**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 2012*.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 2012. According to the 2010 version of 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 in each county was assumed to practice open burning. The ratio of rural to total population was obtained from 2010 U.S. Census data.6 This ratio was then multiplied by the 2014 U.S. Census Bureau estimate7 of the population in each county to obtain the county-level rural population for 2014. 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 2014.

***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, by land area, determined by the 2010 U.S. Census data6, 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:

Rural land fraction of Autauga County in 2010 = .97, so no controls.

Population of Autauga County in 2014 = 55,395

Rural fraction of Autauga County 2010 population = 0.42

Per capita MSW generated (lb/person/day) = 1.91

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

2014 MSW burning activity in Autauga County = 55,395 \* 0.42 \* 1.91 \* 0.28 \* 365 \* 1/2000

2014 MSW activity in Autauga County = 2,270 tons

VOC emissions = MSW burned \* VOC emission factor

VOC emission factor = 8.56 lb/ton

VOC emissions from MSW burning in Autauga County = 2,270 tons \* 8.56 lbs/ton \* 1 ton/2000 lbs

VOC emissions from MSW burning in Autauga County in 2010 = 9.7 tons

***g. Changes from 2011 Methodology***

The main change to the methodology as compared to the 2011 NEI was designation of counties that do not practice burning. In the previous methodology, the 80% urban no-burn threshold was based on the ratio of urban to rural *population*. In the current methodology, these were replaced with ratios calculated using *land area*. In both cases, this data are from the 2010 census.

***h. Puerto Rico and US Virgin Islands Emissions Calculations***

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island county, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory’s activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are “EACH”.

***i. References***

1. U.S. Environmental Protection Agency, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012*, "Table 1. Materials Generated in the Municipal Waste Stream, 1960 to 2010," February 2014, available at http://www3.epa.gov/epawaste/nonhaz/municipal/pubs/2012\_msw\_dat\_tbls.pdf (accessed December 2015).

2. U.S. Environmental Protection Agency, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2012*, "Table 2. Materials Recovered in the Municipal Waste Stream, 1960 to 2010," February 2014, available at http://www3.epa.gov/epawaste/nonhaz/municipal/pubs/2012\_msw\_dat\_tbls.pdf (accessed December 2015).

3. U.S. Environmental Protection Agency, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*," p. 4, December 2011, available at http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw\_2010\_rev\_factsheet.pdf (accessed April 2012).

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*, prepared by Zenith Research Group for Minnesota Pollution Control Agency, June 2010, available at http://www.pca.state.mn.us/index.php/view-document.html?gid=14316 (accessed June 10, 2011).

6. U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1. Available at: <http://www2.census.gov/census_2010/04-Summary_File_1/>.

7. U.S. Census Bureau. *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2014 Populations Estimates,* available at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP\_2014\_PEPANNRES&prodType=table (accessed December 2015).

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 |