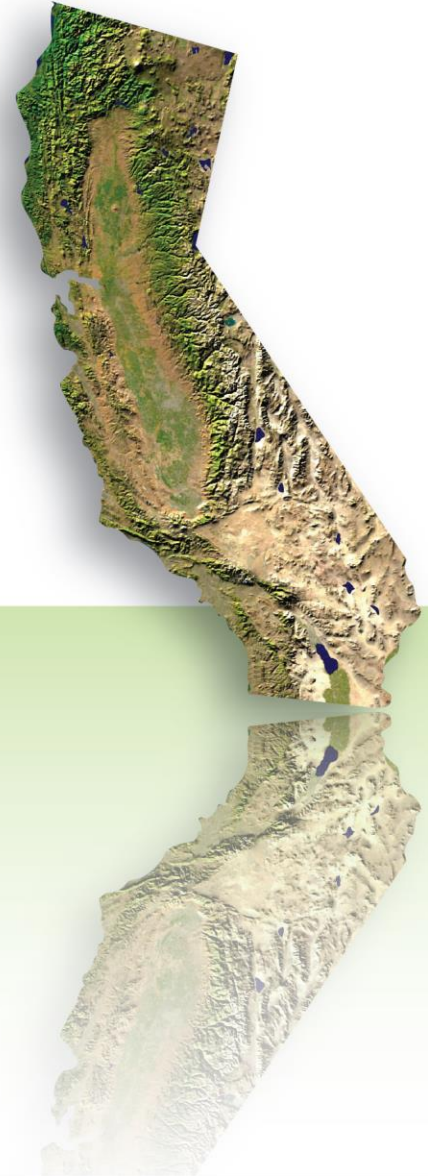


Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting



Process Emissions Specialty
Course 4.3: Glass Manufacturing

California Environmental Protection Agency

 **Air Resources Board**

Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting

Course 4: Process Emissions Specialty

4.1 Cement Production

4.2 Lime Manufacturing

4.3 Glass Manufacturing

4.4 Nitric Acid Production

4.5 Iron and Steel Production

4.6 Pulp and Paper Manufacturing

4.7 Lead Production

California Environmental Protection Agency

 **Air Resources Board**

Course 4.3 Handouts

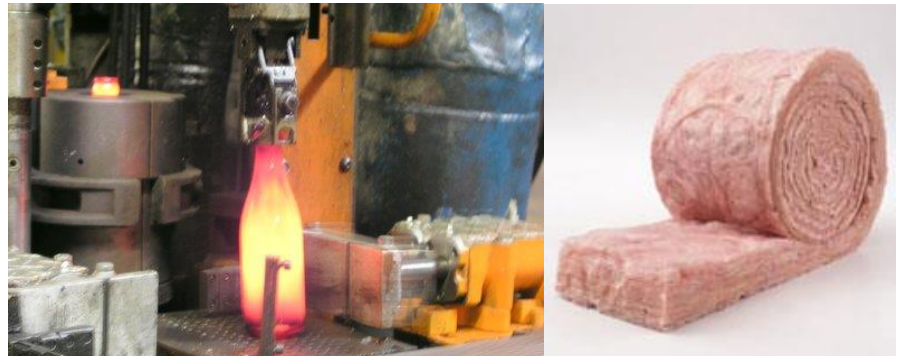
No handouts are used for this course.

Course 4.3 Glass Manufacturing

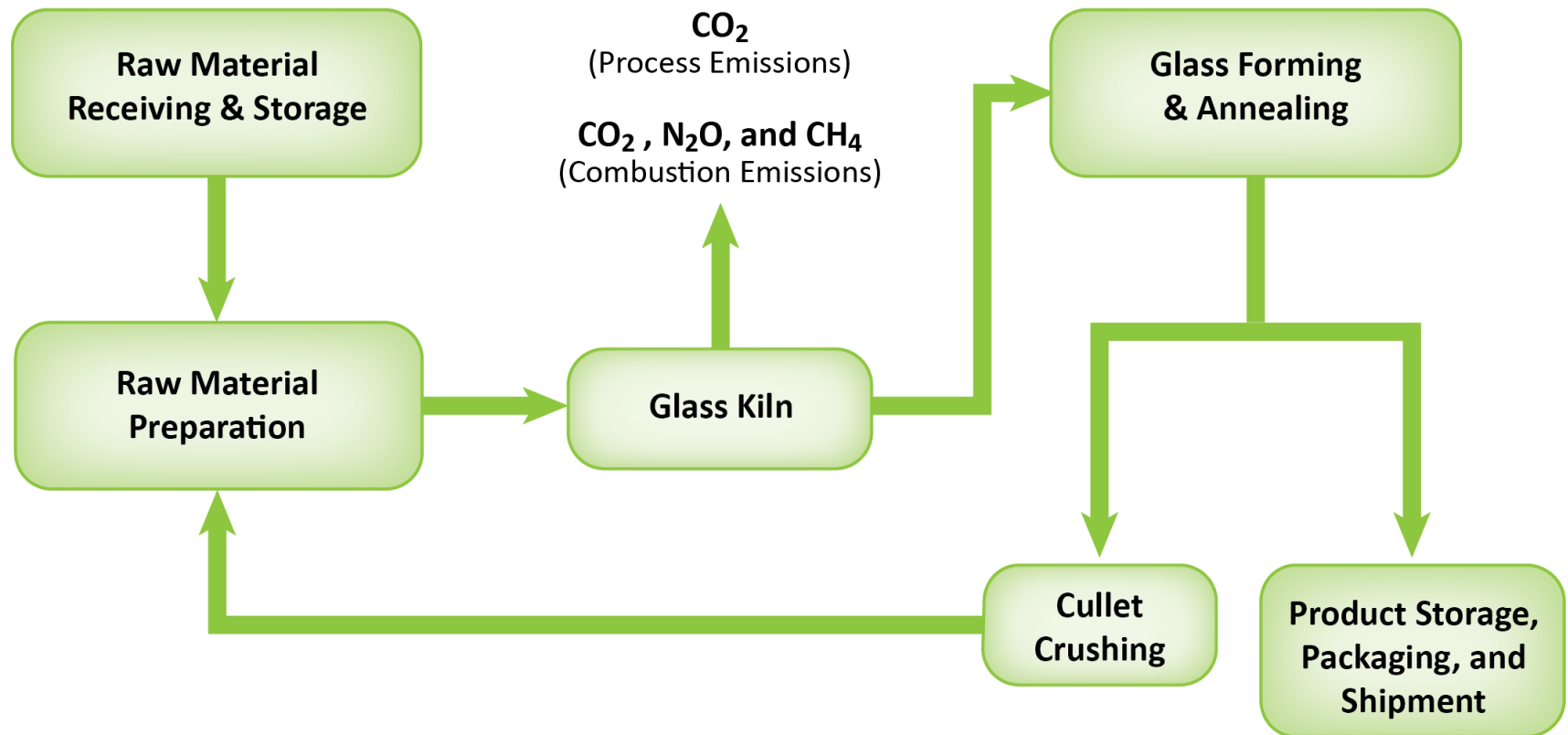
1. Overview
2. Emissions Data
3. Verifying Emissions
4. Product Data
5. Verifying Product Data
6. Group Participation Exercise

§95116 Glass Production

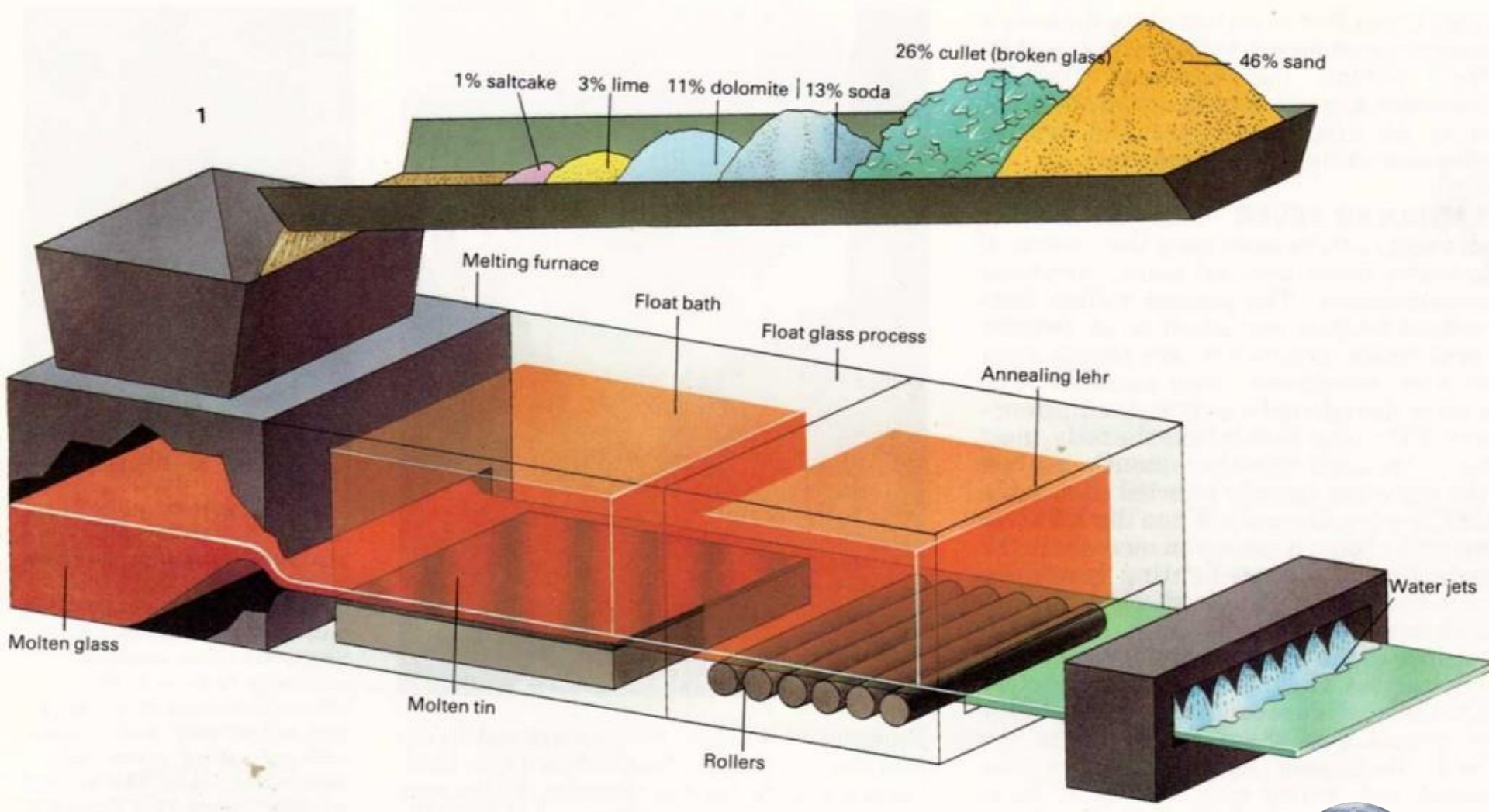
- Applies to glass manufacturing facilities that manufacture flat glass, container glass, or fiberglass by melting a mixture of raw materials to produce molten glass and form the molten glass into sheets, containers, or fibers
- Reporting is required only for continuous glass melting furnaces
 - Excludes batch and experimental furnaces
- 10 glass manufacturing facilities have been verified



Process Flow for a Glass Manufacturing Facility



Flat Glass Manufacturing Example



Emissions Data Reported for Glass Manufacturing Facilities

- These emissions must be reported:
 - CO₂ process emissions from glass kiln/furnace §95116
 - Stationary combustion emissions from all fuels § 95115
 - Includes kiln plus other ovens and heaters
- All process emissions assumed to occur in furnace
 - Process emissions are not separately reported for
 - Raw material handling - receiving, crushing, weighing, mixing
 - Glass forming - annealing, curing, molding, glass fiber forming

§ 95116 Relation to Subpart N

In addition to Subpart N, § 95116 requires

- Missing emissions data substitution for annual amount of raw materials
 - If $\leq 20\%$ missing - use best available data
 - If $> 20\%$ missing - use maximum capacity of glass kiln
- If mass fraction data from suppliers (or sampling data) is missing, a mass fraction of 1.0 (100%) must be used
- Covered product data defined as glass pulled § 95116(d)
 - No substitute data are allowed for missing covered product data

Verifying CO₂ Process Emissions (1 of 3)

Evidence to request

- Documentation describing how facility derived its carbonate-based raw material rates and mineral-based fractions
- Monthly measurements of raw material charged to each furnace
 - Calibration records for batch scales or weigh hoppers
 - Records of raw material purchases



Verifying CO₂ Process Emissions (2 of 3)

How to evaluate evidence

- Compare mass of raw material charged to each furnace with purchases 40 CFR 98.144(a)
 - Review inventory adjustment (Dec/Jan) if needed to validate reported raw material usage
 - If total quantities are accurate, a reasonable allocation of materials/emissions is acceptable between furnaces
- Reproduce CO₂ emission calculations using Eq. N-1
 - Verify equation inputs to Cal e-GGRT

Verifying CO₂ Process Emissions (3 of 3)

$$E_{\text{CO}_2} = \sum_{i=1}^n MF_i \cdot \left(M_i \cdot \frac{2000}{2205} \right) \cdot EF_i \cdot F_i$$

Carbonate-based mineral mass fraction

Calcination fraction

- A default of 1 may be used for carbonate-based mineral mass fraction (40 CFR 98.144(c))
 - Otherwise, must use documentation from suppliers and at least annual sampling/chemical analysis to verify supplier data
- A default of 1 may be used for calcination fraction (40 CFR 98.144(d))
 - Otherwise, use records of annual sampling and chemical analysis of the calcination fraction for each carbonate consumed

Verifying Missing Emissions Data Substitution (§ 95116)

- Section 95116 refers to § 95129 for missing SFC data
- For monthly quantities of carbonate-based raw materials
 - If at least 80% data capture, use Subpart N
 - If <80% data capture, substitute each missing value with max. capacity of the system (§ 95116(c)(4))

“Glass Pulled” as Covered Product Data

§ 95116(d)

- All facilities must report annual quantity of glass “pulled” from each melting furnace
- All **glass pulled** from a melting furnace is considered covered product data
 - Glass that is recycled back to the furnace is not subtracted from covered product data (cullet is included if it passes through the furnace again)
- Covered product data only includes glass pulled during that reporting period
 - Guidance
 - Inventory adjustment is not applicable
 - Glass that is off-spec is still covered product data

How Glass Pulled Is Measured

Actual measurement depends on the type of glass

- **Container glass** requires information on conveyor speed, average bottle mass (typically at 15-minute increments), bottle count, type of bottle, frequency of sheer cut, production hours for furnace and glass feed and cutter time vs. glass dumped to basement when mold shop is “down”
- **Flat glass** requires conveyor speed, dimensions of glass panels including thickness (which is QA’d several times per shift), and density measurements and calculations
- **Fiberglass** is measured by glass flow cameras that track fiber manufactured and curtailed (recycled) back to furnace; pull-rate measured by frequent weight validations

Verifying Glass Pulled (1 of 2)

Evidence to request

- Documentation describing how the operator determined its production data including
 - the location of the glass pulled measurement
 - query that compiles daily/monthly glass pulled data from a data management system
- Direct, original measurement records from product weighing (e.g., weighing measurement records, daily production data)
- Other records
 - Product sales invoices/delivery receipts for a cross-check
 - Maintenance and calibration records for weighing scales

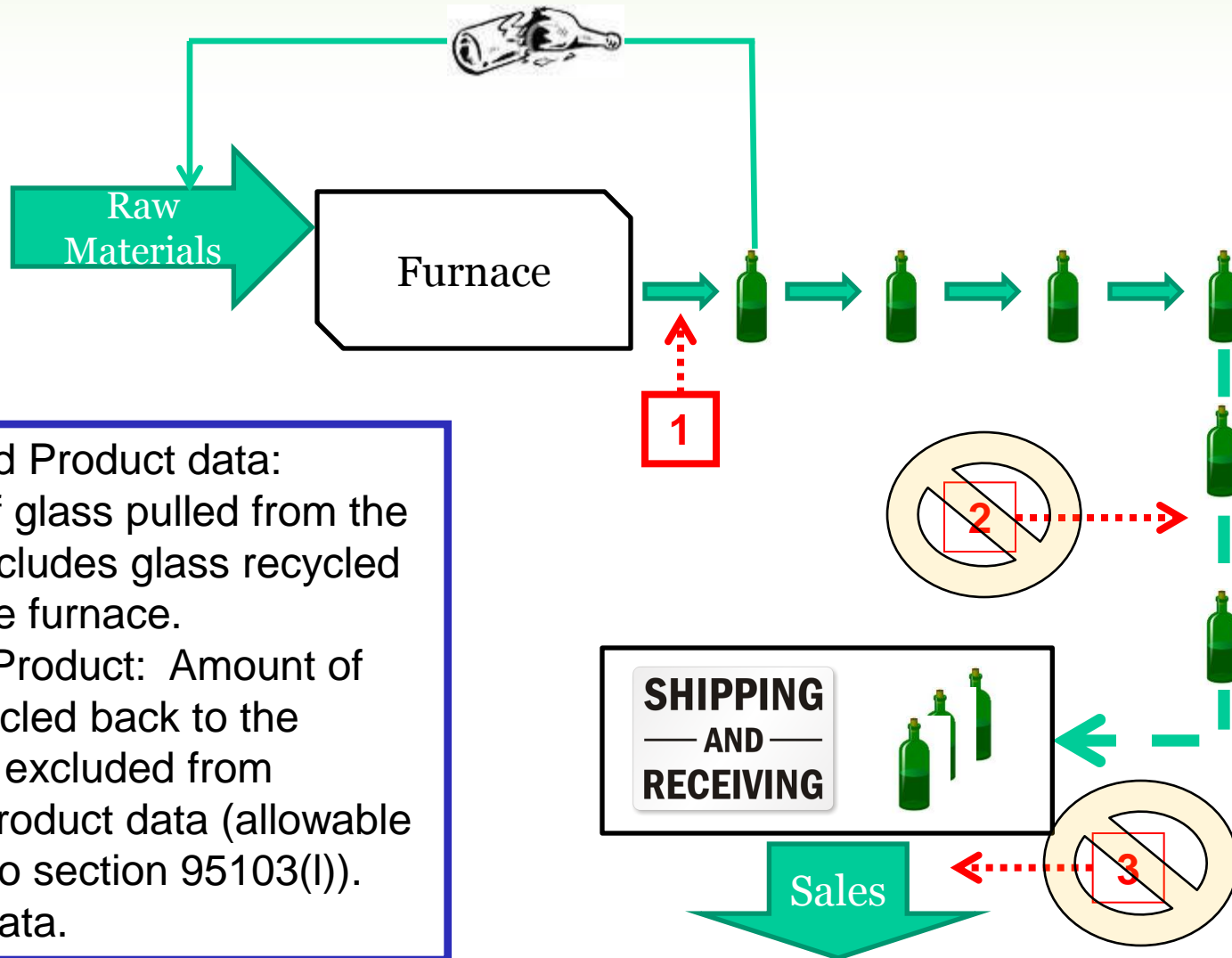
Verifying Glass Pulled (2 of 2)

How to evaluate evidence

- Confirm record completeness
- Confirm glass pulled data collection location is appropriate
- Compare summed monthly data with reported annual production data
- Cross-check with raw material and cullet usage using a material mass-balance estimation



Location of Glass Pulled Measurement



- 1: Covered Product data: Amount of glass pulled from the furnace includes glass recycled back to the furnace.
- 2: Glass Product: Amount of glass recycled back to the furnace is excluded from covered product data (allowable pursuant to section 95103(l)).
- 3: Sales data.



Group Participation Exercise 4.3.1

Glass Kiln Process Emissions (1 of 2)

- A glass manufacturing facility with one kiln uses the following quantities of raw materials in its production of flat glass:
 - Silica (SiO_2) - 57,950 short tons
 - Soda ash (Na_2CO_3) - 21,500 short tons
 - Limestone (CaCO_3) - 21,450 short tons
 - Albite (feldspar) ($\text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$) - 10,250 short tons
 - Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) - 10,450 short tons
- According to the raw material vendors, the silica, albite, and borax have a purity of 98%, while the soda ash and limestone have purities of 99.8% and 99.5%, respectively
- The plant manager estimates that calcination of the carbonates in the furnace is about 98%

Group Participation Exercise 4.3.1

Glass Kiln Process Emissions (2 of 2)

What are the estimated CO₂ process emissions in MT CO₂/yr?

- A. 17,968
- B. 16,595
- C. 18,335
- D. 18,297

Group Participation Exercise 4.3.1

Glass Kiln Process Emissions Solution (1 of 2)

- Since the facility does not have CEMS, emissions must be calculated using mass balance Eq. N-1.

$$E_{\text{CO}_2} = \sum_{i=1}^n M F_i \cdot \left(M_i \cdot \frac{2000}{2205} \right) \cdot E F_i \cdot F_i$$

- Although the facility uses silica, soda ash, limestone, albite and borax in their production process, only the soda ash and limestone are carbonate-containing materials
- The plant manager estimated the fraction of calcination for soda ash and limestone to be 98%. However, the operator must have completed tests to determine the fraction of calcination. Therefore, the verifier must assume calcination is 100%, not 98%.

Group Participation Exercise 4.3.1

Glass Kiln Process Emissions Solution (2 of 2)

Entering the values for soda ash and limestone into Eq. N-1

$$E_{CO_2} = [0.998 \times 21,500 \text{ short tons} \times (2000 \text{ MT} / 2205 \text{ short ton}) \times 0.415 \times 1] \\ + \\ [0.995 \times 21,450 \text{ short tons} \times (2000 \text{ MT} / 2205 \text{ short ton}) \times 0.440 \times 1]$$

$$E_{CO_2} = 16,595 \text{ MT CO}_2/\text{year}$$

(Answer B)

Note: Emission factors for carbonate-based raw materials in Table N-1 are in units of MT CO₂ emitted per MT of carbonate-based raw material

Questions and ARB Comments

Course 4: Process Emissions Specialty

Complete:

4.1 Cement Production

4.2 Lime Manufacturing

4.3 Glass Manufacturing

Next:

4.4 Nitric Acid Production

4.5 Iron and Steel Production

4.6 Pulp and Paper Manufacturing

4.7 Lead Production