North Carolina Department of Environment and Natural Resources
Division of Air Quality

Beverly Eaves Purdue, Governor

Dee Freeman, Secretary
B. Keith Overcash, P.E., Director

June 30, 2009

**MEMORANDUM**

TO: B. Keith Overcash

THROUGH: Sammy L. Amerson, Permit Workgroup Lead
Raleigh Central Office Permitting Section

FROM: Permit Workgroup Emission Factor Ad Hoc Sub-Committee for Crematories
Dean Carroll, Ad Hoc Sub-Committee Lead
Wilmington Regional Office

SUBJECT: Review and Recommended Update of the DAQ Emission Factors for Human Crematories (DAQ online spreadsheet)

## Introduction

The Permit Workgroup (PWG) has long discussed the Division of Air Quality (DAQ) emission factors (EF) for human crematories. The Environmental Protection Agency (EPA) currently has no AP-42 Chapter or Section for these sources. The current factors have been based on testing back in 1992 with the California Air Resources Board (CARB), which have been in question for some time. This memo is the result of the "Permit Workgroup Emission Factor Ad Hoc Sub-Committee for Crematories".

- DAQ gathered data from all available crematory tests performed in the recent past. These tests included the original CARB testing (1992), corrected CARB data which is WebFIRE (1997), Woodlawn testing in Bronx, NY (1999), and Matthews testing in Apopka, FL (2004).
- EPA plans to work on this same source category in the future and add their version of emission factors to AP-42 in Chapter 13 Section 6 "Miscellaneous Sources". These DAQ factors will be used in the interim until EPA develops the federal EF's.
- At the last Permit Workgroup (March 19, 2009), there was an 8-0 vote among voting members to proceed with the factors shown below. These numbers are not to establish DAQ policy or a rule change, but are provided to update data for North Carolina facilities to calculate emissions from human crematories.
- The EF's are believed to be accurate and reliable and have been through extensive review by DAQ staff and Forsyth County.
- Upon signature of the Division Director, the DAQ online spreadsheet will be re-done by the Wilmington Regional Office/DAQ staff. Dean Carroll, PE, WiRO, was the lead engineer for this assignment.

- Mr. Paul Harris, Executive Director of the NC Board Funeral Service, was contacted to discuss this issue. Across NC, only about 5 facilities may require an air permit.

## 1. Basis and Recommendation for Revised Human Crematory Emission Factors

Statement of the Problem

This topic has been an issue for a long time. Concerns over the validity of the human crematory emission factors have been discussed at permit workgroup meetings for years. Requests were made to EPA for guidance but no updated information has been available. Various tests have been conducted by private companies for a number of reasons, but again, no AP-42 section has been developed. The current DAQ EF spreadsheet has not been used for some time and as a result, no permit determinations have been made recently.

Statement of the Solution

Finally, adequate time and resources were given to this task. Forsyth County (Rob Russ) provided invaluable background data for these factors. Rob and Dean Carroll collaborated on many occasions to develop these final draft EFs. The information was updated from CARB (1992) to WebFIRE (1997) to Woodlawn testing (1999) to Matthews Cremation testing (2004). All hard copy information is on file in the Wilmington Regional Office and in limited form online. A compilation and combination approach was taken and presented to the permit workgroup for a vote (8-0). While these factors are being used in the interim by DAQ, EPA intends to perform the same research and evaluation and post an updated set of crematory EFs in a new "Electronic Reporting Tool (ERT)".

## 2. Sub-Committee Members

Dean Carroll, PE, WiRO, lead engineer. Rob Russ, Forsyth County Engineer, expertise in permitting and inspecting crematory facilities in Forsyth County. Sammy Amerson, RCO, PWG Chairman. Jay Evans, RCO, Permit Engineer contact. Gary Saunders, RCO Engineer, toxics branch contact. Gregg O'Neal, RCO Engineer, stationary source compliance branch contact.

## 3. Technical Basis and Rationale for Approving the New EFs

a. The existing DAQ online EFs have been suspect for some time.
b. Forsyth County has been using WebFIRE emission factors since 2002 for permit reviews and emission inventories.
c. EPA has not updated the factors since the CARB 1992 data – although there is additional information online from federal sources (WebFIRE is a product of US EPA). Also, the Woodlawn testing (Bronx, NY, 1999) was an EPA project conducted by Midwest Research Institute (Kansas City, MO) for the US EPA. This information is available from EPA and would be given to a person who asked for current crematory EF data for mercury.
d. Matthews Cremation (Apopka, FL) has conducted internal tests primarily for criteria pollutants in association with the Crematory Association of North America (CANA).
e. Thus, this information is in many different places.
f. Once the time was given to collect and analyze this data, an updated EF spreadsheet could be provided for NC cremation facilities.
g. Several facilities have submitted permit applicability determinations which can now be completed.
h. Permitting implications should be minimal (~ 5 across the State).

## Table 1. New Emission Factors for Human Crematories

**This data has been gathered from CARB testing (1992), WebFIRE data (1997), Woodlawn testing for mercury, cadmium, and hydrochloric acid (1999), and Matthews testing for criteria pollutants (2004). The NC DAQ spreadsheet will include criteria pollutants, federal HAPs, and NC toxics for permitting purposes and Emission Inventories.**

| WebFIRE Emission Factors<br>Pollutant | CAS | Federal HAP | WebFIRE Emission Factor lb/case | NC TAP | 2Q 0.0711 TPER Value | Limit on Number of Cases |
|---|---|---|---|---|---|---|
| Antimony | 7440-36-0 | Y | 3.02E-05 | | NA | 10 tpy issue |
| **Arsenic *** | **7440-38-2** | **Y** | **3.00E-05** | **Y** | **0.016 lb/yr** | **533 / yr *** |
| benzo(a)pyrene | 50-32-8 | | 2.91E-08 | Y | 2.2 lb/yr | 75 Mill / yr |
| Beryllium | 7440-41-7 | Y | 1.37E-06 | Y | 0.28 lb/yr | 204 k / yr |
| Chromium | 7440-47-3 | Y | 2.99E-05 | Y | 0.013 /b/day | 434 / day |
| chromium (VI), soluble as chromic acid | 7440-47-3(Cr6+) | Y | 1.35E-05 | Y | 0.013 lb/day | 962 / day |
| Cobalt | 7440-48-4 | Y | 1.75E-06 | | NA | 10 tpy issue |
| hydrogen fluoride | 7664-39-3 | Y | 6.55E-04 | Y | 0.63 lb/day | 962 / day |
| hydrogen fluoride | 7664-39-3 | Y | 6.55E-04 | Y | 0.064 lb/hr | 97 / hour |
| Lead | 7439-92-1 | Y | 6.62E-05 | | NA | 10 tpy issue |
| nickel metal | 7440-02-0 | Y | 3.82E-05 | Y | 0.13 lb/day | 3,403 / day |
| Selenium | 7782-49-2 | Y | 4.36E-05 | | NA | 10 tpy issue |
| 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin | 57653-85-7 | | 3.97E-10 | Y | 0.0051 lb/yr | 12.8 Mill / yr |
| 2,3,7,8-tetrachlorodibenzo-p-dioxin | 1746-01-6 | Y | 7.94E-11 | Y | 0.0002 lb/yr | 2.5 Mill / yr |

* Denotes limiting pollutant to trigger NC toxics.

Also: Deleted EF for formaldehyde (7.79E-10 lb/body) since EPA deleted it from WebFIRE due to QA concerns; same for acetaldehyde (2.17E-10 lb/body).

| Woodlawn Emission Factors<br>Pollutant | CAS | Federal HAP | Woodlawn Emission Factor lb/case | NC TAP | 2Q 0.0711 TPER Value | Limit on Number of Cases |
|---|---|---|---|---|---|---|
| Cadmium | 7440-43-9 | Y | 2.47E-04 | Y | 0.37 lb/yr | 1,498 / yr |
| Hydrochloric Acid | 7647-01-0 | Y | 3.02E-01 | Y | 0.18 lb/hr | 0.59 / hour |
| **Mercury (vapor) *** | **7439-97-6** | | **9.92E-04** | Y | **0.013 lb/day** | **13 / day *** |

**Table 2. New Criteria Pollutant Emission Factors for Human Crematories**

| Criteria Pollutants<br><br>Matthews Emission Factors | CAS | Matthews Emission Factor lb/case | Actual Emissions<br>Tons/Yr | Limit on Numb. Cases |
|---|---|---|---|---|
| PM | NA | NA | NA | |
| PM-10 | NA | 0.1318 | 0.3295 tpy | 75,872 |
| SO2 | 7446-09-5 | 0.308 | 0.77 tpy | 32,467 |
| **NOx** | **10102-44-0** | **2** | **5 tpy** | **5,000** |
| CO | 630-08-0 | 0.0094 | 0.0235 tpy | 1 Mill + |
| VOC | NA | 0.007 | 0.0175 tpy | 1.4 Mill+ |
| Lead | 7439-92-1 | 6.62 E-05 | 0.000165 t | 151 Mill |

**NOTES:**

*The current DAQ spreadsheet for Crematories should be completely removed.*

1. Criteria Pollutants are from 2004 Matthews Cremation testing in Apopka, FL.
2. Most Federal HAP's and NC toxics are from 1997 WebFIRE data.
3. Three (3) NC toxics are from 1999 Woodlawn testing since this test was more recent including cadmium, HCl, and mercury.
4. This spreadsheet does not include the emissions from natural gas/propane firing of the crematory. This should be added separately.
5. A new column will be added to the spreadsheet which calculates actual emissions & PTE from combustion of fuel. This will provide conservative emission values.
6. When these factors are approved by DAQ, the spreadsheet will be completely re-done by the Wilmington Regional Office.
7. Permitting implications = roughly five facilities across the State *may* require a permit as a Small category permit (due to arsenic).

- Website for WebFIRE information:

http://cfpub.epa.gov/oarweb/index.cfm?action=fire.main

- Website for Matthews Cremation Division, Apopka, FL:

http://www.matthewscremation.com/

- Woodlawn is a technical document available in hard copy.

**4. Other Factors to be Considered**

a. All pollutants affected: every pollutant currently on the DAQ spreadsheet.
b. Two pollutants deleted: acetaldehyde and formaldehyde were deleted for QA concerns; these were not an issue anyway.

c. New pollutants added: lead and selenium were added so that a complete review and/or E.I. could be performed. These factors are HAP only (not NC toxics) but should be included along with antimony, beryllium, chromium, and cobalt; all were provided in WebFIRE.
d. Number of possible affected facilities: 5.
e. Impact on industry: all newly permitted facilities would be expected to be classified as a Small category facility with a $50 permit application fee and $250 annual fee. No new controls would be expected as a result of this change.
f. NC toxics: only larger crematory facilities may require an air permit. These 5 sources may trigger toxics due to arsenic; any facility cremating more than 533 cases per year would be greater than the 2Q .0711 TPER of 0.016 lb/yr arsenic. An air toxics modeling demonstration may be required in accordance with 2D .1104, Toxic Air Pollutant Guidelines (AAL of 2.3E-07 mg/cubic meter).
g. DAQ regulations involved: 2D .0202, 2D .1104, 2D .1208 (Other Incinerators). 2D .1208 includes references to a PM standard, an SO2 standard (2D .0516), a VE standard (2D .0521), and odors (2D .1806). 2D .1208 includes paragraphs (a), (b)(1) through (b)(9), (c), (d), (e), and (f).
h. Time and burden on industry would be minimal.
i. Target facilities can be identified by WiRO in cooperation with the NC Board of Funeral Services.

**Recommendation**

It is recommended by the Permit Workgroup Emission Factor Ad Hoc Sub-Committee for Crematories to change the DAQ human crematory EFs from the current 1992 CARB data to the updated EFs in this memo. A PWG vote of 8-0 supports this request. A new DAQ spreadhseet will be developed by the Wilmington Regional Office.

The five facilities are:
1. Cape Fear Crematory – Fayetteville
2. Carolina Cremation Services – Ral.
3. Guilford Cremation Services – GBO
4. Longleaf Crematory – Southern Pines
5. Yates Wilbert Vault Co. – Charlotte

cc: Permit Workgroup Members
Permit Workgroup Emission Factor Ad Hoc Sub-Committee for Crematories
Air Quality Regional Supervisors
Donald Van der Vaart, Chief, Air Permitting Section