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KICK-OFF MEETING

FOR THE REVIEW OF THE

BEST AVAILABLE TECHNIQUES (BAT) REFERENCE DOCUMENT FOR THE CERAMIC MANUFACTURING INDUSTRY (CER BREF)

SEVILLE

(Meeting date to be defined)

BACKGROUND PAPER

INTRODUCTION

The Industrial Emissions Directive (IED) (2010/75/EU), through its Chapters I and II, lays down a framework requiring Member States to issue operating permits for certain installations carrying out industrial activities described in its Annex I (energy industries, production and processing of metals, *mineral industry*, chemical industry, waste management, and other activities). The '*mineral industry*' includes manufacture of ceramic products by firing, which is referred to in this document as '**Ceramic Manufacturing Industry (CER)**'.

The Directive stipulates that permits must contain conditions based on **Best Available Techniques** (BAT) as defined in Article 3(10) of the Directive, to achieve a high level of protection of the environment as a whole.

The BAT conclusions of the BAT reference documents (BREFs) serve as the reference for the competent authorities when setting permit conditions for installations. BREFs are also used by the industry concerned in preparing applications for operating permits. Additionally, BREFs are a source of information for other parties interested (including outside of the EU) in ways to minimise the environmental impacts of industry.

BAT is a dynamic concept because new techniques may emerge; science and technologies are continuously developing, and new environmental processes are being successfully introduced in industry. Since the elements of BAT change over time, BREFs have to be reviewed and updated as appropriate. In addition, with the entry into force of the IED, the existing BREFs, which were adopted under the former IPPC Directive (i.e. Directive 96/61/EC, which was repealed by Directive 2008/1/EC), need to be reviewed and, where necessary, updated.

The purpose of this paper is to provide TWG members with an outline of the matters that are proposed for discussion at the Kick-off Meeting.

This Kick-off Meeting will determine/clarify the review process for the CER BREF so that TWG members are aware of the specific tasks needed to deliver a high-quality BREF according to the agreed timetable.

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ACRONYMS USED IN THIS BACKGROUND PAPER

General acronyms – Definitions

Acronym	Meaning
BAT	Best Available Techniques (as defined in Article 3(10) of the IED)
BAT-AEL	Emission level associated with the BAT (as defined in Article 3(13) of the IED)
BAT-AEPL	BAT-associated environmental performance level (as described in Section 3.3 of Commission Implementing Decision 2012/119/EU). BAT-AEPLs include BAT-AELs
BATIS	BAT Information System
BP	Background Paper
BREF	BAT reference document (as defined in Article 3(11) of the IED)
CER BREF	BAT reference document for the Ceramic Manufacturing Industry
CER sector	The ceramic manufacturing industry sector
CLM BREF	Best Available Techniques (BAT) Reference Document for the Production of Cement, Lime and Magnesium Oxide
CMR	Carcinogenic, mutagenic or toxic for reproduction
CMR 1A	CMR substance of category 1A as defined in Regulation (EC) No 1272/2008 as amended
CMR 1B	CMR substance of category 1B as defined in Regulation (EC) No 1272/2008 as amended
CMR 2	CMR substance of category 2 as defined in Regulation (EC) No 1272/2008 as amended
ECHA	European Chemicals Agency
EFS BREF	BAT reference document on Emissions from Storage
EIPPCB	European IPPC Bureau
ELV	Emission limit value
EN	European Standard adopted by CEN (European Committee for Standardisation, from its French name Comité Européen de Normalisation)
ENE BREF	BAT reference document for Energy Efficiency
E-PRTR	European Pollutant Release and Transfer Register
ESP	Electrostatic precipitator
EU	European Union
GLS BREF	BAT reference document for the Manufacture of Glass
ICS BREF	BAT reference document on Industrial Cooling Systems
IED	Industrial Emissions Directive (2010/75/EU)
INERIS	Institut national de l'environnement industriel et des risques (French National Competence Centre for Industrial Safety and Environmental Protection)
IPs	Initial positions and input
IPPC	Integrated Pollution Prevention and Control
IS BREF	BAT reference document for Iron and Steel Production
ISO	International Organisation for Standardisation. Also international standard adopted by this organisation.
KEI	Key environmental issue
KoM	Kick-off Meeting
LCP BREF	BAT reference document for Large Combustion Plants
MAC-EQS	Maximum allowable concentration of the Environmental Quality Standards for short-term pollution peaks set by Directive 2013/39/EU
MS	Member State (of the European Union)
NGO	Non-governmental organisation
OTNOC	Other Than Normal Operating Conditions
REACH	Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
ROM	JRC Reference Report on Monitoring of Emissions to Air and Water from IED installations
SF BREF	BAT reference document for the Smitheries and Foundries Industry
STM BREF	BAT reference document for the Surface Treatment of Metals and Plastics

STS BREF	BAT reference document on Surface Treatment Using Organic Solvents including Wood and Wood Products Preservation with Chemicals
TWG	Technical working group
UBA	Umweltbundesamt (German Federal Environment Agency)
US EPA	United States Environmental Protection Agency
WI BREF	BAT reference document for Waste Incineration
WT BREF	BAT reference document for Waste Treatment
WWTP	Waste water treatment plant

Substances, groups of substances and parameters

Acronym	Meaning
AOX	Adsorbable organically bound halogens
CMR	Carcinogenic, mutagenic or toxic for reproduction (substance)
CO	Carbon monoxide
COD	Chemical oxygen demand
HOI	Hydrocarbon oil index. The sum of compounds extractable with a hydrocarbon solvent (including long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbons)
NMVOC	Non-methane volatile organic compound(s)
PAHs	Polycyclic aromatic hydrocarbons
PCDD/Fs	Polychlorinated dibenzo-*p*-dioxins/furans
SVHC	Substance of very high concern
TOC	Total organic carbon
TSS	Total suspended solids
TVOC	Total volatile organic carbon
VOC	Volatile organic compound (as defined in Article 3(45) of the IED)

Member States (MS)

MS	Member State
AT	Austria
BE	Belgium
CZ	Czechia
DE	Germany
DK	Denmark
EL	Greece
ES	Spain
FI	Finland
FR	France
IE	Ireland
IT	Italy
NL	The Netherlands
PL	Poland
PT	Portugal
SE	Sweden

Other TWG members

Acronym	Meaning
EEB	European Environmental Bureau
C.U.	CERAME-UNIE, the European Ceramic Industry Association
FEPA	Federation of European Producers of Abrasives

Other Countries

Code	Country
UK	United Kingdom

1 GENERAL INFORMATION

1.1 The current CER BREF and the CER BREF review

The information exchange for the original Ceramic Manufacturing Industry (CER) BREF was carried out from late 2003 to the beginning of 2006 with the BREF formally adopted by the European Commission in 2007[1] under the IPPC Directive (96/61/EC)[2]. The review of the CER BREF is the 22nd review of an existing (B)REF to be launched.

The review of the CER BREF started with the reactivation of the TWG in May 2019[3]. This resulted, as of today, in a list of 129 TWG members from Member States, industry, environmental non-governmental organisations (NGOs), and services of the Commission, as well as 8 TWG observers from third countries and EU agencies. The TWG members and observers list is available in the BAT Information System (BATIS).

This was followed by the call for initial positions (IPs) to the TWG members (September 2019) to provide opinions and initial positons on a number of issues related to the review of the BREF.

1.2 Objectives of the CER BREF review

The main goals of the review are:

- the scope;
- to bring the CER BREF in line with the IED, in particular with the BREF Guidance[4];
- to update the information and data contained in the CER BREF, in particular on the environmental performance of CER installations, on techniques to consider in the determination of BAT and on emerging techniques;
- to improve clarity, coherence and consistency; and
- to revise the BAT conclusions and set BAT-AEPLs.

The review will also address those issues identified in the 'Concluding remarks' chapter of the current CER BREF (Chapter 7), where these are still deemed relevant by the TWG.

1.3 Process to review the CER BREF

The general timeline for the review of a BREF is given in the BREF Guidance[4] (see Section 1.2.4 of the Guidance) and the approach to take was further agreed at the IED Article 13 Forum meeting of 6 June 2013[5]. The CER TWG will work using the following approach:

- Adopt a more focused approach to the overall CER BREF review process by:
  - focusing on BAT conclusions (and the associated BAT candidates chapter);
  - targeting the most polluting sectors and a limited number of key environmental issues (KEIs) for this BREF review, to be discussed and agreed at the Kick-off Meeting;

[1] Official Journal of the European Union, C 202/02, 30.8.2007.
[2] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control.
[3] Letter Ares(2019)3587668 from Luis Delgado dated 4 June 2019.
[4] Commission Implementing Decision (2012/119/EU) of 10 February 2012 laying down rules concerning guidance on the collection of data and on the drawing up of BAT reference documents and on their quality assurance referred to in the Industrial Emissions Directive 2010/75/EU (IED): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:063:FULL:EN:PDF
[5] Work programme for the exchange of information under Article 13(3)(b) of the IED for 2014, Section 4. Consequences for the working methods of the TWGs.

- collecting sound and reliable data, followed by appropriate data checking and processing.
- Strictly limit the possibilities for time slippages.
- 'Front-load' the exchange of information to achieve the best preparation for the Kick-off Meeting (KoM). The front-loading corresponds to Step 3 'Call for expression of initial positions' in Table 1 below.

The timetable for the next steps of the review of the CER BREF will be discussed at the KoM. The steps completed and the main envisaged milestones and deadlines are summarised in Table 1. A more detailed timeline for the immediate next steps is given in Section 2.4.

Table 1: Milestones for the review of the CER BREF

Step	Milestones	CER BREF review
1	Reactivation of the TWG	30 May 2019
2	Nominations of TWG members	31 July 2019 (deadline)
3	Call for expression of initial positions	26 September 2019 (deadline: 26 November 2019)
4	**Kick-off Meeting (KoM)**	**To be defined**
5	First formal draft of the revised CER BREF (D1)	Q4 2021 (tentative)
6	TWG comments on D1	Q1 2022 (tentative)
7	Final TWG meeting	Q1 2023 (tentative)
8	Final draft of the revised CER BREF delivered to the IED Article 13 Forum	Q4 2023 (tentative)
9	BAT conclusions vote at an IED Article 75 Committee meeting	Q1 2024 (tentative)
10	Publication of the BAT conclusions in the Official Journal of the European Union	Q2 2024 (tentative)
11	Publication of the BREF on the EIPPCB website	Q2 2024 (tentative)

1.4 Call for initial positions

The call for the expression of TWG members' initial positions (IPs) was issued by the EIPPCB on 26 September 2019, with a deadline for responses of 26 November 2019. It took into account the preliminary contributions of the TWG and contained a number of EIPPCB requests for information and proposals on the issues to be covered by the CER BREF, including:

- the scope;
- the BREF structure;
- the KEI candidates;
- the information and data collection;
- the selection of plants for the collection of plant-specific data;
- the techniques to consider in the determination of BAT and emerging techniques.

Seventeen (17) stakeholder groups submitted their initial positions (IPs) by the deadline of 26 November 2019:

- 13 Member States (i.e. AT, BE, CZ, DE, DK, ES, FI, FR, IT, NL, PL, PT, and SE);
- 2 industrial organisations (i.e. C.U., FEPA);
- 1 environmental NGO (EEB);
- the UK submitted also its initial position[6].

All IPs were presented using the 'Document 3' template that was attached to the call for the expression of IPs. Some TWG members also provided additional information.

[6] See Section 1.6.2 on the withdrawal of UK from the EU.

All information related to the TWG initial positions is available in BATIS (>BATIS>Forum>Ceramic Manufacturing Industry>02 First CER BREF review 2019->02 Call for initial positions>02 TWG Initial Positions).

1.5 Objectives of the Kick-off Meeting

A description of the purpose of the KoM is given in Section 4.6.2.2 of the BREF Guidance.

The KoM will decide in particular on the **scope** (see Section 2.1) and the **key environmental issues (KEIs)** (see Section 2.2) based on the stakeholders' input received via the call for initial positions. As agreed at the IED Article 13 Forum meeting of 6 June 2013, the KoM will adopt a focused approach to the overall CER BREF review process and to deriving BAT conclusions. This may be achieved by ensuring that the scope of the CER BREF is manageable and by limiting the number of KEIs.

Furthermore, the KoM will address and reach conclusions on the items listed below:

- the nature and extent of the data collection, including via questionnaire and addressing confidentiality issues – see Section 2.3;
- the general timeline of the work – see Section 1.3 and the specific tasks to be carried out by the TWG, especially indicating which TWG member will deliver specific information – see Section 2.4.

During the KoM, there will be time to discuss the TWG members' initial positions. **The discussions will necessarily be kept general, and discussions will not enter into deep technical debates. For example, positions on techniques and on whether a particular technique is BAT will not be discussed at this stage, because questions of this nature need to be informed by the upcoming data collection exercise**.

1.6 Structure and overview of this Background Paper

1.6.1 General

The aim of this Background Paper (BP) is to assist TWG members in their preparation for the KoM and to create a common basis for the discussion during the meeting.

The TWG initial positions have been analysed and presented in subject groups, or issues, described in Sections 2 and 3. Issues where the initial feedback from the TWG showed differing views and any new issues requiring discussion within the TWG are presented in Section 2. These are the items considered the most important in terms of obtaining clarification before starting the CER BREF review process and the EIPPCB proposes to discuss these at the KoM.

The EIPPCB proposals provided in the call for initial positions upon which the TWG members generally agree are presented in Section 3 together with other issues that do not need to be discussed during the KoM.

Individual issues in this Background Paper are presented as far as possible as follows.

Original EIPPCB proposal and/or request
This cell contains the original EIPPCB proposal and/or request from the call for initial positions issued on 26 September 2019 (when relevant).
Summary of initial positions
This cell contains a summary of the TWG members' initial positions. The full text of the position is usually not provided. For more details on the initial positions (in particular the detailed underlying rationale), please refer to BATIS where the initial positions of all the contributors can be found in full.
EIPPCB assessment
This cell contains the EIPPCB's assessment of the positions and, where relevant, new information and forms the basis for the EIPPCB proposal(s).
EIPPCB proposal
This cell contains the EIPPCB proposal(s) to develop or resolve the issue.

A number of supporting documents are referred to in this BP. These documents can be found in the following BATIS folder: >BATIS >Forum>Ceramic Manufacturing Industry>02 First CER BREF review 2019>02 Call for initial positions>02 TWG Initial Positions>02 TWG members' Initial Positions or in BATIS >Forum>Ceramic Manufacturing Industry>02 First CER BREF review 2019>04 Information collection.

The order of the discussion items in this Background Paper will not necessarily be the order of the discussion at the KoM.

1.6.2 Withdrawal of the UK from the EU

The United Kingdom (UK) formally left the European Union (EU) on 1 February 2020 and became a third country.

The withdrawal agreement[7] establishes the terms of the UK's withdrawal from the EU, including a transition period that began on 1 February 2020 and is due to end on 31 December 2020 at 24:00 CET.

During the transition period after 31 January 2020, the UK is no longer represented in the EU institutions and does not participate in the decision-shaping and decision-making process of the EU. Therefore, UK representatives cannot participate in any TWG meeting.

The UK submitted its initial position at a time when it was still an EU Member State; this Background Paper reflects this in the indication of the amounts of initial positions received. Following the UK's withdrawal from the EU, the EIPPCB assessed only the technical information submitted by the UK and reflected it in this Background Paper by identifying the UK as a third country.

1.6.3 FEPA input

The Federation of European Producers of Abrasives (FEPA[8]) became an IED Art. 13 Forum member during the preparation of this Background Paper. FEPA sent its input to the call for initial positions through C.U., although it is not formally part of C.U. This BP represents FEPA's input individually for the sake of traceability.

[7] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ%3AC%3A2019%3A384I%3AFULL&from=EN

[8] https://www.fepa-abrasives.com/

1.7 Before coming to the meeting

To enable meaningful discussions at the KoM, it is important that TWG members have read this Background Paper in advance of the meeting.

If you believe that issues not proposed for discussion at the KoM (as laid down in Section 3) or issues other than those included in this BP need to be discussed at the KoM, please directly post your request **before 29 May 2020** in the following BATIS folder:

>BATIS>Forum>Ceramic Manufacturing Industry>02 First CER BREF Review 2019>03 Kick-off meeting>03 TWG reactions.

Before coming to the KoM, it is recommended that TWG members read and familiarise themselves with the contents of the following documents and bring them to the meeting:

- The initial positions of TWG members posted in the BATIS forum for the CER BREF (>BATIS >Forum>Ceramic Manufacturing Industry>02 First CER BREF review 2019>02 Call for initial positions>02 TWG Initial Positions>02 TWG members' Initial Positions);

- The BREF Guidance (Commission Implementing Decision 2012/119/EU) http://data.europa.eu/eli/dec_impl/2012/119/2012-03-02;

- The IED (2010/75/EU) http://data.europa.eu/eli/dir/2010/75/2011-01-06.

2 ITEMS FOR DISCUSSION AT THE KICK-OFF MEETING

2.1 Scope of the CER BREF

2.1.1 Ceramic manufacturing process steps

Original EIPPCB proposal

Proposal 2: The EIPPCB proposes:

- to cover in the CER BREF the following process steps:
  - storage and handling of raw materials;
  - preparation of raw materials;
  - mixing of raw materials;
  - shaping/forming of ware;
  - drying of ware;
  - surface treatment and decoration of ware;
  - firing of ware;
  - subsequent treatment (ceramic product finishing);
  - addition of auxiliary materials to the ceramic product;
  - sorting, packaging and storage of ceramic products;
- not to include in the scope of the CER BREF the upstream processing of raw materials, such as calcining and the production of magnesium oxide.

Summary of initial positions

- 6 out of 17 IPs agree with the proposal, 11 partly agree, none disagree.
- The main comments of the IPs which agree or partly agree are as follows:
  - Exclude from the scope of the CER BREF on-site quarrying of raw materials and/or production of virgin materials (FR).
  - Include in the scope of the CER BREF the upstream processing of raw materials as directly associated activities with the aim to update outdated sections/conclusions of the CLM, LVIC and SIC BREFs (EEB). Other BREFs might be relevant to upstream processes (UK).
  - Specify that the preparation of raw materials also includes the reuse of solid process losses generated within the same installation (e.g. process losses before and after drying, broken ware, dust collected by applying bag filters, process losses from mechanical handling and processing of raw materials) (IT).
  - Include spray drying in order to cover independent plants whose principal activity is spray drying in the scope of the CER BREF (ES). Include powder production processes (i.e. drying the slurry after mixing the raw materials) in particular for the production of wall and floor tiles (PL).
  - Clarify that the making of moulds is not covered under the shaping/forming of ware step (SE).
  - Some process steps may not be applicable to some of the sectors (UK). Drying and firing is relevant for all sectors (CZ, FI, PT, C.U.). Additional process steps are relevant only to certain sectors (PT, C.U.). Surface treatment and decoration of ware is not relevant for expanded clay aggregates (CZ, FI) or for inorganic bonded abrasives (FEPA).
  - Clarify whether clamp firing falls under the scope of the CER BREF (BE).

EIPPCB assessment

- The scope of the current CER BREF does not address certain activities such as the quarrying of raw materials or the production of virgin materials as they are not considered to be directly associated with the primary activities. However, it is considered useful to refer to the relevant BREFs where some of these activities are described (e.g. CLM, LVIC, SIC).
- The direct recovery of waste and the reuse of residues is proposed to be covered in the revised CER BREF since it is considered a technique to substitute raw materials (see Section 2.1.2.2).

- Spray drying is considered a process step that is covered under the preparation of raw materials and mainly applied in wall and floor tiles and tableware sectors (see Section 3.1.1). Point 3.5 of Annex I to the IED refers to the manufacture of ceramic products by firing. Therefore, plants producing solely dust pressing powder via spray drying may not be considered in the scope of CER BREF unless these activities are directly associated with the main IED Annex I activity.
- Mould-making may take place on site especially for the slip casting methods applied for the production of sanitaryware or tableware. In addition, Figure 1.1 of the current CER BREF clarifies that the making of moulds is inside the scope of BAT determination.
- Chapter 2 of the current CER BREF provides a general overview of applied processes and techniques. It also contains sector-specific sections (i.e. Sections 2.3.1 to 2.3.9 of the CER BREF) with information (e.g. on materials and techniques used) and schematics clarifying the relevant process steps for the sectors. As it is later proposed to follow the structure of the current BREF with minor adaptations depending on the information and data collected (see Section 3.2), current information on the particularities of the sectors in terms of applied process steps is expected to be maintained and/or updated in the revised CER BREF.
- In the current CER BREF, clamp firing is described as an applied process for the production of traditional stock bricks. However, no example plant is given. It is not clear if the capacity of plants using clamp firing could be above the IED thresholds, as the clamp firing takes several weeks and kilns of different sizes are constructed. The forthcoming data collection should allow clarifying whether any plants using clamp firing operate in the EU above the IED thresholds.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- To cover in the CER BREF the following process steps:
    - storage and handling of raw materials;
    - preparation of raw materials;
    - mixing of raw materials;
    - shaping/forming of ware;
    - drying of ware;
    - surface treatment and decoration of ware;
    - firing of ware;
    - subsequent treatment (ceramic product finishing);
    - addition of auxiliary materials to the ceramic product;
    - sorting, packaging and storage of ceramic products;
- Not to include in the scope of the CER BREF the quarrying of raw materials (e.g. clays), the upstream processing of raw materials (e.g. calcining) and the production of magnesium oxide.
- To include where appropriate cross-references to other BREFs (e.g. CLM, LVIC, SIC).

2.1.2 Interface with other BREFs

2.1.2.1 LCP BREF and MCP Directive

Original EIPPCB proposal
Proposal 5: The EIPPCB proposes to include in the scope of the CER BREF only those on-site combustion plants that either: • generate hot gases for direct contact heating, drying or any other treatment of objects or materials; or • whose radiant and/or conductive heat is transferred to objects or feed material through a solid wall without using an intermediary heat transfer fluid. Request 1: The TWG is asked to provide a list of processes in which either: • hot gases from combustion plants are used for direct contact heating, drying or any other treatment of objects or materials; or • the radiant and/or conductive heat is transferred to objects or feed material through a solid wall without using an intermediary heat transfer fluid.
Summary of initial positions
• 14 out of 17 IPs agree with the proposal, 3 partly agree, none disagree. • The main comments of the IPs which partly agree are as follows: o The MCP Directive and other BREFs set a total rated thermal input threshold of 1 MW for on-site combustion plants. For consistency, a similar threshold should be set in the scope of the CER BREF (FI, FR). o The UK does not currently set ELVs or require monitoring for kilns with a total rated thermal input below 2 MW; the threshold for the MCP Directive is 1 MW. Different thresholds for new and existing plants address the difficulty of retrofitting (UK). • Several IPs (AT, BE, CZ, DE, DK, ES, FI, FR, IT, PL, PT, SE and C.U.) provide information on combustion processes in general indicating that direct contact heating is applied for raw material preparation, spray drying, firing and ware drying steps. One IP (IT) mentions that direct contact heating would be relevant for the packaging of ceramic products. • Indirect heating without using an intermediary heat transfer fluid is mentioned for the following: o Raw material preparation for the manufacturing of technical ceramics (C.U.). o The sector of refractory products (CZ). o Rotary kiln installed in a non-IED plant for the production of plant substrates, which is considered similar to the production of expanded clay aggregates (DE).
EIPPCB assessment
• Emissions from direct contact heating, drying or any other treatment may be affected by the nature of the processed objects or materials (e.g. emissions of fluoride originating from the raw materials). A general threshold for the capacity of the installation is provided for the activities listed in point 3.5 of Annex I to the IED. • The scope of the LCP BAT conclusions excludes combustion plants whose radiant and/or conductive heat is transferred to objects or feed material through a solid wall without using an intermediary heat transfer fluid (i.e. process heaters). However, the MCP Directive covers these process heaters if their total rated thermal input is equal to or greater than 1 MW and less than 50 MW. According to the IPs, a limited number of processes adopt such process heaters.
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include in the scope of the CER BREF on-site combustion plants that generate hot gases for direct contact heating, drying or any other treatment of objects or materials. • To exclude from the scope of the CER BREF on-site combustion plants whose radiant and/or conductive heat is transferred to objects or feed material through a solid wall.

2.1.2.2 WT BREF

Original EIPPCB proposal
Proposal 8: The EIPPCB proposes: • to cover in the CER BREF the direct recovery (i.e. without pretreatment) of waste; • to exclude waste treatment covered by the WT BREF from the scope of the CER BREF.
Summary of initial positions
• 11 out of 17 IPs agree with the proposal, 6 partly agree, none disagree. • The main comments of the IPs which agree or partly agree are as follows: o Since physical or physico-chemical pretreatment for waste recovery may be carried out in ceramic plants, this should be covered in the scope of the CER BREF (AT). o Since several types of waste generated by ceramic production plants could be recovered in the same plants after a pretreatment, this should be covered in the scope of the CER BREF (ES). o There is a need to distinguish between 'waste' (from other activities) and 'solid process losses' (e.g. as internal residues). Therefore, the scope of the CER BREF should cover the direct recovery (i.e. without pretreatment) of waste from other activities, but exclude waste treatment covered by the WT BREF (IT). o Define pretreatment (SE). o References to specific materials (e.g. to scrap clay, and not to waste) for internally recycled streams prevent misunderstanding (UK). o Provide or clarify the definitions of ‘waste’ and of ‘direct recovery’. Production residues or by-products reused/recycled on site (refeed) should not be considered waste (C.U.). The term ‘direct recovery’ does not exist in waste legislation (FEPA). o The use of biomass (as fuel or as pore-forming agent, whether it is considered waste or not) should be covered in the CER BREF (FR).
EIPPCB assessment
• The WT BAT conclusions do not address the direct recovery (i.e. without pretreatment) of waste as a substitute for raw materials in installations carrying out activities covered by other BAT conclusions. • The original EIPPCB proposal not to include in the scope of the CER BREF the waste treatment which is covered by the WT BREF implies for example not collecting data on emissions from this activity, not deriving BAT conclusions to prevent/reduce emissions from this activity and not deriving associated environmental performance levels. However, techniques to prevent and/or to reduce the amount of waste sent for disposal can be addressed and described in the CER BREF to enhance the circular economy performance of the ceramic manufacturing installations. • The current CER BREF mentions the reuse of residues in the production of ceramics and reports a technique on the direct recovery of sludge arising in the manufacture of ceramic products that would be used in wet milling, either without any pretreatment or with simple physical or physico-chemical treatment. Sludge may also be incorporated to the dry body preparation process, but it needs to be dried first. The forthcoming data collection should aim to update this information. • The use of sawdust as pore-forming agent is mentioned in the current CER BREF for the production of bricks. The forthcoming data collection should aim to update this information. • There may be different interpretations between Member States on the definitions of ‘waste’, ‘residues’ and ‘by-products’. General EU law definitions apply and EU law interpretation or implementation issues cannot be addressed in a BREF. However, the forthcoming questionnaire for the plant-specific data collection (see Section 3.4) should include predefined categories of processes for the handling of residues (e.g. recycled/reused on site or off site, sent off site for disposal) to be collected as contextual information (see also Section 2.2.8).

EIPPCB proposal
To clarify the original EIPPCB proposal: • To cover in the CER BREF the direct recovery (i.e. without pretreatment) of waste in ceramic manufacturing installations. • To exclude waste treatment covered by the WT BREF from the scope of the CER BREF. • To address in the CER BREF techniques related to the management of waste.

2.2 Key environmental issues (KEIs) for the CER BREF

2.2.1 Overview

In the call for IPs, the EIPPCB made a number of proposals and requests in order to seek the TWG's opinion about issues which may be considered KEIs or for which data may be collected as contextual information.

The feedback provided by the initial positions and the TWG proposals for candidate KEIs have been assessed by the EIPPCB. This assessment and the subsequent EIPPCB proposals for ceramic manufacturing industries are presented in the following sections:

- Candidate KEIs for emissions to air: Sections 2.2.3 and 3.3.1;
- Candidate KEIs for emissions to water: Sections 2.2.4 and 3.3.2;
- Candidate KEIs for energy consumption: Section 2.2.5;
- Candidate KEIs for water consumption and amount of waste water discharged: Section 2.2.6;
- Candidate KEIs for the consumption of raw materials and chemicals: Section 2.2.7;
- Candidate KEIs for waste generation: Section 2.2.8.

In addition, Section 3.1.2.3 addresses feedback provided with the initial positions and the TWG proposals for candidate KEIs to consider for porcelain/vitreous enamelling of metals.

Important:
In this BP, a KEI is understood as an environmental issue that is considered so important for the sector that information should be collected in the CER BREF review process through plant-specific questionnaires and/or as bulk information. The aim of collecting such information may then differ from one KEI to another. For example, the aim could be to derive BAT-AELs for emissions to air or water, to derive BAT-AEPLs for energy, water or material consumption, or to derive BAT without any associated environmental performance levels. Therefore, the KEI proposals presented in the following sections are accompanied by proposals with respect to the aim of the information collection.

2.2.2 Approach for emissions to air and to water

With a view to a targeted data collection, the so-called focused approach and the front-loading of the information exchange were presented to stakeholders by the Commission at the IED Article 13 Forum meeting in June 2013[9].

At the Forum meeting in 2015[10], the Commission presented the following criteria for defining KEIs at the earliest possible stage of the information exchange for reviewing a BREF:

- **Criterion 1: environmental relevance of pollution** caused by the activity or process, i.e. whether it may cause an environmental problem;
- **Criterion 2: significance of activity** (number of installations, geographical spread, contribution to total (industrial) emissions in the EU);
- **Criterion 3:** potential of the BREF review for identifying **new or additional techniques** that would further significantly reduce pollution;
- **Criterion 4:** potential of the BREF review to set **BAT-AELs** that would significantly improve the level of environmental protection compared to current emission levels.

[9] IED Article 13 Forum meeting of 6 June 2013, https://circabc.europa.eu/w/browse/77c81228-4492-4348-9b3f-299ee5ecca93
[10] IED Article 13 Forum meeting of 19 October 2015, https://circabc.europa.eu/w/browse/33cff69c-bfd0-49e7-8f19-f75a9e062745

Based on the information currently available and on the initial positions received, the EIPPCB has used the four criteria mentioned above to assess candidate KEIs in this Background Paper.

Criterion 1

As explained in the call for initial positions, a number of available sources allowed the assessment of Criterion 1 regarding the environmental relevance of pollutants emitted to air and to water. The EIPPCB carried out a screening of these sources, which resulted in a brief description and a summary of the potential KEIs associated with the processes used in the ceramic manufacturing industry presented in Annex 2 of the call for initial positions. This work resulted in the establishment of a preliminary list of pollutants potentially relevant for the ceramic manufacturing industry. This preliminary list of pollutants was presented in Section 3.3 of the call for initial positions together with details of the information sources.

Based on the information provided with the initial positions, this Background Paper aims at assessing the environmental relevance of the candidate KEIs, i.e. whether they are relevant to the ceramic manufacturing industry and for which process(es), as well as whether these pollutants have intrinsic characteristics which may lead to environmental problems.

Criterion 2

The assessment of Criterion 2 is more difficult as little information is available about the quantities emitted to air and to water. For instance in 2015, only a limited share of the IED ceramic production installations in the EU reported data in the E-PRTR database, possibly because the emissions are below the reporting thresholds, which implies E-PRTR data need to be interpreted carefully. Based on information in the E-PRTR, emissions from CER installations represent a minor share of the total industrial emissions to air of Cd, Hg, Ni, Pb, Zn, CO, NO_X, SO_X, HCFCs, HCN, NMVOC, benzene and NH_3 (around or below 1 %), with the exception of Cr, PM_{10}, HCl, HF and PAH emissions to air, which represent up to 12 % of the total industrial emissions.

Criteria 3 and 4

Among the four criteria to identify KEIs, Criteria 3 and 4 are the ones which are most difficult to assess, as they rely on projections for the future. Nevertheless, some information is available regarding existing/new techniques and current legislation.

In particular, when pollutants are covered by national regulations, they are included in a monitoring plan and there is therefore potential to collect data and then to set BAT-AELs. Those BAT-AELs could have the potential to improve the current state-of-play at European level as the BAT-AELs in the current CER BREF (adopted under the predecessor IPPC Directive) do not have the same legally binding status as BAT-AELs in BAT conclusions adopted under the IED.

In order to prepare the call for initial positions, the EIPCCB screened a number of pieces of national legislation/guidance and permits (from AT, BE, DE, ES, FR, IE, IT, UK and Nordic Council of Ministers which includes DK, FI and SE). This initial screening, together with the information provided with the initial positions, allowed insights into the availability of data.

EIPPCB assessment

The assessment of the four criteria for each of the candidate KEIs is given in the following sections. In the event that parameters proposed as KEIs by the EIPPCB are supported without comments in the IPs, the assessment is not detailed as it was already part of the call for IPs.

Each assessment is followed by a proposal as to whether a parameter, a substance or a group of substances should be considered a KEI for the review of the CER BREF or not. This is then accompanied by proposals with respect to the aim of the information collection for the KEI concerned.

Apart for KEIs, the EIPPCB also proposes to collect data for other parameters for which the aim is not to derive BAT-AE(P)Ls, because this contextual information is needed for a better understanding of the performances of the abatement techniques used in the ceramic manufacturing industry.

2.2.3 Emissions to air

2.2.3.1 EIPPCB proposals

2.2.3.1.1 Benzene

Original EIPPCB proposal
To include benzene as a KEI for firing of ware.
Summary of initial positions

• 5 out of 17 IPs agree with the proposal, 8 disagree, 4 do not provide answers.
• The main comments of the IPs which agree are as follows:
  o Benzene is a KEI for:
  ▪ all production sectors where organic additives are used for the firing process step (e.g. as pore-forming agents) (AT, BE, DE, EEB);
  ▪ the brick sector (FR);
  ▪ for the drying process step: when organic agents are used (DE); when waste gases from kilns are used (FR).
• The main comments of the IPs which disagree are as follows:
  o Benzene is not a relevant parameter; for wall and floor tiles, refractory products and sanitaryware (CZ), for wall and floor tiles, bricks and roof tiles, vitrified clay pipes, expanded clay aggregates, inorganic bonded abrasives (UK).
  o Benzene is not a KEI for the brick and expanded clay sectors (FI).

EIPPCB assessment
• Benzene is classified as a carcinogenic CMR 1A and mutagenic CMR 1B substance. • According to the IPs, benzene emissions are monitored in 4 MS (AT, BE, DE, FR); therefore, some data would be available. The AT BAT study[11] reports benzene emission levels from the production of refractory bricks (< 0.1–0.2 mg/Nm^3 after thermal oxidation) and facing bricks (< 0.1–3.0 mg/Nm^3, no treatment). The national regulation of DE contains a specific ELV for benzene emissions from ceramic manufacturing plants that do not use thermal waste gas treatment techniques. • While no specific EN or ISO standard is available for measuring benzene emissions to air, CEN/TS 13649:2014 describes the determination of the mass concentration of individual gaseous organic compounds, such as benzene. • Benzene emissions to air may occur during the firing step, mainly from additives/auxiliary agents used (e.g. organic pore-forming agents). • In the current CER BREF, benzene emission levels for table- and ornamental ware (i.e. household ceramics), bricks and roof tiles are presented in relation to certain pore-forming agents. • Several techniques are available to prevent and reduce emissions of organic compounds, including benzene, such as thermal and catalytic oxidation.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include benzene as a KEI for firing and drying, and to collect data on benzene emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

[11] State of the art of the Ceramic Manufacturing Industry – Austrian installations (2018), AT UBA report REP-0655 (2018), available in BATIS.

2.2.3.1.2 Boron and its compounds

Original EIPPCB proposal
To include boron and its compounds (expressed as B) as a KEI for surface treatment and firing of ware.
Summary of initial positions

• 4 out of 17 IPs agree with the proposal, 1 partly agrees, 8 disagree, 4 do not provide answers.
• The main comments of the IPs which agree or partly agree are as follows:
  o Boron compounds may be used in enamelling of floor tiles, table- and ornamental ware, sanitary ceramics and refractory products. Boron compounds may be emitted from drying and firing steps (FR).
  o Boron and its compounds are emitted from firing in the wall and floor tiles sector (IT).
  o Boron and its compounds are emitted from the firing step (EEB).
• The main comments of the IPs which disagree are as follows:
  o Boron has not been considered relevant in the following sectors:
  ▪ bricks and expanded clay (FI, BE);
  ▪ refractory products (BE, CZ, UK);
  ▪ roof tiles, vitrified clay pipes (BE);
  ▪ wall and floor tiles, sanitaryware (CZ);
  ▪ wall and floor tiles, bricks and roof tiles, vitrified clay pipes, expanded clay aggregates, inorganic bonded abrasives (UK).

EIPPCB assessment
• Certain boron oxides are classified as reprotoxic CMR 1B substances. • According to the IPs, boron is monitored in IT; limited data would be available. • Boron compounds are still used in the production of tiles, table- and ornamental ware, sanitaryware and abrasives, although there are efforts to phase out their use. Boron compounds are used in certain lead-free glazes. • The current CER BREF reports boron levels in raw gas from firing in the production of tiles (< 0.5 mg/Nm^3). • Boron emissions to air may result from the use of boron compounds as fluxing agents and in the glazing step and may be controlled through techniques to abate dust.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include boron as a KEI for drying and firing, and to collect data on boron emissions to air through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for boron emissions to air.

2.2.3.1.3 Formaldehyde

Original EIPPCB proposal
To include formaldehyde as a KEI for firing of ware.
Summary of initial positions

• 6 out of 17 IPs agree with the proposal, 7 disagree, 4 do not provide answers.
• The main comments of the IPs which agree are as follows:
  ○ Formaldehyde is emitted from firing (AT, BE, DE, EEB, FR, IT) and drying (BE, DE, FR).
  ○ Emissions of formaldehyde from firing are relevant if pore-forming agents are used (AT), e.g. sawdust in roof tiles and bricks production (DE).
  ○ Emissions from finishing should be explored via data collection (AT).
  ○ Emissions are relevant for processes using organic products and/or biomass (FR).
  ○ Formaldehyde is emitted in the wall and floor tiles sector (IT).
• The main comments of the IPs which disagree are as follows:
  ○ Formaldehyde emissions are not relevant for wall and floor tiles, refractory products, sanitaryware (CZ) or for bricks and expanded clay (FI).

EIPPCB assessment
• Formaldehyde is classified as a carcinogenic CMR 1B substance. • According to the IPs, formaldehyde is monitored in 5 MS (AT, BE, DE, FR, IT); therefore, sufficient data would be available. The AT BAT study reports formaldehyde emission values from the firing of different ceramic products up to 20 mg/Nm^3 for cases where no waste gas treatment is applied and values < 2 mg/Nm^3 when thermal oxidation techniques are used. The C.U. study[12] reports formaldehyde emission values for ceramic tiles (2–4 mg/Nm^3) and, in addition, that formaldehyde emissions occur in several other sectors. • While no EN or ISO standard is available[13], national/industry standards for the measurement of formaldehyde emissions to air are available[14]. • Formaldehyde emissions to air may result mainly from firing and drying from additives/auxiliary agents used (e.g. organic pore-forming agents, such as sawdust). Emission levels from special process steps (e.g. formation of carbon bonding, pitch impregnation) for refractory products are also reported. • The current CER BREF reports formaldehyde levels in the raw exhaust gas from firing of refractory products, bricks and roof tiles, also in relation to the use of certain binding or pore-forming agents, with values up to 100 mg/Nm^3. • Several techniques are available to prevent and reduce emissions of organic compounds, including formaldehyde, such as thermal and catalytic oxidation. • In BAT conclusions for other sectors (e.g. GLS, LCP, LVOC, WBP), BAT-AELs have been set for formaldehyde emissions to air in the range of < 2–20 mg/Nm^3.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include formaldehyde as a KEI for firing, drying and for special processes for refractory products and to collect data on formaldehyde emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for formaldehyde emissions to air.

[12] Cerame-Unie and Ramboll study on 'Key Environmental Issues for the European Ceramics Industry (2019)'.

[13] Work is ongoing to produce an EN standard through the working group CEN/TC 264/WG 40 https://standards.cen.eu/dyn/www/f?p=CENWEB:7:0:::FSP_ORG_ID:2004747&cs=16E84973BC9D2676F1F629DCDBF67764F

[14] ROM, p. 53 and 127.

2.2.3.1.4 Lead and its compounds

Original EIPPCB proposal
To include lead and its compounds (expressed as Pb) as a KEI for surface treatment and firing of ware.
Summary of initial positions
• 5 out of 17 IPs agree with the proposal, 2 partly agree, 6 disagree, 4 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o When lead-based additives are used, Pb is emitted from firing (AT, DE, EEB) of wall and floor tiles (IT) and from finishing (i.e. engobing, glazing, printing or decorating) (AT). o Pb may be a KEI for table- and ornamental ware ceramics with lead enamels (FR). o Pb is a KEI only when wastes are used as a fuel in firing; otherwise, emissions of lead are not relevant in the brick production and in the expanded clay production (FI). o Pb is a KEI when hot gases from the firing furnace are used for drying (FR). o Pb is KEI to relevant process steps (UK). • The main comments of the IPs which disagree are as follows: o Pb is not relevant for: ▪ any sector (PL, PT, C.U., FEPA); ▪ for bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay (BE); ▪ wall and floor tiles, refractory products, sanitaryware (CZ). o Intentional use of lead in glaze is being phased out (C.U.).
EIPPCB assessment
• Lead compounds are generally classified as reprotoxic CMR 1A substances. • According to the IPs, lead is monitored in 5 MS (AT, DE, FI, FR, IT); therefore, sufficient data would be available. • The EN 14385:2004 standard is available to measure lead emissions to air. • Lead emissions to air may occur from firing mainly depending on the type of glaze, but also on the fuel used (e.g. coal, heavy fuel oil, petroleum coke, waste)[15]. • The current CER BREF mentions lead among the elements possibly used in glaze. The current CER BREF also indicates lead-free glaze techniques as emerging. VDI 2585:2018[16] mentions the use of lead oxides in technical ceramics to achieve the intended product properties. • The AT BAT study reports lead emission values of < 0.05 mg/Nm^3 from the firing of refractory bricks, after abatement with a fabric filter. The C.U. study indicates that lead could be potentially emitted from several sectors. • Techniques are available to prevent and reduce lead emissions to air, such as substitution techniques and techniques to abate dust.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include lead as a KEI for firing, drying and surface treatment and to collect data through plant-specific questionnaires on lead emissions to air, where lead-bearing additives or fuels such as coal, pet coke, heavy fuel oil and waste are used. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for lead emissions to air.

[15] CER BREF, LCP BREF

[16] VDI 2585 'Emission control in ceramic industry' (2018), available in BATIS.

2.2.3.1.5 PAHs

Original EIPPCB proposal
To include PAHs as a KEI for firing and drying of ware, finishing of ceramic product.
Summary of initial positions
• 3 out of 17 IPs agree with the proposal, 2 partly agree, 7 disagree, 5 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o PAHs are a KEI for printing and decorating, drying and firing; the data collection will clarify if PAH is emitted from finishing (AT). o PAH are a KEI in inorganic bonded abrasives production (AT). o PAHs are a KEI where organic binders or pore-forming agents are used. They are generally well controlled via thermal oxidation (DE). o PAHs are KEI when using: organic products and biomass (FR), waste as fuel (UK). o Drying is to be considered when hot gases from the firing furnace are used (FR). • The main comments of the IPs which disagree are as follows: o PAH emission to air may occur when paper-binding substances are used (C.U.). o PAHs are not a relevant parameter for: wall and floor tiles, refractory products and sanitaryware (CZ), bricks and expanded clay aggregates (FI), ceramic tiles (IT), inorganic bonded abrasives (FEPA).
EIPPCB assessment
• PAHs are toxic substances regulated as persistent organic pollutants under Regulation (EU) 2019/1021. • According to the IPs, PAHs are monitored in 3 MS (AT, DE, FR); therefore, some data would be available. • The AT BAT study reports PAH emission values of < 0.01 mg/Nm^3 (mainly naphthalene) from the firing of inorganic bonded abrasives, after abatement with thermal oxidation. The C.U. study indicates that no emissions of PAHs occur in the various sectors. • While no EN standards are available, the ISO 11338-1:2003 and ISO 11338-2:2003 standards for the measurement of PAHs in emissions to air are available. • PAH emissions may occur unintentionally during the firing step mainly from the organic additives/auxiliary agents used (e.g. paper-binding or pore-forming agents). • The current CER BREF reports PAH emissions for special finishing processes in the refractory products sector when certain organic binding agents are used. • Several techniques are available to prevent and reduce emissions of organic compounds, including PAHs, for example thermal and catalytic oxidation. • See also the assessment of naphthalene in Section 2.2.3.2.2. • If PAHs were considered a KEI, the questionnaire should be designed in a way that allows comparable data to be obtained. This would include specifying the PAHs for which emissions should be reported (e.g. for each of the 16 US EPA PAHs individually or for the sum of them).
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include PAHs (e.g. 16 US EPA PAHs) as a KEI for drying and firing and to collect data on PAH emissions to air through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for PAH emissions to air. • The TWG to decide during the questionnaire development for which PAHs emission data should be collected (e.g. for each of the 16 US EPA PAHs individually or for the sum of them).

2.2.3.1.6 PCDD/Fs

Original EIPPCB proposal
To include PCDD/Fs as a KEI for firing and drying of ware.
Summary of initial positions

• 5 out of 17 IPs agree with the proposal, 4 partly agree, 5 disagree, 3 do not provide answers.
• The main comments of the IPs which agree or partly agree are as follows:
  o PCDD/Fs are a KEI:
  ▪ for firing in expanded clay production (C.U., DK);
  ▪ where organic binders or pore-forming agents are used; they are generally well controlled via thermal oxidation (DE);
  ▪ for bricks (EEB);
  ▪ when wastes are used as a fuel (UK) in firing in the production of bricks and expanded clay aggregates (FI);
  ▪ when using organic products and biomass (FR).
  o Drying is to be considered when hot gases from the firing furnace are used (FR).
• The main comments of the IPs which disagree are as follows:
  o PCDD/Fs are not a relevant parameter for: wall and floor tiles, refractory products and sanitaryware (CZ), inorganic bonded abrasives (FEPA).

EIPPCB assessment
• PCDD/Fs are very toxic substances regulated as persistent organic pollutants under Regulation (EU) 2019/1021. • According to the IPs, PCDD/Fs are monitored in 4 MS (BE, DE, FI, FR); therefore, some data would be available. • The C.U. study indicates that some European plants monitor PCDD/F emissions, e.g. when waste is co-incinerated in ceramic kilns. • The EN 1948-1:2006, EN 1948-2:2006 and EN 1948-3:2006 standards for the measurement of PCDD/F emissions to air are available. • PCDD/F emissions may be formed unintentionally during the firing step mainly if organochlorine compounds are present during firing, for example when waste is used as a fuel (e.g. waste oils) or if chlorinated substances are introduced, e.g. through additives. VDI 2585:2018 indicates that most measured emission levels are significantly below 0.1 ng I-TEQ/m^3. • The current CER BREF indicates that expanded clay production plants may emit PCDD/Fs. • Several techniques are available to prevent and reduce PCDD/Fs, for example thermal oxidation.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include PCDD/Fs as a KEI for drying and firing and to collect data on PCDD/F emissions to air through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for PCDD/F emissions to air.

2.2.3.1.7 Phenols

Original EIPPCB proposal
To include phenols as a KEI for firing of ware.
Summary of initial positions

• 5 out of 17 IPs agree with the proposal, 2 partly agree, 6 disagree, 4 do not provide answers.
• The main comments of the IPs which agree or partly agree are as follows:
  o Phenols are a KEI when pore-forming agents are used in firing of clay blocks (AT).
  o Phenols are a KEI for all sectors (BE, DE, EEB) when using organic products and biomass (FR).
  o Phenols are potentially relevant to process steps other than firing: drying (DE), drying when hot gases from the firing furnace are used (FR), finishing (AT).
  o Phenols are possibly a KEI for sectors other than: wall and floor tiles, bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay aggregates and inorganic bonded abrasives (UK).
• The main comments of the IPs which disagree:
  o Phenols are not a KEI for: wall and floor tiles, refractory products and sanitaryware (CZ), bricks and expanded clay production (FI), inorganic bonded abrasives (FEPA), ceramic tiles (IT).
  o Phenols emissions could arise only from the use of resins, e.g. in the refractory or inorganic bonded abrasives production or when organic additives are used in firing (C.U.).

EIPPCB assessment
• Phenol is classified as a mutagenic CMR 2 substance, whereas some phenolic compounds are classified as CMR substances. • According to the IPs, phenols emissions are monitored in AT; therefore, limited data would be available. • While no EN or ISO standard is available, national/industry standards for the measurement of phenol emissions to air are available. • The AT BAT study provides phenols emission values from the firing of different ceramic products in the range of < 0.01 to 0.4 mg/Nm^3, after abatement with thermal oxidation. • Phenols emissions to air may occur during the firing step mainly from additives/auxiliary agents used (e.g. organic pore-forming agents, such as sawdust). • The current CER BREF reports phenols emission levels from firing bricks and roof tiles, in relation to the use of certain pore-forming agents. Values in the raw exhaust gas are up to 20 mg/Nm^3 and emission levels up to 6 mg/Nm^3 after treatment. In addition, the current CER BREF reports emission levels for special processes for refractory products. • Several techniques are available to prevent and reduce emissions of organic compounds, including phenols, such as adsorption with activated carbon, thermal and catalytic oxidation. • BAT-AELs for phenols emissions to air in the range of < 2–10 mg/Nm^3 have been set in the GLS BAT conclusions.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include phenols as a KEI for firing and for special processes for refractory products and to collect data on phenols emissions to air through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for phenols emissions to air. • The TWG to decide during the questionnaire development for which phenols emission data should be collected.

2.2.3.2 Additional proposals

A number of other additional parameters are proposed as candidate KEIs in the IPs received. The detailed proposals are presented in the following sections.

2.2.3.2.1 Acetaldehyde

Summary of initial positions
• 2 IPs propose the inclusion of acetaldehyde as a KEI. More specifically: o Acetaldehyde is used in pore-forming agents for the manufacturing of bricks and clay blocks. It may be released during the firing step. Oxidation or the choice of pore-forming agents are possible BATs for the reduction of acetaldehyde emissions to air (AT). o Acetaldehyde was identified as a relevant issue in the AT BAT study and the current CER BREF (EEB).
EIPPCB assessment
• Acetaldehyde is classified as a carcinogenic CMR 2 substance. • The current CER BREF includes measurement results of acetaldehyde emissions to air for two brick plants using different pore-forming agents (i.e. < 1 mg/Nm^3 for the plant using sawdust and < 0.1 mg/Nm^3 for the plant using paper and polystyrene). As highlighted by the IPs, acetaldehyde emissions to air may occur during the firing step depending on the pore-forming agents used. • One MS (AT) seems to monitor acetaldehyde emissions to air; therefore, limited data would be available. Permits of a few Italian wall and floor tiles plants include ELVs for aldehydes, as a sum parameter. • There is no EN standard available for the monitoring of acetaldehyde. • Although aldehyde emissions could be considered to be covered by the parameter TVOC, formaldehyde was proposed as a KEI in the call for IPs as an indicator parameter for aldehyde emissions, since it was reported by many plants in the current CER BREF (see Sections 2.2.3.1.3 and 3.3.1.1.6). More data may be available as some MS' national legislation (e.g. AT, DE) includes acetaldehyde. However, the majority of the brick production plants that participated in the AT BAT study reported almost the same or even higher levels of acetaldehyde emissions to air in comparison with formaldehyde emissions.
EIPPCB proposal
• To include acetaldehyde as a KEI and to collect data on acetaldehyde emissions to air for firing through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for acetaldehyde emissions to air.

2.2.3.2.2 Naphthalene

Summary of initial positions
• 2 IPs propose the inclusion of naphthalene as a KEI. More specifically: o Naphthalene is used as a binding agent for the manufacturing of inorganic bonded abrasives. It evaporates during the drying and firing steps. It may not be covered under the parameter PAH, if PAH emission values are only based on benzo[*a*]pyrene measurements. Oxidation is used for its abatement (AT, EEB).
EIPPCB assessment
• The current CER BREF mentions the use of naphthalene as a pore-forming agent in the manufacturing of inorganic bonded abrasives. Emissions of naphthalene to air were also reported by one plant (out of two) that participated in the AT BAT study, for which measurement results were 7.03 µg/Nm^3 for PAHs (as the sum of the 16 US EPA PAHs) and 6.38 µg/m^3 for naphthalene. • The ECHA substance evaluation report on naphthalene[17] states that during its use in the abrasive industry, the abatement is mainly carried out via thermal oxidation. • PAH emissions are proposed for inclusion as a KEI in the CER BREF review (see Section 2.2.3.1.5).
EIPPCB proposal
• See Section 2.2.3.1.5.

2.2.3.2.3 Styrene

Summary of initial positions
• 2 IPs propose the inclusion of styrene as a KEI. More specifically: o Styrene is used in pore-forming agent for the manufacturing of bricks and clay blocks and may be formed during the firing step. Oxidation is used for its abatement (AT). o The AT BAT study reports styrene emissions for processes where styrene compounds are used as pore-forming agents (EEB).
EIPPCB assessment
• Styrene is classified as a reprotoxic 2 substance. • Polystyrene was mentioned as a pore-forming agent used in the production of bricks in the current CER BREF, where many plants reported the measurement of styrene emissions to air in the range of 0.03 mg/Nm^3 to 2 mg/Nm^3 after treatment. • The majority of the brick-producing plants that participated in the AT BAT study reported styrene emissions to air. • Styrene emissions to air seem to be monitored only in one MS (AT); limited data would be available.
EIPPCB proposal
• To include styrene as a KEI for drying and firing and to collect data on styrene emissions to air through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for styrene emissions to air.

[17] Substance Evaluation Conclusion as required by REACH Article 48 and Evaluation Report for Naphthalene (EC No: 202-049-5 / CAS No: 91-20-3), UK, 2018.

2.2.3.2.4 Other metals/metalloids

Summary of initial positions

- 4 IPs propose the inclusion of other metals and metalloids as KEIs. More specifically:
  - Sb, Cr(VI), Cr, Co, Mn, Ni, Sn, V and their compounds are emitted in sectors producing glazed, engobed, printed or decorated products. Emissions of these metals and metalloids to air occur in the form of particles from surface treatment, firing and finishing steps. In particular, chromium can be used as raw material in the production of refractory products (i.e. magchrom bricks) (AT).
  - Hg emissions may be generated during the firing step due to the raw materials used. A BAT study prepared by EEB regarding emissions to air from the ceramics industry in Germany showed that Hg contents in clay can potentially lead to noticeable Hg levels in the flue-gas of kilns (i.e. in the range of 0.03–0.05 mg/m^3). Regarding the Minamata Convention, the monitoring of Hg emissions needs to be discussed at the KoM (DE).
  - Hg and other metals may be emitted during the firing step of expanded clay aggregates production. These emissions may be related to the use of auxiliary components (e.g. co-incineration of waste, use of waste as raw material - e.g. waste water sludge) (DK).
  - Co, Cr, Cu, Mn, Ni, V and Zn are emitted from ceramic manufacturing plants. In particular, Mn compounds are used as colouring agent in the production of bricks and roof tiles. These metals are considered as a group in the permits (FR).
  - As, Cd, Cr, Co, Cu, Hg, Mn, Ni, Pb, Sb, Se, Sn, Tl, Te, V and Zn are KEIs when biomass is used. These metals are considered as a group in the permits (FR).
  - Cd, Cr, Co, Ni and their compounds for several sectors. Hg is emitted in the production of bricks and Mo is emitted in the production of expanded clay aggregates. In general, these metals and metalloids are emitted from the firing step as mentioned in the BAT study prepared by the EEB regarding emissions to air from the ceramics industry in Germany (EEB).

EIPPCB assessment

- Metal/metalloid emissions to air may have significant environmental impacts. Nickel oxides are generally classified as carcinogenic CMR 1A substances and cadmium oxide is classified as a carcinogenic CMR 1B substance. Mercury is a very toxic substance addressed under Regulation (EU) 2017/852.
- Information in the IPs (AT, DE and FR) indicates that metal emissions from surface treatment, firing and finishing steps are monitored. Metal emissions to air are also addressed in permits of ceramic installations in IT, PT and FR. Some data would be available.
- The current CER BREF mentions the presence of a variety of metals in dust emissions which mainly arise from glazing and glaze preparation steps for the production of wall and floor tiles, tableware and sanitaryware. From spray drying and firing steps of the wall and floor tiles production (without abatement), boron and lead emissions were reported in the range of < 0.3 mg/m^3 to < 0.5 mg/m^3 and < 0.15 mg/m^3, respectively. For the decoration firing of household ceramics (without abatement), metal emissions to air were reported as follows: Pb (0.002 mg/m^3 to 2.75 mg/m^3), Cd (0.03 mg/m^3 to 0.07 mg/m^3), Co (0.054 mg/m^3 to 0.26 mg/m^3) and Ni (0.06 mg/m^3 to 0.4 mg/m^3). Finally, a sanitaryware plant reported emissions to air of Co, Ni, Cr, Mn, V, Sn and Sb from the first firing tunnel kiln coupled with a lime-packed bed absorber system, where measurement results for all parameters were < 0.1 mg/m^3.
- The AT BAT study reported metal emission levels for the production of refractory bricks (< 0.2 mg/Nm^3 for Pb, Cr and Cr(VI)) and sanitaryware (< 0.1 mg/Nm^3 for Cr, Co, Mn, Ni, Sb, Sn and V).
- The E-PRTR reports Cd, Cr, Hg, Ni, Pb and Zn emissions to air from a number of ceramic manufacturing plants mostly representing a very small share (around or below 1 %) of the total industrial emissions. For Cr, however, a total amount of 800 t/y was reported for 4

Portuguese plants in 2015 corresponding to a share of 1.32 %. In terms of total emissions of certain metals/metalloids, the ceramic sector reports levels that are either lower or comparable to the ones for the glass and the cement and lime sectors. The revised GLS and CLM BREFs set BAT-AELs for metal emissions from melting furnaces or kilns (mostly as a sum of several metals).

EIPPCB proposal

- To include metals/metalloids as a KEI for surface treatment and firing and to collect data on emissions to air of As, Cd, Cr, Cr(VI), Co, Cu, Hg, Mn, Ni, Sb, Se, Sn, Tl, Te, V and Zn through plant-specific questionnaires.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for metals/metalloids or groups of metals and, if so, for which ones.

2.2.3.2.5 Carbon dioxide and other parameters

Summary of initial positions

- The following parameters are each proposed to be included as a KEI by only one IP:
  - **Fibre dust:** Mineral fibres are used as raw material for the manufacturing of refractory products. Therefore, fibre dust emissions to air may result during moulding and finishing steps. Absolute filters are used for its abatement (AT).
  - **Additional carcinogenic substances:** Bromoethane, 1,3-butadiene, 1,2-dichloroethane, 1,2-propyleneoxide (1,2-epoxypropane), styroloxide (styrene oxide), *o*-toluidine, trichloroethene and vinyl chloride are KEIs for the firing and debinding steps. However, these are not relevant for plants with external afterburning for which ELVs are only set for TOC and benzene (DE).
  - **Ammonia (NH_3):** Ammonia may be emitted during the firing step of expanded clay aggregates production due to the use of auxiliary components (e.g. co-incineration of waste, use of waste as raw material - e.g. waste water sludge) (DK).
  - **Isocyanates:** Isocyanates may be emitted from wall and floor tiles (IT).
  - **Carbon dioxide (CO_2):** Carbon dioxide is a KEI for the drying and firing steps as mentioned in the additional information provided by EEB on decarbonisation and greenhouse gas emissions. CO_2 emissions to air were also referred to in the current CER BREF (i.e. Section 3.1.1.2.3 and Tables 3.5, 3.15, 3.25, 3.26, 3.27 and 3.54). A load-based approach (i.e. g/kg) is considered appropriate to express the BAT-AELs (EEB).

EIPPCB assessment

- **Fibre dust:** Fibre dust emissions were reported by one refractory plant (out of 5) which participated in the AT BAT study, referring to a national standard as monitoring method. Fibre dust emissions are considered to be covered by the parameter dust. It is not clear if data for fibre dust emissions are available throughout the EU.
- **Additional carcinogenic substances:** It is not clear from the IP for which sectors the proposed parameters are relevant. In general, emissions of these substances are covered by the parameter TVOC (see Section 3.3.1.1.6). It is not clear if data for emissions of these individual parameters are available throughout the EU.
- **Ammonia:** The current CER BREF includes measurement results for ammonia emissions to air from the production of refractory products as decomposition products of special binding agents used (e.g. resins). Ammonia emissions were identified as a possible KEI for the firing step of sanitaryware products in the Ricardo study[18] based on information contained in the BAT study prepared by EEB which includes an installation with an ELV

[18] Available in BATIS at: BATIS > Forum > Ceramic Manufacturing Industry > 02 First CER BREF review 2019- > 04 Information collection > EIPPCB

of 30 mg/Nm^3 (at 17 % O_2). There is also one inorganic abrasives plant from DK that reported data on ammonia emissions to air under the E-PRTR (11.7 t in 2017). VDI 2585:2018 also mentions ammonia emissions to air from the production of catalysts (in technical ceramics). However, it is not clear whether the above-mentioned situations are relevant for the majority of the plants operating in those sectors or for a few specific plants only. It is also not clear from the IPs if data for ammonia emissions to air are available.

- **Isocyanates:** Research has been carried out on the chemical functionalisation of ceramic tile surfaces by their modification with an isocyanate-trialkoxysilane coupling agent in order to enhance the interfacial adhesion with an EVA-polymer-modified mortar[19]. Therefore, the use of isocyanates for the surface treatment of tiles may be relevant, although it is not clear whether it is applied by the majority of the plants or used only for specific applications. It is also not clear from the IPs if data for isocyanate emissions to air are available as it was reported by only one IP.
- **Carbon dioxide (CO_2):** Section 3.1.1.2.3 of the current CER BREF reports that CO_2 is emitted to air due to the combustion of fossil fuels and due to the organic matter and carbonates in the ceramic body. However, the reported CO_2 emission levels from the firing step are given as wide ranges and thus instead represent indicators of the combustion conditions. In general, greenhouse gas emissions are already addressed in the Emissions Trading System Directive (2003/87/EC) which includes special provisions for certain ceramic sectors. The constraints imposed by IED Article 9(1) mean that, in practice, the setting of BAT-AELs for any emissions covered by the EU ETS is of little value, because there is no obligation to use those BAT-AELs in permits. However, there could be merits in deriving BAT to reduce CO_2 emissions. These techniques could include techniques to increase energy efficiency (see Section 2.2.5), but also techniques that reduce CO_2 emissions originating from the materials used. The comparison of energy efficiency and other decarbonisation techniques may be corroborated through data on CO2 emissions collected as contextual information, e.g. obtained from fuel and material consumptions.

EIPPCB proposal

- Not to include fibre dust as a KEI for emissions to air and not to collect data on fibre dust emissions to air through plant-specific questionnaires.
- Not to include bromoethane, 1,3-butadiene, 1,2-dichloroethane, 1,2-propyleneoxide (1,2-epoxypropane), styroloxide (styrene oxide), o-toluidine, trichloroethene, vinylchloride as KEIs for emissions to air and not to collect data on emissions of these substances to air through plant-specific questionnaires.
- Not to include ammonia as a KEI for emissions to air and not to collect data on ammonia emissions to air through plant-specific questionnaires.
- Not to include isocyanates as a KEI for emissions to air and not to collect data on isocyanate emissions to air through plant-specific questionnaires.
- Not to include carbon dioxide as a KEI for emissions to air. To collect information on techniques related to the reduction of CO2 emissions from ceramic manufacturing plants and to collect data on carbon dioxide emissions to air as contextual information through plant-specific questionnaires.

[19] Mansur et.al. (2010). Porcelain tile surface modification with isocyanate coupling agent: interactions between EVA modified mortar and silane improving adherence. Surface and Interface Analysis, 43, 738–743.

2.2.4 Emissions to water

2.2.4.1 EIPPCB proposals

2.2.4.1.1 Adsorbable organically bound halogens (AOX)

Original EIPPCB proposal
To include AOX as a KEI.
Summary of initial positions

• 4 out of 17 IPs agree with the proposal, 1 partly agrees, 7 disagree and 5 do not provide answers.
• The main comments of the IPs which agree or partly agree are as follows:
  o AOX is a KEI for the production of stove tiles (AT).
  o AOX is a KEI for the production of technical ceramics, household ceramics and sanitaryware (DE).
  o AOX is possibly a KEI for sectors other than: wall and floor tiles, bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay aggregates and inorganic bonded abrasives (UK).
• The main comments of the IPs which disagree are as follows:
  o AOX is not relevant for the following sectors: wall and floor tiles, refractory products and sanitaryware (CZ).
  o Due to the nature of the processes, waste water from the production of technical ceramics does not contain this pollutant (PL).
  o AOX is a KEI for technical ceramics (but technical ceramics should not be kept in the scope of the review process as there is only one technical ceramics plant which fulfils the IED criterion) (C.U.).

EIPPCB assessment
• According to the IPs, AOX are monitored in two MS (AT and DE); limited data would be available. The AT BAT study reports AOX emission levels of < 0.05 mg/l for the production of refractory bricks and stove tiles. AOX emission limit values were also set in the national regulations of DE and IT. • There is an EN standard available for the monitoring of AOX emissions to water (i.e. EN ISO 9562:2004). • The current CER BREF contains a BAT-AEL for AOX emissions to water of 0.1 mg/l. The reported emission levels for table- and ornamental ware (household ceramics) and technical ceramics are quite low (< 0.001 mg/l and < 0.1 mg/l, respectively). • AOX emissions to water may originate from the raw materials used (e.g. formed through the reaction of chlorine with organic substances). Therefore, AOX may be a relevant parameter for waste water released from cleaning and surface treatment applications. • The information provided by the IPs on relevant sectors is quite divergent. The forthcoming data collection should allow the clarification of the situation. • Several techniques (e.g. adsorption, stripping) are available for the treatment of AOX emissions to water. Urban WWTPs are usually not designed and equipped appropriately to abate halogenated organic compounds.
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include AOX as a KEI both for direct and indirect discharges and to collect data on AOX emissions to water through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for AOX emissions to water.

2.2.4.1.2 Naphthalene

Original EIPPCB proposal
To include naphthalene as a KEI.
Summary of initial positions
• 2 out of 17 IPs agree with the proposal, 1 partly agrees, 7 disagree and 7 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o Naphthalene is a KEI for the inorganic bonded abrasives sector (AT). o Naphthalene is possibly a KEI for sectors other than: wall and floor tiles, bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay aggregates and inorganic bonded abrasives (UK). • The main comments of the IPs which disagree are as follows: o Naphthalene is not relevant for the following sectors: wall and floor tiles, refractory products and sanitaryware (CZ). o Due to the nature of the processes, waste water from the production of technical ceramics does not contain this pollutant (PL). o According to the current CER BREF, naphthalene is used in binders within the refractory products sector. It is furthermore applied in the inorganic bonded abrasives sector (C.U.).
EIPPCB assessment
• According to the IPs, naphthalene is monitored only in one MS (AT); limited data would be available. • The current CER BREF contains no information on emission levels. However, the use of naphthalene as a pore-forming agent was reported for the manufacturing of inorganic bonded abrasives (grinding wheels). It was also mentioned that only small amounts of waste water are generated from cleaning activities in the inorganic bonded abrasives sector. • The ECHA substance evaluation report on naphthalene[20] states that naphthalene is mainly used in the abrasive industry during processes such as mixing/sieving and pressing/moulding where the cleaning of the equipment/moulds may be carried out by dry hand brushing or by compressed air. Final processing of the abrasive products includes the use of grinding and polishing machines. Sometimes, water is used as a dust suppressant, but dry processing also occurs. The ECHA report also includes information on possible substitutes for naphthalene such as; 1,4-dichlorobenzene (considered carcinogenic), bubbled alumina and glass spheres, butyl carbamate, plastics and plant-derived pore formers such as crushed nuts and nutshells, wood chippings, rice and olive stones. • The AT BAT study reports naphthalene emissions only for inorganic bonded abrasives, mainly for cleaning water from the mixing plant. According to the measurement results, naphthalene seems to be the main constituent of the PAHs in waste water, potentially due to its high solubility compared to that of other PAHs (other compounds were found in concentrations < 0.002 mg/l while the naphthalene concentration was 4.5 mg/l). • The INERIS study[21] reports mean concentration levels for naphthalene of 0.04 µg/l which is below the maximum allowable concentration of the Environmental Quality Standards (MAC-EQS) (130 µg/l). • The current BREF reports on the use of naphthalene as a binder or aggregate in the production of refractory products. However, no recent information is available to assess whether it is still used or not. • The removal of PAHs may require a pretreatment step (e.g. chemical oxidation) before waste water is sent to a downstream (urban) WWTP as urban WWTPs are usually not

[20] Substance Evaluation Conclusion as required by REACH Article 48 and Evaluation Report for Naphthalene (EC No: 202-049-5 / CAS No: 91-20-3), UK, 2018.

[21] Ineris: Les substances dangereuses pour le milieu aquatique dans les rejets Industriels, 2019, available in BATIS

designed and equipped appropriately to abate PAHs. However, this may not apply to naphthalene, as its inherent biodegradability (e.g. measured with the Zahn-Wellens test according to EN ISO 9888:1999) is 100 %[22]. Therefore, naphthalene emissions may be considered to be covered by the parameters TOC/COD (see Section 3.3.2.2.1).
EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To exclude naphthalene as a KEI and not to collect data on naphthalene emissions to water through plant-specific questionnaires.

2.2.4.1.3 Boron and its compounds

Original EIPPCB proposal
To include B as a KEI.
Summary of initial positions
• 4 out of 17 IPs agree with the proposal, 1 partly agrees, 7 disagree and 5 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o Boron is a KEI for the following sectors: bricks and roof tiles, wall and floor tiles and refractory products (ES), technical ceramics, household ceramics and sanitaryware (DE). o Boron is possibly a KEI for sectors other than: wall and floor tiles, bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay aggregates and inorganic bonded abrasives (UK). • The main comments of the IPs which disagree are as follows: o Boron is not relevant for the following sectors: wall and floor tiles, refractory products and sanitaryware (CZ). o Boron was considered relevant in former environmental permits. However, the technological development of enamel formulations has effectively eliminated the use of boron compounds (C.U.).
EIPPCB assessment
• According to the IPs, boron is monitored in two MS (DE and ES); limited data would be available. • The current CER BREF reports emission levels for the production of wall and floor tiles in the range of 1–60 mg/l and for tableware of 2 mg/l. Boron emissions to water were also mentioned in the Nordic BAT study[23], the ES Guidance note[24] and the Ricardo study. • Boron emissions to water may originate from glazing units since boron compounds are mainly used as fluxing agent in frits. • The current CER BREF mentions that ion exchange and reverse osmosis could be relevant for boron removal from waste water. Recent studies[25,26] also investigate the efficiency of boron removal when using techniques such as nanofiltration and bioadsorbents. • Urban WWTPs are usually not designed and equipped appropriately to abate boron compounds.

[22] Source: ECHA brief profile, https://echa.europa.eu/brief-profile/-/briefprofile/100.001.863
[23] Nordic Ceramics Industry – Best Available Technique (BAT), Nordic Council of Ministers, 2019.
[24] Guía de mejores técnicas disponibles para el sector de fabricación de baldosas cerámicas en la comunitat Valenciana, 2009.
[25] Moliner-Salvador et.al (2012). Use of nanofiltration membrane technology for ceramic industry wastewater treatment. Boletín de la Sociedad Española de Cerámica y Vidrio.
[26] BIOMETAL DEMO Project - Biometal demonstration plant for the biological rehabilitation of metal bearing-waste waters (treating waste water originating from ceramic sector using the biosorption processes), 2013-2017.

EIPPCB proposal
To modify the original EIPPCB proposal as follows: • To include boron as a KEI for both direct and indirect discharges and to collect data on boron emissions to water through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for boron emissions to water.

2.2.4.1.4 Metals

Original EIPPCB proposal
To include Cd, Co, Cr, Cu, Ni, Pb and Zn as KEIs.
Summary of initial positions
• 4 out of 17 IPs agree with the proposal considering Cd and Co as KEIs, 2 partly agree, 6 disagree and 5 do not provide answers. • 5 out of 17 IPs agree with the proposal considering Cr and Zn as KEIs, 1 partly agrees, 6 disagree and 5 do not provide answers. • 6 out of 17 IPs agree with the proposal considering Cu, Ni and Pb as KEIs, 1 partly agrees, 6 disagree and 4 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o Co, Cr, Cu, Ni, Pb and Zn are emitted in the production of stove tiles, sanitaryware, table- and ornamental ware, refractory products and inorganic bonded abrasives. Cd is only considered relevant for the following sectors: sanitaryware, table- and ornamental ware and refractory products (AT). o Metals are emitted in the production of technical ceramics, household ceramics and sanitaryware (DE). o Metals are emitted in glazing (NL). o Metals except Pb and Zn are not relevant for the following sectors: wall and floor tiles, bricks and roof tiles, refractory products, vitrified clay pipes, expanded clay aggregates and inorganic bonded abrasives. Pb and Zn are KEIs for the production of whiteware (UK). o Some metals (e.g. Cu, Pb and Ni) in the waste water from the production of expanded clay aggregates may be subject to monitoring depending on the materials stored (DK). • The main comments of the IPs which disagree are as follows: o Metals are not relevant for the following sectors: wall and floor tiles, refractory products and sanitaryware (CZ). o Pb is a KEI for technical ceramics. However, this sector should be outside the scope of the review process as there is only one technical ceramics plant which fulfils the IED criterion (C.U.). o Waste water discharge is very limited for the production of wall and floor tiles. The presence of metals in the waste water is due to the elements that may be present in the materials of substrates and enamels. Metal emissions are usually monitored through the TSS parameter. Since sanitaryware products are primarily glazed white, metal and metalloid compounds used for coloured glazes do not occur in this sector. In addition, the use of lead compounds in ceramic sectors has been largely minimised or eliminated (C.U.).
EIPPCB assessment
• According to the IPs, metals are monitored in three MS (AT, DE and PL); therefore, some data would be available. • The current CER BREF contains BAT-AELs for Pb (0.3 mg/l), Zn (2 mg/l) and Cd (0.07 mg/l) emissions to water. Various metal emission levels were reported, mainly for wall and floor tiles, sanitaryware, table- and ornamental ware (household ceramics) and technical ceramics.

- Metal emissions to water mainly originate from the raw materials used (mainly glaze) and may thus be relevant for waste water from glazing and other decoration units. Ceramic pigment systems used for the decoration of tableware were summarised in Table 3.36 of the current CER BREF indicating the presence of various metal and metalloid compounds in the pigments (i.e. Cr, Co, Al, Zn, Zr, V, Pb, Sb, Fe, Mn, Cu, Sn, Ce, Ti). The AT BAT study reports emission levels for metals from the production of table- and ornamental ware (i.e. Pb, Cd, Cr, Co, Cu, Ni, Zn) and from the production of sanitaryware (i.e. Ba, Pb, Cd, Cr, Co, Cu, Ni, Zn).
- Metal emissions to water from the production of refractory products and inorganic bonded abrasives were reported in the AT BAT study. In general, metal-containing raw materials are used in both of the sectors as mentioned in the current CER BREF (see Sections 2.3.3.1 and 2.3.9.1). Metal emissions to water may be relevant when wet surface treatment methods are applied (e.g. wet grinding).
- All of the metal parameters proposed within the call for IPs except Co were reported under the E-PRTR (mainly for one installation, only Pb was reported for two installations in 2015).
- Within the INERIS study, measured parameters were Zn, Cu, Ni, Pb, As, Cd and Hg. The mean Pb concentration level (13.6 μg/l) was very close to the MAC-EQS (< 14 μg/l).
- The current CER BREF reports several emission levels for Ni from the production of sanitaryware and technical ceramics of < 0.01 mg/l and < 0.1 mg/l, respectively. Ni is a priority substance under the Water Framework Directive. Emission levels were reported by 18 plants in the INERIS study, with a mean concentration of 16.4 μg/l which is below the MAC-EQS of 34 μg/l.
- ELVs for Cd, Co, Cr, Cu, Ni, Pb and Zn are included in the AT and DE national regulations. The ES and UK guidance documents report Pb, Zn and Cr emissions to water. In addition, the current CER BREF reports Ni, Cr, Cu and Co emissions to water from several sectors (e.g. table- and ornamental ware, sanitaryware, technical ceramics). Metals are monitored as a sum or as groups in some MS (e.g. IT).
- Precipitation and filtration as well as ion exchange may be among the relevant techniques for the treatment of metal emissions to water.
- Urban WWTPs are usually not designed and equipped appropriately to abate metals.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:

- To include Cd, Co, Cr, Cu, Ni, Pb and Zn as KEIs for both direct and indirect discharges and to collect data on Cd, Co, Cr, Cu, Ni, Pb and Zn emissions to water through plant-specific questionnaires.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for Cd, Co, Cr, Cu, Ni, Pb and Zn emissions to water.

2.2.4.2 Additional proposals

2.2.4.2.1 Total hydrocarbons / hydrocarbon oil index (HOI)

Summary of initial positions

• 2 out of 17 IPs propose to include hydrocarbons as a KEI. More specifically:
  o Total hydrocarbons is a KEI for run-off water from the storage areas (FR).
  o HOI is a KEI for run-off water when hydrocarbon-fuels are used on the site (EEB).

EIPPCB assessment
• ELVs for the group parameter of hydrocarbons are included in the AT national legislation. In addition, the IE and UK guidance documents provide indicative levels when implementing BAT for CER installation permits. Limited data would be available. • The AT BAT study reports hydrocarbon emission levels in the range of < 0.1 mg/l to 5 mg/l for refractory products, tableware and stove tiles and of < 15 mg/l for inorganic bonded abrasives. • The current CER BREF includes information on the use of waxes, mineral oils etc. as binding agents during the shaping/pressing of ware. Therefore, the HOI could be a relevant parameter for waste water streams originating from the cleaning of these systems and from storage areas, i.e. run-off water. • EN ISO 9377-2:2000 can be used for the measurement of the HOI. • Urban WWTPs are usually not designed and equipped appropriately to abate hydrocarbons.
EIPPCB proposal
• To include HOI as a KEI for both direct and indirect discharges and to collect data on HOI for emissions to water through plant-specific questionnaires. • The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs should be derived for HOI in relation to emissions to water.

2.2.5 Consumption of energy

Original EIPPCB proposal
Proposal 11: The EIPPCB proposes to include specific energy consumption as a KEI for firing kilns, spray dryers and ware dryers. Request 8: TWG members are asked to provide information regarding the most common type of fuels used and a description of the techniques used to increase the energy efficiency of kilns and dryers.
Summary of initial positions

• Specific energy consumption of spray dryers: 9 out of 17 IPs agree with the proposal, 1 partly agrees, 4 disagree and 3 does not provide answers.
• Specific energy consumption of ware dryers: 10 out of 17 IPs agree with the proposal, 3 partly agree and 4 disagree.
• Specific energy consumption of firing kilns: 11 out of 17 IPs agree with the proposal, 3 partly agree and 3 disagree.
• The main comments of the IPs which agree or partly agree are as follows:
  o The specific energy consumption depends on several factors which need to be taken into account for the elaboration of the questionnaire, e.g.:
  ▪ type of product, product geometry/size, kiln type, firing temperature, size of product lots or delivery period requirements (AT);
  ▪ process used, the quality of the raw materials, the characteristics and quality of the products (FR);
  ▪ water content of the clays, production techniques, fuel used (SE).

- Data may not be available at process level (FR).
- There may not be a sufficient number of comparable installations for the energy consumption of spray dryers (UK).
- Information on applied techniques to increase energy efficiency should be collected (DE, IT). Heat recovery from the cooling zone of the kilns is one technique (IT). A comprehensive list of techniques to reduce energy consumption is already included in the AT BAT study (AT).
- The specific energy consumption of kilns may be a relevant parameter for the expanded clay aggregates sector (C.U.).
- Energy efficiency is a relevant parameter, but it is already regulated by the Energy Efficiency Directive, the EU ETS and the ENE BREF. Based on the requirements of local legislation in Denmark, plants conduct yearly energy audits and a benchmark report is prepared. Energy consumption figures are anonymised, since the collected data are considered confidential in terms of economic competition (DK).
- All sectors of the ceramics industry are energy-intensive. It is therefore of utmost importance to develop sound BAT conclusions on energy efficiency. Energy consumption should be minimised due to the limited sources (EEB).
- The specific energy consumption depends on the firing temperature of the products (DE).

- The main comments of the IPs which disagree are as follows:
  - The Energy Efficiency Directive, the EU ETS and the ENE BREF already cover energy efficiency (PT, C.U.).
  - The specific energy consumption of dryers and kilns operated in the inorganic bonded abrasives sector depends on several factors such as: product/product mix, drying/firing curve determined based on the product category. Therefore, it is not possible to compare the specific energy consumption of different products/companies (FEPA).
  - Data on specific energy consumption are considered confidential (CZ).

An additional KEI candidate is proposed as follows:

One IP suggests that the choice of energy generation type and fuel should be considered a KEI for firing and drying as well as any other energy-intensive process, since various energy carriers used for heat generation (firing/drying) and types of process kilns/dryers have a direct impact on air emissions including greenhouse gases (EEB).

EIPPCB assessment

- The manufacturing of ceramic products is energy-intensive and a recent report[27] prepared for those industries indicated that several technological options might be relevant for the ceramic industry (e.g. improvement of efficiency, vacuum drying, electrification of heat demand, hydrogen use for energy generation, carbon capture and utilisation, use of biomass). Some of these options focus on energy efficiency while others focus on the reduction of CO_2 emissions to air (see also Section 2.2.3.2.5).
- The current CER BREF includes several BAT candidates and general conclusions focusing on energy efficiency (Sections 4.1.1 to 4.1.5 and 5.1.2). In addition, specific energy consumption figures have been reported for all of the sectors either for specific process steps or for the entire plant.
- There are several parameters that may affect the derivation of BAT-AEPLs for the specific energy consumption such as: methodologies used for monitoring and calculation, boundaries defined, process conditions (e.g. type of kiln/dryer, firing regime), raw material characteristics and product specifications. In the event that specific energy consumption is considered a KEI, these parameters need to be clearly defined during the questionnaire development process.

[27] Industrial value chain: A bridge towards a carbon neutral Europe, Europe's Energy Intensive Industries contribution to the EU Strategy for long-term EU greenhouse gas emissions reductions, Institute for European Studies, 2018.

- The derivation of BAT-AEPLs for specific energy consumption may be hampered by the confidentiality of the data (see Section 2.3.2) and the difficulty in clearly defining the system boundaries. However, these issues have been overcome in recent BREF reviews.
- The ENE BREF is a 'horizontal' BREF addressing energy efficiency techniques used in all sectors and it does not include a specific section dealing with consumption. The ENE BREF does not include BAT-AEPLs for individual sectors.
- Several BAT-AEPLs for energy consumption or energy efficiency have been derived in BREFs including for activities targeted by other relevant legislation on energy efficiency or greenhouse gases (e.g. LCP BREF, CLM BREF). This is not considered as a contradiction or redundancy but as a complement.
- Some IPs indicated that data on energy consumption might be available, especially for kilns and dryers (see Section 3.4.4.1). However, it may be useful to also collect data on the specific energy consumption for the whole plant, in particular for those plants that are not in a position to provide data for specific process steps.
- The additional KEI candidates that were proposed by one IP are rather considered techniques to consider in the determination of BAT or contextual information to assist the assessment of the specific energy consumption levels.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:

- To include specific energy consumption as a KEI for firing kilns, spray dryers and ware dryers and to collect data through plant-specific questionnaires with the aim to derive BAT-AEPLs.
- To include the specific energy consumption of the plant as a KEI and to collect data through plant-specific questionnaires with the aim to derive BAT-AEPLs.
- The TWG to identify the contextual information (e.g. applied techniques, type of processes, fuels and raw materials used, product specifications, methods used for monitoring and calculation, plant configuration and boundaries defined, level of aggregation of consumption data) needed to understand and compare the data collected through plant-specific questionnaires.

2.2.6 Consumption of water and amount of waste water discharged

Original EIPPCB proposal

Proposal 13: The EIPPCB proposes to include specific water consumption and water recycling rate as KEIs and to collect data on waste water discharge as contextual information.

Request 9: TWG members are asked to provide information regarding the techniques used to decrease water and raw materials consumption.

Summary of initial positions

- Specific water consumption: 10 out of 17 IPs agree with the proposal, 3 partly agree, 3 disagree and 1 does not provide answers.
- Water recycling rate: 9 out of 17 IPs agree with the proposal, 5 partly agree, 2 disagree and 1 does not provide answers.
- Specific waste water discharge: 11 out of 17 IPs agree with the proposal, 3 partly agree, 2 disagree and 1 does not provide answers.
- The main comments of the IPs which agree or partly agree are as follows:
    - Many of the plants recycle their process water (DK, FR). The waste water may be reused without prior treatment (IT). The reuse of waste water may be restricted by product specifications (SE). One Danish plant cleans the run-off water (DK).
    - Information should be collected on applied techniques and achieved levels for the reduction of water consumption. Water consumption may depend on the characteristics of the raw materials used (e.g. moisture content) (IT).
    - The quantity of waste water generated from these activities is generally not relevant (IT).

- Water consumption should be reduced due to the limited resources. BAT-AEPLs should be derived since water scarcity may be an issue for some regions (EEB).
- Water is consumed in small amounts; water consumption is not a KEI (DE).
- The specific water consumption is not a KEI for the sectors of the CER BREF with the exception of expanded clay aggregates for which all three parameters proposed are relevant (C.U.).
- The water recycling rate and the waste water discharge are not relevant for the production of bricks and expanded clay aggregates (FI).
- The water recycling rate and the waste water discharge are KEIs for the sectors of wall and floor tiles, sanitaryware, technical ceramics and tableware since up to 50 % of the process water is reused in those sectors (PT, C.U.).
- The water recycling rate and the waste water discharge are considered performance indicators instead of KEIs for the sectors of bricks and roof tiles, refractory products and vitrified clay pipes (C.U.).
- The specific waste water discharge is the most suitable parameter considering rainwater harvesting and reuse as relevant techniques (UK). It may be appropriate to collect information on the recovery of rainwater (IT).
- The quantity of recycled water is not often measured. It is more difficult to measure untreated borehole water and harvested rainwater in comparison to water from mains (UK).

- The main comments of the IPs which disagree are as follows:
  - Data on the specific water consumption and the water recycling rate are considered confidential (CZ).
  - For the inorganic bonded abrasives sector, water consumption is limited to cleaning and grinding processes (FEPA).
  - The quantity of discharged waste water is not significant (ES). Only a very small amount of water is used and discharged from the production of inorganic bonded abrasives (FEPA).

EIPPCB assessment

- The current CER BREF reports the use of water, in particular for the preparatory process steps (see also the assessment in Section 3.3.2.1 on the most important sources of water consumption and/or emissions to water). There may be no waste water discharge from certain sectors since the used water evaporates during the process or process waste water is entirely reused. However, based on the variations among the IPs, several factors might be limiting the reuse of process waste water (e.g. waste water characteristics, amount of waste water generated). The possible restrictions related to the reuse of waste water should be clarified during the forthcoming information collection.
- The current CER BREF includes several BAT candidates and general conclusions focusing on recycling and reuse of water (Sections 4.4.1 to 4.4.4), process optimisation for the reduction of water consumption (Section 4.4.5.1) and waste water treatment techniques (Section 4.4.5.2). Process waste water recycling rates were also defined for wall and floor tiles, sanitaryware and tableware.
- Although the current CER BREF does not contain specific performance levels on water consumption, it includes example mass flow charts for several sectors providing basic information on water consumption levels, which seem to be higher for the sanitaryware and tableware sectors in comparison to the other sectors.
- Although the manufacture of ceramic products does use water, it does not rank among the industrial sectors having the highest water use[28].
- The collection and use of rainwater and the recycling of wastewater after treatment may be among the applied techniques for the reduction of fresh water consumption, as mentioned for example in the permits of brick production plants and as also highlighted in several IPs.
- There are several parameters that may affect the derivation of BAT-AEPLs for specific water consumption such as: methodologies used for monitoring and calculation, boundaries

[28] "Summary on IED contribution to water policy", Report ED 632935 for DG Environment, RICARDO, 2018, https://circabc.europa.eu/webdav/CircaBC/env/ied/Library/studies/

defined (e.g. whether specific streams are included or not), process steps followed (e.g. whether wet or dry processes are used) and product specifications. In the event that specific water consumption is considered a KEI, these parameters need to be clearly defined during the questionnaire development process.
- The determination of the water recycling rate and of several other parameters defined on site and on a case-by-case basis may differ based on the boundaries.
- BAT-AEPLs (or indicative levels) for specific water consumption or waste water discharge have been derived in some BREFs (e.g. FDM, LVOC, STS, TAN) but not for the water recycling rate.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:
- To include specific water consumption and waste water discharge as KEIs and to collect data through plant-specific questionnaires.
- The TWG to identify the contextual information (e.g. applied techniques, type of processes and raw materials used, product specifications, methods used for monitoring and calculation, plant configuration and boundaries defined, level of aggregation of consumption data) needed to understand and compare the data collected through plant-specific questionnaires.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AEPLs on specific water consumption and/or waste water discharge should be derived.
- To collect data on the water recycling rate as contextual information through plant-specific questionnaires.

2.2.7 Consumption of raw materials and chemicals

Original EIPPCB request

Proposal 14: The EIPPCB proposes to include specific raw materials consumption and the replacement of raw materials with waste or residues as KEIs.

Request 9: TWG members are asked to provide information regarding the techniques used to decrease water and raw materials consumption.

Request 10: TWG members are asked to provide their view regarding whether the specific quantity of chemicals (e.g. additives, binders and surface treatment materials) and in particular CMR substances consumed should be considered a KEI for the review of the CER BREF.

Summary of initial positions

- Specific consumption of raw materials: 9 out of 17 IPs agree with the proposal, 1 partly agrees, 6 disagree and 1 does not provide answers.
- Replacement of raw materials with waste/residues: 10 out of 17 IPs agree with the proposal, 2 partly agree and 5 disagree.
- Specific quantity of chemicals (additives, binders and surface treatment materials) and in particular CMR substances consumed: 4 out of 17 IPs agree with the inclusion of specific quantity of chemicals and in particular CMR substances consumed as a KEI, 3 partly agree, 7 disagree and 3 do not provide answers.
- The main comments of the IPs which agree or partly agree are as follows:

Comments on raw materials:
  - The consumption of certain raw materials may depend on the specifications of the products (IT). The composition of inorganic bonded abrasives mostly depends on the subsequent application conditions, including also safety aspects (FEPA).
  - The specific consumption of raw materials and the replacement of raw materials with waste/residues are considered KEIs only for the production of expanded clay aggregates (C.U.).
  - The recovery of broken material for raw material savings needs to be further

explored by the TWG (i.e. by checking maximum accepted input rates for broken materials). Material consumption should be minimised due to the limited sources (EEB).
    - The replacement of raw materials with waste/residues may also influence energy consumption and emissions (BE).
    - A variety of waste fractions to replace raw materials is used in the production of expanded clay aggregates (DK).
    - The feasibility to replace raw materials with external or internal waste/residues may depend on the type of manufacturing process and the product specifications (IT) or on the availability of waste/residues near the plant (SE).
    - The TWG should agree on harmonised permitting conditions if waste is used for recovery (EEB).

Comments on chemicals:

- KEIs should focus on all substances on the candidate list of substances of very high concern (SVHC) for authorisation under REACH and other additional CMR substances (DE).
- Manganese compounds are used as additives to colour bricks. Barium compounds are used in the manufacturing of bricks in order to prevent/mitigate salt extraction from brickwork (DK).
- Information on hazardous substances should be collected (ES).
- The use of hazardous substances is a candidate KEI in the Ricardo study for surface treatment and decoration, and possibly for component mixing (EEB).
- Information on substitution techniques for CMR substances should be collected (AT).

- The main comments of the IPs which disagree are as follows:

Comments on raw materials:

- All of the parameters proposed for the consumption of raw materials are considered confidential business information (CZ).
- The specific consumption of raw materials and the replacement of raw materials with waste/residues are considered techniques to monitor resource efficiency rather than KEIs (PT, C.U.).
- The raw material consumption depends on the products; there may be a very high number of different products. Data may be collected as contextual information, but not as a KEI (C.U.).
- These activities cannot replace their raw material input with external waste (e.g. waste from the building sector) (FR).
- The distinction between waste/by-product and secondary product/internal recycle stream within the sector is important (UK).

Comments on chemicals:

- All of the parameters proposed for the consumption of chemicals are considered confidential business information (CZ).
- The consumption of chemicals is not considered a major issue for this sector in comparison to other industrial sectors (FR).
- The consumption of chemicals is highly dependent on the raw material and product specifications and information collected would not be comparable (PT, C.U.).
- Information on techniques to minimise the consumption of chemicals without quantitative data would be useful information (UK).

- Several IPs provided information on the techniques used to decrease raw materials consumption:
    - Design of bricks with holes for the reduction of clay input (SE).
    - Use of paper fibres (which also reduces SO_X and HF emissions to air) (BE).
    - Waste quality management (DE).
    - Use of tile waste material in the production of bricks and roof tiles (DK).
    - Use of waste as raw material, such as glass filter dust and bauxite tailings (EEB).
    - Use of internal residues in the raw material preparation, such as solid process losses before and after drying (IT).

Additional KEI candidates are proposed as follows:

- One IP considers the specific consumption of packaging materials as a KEI and provides information on applied techniques such as deposit return schemes for packaging materials and reusable packaging materials (e.g. pallets) (AT).
- Another IP suggests the use of chemicals with hazardous properties and their substitution as a KEI and proposes to address 'chemicals of concern' in general, where these are identified as relevant in the inventory (EEB).

EIPPCB assessment

- A variety of natural and synthetic raw materials is used in the ceramic manufacturing industry. While clay minerals are used as the main raw material input, the quality of clay may differ among sectors due to e.g. the diversity of the product specifications, local conditions and applied processes. Therefore, it is not clear if a comparable and representative dataset could be built with data from the forthcoming data collection.
- The current CER BREF also reports the use of pore-forming agents (e.g. polystyrene, sawdust, paper, brown coal, perlite), additives and binders (e.g. coal tar pitch, naphthalene, synthetic resins, acrylates, polyvinyl alcohol) as well as surface treatment/decoration agents (e.g. metal oxides, frits). On the other hand, it does not contain specific performance levels for material consumption. Instead, it includes only information on the main types of raw materials used in individual sectors and example mass flow charts providing basic information on material consumption levels.
- There are several parameters that may affect the derivation of BAT-AEPLs for the specific consumption of raw materials and chemicals such as: definition of boundaries, applied processes, raw material characteristics and product specifications. In the event that the specific consumption of raw materials and chemicals are considered KEIs, these parameters need to be clearly defined during the questionnaire development process.
- The current CER BREF already mentions the substitution of virgin raw materials with waste and/or residues and within the call for IPs (see Section 2.2.8). A recent DE UBA study[29] on the circular economy potential and BAT in the ceramic sector includes several techniques to reduce the consumption of raw materials and increase the recycling of waste/residues in the different ceramic sectors as well as the recycling of ceramic waste in other industry sectors. The report highlights that the availability of secondary raw materials in sufficient quantities and quality for long-term periods represents the main problem for their widespread utilisation.
- The BAT Reference Document for the Management of Waste from Extractive Industries[30] mentions certain extractive waste as secondary raw materials for production of ceramics and bricks.
- Setting BAT-AEPLs on chemical consumption would be highly dependent on the availability of comparable and representative data differentiated across a number of parameters such as different product specifications, processes, types of processes and machinery.
- The large number of potential chemicals used in combination with the variety of processes, techniques, raw materials and product specifications makes it very unlikely that meaningful BAT-AEPLs could be derived.
- Other drivers to reduce the consumption of (hazardous) chemicals exist (e.g. REACH). Adopting a focused approach for the CER BREF review suggests focusing on emissions and on a limited amount of specific materials and substances.
- In line with the focused approach for BREFs, it would seem reasonable to address the most important raw materials/inputs (i.e. both in terms of quantities and environmental relevance). Moreover, bulk information on techniques to reduce the consumption of those

[29] Innovative Techniken: Festlegung von besten verfügbaren Techniken (BVT) in Europa für die Bereiche der Keramik-, Zement-, Nahrungsmittel- und in der chemischen Industrie, Teilvorhaben 1: Keramikindustrie, Umweltbundesamt, 78/2018.

[30] https://susproc.jrc.ec.europa.eu/activities/MWEI/documents/jrc109657_mwei_bref_-_for_pubsy_online.pdf

raw materials/inputs may be collected.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:

- To include raw material consumption as a KEI and to collect information on techniques to increase the substitution of raw materials with waste and/or residues and to reduce the raw material consumption with the aim to derive BAT without any associated environmental performance levels.
- To include the specific quantity of hazardous chemicals consumed for a manageable list of hazardous chemicals.
- The TWG to define this manageable list of hazardous chemicals during the questionnaire development phase.
- To collect data on the specific consumption of these hazardous chemicals through plant-specific questionnaires.
- To collect information on potential substitution techniques to prevent or reduce the use of hazardous chemicals (in particular CMR substances and SVHCs).
- The TWG to identify during the questionnaire development phase the contextual information (e.g. applied techniques, type of processes used, product specifications, plant configuration and definition of boundaries, level of aggregation of consumption data) needed to understand and compare the data collected through plant-specific questionnaires.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AEPLs on the specific quantity of hazardous chemicals consumed should be derived.

2.2.8 Waste generated

Original EIPPCB request

Proposal 15: The EIPPCB proposes to include generation of waste as a KEI and to collect data on the generation and recycling of sludge, used/broken ware/materials and flue-gas cleaning waste.

Summary of initial positions

- Generation of sludge: 11 out of 17 IPs agree with the proposal, 2 partly agree, 2 disagree and 2 do not provide answers.
- Generation of used/broken ware/materials: 14 out of 17 IPs agree with the proposal, 1 partly agrees, 1 disagrees and 1 does not provide answers.
- Generation of flue-gas cleaning waste: 11 out of 17 IPs agree with the proposal, 1 partly agrees, 3 disagree and 2 do not provide answers.
- Recycling of generated waste: 12 out of 17 IPs agree with the proposal, 1 partly agrees, 3 disagree and 1 does not provide answers.
- The main comments of the IPs which agree or partly agree are as follows:
    - Differentiate between hazardous and non-hazardous waste (AT).
    - The generation of sludge is not relevant for the production of bricks, roof tiles and expanded clay aggregates (FI).
    - Recycling, reuse and valorisation are always considered KEIs (ES).
    - Sludge, solid process losses and dusts generated in abatement systems are generally reused internally or sent to third parties as ‘by-product’ (IT).
    - The distinction between waste/by-product and secondary product/internal recycle stream within the sector is important (UK).
    - Most of the sectors reuse materials in the manufacturing process. However, the recycling of waste is generally considered a technique to reduce waste disposal rather than a KEI (C.U.).
    - The generation of flue-gas cleaning waste is a cross-media effect of the abatement systems (UK, C.U.).
    - The generation of waste is considered a KEI in the Ricardo study for the preparation of raw materials, component mixing, shaping and forming of ware,

surface treatment and decoration, firing, subsequent treatment (product finishing), sorting, packaging and storage as well as supply and disposal facilities (off-gas treatment and process waste water). The current CER BREF describes BAT to reduce solid process losses/solid waste for several sectors (EEB).
    - The 'recycling of waste from other activities' is considered a more appropriate KEI in the context of the Circular Economy principles (IT). Only internally generated waste should be covered, therefore the KEI should be 'recycling of generated residues' (FR).
- The main comments of the IPs which disagree are as follows:
    - Sludge is a mixed waste that cannot be reused in production (CZ).
    - All waste generated within plants producing bricks and roof tiles is recycled (DK).
    - None of the proposed parameters for waste generation and recycling are relevant for the production of inorganic bonded abrasives, where only small amounts of flue-gas cleaning waste (mainly dust) arise (FEPA).
    - The reduction of flue-gas cleaning waste is only achievable by either setting less stringent ELVs on hydrogen fluoride and other pollutants originating from clay, which should not be the aim, or by using clay containing lower amounts of fluorine. The second option also may not be feasible since clay is mainly obtained from nearby sources (due to cost/transport relations) (SE).
- One IP that does not provide an answer indicated that sludge is not used, that filter dust is reused in the production and that $Ca(OH)_2$ is handled as waste and sent to the landfill (DK).

Additional KEI candidates are proposed as follows:

- One IP proposes the making of moulds from forming as a KEI and the inclusion of the following parameters in the data collection: number of times the moulds are reused; recycling (%) or disposal (kg of mould material/t of product) of moulds which are not used any more (AT).
- Another IP suggests the generation of packaging waste as a KEI and proposes to identify BAT candidates such as deposit return schemes for packaging materials and reusable packaging materials. Moreover, the waste hierarchy for the sector should be concretised (EEB).
- The same IP proposes to include the prevention of waste/residues and recycling as a KEI to prioritise the prevention of waste as BAT (EEB).

EIPPCB assessment

- The current CER BREF reports the generation of process losses/wastes for all sectors except manufacturing of expanded clay aggregates (for which only gypsum from flue-gas cleaning units was mentioned and which is recycled in the cement industry). The main types of solid residues specific to ceramic manufacturing installations are as follows:
    - different kinds of sludge arising from certain process steps such as cleaning of units for body preparation, glaze preparation and application, and wet grinding;
    - broken ware from different process steps;
    - used/broken plaster moulds and refractory materials;
    - dust and sorption agents from flue-gas cleaning;
    - packaging waste.
- The current CER BREF describes BAT candidates that reduce the amount of solid process losses/solid wastes, mainly by reusing/recycling of solid residues internally or externally and also by improving operating conditions (e.g. electronic control of firing cycles). The forthcoming data/information collection should aim at collecting information on applied techniques to clarify their relation to the amount of waste generated.
- Both generic and sector-specific BAT conclusions are included in the current CER BREF, focusing mainly on the following sectors: refractory products, wall and floor tiles, table- and ornamental ware, sanitaryware and technical ceramics. Some sectors may not generate any waste; the forthcoming data/information collection should allow the clarification of the situation. The current CER BREF also contains a BAT-AEPL on the reuse of waste water treatment sludge in the ceramic body preparation process, in particular for the manufacturing of wall and floor tiles (expressed as the weight ratio of dry sludge added to the ceramic body).

- There are several parameters that may affect the derivation of BAT-AEPLs for the specific waste generation and recycling of waste such as: boundaries defined, process steps followed and product specifications. These will need to be defined and taken into consideration during the questionnaire development process.
- There may be different interpretations between Member States on the definitions of waste, residues and by-products. General EU law definitions apply and EU law interpretation or implementation issues cannot be addressed in a BREF. However, it may be useful to collect contextual information on the type of the waste (e.g. EU waste code, hazard status, final destination) by including predefined categories of processes for the handling of residues (e.g. recycled/reused on site or off site, sent off site for disposal).
- According to some IPs, waste generated due to the use of certain abatement techniques is considered a cross-media effect of the technique concerned. There may be merit in collecting related data/information with the aim to define the specificities of those installations. A similar approach was followed in the STS BREF, where the data collection indicated higher levels of waste generated in plants using a specific technique to reduce emissions to air (i.e. dry scrubbing with limestone), while sending the spent limestone to a lime or cement kiln was considered BAT.
- Some IPs propose the waste from the making of mould as well as the prevention of waste/residues and recycling as KEIs. These issues are already addressed in the current EIPPCB proposal, which includes the generation of used materials and the recycling of generated waste as KEIs.
- Sludge, used/broken ware/materials and flue-gas cleaning waste are the main waste streams specific to the ceramic manufacturing industry; certain techniques are available to prevent or reduce their generation.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- To include the following waste streams as KEIs and to collect data through plant-specific questionnaires:
    - the specific amount of sludge generated and sent to disposal and/or internal/external recovery;
    - the specific amount of used/broken ware/materials generated and sent to disposal and/or internal/external recovery;
    - the specific amount of flue-gas cleaning waste generated and sent to disposal and/or internal/external recovery.
- The TWG, during the questionnaire development phase, to identify the contextual information (e.g. applied techniques, type of processes, raw materials, product specifications, classification and final destination of waste, plant configuration and boundaries defined, level of aggregation of consumption data) needed to understand and compare the data collected.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether and how BAT-AEPLs on specific waste generation and recycling of waste should be derived.

2.3 Information and data collection

2.3.1 Environmental performance levels

2.3.1.1 Expression of BAT-AELs for emissions to air and water

In order to evaluate the environmental performance of techniques (or combinations of techniques), plant-specific data on emissions and/or on the efficiency of emission abatement techniques are needed and will be collected during the BREF review. As per the BREF Guidance, the collected data will be used to derive 'environmental performance levels associated with BAT' (i.e. the so-called BAT-AEPLs, which include BAT-AELs), where there is a sound basis for doing so (see Section 3.3. of the BREF Guidance).

The current CER BREF usually expresses BAT-associated emission levels as daily average values. Concentration values for emissions to air are based on standard conditions of 273 K, 101.3 kPa and dry gas. The reference oxygen value for gaseous substances or mixtures of substances was 18 vol-%, with the exception of benzene for which the reference oxygen value was 15 vol-%. Emissions to water are given as 2-hour composite sample values.

The choice of the units (e.g. mg/Nm^3, mg/l, g/t) to be used in the BAT conclusions for expressing BAT-AE(P)Ls in the revised CER BREF has a strong implication for the data collection. The TWG should agree at an early stage of the BREF review process on the units to be used so that the data collection can effectively be done to provide the necessary data for the assessment of the techniques to consider in the determination of BAT (i.e. 'BAT candidates') and for the appropriate derivation of BAT conclusions including the relevant BAT-AEPLs (including BAT-AELs).

Original EIPPCB proposal
Proposal 16: The EIPPCB proposes: • to generally express BAT-AEPLs for channelled emissions to air and to water in concentrations, and/or if deemed appropriate as specific loads; • to clearly define (during the drafting of the questionnaire(s)) all parameters influencing emission concentrations, loads or abatement efficiencies (e.g. type and quantity of products/raw materials, boundaries of the process/system, direct/indirect discharge, sources and characteristics of waste gases and waste waters, specific operating conditions associated with the manufacture of products).
Summary of initial positions
• 11 out of 17 IPs agree with the first bullet point of the proposal, 6 partly agree, none disagree. • The main comments of the IPs which partly agree are as follows: o BAT-AELs (not BAT-AEPLs) for emissions to air and water should be expressed in concentrations since specific loads require production figures that are considered confidential by several operators (AT). o Do not derive BAT-AELs for emissions to water (PT, C.U.). o Replace 'and/or' with 'and' to make sure that BAT-AEPLs will be presented at least as concentrations (DE, NL). Loads are difficult to monitor (DE). o BAT-AEPLs should be expressed both in concentrations and in loads since concentrations are useful to assess the performance of the techniques and loads serve the objective of assessing the environmental impact (EEB). • 13 out of 17 IPs agree with the second bullet point of the proposal, 3 partly agree and 1 disagrees. • The main comments of the IPs which partly agree are as follows: o Collect also information on chloride, fluoride and sulphide contents of the clay and size of the plants and kilns (FI). o The proposal is appropriate for the majority of the sectors except for wall and floor tiles due to the complexity of the issue and a lack of information (C.U.).

- Include OTNOC to define its influence on the performance of the techniques and to harmonise permitting conditions for these situations (e.g. failure of waste gas treatment) (EEB).

- The main comment of the IP which disagrees is as follows:
  - These parameters are not expected to have a direct impact on the possible reduction of emissions. This kind of information can be misused in a competitive environment of manufacturers (CZ).

EIPPCB assessment

- According to the BREF Guidance, BAT-AELs can be expressed as concentrations (mass of pollutant released per volume) or specific loads (mass of pollutant release per mass of product manufactured or raw material used). To set BAT-AELs as specific loads, appropriate contextual information (e.g. the volume flow of waste gases through the outlet (Nm^3) and the amount of product (kg) – during the same time period) may need to be collected.
- Since specific loads are in general considered to be affected by plant-specific conditions such as product types, product specifications or process-integrated techniques applied, it may be challenging to collect the necessary amount of detailed information to derive meaningful BAT-AELs expressed in specific loads.
- The question on whether BAT-AELs for emissions to water should be derived or not is addressed for each individual parameter proposed as a KEI (see Sections 2.2.4 and 3.3.2).
- OTNOC may indeed influence emissions and are considered to be covered by 'specific operating conditions'.
- The contextual information that needs to be collected in order to have a better understanding of data on emission concentrations or loads is proposed to be defined during the drafting of the questionnaire (see Section 3.4.4). The current proposal includes a non-exhaustive list of example parameters.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- To generally express BAT-AELs for channelled emissions to air and to water in concentrations, and, if deemed appropriate, also as specific loads.
- To clearly define (during the drafting of the questionnaire) all parameters influencing emission concentrations or loads (e.g. techniques used, reference conditions, type and quantity of products/raw materials, boundaries of the process/system, direct/indirect discharge, sources and characteristics of waste gases and waste waters, specific operating conditions associated with the manufacture of products).

2.3.1.2 Averaging periods for BAT-AELs related to emissions to air and to water

Original EIPPCB proposal

Proposal 17: For channelled emissions to air, the EIPPCB proposes to express BAT-AELs generally as short-term averages, i.e. as daily averages (for continuous measurements) or as averages over the sampling period (for periodic measurements). For emissions to water, the EIPPCB proposes to express BAT-AELs generally as daily averages, obtained via 24-hour flow-proportional composite samples.

Summary of initial positions

- **Emissions to air:** 15 out of 17 IPs agree with the proposal on channelled emissions to air, 2 partly agree and none disagree.
- The main comments of the IPs which agree or partly agree are as follows:
  - The operation of batch kilns and variabilities of clay input is important when setting BAT-AELs (UK).
  - Short-term measurements (half-hourly averages) should be considered in particular for the production of refractory products (C.U.).

- BAT-AEPLs should be expressed both in half-hourly and in daily averages since half-hourly averages allow for a better monitoring of the situation and give an incentive to the operator to limit emission peaks (EEB).

- **Emissions to water:** 10 out of 17 IPs agree with the proposal on emissions to water, 4 partly agree, 1 disagrees and 2 do not provide answers.
- The main comments of the IPs which agree or partly agree are as follows:
  - For batch discharges, BAT-AELs should be expressed as averages over the sampling period (IT).
  - The intermittency of flow from lagoons is important (UK).
  - Include other types of samples, i.e. time-proportional composite samples or spot samples (DK). Include the option of spot sampling since some parameters are not stable over 24 hours (AT).
  - The proposal is appropriate for the sectors where emissions to water may occur (e.g. technical ceramics, table- and ornamental ware and expanded clay aggregates). For the production of wall and floor tiles and sanitaryware, it depends on a case-by-case basis (C.U.).
- The main comment of the IP which disagrees is as follows:
  - 24-hour composite samples are difficult to take both in economic and technical terms. In Czechia, measurements are carried out once per month via sampling every half hour for a total of 2 hours (CZ).

EIPPCB assessment

- **Emissions to air:**
  - Continuous measurements of emissions to air were reported only for a few parameters and for specific cases (e.g. continuous monitoring of dust is applied in BE when the mass flows are above 5 kg/h or continuous monitoring of HCl is applied in FI when wastes are used as a fuel in kilns). However, most of the IPs reported periodic measurements of emissions to air.
  - Several parameters may influence the emission concentrations and therefore may affect the derivation of BAT-AELs. The TWG will clearly define those parameters during the drafting of the questionnaire (see Section 2.3.1.1).
  - Several recent BREFs report averaging periods associated with BAT-AELs for emissions to air for periodic measurements expressed as the average of three consecutive measurements of at least 30 minutes each. In the case of continuous measurements, daily averages have been set.
  - The derivation of BAT-AELs expressed as short- or long-term averages depends on the availability of data.
- **Emissions to water:**
  - According to the IPs, short-term averages seem more common and accessible for data collection purposes.
  - Several recent BREFs report averaging periods associated with BAT-AELs for emissions to water for batch discharges expressed as average values over the release duration taken as flow-proportional composite samples. In addition, the possibility to use time-proportional composite samples or spot samples for specific cases was mentioned.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- For channelled emissions to air, to generally express BAT-AELs as short-term averages, i.e. as daily averages (for continuous measurements) or as averages over the sampling period (for periodic measurements).
- For emissions to water, to generally express BAT-AELs, in the case of continuous discharges as daily average values obtained via 24-hour flow-proportional composite samples and in the case of batch discharges as average values over the release duration obtained via flow-proportional composite samples. The TWG to decide at a later stage which other sampling techniques could be considered appropriate.

2.3.2 Confidentiality issues

Original EIPPCB proposal

Proposal 19: The EIPPCB proposes to design the questionnaire(s) in a way that avoids requesting confidential data as much as possible so that all data provided by operators can be posted directly onto BATIS by Member States' representatives and thus shared with the whole TWG.

Summary of initial positions

- 16 out of 17 IPs agree with the proposal, none disagree and 1 does not provide an answer.
- The main comments of the IPs which agree are as follows:
    - The decision to include confidential data should be made at the TWG level and individual validation of requests for confidentiality by MS should be avoided (FR, EEB).
    - Plants participating in the data collection should be anonymised (CZ, C.U.). The names and addresses of the plants should not be provided on BATIS (C.U.).
    - Energy consumption is not confidential information since it correlates with emissions to environment (fuel use). A practical solution can be found where the operators do not see the data of each other but only NGO and MS delegates are eligible to see the confidential data (EEB).

EIPPCB assessment

- The transparency of the information exchange was discussed by the IED Article 13 Forum on 6 June 2013. Since then, the established practice in the Sevilla process is to post the non-confidential questionnaire versions in BATIS including the plant name and location. This ensures transparency and allows the cross-checking of the information provided.
- Also, at the meeting of the IED Article 13 Forum of 6 June 2013 it was decided that any confidentiality claims should be fully justified, with a mechanism for checking why they were granted and what the risks of sharing such data would be. The confidential information needed could be agreed by the TWG during the information exchange process for the questionnaire development (see also Section 3.4.4.2). The Member States representatives would then need to ensure, as part of the quality check, that these data are submitted separately to the EIPPCB and that the questionnaires without confidential data are posted on BATIS.
- In some cases, it might be possible to avoid the collection of confidential data by using drop-down menus with predefined ranges for the relevant parameter (e.g. for production capacity).
- During the review of recent BREFs, different practical solutions were followed for the collection of confidential information, such as:
    - the fields in the questionnaires containing confidential data may be marked with a different background colour; a separate sheet of the questionnaire may be used;
    - the questionnaire version containing the non-confidential information is posted onto BATIS whereas the questionnaire version containing the parts claimed to be confidential may be submitted directly (and only) to the EIPPCB via email and not shared with the whole TWG on BATIS.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- To design the questionnaire in a way that avoids requesting confidential data as much as possible so that all data provided by operators can be posted directly onto BATIS by Member States' representatives and thus shared with the whole TWG.
- The TWG to decide at a later stage (i.e. during the questionnaire development) about the type and format of potentially confidential information that needs to be collected.
- The Member States' representatives in the TWG to: i) submit the versions of the questionnaires containing the confidential information directly to the EIPPCB via email, and ii) post the versions of the questionnaires containing the non-confidential information onto BATIS.

2.4 Next steps

This section aims to present the next steps of the CER BREF review related to the collection of data and information.

The process to prepare questionnaire(s) and collect information via questionnaire(s) is presented in Section 3.4.4. The tentative timeline associated with this process is presented in Table 2 below. This information will allow in particular the update of Chapter 3 of the CER BREF on emission and consumption levels.

In addition to the collection of information via questionnaire(s), it is necessary to collect bulk information in order to update the text of the CER BREF, namely information on the processes and techniques in Chapter 2 (see Section 3.2), on the techniques to consider in the determination of BAT in Chapter 4 and on emerging techniques in Chapter 6 (see Sections 3.5 and 3.4.1). Information will also be needed to update Chapter 1 (see Section 3.2).

Some information is already available to update certain sections of the BREF. This is summarised below and can be found in the following BATIS folder:

>BATIS>Forum>Ceramic Manufacturing Industry>02 First CER BREF review 2019>04 Information collection

- 'State of the art of the Ceramic Manufacturing Industry – Austrian installations (2018)' describes the processes and emissions of the sector, based on real emission and consumption data from selected Austrian ceramic manufacturing installations.
- The AT UBA and the Ricardo study on 'Preliminary Determination of Key Environmental Issues for the Ceramic Manufacturing Industry (2018)' include proposals for the selection of KEIs.
- The DE UBA study 'Innovative Techniken: Festlegung von besten verfügbaren Techniken (BVT) in Europa für die Bereiche der Keramik-, Zement-, Nahrungsmittel- und in der chemischen Industrie Teilvorhaben 1: Keramikindustrie' on the circular economy potential and on BAT in the ceramic sector illustrates several techniques to reduce the use of raw material and increase the recycling of waste in the different ceramic sectors or the recycling of ceramic waste in other sectors.
- 'VDI 2585:2018 - Emission Control Ceramic Industry', provides information on applied techniques and related emission levels in different sectors of the ceramic industry.
- The study 'Estudio Energético Sector de Baldosas Cerámicas de la Comunidad Valenciana (2011)' includes information on energy consumption and carbon dioxide emissions in the ceramic tile manufacturing process.
- The study 'Medidas de Eficiencia Energética Aplicadas en la Industria Española de Azulejos y Baldosas (2019)', provides a list of measures for energy efficiency in ceramic tile manufacturing.
- 'Nordic Ceramics Industry – Best Available Technique (BAT), Nordic Council of Ministers (2019)' is a report that describes the main environmental indicators and techniques used in the ceramics manufacturing industry in Nordic countries.
- The Cerame-Unie and Ramboll study on 'Key Environmental Issues for the European Ceramics Industry (2019)' provides additional input on key environmental issues (KEIs) in the ceramic industry on a sector basis and information on abatement systems, emerging techniques and emission monitoring frequencies.
- Some information on BAT candidates or emerging techniques has been obtained from EU-funded LIFE projects, Eco-innovation projects and EU Research and Innovation programme projects (e.g. under the 7th Framework Programme or Horizon 2020). These are referred to in the call for initial positions (see Section 3.5).

EIPPCB proposal

Table 2: Tentative timeline of the data and information collection

Step	Tentative time
EIPPCB to issue the first draft questionnaire template	KoM date + 18 weeks
TWG feedback on the first draft questionnaire	KoM date + 22 weeks
EIPPCB to issue the second draft questionnaire	KoM date + 25 weeks
Workshop on the questionnaire finalisation (if necessary)	KoM date + 27 weeks
TWG to provide proposals of well-performing plants for the data collection via questionnaire	KoM date + 32 weeks
EIPPCB to compile the list of well-performing plants and to check its completeness; if necessary, EIPPCB to ask TWG members to amend/complete the list	KoM date + 36 weeks
EIPPCB to issue the third draft questionnaire	KoM date + 36 weeks
Questionnaire testing	KoM date + 38 weeks
EIPPCB to issue the final questionnaire to the TWG and distribution to the participating plants through the Member States' representatives	KoM date + 40 weeks
TWG to provide bulk information in order to update the text of the SF BREF, namely information on applied processes and techniques, on the techniques to consider for the determination of BAT and on emerging techniques.	KoM date + 42 weeks
Submission of filled-in questionnaires in BATIS	KoM date +52 weeks

3 ITEMS NOT FOR DISCUSSION AT THE KICK-OFF MEETING

3.1 Scope of the CER BREF

3.1.1 Ceramic manufacturing sectors

Original EIPPCB proposal
Proposal 1: The EIPPCB proposes to include in the scope of the CER BREF the activities listed in point 3.5 of Annex I to the IED and to focus the CER BREF on the nine sectors already present in the 2007 CER BREF, but not to limit the scope of the CER BREF only to those sectors.
Summary of initial positions
• 15 out of 17 IPs agree with the proposal, 2 partly agree, none disagree. • The main comments of the IPs which agree or partly agree are as follows: o Clarify how the current wording of the scope should be interpreted in terms of thresholds (BE). Plants having either a production capacity above 75 tonnes per day or a kiln capacity above 4 m^3 are appropriate for inclusion in the scope of the CER BREF (UK). o Include in the scope of the CER BREF independent plants whose principal activity is spray drying (ES). o There are no Italian plants above the IED threshold of 75 tonnes per day for the sector of table- and ornamental ware (household ceramics). Therefore, focus the data collection on sectors for which there are plants in the EU above the IED thresholds (IT). o There are no plants in the EU for the sector of inorganic bonded abrasives fulfilling the IED criteria (FEPA).
EIPPCB assessment
• The IED wording is typically copied into the scope of the BAT conclusions to avoid any possible discrepancies or room for interpretation. The BREFs cannot interpret the IED. • Spray drying is considered a process step covered under the preparation of raw materials and mainly applied in the wall and floor tiles and tableware sectors. Point 3.5 of Annex I to the IED refers to the manufacture of ceramic products by firing. Therefore, plants producing solely dust pressing powder via spray drying may not be considered in the scope of the CER BREF unless these activities are directly associated with the main activity. • Based on the preliminary list of installations provided by 13 MS through the call for IPs (see Section 3.4.1), there are 19 IED plants for the table- and ornamental ware sector and at least 2 IED plants for the inorganic bonded abrasives sector.
EIPPCB proposal
To confirm the original EIPPCB proposal as follows: • To include in the scope of the CER BREF the activities listed in point 3.5 of Annex I to the IED and to focus the CER BREF on the nine sectors already present in the 2007 CER BREF, but not to limit the scope of the CER BREF only to those sectors.

3.1.2 Interface with other BREFs

3.1.2.1 GLS BREF

Original EIPPCB proposal
Proposal 6: The EIPPCB proposes: • to cover in the CER BREF the use of glassy materials (e.g. frits) in surface treatment processes (i.e. glazing) of ceramic products; • not to include in the scope of the CER BREF: o the manufacturing of glass ceramics; o the production of refractory ceramic fibres; o the production of frits.
Summary of initial positions
• 14 out of 17 IPs agree with the proposal, 2 partly agree, none disagree, 1 does not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o A gap or overlap with the GLS BREF may create problems (UK). o The production of glass elements is an important part of the production of ceramic tiles; the reasons for its exclusion should be further specified (PL). o Include in the scope of the CER BREF the production of frits with the aim to update outdated sections/conclusions of the GLS BREF (EEB). o Glassy materials are not used in the surface treatment of inorganic bonded abrasives (FEPA).
EIPPCB assessment
• The revised GLS BREF published in 2012 covers the manufacturing of glass ceramics, refractory ceramic fibres (also known as aluminium-silicate glass wools) and frits. Especially in terms of frits production, specific BAT conclusions were derived including several BAT-AELs on both emissions to air (e.g. for dust, NO_X, SO_X, HF, HCl, metals) and water (e.g. for TSS, COD, sulphates, fluorides, total hydrocarbons, phenols, metals). • The current CER BREF mentions that frits are supplied to the ceramic tile industry which is one of the main consumers. In rare cases, the production of frits is carried out at the same installation as the manufacturing of ceramics. The boundaries are clarified in Figure 1.1 of the current CER BREF where the production of frits are shown to be outside the scope of BAT determination.
EIPPCB proposal
To confirm the original EIPPCB proposal as follows: • To cover in the CER BREF the use of glassy materials (e.g. frits) in surface treatment processes (i.e. glazing) of ceramic products. • Not to include in the scope of the CER BREF: o the manufacturing of glass ceramics; o the production of refractory ceramic fibres; o the production of frits.

3.1.2.2 WI BREF

Original EIPPCB proposal
Proposal 7: The EIPPCB proposes: • to cover in the CER BREF co-incineration of waste in ceramic manufacturing kilns; • to exclude waste incineration covered by the scope of the WI BREF from the scope of the CER BREF.
Summary of initial positions
• 13 out of 17 IPs agree with the proposal, 4 partly agree, none disagree. • The main comments of the IPs which agree or partly agree are as follows: o The use of biomass (as fuel or as pore-forming agent, whether it is considered a waste or not) should be covered in the CER BREF (FR). o It is necessary to define the interface between the WI BREF and this new CER BREF (PT). o The WI BREF does not include plants incinerating non-hazardous waste below 3 tonnes/hour or hazardous waste below 10 tonnes/day (UK). o Waste management techniques and precise references to WI techniques should be included in the CER BREF (DE).
EIPPCB assessment
• Waste co-incineration could be considered relevant for the manufacturing of expanded clay aggregates where the use of alternative fuels (e.g. biofuels, biomass, waste oils, solvents) is reported in the current CER BREF. In the current CER BREF's concluding remarks, it was mentioned that only few emission and consumption data on the use of alternative fuels (e.g. biogas/biomass) were provided while most of them were very late and therefore could not be fully taken into consideration. Therefore, it is considered important to update those sections with the current information on alternative fuels used within the sector. • The scope of WI BAT conclusions does not cover waste co-incineration plants whose main purpose is the production of material products. This is left to be addressed in the relevant specific BREFs as the emissions from the co-incineration of waste depend to some extent on the process. • Waste co-incineration is covered by Chapter IV of and Annex VI to the IED irrespective of the thresholds of Annex I to the IED. • The recently published WI BREF provides valuable information on operational techniques applied in relation to the quality control, storage and handling of incoming waste which may be referred to in the revised CER BREF if needed or considered useful.
EIPPCB proposal
To confirm the original EIPPCB proposal as follows: • To cover in the CER BREF the co-incineration of waste in ceramic manufacturing kilns. • To exclude waste incineration covered by the scope of the WI BREF from the scope of the CER BREF.

3.1.2.3 STM BREF

Original EIPPCB proposal
Proposal 9: The EIPPCB proposes to exclude porcelain/vitreous enamelling of metals from the scope of the CER BREF. The CER TWG could recommend to the STM TWG to consider including porcelain/vitreous enamelling of metals in the scope of the review of the STM BREF. Request 2: TWG members are asked to indicate in the event that porcelain/vitreous enamelling of metals is included in the scope of the CER BREF: the number of installations for porcelain/vitreous enamelling of metals in operation in the Member States, the IED activity under which these installations are permitted, the specific key environmental issues of porcelain/vitreous enamelling of metals (in terms of emissions to air and water, waste generation, consumption of energy, water and chemicals, odours, noise and vibrations).
Summary of initial positions
• 12 out of 17 IPs agree with the proposal, 3 partly agree, none disagree, 2 do not provide answers. • The main comments of the IPs which partly agree are as follows: o Enamelling of metals is considered neither a directly associated activity for the scope of the CER BREF since the end-product is not ceramic nor relevant for the scope of the STM BREF as it does not raise the same issues as STM activities (thermal process) (FR). It is a coating process and subsequent firing is likely to be under the threshold (UK). • In addition, one IP that does not provide an answer indicates that the current proposal is acceptable from a legal perspective, but that it should be further assessed when and how this could be addressed under the scope of the STM BREF (EEB). • 7 MS provided information on request 2: o There are no known IED-permitted installations in Austria (AT). o There is at least one plant in Belgium permitted under activity 2.4, but the list is not complete (BE). o There are no installations in Czechia, Spain and Sweden (CZ, ES, SE). o In France, this activity is not covered by any IED activity. However, there are 60 installations permitted for the enamelling activity according to the French nomenclature (i.e. 2570-2) (FR). o This is a coating activity, rather than surface treatment. The subsequent firing is likely to be below the ceramics threshold (UK).
EIPPCB assessment
• Porcelain enamel is an inorganic and non-metallic solid used to coat metal components of certain products (e.g. hot water tanks, cookers, pots, pans), which includes a firing step at high temperatures similar to ceramic manufacturing. However, based on the IPs, porcelain enamelling is considered a coating process rather than manufacture of a ceramic product. • The scope of the STM BREF will be discussed in due course when that BREF is reviewed.
EIPPCB proposal
To keep the first part of the original EIPPCB proposal and to change the second part as follows: • To exclude porcelain/vitreous enamelling of metals from the scope of the CER BREF.

3.1.3 Independently operated waste water treatment plants and combined treatment of waste water

Original EIPPCB proposal
Proposal 3: The EIPPCB proposes to include in the scope of the CER BREF the activity listed in point 6.11 of IED Annex I (i.e. independently operated treatment of waste water not covered by Directive 91/271/EEC) when the main pollutant load originates from the activities covered by the scope of the CER BREF. Proposal 4: The EIPPCB proposes to include in the scope of the CER BREF the combined treatment of waste water from different origins provided that the main pollutant load originates from the activities covered by the scope of the CER BREF and that the waste water treatment is not covered by Directive 91/271/EEC.
Summary of initial positions
• 16 out of 17 IPs agree with the proposals, 1 partly agrees, none disagree. • The main comments of the IPs which agree or partly agree are as follows: o Define 'the main pollutant load' with the aim to facilitate the implementation (EEB). o In the UK, there is no example of an independently operated WWTP treating waste water for which the main pollutant load originates from the activities covered by the scope of the CER BREF. Further clarifications are needed for the brickworks that share lagoons with adjacent clay quarries (UK).
EIPPCB assessment
• The EIPPCB proposals concerning both independently operated WWTPs and the combined treatment of waste water are consistent with the approach followed in recently adopted BREFs (e.g. WT, FDM, STS), as well as in the first drafts of the revised FMP and TXT BREFs. The scope section of the BAT conclusions of these FMP and TXT BREF drafts refer to the main pollutant load. • As mentioned earlier, the quarrying of raw materials is proposed to be outside the scope of the CER BREF (see Section 2.1.1).
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include in the scope of the CER BREF the activity listed in point 6.11 of IED Annex I (i.e. independently operated treatment of waste water not covered by Directive 91/271/EEC) when the main pollutant load originates from the activities covered by the scope of the CER BREF. • To include in the scope of the CER BREF the combined treatment of waste water from different origins provided that the main pollutant load originates from the activities covered by the scope of the CER BREF and that the waste water treatment is not covered by Directive 91/271/EEC.

3.2 Structure of the BREF and of its BAT conclusions

Original EIPPCB proposal
Proposal 10: The EIPPCB proposes to use the structure of the 2007 CER BREF and to include minor adaptations, if deemed appropriate.
Summary of initial positions
• 15 out of 17 IPs agree with the proposal, 1 partly agrees, none disagree and 1 does not provide answers. • The main comment of the IP which partly agrees is as follows: o The updated BREF should include sections on activities proposed for exclusion from the scope of the CER BREF (see Sections 2.1.1 and 2.1.2) as well as on decarbonisation and reduction of greenhouse gas emissions (EEB).
EIPPCB assessment
• Some activities are proposed to be excluded from the scope of the BREF, which means they are also proposed to be excluded from the data collection. However basic information on the activities excluded from the scope of the BREF can be included if bulk information on these activities is provided. Such information would also clarify/explain the reasons for the exclusion of these activities. Cross references to other BREFs can be used, where appropriate. • Information on techniques to reduce greenhouse gas emissions could be collected (see Section 2.2.3.2.5).
EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:
• To generally use the following structure, which can be adapted depending on the information and data collected during the CER BREF review:
  o Preface
  o Scope
  o Chapter 1: General information about the CER sector
  o Chapter 2: Applied processes and techniques
  o Chapter 3: Current emission and consumption levels
  o Chapter 4: Techniques to consider in the determination of BAT
  o Chapter 5: BAT conclusions
  ▪ Generic BAT conclusions
  ▪ Specific BAT conclusions
  o Emerging techniques
  o Concluding remarks and recommendations for future work
  o Annexes
  o References
  o Glossary

3.2.1 Applied processes and techniques in the current CER BREF

Original EIPPCB request
Request 3: TWG members are asked to provide their feedback on applied processes and techniques listed in Chapter 2 of the 2007 CER BREF and to indicate: • any obsolete processes, i.e. that are no longer used; • which processes require updating and why; • what information can be provided; • any relevant process that is missing.
Summary of initial positions
• 9 out of 17 IPs considered that all of the process descriptions in the current CER BREF require updating, 2 IPs considered that some descriptions of process steps listed in the current CER BREF require updating and 6 do not provide answers. • The main comments of the IPs which provided answers are as follows: o There may be technological developments in every process step described in the current CER BREF to take into consideration (DE). o The sections on bricks and roof tiles, wall and floor tiles and refractory products need to be updated (ES). • Some IPs propose to include the following information on individual process steps: o Reduction firing where fired bricks are heated in an atmosphere that is deficient in free oxygen in order to produce different colours and visual effects (BE). o Continuous pressing technologies (where no moulds are used) for the shaping/forming of ware (IT). o Ink-jet technologies (widespread system, currently prevailing on traditional ones) for the surface treatment and decoration of ceramic products (IT). o Fibreglass mats that are used in the extra-large ceramic slabs production (characterised by slender thicknesses) under the addition of auxiliary materials step (IT). • In addition two IPs propose to include the following process steps: o Debinding is used in some specialist applications of technical ceramics to reduce the content of organic binders at temperatures up to 600 °C; it is a possible source of VOCs (DE). o Decoration of fired materials (i.e. third firing applications) which increases the overall energy consumption, but which is not very widely used (IT).
EIPPCB assessment
• According to the IPs, most of the processes listed in Chapter 2 of the BREF need to be updated. Unfortunately, so far little information has been declared available for these updates. • Various types of shaping and decoration techniques are described in the current CER BREF, both in general and more specifically for the sectors. This information may be updated, including by adding recently emerged techniques such as continuous pressing or ink-jet technologies. • The application of fibreglass mats as an auxiliary material to the ceramic tiles can be added to Section 2.3.5.6 of the current CER BREF, if information is provided. • Section 2.3.1.5 of the current CER BREF includes information on reduction firing of bricks which can be updated if the information is made available. • Information on debinding of technical ceramics may be used to update Section 2.3.8.6 of the current CER BREF where similar process steps are described. • Decoration firing is already described for the production of tableware where operating data for on-glaze decoration kilns are presented. This section may be updated with new information, if available.
EIPPCB proposal
• To update the process descriptions listed in Chapter 2 of the BREF with the information provided by the TWG, in particular on the following topics:

- reduction firing of bricks, decoration (or third) firing, debinding of technical ceramics;
- continuous pressing technologies for the shaping of ware;
- decoration of ware using ink-jet technologies;
- application of fibreglass mats to the ceramic tile products.

- The TWG to provide written contributions on the processes and techniques referred to above in order to be considered in the CER BREF review (see Section 2.4 for a tentative timeline).

3.3 Key environmental issues (KEIs) for the CER BREF

3.3.1 Emissions to air

3.3.1.1 EIPPCB proposals

3.3.1.1.1 Dust

Original EIPPCB proposal
To include dust as a KEI for all processes.
Summary of initial positions

• 17 out of 17 IPs agree with the proposal.
• The main comments of the IPs are as follows:
  o Dust is a KEI for firing (all IPs);
  o Dust is a KEI at least for some sectors for the following process steps:
  ▪ storage and handling (AT, DK, ES, FR, IT, PL, C.U.);
  ▪ raw material preparation (AT, C.U. , ES, FEPA, FR, IT, PL, C.U.);
  ▪ spray drying (CZ, DE, ES, IT, NL, PT, UK, C.U.);
  ▪ pressing (AT, DE, IT, PL, PT);
  ▪ extruding (DE, IT);
  ▪ moulding (DE, IT);
  ▪ casting (DE, IT);
  ▪ drying (AT, CZ, DE, DK, ES, FEPA, FI, FR, IT, PL, PT, C.U.);
  ▪ texturing (FR, IT);
  ▪ coating (FR);
  ▪ glazing (AT, DE, ES, FR, IT, PT, C.U.);
  ▪ engobing (AT, ES, FR, IT, PL);
  ▪ printing and decorating (AT, FR, IT, PL);
  ▪ finishing (AT, DE, ES, IT, PL, PT, C.U.).
  o ELVs are set in the permits of three Swedish plants in the sectors of bricks, refractory products and sanitaryware (SE).

EIPPCB assessment

• According to the IPs, dust is monitored in at least 14 MS; many data would be available.
• There is an EN standard available for measuring dust emissions to air (i.e. EN 13284-1:2017).
• Dust emissions to air occur during several process steps in all sectors and originate from the materials used and/or from combustion.
• The current CER BREF contains BAT-AELs for dust emissions from several process steps for all sectors and sometimes also for specific sectors, i.e.:
  o dusty operations other than from drying, spray drying or firing;
  o drying;
  o kiln firing.
• Several primary and secondary techniques are available to prevent and reduce dust emissions to air (e.g. cyclones, fabric filters, ESPs, wet scrubbers) and diffuse dust emissions from dusty operations and bulk storage areas (e.g. enclosure).

EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include dust as a KEI for all process steps and to collect data on dust emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs. • To collect information on techniques to prevent and/or reduce diffuse dust emissions.

3.3.1.1.2 Gaseous chlorides

Original EIPPCB proposal
To include hydrogen chloride and other gaseous chlorides compounds (expressed as HCl) as a KEI for firing of ware and preparation of raw materials.
Summary of initial positions

• 10 out of 17 IPs agree with the proposal, 3 partly agree, 3 disagree, 1 does not provide answers.
• The main comments of the IPs which agree or partly agree are as follows:
  o HCl is a KEI:
  ▪ for firing when clay is used as a raw material in the sectors: all sectors (AT, BE, DE, EEB), bricks and roof tiles (ES, FI, IT, PT, C.U.), wall and floor tiles (ES), expanded clay aggregates (ES, FI, C.U.), refractory products (ES, IT, C.U.), all but floor tiles (FR);
  ▪ for drying (FI): when hot gases from the firing are used (FR); for expanded clay aggregates (DK).
• The main comment of the IP which disagrees is as follows:
  o HCl is not a relevant parameter for wall and floor tiles, refractory products, sanitaryware (CZ).

EIPPCB assessment
• According to the IPs, hydrogen chloride is monitored in 8 MS (AT, BE, DE, ES, FI, FR, IT, PT); many data would be available. • The EN 1911:2010 standard for measuring emissions of gaseous chlorides to air is available. • Gaseous chloride emissions to air may occur during the firing step and originate from the raw material used (e.g. clay). • The current CER BREF contains a BAT-AEL of 1–30 mg/Nm^3 for gaseous chlorides expressed as HCl for all sectors. • The AT BAT study reports emission values for gaseous chloride emissions to air from firing in different sectors in the range of < 0.1–15 mg/Nm^3. The C.U. study reports HCl emissions for several sectors, mentioning that HF emission control systems also abate HCl or can be easily combined with HCl abatement. • Several techniques are available to prevent and reduce gaseous chloride emissions (e.g. packed-bed scrubbers), which are often used to simultaneously abate several acidic substances. For example, VDI 2585:2018 reports the improved absorption of HCl in a conventional HF abatement system by using granulate made of chalk or hydrate of lime.
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include gaseous chlorides expressed as HCl as a KEI for drying and firing and to collect data on gaseous chloride emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

3.3.1.1.3 Gaseous fluorides

Original EIPPCB proposal
To include hydrogen fluoride and other gaseous fluorides compounds (expressed as HF) as a KEI for firing of ware and preparation of raw materials.
Summary of initial positions

• 15 out of 17 IPs agree with the proposal, 1 partly agrees and 1 disagrees.
• The main comments of the IPs which agree are as follows:
  o HF is emitted from firing for all sectors when natural clay is used (AT, BE, DE, EEB, FEPA, FR, NL, PL, PT, C.U.), bricks and roof tiles (ES, FI, IT, SE), wall and floor tiles (ES, IT), expanded clay aggregates (ES, FI), refractory products (ES, SE), sanitaryware (SE), inorganic bonded abrasives (FEPA).
  o Fuel containing fluorine (e.g. lignite) leads to HF emissions as a rare case (DE).
  o HF is emitted from drying (IT) when hot gases from the firing furnace are used (FR).
• The main comments of the IPs which disagree:
  o HF is not a relevant parameter for wall and floor tiles, refractory products, sanitaryware (CZ).

EIPPCB assessment
• According to the IPs, hydrogen fluoride is monitored in 10 MS (AT, BE, DE, ES, FI, FR, IT, PL, PT, SE); many data would be available. • The ISO 15713:2006 standard for measuring emissions of gaseous fluorides to air is available. • Gaseous fluoride emissions to air may occur during the firing step and originate from the raw material used (e.g. clay). • The current CER BREF contains a BAT-AEL of 1–10 mg/Nm^3 for gaseous fluorides expressed as HF for all sectors. • The AT BAT study reports emission values for gaseous fluoride emissions to air from firing in different sectors in the range of < 0.04–2 mg/Nm^3. The C.U. study reports HF emissions for several sectors. • Several techniques are available to prevent and reduce gaseous fluoride emissions (e.g. packed-bed scrubbers).
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include gaseous fluorides expressed as HF as a KEI for drying and firing and to collect data on gaseous fluorides emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

3.3.1.1.4 NO_X

Original EIPPCB proposal
To include NO_X as a KEI for firing and drying of ware, preparation of raw materials.
Summary of initial positions
• 17 out of 17 IPs agree with the proposal. • The main comments of the IPs are as follows: - NO_X is a KEI for: ▪ all sectors: for firing (BE, DE, FR, IT, PT, SE, C.U., FEPA, EEB) and drying (DE, FR, IT), raw material preparation (ES, NL, PL); ▪ firing: wall and floor tiles (CZ, ES, IT), bricks and roof tiles (ES, FI, IT), refractory products (CZ, ES, IT, SE), sanitaryware (CZ, ES, SE) and expanded clay aggregates (ES, FI); ▪ drying: sanitaryware, table- and ornamental ware (C.U.), wall and floor tiles (ES, IT), bricks and roof tiles (ES, FI, IT), expanded clay aggregates (FI) and refractory products (ES, IT); ▪ spray drying: wall and floor tiles (ES, FR). - Emissions originate from drying processes other than spray drying (AT). - NO_X is a KEI for drying depending on the energy source (PT). - The high temperatures that are necessary in refractory production favour NO_X formation (C.U.).
EIPPCB assessment
• According to the IPs, NO_X is monitored in 11 MS (AT, BE, CZ, DE, ES, FI, FR, IT, PL, PT, SE); many data would be available. • The EN 14792:2017 standard is available to measure NO_X emissions to air. • NO_X emissions to air are mainly due to nitrogen oxidation at the high temperatures during firing, drying and spray drying. • The current CER BREF contains NO_X BAT-AELs of < 250 mg/Nm^3 or < 500 mg/Nm^3 (depending on the kiln temperature) for all sectors and of < 500 mg/Nm^3 for rotary kilns in the production of expanded clay aggregates (irrespective of kiln temperature). • The AT BAT study reports NO_X emission values from the firing of different ceramic products in the range of < 15–400 mg/Nm^3. In addition, NO_X emission levels of < 10 mg/Nm were reported for dryers employed in the production of refractory bricks. The C.U. study indicates that NO_X could be emitted from all sectors, mainly during firing. • Several techniques are available to prevent and reduce NO_X emissions to air (e.g. low-NO_X burners).
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include NO_X as a KEI for preparation of raw materials, drying and firing and to collect data on NO_X emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

3.3.1.1.5 SO_X

Original EIPPCB proposal
To include SO_X as a KEI for firing and drying of ware.
Summary of initial positions
• 16 out of 17 IPs agree with the proposal for firing, 1 does not provide answers. • 4 out of 17 IPs agree with the proposal for drying, 3 disagree, 3 partly agree, 7 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o SO_X is a KEI for: ▪ all sectors for firing (BE, PT, C.U., EEB), for spray drying (ES, IT, PL); ▪ firing: wall and floor tiles (CZ, ES, IT), refractory products (CZ, DE, ES, IT) and sanitaryware (CZ, ES), expanded clay aggregates (DE, ES, FI), inorganic bonded abrasives (DE, FEPA), bricks and roof tiles (DE, ES, FI, IT); ▪ drying: wall and floor tiles (ES, IT), bricks and roof tiles (ES, FI, IT), refractory products (ES, IT), expanded clay aggregates (FI); ▪ spray drying: wall and floor tiles (ES, IT). o SO_X is emitted from firing when natural clay raw material or sulphur-bearing binding agents are used (DE), depending on the sulphur content of the raw materials and fuels used (IT). o SO_X is a KEI because sulphur compounds are present in the clay (DK); some clays have a high sulphur content (UK). o SO_X is emitted from drying when sulphur-bearing fuels are used (DE, PT), when hot gases from the firing furnace are used (FR).
EIPPCB assessment
• According to the IPs, SO_X is monitored in 10 MS (AT, BE, CZ, DE, ES, FI, FR, IT, PL, PT); many data would be available. • The EN 14791:2017 standard for measuring SO_X emissions to air is available. • SO_X emissions to air are mainly due to the oxidation of sulphur compounds contained in the raw materials and/or fuels during firing and drying. • The current CER BREF contains SO_X BAT-AELs of < 500 mg/Nm^3 or 500–2 000 mg/Nm^3 (depending on the sulphur content of the raw material) for all sectors. • The AT BAT study reports emission values for SO_X emissions to air from firing of different ceramic products in the range of 0.1–250 mg/Nm^3 (bricks, refractory bricks, technical ceramics, sanitaryware) or ≤ 500 mg/Nm^3 (clay blocks, refractory bricks). The C.U. study indicates that SO_X could be emitted from all sectors mainly during firing, depending on the raw materials and fuels used. • Several techniques are available to prevent and reduce SO_X emissions to air (e.g. cascade-type packed-bed adsorbers, dry sorbent injection).
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include SO_X as a KEI for drying and firing and to collect data on SO_X emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

3.3.1.1.6 TVOC

Original EIPPCB proposal
To include TVOC (VOC / TOC / NMVOC) as a KEI for firing and drying of ware.
Summary of initial positions
• 9 out of 17 IPs agree with the proposal for firing, 1 disagrees, 5 partly agree, 2 do not provide answers. • 4 out of 17 IPs agree with the proposal for drying, 3 disagree, 2 partly agree, 8 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o TVOC is a KEI for: ▪ all sectors for firing (BE, EEB); ▪ firing: wall and floor tiles (CZ, ES, IT) , refractory products (CZ, ES, IT, PT, C.U.), sanitaryware (CZ, C.U.), bricks and roof tiles (ES, FI, IT, PT, C.U.), expanded clay aggregates (FI), technical ceramics and table- and ornamental ware (C.U.). o TVOC emissions from the finishing process steps should be explored via data collection (AT). o TVOC is emitted from firing when organic additives (e.g. pore-forming agents) or clays with a high carbon content are used (DE, DK, ES, PT, UK, C.U., FEPA) or when waste is used as fuel (FI). o TVOC is emitted from drying when hot gases from the firing furnace are used (FR), depending on the energy source (PT). o TVOC is a KEI also for debinding (DE).
EIPPCB assessment
• TVOC is a parameter for a group of substances, including CMR substances. • According to the IPs, TVOC is monitored in 9 MS (AT, BE, CZ, DE, ES, FI, FR, IT, PT); many data would be available. • The EN 12619:2013 standard for the measurement of TVOC emissions to air is available. • The AT BAT study reports TVOC emission values from the firing of different ceramic products in the ranges of < 2–15 mg/Nm^3 (clay blocks) and < 1–4 mg/Nm^3 (refractory products, facing bricks, roof tiles), after abatement with thermal oxidation. • TVOC emissions to air may occur during the firing step mainly due to the additives/auxiliary agents used (e.g. organic pore-forming agents or other organic additives). In addition, VDI 2585:2018 mentions the pretreatment (debinding) of technical ceramics containing high contents of organic binders in furnaces at temperatures of up to 600 °C before firing. • The current CER BREF contains a TVOC BAT-AEL of 5–20 mg/Nm^3 for the firing of bricks and roof tiles, refractory products, technical ceramics and inorganic bonded abrasives. Emission levels for special process steps for refractory products are also reported. • Several techniques are available to prevent and reduce TVOC emissions, such as activated carbon filters, thermal and catalytic oxidation.
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: • To include TVOC as a KEI for drying and firing, as well as for debinding and special procedures of refractory products and to collect data on TVOC emissions to air through plant-specific questionnaires with the aim to derive BAT-AELs.

3.3.1.1.7 Odour

Original EIPPCB proposal and request
To include odour as a KEI for surface treatment and finishing. **Request 5:** TWG members are asked to provide their view regarding whether odour emissions is a KEI for this CER BREF review and to provide a description of the techniques used to reduce odour emissions and the availability of information on the odour concentration in channelled emissions to air.
Summary of initial positions
• 4 out of 17 IPs agree with the proposal, 7 disagree, 5 partly agree, 1 does not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o Odour may also occur from firing of refractory bricks depending on the binding agent used and from drying and firing of inorganic bonded abrasives (AT). Firing activities involve odour emissions due to the binders used (EEB). o Odour may occur during the reduction firing of bricks and roof tiles (BE). o Odour is a KEI for all sectors where potentially odorous materials are used (e.g. pore-forming or binding agents) (DE). o For the production of wall and floor tiles, odour may occur during printing and decorating processes where solvents or other organic compounds are used (ES). o Some types of clay containing excessive amounts of sulphur might cause odour emissions (DK). Odour emissions may occur depending on the process and composition of the clay (UK). o Do not derive BAT-AELs, rather define a BAT on odour management (DE, SE). Collect information on relevant abatement techniques applied (e.g. activated carbon adsorption or thermal oxidation downstream of the fabric filters treating waste gases from kiln firing (IT). o Odour is best addressed as a local issue and on a case-by-case basis (DK, IT, SE, UK). o Odour is not a KEI for the production of bricks and expanded clay aggregates (FI). • The main comments of the IPs which disagree: o Odour is considered a local issue (NL, C.U.). o Odour emissions may originate from the firing step due to the use of organic additives or from anaerobic degradation in water. However, the current method (i.e. EN 13725) is not applicable for low odour concentrations and has certain uncertainties, mainly associated with the dispersion modelling process (C.U.). o Odour is not relevant for the production of inorganic bonded abrasives (FEPA).
EIPPCB assessment
• None of the IPs indicate the monitoring of odour emissions in ceramic manufacturing plants. Data may not be available. • Odour emissions are mentioned in the permits of a few installations: o The permit of an Italian wall and floor tiles plant mentions odour emissions from kilns where digital printing is used for the surface treatment with levels in the range of 1 491–3 416 ou_E/Nm^3. ELVs for TVOC and aldehydes apply for the same emission points. o The permit of a Belgian brick plant mentions the occurrence of odour due to the use of paper waste which appeared to be related to the presence of phthalates in it. • Odour emissions may originate from the organic substances used in surface treatment and finishing operations. Since ceramic articles treated during these steps are sent to the firing kilns, odour emissions may occur from the kilns. This was also confirmed by the AT BAT study which mentions that oxidation techniques are used to treat waste gases from kilns of two refractory plants with the aim to reduce odour emissions originating from the use of binders. • Channelled odour emissions are closely linked to the use of organic substances which are

covered by the parameter TVOC (see Section 3.3.1.1.6).
- Recently adopted BREFs (e.g. FDM, STS) include conclusions on odour management plans and techniques to prevent and/or reduce odour emissions without associated environmental performance levels.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:
- To include odour as a KEI and to collect information on techniques to prevent and/or reduce odour emissions with the aim to derive BAT without associated environmental performance levels.

3.3.1.1.8 Noise

Original EIPPCB proposal

Proposal 12: The EIPPCB proposes to exclude noise as a KEI for this BREF review.

Summary of initial positions

- 9 out of 17 IPs agree with the proposal, 7 disagree, 1 partly agrees.
- The main comments of the IPs which agree or partly agree are as follows:
  - Noise is not a KEI (ES, FI).
  - Noise is a local issue (IT, NL).
  - Noise is considered a health and safety issue (C.U.).
  - Update the information on techniques to reduce noise levels (IT).
  - Noise is not relevant for inorganic bonded abrasives (FEPA).
- The main comments of the IPs which disagree:
  - There are several noisy operations in the ceramic manufacturing industry (AT).
  - Noise is a KEI, but there is no need to collect data on its monitoring (DE).
  - Collect information on techniques to prevent or reduce noise emissions (AT, DE).
  - Noise is mentioned as a cross-media effect for several BAT candidates (e.g. centrifugal separators) in the current CER BREF (EEB).
  - Noise is a KEI for the milling plant and the vacuum booth (PL).

EIPPCB assessment

- None of the IPs indicate the monitoring of noise levels in ceramic manufacturing plants. Data may not be available.
- Noise emissions occur in several steps of ceramic manufacturing mainly related to the operation of machinery (compressors, motors of raw material preparation and handling units) and to the carrying out of noisy operations (e.g. crushing, grinding, pressing). The current CER BREF includes information on techniques to prevent and/or reduce noise emissions such as: enclosure, insulation, time-limiting noise-intensive work.
- ELVs for noise emissions are often primarily set on the basis of local factors such as: the distance to the receiver, the local meteorological conditions, the type of source, the noise intensity and frequency as well as the individual perception.

EIPPCB proposal

To modify the original EIPPCB proposal as follows:
- To include noise as a KEI and to collect information on techniques to prevent and/or reduce noise emissions with the aim to derive BAT without associated environmental performance levels.

3.3.1.2 Parameter proposed as contextual information

3.3.1.2.1 Carbon monoxide (CO)

Original EIPPCB proposal
• Not to include carbon monoxide (CO) as a KEI but as a parameter in the questionnaires in order to obtain contextual information for assessing NO_X emissions and on combustion efficiency.
Summary of initial positions

• 9 out of 17 IPs agree with the proposal, 4 partly agree, 4 disagree.
• The main comments of the IPs which agree or partly agree are as follows:
  o CO may be a KEI (AT, EEB).
  o CO is a relevant process parameter for the firing step (AT, BE, EEB, NL, PT):
  ▪ for firing under reducing atmosphere or for plants with external afterburning or plants with additional combustion plants (DE);
  ▪ with oxygen in deficit and for expanded clay aggregates (DK);
  ▪ for wall and floor tiles, bricks and roof tiles and refractory products (IT).
  o CO is a relevant process parameter for the drying step (AT):
  ▪ when hot gases from firing are used (FR);
  ▪ for brick and expanded clay (FI);
  ▪ for wall and floor tiles, bricks and roof tiles and refractory products (IT).
  o CO is a relevant process parameter for the raw material preparation (AT).
• The main comments of the IPs which disagree:
  o CO is not relevant for the following sectors: wall and floor tiles, refractory products, sanitaryware (CZ).
  o CO is a specific parameter for combustion processes and not for the ceramic manufacturing process (C.U.).

EIPPCB assessment
• Information in the IPs (AT, BE, ES, FI, IT, and PL) indicates that CO emissions are mainly monitored from raw material preparation, drying and firing steps. • CO emissions result from incomplete combustion. Therefore, CO is a relevant parameter for the same sources as the other combustion-related parameters which are proposed to be KEIs (i.e. SO_X and NO_X). In addition to combustion processes, CO may also be formed from carbon dioxide released due to the thermal dissociation of carbonates. It is difficult to differentiate between CO originating from fuel combustion and from raw materials as it is released during the same process step. • Indicative levels for CO emissions to air have been set in recent BREFs (e.g. STS, LVOC, LCP).
EIPPCB proposal
To confirm the original EIPPCB proposal as follows: • Not to include CO as a KEI, but as a parameter in the questionnaires in order to obtain contextual information for assessing NO_X emissions and on combustion efficiency.

3.3.2 Emissions to water

3.3.2.1 Waste water sources

Original EIPPCB request
Request 6: TWG members are asked to provide feedback on the most important waste water emissions sources for the ceramic manufacturing processes, in particular by specifying sectors where these are relevant.
Summary of initial positions
• A summary of responses on the most important emission sources is provided in Annex IV. The main comments of the IPs are as follows: o There is no waste water discharge for the following sectors: bricks and roof tiles (BE, DE, FR, SE), refractory products (BE, DE, FR), vitrified clay pipes (BE), expanded clay aggregates (BE, DE, SE), wall and floor tiles (DE, FR), inorganic bonded abrasives (DE). o For the following sectors, most of the installations do not discharge any waste water or only in small quantities: bricks and roof tiles, wall and floor tiles and refractory products (ES), inorganic bonded abrasives (FEPA), bricks and roof tiles (PT, C.U.), vitrified clay pipes (C.U.). o Emissions to water are not a KEI for the production of bricks and expanded clay aggregates (FI). o In general, process waste water is reused internally or sent for disposal as waste (IT). Process waste water is reused up to 50 % (PT, C.U.). o Zero liquid discharge should be considered BAT and residual waste water discharge should only be considered BAT if is based on a solid justification (e.g. cross-media effects) (EEB).
EIPPCB assessment
• Although it was reported by several IPs that waste water discharge does not occur in many of the sectors, there is still a divergence between the MS which arises from differences in the applicability of techniques for the reuse of process waste water. Nevertheless, it is clear from the IPs that waste water discharge may be mostly relevant for the production of fine ceramics (e.g. tableware, sanitaryware, technical ceramics) where the reuse of process water may be restricted due to product quality requirements. • Based on the comments received and information contained in several sources (such as the current CER BREF, recent articles[31] and reports), the most important sources of water consumption for ceramic manufacturing processes are as follows: o Water is used as raw material in the preparation (casting slip, dust pressing powder, glaze) and in the product wetting for subsequent glaze application, which is subsequently evaporated into the air during drying and firing stages. Therefore, there are no emissions to water. o Water sprays are used in storage areas to reduce diffuse dust emissions. As the water subsequently evaporates, there are no emissions to water. o Water is used for wet scrubbing systems for the treatment of off-gases. In these systems, recycled process waste water can be reused after a simple physical treatment. o Water is used for the cooling systems, mostly in closed loops (e.g. in forming presses). o Water is used for the cleaning of units (raw material preparation units, moulds and other casting units, glazing lines, engobing and other decoration units). Water consumption can be reduced if the water is treated and reused in cleaning operations.

[31] Monfort, E. M. et.al (2014). Ceramic Manufacturing Processes: Energy, Environmental, and Occupational Health Issues. In Comprehensive Materials Processing - Volume 8. Elsevier Ltd.

○ Water is used in surface treatment activities (e.g. polishing, grinding, and cutting of fired products). ○ Water is used to test the product for leakages (e.g. vitrified clay pipes) or for the final cleaning of the products.
EIPPCB proposal
• To take into account the information provided for the drafting of the revised CER BREF. • To collect information on direct and indirect waste water discharges from all sectors through plant-specific questionnaires.

3.3.2.2 EIPPCB proposals

3.3.2.2.1 Total Organic Carbon (TOC) and/or Chemical Oxygen Demand (COD)

Original EIPPCB proposal
To include TOC and/or COD as KEIs.
Summary of initial positions
• 7 out of 17 IPs agree with the proposal of considering COD a KEI, 5 partly agree, 1 disagrees and 4 do not provide answers. • 5 out of 17 IPs agree with the proposal of considering TOC a KEI, 3 partly agree, 4 disagree and 5 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: ○ COD and TOC are KEIs for the following sectors: sanitaryware (AT, C.U.), refractory products, expanded clay aggregates, inorganic bonded abrasives and stove tiles (AT), household ceramics and technical ceramics (C.U.). ○ Only COD is a KEI for the following sectors: wall and floor tiles (CZ, ES, IT, C.U.), refractory products (CZ, ES, IT), bricks and roof tiles (ES, IT), sanitaryware (CZ). ○ Only TOC is a KEI for the production of technical ceramics, household ceramics and sanitaryware. The monitoring of COD will likely be replaced by TOC (DE). ○ Only COD is a KEI for run-off water from the storage areas (FR). ○ COD and TOC are relevant parameters for all sectors except bricks and roof tiles (PT). ○ One Swedish plant for the production of sanitaryware has an ELV for COD (SE). ○ Both COD or TOC are a KEI for direct discharges (UK). ○ COD and TOC should be considered alternatives (SE).
EIPPCB assessment
• According to the IPs, COD is monitored in 8 MS (AT, CZ, DE, ES, FR, IT, PT, SE) and in the UK, while TOC is monitored in 3 MS (AT, DE, PT) and in the UK. Therefore, data are available. • An EN standard for the monitoring of TOC emissions to water is available (i.e. EN 1484:1997), while there is no EN standard available for the monitoring of COD. According to the ROM, there is a tendency to replace COD with TOC for economic and environmental reasons, as the use of chromate and mercury, necessary for the COD determination, can be avoided by determining TOC. • The current CER BREF does not contain a BAT-AEL for TOC/COD emissions to water, although it reports emission levels mainly for wall and floor tiles, table- and ornamental ware (household ceramics) and technical ceramics. TOC emissions are reported under the E-PRTR only for one installation and for 1 year (i.e. 2014). • Organic matter may be found in waste water from the production of ceramics due to impurities in the raw materials and the use of organic substances/additives, e.g. in screen printing and glazing operations. • There are several techniques for the treatment of COD/TOC emissions to water; stripping, distillation, adsorption, extraction, chemical oxidation, biological treatment, filtration.

- Biodegradable TOC/COD can typically be abated by a downstream (urban) WWTP and is therefore not relevant for indirect discharges.
- The parameter COD/TOC may in some cases be useful for assessing the performance of physico-chemical treatments of waste water.

EIPPCB proposal

To change the original EIPPCB proposal as follows:

- To include both TOC and COD as KEIs for direct discharges and to collect data on TOC and COD emissions to water through plant-specific questionnaires.
- To aim at deriving BAT-AELs for direct emissions of TOC and COD to water, with the possibility to use only one of the two, but with preference being given to TOC.
- To collect data on emissions of poorly biodegradable compounds (as part of TOC and COD) to water for indirect discharges.
- The TWG to decide at a later stage, based on the data collected through the questionnaires, whether BAT-AELs on biodegradability of the COD/TOC content sent to biological treatment through indirect discharges should be derived.

3.3.2.2.2 Total suspended solids (TSS)

Original EIPPCB proposal

To include TSS as a KEI.

Summary of initial positions

- 11 out of 17 IPs agree with the proposal, 2 partly agree, 2 disagree and 2 do not provide answers.
- The main comments of the IPs which agree or partly agree are as follows:
  - TSS is a KEI for all sectors (AT, NL).
  - TSS is a KEI for the following sectors: wall and floor tiles (CZ, ES, IT, C.U.), household ceramics (DE, C.U.), technical ceramics (DE, C.U.), sanitaryware (CZ, DE), refractory products (CZ, ES, IT), bricks and roof tiles (ES, IT).
  - Clay particles may be suspended in run-off water from the production areas and in process water from bricks and roof tiles production (DK).
  - TSS is a KEI for run-off water from the storage areas (FR).
  - One Swedish plant for the production of sanitaryware has an ELV for TSS (SE).
  - TSS is a KEI for direct discharges only (UK).

EIPPCB assessment

- According to the IPs, TSS is monitored in 8 MS (AT, CZ, DE, ES, FR, IT, PL, SE) and in the UK; many data would be available.
- An EN standard available for the monitoring of TSS emissions to water is available (EN 872:2005).
- The current CER BREF contains a BAT-AEL for TSS emissions to water of 50 mg/l for all sectors. Chapter 3 of the current CER BREF reports several emission levels, mainly for wall and floor tiles, table- and ornamental ware (household ceramics) and technical ceramics.
- TSS emissions to water may originate from the raw materials used (e.g. clays, frit residues, insoluble silicates). Therefore, TSS could be relevant for waste water from all cleaning activities and from the surface treatment of fired products.
- There are several techniques for the treatment of TSS emissions to water such as filtration (e.g. sand filtration, microfiltration, membrane bioreactor), sedimentation, coagulation and flocculation, flotation.
- Normally, TSS can be abated by a downstream (urban) WWTP and is therefore not relevant for indirect discharges.
- TSS is considered a useful parameter for assessing the performance of physico-chemical treatments of waste water, for example when dissolved metals are precipitated and the resulting solids are removed (e.g. by filtration, sedimentation) which may be commonly applied in ceramic manufacturing facilities.

EIPPCB proposal
To change the original EIPPCB proposal as follows: • To include TSS as a KEI for direct discharges and to collect data on TSS emissions to water through plant-specific questionnaires. • To aim at deriving BAT-AELs for direct TSS emissions to water. • To collect data on TSS emissions to water for indirect discharges as contextual information through plant-specific questionnaires.

3.3.2.3 Additional proposals

A number of other additional parameters are proposed as candidate KEIs in the IPs received. The detailed proposals are presented in the following sections.

3.3.2.3.1 Other metals/metalloids

Summary of initial positions
• The following parameters for metal/metalloid emissions to water are proposed by IPs: o Aluminium (Al): 2 out of 17 IPs propose to include Al as a KEI. o Arsenic (As): 2 out of 17 IPs propose to include As as a KEI. o Barium (Ba): 3 out of 17 IPs propose to include Ba as a KEI. o Manganese (Mn): 2 out of 17 IPs propose to include Mn as a KEI. o Mercury (Hg): 1 out of 17 IPs proposes to include Hg as a KEI. • The more specific comments provided on the individual parameters are as follows: o Aluminium may be present in waste water from sectors using corundum (Al_2O_3) as raw material, e.g. inorganic bonded abrasives (AT). Al was mentioned in the AT BAT study (EEB). Aluminium is widely used as precipitation/coagulation agent (DE). o Arsenic was mentioned in the INERIS study. However, it is not clear whether these discharges refer to accidental releases since the FR IP reports zero discharge of water from the CER sector excluding surface run-off water (EEB, making reference to the FR IP). o Barium needs to be monitored if sulphate in waste water from plaster mould-making is precipitated with barium, in particular for the production of sanitaryware and stove tiles (AT). Ba was mentioned in the AT BAT study (EEB). $BaCO_3$ is used in the manufacture of bricks in order to prevent/mitigate salt extraction from brickwork (DK). o Manganese compounds are used as additives to colour the bricks. There may be no data available, but high emissions of Mn to water may result in negative impacts on the environment (DK). Data should be collected to decide later whether Mn is a KEI or not (EEB). o Some metals/metalloids (e.g. Hg and As) in waste water from the production of expanded clay aggregates may be subject to monitoring depending on the materials stored (DK).
EIPPCB assessment
• The current CER BREF reports emission values for Al emissions to water from the production of wall and floor tiles and technical ceramics, in the range of < 0.1 to < 2 mg/l. The AT BAT study reports one measurement result (1.36 mg/l) for Al emissions to water from a plant producing inorganic bonded abrasives. It is not clear from the IPs if monitoring data are available throughout the EU since it seems to be monitored in only one MS (AT). Aluminium compounds are sometimes used as coagulants in waste water treatment. • The current CER BREF reports Ba emissions to water (0.32 mg/l) for the production of sanitaryware. The AT BAT study also reported emission levels for the following sectors:

sanitaryware (0.30 mg/l and 0.64 mg/l) and stove tiles (< 0.5 mg/l). Barium compounds may be used for the precipitation of sulphate resulting in waste water from the mould-making process. Barium emissions to water are monitored in two MS (AT and DK); limited data would be available.
- According to the current CER BREF, manganese compounds are used as colouring agents in ceramic sectors. There are also measurement results for a tableware plant indicating levels before and after treatment, of 0.2 mg/l and 0.035 mg/l, respectively. There is no information provided with the IPs concerning the monitoring of Mn emissions to water.
- There is no information on Hg emissions to water in the E-PRTR or in the current CER BREF. While mercury emissions to water may be relevant for some cases where certain wastes from other industries are used, Hg is present only as an unwanted impurity in waste.
- The current CER BREF does not contain information on the use of arsenic compounds and related emissions to water. In the INERIS study, As mean concentration levels of 7.5 μg/l were reported for 18 plants. However, the source of As is not clear.

EIPPCB proposal

- Not to include Al, As, Ba, Hg and Mn as KEIs for emissions to water and not to collect data on Al, Ba, Mn and As emissions to water.

3.3.2.3.2 Phenols

Summary of initial positions

- 2 out of 17 IPs propose to include phenols as a KEI. More specifically:
    - Phenols may be present in waste water from the cleaning of containers and tools used for the mixing of raw materials, in particular for the following sectors: refractory products, table- and ornamental ware and inorganic bonded abrasives (AT). Phenols were mentioned in the AT BAT study (EEB).

EIPPCB assessment

- The phenol index is monitored in one MS (AT); limited data would be available.
- There is an EN standard available for the measurement of the phenol index (EN ISO 14402). In addition, several EN standards for the measurement of individual phenolic compounds are available.
- The current CER BREF reports that phenols occur during the production of:
    - refractory products (special procedures) as decomposition products of special binding agents (i.e. coal tar, pitch, resin);
    - bricks as decomposition products of pore-forming agents (e.g. polystyrene, sawdust and paper-binding agents).
- The AT BAT study reports phenol emission for the production of refractory products, tableware and inorganic bonded abrasives. While low levels of phenol emissions were reported for refractory and tableware (i.e. < 0.1 mg/l), levels of 0.073 mg/l and 3 mg/l were reported for two plants producing inorganic bonded abrasives, plants that also reported naphthalene and formaldehyde emissions to water.

EIPPCB proposal

- Not to include phenols as a KEI and not to collect data on phenol emissions to water.

3.3.2.3.3 PAHs

Summary of initial positions
• 2 out of 17 IPs propose to include PAHs as a parameter to be included as contextual information. More specifically: o Data on PAH emissions to water from the inorganic bonded abrasives sector should be collected as contextual information with the aim to check whether naphthalene is the only relevant PAH in the CER sector (AT). PAHs were mentioned in the AT BAT study (EEB).
EIPPCB assessment
• The use of naphthalene in the production of inorganic bonded abrasives was mentioned in several sources. Therefore, it is proposed as a KEI for the production of inorganic bonded abrasives (see Section 2.2.4.1.2). The AT BAT study reports the same emission levels for naphthalene and the 16 US EPA PAHs (which include naphthalene) in the case of two different plants producing inorganic bonded abrasives, indicating that the major PAH component is naphthalene.
EIPPCB proposal
• Not to include PAHs as a KEI for emissions to water and not to collect data on PAH emissions to water.

3.3.2.3.4 Formaldehyde

Summary of initial positions
• 2 out of 17 IPs propose to include formaldehyde as a KEI. More specifically: o Formaldehyde may be present in waste water from the cleaning of containers and tools used for the mixing of raw materials, in particular for the inorganic bonded abrasives sector (AT). Formaldehyde was mentioned in the AT BAT study (EEB).
EIPPCB assessment
• Formaldehyde is monitored in one MS (AT); limited data would be available. • The current CER BREF reports that formaldehyde occurs during the production of: o refractory products (special process) as decomposition products of special binding agents (coal tar, pitch, resin); o bricks as decomposition products of pore-forming agents (polystyrene, sawdust and paper-binding agents); o inorganic bonded abrasives as binding agents (e.g. converted urea-formaldehyde condensation products). • The AT BAT study reports formaldehyde emissions to water only for inorganic bonded abrasives in relation to the waste water originating from the cleaning of mixing units. Measurement results are as follows for one plant (out of two): 0.024 mg/l in 2016 and 0.4 mg/l in 2017. The reason for this variation is not clear and no further information on the use of formaldehyde is given in the report.
EIPPCB proposal
• Not to include formaldehyde as a KEI for emissions to water and not to collect data on formaldehyde emissions to water.

3.3.2.3.5 Ammonium-N (NH_4 as N)

Summary of initial positions
• 2 out of 17 IPs propose to include ammonium-N as a KEI. More specifically: o The AT ordinance on waste water contains ELVs for NH_4-N from the CER sector (AT, EEB).
EIPPCB assessment
• NH_4-N is included in the AT national legislation. Ammonium-N emissions to water that were reported for some plants in the AT BAT study are as follows: o refractory products: 1 plant - 0.018 mg/l; o expanded clay aggregates: 1 plant - 1.01–1.58 mg/l; o tableware: 1 plant - 0.34 mg/l. • The current CER BREF mentions cases that could potentially lead to ammonium-N emissions to water: o for refractory products: the use of special binding agents which result in ammonia emissions to air; o for inorganic bonded abrasives: the use of converted urea-formaldehyde condensation products as binding agents; o the use of polyamines for glaze composition in the sanitaryware and tableware. • Ammonium-N is monitored in one MS (AT); limited data would be available.
EIPPCB proposal
• Not to include ammonium-N as a KEI for emissions to water and not to collect data on ammonium-N emissions to water.

3.3.2.3.6 Other parameters

Summary of initial positions
• The following parameters are each proposed by only one IP: o Brominated diphenyl ethers (BDE) and benzene: these parameters were mentioned in the INERIS study. However, it is not clear whether these discharges refer to accidental releases since the IP of FR indicating zero discharge of water from CER sector excluding surface run-off water (EEB, making reference to the FR IP). o One IP proposes phosphorus as a KEI without providing a particular rationale (DE).
EIPPCB assessment
• BDE and benzene are priority substances under the Water Framework Directive and emission levels were reported in the INERIS study. For BDE, the mean concentration reported (0.13 μg/l) is close to the maximum allowable concentration of the Environmental Quality Standards (EQS) (0.14 μg/l). For benzene, the mean concentration reported (0.31 μg/l) is below the maximum allowable concentration of the Environmental Quality Standards (EQS) (50 μg/l). • There is no information in the current CER BREF on possible BDE and benzene emissions to water. No information on the sources of these emissions is given in the IPs. No information is available on their monitoring in EU MS except FR. • The current CER BREF reports measurement results of phosphate emissions to water for a tableware plant indicating levels before and after treatment, of 80 mg/l and 0.4 mg/l, respectively. For the same sector, it is also mentioned that organic additives and agents and inorganic binding agents including phosphates are used to increase the strength of the plastic compounds for soft-plastic shaping. However, it is not clear whether phosphates are still used for that purpose. Total phosphorus seems to be monitored in one MS (DE); limited data would be available.

EIPPCB proposal
• Not to include brominated diphenyl ethers, benzene and phosphorus as KEIs and not to collect data on brominated diphenyl ether, benzene and phosphorus emissions to water.

3.3.2.4 Parameters proposed as contextual information

Original EIPPCB proposal
To include in the questionnaires the following parameters in order to obtain contextual information about the abatement efficiency of the waste water treatment: • pH; • conductivity; • chlorides; • fluorides; • sulphates.
Summary of initial positions
• Conductivity: 6 out of 17 IPs agree with the proposal, 1 partly agrees, 4 disagree and 6 do not provide answers. • pH: 9 out of 17 IPs agree with the proposal, 1 partly agrees, 3 disagree and 4 do not provide answers. • Chloride: 9 out of 17 IPs agree with the proposal, none partly agrees, 4 disagree and 4 do not provide answers. • Fluoride: 6 out of 17 IPs agree with the proposal, 1 partly agrees, 5 disagree and 5 do not provide answers. • Sulphate: 10 out of 17 IPs agree with the proposal, none partly agrees, 3 disagree and 4 do not provide answers. • The main comments of the IPs which agree or partly agree are as follows: o Conductivity and pH are relevant for the wall and floor tiles sectors (C.U.). o Conductivity, pH, chloride and sulphate are relevant parameters for the following sectors: bricks and roof tiles, wall and floor tiles and refractory products (ES, IT), for all sectors (NL). o Sulphate emissions to water may originate from plaster mould-making and scrubbing of flue-gas (AT). • The main comments of the IPs which disagree are as follows: o pH should be considered a KEI for several sectors since the discharge of strongly acidic or basic waste water is harmful to the environment and their abatement is possible (AT). o Fluoride should be considered a KEI. It may occur in waste waters from mixing of raw materials (cleaning of containers and tools) or glazing. ELVs are set in Austria. The generation of fluoride-containing waste water should be avoided as far as possible since the abatement of fluoride through precipitation with calcium shows a limited removal efficiency of 20 % to 30 % (AT).
EIPPCB assessment
• These parameters are proposed to be included in the questionnaires with the aim of collecting contextual information which is considered useful for assessing the waste water quality and the good operation of waste water treatment plants. • The current CER BREF reports measurement results for Cl^-, F^- and SO_4^{2-} emissions to water from several sectors. These parameters could be relevant for situations where acidic gases are treated with wet scrubbers. There is one example for this in the AT study for expanded clay aggregates. • The presence of these anions may interfere with waste water reuse. • Chloride and sulphate are often added during waste water treatment through inorganic coagulant such as aluminium sulphate, aluminium chloride, iron sulphate and iron chloride.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:
• To collect data on the following parameters as contextual information through plant-specific questionnaires:
  ○ pH;
  ○ conductivity;
  ○ chloride;
  ○ fluoride;
  ○ sulphate.

3.4 Information and data collection

3.4.1 Ceramic manufacturing installations in the EU

Original EIPPCB request

Request 11: TWG members are asked to confirm or update the total number of installations permitted for activity 3.5 of Annex I to the IED in each Member State and to provide further details on the number of installations according to the sectors.

Summary of initial positions

- 13 MS provided information on the number of installations permitted for activity 3.5 of Annex I to the IED. The total number of installations is currently 1 123. A summary of the answers provided on the sectors is given in the table below.

Country code ([1])	Wall and floor tiles	Bricks and roof tiles	Table- and ornamental ware	Refractory products	Sanitaryware	Technical ceramics	Vitrified clay pipes	Expanded clay aggregates	Inorganic bonded abrasives
AT		19		4					
BE		20		1			1	1	
CZ	4	25		9	2			1	
DE	24	114	1	12	0	4	2	1	0
DK	0	15	0	1	0	0	0	1	0
ES ([2])	141	256	1	23	2	1	0	7	0
FI	3							1	
FR	7	40	0	2	0	0	0	0	0
NL	2	36	3	1		5			>1
PL	17	173	14	8	5	7	10	5	0
PT	2	20							
SE		2		1	1				
UK	1	56	0	3	0	0	2	1	1
Total	**201**	**776**	**19**	**65**	**10**	**17**	**15**	**18**	**2**

([1]) Information on Italian plants will be provided later.
([2]) 147 plants are currently not in operation, but they keep their permit due to legal reasons. In addition, 13 plants reported are independent plants whose principal activity is spray drying.

EIPPCB assessment

- The information received from 13 MS corresponds to almost 70 % of all installations permitted under activity 3.5 of Annex I that were reported under the 2016 reporting of MS to the IED. The total number of installations in the EU seems to remain stable, with only a few variations by MS. However, it is not clear if the information provided on the operational status of 147 plants in Spain may also be valid for some plants in other MS.
- The limited number of installations reported for the production of inorganic bonded abrasives may hamper the derivation of specific BAT and BAT-A(E)PLs for this sector.

EIPPCB proposal

- To collect data from well-performing IED plants carrying out activity 3.5 of Annex I to the IED.

3.4.2 Selection of plants/installations for the plant-specific information and data collection

The experience from other BREF reviews has shown that the finalisation of a list of plants that could take part in the data collection via a questionnaire takes time, e.g. due to the need to send requests to operators, wait for responses, and finally select the most suitable plants. For this reason, and in the spirit of front-loading the work, it is recommended that TWG members start the process of selecting plants for the data collection **as early as possible** with the aim of having a draft list available in time for the Kick-off Meeting.

Original EIPPCB request

Request 12: TWG members are asked to propose well-performing plants for the data collection by filling in Document 3.

Summary of initial positions

- 6 MS proposed 150 plants/installations: AT (28 - 5 non-IED), BE (22), CZ (42), DE (34 – 16 non-IED), DK (8), ES (16). A summary of the answers provided on sectors is given in the table below:

Sector	Amount of IED plants	Amount of non-IED plants
Wall and floor tiles	5	-
Bricks and roof tiles	96	-
Table- and ornamental ware	1	5
Refractory products	19	1
Sanitaryware	3	5
Technical ceramics	-	7
Vitrified clay pipes	1	-
Expanded clay aggregates	4	1
Inorganic bonded abrasives	-	2
Total	**129**	**21**

EIPPCB assessment

- The selection of plants/installations that will participate in the data collection should take into account the representativeness in terms of sectors and plant configurations.
- No IED plants have been proposed for two sectors (i.e. technical ceramics and inorganic bonded abrasives). The reasons for this need to be further assessed.
- Non-IED installations data may only complement the data collection if considered useful; the scope of the BAT conclusions will in any case be restricted to installations falling under the scope of the IED.

EIPPCB proposal

- The TWG to complete their proposals of well-performing (including best-performing) plants/installations to be included in the data collection (see Section 2.4).

3.4.3 Environmental performance levels

Original EIPPCB request

Request 13: TWG members are asked to provide their opinion on which units are the most appropriate for collecting data on the consumption of energy, water, raw materials and on waste/residues generation and recycling in the ceramic manufacturing industry, if necessary differentiating by process or more suitable categorisation, e.g. consumption of material/energy/water per unit of mass of products/materials generated or processed, consumption per mass or volume of process liquid treated/recycled, mass or volume of waste generated, share of waste recycled.

Summary of initial positions

- **Energy consumption:**
  - Units for collecting data:
    - kWh/t (AT, CZ, ES, FR, IT), MWh/t (PL), MJ/t (BE, DE, ES, NL, EEB), GJ/t (IT);
    - MJ/m^3 (DE);
    - denominator could be weight or number of production units depending on the sector (UK).
  - Averaging periods:
    - monthly (EEB);
    - yearly (AT, DE, ES, IT, NL, PL, UK);
    - both monthly and yearly (CZ).
  - Whether it is regulated in permits or not:
    - not regulated (AT, CZ, DK, ES, C.U.);
    - internal benchmarks or target values may be set (AT);
    - monitoring is required (IT);
    - the integrated permit requires energy consumption reporting in MWh/year corresponding to the annual production volume (PL);
    - annual reporting is required (PT).
- **Water consumption:**
  - Units for collecting data:
    - m^3/t (AT, BE, CZ, DE, ES, FR, IT, NL, EEB);
    - m^3/year (DK, ES, IT, PL);
    - $m^3/1000\ m^2$ (IT).
  - Averaging periods:
    - monthly (EEB);
    - yearly (AT, DE, ES, IT, NL, UK);
    - both monthly and yearly (CZ).
  - Whether it is regulated in permits or not:
    - not regulated (AT, CZ, DK, C.U.);
    - internal benchmarks or target values may be set (AT);
    - sometimes regulated as m^3/year (ES);
    - monitoring is required (IT);
    - regulated in the integrated permit (PL);
    - annual reporting is required (PT).
- **Raw material consumption:**
  - Units for collecting data:
    - t/t (AT, CZ, DE, IT, NL, PL), kg/t (BE, ES);
    - t/year (ES, IT);
    - t/m^3 (DE).
  - Averaging periods:
    - monthly (EEB);
    - yearly (AT, DE, ES, IT, NL, PL);
    - both monthly and yearly (CZ).
  - Whether it is regulated in permits or not:
    - not regulated (AT, CZ, DE, PT, C.U.);
    - internal benchmarks or target values may be set (AT);
    - sometimes regulated as t/year (ES);
    - monitoring is required (IT);
    - raw materials are listed in the permits, but consumption is not regulated (DE, PT, C.U.);
    - the integrated permit requires raw material consumption reporting in kg/year corresponding to the annual production volume (PL);
    - annual reporting is required (PT).
- **Waste water reuse:**
  - Units for collecting data:
    - percentage (AT, BE, DE, ES, IT, NL, EEB);

        - m^3/t (CZ);
        - m^3/year (ES, IT), t/year (DK).
    - Averaging periods:
        - monthly (EEB);
        - yearly (AT, ES, IT, NL);
        - both monthly and yearly (CZ).
    - Whether it is regulated in the permits or not:
        - not regulated (AT, CZ, C.U.);
        - sometimes regulated as m^3/year (ES);
        - monitoring is required (IT);
        - annual reporting is required (PT).
    - Other comments:
        - Water recovery should increase in areas where lack of water is an issue (EEB).
- **Waste/residue generation:**
    - Units for collecting data:
        - t/t (AT, CZ, DE); kg/t (BE, ES, IT, NL);
        - m^3/t (EEB);
        - t/year (ES, IT, PL).
    - Averaging periods:
        - monthly (EEB);
        - yearly (AT, DE, ES, IT, NL, UK);
        - both monthly and yearly (CZ).
    - Whether it is regulated in the permits or not:
        - not regulated (AT, CZ, C.U.);
        - sometimes regulated as t/year (ES);
        - monitoring is required (IT);
        - regulated as t/year; monitored qualitatively and quantitatively(PL).
        - annual reporting is required (PT).
    - Other comments:
        - By-products from shaping and drying are reused as raw material (DE, C.U.).
        - Define waste fractions, in particular waste from firing (EEB).
- **Recycling of waste:**
    - Units for collecting data:
        - percentage (AT, BE, CZ, ES, IT, NL, EEB);
        - t/year (ES, IT).
    - Averaging periods:
        - monthly (EEB);
        - yearly (AT, ES, IT, NL);
        - both monthly and yearly (CZ).
    - Whether it is regulated in the permits or not:
        - not regulated (AT, CZ, DE, C.U.);
        - sometimes regulated as t/year (ES);
        - monitoring is required (IT);
        - recycling is not regulated quantitatively in permits (PL);
        - annual reporting is required (PT).
    - Other comments:
        - Scrap and dust are reused, but plants do not always measure their quantity (PL).
        - By-products from shaping and drying are reused as raw material (PT, C.U.).

EIPPCB assessment

- **General:** The majority of the IPs consider yearly averages appropriate for the proposed parameters. Yearly averages enable the comparison of plant performances without the interaction of seasonal fluctuations.
- **Energy consumption:**

- The units used in the current CER BREF to express energy consumption levels are: GJ/t or MJ/kg of products (for total, thermal and electrical energy), MJ/m^3 of product (only for expanded clay aggregates) and kWh/year (electricity and natural gas consumption of example plants for inorganic bonded abrasives). The specific energy consumption should be linked to a suitable activity rate figure which may be defined for each sector during the drafting of the questionnaire.
- The specific energy consumption is proposed as a KEI for the most relevant energy-consuming process steps (i.e. firing kilns, spray dryers and ware dryers) and for the whole plant (see Section 2.2.5).
- Several BAT-AEPLs for energy consumption or energy efficiency have been derived in BREFs including activities targeted by other relevant legislation on energy efficiency or greenhouse gases (e.g. LCP BREF, CLM BREF).

- **Water and raw material consumption:**
  - Although the current CER BREF does not contain information on specific water or raw material consumption levels, there are mass flow charts including information from example plants in several sectors (e.g. showing kg water or raw material used per tonne of ceramic product or as percentages).
  - The definition of a suitable activity rate figure for the specific water or raw material consumption may follow the decision that will be taken for other consumption parameters (e.g. energy), depending on the sector.
- **Waste water reuse:**
  - The current CER BREF set a BAT-AEPL on recycling rates for process waste water, expressed in percentages, for the following sectors: wall and floor tiles, sanitaryware and tableware. The majority of the IPs are also in favour of expressing performance levels in percentages.
  - As the specific waste water discharge is proposed to be a KEI (see Section 2.2.6), a unit and an averaging period should be defined for the plant-specific data collection.
- **Waste/residue generation:**
  - Although the current CER BREF does not contain information on specific waste generation levels, there are mass flow charts including information from example plants in several sectors (e.g. showing kg waste generated/used per tonne of ceramic product or as percentages).
  - The definition of a suitable activity rate figure for the specific waste generation may follow the decision that will be taken for other consumption parameters (e.g. energy, water, raw material), depending on the sector.
- **Recycling of waste:**
  - The current CER BREF provides a BAT-AEPL on the reuse of sludge generated within waste water treatment units in the ceramic body preparation process, in particular for the manufacturing of wall and floor tiles. The BAT-AEPL is expressed as the weight ratio of weight of dry sludge added to the ceramic body.

EIPPCB proposal

- To collect data on the specific energy consumption of the processes/plants as the ratio of the respective energy consumption divided by a suitable activity rate figure and expressed as yearly averages.
- To collect data on the specific water consumption of the plants as the ratio of the total water consumption divided by a suitable activity rate figure and expressed as yearly averages.
- To collect data on the specific waste water discharge of the plants as the ratio of the total waste water discharge divided by a suitable activity rate figure and expressed as yearly averages.
- To collect data on the water recycling rate of the plants as a percentage and expressed as yearly averages.
- To collect data on the specific consumption of the hazardous chemicals (to identify during the drafting of the questionnaire) as the ratio of the total consumption of hazardous chemicals of the plant divided by a suitable activity rate figure and expressed as yearly averages.

- To collect data on the specific waste generation of the plants as the ratio of the respective waste generated divided by a suitable activity rate figure and expressed as yearly averages for the following waste streams:
    - waste water sludge;
    - used/broken ware/materials;
    - flue-gas cleaning waste.
- The TWG to decide on suitable activity rate figures for each sector during the drafting of the questionnaire.

3.4.4 Questionnaire for gathering plant-specific information and data

The content of the questionnaire will not be discussed in detail at the KoM, but will be further developed based on the general discussions and agreements reached during the KoM.

Original EIPPCB request

Request 14: TWG members are invited to provide their initial positions regarding content and format for the questionnaire template(s) as well as other important considerations on the drafting of questionnaire templates.

Summary of initial positions

- Collect information on ELVs and reference oxygen levels for each emission point and pollutant, as they may differ (AT).
- Collect information on the sulphur content of the raw materials (AT, BE).
- Collect information on input materials and types of fuel used (e.g. pore-forming agents used in brick production such as polystyrene, sawmill dust, de-inking sludge) (EEB).
- Collect information on start-up and shutdown phases of intermittently operated kilns. Emissions of some pollutants are higher during the maximum temperature phase (e.g. NO_X), while emission of others are higher during the heat-up phase (e.g. organic compounds) (AT).
- Collect information on the size of the installations (production and/or capacity) to differentiate the BAT-AEPLs between small and large installations (AT).
- All specific values should be based on production rates. Otherwise it needs to be clearly indicated if values are related to the material input (e.g. possible inclusion or exclusion of additives like binders, pore-forming agents) or to the product (AT).
- Do not collect data related to the production (e.g. consumption of energy, water and raw materials, waste generation), as such data are considered confidential business information (CZ).
- Make sure that the questionnaire allows linking the BAT candidates with the achieved environmental performance (AT).
- Differentiate between hazardous and non-hazardous waste, as it would have implications on the reuse/recycling potential or the disposal of wastes (AT).
- Collect detailed information on waste gas treatment techniques (e.g. number of chambers for regenerative thermal oxidation) (EEB).
- Develop instructions for operators to complete the questionnaires in a correct and time-efficient way (PL).

EIPPCB assessment

- Both the ROM and the BREF Guidance (i.e. Commission Implementing Decision 2012/119/EU, Section 5.4.7.2 ‘Monitoring’, p.35) summarise the contextual information that needs to be collected to understand and compare the emission data. A non-exhaustive list of important contextual information is provided below:
    - the parameters monitored;
    - the monitoring standards used (e.g. EN or ISO standards);
    - the monitoring method used (e.g. direct measurement, indirect measurement, mass/heat balances, emission factors)
    - the limit of detection (LOD) and/or the limit of quantification (LOQ);

- the associated measurement uncertainties;
- information on any corrections applied to the data (e.g. for the moisture or oxygen content of the waste gas);
- the purpose of the monitoring (e.g. compliance monitoring, operational control);
- who carried out the monitoring (operator, testing laboratory on behalf of the regulatory authority);
- the monitoring frequencies (e.g. continuous, once every year, once every day);
- the units and averaging periods used;
- an indication of the type of emission pattern (e.g. minimum/maximum values, percentiles or a graphic presentation);
- certain issues regulated by the permit conditions (e.g. ELVs, point of monitoring);
- information on operating conditions under which the measurements are performed (e.g. different process modes during production, different raw materials or fuels used, plant operating at a specified load or capacity, batch processing or production) and in particular whether the conditions are considered OTNOC or not.

- There are several parameters that may have an impact on emission and consumption levels of the plant and also on the BAT candidates and their applicability. All these parameters need to be defined during the drafting of the questionnaire in order to collect contextual information with the aim to correctly understand/interpret the data or to make comparisons between plants. A non-exhaustive list of important contextual information is provided below:
  - general plant activities and relevant sectors;
  - plant size;
  - types of processes used (e.g. tunnel or shuttle kilns, dry or wet grinding);
  - types of raw materials used (e.g. types of pore-forming agents, additives and binders used as well as characteristics of the clay materials used);
  - number and capacity of kilns operated;
  - types of fuels used (e.g. natural gas);
  - types of products (e.g. glazed or unglazed porcelain tiles, single- or double-fired glazed tiles);
  - type of abatement systems used (e.g. oxidation, fabric filter, wet scrubber).
- In recently adopted BAT conclusions, a footnote in the monitoring tables specifies that the measurements are carried out at the highest expected emission state under normal operating conditions. The ROM mentions that the highest emission state usually corresponds to the maximum (permitted) plant output. However, the type and composition of the feed materials may also influence the expected emissions. Therefore, information on operating conditions under which the measurements are performed should be collected as contextual information.
- For the parameters related to consumption (i.e. energy, water, raw materials) and generation (i.e. waste water discharge, waste) that are proposed as KEIs, data should be collected as specific values with the aim of avoiding the collection of data which may be considered CBI (confidential business information).
- For the derivation of BAT-AE(P)Ls, it is considered most important to establish a relationship between the levels and the BAT candidates. Therefore, as a first step, BAT candidates need to be identified and short descriptions need to be provided within the questionnaire.
- As mentioned earlier, it is considered useful to collect contextual information on the waste type (e.g. hazard status).
- A user manual on how to fill in the questionnaires for the data collection was provided during recent BREF reviews. A similar approach may be followed for the review of CER BREF.

EIPPCB proposal

- To follow the established BREF process for the collection of plant/installation-specific data via questionnaire(s) (see Section 3.4.4.2).
- The TWG to take into account the various IPs for the development of the questionnaire.

3.4.4.1 Collection of data at process level

Original EIPPCB request
Request 15: TWG members are invited to provide their initial positions on collecting data at process level with a view to evaluating the environmental performance of each process. In particular: o is monitoring carried out at the process step level? o for which parameter (for instance emissions to air or water, consumption of energy, raw materials or water, waste generation)? o for which processes (for instance storage and handling of raw materials, preparation and mixing of raw materials, shaping/forming of ware, drying of ware, surface treatment and decoration of ware, firing of ware, finishing of ceramic product)?
Summary of initial positions
• Environmental issues that are **not monitored** at process level include the following: o Raw material preparation, mixing, shaping: emissions to air (BE). o Drying: emissions to air (BE). o All process steps: water consumption and waste water generation (AT). o All process steps: waste generation of installation. Nevertheless, most waste types can be attributed to a specific process (AT). • Parameters or environmental issues that are **monitored** at process level include the following: o All process steps: emissions to air (AT). o Storage and handling of materials: emissions to air (ES, IT), consumption of raw materials (PL). o Preparation and mixing of raw materials: environmental issue not specified (IT). o Firing: emissions to air (BE, CZ, DE, ES, IT, PL, PT, UK, C.U.), energy consumption (AT, FR). o Drying: emissions to air (CZ, DE, ES, PL, PT, C.U.), energy consumption (AT, FR) or energy flow when heat recovery is used (AT). o Spray drying: emissions to air (DE, ES, IT, PT, UK, C.U.). o Shaping/forming of ware: waste water generation from the production of plaster moulds (AT), cooling water from presses (AT). o Surface treatment and decoration: emissions to air from glazing (DE, IT, PT) in particular for the sectors of sanitaryware and tableware (C.U.), waste water from glazing, engobing and decorating (AT). o Waste gas treatment: energy consumption of thermal oxidation units (AT). o Other: emissions to air (dust) from sorting (IT), production volume (PL).
EIPPCB assessment
• According to the IPs, emissions to air are typically monitored at process level. However, data may not be available for some process steps (e.g. raw material preparation, mixing, shaping). With the aim of establishing a comparable data set, contextual information on the origin of the emissions needs to be collected. • The current CER BREF provides specific energy consumption values at process level for almost all sectors. The IPs also indicate that such data are available. On the other hand, the IPs indicate that consumption data for water and raw materials are not available at process level. • The availability of data at process level is also assessed in Sections 2.2.5, 2.2.6, 2.2.7 and 2.2.8.
EIPPCB proposal
• No additional proposal compared to Sections 2.2.5, 2.2.6, 2.2.7 and 2.2.8.

3.4.4.2 Data collection procedure

Original EIPPCB proposal

Proposal 18: The EIPPCB proposes:

- to follow the established BREF process for the collection of plant/installation-specific data via questionnaires including the following:
    - the preparation of the draft questionnaire(s) by the EIPPCB followed by the commenting of the whole TWG, if necessary in several iterations;
    - the organisation of a questionnaire(s) workshop to finalise the questionnaire(s);
    - the testing of the draft final questionnaire(s) by a selected (small) number of plants/installations;
    - the preparation of the final questionnaire(s) by the EIPPCB;
    - the distribution of the final questionnaire(s) by Member States' representatives, if deemed necessary in cooperation with the other stakeholders, to the participating plants/installations;
    - the filling in of the questionnaire(s) by the plants/installations;
    - the collection of the filled-in questionnaires by Member States' representatives;
    - the quality check of the filled-in questionnaires by Member States' representatives (possibly) with the help of a checklist that the TWG and the EIPPCB could have developed;
    - the submission of the quality-checked questionnaires to the TWG via BATIS by Member States' representatives.
- that the TWG decides on the content and format of the questionnaire(s) during the preparation of the questionnaire(s) as described above.
- to collect data over the last 3 years or for the last three measurement campaigns.

Summary of initial positions

- For all the bullet points described above, at least 12 out of 17 IPs are in agreement with the proposal and none disagree. Five IPs partly agree with some proposals made by the EIPPCB and propose the following:
    - A draft questionnaire will be provided by Cerame-Unie (CZ, C.U.).
    - A questionnaire(s) workshop is needed only if conflicting comments are received which cannot be solved without a physical meeting (EEB).
    - The distribution of the final questionnaire(s) to the participating plants should only be carried out through the Member States' competent authorities (IT).
    - Data should be collected from continuous monitoring for the last 3 years and from periodic monitoring for at least the last three measurement campaigns (EEB).
    - For new or retrofitted plants, any data available should be collected since the results of three measurement campaigns are not always available (NL).

EIPPCB assessment

- The proposed questionnaire development follows the four stages mentioned in the IP: draft preparation, commenting (in iterations), testing and finalisation. Depending on the TWG's decision a dedicated TWG workshop may be organised to finalise the questionnaire.
- Any proposals for the questionnaire by TWG members would be welcome within the defined deadlines (see Section 2.4).
- As mentioned in the call for IPs, the final questionnaire will be sent to, filled in by and collected from operators, followed by a first quality check of the filled-in data and information by the corresponding MS representatives. This quality-check by MS representatives (foreseen in Section 4.2.2 of the BREF Guidance) is considered of paramount importance for a correct setting of BAT and BAT-AEPLs.
- As per the BREF Guidance (Section 5.2.3), the data provided should be from recent years (especially emission and consumption data). Data from at least last 3 years were collected during recent BREF reviews to cover the yearly variations. It is also reasonable to collect data for the last three measurement campaigns for cases where less frequent measurements are carried out.
- Proposals on how to handle confidential data are given in Section 2.3.2.

EIPPCB proposal

To slightly modify the original EIPPCB proposal as follows:

- To follow the established BREF process for the collection of plant/installation-specific data via questionnaires including the following:
    - the preparation of the draft questionnaire by the EIPPCB followed by the commenting of the whole TWG, if necessary in several iterations;
    - if deemed necessary, the organisation of a questionnaire development workshop to finalise the questionnaire;
    - the testing of the draft final questionnaire by a selected (small) number of plants;
    - the preparation of the final questionnaire by the EIPPCB;
    - the distribution of the final questionnaire to the participating plants through the Member States' representatives;
    - the filling in of the questionnaire by the participating plants;
    - the collection of the filled-in questionnaires by the Member States' representatives;
    - the quality check of the filled-in questionnaires by the Member States' representatives (possibly) with the help of a checklist that the TWG and the EIPPCB could have developed;
    - the submission of the quality-checked questionnaires by the Member States' representatives:
        - for the non-confidential version: submission to the TWG via BATIS;
        - for the confidential version: submission to the EIPPCB via email.
- The TWG to decide on the content and format of the questionnaire during the preparation of the questionnaire as described above.
- To collect data for the reference years 2019, 2018, 2017 or, if such data are not available, for the last 3 years for which data are available.

3.5 Techniques to consider in the determination of BAT and emerging techniques

3.5.1 Generic techniques in the ENE, EFS and ICS BREFs

Original EIPPCB request
Proposal 20: The EIPPCB proposes to refer to 'horizontal' BREFs for generic techniques, namely: • the ENE BREF for generic techniques associated with energy efficiency; • the EFS BREF for generic techniques associated with the storage, transfer and handling of materials; • the ICS BREF for generic industrial cooling systems; and to include in the CER BREF only techniques that are specific to the ceramic manufacturing industry.
Summary of initial positions
• 16 out of 17 IPs agree with the proposal, 1 partly agrees, none disagree. • The main comment of the IP which partly agrees is as follows: o Instead of referring to the relevant techniques of 'horizontal' BREFs, include the information in the revised CER BREF in order to make it more visible to permit writers (EEB).
EIPPCB assessment
• In order to avoid duplications, the CER BREF should only include information on techniques that are specific to the ceramic manufacturing industry. However, BAT conclusions may include generic techniques related to energy efficiency, to storage, transfer and handling of materials as well as to industrial cooling systems (included in the ENE, EFS or ICS BREFs). • The ICS BREF only covers indirect cooling with water, not all industrial cooling systems.
EIPPCB proposal
To slightly modify the original EIPPCB proposal as follows: to refer to 'horizontal' BREFs for generic techniques, namely: • the ENE BREF for generic techniques to increase energy efficiency; • the EFS BREF for generic techniques to reduce emissions from the storage, transfer and handling of materials; • the ICS BREF for generic techniques associated with indirect cooling with water; and to include in the CER BREF only techniques that are specific to the ceramic manufacturing industry.

3.5.2 Techniques to consider in the determination of BAT in the current CER BREF

Original EIPPCB request
Request 16: TWG members are asked to evaluate the 'Techniques to consider in the determination of BAT' and the 'Emerging techniques' in the 2007 CER BREF and to indicate in the corresponding section of Document 3 the following information for the CER sector: • any obsolete techniques, i.e. that are no longer used; • which technique descriptions require updating (and which part of the information needs to be updated, e.g. description, emission/consumption information, applicability, economics); • what information can be provided; • any emerging techniques which could now be considered BAT candidates.

Summary of initial positions

- Most of the techniques to consider in the determination of BAT described in Chapter 4 of the current CER BREF are considered by the TWG to be still relevant but in need of updating. Several information sources have been referred to such as Austrian BAT study (AT), VDI 2585:2018 'Emission control on ceramic industry' (DE), energy management reports of the plants (PL).
- The following techniques were considered obsolete by some TWG members:
    - In the 'Reduction of energy consumption (energy efficiency)' section:
        - 'Substitution of heavy fuel oil and solid fuels by low emission fuels' (in Section 4.1.4) for the wall and floor tiles sector (C.U.). Natural gas may not be supplied to some regions. Biomass should also be considered a solid fuel (ES). Heavy oil is not used in the inorganic bonded abrasives sector (FEPA). The technique may be moved to Sections 4.2 or 4.3 of the BREF as it is related to the reduction of emissions to air (SE).
        - 'Modification of ceramic bodies' (in Section 4.1.5) for the inorganic bonded abrasives sector since the body composition is defined by application and safety requirements (FEPA).
    - In the 'Emissions of dust (particulate matter)' section:
        - 'Centrifugal separators' (in Section 4.2.3.1) and 'Sintered lamellar filters' (in Section 4.2.3.3.) (IT) – no rationale provided.
        - 'Electrostatic precipitators (ESP)' (in Section 4.2.3.5) as it is not relevant for the sector of inorganic bonded abrasives (FEPA).
    - In the 'Gaseous compounds' section:
        - The following techniques are not considered relevant for the sector of inorganic bonded abrasives (FEPA).
            - 'Reducing the input of pollutant precursors' (in Section 4.3.1),
            - 'Addition of calcium rich additives' (in Section 4.3.2),
            - 'Reduction of water vapour levels in the kiln gases' (in Section 4.3.3.2),
            - 'Internal carbonisation gas combustion' (in Section 4.3.3.3),
            - 'Low-NO_X burners'(in Section 4.3.3.4),
            - 'Cascade-type packed bed adsorbers'(in Section 4.3.4.1),
            - 'Module adsorber systems'(in Section 4.3.4.2),
            - 'Catalytic afterburning' (in Section 4.3.5.2).
        - 'Wet flue-gas cleaning' (in Section 4.3.4.4) and 'Biological scrubbers' (in Section 4.3.4.6) (IT) – no rationale provided.
    - In the 'Process waste water' section:
        - 'Water used as a raw material' (in Section 4.4.1), 'Water used as a heat exchange vehicle' (in Section 4.4.2), 'Water used as a scrubbing agent' (in Section 4.4.3) and 'Water used as a cleaning agent' (in Section 4.4.4) as these sections do not describe a BAT candidate (AT).
    - In the 'Process losses/waste' section:
        - 'Sludge re-use in other products' (in Section 4.5.1.2) (FEPA) – no rationale provided.
- In addition, one IP mentions that Sections 4.5.2.1, 4.5.2.2 and 4.6 of the current CER BREF needs to be reorganised in accordance with the standard BAT structure (AT).

EIPPCB assessment

- **Reduction of energy consumption (energy efficiency):**
    - Natural gas is commonly used in most of the sectors of the ceramic manufacturing industry. Other fuels may also be used depending on several factors such as product specifications, type of kilns/dryers and availability of fuels. Section 2.3.4.2.2 of the current BREF mentions the use of biomass in particular for the production of expanded clay aggregates. Data should be collected on alternative fuels that are used in the different sectors.
    - Section 4.1.5 of the current CER BREF already mentions that the modification of

ceramic bodies may not be possible for all ceramic products due to market requirements on the shape and composition of the products. The forthcoming data collection should allow the clarification of the situation in terms of sectors and products.

- **Emissions of dust (particulate matter):**
  - Centrifugal separators and sintered lamellar filters are considered obsolete by only one IP which does not provide any rationale. However, several other IPs consider that these techniques are relevant for the ceramic manufacturing industry indicating the necessity to include them in the data/information collection with the aim to further specify the operational performance and possible restrictions related to these techniques.
  - When a technique is not considered relevant for a specific sector, this does not necessarily mean that it is also not relevant for other sectors. The forthcoming data collection should allow the clarification of the situation.
- **Gaseous compounds:**
  - It is not clear why several techniques are not considered relevant for the inorganic bonded abrasives sector. The forthcoming data collection should seek data and information on possible restrictions in relation to sectors and products.
  - One IP considers the techniques in Sections 4.3.4.4 and 4.3.4.6 obsolete without providing any rationale, while other IPs refer to additional sources of information supporting the importance of these techniques.
- **Process waste water:**
  - Sections 4.4.1 to 4.4.4 contain information on water use in the ceramic manufacturing industry. These sections are not structured according to the standard 10-heading format. Information contained in these sections may be used to draft a possible BAT candidate on the reuse and recycling of process waste water.
- **Process losses/waste:**
  - Only one IP considers the technique in Section 4.5.1.2 obsolete which in general describes the use of sludge generated in other sectors of the ceramic manufacturing industry. The same IP considers the previous technique on the use of internally generated sludge (see Section 4.5.1.1) important and mentions that additional information could be provided. Possible restrictions related to these two techniques should be further addressed within the forthcoming data collection.
- Sections 4.5.2.1, 4.5.2.2 and 4.6 of the current CER BREF are not structured according to the standard 10-heading format. Sections 4.5.2.1 and 4.5.2.2 include information on the applied practices and considerations for the recycling and reuse of waste generated both internally and externally. This information may be used to draft possible specific techniques on waste recycling and reuse. Section 4.6 contains general considerations on noise reduction techniques, which may be updated taking into account the generic techniques reported within other BREFs.

EIPPCB proposal

- To update and restructure Section 4.4 of the current CER BREF with the aim to add BAT candidates on the reuse and recycling of process waste water.
- To update and restructure Sections 4.5.2.1 and 4.5.2.2 of the current CER BREF with the aim to add BAT candidates on the reuse and recycling of waste generated.
- To update and restructure Section 4.6 of the current CER BREF with the aim to add BAT candidates on the reduction of noise (including generic techniques).
- The TWG to provide information using the standard 10-heading template for all the other techniques that are not mentioned above but included in Chapter 4 of the current CER BREF.

3.5.3 Emerging techniques in the current CER BREF

Original EIPPCB request

Request 16: TWG members are asked to evaluate the 'Techniques to consider in the determination of BAT' and the 'Emerging techniques' in the 2007 CER BREF and to indicate in the corresponding section of Document 3 the following information for the CER sector:

- any obsolete techniques, i.e. that are no longer used;
- which technique descriptions require updating (and which part of the information needs to be updated, e.g. description, emission/consumption information, applicability, economics);
- what information can be provided;
- any emerging techniques which could now be considered BAT candidates.

Summary of initial positions

- The IPs are summarised in Annex I.
- 7 out of 17 IPs did not provide any feedback on the list of techniques listed in the call.
- One IP indicated that the decision would be taken after the data collection (EEB).
- A summary of the comments provided by the TWG members is given below:
    - 'Radiant tube burners': There is no example of its use in the UK (UK). It is not applicable in the production of wall and floor tiles and fired refractory bricks (ES). It is still considered as an emerging technique (CZ, ES).
    - 'Microwave-assisted firing and microwave dryers': The technique is not relevant for the following sectors: production of fired refractory bricks (ES), wall and floor tiles and refractory products (C.U.), inorganic bonded abrasives – only one non-IED plant in the EU – (FEPA). It is a BAT candidate since an example plant for inorganic bonded abrasives is given in the AT BAT study (AT). It is a BAT candidate for the production of technical ceramics and tableware (C.U.). It is an emerging technique since it is not yet technically operable at industrial scale (UK).
    - 'New type of drying system for refractory products': It is not applicable in the production of fired refractory bricks (ES). There is no example of its use in the UK (UK).
    - 'Advanced process waste water management with integrated glaze recovery': The technique is not relevant for the following sectors: wall and floor tiles and fired refractory bricks (ES), bricks and roof tiles, refractory products, vitrified clay pipes (C.U.), inorganic bonded abrasives (FEPA). Glaze recovery is an integral part of the glazing unit for technical ceramics and tableware sectors (C.U.). It is a BAT candidate for the production of sanitaryware (PT, C.U.).
    - 'Lead-free glazing of high-quality table porcelain': The technique is not relevant for the following sectors: bricks and roof tiles, refractory products, vitrified clay pipes (C.U.), inorganic bonded abrasives (FEPA). There is no example of its use in the UK (UK). It is a BAT candidate for the production of technical ceramics and tableware. However, lead compounds may be needed for the traditional painting on porcelain (C.U.).

EIPPCB assessment

- Some IPs consider some of the emerging techniques mentioned in the current CER BREF not relevant for specific sectors. If a technique is considered relevant by at least one IP or for at least one sector, there is merit in including the mentioned technique in the data/information collection with the aim to clarify and update the status of the technique (i.e. whether it is currently used (and therefore possibly a BAT candidate) or still in development (and therefore possibly an emerging technique)). Moreover, the information submitted with the IPs does not allow a clear decision on whether some of the techniques are not relevant. More specifically on the individual techniques:
    - **Radiant tube burners:** The current CER BREF mentions that it may not be applicable in some sectors due to the scale of the production (e.g. bricks and roof tiles, vitrified clay pipes, refractory products and expanded clay aggregates).
    - **Microwave-assisted firing and microwave dryers:** The majority of the IPs

consider this technique either an emerging technique or a BAT candidate. As indicated by one IP, there is an example plant using microwave dryers for the production of inorganic bonded abrasives. VDI 2585:2018 mentions the use of microwave dryers in specific cases for the production of technical ceramics depending on product geometry and raw materials. o **New type of drying system for refractory products:** The current CER BREF mentions that several manufacturers used the technique. o **Advanced process waste water management with integrated glaze recovery:** Several IPs mention that the technique is already used in several sectors producing glazed products (i.e. sanitaryware, technical ceramics and tableware). o **Lead-free glazing of high-quality table porcelain:** Emissions of Pb to air and water are proposed as KEIs (see Sections 2.2.3.1.4 and 2.2.4.1.4).
EIPPCB proposal
• To take into account all the information provided for the drafting of the revised CER BREF. • The TWG to provide information on these techniques using the standard 10-heading template.

3.5.4 Additional techniques

Original EIPPCB request
Request 17: TWG members are asked to evaluate the preliminary list of additional techniques (i.e. technique(s) not listed in the 2007 CER BREF) which may be included in the CER BREF review and to indicate in the corresponding section of Document 3: • techniques which may be considered as BAT candidates or emerging techniques in the CER BREF review; • what information can be provided; • any other relevant technique that is missing in the proposed list(s) ('BAT candidate' or emerging technique).
Summary of initial positions
• The TWG was provided with a list of 70 additional techniques which was built on information provided by the TWG members and information screened in EU databases, including EU-funded LIFE projects[32], eco-innovation projects[33] and projects funded by the EU research and innovation programme (e.g. 7th Framework Programme[34], Horizon 2020[35]). • The IPs are summarised in Annex II. • 7 out of 17 IPs did not provide any feedback on the list of techniques listed in the call. • One IP indicated that a final assessment of all the individual techniques is not possible based on the information currently available but that these techniques would be reviewed at a later stage in the review process if some of those techniques come up as solutions to tackle specific KEIs (DE). • One IP provided information on the individual sectors, which is summarised in Annex III (C.U.). • Only two techniques are relevant for the production of inorganic bonded abrasives except: 'Carry out daily check on kiln burners to ensure complete combustion at point of entry' and 'To check that the exhaust fan speed reduces with kiln thermal input i.e. at the end of a push period in order to avoid fresh cold air to being pulled into the kiln'. These two techniques are BAT candidates (FEPA).

[32] http://ec.europa.eu/environment/life/
[33] http://ec.europa.eu/environment/eco-innovation/projects/
[34] https://ec.europa.eu/research/fp7
[35] https://ec.europa.eu/programmes/horizon2020/en

- A summary of the comments provided by the TWG members who considered that some of the additional techniques are not relevant is given below:
  1. 'LIFE: Force of the Future - New circular business concepts for the predictive and dynamic environmental and social design of the economic activities': There are some doubts on its results in practice (C.U.).
  2. 'LIFE ECONOMICK - Energy consumption and CO_2 and NO_X emissions minimised in an intermittent ceramic kiln': The technique is not relevant for the production of refractory products (ES).
  3. 'LIFE FOUNDRYTILE - Valorisation of iron foundry sands and dust in the ceramic tile production process': The percentage of valorisation is low and the quality of the ceramic tiles may be negatively affected (C.U.).
  4. 'LIFE+DIGITALIFE - A novel manufacturing process for photocatalytically activate ceramic tiles by digital printing': TiO_2 could be classified as a carcinogen (C.U.).
  5. 'LIFE CLAYGLASS - Adaptation to climate change by the structural ceramics industry through the use of recycled glass as pastry': Glass is not used for the production of refractory products since the melting temperature is too low (C.U.).
  6. 'LIFE CERAM - Zero waste in ceramic tile manufacture': There are problems with some residues (concrete, tiles mortar / glue) and no system was developed for the collection of tiles at the end of their life (C.U.).
  7. 'LIFE ENVIP - New environmentally friendly forming technique of ceramic sanitarywares by isostatic pressing': Isostatic pressing is used for some refractory products (AT, ES), but it may be too costly for normally shaped bricks (ES). Isostatic pressing may yield better results in terms of product quality, defect rates and material consumption, especially for thin-walled products (CZ). Although pressure casting is used in the manufacturing of sanitaryware products, traditional shaping methods must be used for some products, depending on their shape (PT).
  8. 'LIFE Sustainable Mission - Test 1.0 of chemical industry for global sustainable organization as industrial total symbiosis and low energy and water': The firing temperature assessed within the project is too low for the production of refractory products (C.U.).
  9. 'CERAMGLASS - Environmentally friendly processing of ceramics and glass': For the production of refractory products, there is only one-step firing (C.U.).
  10. 'P.S.V. - Polishing Sludge Valorisation': Bricks are normally not polished except for a few cases (C.U.).
  11. 'INTERCER2 - Modelling and optimal design of ceramic structures with defects and imperfect interfaces': The environmental advantages of the techniques need to be assessed (PT). The technique is not clear, it could be a finite-element method – calculation (C.U.).
  12. 'NOVAPRESS - Development of a non-destructive sensor to determine density gradient of ceramic tiles during pressing': Improvements in the forming technology should be sought instead (C.U.).
  13. 'Use of laser-induced breakdown spectroscopy (LIBS) for the quality control of secondary raw materials': The technique is used in one special recycling/waste treatment company, but not relevant for refractory products (C.U.).
  14. 'Optimised modelling and production of moulds, e.g. by using a modelling software': The technique is not relevant for fired refractory products where steel moulds are used (C.U.).
  15. 'Carbon Capture and Storage (CCS)': CCS has to be developed and offered by third parties: ,Only the capture of CO_2 is relevant for ceramic plants (C.U.).
  16. 'Automated and phased switch-off of the plant when production ceases': The technique is only applicable to continuously operated kilns (C.U.).
  17. 'Automatic compressor sequencer control': Compressed air consumption is rather low in the production of refractory products. There could be risk of destroying continuously operated kilns (C.U.).
  18. 'Heat recovery from compressors for washroom water or combustion air': Compressed air consumption is rather low in the production of refractory products (C.U.).

19. 'Ensure burner dilution air is maintained to a minimum on dryer top-up burners': For the production of refractory products, dryers are heated with hot air from the cooling zone of the kiln, no burners are installed (C.U.).
20. 'Minimise the standing time between dryer and kiln to avoid the re-absorption of moisture': The absorption of moisture is negligible for refractory products (C.U.).
21. 'Elevated temperature forming': Insufficient information is available to assess this technique (PT, C.U.).
22. 'Dryer exhaust heat recovery': Waste heat is already used for drying (C.U.).
23. 'Incorporation of biomass fuel within the product': The addition of pore-forming agents is commonly applied in the Austrian clay block industry in order to produce bricks with good insulation properties. Although this is desirable from a product use standpoint (better building insulation properties), it is an applied process rather than a BAT candidate (AT).

- The TWG members proposed the following additional techniques to be considered as BAT candidates:
  - 'Use of electric kilns instead of fossil fuel-fired kilns' (AT).
  - 'Pore-forming agents with low associated emissions of formaldehyde and acetaldehyde' (AT).
  - 'Absolute filter to abate fibre dust emissions' (AT).
  - 'Additional waste water treatment techniques: neutralisation (pH value), oil-water separation (hydrocarbons)' (AT).
  - 'Cold sintering' (EEB).

EIPPCB assessment

- The data collection should allow clarification of whether or not the additional techniques are used by the plants.
- All of the IPs identify some techniques as not relevant.
- The rationale/information submitted with the IPs does not always allow a clear decision as to whether some of the techniques are not relevant.
- There is also merit in including in the data/information collection the techniques that are considered as emerging or BAT candidates by at least one IP or for at least one sector.
- More specifically on the individual techniques that were not considered relevant by some IPs:
  - The 'LIFE: Force of the Future' project aims to demonstrate the feasibility of introducing dynamic monitoring of environmental, economic and social impacts of a ceramic company, by integrating sustainability issues into the existing production data for the company's enterprise resource planning. The project is planned to be finalised by the end of 2020.
  - The 'LIFE ECONOMICK' project results indicate considerable improvements in energy consumption of a prototype shuttle kiln used for the firing of sanitaryware and tableware products. The information may be useful to update Section 4.1.1 of the current CER BREF.
  - The 'LIFE FOUNDRYTILE', 'LIFE CLAYGLASS', 'LIFE CERAM' and 'LIFE – Sustainable Mission' projects focus on the use of waste/residues for the manufacturing of ceramics. These wastes/residues may be either external (e.g. foundry sand, waste glass and fly ash) or internal (e.g. glazing/polishing sludge). The results of these projects[36] seem promising for the production of ceramic tiles on an industrial scale. The use of foundry by-products does not have an impact on gaseous emissions associated with the firing of ceramic tiles. A similar assessment is not available for the use of waste glass. On the other hand, the 'LIFE CERAM'

[36] LIFE FOUNDRYTILE: https://www.foundrytile.eu/media/1408/foundrytile-eng.pdf
LIFE CLAYGLASS: https://www.secv.es/nota-tecnica-proyecto-life-clayglass-adaptacion-al-cambio-climatico-la-industria-ceramica-estructural-mediante-uso-vidrio-reciclado-fundente/?gm2[category__in]=4
LIFE CERAM: https://www.lifeceram.eu/media/12930/Final_report2.pdf
LASERFIRING: https://www.hispalyt.es/show_doc.asp?id_doc=5777

project reports that higher levels of SO_2 and HCl emissions to air were observed due to the use of fly ashes/dust from kiln filters and polishing sludge. The 'LIFE – Sustainable Mission' project assesses benefits for other process steps (e.g. for the finishing operation or the firing temperature). The forthcoming data/information collection need to address further possible cross-media effects due to the use of these waste/residues.

- The 'LIFE+DIGITALIFE' project reports on the use of a digital printing technique that results in reduced consumption levels of TiO_2 and water.
- The 'LIFE-ENVIP' project aims to reduce the overall environmental impacts of forming processes for sanitaryware products by using a new technology based on isostatic pressing of a granulated body. Sanitaryware products in different sizes and geometries were produced in a prototype plant.
- The 'CERAMGLASS' and 'LASERFIRING' projects investigate the use of laser-fired kilns for the production of tiles and bricks. The 'LASERFIRING' project reports the reduction of firing temperatures from 1 200 °C to 800 °C and the reduction of emissions to air of some pollutants.
- The 'W-LAP' project aims at replacing the current surface finishing stage of ceramic tiles (e.g. grinding, polishing, lapping, etc.) with an innovative polishing technology which is based on the controlled deposition of a very thin layer of polymer-based material with a suitable light refraction index onto the tile surface. However, limited information is available as to whether the technique is currently used in a plant or if there are related cross-media effects.
- The 'P.S.V.' project focuses on the recycling of sludge generated during surface treatment processes such as polishing, lapping etc. Section 4.5.1.1 of the current CER BREF includes a BAT on sludge recycling systems.
- The 'BIOMETAL DEMO' project investigates the use of sorption processes (using biomass or biopolymers) for the treatment of waste waters from ceramic manufacturing plants. The project results demonstrate low efficiency for the removal of boron compounds by using bioadsorbents.
- The 'INTERCER2' project aims at designing a software tool that simulates the forming process of ceramics from the raw materials to the final product. The tool is expected to increase productivity and reduce scrap rates. Similarly, an *in-situ* sensor was developed within the 'NOVAPRESS' project. It allows the measurement of the density of ceramic tiles during pressing.
- Laser-induced breakdown spectroscopy (LIBS) is a technique referred to in the DE UBA study[37] on the circular economy potential and BAT in the ceramic sector. LIBS allows pre-sorting of refractory products' wastes to enhance recycling. One of the potential barriers mentioned is the need for further examination of the mineral structure of the collected waste as LIBS only determines the chemical composition.
- The optimised modelling and production of moulds is also a technique referred to in the above-mentioned DE UBA study. The technique consists of the use of computer-aided design and manufacturing (CAD/CAM) of moulds during the manufacturing of sanitaryware products.
- Certain projects (e.g. 'LIFE ZEF-tile') reported additional environmental benefits such as reduced emissions to air of CO_2, NO_X and dust when adopting Carbon Capture and Storage (CCS), which may be of relevance for the manufacturing of ceramics, in particular when oxy-fuel combustion is used.
- The current CER REF describes the technique 'Minimum standing time between

[37] Innovative Techniken: Festlegung von besten verfügbaren Techniken (BVT) in Europa für die Bereiche der Keramik-, Zement-, Nahrungsmittel- und in der chemischen Industrie, Teilvorhaben 1: Keramikindustrie, Umweltbundesamt, 78/2018.

dryer and kiln' as the minimisation of the passage between the dryer and the kiln.
    - A report[38] prepared under the Industrial Energy Efficiency Accelerator (IEEA) Programme describes the technique 'Elevated temperature forming'.
- A number of additional techniques proposed by some IPs indicate overall environmental benefits for the ceramic manufacturing installations. There may be merit in including these techniques in the forthcoming data/information collection.

EIPPCB proposal

- To take into account the information provided for the drafting of the revised CER BREF.
- The TWG to provide information on these techniques using the standard 10-heading template.

[38] Industrial Energy Efficiency Accelerator, Guide to the Brick Sector, Carbon Trust, 2010.

ANNEX I: SUMMARY OF INITIAL POSITIONS ON EMERGING TECHNIQUES IN THE CURRENT CER BREF

TWG Member/Observer	Technique				
	Radiant tube burners (in Section 6.1)	**Microwave-assisted firing and microwave dryers (in Section 6.2)**	**New type of drying system for refractory products (in Section 6.3)**	**Advanced process waste water management with integrated glaze recovery (in Section 6.4)**	**Lead-free glazing of high-quality table porcelain (in Section 6.5)**
AT	NP	BC	NP	NP	NP
BE	NP	NP	NP	NP	NP
CERAMEUNIE	NR	BC	NR	BC	BC
CZ	ET	ET	NR	ET	ET
DE	NP	NP	NP	NP	NP
DK	NP	ET	BC	NP	NP
EEB	NP	NP	NP	NP	NP
ES	ET	ET	NR	ET	NP
FEPA	NR	NR	NR	NR	NR
FI	NP	NP	NP	NP	NP
FR	NP	NP	NP	NP	NP
IT	NP	NP	BC	BC	BC
NL	NP	NP	NP	NP	NP
PL	NP	ET	NP	BC	NP
PT	NR	ET	NP	BC	BC
SE	NP	NP	NP	NP	NP
UK	NR	ET	NR	BC	NR
NB: BC = BAT candidate; ET = emerging technique; NP = no position expressed; NR = not relevant.					

ANNEX II: SUMMARY OF INITIAL POSITIONS ON ADDITIONAL TECHNIQUES TO CONSIDER IN THE DETERMINATION OF BAT

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
LIFE: Force of the Future - New circular business concepts for the predictive and dynamic environmental and social design of the economic activities	NP	NR	ET	ET	ET	NR	ET	NP	ET	NP
LIFE ECONOMICK - Energy consumption and CO_2 and NO_X emissions minimised in an intermittent ceramic kiln	BC	ET	ET	NP	NR	NR	BC	ET	ET	NP
LIFE ECLAT - New model of circular economy that also predisposes the use of waste materials in other industries	NP	ET	ET	NP	ET	NR	ET	NP	ET	NP
Waste3 - Extreme energy-free valorisation of copper metallurgical waste in heating elements and semiconductive nanoceramic enamels	NP	ET	NR	NP	NR	NR	NP	NP	ET	NP
LIFE FOUNDRYTILE - Valorisation of iron foundry sands and dust in the ceramic tile production process	NP	ET	ET	NP	ET	NR	NP	NP	ET	NP
LIFE+DIGITALIFE - A novel manufacturing process for photocatalytically activate ceramic tiles by digital printing	NP	BC	ET	NP	ET	NR	ET	NP	BC	NP
LIFE ReTSW-SINT - Recycling of thermal spray waste in sintered products	NP	ET	ET	NP	ET	NR	NP	NP	ET	NP
LIFE CLAYGLASS - Adaptation to climate change by the structural ceramics industry through the use of recycled glass as pastry	NP	ET	NR	NP	ET	NR	ET	ET	ET	NP

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
LIFE CERAM - Zero waste in ceramic tile manufacture	NP	BC	NR	ET	ET	NR	ET	ET	BC	NP
LIFE ENVIP - New environmentally friendly forming technique of ceramic sanitarywares by isostatic pressing	BC	BC	ET	NP	NR	NR	NP	ET	ET	NP
LIFE ZEF-tile - Zero Emission Firing strategies for ceramic tiles by oxy-fuel burners and CO_2 sequestration with recycling of by-products	NP	ET	NR	ET	ET	NR	ET	NP	ET	NP
LIFE Sustainable Mission - Test 1.0 of chemical industry for global sustainable organization as industrial total symbiosis and low energy and water	NP	BC	NR	NP	NR	NR	ET	NP	ET	NP
LIFE HEART - Improved heat recovery in clay roof tiles and bricks production	BC	BC	NR	NP	ET	NR	NP	ET	ET	NP
CERAMGLASS - Environmentally friendly processing of ceramics and glass	NP	ET	NR	NP	ET	NR	ET	NP	ET	NP
Low resources Low energy - Ennobling mixture of waste for full low-energy replacement of exhaustible natural resources in building materials output	NP	ET	ET	NP	ET	NR	ET	NP	ET	NP
W-LAP - Waste eliminating and water-free new revolutionary technology for surface treatment of marbles, stones and tiles	NP	NR	ET	NP	NR	NR	ET	ET	NR	NP
LEAD-COLOURED LEAD-FREE - Replacement of toxic lead compounds by new non-toxic substitutes as brilliant aid agent in polychromatic glazes	NP	BC	ET	NP	NR	NR	ET	ET	ET	NP

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
LASERFIRING - Climate change adaptation of the structural ceramics industry by decreasing the firing temperature using laser technology	NP	ET	NR	NP	ET	NR	ET	NP	ET	NP
UME - Ultrasound micro-cut ecosustainable	NP	BC	NR	NP	NR	NR	ET	NP	ET	NP
ECO-CERAMICS - Ecological ceramics optimization. Alternative to sludge disposal	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
P.S.V. - Polishing Sludge Valorisation	BC	BC	ET	NP	NR	NR	ET	NP	ET	NP
Eco bull-nose - Abrasive-abraded sludge transformation into "abrading paste", to be re-inserted in the bull-nose manufacturing cycle, by means of an innovative, self-feeding and environmental-friendly "polymeric passive wheel" system	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
GLASS PLUS - Sustainable ceramic tiles from cathode ray tube	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
ECO BULL-NOSE v2.0 - A new eco-process for the finishing of high-quality ceramic	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
CFT - A clean cut of the ceramic floor tile	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
NATSTOCER - Sludge free-process for the production of innovative natural stone-like obtained by micro-structuring of sintered tiles	NP	ET	NR	NP	NR	NR	ET	NP	ET	NP
WINCER - Waste synergy in the production of innovative ceramic tiles	NP	ET	ET	NP	NR	NR	ET	NP	ET	NP
BIOMETAL DEMO - Biometal demonstration plant for the biological rehabilitation of metal bearing-waste waters (treating waste water originating from ceramic sector using the biosorption processes)	NP	NR	ET	NP	NR	NR	ET	NP	NR	NP

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
EDEFU - New designs of ecological furnaces	ET	ET	NR	NP	NR	NR	ET	NP	ET	NP
CERMAT2 - New ceramic technologies and novel multifunctional ceramic devices and structures	NP	NR	ET	NP	NR	NR	ET	NP	NR	NP
INTERCER2 - Modelling and optimal design of ceramic structures with defects and imperfect interfaces	NP	NR	NR	NP	NR	NR	ET	NP	NR	NP
NOVAPRESS - Development of a non-destructive sensor to determine density gradient of ceramic tiles during pressing	NP	NR	NR	NP	NR	NR	NP	NP	NR	NP
DREAM - Design for resource and energy efficiency in ceramic kilns	ET	BC	ET	NP	ET	NR	ET	NP	ET	NP
EFFIKILN - Development of an efficient hydro-based, waste heat extraction system for kiln rollers in ceramic tile production	BC	BC	ET	NP	NR	NR	ET	NP	ET	NP
DryFiciency - Waste heat recovery in industrial drying processes	ET	BC	ET	NP	NR	NR	ET	NP	ET	NP
ETEKINA - Heat pipe technology for thermal energy recovery in industrial applications	ET	BC	ET	NP	NR	NR	NP	NP	ET	NP
SMARTREC - Developing a standard modularised solution for flexible and adaptive integration of heat recovery and thermal storage capable of recovery and management of waste heat	ET	ET	ET	NP	NR	NR	ET	NP	ET	NP
ULTIMATE CERAMICS - Printed Electroceramics with Ultimate Compositions	NP	NR	NR	NP	NR	NR	NP	NP	NR	NP

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
Use of externally generated residues / wastes e.g. used bricks/tiles from dismantling and deconstruction in the manufacturing of bricks and roof tiles/wall and floor tiles, glass powder in the manufacturing of wall and floor tiles, used refractory materials (e.g. furnace linings) in the manufacture of refractory products	BC	ET	ET	NP	ET	NR	ET	NP	ET	NP
Use of Finite Element Method (FEM) to reduce rejects during drying/firing	ET	ET	NR	NP	ET	NR	ET	NP	ET	NP
Digital printing for decoration and/or glazing of wall and floor tiles	ET	ET	NR	NP	ET	NR	BC	ET	ET	NP
Use of thermographic methods e.g., for the control of glazing in the manufacturing of wall and floor tiles, for determination of defects in the manufacturing of sanitaryware	NP	ET	NR	NP	NR	NR	NP	NP	ET	NP
Use of laser-induced breakdown spectroscopy (LIBS) for the quality control of secondary raw materials	NP	ET	NR	NP	NR	NR	NP	NP	ET	NP
Optimised modeling and production of moulds e.g. by using a modelling software	ET	ET	ET	NP	NR	NR	NP	NP	ET	NP
Development of a new method for repairing material defects after the firing process in the manufacturing of sanitaryware	NP	ET	NR	NP	NR	NR	NP	NP	ET	NP
Substitution of fossil fuels (e.g. through utilization of waste fuels and renewable resources including biogas, hydrogen, syngas and power to gas techniques)	ET	ET	NR	NP	ET	NR	ET	NP	ET	NP
Biomethane firing	BC	BC	ET	NP	ET	NR	ET	NP	ET	NP
Carbon Capture Storage (CCS)	NP	ET	ET	NP	ET	NR	NP	NP	ET	NP

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
Vacuum drying combined with microwave or infrared (IR)	ET	ET	ET	NP	ET	NR	ET	NP	ET	NP
Automated and phased switch off of plant when production ceases	BC	NR	ET	NP	NR	NR	NP	NP	NR	BC
Use of VSDs on air movement fans to control speed	BC	NR	ET	NP	ET	NR	NP	NP	NR	BC
Automatic compressor sequencer control	BC	NR	ET	NP	NR	NR	NP	NP	NR	BC
Heat recovery from compressors for washroom water or combustion air	NP	NR	ET	NP	NR	NR	NP	ET	NR	NR
Ensure burner dilution air is maintained to a minimum on dryer top-up burners	BC	NR	ET	NP	NR	NR	NP	NP	NR	BC
Carry out daily check on kiln burners to ensure complete combustion at point of entry	BC	NR	NR	NP	BC	BC	NP	ET	NR	BC
To check that the exhaust fan speed reduces with kiln thermal input i.e. at the end of a push period in order to avoid fresh cold air to being pulled into the kiln	BC	NR	NR	NP	BC	BC	NP	NP	NR	BC
Increase exit controvec fan speeds to decrease brick exit temperatures	BC	NR	ET	NP	BC	NR	NP	NP	NR	NR
Minimise the standing time between dryer and kiln to avoid the re-absorption of moisture	BC	NR	ET	NP	ET	NR	NP	NP	NR	BC
Replacing high bays with efficient high-pressure sodium and T5 fluorescent for medium heights	NP	NR	NR	NP	NR	NR	NP	NP	NR	NR
Optimise throughput of preparation plant and forming by minimising downtime and optimising feed rates	NP	BC	NR	NP	ET	NR	NP	ET	ET	NR
Use of high-emissivity coating in kiln to increase heat transfer	NP	NR	NR	NP	NR	NR	NP	NP	NR	NR

Technique	TWG Member/ Observer*									
	AT	CERAME-UNIE	CZ	DK	ES	FEPA	IT	PL	PT	UK
Elevated temperature forming	NP	NR	NR	NP	NR	NR	NP	NP	NR	BC
Rock wheel generators for the clay preparation	NP	NR	NR	NP	NR	NR	NP	NP	NR	NR
Dryer exhaust heat recovery	BC	NR	NR	NP	NR	NR	ET	NP	ET	ET
Power generation from waste heat	BC	ET	ET	NP	ET	NR	NP	NP	ET	BC
Incorporation of biomass fuel within the product	NR	NR	ET	NP	NR	NR	NP	NP	NR	ET
Co-firing of kilns with syngas	NP	ET	NR	NP	ET	NR	NP	NP	ET	ET
Biomass CHP	BC	ET	NR	NP	ET	NR	NP	NP	ET	ET
Process modelling for minimum emissions	BC	ET	NR	NP	ET	NR	NP	NP	ET	ET
Process fault elimination	BC	ET	NR	NP	ET	NR	NP	ET	ET	BC

NB:
*No positions expressed by the following TWG members: BE, DE, EEB, FI, FR, NL and SE.
BC = BAT candidate; ET = emerging technique; NP = no position expressed; NR = not relevant.

ANNEX III: SUMMARY OF CERAME-UNIE'S INITIAL POSITION ON ADDITIONAL TECHNIQUES TO CONSIDER IN THE DETERMINATION OF BAT

Technique / Sector*	Wall and floor tiles	Bricks and roof tiles	Table- and ornamental ware	Refractory products	Sanitaryware	Technical ceramics
LIFE: Force of the Future - New circular business concepts for the predictive and dynamic environmental and social design of the economic activities	NR	NR	NR	NR	NR	NR
LIFE ECONOMICK - Energy consumption and CO_2 and NO_X emissions minimised in an intermittent ceramic kiln	NR	NR	ET	NR	ET	ET
LIFE ECLAT - New model of circular economy that also predisposes the use of waste materials in other industries	ET	NR	ET	NR	ET	ET
Waste3 - Extreme energy-free valorisation of copper metallurgical waste in heating elements and semiconductive nanoceramic enamels	NR	NR	ET	NR	ET	ET
LIFE FOUNDRYTILE - Valorisation of iron foundry sands and dust in the ceramic tile production process	NR	NR	ET	NR	ET	ET
LIFE+DIGITALIFE - A novel manufacturing process for photocatalytically activate ceramic tiles by digital printing	NR	NR	BC	NR	BC	BC
LIFE ReTSW-SINT - Recycling of thermal spray waste in sintered products	NR	NR	ET	ET	ET	ET
LIFE CLAYGLASS - Adaptation to climate change by the structural ceramics industry through the use of recycled glass as pastry	NR	ET	ET	NR	ET	ET
LIFE CERAM - Zero waste in ceramic tile manufacture	ET	BC	NR	NR	NR	NR
LIFE ENVIP - New environmentally friendly forming technique of ceramic sanitarywares by isostatic pressing	NR	NR	BC	NR	BC	BC
LIFE ZEF-tile - Zero Emission Firing strategies for ceramic tiles by oxy-fuel burners and CO_2 sequestration with recycling of by-products	ET	BC/ET	ET	ET	ET	ET
LIFE Sustainable Mission - Test 1.0 of chemical industry for global sustainable organization as industrial total symbiosis and low energy and water	ET	BC	ET	NR	ET	ET
LIFE HEART - Improved Heat recovery in clay roof tiles and bricks production	NR	BC	ET	ET	ET	ET
CERAMGLASS - Environmentally friendly processing of ceramics and glass	NR	NR	ET	NR	ET	ET
Low resources Low energy - Ennobling mixture of waste for full low-energy replacement of exhaustible natural resources in building materials output	NR	NR	ET	ET	ET	ET
W-LAP - Waste eliminating and water-free new revolutionary technology for surface treatment of marbles, stones and tiles	NR	NR	NR	NR	NR	NR
LEAD-COLOURED LEAD-FREE - Replacement of toxic lead compounds by new non-toxic substitutes as brilliant aid agent in polychromatic glazes	BC	BC	BC	NR	BC	BC
LASERFIRING - Climate change adaptation of the structural ceramics industry by decreasing the firing temperature using laser technology	NR	ET	ET	NR	ET	ET
UME - Ultrasound micro-cut ecosustainable	ET	NR	BC	NR	BC	BC
ECO-CERAMICS - Ecological ceramics optimization. Alternative to sludge disposal	NR	NR	ET	NR	ET	ET
P.S.V. - Polishing Sludge Valorisation	ET	BC	ET	NR	ET	ET
Eco bull-nose - Abrasive-abraded sludge transformation into	NR	NR	ET	NR	ET	ET

Technique / Sector*	Wall and floor tiles	Bricks and roof tiles	Table- and ornamental ware	Refractory products	Sanitaryware	Technical ceramics
"abrading paste", to be re-inserted in the bull-nose manufacturing cycle, by means of an innovative, self-feeding and environmental-friendly "polymeric passive wheel" system						
GLASS PLUS - Sustainable ceramic tiles from cathode ray tube	NR	NR	ET	NR	ET	ET
ECO BULL-NOSE v2.0 - A new eco-process for the finishing of high-quality ceramic	NR	NR	ET	NR	ET	ET
CFT - A clean cut of the ceramic floor tile	NP	NR	ET	NR	ET	ET
NATSTOCER - Sludge free-process for the production of innovative natural stone-like obtained by micro-structuring of sintered tiles	NR	NR	ET	NR	ET	ET
WINCER - Waste synergy in the production of innovative ceramic tiles	ET	NR	ET	NR	ET	ET
BIOMETAL DEMO - Biometal demonstration plant for the biological rehabilitation of metal bearing-waste waters (treating waste water originating from ceramic sector using the biosorption processes)	NR	NR	NR	NR	NR	NR
EDEFU - New designs of ecological furnaces	NR	BC	ET	NR	ET	ET
CERMAT2 - New ceramic technologies and novel multifunctional ceramic devices and structures	NR	NR	NR	NR	NR	NR
INTERCER2 - Modelling and optimal design of ceramic structures with defects and imperfect interfaces	NR	NR	NR	NR	NR	NR
NOVAPRESS - Development of a non-destructive sensor to determine density gradient of ceramic tiles during pressing	NR	NR	NR	NR	NR	NR
DREAM - Design for resource and energy efficiency in ceramic kilns	NR	BC	ET	ET	ET	ET
EFFIKILN - Development of an efficient hydro-based, waste heat extraction system for kiln rollers in ceramic tile production	NR	BC	ET	NR	ET	NP
DryFiciency - Waste heat recovery in industrial drying processes	NR	BC	NP	NR	NP	NP
ETEKINA - Heat pipe technology for thermal energy recovery in industrial applications	NR	BC	ET	ET	ET	ET
SMARTREC - Developing a standard modularised solution for flexible and adaptive integration of heat recovery and thermal storage capable of recovery and management of waste heat	NR	ET	NR	NR	NR	NR
ULTIMATE CERAMICS - Printed Electroceramics with Ultimate Compositions	NR	NR	NR	NR	NR	NR
Use of externally generated residues / wastes e.g. used bricks/tiles from dismantling and deconstruction in the manufacturing of bricks and roof tiles/wall and floor tiles, glass powder in the manufacturing of wall and floor tiles, used refractory materials (e.g. furnace linings) in the manufacture of refractory products (See in particular the following measures: ZM2, FM3, FM4, FFM3, SM3, GM3)	NP	NR	ET	ET	ET	ET
Use of Finite Element Method (FEM) to reduce rejects during drying/firing (See in particular the following measures: ZP7, GT8)	ET	ET	ET	ET	ET	ET
Digital printing for decoration and/or glazing of wall and floor tiles (See in particular the following measures: FG10, FG11)	NP	ET	ET	NR	ET	NP
Use of thermographic methods e.g., for the control of glazing in the manufacturing of wall and floor tiles, for determination of defects in the manufacturing of sanitaryware (See in particular the following measures: FG13, ST11)	NP	NR	ET	NR	ET	ET
Use of laser-induced breakdown spectroscopy (LIBS) for the quality control of secondary raw materials (See in particular the following measure: FFV8)	NP	NR	ET	NR	ET	ET

Technique / Sector*	Wall and floor tiles	Bricks and roof tiles	Table- and ornamental ware	Refractory products	Sanitaryware	Technical ceramics
Optimised modelling and production of moulds e.g. by using a modelling software (See in particular the following measure: SP7)	NP	ET	ET	NR	ET	ET
Development of a new method for repairing material defects after the firing process in the manufacturing of sanitaryware (See in particular the following measure: SN13)	NP	NR	ET	NR	ET	ET
Substitution of fossil fuels (e.g. through utilization of waste fuels and renewable resources including biogas, hydrogen, syngas and power to gas techniques) (See in particular Section 5.6 of the document)	NP	NP	ET	ET	ET	ET
Biomethane firing	NP	BC	ET	ET	ET	ET
Carbon Capture Storage (CCS)	NP	NR	NR	ET	NR	NR
Vacuum drying combined with microwave or infrared (IR)	NP	NR	ET	ET	ET	ET
Automated and phased switch off of plant when production ceases	NR	NR	NR	NR	NR	NR
Use of VSDs on air movement fans to control speed	NR	NR	NR	NR	NR	NR
Automatic compressor sequencer control	NR	NR	NR	NR	NR	NR
Heat recovery from compressors for washroom water or combustion air	NR	NR	NR	NR	NR	NR
Ensure burner dilution air is maintained to a minimum on dryer top-up burners	NR	NR	NR	NR	NR	NR
Carry out daily check on kiln burners to ensure complete combustion at point of entry	NR	NR	NR	NR	NR	NR
To check that the exhaust fan speed reduces with kiln thermal input i.e. at the end of a push period in order to avoid fresh cold air to being pulled into the kiln	NR	NR	NR	NR	NR	NR
Increase exit controvec fan speeds to decrease brick exit temperatures	NR	NR	NR	NR	NR	NR
Minimise the standing time between dryer and kiln to avoid the re-absorption of moisture	NR	NR	NR	NR	NR	NR
Replacing high bays with efficient high-pressure sodium and T5 fluorescent for medium heights	NR	NR	NR	NR	NR	NR
Optimise throughput of preparation plant and forming by minimising downtime and optimising feed rates	NP	NR	NR	BC	NR	NR
Use of high-emissivity coating in kiln to increase heat transfer	NR	NR	NR	NR	NR	NR
Elevated temperature forming	NR	NR	NR	NR	NR	NR
Rock wheel generators for the clay preparation	NR	NR	NR	NR	NR	NR
Dryer exhaust heat recovery	NR	NR	NR	NR	NR	NR
Power generation from waste heat	NP	NR	NR	ET	NR	NR
Incorporation of biomass fuel within the product	NR	NR	NR	NR	NR	NR
Co-firing of kilns with syngas	NP	NR	NR	ET	NR	NR
Biomass CHP	NP	NR	NR	ET	NR	NR
Process modelling for minimum emissions	NP	NR	NR	ET	NR	NR
Process fault elimination	NP	NR	NR	ET	NR	NR

NB:
*No positions expressed for the following sectors: vitrified clay pipes and expanded clay aggregates.
BC = BAT candidate; ET = emerging technique; NP = no position expressed; NR = not relevant.

ANNEX IV: SUMMARY OF INITIAL POSITIONS ON WASTE WATER SOURCES

Process steps/sectors ([1])	Preparation of raw materials	Mixing of raw materials	Shaping/forming of ware	Surface treatment of ware	Subsequent treatment of ware	Other
Wall and floor tiles	Surface run-off water (FR) Raw material preparation (PL, PT)	Cleaning operations (AT, ES, IT, PL, PT, C.U.)	Cleaning operations (AT, IT, PL) Forming of ware (ES)	Cleaning operations (AT, IT, PL) Glazing (PT, C.U.) Coating, glazing and engobing (PL)	Wet surface treatment (ES) Sawing (PL)	Wet dedusting (PL)
Bricks and roof tiles	Surface run-off water (FR, DK)	Cleaning operations (ES, IT)	Forming of ware (ES) Cleaning of moulds (IT)	NA	Wet surface treatment (ES)	NA
Tableware	Raw material preparation (DE, PT, C.U.)	Cleaning operations (DE, PT, C.U.)	Production of plaster moulds (AT)	Glazing (PT, C.U.) Surface treatment (DE)	Final cleaning of products (AT)	NA
Refractory products	Surface run-off water (FR, DK, SE)	Cleaning operations (AT, ES, IT)	Cleaning of moulds (DK, IT) Forming of ware (ES)	NA	Wet surface treatment e.g. grinding, cutting (AT, ES, C.U.)	Condensate from compressors (SE)
Sanitaryware	Raw material preparation (DE, PT, C.U.)	Cleaning operations (AT, DE, PT, C.U.)	Production of plaster moulds (AT)	Glazing (PT, C.U.) Surface treatment (DE)	Final cleaning of products (AT) Product treatment after firing (e.g. wet grinding, cutting) (AT)	NA
Technical ceramics	Raw material preparation (DE, PT, C.U.)	Cleaning operations (AT, DE, PL, PT, C.U.)	Cleaning of moulds (PL)	Glazing (PT, C.U.) Surface treatment (DE)	Product treatment after firing (e.g. wet grinding, cutting) (AT)	Washing machines, devices, tools, filters, tanks, etc. (PL) Isostatic test (PL) Sewage from the demineralisation station (PL) Cooling water (PL)
Expanded clay aggregates	Surface run-off water (DK)	NA	NA	NA	NA	NA
Inorganic bonded abrasives	NA	Cleaning of containers and tools (AT, FEPA)	Production of plaster moulds (AT)	NA	Final cleaning of products (AT) Wet surface treatment e.g. grinding, cutting (AT, FEPA)	Wet scrubbers (FEPA)

NB: some of the comments did not detail the whole range of sectors. NA = no information available
([1]) No information provided for the manufacturing of vitrified clay pipes.