

BAKING OPERATIONS

Date Initiated:

April 7, 1994

Dates Modified / Updated:

March 12, 1998

PROCESS DESCRIPTION:

Bakeries can be major emission sources. Ethanol is produced by yeast added to the dough mixture during the fermentation (rising) stages of bread production and evaporated in the ovens during the baking process. Emissions are directly proportional to the amount of product generated. Particulate emissions from flour handling equipment is usually considered negligible due to baghouse controls. Natural gas combustion in the baking ovens can also result in emissions of NO_x, CO, and trace amounts of acetaldehyde, acetone, benzene, isobutanol, toluene, and xylenes. The standard estimation techniques used by the District to estimate emissions from baking are based upon yeast content, fermentation time, and the amount of production:

$$E_a = U_a \times [(0.95 \times Y1) + (0.19 \times T1) - (0.51 \times Y2) - (0.86 \times T2) + 1.9] \times C_i \times (1 - e)$$

$$E_h = U_h \times [(0.95 \times Y1) + (0.19 \times T1) - (0.51 \times Y2) - (0.86 \times T2) + 1.9] \times C_i \times (1 - e)$$

Where:

E_a = Annual emissions of each listed substance per baked product, (lbs/year)

E_h = Maximum hourly emissions of each listed substance per baked product, (lbs/hour)

Ua = Total annual production amount of each baked product, (tons/year)

Uh = Maximum hourly production amount of each baked product,
(tons/year)

Y1 = Initial baker's percent of yeast for each baked product, (%)

T1 = Total yeast action time for each baked product, (hours)

Y2 = Final (spike) baker's percent of yeast for each baked product, (%)

T2 = Spiking time for each baked product, (hours)

Ci = Weight fraction of each listed substance, (lbs/lb)

e = Control equipment VOC collection and removal efficiency, (%)

EMISSIONS INFORMATION:

The primary volatile organic compound emitted from baking operations is ethanol. The above emission estimation technique is obtained from District Rule 67.24 and EPA Alternative Control Technology Document for Bakery Oven Emissions, EPA 453/R-92-017, December 1992 page 2-19 to 2-20. Source testing was conducted which provided information of the toxic composition of the volatile organic compounds emitted. Emissions from natural gas combustion are calculated separately using natural gas combustion procedures.

ASSUMPTIONS / LIMITATIONS:

- Site specific test results approved by the District may be used to speciate baking emissions where appropriate. Otherwise, the following default VOC speciation values from testing at the Fornaca bakery will be used by the District;

Contaminant	Weight Percent, %
Ethanol	97.63
Acetaldehyde	1.40
Acetone	0.43
Isobutanol	0.54

- An EPA Research Triangle Institute document dated 10/25/92 indicates several trace toxic air contaminants may be present in the exhaust of bakery ovens. The EPA report indicates an acetaldehyde content of 1 to 3% of the total VOC emissions.

- Some sites have or will soon install VOC control devices on bakery ovens. The overall control device efficiencies must account for the expected collection efficiency of the device as well as the VOC destruction efficiency. Verify reported control device efficiency with District approved source test reports.

FORMS:

A separate reporting form should be completed for EACH type of recipe (different yeast contents and/or fermentation times) produced in EACH type of oven (different baking times and/or VOC control equipment). The default procedure will assume no control equipment and an emission speciation profile based on the Fornaca results.