Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

"Branscome, Marvin R." <marvin@rti.org>

05/09/01 07:31 AM

To: Ron Myers/RTP/USEPA/US@EPA
cc:
Subject: FW: COETF's 7-PAH Estimates

Ron,

This is what I received from Dave Ailor. Although he only provided info on the 7 PAHs, we have requested data on all of the compounds that were analyzed. I will forward that if he sends it.

Marvin Branscome
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
phone: 919-990-8643
fax: 919-990-8600

-----Original Message-----
From: David Ailor [mailto:dailor@accci.org]
Sent: Friday, September 22, 2000 4:46 PM
To: Branscome, Marvin R.
Subject: COETF's 7-PAH Estimates

Dear Marvin: This e-mail is in response to your August 11 e-mail to me requesting additional information on the speciation of the seven PAHs discussed in the May 22 comments of the AISI/ACCCI Coke Oven Environmental Task Force (COETF) on EPA's Draft PBT National Action Plan for Benzo(a)pyrene **(see "BAPCmts.doc")**. Our comments presented coke industry 7-PAH emission estimates for 1993 and 1996. These emission estimates were based in part on a speciation of estimated coke oven benzene-soluble organic (BSO) emissions, using crude coal tar analytical data previously generated by the American Coke and Coal Chemicals Institute (ACCCI) under an ACCCI project to develop "Minimum Generic Language for Crude Coal Tar Material Safety Data Sheets" ("Crude Coal Tar MSDS Project").

In this Project, 12 plants submitted samples of crude coal tar to a common laboratory for quantitative analysis of six volatile and 27 semi-volatile chemical constituents, including each of the seven PAHs addressed in the EPA study, as well as additional PAHs. The attached table **(see "BAP082~1.doc")** summarizes the results of the analyses for the seven PAHs. The COETF's coke industry emission estimates were based on the average concentration (ppm) for each of the seven PAHs.

Call me if you have any questions. DCA


BAPCmts.doc


BAP082~1.doc


ATT169608.txt

Comments of the
AISI/ACCCI Coke Oven Environmental Task Force (COETF)
on EPA's Draft PBT National Action Plan for Benzo(a)pyrene

On Wednesday, April 5, 2000, EPA provided the domestic coke industry with and asked it to comment on a draft National Action Plan (NAP) for Benzo(a)pyrene (B(a)P), as developed by the Agency's Plenary Group for the Persistent Bioaccumulative and Toxic (PBT) Pollutants Initiative. This draft NAP included emission estimates for seven polycyclic aromatic hydrocarbons (PAHs). These PAHs, which include Benz(a)anthracene, Chrysene, Benzo(b)flouranthene, Benzo(k)flouranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene, are of similar molecular weight and are primarily found on particles in air emissions.

Table 1 of Section 5.2.2 (Air Emissions) of the National Action plan contains a listing of the baseline National Toxics Inventory 7-PAH emissions estimates, by source category. In this table, "coke ovens" (charging, topside, and door leaks) is listed as the third highest source category of air emissions, contributing 143,600 lbs/yr, or 5.45 percent of the total, of 7-PAH emissions for 1993.

In the attachment that follows (see Attachment), we provide a refined estimate of 7-PAH emissions for coke oven charging, topside, and door leak air emissions, based on historical industry coal charge data, EPA-approved methodologies for estimating charging, topside, and door leak benzene soluble organic (BSO) emissions as a function of coke oven visible emissions data, EPA estimates of average industry visible emissions levels prior to and after the Coke Oven NESHAP (40 CFR Part 63 Subpart L), and current industry data on 7-PAH concentrations in coal tar (which is assumed as a surrogate for coke oven BSO emissions). Emission estimates were made for both 1993 (pre-NESHAP) and 1996 (post-NESHAP).

The results of this analysis are presented in the following table, which lists the 1993 and 1996 estimates of 7-PAH emissions from coke oven charging, topside, and door leaks:

Table 1: 7-PAH Emission Estimates (TPY)
for Coke Oven Charging, Topside, and Door Leaks for 1993 and 1996

Emission Source	1993	1996
Charging Emissions	2.862	0.345
Topside Leaks	5.350	0.934
Door Leaks	20.414	1.872
TOTAL	28.626	3.151

Note:
The EPA estimate for 7-PAH emissions from coke oven charging, topside, and door leaks for 1993 is 143,600 lbs, or 71.8 TPY.

The Table shows that the EPA 1993 estimate exceeds our 1993 estimate by about a factor of about 2.5. Our analysis furthermore shows that post-NESHAP (1996) emission levels are about a factor of 9 lower than the pre-NESHAP (1993) levels.

It is important to note that coke oven charging, topside, and door leaks are the major contributors of 7-PAH emissions from coke plants. Other sources of 7-PAH emissions at coke plants, including coke pushing, combustion stacks, and coke byproduct recovery plant tank emissions and equipment leaks, contribute much smaller quantities. This has been recently confirmed for pushing and battery underfiring by EPA source tests at two coke plants, resulting in estimated industry 7-PAH emissions from these sources of much less than one ton per year. Controls required under the Benzene NESHAP (40 CFR Part 61 Subpart L), including gas blanketing of storage tanks and process vessels and comprehensive leak detection and repair work practice standards, similarly limit industry 7-PAH emissions to less than one ton per year.

Attachment

1993 and 1996 7-PAH Emission Estimates for Coke Ovens: Charging, Topside, and Door Leaks

Nationwide emission estimates of 7-PAH for coke ovens from charging, topside, and door leaks were based on the following information:

1. Coal charge and coke production data for 1993 and 1996 provided by the American Coke and Coal Chemicals Institute (ACCCI);

2. Correlations between coke oven visible emissions estimates (i.e., average number of seconds of visible emissions per charge, percent leaking lids, percent leaking offtakes, and percent leaking doors) and emissions of benzene soluble organics (BSO), as presented in the U.S. EPA report *Coke Oven Emissions from Wet-Coal Charged By-Product Coke Oven Batteries - Background Information for Proposed Standards,* EPA-450/3-85-028a, April 1987 (hereafter called the 1987 BID); and,

3. Data provided by ACCCI on crude coal tar analyses from 12 coke byproduct recovery plants for the following semi-volatile compounds: Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)flouranthene, Benzo(k)flouranthene, Chrysene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene, collectively known as 7-PAH.

7-PAH emission estimates for 1993 and 1996 were based on the following assumptions:

1. 1993 coke oven emissions of BSO were based on visible emissions levels which are considered representative of the period prior to controls required by the Coke Oven NESHAP (40 CFR Part 63 Subpart L), as listed in Table 12.2-1 of the May 1995 EPA Draft AP-42 document for the coke industry (Section 12.2).

2. 1996 BSO emissions were based on post-NESHAP coke oven controls, as listed in Table 12.2-1 of the above-referenced AP-42 document.

3. 7-PAH emissions were based on a speciation of the estimated coke oven BSO emissions, using the ACCCI tar analysis data (i.e., it was assumed that the BSO emissions contain the tarry compounds that are recovered in the byproduct recovery plant as tar).

4. Emission estimates are based on a “model” coke battery consisting of 62 4-meter ovens on an 18-hour cycle, with a total battery coal charge of 542,000 TPY, each oven having two doors, two offtakes, and four lids, as specified in the 1987 BID.

Table A-1 presents the visible emission levels associated with the pre-NESHAP and post-NESHAP coke oven controls, as listed in Table 12.2-1 of Draft AP-42:

Table A-1: Pre- and Post-NESHAP Coke Oven Control Levels for Charging and Lid, Offtake, and Door Leaks[1]

Source	Pre-NESHAP Controls	Post-NESHAP Controls
Charging	25-30 seconds/charge	10 seconds/charge
Lid Leaks	3.5% leaking	0.3% leaking
Offtake Leaks	6.5% leaking	2.0% leaking
Door Leaks	10% leaking	4% leaking

Note:
1. Taken from EPA Draft AP-42 (May 1995) Table 12.2-1, Section 12.2

Emission Estimates of 7-PAH for 1993

1. *Charging*

Based on the description of the model battery provided earlier, the number of coal charges per battery per year is calculated as:

(8760 hrs/yr per oven)(62 ovens/battery)/(18 hrs/charge) = 30,173 charges/battery-yr

For a total industry-wide 1993 coal charge of 32,489,000 TPY,

(32,489,000 TPY coal charge)/(542,000 TPY coal charge/battery) = 59.94 batteries

Using the pre-NESHAP estimate of 25-30 seconds visible emissions per charge, the industry-wide BSO emissions are estimated according to the 1987 BID as follows:

- Min. BSO emissions (g) per charge = (Avg. sec./charge)(0.006) = (27.5)(0.006) = 0.165 g/charge
- Max. BSO emissions (g)/charge = (Avg. sec. per charge/300)^2(7500) = (27.5/300)^2(7500) = 63.021 g/charge
- Avg. emissions (g per charge) = (Min. + Max.)/2 = (0.165 + 63.021)/2 = 31.593 g/charge
- (31.593 g/charge)(30,173 charges/yr)/(453.6 g/lb)(2000 lb/ton) = 1.051 TPY BSO emissions/battery

(1.051 TPY BSO/battery)(59.94 batteries) = 62.983 TPY BSO

The BSO emissions are speciated for 7-PAH using ACCCI tar analysis data, which show an average 7-PAH concentration for 12 plants of 45,438 ppm,

(62.983 TPY BSO)(45,438 x 10^{-6}) = **2.862 TPY 7-PAH**

2. *Lid and Offtake Leaks*

From the 1987 BID,

- Min. BSO emissions (kg/hr) per leak = 0.0033;
- Max. BSO emissions (kg/hr) per leak = 0.021; and,
- Average BSO emissions = 0.01215 kg/hr/leak

For the model battery, the following topside BSO emissions are calculated, using the pre- NESHAP PLL and PLO estimates:

(0.01215 kg/hr/leak)(8760 hr/yr per oven)(2.2046 lb/kg)/(2000 lb/ton) = 0.117 TPY BSO per leak per oven

(0.117 TPY/leak/oven)[(4 lids/oven)(62 ovens/battery)(0.035 leak rate) + (2 offtakes/oven)(62 ovens/battery)(0.065 leak rate)] = 1.964 TPY BSO per battery

(1.964 TPY BSO/battery)(59.94 batteries) = 117.720 TPY BSO

(117.720 TPY BSO)(45,438 x 10^{-6}) = **5.350 TPY 7-PAH**

3. *Door Leaks*

From the 1987 BID, and using the pre-NESHAP PLD estimate:

Min. BSO emissions (kg/hr) per leak = $[(PLD)/70\}^{1.5}(0.19) = (10/70)^{1.5}(0.19)$ = 0.0103 kg/hr

Max. emissions (kg/hr) per leak = (11.2)(min.) = (11.2)(0.0103) = 0.1149 kg/hr
Average emissions = (Min. + Max.)/2 = (0.0103 + 0.1149)/2 = 0.0626 kg/hr/leak

For the model battery, the following door leak BSO emissions are calculated:

(0.0626 kg/hr per leak)(8760 hr/yr per oven)(2.2046 lb/kg)/(2000 lb/ton) = 0.604 TPY BSO per leak per oven

(0.604 TPY/leak/oven)(2 doors/oven)(62 ovens/battery)(0.10 leak rate) = 7.495 TPY per battery

(7.495 TPY BSO/battery)(59.94 batteries) = 449.277 TPY BSO

(449.277 TPY BSO)(45,438 x 10^{-6}) = **20.414 TPY 7-PAH**

Emission Estimates of 7-PAH for 1996

1. *Charging*

Based on the description of the model battery provided earlier, the number of coal charges per battery per year is calculated as:

(8760 hrs/yr per oven)(62 ovens/battery)/(18 hrs/charge) = 30,173 charges per battery per year

For a total industry-wide 1996 coal charge of 29,452,000 TPY,

(29,452,000 TPY coal charge)/(542,000 TPY coal charge per battery) = 54.34 batteries

Using the post-NESHAP estimate of 10 seconds visible emissions per charge, the industry-wide BSO emissions are estimated according to the 1987 BID as follows:

- Min. BSO emissions (g) per charge = (Avg. sec./charge)(0.006) = (10)(0.006) = 0.060 g/charge
- Max. BSO emissions (g) per charge = (Avg. sec./charge/300)^2(7500) = (10/300)^2(7500) = 8.333 g/charge
- Avg. emissions (g per charge) = (Min. + Max.)/2 = (0.060 +8.333)/2 = 4.197 g/charge

(4.197 g/charge)(30,173 charges/yr)/(453.6 g/lb)(2000 lb/ton) = 0.140 TPY BSO emissions per battery

(0.140 TPY BSO/battery)(54.34 batteries) = 7.585 TPY BSO

The BSO emissions are speciated for 7-PAH using the ACCCI tar analysis data, which shows an average 7-PAH concentration for 12 plants of 45,438 ppm,

(7.585 TPY BSO)(45,438 x 10^{-6}) = **0.345 TPY 7-PAH**

2. *Lid and Offtake Leaks*

From the 1987 BID,

- Min. BSO emissions (kg/hr) per leak = 0.0033;
- Max. BSO emissions (kg/hr) per leak = 0.021; and,
- Average BSO emissions = 0.01215 kg/hr/leak

For the model battery, the following topside BSO emissions are calculated, using the post- NESHAP PLL and PLO estimates:

(0.01215 kg/hr/leak)(8760 hr/yr per oven)(2.2046 lb/kg)/(2000 lb/ton) = 0.117 TPY BSO per leak per oven

(0.117 TPY/leak/oven)[(4 lids/oven)(62 ovens/battery)(0.003 leak rate) + (2 offtakes/oven)(62 ovens/battery)(0.02 leak rate)] = 0.378 TPY BSO per battery

(0.378 TPY BSO/battery)(54.34 batteries) = 20.554 TPY BSO

(20.554 TPY BSO)(45,438 x 10^{-6}) = **0.934 TPY 7-PAH**

3. *Door Leaks*

From the 1987 BID, and using the post-NESHAP PLD estimate:

- Min. BSO emissions (kg/hr) per leak = $[(PLD)/70\}^{1.5}(0.19) = (4/70)^{1.5}(0.19)$ = 0.0026 kg/hr
- Max. emissions (kg/hr) per leak = (11.2)(min.) = (11.2)(0.0026) = 0.0291 kg/hr
- Average emissions = (Min. + Max.)/2 = (0.0026 + 0.0291)/2 = 0.0158 kg/hr/leak

For the model battery, the following door leak BSO emissions are calculated:

(0.0158 kg/hr per leak)(8760 hr/yr per oven)(2.2046 lb/kg)/(2000 lb/ton) = 0.153 TPY BSO per leak per oven

(0.153 TPY/leak/oven)(2 doors/oven)(62 ovens/battery)(0.04 leak rate) = 0.758 TPY per battery

(0.758 TPY BSO/battery)(54.34 batteries) = 41.209 TPY BSO

(41.209 TPY BSO)(45,438 x 10^{-6}) = **1.872 TPY 7-PAH**

Table. Concentration Averages and Ranges for the Seven PAHs Analyzed in ACCCI Crude Coal Tar MSDS Project

Compound	Average Concentration (ppm)	Range in Concentration (ppm)
Benzo[a]anthracene	9026	5710 - 14,600
Benzo[a]pyrene	8365	4600 - 12,500
Benzo[b]flouranthene	6804	3740 - 11,200
Benzo[k]fluoranthene	5863	3720 - 9960
Chrysene	11,125	7950 - 21,900
Dibenz[a,h]anthracene	517	153 - 1060
Indeno[1,2,3-cd]pyrene	3738	2050 - 5290