEI	To develop abatement techniques.
Heat efficiency	To include as KEI	Dependent on installation type and more suited to narrative BAT approach.
Replacement of virgin material with recovered wastes or secondary materials	To include as KEI	Product specific and limited to availability of replacement materials.
Waste streams and how they are treated/disposed of	To include as KEI	To develop narrative BAT Techniques.
Water efficiency	To include as KEI	Water use in ceramic installations is limited. Limited to certain products.

The TWG discussed how circular economy principles are applied within the sector, and the use (and disposal) of residues and waste streams. The TWG agreed that most ceramic products can be re-used as raw materials before firing and once fired they can be reused again with limited processing, e.g. crushed to provide aggregate. The TWG also discussed the use of recycled materials in manufacturing ceramic products, agreeing that this was good practice. However, this is limited by the product specification and availability of replacement materials.

The TWG discussed and agreed that plant efficiency is vital to ceramic installations, however, it is very dependent on installation and product type.

The TWG discussed and agreed that climate change adaptation is important for installations but is very dependent on the specifics of the installation and location.

Throughout the discussion on KEIs the TWG noted that some operations in the sector currently do not have to undertake emissions monitoring as part of current environmental permits. These current requirements may mean data from installations could be limited. Appropriate benchmarking of techniques and

emissions may therefore be required to support the development of BATC and BAT-AELs. The TWG acknowledged that this will impact on evidence gathering.

Key environmental issues not included in the BATC review

Emissions to air

The TWG also agreed by consensus not to include the following as KEIs for emissions to air:

KEI	TWG agreed position	Additional notes
Acetaldehyde (C ₂ H ₄ O)	Not to include as KEI	No installations submitted PI/PRTR data as not considered to be released.
Ammonia (NH ₃)	Not to include as KEI	No installations submitted PI/PRTR data as not considered to be released.
Boron (B)	Not to include as KEI	Primarily relevant to whiteware sector
Dioxins & Furans (PCDD/Fs)	Not to include as KEI	No installations submitted PI/PRTR data as not considered to be released.
Formaldehyde (CH ₂ O)	Not to include as KEI	No installations submitted PI/PRTR data as not considered to be released.
Hydrofluorocarbons (HFC)	Not to include as KEI	Considered a mistake on the PRTR and TWG agree that not released in the process.
Nitrous Oxide (N ₂ O)	Not to include as KEI	Considered a mistake on the PRTR and TWG agree that it is not released in the process.
Petroleum pitch fume	Not to include as KEI	Used in some refractory manufacturing, but not in UK.
Phenol (C ₆ H ₆ O)	Not to include as KEI	Primarily relevant to whiteware sector.
Styrene (C ₈ H ₈)	Not to include as KEI	No installations submitted PI/PRTR data as not considered to be released.
Sulphur hexafluoride (SF ₆)	Not to include as KEI	Considered a mistake on the PRTR and TWG agree that it is not released in the process.

The TWG discussed the above pollutants and believed most of them are only released during the production of specific ceramic products, which are not manufactured in the UK. The TWG agreed by consensus that no further work will be undertaken on these in the BAT review.

Emissions to water

The TWG discussed and agreed by consensus to exclude the following parameters as KEIs for emissions to water.

KEI	TWG agreed position	Additional notes
Arsenic (As)	Not to include as KEI	Arsenic is found in glazes which are not used in the UK
Boron (B)	Not to include as KEI	Boron is found in glazes which are not used in the UK
Cadmium (Cd)	Not to include as KEI	Cadmium is found in glazes which are not used in the UK
Chromium (Cr)	Not to include as KEI	Chromium is found in glazes which are not used in the UK
Copper (Cu)	Not to include as KEI	Copper is found in glazes which are not used in the UK
Fluoride (F)	Not to include as KEI	Fluoride is found in glazes which are not used in the UK
Lead (Pb)	Not to include as KEI	Lead is found in glazes which are not used in the UK
Nickel (Ni)	Not to include as KEI	Nickel is found in glazes which are not used in the UK
Zinc (Zn)	Not to include as KEI	Zinc is found in glazes which are not used in the UK

The TWG discussed and agreed by consensus that these pollutants are released only when glazes are used in whiteware ceramic manufacturing, which has been excluded from the scope of this BAT review. The associated KEIs should therefore also be excluded from the BAT review.

Techniques

Techniques included in the BATC review

The TWG agreed by consensus to include the following techniques which are directly applicable within the sector. They include:

- Management Techniques
 - Environmental Management Systems
 - Energy Management systems/Plan
 - Chemical Management Systems/plans
 - Noise Management Plan
 - Odour Management Plan
 - Climate Change Mitigation Plans
 - Climate Change Adaptation Plans

The TWG discussed the design and use of management systems across the sector. The discussions highlighted that often integrated management systems, covering multiple elements of management are used across the sector, including compliance with other regimes e.g. COSHH and REACH. The TWG also confirmed that the sector uses minimal chemicals and has few noise or odour issues.

The TWG also agreed by consensus to include techniques related to process operations for the sector including:

- Process techniques
 - Inventory of Inputs and Outputs
 - Plan for the prevention and control of leaks and spillages
 - Techniques for the structuring and management of process areas and raw material storage areas
 - Prevention of contamination of surface run-off water
 - Good housekeeping
 - Other than normal operating conditions (OTNOC) management, at all stages of the process
 - Measurement/monitoring of resource consumption, waste generation and material recovery
 - Emissions monitoring

As part of these discussions the TWG discussed the process steps different products require and the impact on emissions. They agreed that the process steps are similar in manufacturing different ceramic products. However, the plant, especially kilns and dryers, are normally different in size and nature of operation. The applicability of techniques may be installation specific and this will need to be included in evidence collection, before determining the BATC and BAT-AELs.

The TWG discussed the use of techniques used to improve resource use in production. They agreed by consensus that the following techniques are appropriate to include in the review of BAT:

- Resource efficiency
 - Energy Efficiency
 - Water Efficiency
 - Water management plans

- Minimisation of water consumption
- Segregation of polluted and unpolluted water streams
- Water reuse and/or recycling
- Consumption of Specified Materials
 - Reduce consumption of hazardous substances
 - Automatic systems for the preparation and dosing of process chemicals
 - Recovery and use of leftover process chemicals
- Residues and Wastes, recycling, treatment, and disposal
 - Residues management plan
 - Use of process residues as raw materials
 - Reduction, reuse and recycling of packaging
 - Use of broken materials in other sectors
 - Breakage detection before firing
 - Modification of product design

The TWG discussed in detail different resource efficiency techniques. They agreed that these may also be product and process specific. The TWG discussed the range of products that require different process steps and plant. The TWG agreed by consensus that many of the resource efficiency techniques will only be specific for certain installations. For example, water usage is very low compared to energy usage. The TWG considered other available techniques, however, some techniques may not be suitable due to health and safety reasons for large installations.

The TWG discussed residues, which are a substance that are generated by the activities as a waste or by-product, and how re-use within the sector and may be limited to pre-fired material. Sludges, which are an aqueous suspension with a high solid content, are primarily used in whiteware production. Evidence collection may clarify the techniques available.

The TWG also discussed and agreed by consensus to include the following techniques, which can be used to control emissions from operations within the sector. These included:

- Techniques to reduce emissions
 - Techniques to reduce fugitive emissions to air
 - Techniques to reduce channelled emissions in general
 - Techniques to reduce channelled emissions of dust
 - Techniques to reduce channelled emissions of gaseous compounds
 - Techniques to reduce emissions to water
 - Primary Treatment
 - Solids removal
 - Techniques to reduce noise
 - 4.5.1. Noise Management Plan
 - 4.5.2. Appropriate location of equipment and buildings
 - 4.5.3. Operational measures
 - 4.5.4. Low-noise equipment
 - 4.5.5. Noise control and abatement/attenuation equipment
 - Techniques to reduce odour

The TWG discussed the range of techniques that can reduce emissions from installations. Many are dependent on the size and type of installation as some

techniques will only work for specific products or sized installations. The evidence gathering process should be able to confirm this.

Techniques excluded from the BATC review

The TWG discussed and agreed by consensus to exclude the following techniques which are not in scope for the review of UK BAT for the ceramics sector. They covered specific residue, waste, recycling, treatment, and disposal techniques, as specified below:

- Inkjet printing. This is primarily for whiteware sector which is excluded from the scope. However, printing information onto ceramic products is an emerging technique.
- Production of small batches of glaze. This is part of the whiteware sector and therefore excluded from the scope.

Emerging Techniques

The TWG discussed emerging techniques. These are techniques which have moved from lab scale to pilot plant scale (or even limited operational scale) but are not widely in use. The TWG discussed the techniques listed in the detailed industrial questionnaire and agreed by consensus to list them in the final page of the Evidence Questionnaire, with the option to provide additional details and information. This will enable the emerging techniques to be reviewed and analysed in future BAT reviews.

The ceramics sector is diverse in the type of produce and size of installation with some emerging techniques not suitable for every installation.

The following list of techniques have been identified by the TWG as 'still emerging':

- Advanced oxy-fuel technologies to the firing stage
- Rapid dryer
- Radiant tube burners
- Carbon capture and utilisation storage
- Hydrogen and other low carbon fuels as an alternative fuel

The following list of techniques have been identified by the TWG as a 'current technique':

- Heat pipe technologies
- Use of recycled glass as a flux material

The following list of techniques have been identified by the TWG as 'obsolete' in the ceramics sector:

- Microwave heating

The following list of techniques have been proposed as an additional 'emerging technique' by the TWG:

- Inductive drying in expanded aggregates

The following list of techniques have been identified by the TWG that they are currently not considered an emerging technique, but the TWG consider that when technology improves, they could potentially be viable to be 'trialled':

- Carbon capture and utilisation storage

Appendix 1: Key terms and definitions

Within a UK context, key terms have been defined in the following way to ensure clarity with the UK BAT process:

BAT Conclusions (BATC)	means a document laying down the Conclusions on best available techniques, their description, information to assess their applicability, the emission levels associated with the best available techniques, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures.
available techniques	means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the United Kingdom, as long as they are reasonably accessible.
best	means most effective in achieving a high general level of protection of the environment as a whole.
best available techniques	means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole.
emission levels associated with the best available techniques	means the range of emission levels obtained under normal operating conditions, using a best available technique or a combination of best available techniques, as described in BAT Conclusions, expressed as an average over a given period of time, under specified reference conditions.
emission limit value	means the mass, expressed in terms of certain specific parameters, concentration and/or level of an

	emission, which may not be exceeded during one or more periods of time.
techniques	includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.
BAT AEPL	means BAT Associated Environmental Performance Level which may include an emission level, consumption level or other indicator of performance such as abatement efficiency.
Emerging techniques	an 'emerging technique' is defined in the IED as "a novel technique for an industrial activity that, if commercially developed, could provide either a higher general level of protection of the environment, or at least the same level of protection of the environment, and higher cost savings than existing best available techniques"
Activity/activities	the activity/activities listed in the relevant regulations where 'activity' is defined as, subject to the relevant Part, an activity listed in the appropriate Schedule
Directly associated activities	means an operation which— (a) has a technical connection with the activity, (b) is carried on the same site as the activity, and (c) could have an effect on pollution.
Process steps	description of the manufacturing processes which are included within the listed activities and directly associated activities.

Appendix 2: Scope of BAT review

Principal Activities for inclusion within the initial scope

The starting point for the review for the Ceramics sector UK BAT review is detailed below. These activities, which are regulated by the Industrial Emissions Directive (IED), are incorporated into UK law. They are described in Sections 3.5 and 6.11 of Annex I to the IED.

3.5 Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain with a production capacity exceeding 75 tonnes per day and/or with a kiln capacity exceeding 4m³ and with a setting density per kiln exceeding 300kg/m³.

6.11. Independently operated treatment of wastewater not covered by Directive 91/271/EEC, provided that the main pollutant load originates from the activities covered by these BAT Conclusions.

Scope of the UK BAT review

The IED was transposed into UK domestic law as follows:

In England and Wales under the Environmental Permitting Regulations 2016
Schedule 1 Part 2, Chapter 3: Mineral industries

Section 3.6 Ceramic production

- Part A(1)(a) Manufacturing ceramic products (including roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) by firing in kilns, where—
 - (i) the kiln production capacity is more than 75 tonnes per day, or
 - (ii) the kiln capacity is more than 4m³ and the setting density is more than 300kg/m³ and a reducing atmosphere is used other than for the purposes of colouration.
- Part A(2)(a) Unless falling within Part A(1) of this Section, manufacturing ceramic products (including roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) by firing in kilns, where –
 - (i) the kiln production capacity is more than 75 tonnes per day, or
 - (ii) the kiln capacity is more than 4m³ and the setting density is more than 300kg/m³.

Schedule 1 Part 2, Chapter 5 Waste management:

Section 5.7 Treatment of waste water

- Part A(1)(a) Independently operated treatment of waste water not covered by the Urban Waste Water Treatment (England and Wales) Regulations 1994 and discharged by an installation carrying out any other Part A(1) or A(2) activity. Provided that the main pollutant load originates from the activities covered by these BAT conclusions.

In Scotland under the Pollution Prevention and Control (Scotland) Regulations 2012 Chapter 3 Mineral Industries:

Section 3.6 Ceramic production

Part A Manufacturing ceramic products (such as roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) by firing—

- (a) in kilns with a production capacity exceeding 75 tonnes per day, or
- (b) where the kiln capacity exceeds 4m³, and the setting density of the kiln exceeds 300 kg/m³.

Schedule 1 Part 2, Chapter 5 Waste management:

Section 5.7 Treatment of waste water

- Part A Independently operated treatment of waste water not covered by the Urban Waste Water Treatment (Scotland) Regulations 1994 and discharged by an installation carrying out any other Part A activity provided that the main pollutant load originates from the activities covered by these BAT conclusions.

In Northern Ireland under the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 Schedule 1, Part 1, Chapter 3, Section 3.6 Ceramic production

- Part A(a) Manufacturing ceramic products (including roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) by firing in kilns, where—
 - (i) the kiln production capacity is more than 75 tonnes per day; or
 - (ii) the kiln capacity is more than 4m³ and the setting density is more than 300kg/m³.

Schedule 1 Part 2, Chapter 6 Other activities:

- Part A (a) Independently operated treatment of waste water not covered by Directive 91/271/EEC and discharged by a Part A installation or Part A mobile plant provided that the main pollutant load originates from the activities covered by these BAT conclusions.

Associated activities included in scope, but which are not specified activities in the IED include:

- onsite combustion exceeding 50MW that is not covered by the Large Combustion Plant BREF
- onsite combustion between 1MW – 50MW that is not a Medium Combustion Plant
- storage and handling of raw materials
- preparation/mixing of raw materials
- shaping/forming of products
- drying of products, irrespective of size
- surface treatment and decoration of products
- firing of products irrespective of size
- subsequent treatment (ceramic product finishing)
- addition of auxiliary materials to the ceramic products
- storage and handling of waste materials
- sorting, packaging and storage of ceramic products.

The TWG agreed by consensus that the following clay product types will be included in the scope of Ceramics BAT Review:

- Clay construction products

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- Bricks
- Roof tiles
- Drainage pipes
- Abrasives ceramics
- Technical ceramics
- Refractory ceramics
- Expanded Clay

The TWG agreed by consensus that contextual information, e.g. kiln type, size and fuel will be gathered to determine if specific Ceramics BAT Conclusions are required, e.g. for product type or BAT Conclusions which need to be split.

The TWG agreed by consensus the following associated activities not specified in IED, will be excluded in scope of Ceramics BAT Review:

- Standalone calcined clay activities.
- Quarrying of clay
- Directly associated combustion processes when they are already covered by:
 - Large Combustion Plant (LCP) BREF
 - UK Medium Combustion Plant (MCP) Regulations
 - Surface Treatment with Organic Solvents BREF
 - Solvent Emissions Activities within the IED

The TWG agreed by consensus that the following clay product types will be excluded in the scope of Ceramics BAT Review:

- Whiteware goods
 - Gift and tableware
 - Sanitaryware
 - Wall and floor tiles

Appendix 3: Actions

The following actions were agreed at the TWG KO meeting. These will be reviewed by the TWG Chair to ensure completion.

Action Item	Owner
The TWG were asked to review the presented installation list and confirm if it was accurate in capturing the number of installations within the UK. This list would be used for engagement purposes to ensure a wide range of views are obtained.	TWG
The industry representatives were asked to provide process flow diagrams for their operations. These flow diagrams will ensure the TWG have a common understanding of the process steps, material and energy usage, related emissions and abatement techniques.	TWG
To obtain a clear view on the scale and impacts of the ceramics industry within the UK the trade associations agreed to provide a narrative description that could be used to describe the current state of the sector.	Trade association
When reviewing the available public data linked to releases from ceramic installations a number of pollutants of concern were identified that did not have a clear link to the known installation operations. The Local Authority Unit (LAU) to investigate the unexpected PRTR data and share initial findings with TWG.	LAU