**OPEN BURNING - RESIDENTIAL HOUSEHOLD WASTE**

***a. Source Category Description***

Open burning of residential municipal solid waste (MSW) is the purposeful burning of MSW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for MSW burning are a function of the amount of waste burned per year.

For this source category, the following SCC was assigned:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SCC** | **SCC Level 1** | **SCC Level 2** | **SCC Level 3** | **SCC Level 4** |
| 2610030000 | Waste Disposal, Treatment, and Recovery | Open Burning | Residential | Household Waste (use 26-10-000-xxx for Yard Wastes) |

***b. Activity Data***

The amount of household MSW burned was estimated using data from EPA’s report *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010*.1,2 The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2010. According to the EPA report, residential waste generation accounts for 55-65 percent of the total waste from the residential and commercial sectors.3 For the calculation of per capita household waste subject to burning, the median value of 60 percent was assumed. This information was used to calculate a daily estimate of the per capita household waste subject to burning of 1.94 lbs/person/day. Non-combustible waste, such as glass and metals, was not considered to be waste subject to burning. Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential MSW. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned.4,5 A median value of 28 percent is assumed to be burned in all counties in the United States.

Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2010 U.S. Census data.6 This ratio was then multiplied by the 2010 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2010.7 The county-level rural population was then multiplied by the per capita household waste subject to burning to determine the amount of rural household MSW generated in each county in 2010.

***c. Controls***

Controls for residential MSW burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential municipal solid waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential waste in all Colorado counties were assumed to be zero.

***d. Emission Factors***

Emission factors are reported in Table 1 below. Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report.8,9 Emission factors for HAPs are from an EPA Control Technology Center report and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report.10,11

***e. Emissions***

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of residential municipal solid waste burned per year by an emission factor.

***f. Example Calculations***

VOC emissions in Autauga County, Alabama from open burning of residential MSW:

Population of Autauga County in 2010 = 54,571

Rural fraction of Autauga County population = 0.42

Per capita MSW generated (lb/person/day) = 1.9435

Fraction of rural population that burns MSW = 0.28

Number of days in a year = 365

Factor to convert from lbs to tons = 1/2000

2010 MSW burning activity in Autauga County = 54,571 \* 0.42 \* 1.9435 \* 0.28 \* 365 \* 1/2000

2010 MSW activity in Autauga County = 2,276 tons

VOC emissions = MSW burned \* VOC emission factor

VOC emission factor = 8.56 lb/ton

VOC emissions from MSW burning in Autauga County = 2,276 tons \* 8.56 lbs/ton \* 1 ton/2000 lbs

VOC emissions from MSW burning in Autauga County in 2010 = 9.74 tons

***g. References***

1. U.S. Environmental Protection Agency, [*Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010*](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management-0), "Table 1. Materials Generated in the Municipal Waste Stream, 1960 to 2010," December 2011, (accessed June 2019).

2. U.S. Environmental Protection Agency, [*Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010*](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management-0), "Table 2. Materials Recovered in the Municipal Waste Stream, 1960 to 2010," December 2011, (accessed June 2019).

3. U.S. Environmental Protection Agency, [*Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management-0)," p. 4,December 2011, (accessed June 2019).

4. U.S. Environmental Protection Agency, Region V. “Emission Characteristics of Burn Barrels.” Prepared by Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. June 1994.

5. [*Garbage Burning in Rural Minnesota: Key Results and Findings*](https://www.pca.state.mn.us/sites/default/files/p-rrr1-01.pdf), prepared by Zenith Research Group for Minnesota Pollution Control Agency, June 2010, (accessed May 2019).

6. U.S. Census Bureau, Decennial Censuses, 2010 Census: SF1, Table P2

7. U.S. Census Bureau. [*Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2011 (NST-EST2011-01)*](https://www.census.gov/data/datasets/time-series/demo/popest/2010s-total-puerto-rico.html)*,* (accessed May 2019).

8. Huntley, Roy, U.S. Environmental Protection Agency, “state\_comparison ERTAC SS\_version7\_3 Oct 20 2009 [electronic file],” November 5, 2009.

9. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning*. Research Triangle Park, NC. October 1992.

10. U.S. Environmental Protection Agency, Control Technology Center. “Evaluation of Emissions from the Open Burning of Household Waste in Barrels.” EPA‑600/R‑97‑134a. November 1997.

11. United States Environmental Protection Agency, Office of Research and Development. *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzeno-p-Dioxin (TCCD) and Related Compounds. Part I: Estimating Exposure to Dioxin-Like Compounds. Volume 2: Sources of Dioxin-Like Compounds in the United States*. EPA/600/P-00/001Ab. Washington D.C. March 2001.

**Table 1. Emission Factors for Open Burning of Residential MSW (2610030000)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Pollutant** | **Pollutant Code** | **Emission Factor**  **(lb/ton)** | **Emission Factor**  **Reference** |
| CO | CO | 8.50E+01 | Reference 9 |
| NOX | NOX | 6.00E+00 | Reference 9 |
| PM10-FIL | PM10-FIL | 3.80E+01 | Reference 8 |
| PM10-PRI | PM10-PRI | 3.80E+01 | Reference 8 |
| PM25-FIL | PM25-FIL | 3.48E+01 | Reference 8 |
| PM25-PRI | PM25-PRI | 3.48E+01 | Reference 8 |
| SO2 | SO2 | 1.00E+00 | Reference 9 |
| VOC | VOC | 8.56E+00 | Reference 8 |
| 1,2,3,4,6,7,8-heptachlorodibenzofuran | 67562394 | 2.48E-07 | Reference 11 |
| 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin | 35822469 | 7.96E-08 | Reference 11 |
| 1,2,3,4,7,8,9-heptachlorodibenzofuran | 55673897 | 3.00E-08 | Reference 11 |
| 1,2,3,4,7,8-hexachlorodibenzofuran | 70648269 | 2.28E-07 | Reference 11 |
| 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin | 39227286 | 1.28E-08 | Reference 11 |
| 1,2,3,6,7,8-hexachlorodibenzofuran | 57117449 | 7.70E-08 | Reference 11 |
| 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin | 57653857 | 1.94E-08 | Reference 11 |
| 1,2,3,7,8,9-hexachlorodibenzofuran | 72918219 | 5.00E-09 | Reference 11 |
| 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin | 19408743 | 3.80E-08 | Reference 11 |
| 1,2,3,7,8-pentachlorodibenzofuran | 57117416 | 7.44E-08 | Reference 11 |
| 1,2,3,7,8-pentachlorodibenzo-p-dioxin | 40321764 | 1.62E-08 | Reference 11 |
| 1,2,4-trichlorobenzene | 120821 | 1.95E-04 | Reference 10 |
| 1,4-dichlorobenzene | 106467 | 6.65E-05 | Reference 10 |
| 2,3,4,6,7,8-hexachlorodibenzofuran | 60851345 | 1.24E-07 | Reference 11 |
| 2,3,4,7,8-pentachlorodibenzofuran | 57117314 | 1.30E-07 | Reference 11 |
| 2,3,7,8-tetrachlorodibenzofuran | 51207319 | 9.12E-08 | Reference 11 |
| 2,3,7,8-tetrachlorodibenzo-p-dioxin | 1746016 | 5.40E-09 | Reference 11 |
| Acenaphthene | 83329 | 1.54E-03 | Reference 10 |
| Acenaphthylene | 208968 | 2.26E-02 | Reference 10 |
| Acetalaldehyde | 75070 | 8.57E-01 | Reference 10 |
| Acrolein | 107028 | 6.19E-02 | Reference 10 |
| Anthracene | 120127 | 3.66E-03 | Reference 10 |
| Benz[a]anthracene | 56553 | 4.48E-03 | Reference 10 |
| Benzene | 71432 | 2.48E+00 | Reference 10 |
| Benzo[a]pyrene | 50328 | 4.24E-03 | Reference 10 |
| Benzo[b]fluoranthene | 205992 | 5.26E-03 | Reference 10 |
| Benzo[g,h,i,]Perylene | 191242 | 3.95E-03 | Reference 10 |
| Benzo[k]fluoranthene | 207089 | 2.05E-03 | Reference 10 |
| Chlorobenzene | 108907 | 8.48E-04 | Reference 10 |
| Chrysene | 218019 | 5.07E-03 | Reference 10 |
| Dibenzo[a,h]anthracene | 53703 | 6.46E-04 | Reference 10 |
| Fluoranthene | 206440 | 8.14E-03 | Reference 10 |
| Fluorene | 86737 | 7.31E-03 | Reference 10 |
| Hexachlorobenzene | 118741 | 4.40E-05 | Reference 10 |
| Hydrochloric Acid | 7647010 | 5.68E-01 | Reference 10 |
| Hydrogen Cyanide | 74908 | 9.36E-01 | Reference 10 |
| Indeno[1,2,3-c,d]pyrene | 193395 | 3.75E-03 | Reference 10 |
| Naphthalene | 91203 | 3.51E-02 | Reference 10 |
| Octachlorodibenzofuran | 39001020 | 7.28E-08 | Reference 11 |
| Octachlorodibenzo-p-dioxin | 3268879 | 9.94E-08 | Reference 11 |
| Pentachlorophenol | 87865 | 1.06E-04 | Reference 10 |
| Phenanthrene | 85018 | 1.46E-02 | Reference 10 |
| Phenol | 108952 | 2.80E-01 | Reference 10 |
| Polychlorinated Biphenyls | 1336363 | 5.72E-03 | Reference 10 |
| Pyrene | 129000 | 9.66E-03 | Reference 10 |
| Styrene | 100425 | 1.48E+00 | Reference 10 |