

## BAKERIES

### DESCRIPTION

This category covers volatile organic compounds (VOC) emissions from yeast leavening of baked goods at commercial and retail bakeries. Commercial bakeries are included in standard industrial classification (SIC) code 2051 and North American industrial classification system (NAICS) code 311812. Retail bakeries are covered by SIC 5461 and NAICS 311811. This category does not include large bakeries which should be inventoried as point sources. Other emissions from bakeries due to fuel combustion are not included in this category.

Yeast-leavened bakery products include bread, bread-type rolls, pretzels, and sweet yeast goods such as doughnuts. Ethanol is the primary VOC emitted from the yeast leavening of baked goods. Baked goods that are chemically leavened with baking powder instead of yeast do not produce VOC and are not included in this source category.

There are two basic types of yeast dough mixing processes used in bakeries: sponge-dough (SCC 30203201) and straight-dough (SCC 30203202). For the purpose of estimating emissions, the length of the fermentation time is the critical difference between these two processes. It is during the fermentation process that the VOC are produced. The sponge dough process, which is most commonly used by commercial bakeries, produces the largest amount of VOC emissions because the required fermentation time can be five hours or more. The straight dough process is primarily used by retail bakeries and has a much lower VOC emissions than the sponge dough process.

### POLLUTANTS

VOC (Ethanol)

### AVAILABLE METHODS

**Activity:** VOC emissions can be estimated by multiplying an emission factor (in pounds of VOC per 1,000 pounds of bread produced) by annual bread production in the inventory area. The preferred method of estimating the amount of bread baked in the inventory area is to conduct a survey of a representative sample of typical bakeries, and scale those results by employment data available from the U.S. Census Bureau or from a state or local commerce department or labor office. The survey should be designed to obtain the number of pounds of bread baked using the straight-dough process versus the number of pounds of bread baked using the sponge-dough process.

Employment data for large commercial bakeries (SIC 2051) are available in the U.S. Census Bureau's *Census of Manufactures*,<sup>1</sup> while employment data for the smaller retail bakeries (SIC 5461) are available in the U.S. Census Bureau's *Census of Retail Trade*.<sup>2</sup> Employment data is also compiled in *County Business Patterns*.<sup>3</sup> Using employment data as a scaling factor with production figures from a representative sample of typical bakeries is a reasonable approach to estimating total production of yeast-leavened baked goods in an inventory area. Please note that employment data for SIC Code 5461, retail bakeries, is not a good surrogate for activity, and may result in overestimated emissions. Not all retail bakeries produce bread at the same location at which it is sold. Furthermore, all employees at a bakery may not be producing yeast-leavened baked goods.

An alternative method of estimating bakery emissions is to use a per capita consumption factor. At the time of this writing, the most recent production data from the U.S. Census Bureau is in the publication *1992 Census of Manufactures*.<sup>4</sup> A per capita consumption factor of 70 lb/person can be calculated using the reported weight of yeast-raised products reported under the bread, cake and related products, and the frozen bakery products categories (2051 and 2053 product codes, respectively), and 1992 U.S. population. More recent data is preferable, when it becomes available. Using a per capita consumption factor may overestimate or underestimate production within an inventory area, as it assumes that all bread is being produced in the same area it is being consumed.

**Emission Factors:** A detailed emission equation is available in AP-42 (USEPA, 1997). It requires information on percent of yeast and yeast rising times. If detailed information is available, this equation can be used. Otherwise, emission factors are available for the straight-dough and sponge-dough baking processes. The high end of the emission factor range had been assumed for bread baked using the sponge-dough process in the California Air Resources Board's area source methodology (CARB, 1998). The EPA memorandum, *VOC Emissions from Bakeries* (EPA, 1992a), suggests using the lower value of the range for sponge-dough emissions:

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<sup>1</sup> <http://www.census.gov/econ/www/ma0100.html>

<sup>2</sup> <http://www.census.gov/econ/www/re0100.html>

<sup>3</sup> <http://tier2.census.gov/cbp/cbp-sts.htm>

<sup>4</sup> The *1992 Census of Manufactures, Industry Series, Bakery Products, Industries 2051, 2052, and 2053*; MC92-I-20E, is available on the U.S. Census Bureau Web site: <http://www.census.gov/prod/1/manmin/92mmi/92manuff.html>. The telephone number for questions about this report is: (301) 457-4651.

Process	Pounds/1,000 pounds baked
Straight-dough	0.5
Sponge-dough	5 to 8

## POINT SOURCE ADJUSTMENTS

Large commercial bakeries which can emit in excess of 100 tons of VOC per year are usually considered point sources. Large commercial bakeries can be alternatively identified by either production levels or employment. For example, BAAQMD (CA) defines large commercial bakeries as any bakery producing more than 100,000 lbs. (45,454 kg) of breads, buns, and rolls per day (BAAQMD 1998). Emissions from large commercial bakeries should not be included in an area source inventory. See Volume III, Chapter 1 of *EIIP Preferred and Alternative Methods for Estimating Air Emissions*, "Introduction to Area Source Emission Inventory Development," for more information regarding point source adjustments.

## ADJUSTMENTS FOR CONTROLS

Incinerators (afterburners) are typically the only control device that can be used at bakeries. In many cases, such controls on individual, small emitting ovens may not be economically feasible. As a result, it was recommended that EPA allow states to establish appropriate exemption levels for small emitting ovens (Seitz, 1995).

## SPATIAL AND TEMPORAL ALLOCATIONS

**Spatial:** The distribution of small commercial and retail bakeries is proportional to population.

**Temporal:** Bakery production is relatively uniform annually and daily, but is slightly higher in the summer and during the night and early morning (CARB, 1998).

## OTHER EMISSION CALCULATION ISSUES

None.

**REFERENCES**

Bay Area Air Quality Management District (BAAQMD). 1998. Rule 8-42: Large Commercial Bread Bakeries, Last Revised 6/1/94.

<http://arbis.arb.ca.gov/DRDB/BA/CURHTM/R8-42.HTML>.

California Air Resource Board (CARB). 1998. Emission Inventory Procedural Manual, Volume III. <http://www.arb.ca.gov/emisinv/areasrc/areameth.html>.

EIIP. August 1996. *Preferred and Alternative Methods for Estimating Air Emissions, Volume III, Chapter 1*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

EPA. April 24, 1992a. Memorandum to SIP Inventory Preparers and EPA Regions. *VOC Emissions from Bakeries*. <http://www.epa.gov/ttnchie1/memslets.html>.

EPA. January 1992b. *Identification and Characterization of Missing or Unaccounted for Area Source Categories* (EPA-600-R-92-006). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

EPA. 1997. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

Seitz, John S. February 8, 1995. Memorandum to EPA Regional Air Division Directors. *Issues Concerning Bakery RACT Requirements*. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.