

# Ceramics Manufacturing

## Subpart ZZ, Greenhouse Gas Reporting Program

### OVERVIEW

Subpart ZZ of the Greenhouse Gas Reporting Program (GHGRP) (40 CFR 98.520 – 98.528) applies to any facility that engages in ceramics manufacturing processes and meets the Subpart ZZ source category definition. Some subparts have thresholds that determine applicability for reporting, and some do not. To decide whether your facility must report under this subpart, please refer to 40 CFR 98.521 and the GHGRP [Applicability Tool](#).

This Information Sheet is intended to help facilities reporting under Subpart ZZ understand how the source category is defined, what greenhouse gases (GHGs) must be reported, how GHG emissions must be calculated and shared with EPA, and where to find more information.



## How is This Source Category Defined?

The Subpart ZZ source category applies to any facility that uses nonmetallic, inorganic materials, many of which are clay-based, to produce ceramic products such as bricks and roof tiles, wall and floor tiles, table and ornamental ware (household ceramics), sanitary ware, refractory products, vitrified clay pipes, expanded clay products, inorganic bonded abrasives, and technical ceramics (e.g., aerospace, automotive, electronic, or biomedical applications).

The source category includes facilities that annually consume at least 2,000 tons of carbonates ( $\text{CO}_3^{2-}$ ), either as raw materials or as a constituent in clay, which is heated to a temperature sufficient to allow the calcination reaction to occur, and operate a ceramics manufacturing process unit. A ceramics manufacturing process unit is a kiln, dryer, or oven used to calcine clay or other  $\text{CO}_3^{2-}$ -based materials to produce a ceramics product.



## What GHGs Must Be Reported?

Ceramics manufacturing facilities must report the following emissions:

- Carbon dioxide ( $\text{CO}_2$ ) process emissions from each ceramics process unit (e.g., kiln, dryer, or oven).
- $\text{CO}_2$  combustion emissions from each ceramics process unit.
- Methane ( $\text{CH}_4$ ) and nitrous oxide ( $\text{N}_2\text{O}$ ) combustion emissions from each ceramics process unit. Report these emissions under 40 CFR Part 98 Subpart C (General Stationary Fuel Combustion Sources). The Information Sheet on General Stationary Fuel Combustion Sources summarizes the rule requirements for calculating and reporting emissions from these units.
- $\text{CO}_2$ ,  $\text{CH}_4$ , and  $\text{N}_2\text{O}$  emissions from each stationary combustion unit other than kilns, dryers, or ovens under Subpart C.

If multiple Greenhouse Gas Reporting Program (GHGRP) source categories are co-located at a facility, the facility may also need to report greenhouse gas (GHG) emissions under a different subpart. Please refer to the relevant information sheet for a summary of the rule requirements for any other source categories located at the facility.



## How Must GHG Emissions Be Calculated?

Under Subpart ZZ, facilities that engage in ceramics manufacturing processes must calculate and report the annual process CO<sub>2</sub> emissions from each ceramics process unit as follows:

- For each ceramics process unit that meets the conditions specified in Subpart C, 40 CFR 98.33(b)(4)(ii) or (iii):
  - Calculate and report under Subpart ZZ the combined process and combustion CO<sub>2</sub> emissions by operating and maintaining a Continuous Emissions Monitoring System (CEMS) to measure CO<sub>2</sub> emissions according to the Tier 4 Calculation Methodology specified in Subpart C (found at 40 CFR 98.33(a)(4)) and all associated requirements for Tier 4.
- For each ceramics process unit that does not meet the conditions specified in Subpart C, 40 CFR 98.33(b)(4)(ii) or (iii), calculate and report the process and combustion CO<sub>2</sub> emissions from the ceramics process unit separately by using the following procedures. When using this mass balance method, process emissions are reported under Subpart ZZ and combustion emissions are reported under Subpart C.
  - For each CO<sub>3</sub><sup>2-</sup>-based raw material (including clay) charged to the ceramics process unit, either obtain the mass fractions of any CO<sub>3</sub><sup>2-</sup>-based minerals from the supplier of the raw material or by sampling the raw material, or use a default value of 1.0 as the mass fraction for the raw material;
  - Determine the quantity of each CO<sub>3</sub><sup>2-</sup>-based raw material charged to the ceramics process unit;
  - Apply the appropriate emission factor (EF) (see Table ZZ-1 below) for each CO<sub>3</sub><sup>2-</sup>-based raw material charged to the ceramics process unit.
  - Use Equation 1 of ZZ to calculate process mass emissions of CO<sub>2</sub> for each ceramics process unit:

**Equation 1 of ZZ:**  $E_{CO_2} = \sum j \left[ \left( M_j \cdot \frac{2000}{2205} \right) \cdot \sum i (MF_i \cdot EF_i \cdot F_i) \right]$

$E_{CO_2}$  = Annual process CO<sub>2</sub> emissions (metric tons/year).

$M_j$  = Annual mass of the CO<sub>3</sub><sup>2-</sup>-based raw material  $j$  consumed (tons/year).

$\frac{2000}{2205}$  = Conversion factor to convert tons to metric tons.

$MF_i$  = Annual average decimal mass fraction of CO<sub>3</sub><sup>2-</sup>-based mineral  $i$  in CO<sub>3</sub><sup>2-</sup>-based raw material  $j$ .

$EF_i$  = EF for the CO<sub>3</sub><sup>2-</sup>-based mineral  $i$  (metric tons CO<sub>2</sub>/metric tons CO<sub>3</sub><sup>2-</sup>, see Table ZZ-1).

$F_i$  = Decimal fraction of calcination achieved for CO<sub>3</sub><sup>2-</sup>-based mineral  $i$ , assumed to be equal to 1.0.

$i$  = Index for CO<sub>3</sub><sup>2-</sup>-based mineral in each CO<sub>3</sub><sup>2-</sup>-based raw material.

$j$  = Index for CO<sub>3</sub><sup>2-</sup>-based raw material.

A value of 1.0 can be used for the mass fraction ( $MF_i$ ) of CO<sub>3</sub><sup>2-</sup>-based mineral  $i$  in each CO<sub>3</sub><sup>2-</sup>-based raw material  $j$ . The use of 1.0 for the mass fraction assumes that the CO<sub>3</sub><sup>2-</sup>-based raw material comprises 100% of one CO<sub>3</sub><sup>2-</sup>-based mineral. As an alternative to the default value, you may use data provided by either the raw material supplier or a lab analysis.

- Determine the combined annual process CO<sub>2</sub> emissions from the ceramic process units at your facility using Equation 2 of ZZ:

**Equation 2 of ZZ:**  $CO_2 = \sum_1^k E_{CO_2k}$

$CO_2$  = Annual process CO<sub>2</sub> emissions from ceramic process units at a facility (metric tons).

$E_{CO_2k}$  = Annual process CO<sub>2</sub> emissions calculated from ceramic process unit  $k$  calculated using Equation 1 of ZZ (metric tons).

$k$  = Total number of ceramic process units at facility.

- Calculate and report under Subpart C the combustion CO<sub>2</sub> emissions in the ceramics process unit according to the applicable requirements in Subpart C (General Stationary Fuel Combustion Sources), found at 40 CFR 98.30 – 98.38.

**Table ZZ-1. CO<sub>2</sub> Emission Factors (EFs) for Carbonate (CO<sub>3</sub><sup>2-</sup>)-Based Raw Materials**

CO <sub>3</sub> <sup>2-</sup>	Mineral Name(s)	CO <sub>2</sub> EF*
BaCO <sub>3</sub>	Witherite, Barium carbonate	0.223
CaCO <sub>3</sub>	Limestone, Calcium carbonate, Calcite, Aragonite	0.440
Ca(Fe,Mg,Mn)(CO <sub>3</sub> ) <sub>2</sub>	Ankerite	0.408 – 0.476 **
CaMg(CO <sub>3</sub> ) <sub>2</sub>	Dolomite	0.477
FeCO <sub>3</sub>	Siderite	0.380
K <sub>2</sub> CO <sub>3</sub>	Potassium carbonate	0.318
Li <sub>2</sub> CO <sub>3</sub>	Lithium carbonate	0.596
MgCO <sub>3</sub>	Magnesite	0.522
MnCO <sub>3</sub>	Rhodochrosite	0.383
Na <sub>2</sub> CO <sub>3</sub>	Sodium carbonate, Soda ash	0.415
SrCO <sub>3</sub>	Strontium carbonate, Strontianite	0.298

\* EFs in units of kilograms (kg) of N<sub>2</sub>O emitted per metric tons of product produced.

\*\* Ankerite EFs are based on a formula weight range that assumes Iron (Fe), Magnesium (Mg), and Manganese (Mn) are present in amounts of at least 1.0%.

A checklist for data that must be monitored is available here: [Subpart ZZ Monitoring Checklist](#).



## What Information Must Be Reported?

In addition to the information required by the General Provisions in Subpart A, found at 40 CFR 98.3(c), the ceramics manufacturing facility must report the following under Subpart ZZ:

- The total number of ceramics process units at the facility and the number of units that operated during the reporting year;
- If a CEMS is used to measure CO<sub>2</sub> emissions from ceramics process units, then report under this subpart the relevant information required under Subpart C (General Stationary Fuel Combustion Sources), found at 40 CFR 98.36, for the Tier 4 Calculation Methodology and the following information:
  - Annual quantity of each CO<sub>3</sub><sup>2-</sup>-based raw material (including clay) charged to each ceramics process unit and for all units combined (tons);
  - Annual quantity of each type of ceramics product manufactured by each ceramics process unit and by all units combined (tons); and
  - Annual production capacity for each ceramics process unit (tons).

- If a CEMS is not used to measure CO<sub>2</sub> emissions from ceramics process units and process CO<sub>2</sub> emissions are calculated according to the procedures specified in Equations 1 and 2 of ZZ, report the following information:
  - Annual process emissions of CO<sub>2</sub> (metric tons) for each ceramics process unit and for all units combined;
  - Annual quantity of each CO<sub>3</sub><sup>2-</sup>-based raw material (including clay) charged to each ceramics process unit and for all units combined (tons);
  - Results of all tests used to verify each CO<sub>3</sub><sup>2-</sup>-based mineral mass fraction for each CO<sub>3</sub><sup>2-</sup>-based raw material charged to a ceramics process unit, as follows:
    - Date of test;
    - Method(s) and any variations used in the analyses; and
    - Mass fraction of each sample analyzed.
  - Method used to determine the decimal mass fraction of CO<sub>3</sub><sup>2-</sup>-based mineral, unless you used the default value of 1.0 (e.g., supplier provided information, analyses of representative samples you collected, or use of a default value of 0.005 as specified in the monitoring and quality assurance (QA) requirements of Subpart ZZ, 40 CFR 98.524(b));
  - Annual quantity of each type of ceramics product manufactured by each ceramics process unit and by all units combined (tons);
  - Annual production capacity for each ceramics process unit (tons); and
  - If missing data procedures are used (see next paragraph and Subpart ZZ, 40 CFR 98.525(b)), for each applicable ceramics process unit report the number of times in the reporting year that missing data procedures were followed to measure monthly quantities of CO<sub>3</sub><sup>2-</sup>-based raw materials or mass fraction of the CO<sub>3</sub><sup>2-</sup>-based minerals (months).

A complete record of all measured parameters used in GHG emissions calculations is required. Whenever the monitoring and QA procedures (see Subpart ZZ, 40 CFR 98.524) cannot be followed and data is unavailable, use the most appropriate of the following missing data procedures in calculations:

- If the CEMS approach is used to determine combined process and combustion CO<sub>2</sub> emissions, the missing data procedures in Subpart C, 40 CFR 98.35 apply;
- For missing data on the monthly amounts of CO<sub>3</sub><sup>2-</sup>-based raw materials charged to any ceramics process unit, use the best available estimate(s) of the parameter(s) based on all available process data or data used for accounting purposes, such as purchase records; or
- For missing data on the mass fractions of CO<sub>3</sub><sup>2-</sup>-based minerals in the CO<sub>3</sub><sup>2-</sup>-based raw materials, assume that the mass fraction of a CO<sub>3</sub><sup>2-</sup>-based mineral is 1.0, which assumes that one CO<sub>3</sub><sup>2-</sup>-based mineral comprises 100% of the CO<sub>3</sub><sup>2-</sup>-based raw material.

Document and keep records of the procedures used for all missing value estimates.



## What Records Must Be Maintained?

Reporters are required to retain records that pertain to their annual GHGRP report for at least three years after the date the report is submitted. Please see the [Subpart A Information Sheet](#) and 40 CFR 98.3(g) for general recordkeeping requirements. Specific recordkeeping requirements for Subpart ZZ are listed at 40 CFR 98.527.



## When and How Must Reports Be Submitted?

Reporters must submit their annual GHGRP reports for the previous calendar year to the EPA by March 31<sup>st</sup>, unless the 31<sup>st</sup> falls on a Saturday, Sunday, or federal holiday, in which case reports are due on the next business day. Annual reports must be submitted electronically using the [electronic Greenhouse Gas Reporting Tool \(e-GGRT\)](#), the GHGRP's online reporting system.

Additional information on setting up user accounts, registering a facility, and submitting annual reports is available on the [GHGRP Help webpage](#).



## When Can a Facility Stop Reporting?

A facility may discontinue reporting under several scenarios, which are summarized in Subpart A (found at 40 CFR 98.2(i)) and the [Subpart A Information Sheet](#).



## For More Information

For additional information on Subpart ZZ, please visit the [Subpart ZZ webpage](#). For additional information on the GHGRP, please visit the [GHGRP website](#), which includes additional information sheets, [data](#) previously reported to the GHGRP, [training materials](#), and links to Frequently Asked Questions ([FAQs](#)). For questions that cannot be answered through the GHGRP website, please contact us at: [GHGreporting@epa.gov](mailto:GHGreporting@epa.gov).

*This Information Sheet is provided solely for informational purposes. It does not replace the need to read and comply with the regulatory text contained in the rule. Rather, it is intended to help reporting facilities and suppliers understand key provisions of the GHGRP. It does not provide legal advice; have a legally binding effect; or expressly or implicitly create, expand, or limit any legal rights, obligations, responsibilities, expectations, or benefits with regard to any person or entity.*