UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
AIR AND RADIATION

Stephen R. Gossett
Senior Environmental Associate
Eastman Chemical Company
P.O. Box 511
Kingsport, TN 37662

Re: Petition for approval of F_C Factors for CEMS at Eastman Units 23, 24, 30, and 31

Dear Mr. Gossett:

EPA has reviewed your March 25, 2003 petition under §75.66(a) in which Eastman Chemical Company (Eastman) requested to use F_C factors for non-fossil fuels not specified in Part 75 and for fuel gas derived from gasified coal. An F_C factor represents a ratio of the volume of carbon dioxide (CO_2) generated to the calorific value of the fuel combusted. The F_C factor is used to calculate the nitrogen oxides (NO_X) emission rate and heat input from a particular fuel burned.

EPA approves Eastman's request to use F_C factors not specified in Part 75 with the conditions described below.

Background

Eastman is in the process of initially certifying a continuous emission monitoring system (CEMS) at four coal-fired steam generating units, Boilers 23, 24, 30, and 31. These four boilers have been identified as affected units in the NO_X Budget Trading Program under Tennessee's NO_X SIP Call rule. Each of the four boilers burns a combination of fossil fuels and non-fossil fuels. Table 1 provides a breakdown of the fuels burned by each boiler.

Table 1. Fuels Combusted by Boiler

Source	Unit ID	Fossil Fuel	Non-fossil Fuel
B-83-1	Boiler 23 Boiler 24	Coal	Biosludge Waste Liquids
B-325-1	Boiler 30 Boiler 31	Coal Natural Gas Fuel Gas (1)	Waste Liquids

Notes: (1) Fuel gas derived from gasified coal

The CEMS for each boiler includes NO_X analyzers, CO_2 diluent gas analyzers, stack gas flow monitors, and data acquisition and handling systems (DAHS). Each of the CEMS uses CO_2 as the diluent gas. Eastman proposed to calculate NO_X emission rate using Equation F-6 in Part 75, Appendix F, §3.2.

$$E = K \times C_h \times F_C \frac{100}{\%CO_2}$$

Equation F-6

Where:
E = Hourly NO_X emission rate during unit operation, lb/mmBtu
$K = 1.194 \times 10^{-7}$, (lb/dscf)/(ppm NO_X)
C_h = Hourly average NO_X concentration during unit operation, ppm
F_C = Ratio of volume CO_2 generated to fuel calorific value, scf CO_2/mmBtu
$\%CO_2$ = Hourly carbon dioxide volume during unit operation, %

The use of the above equation requires an F_C value for each fuel. Also, Eastman proposes to calculate heat input of the units using Equation F-15 in Part 75, Appendix F, §5.2.1.

$$HI = Q_W \frac{1}{F_C} \frac{\%CO_{2W}}{100}$$

Equation F-15

Where:
HI = Hourly heat input rate during unit operation, mmBtu/hr
Q_W = Hourly average volumetric flow rate during unit operation, wet basis, scfh
F_C = Ratio of volume CO_2 generated to fuel calorific value, scf CO_2/mmBtu
$\%CO_{2W}$ = Hourly carbon dioxide volume during unit operation, % wet basis

Since hourly NO_X mass for a particular fuel is derived by multiplying hourly NO_X emissions rate by hourly heat input rate, the F_C factors for the fuel in the NO_X emission rate equation and heat input equation cancel out. The net effect is that the F_C factor affects the determination of emission rate and heat input but not of mass emissions.

F_C factors for coal and natural gas are provided in Table 1 in Part 75, Appendix F, §3.2. Eastman derived F_C factors for the non-fossil fuels using Equation F-7b in Part 75, Appendix F, §3.3.6.

$$F_C = \frac{321 \times 10^3 (\%C)}{GCV}$$

Equation F-7b

Where: F_C = Ratio of volume CO_2 generated to fuel calorific value, scf CO_2/mmBtu
%C = Content by weight of carbon, %
GCV = Gross calorific value of fuel, Btu/lb

The carbon content (%C) and gross calorific value (GCV) of the fuel are based on an ultimate analysis of the fuel using the methods provided in Part 75, Appendix F, §3.3.6.

Also, an F_C factor is derived for the fuel gas although it qualifies as a fossil fuel. The fuel gas is produced from Eastman's coal gasification facility. As such, Eastman believes that the F_C values in Table 1 in Part 75, Appendix F, §3.2 are not representative for this type of fossil fuel. The F_C values provided in Table 1 of Appendix F are meant for specific fossil fuels, such as natural gas, propane and butane, and may not be appropriate for other gas fuels.

Using sampling data for the fuels involved and Equation F-76, Eastman developed the following F_C factors:

Table 2. Developed F_C factors for Non-Fossil Fuels and Fuel Gas

Source	Unit	F_C Factor (scf/mmBtu)		
		Biosludge	Waste Liquids	Fuel Gas
B-83-1	Boiler 23 Boiler 24	1,800	2,000	N/A
B-325-1	Boiler 30 Boiler 31	N/A	1,860	2,740

N/A: The fuel is not applicable as it is not burned in those boilers

These proposed F-factors were determined as follows:

- Four samples for eight different waste streams (32 samples total) for the waste liquids burned in Boilers 23 and 24 were analyzed for %C and GCV;
- Twenty total samples for the biosludge burned in Boilers 23 and 24 were analyzed for %C and GCV;
- Four samples for two different waste streams (8 samples total) for the waste liquids burned in Boilers 30 and 31 were analyzed for %C and GCV; and
- Sixteen total samples for the fuel gas burned in Boilers 30 and 31 were analyzed for %C and GCV.

All of the above fuels typically comprise ten percent or less of the fuel input to each unit. The fuels are projected to affect the prorated F_C factors for the mixture of fuels burned (as provided in Equation F-8 in Part 75, Appendix F, §3.3.6.4) by less than 5 percent for each unit, on average, as compared to running the unit on coal alone.

EPA Determination

EPA finds that it is appropriate to develop F_C factors for biosludge, waste liquids and fuel gas for Eastman's Boilers 23, 24, 30 and 31. However, an analysis of the submitted sample data indicates that Eastman derived its proposed F_C values from average values of the sample data with an addition of an arbitrary factor. EPA believes that F_C factors based on the 90th percentile of the sample data is a more representative and sufficiently conservative estimate method. Also, EPA prefers a standard methodology which is not independently adjusted based on the sample data. Consequently, EPA approves Eastman's request to use F_C factors for non-fossil fuel and fuel gas based on the 90th percentile of the sample data.

As described below, EPA's analysis of the data for the two waste fuel types (biosludge and liquid waste) showed relatively high data scatter, which is to be expected due to the fact that these fuels are not homogeneous. EPA's analysis of the data for fuel gas derived from gasified coal also displayed relatively high data scatter, as expected from a process gas. A summary for each set of sample data is provided below:

- Sampling of the biosludge burned in Boilers 24 and 25 provided F_C factors ranging from 1,243 to 2,184 scf/mmBtu, with an average value of 1,732 scf/mmBtu. The average of the absolute deviation for these values was 227 scf/mmBtu, and the median value was 1,731 scf/mmBtu. Eastman proposed an F_C factor of 1,800 scf/mmBtu.
- Sampling of the liquid waste burned in Boilers 24 and 25 provided F_C factors ranging from 764 to 2,933 scf/mmBtu, with an average value of 1,582 scf/mmBtu. The average of the absolute deviation for these values was 242 scf/mmBtu, and the median value was 1,512 scf/mmBtu. Eastman proposed an F_C factor of 2,000 scf/mmBtu.
- Sampling of the liquid waste burned in Boilers 30 and 31 provided F_C factors ranging from 1,384 to 2,120 scf/mmBtu, with an average value of 1,621 scf/mmBtu. The average of the absolute deviation for these values was 160 scf/mmBtu, and the median value was 1,625 scf/mmBtu. Eastman proposed an F_C factor of 1,860 scf/mmBtu.
- Sampling of the fuel gas burned in Boilers 30 and 31 provided F_C factors ranging from 1,833 to 3,830 scf/mmBtu, with an average value of 2,737 scf/mmBtu. The average of the absolute deviation for these values was 424 scf/mmBtu, and the median value was 2,711 scf/mmBtu. Eastman proposed an F_C factor of 2,740 scf/mmBtu.

In view of the fact that the three fuels (biosludge, liquid waste and fuel gas) make up a small portion of the total heat input for each boiler, EPA finds that the high variability in the sampled F_C values does not preclude the use of a single F_C for each fuel. Also, because the derived F_C factors will affect the prorated F_C factors for the mixture of fuels burned by less then 5 percent on average, as compared to running the units on coal alone, the use of a constant F_C factor for the waste fuels and fuel gas is acceptable. However, due to the variability in the F_C sample values for each fuel, EPA determines that the 90th percentile of the sampling data for each fuel must be used instead of a value based on the average of the sample data. Therefore, the approved F_C factors for each of the non-fossil fuels and the fuel gas are as follows:

Table 3. Accepted F_C factors for Non-Fossil Fuels and Fuel Gas

Source	Unit	F_C Factor (scf/mmBtu)		
		Biosludge	Waste Liquids	Fuel Gas
B-83-1	Boiler 23 Boiler 24	2,145	1,911	N/A
B-325-1	Boiler 30 Boiler 31	N/A	1,821	3,378

N/A: The fuel is not applicable as it is not burned in those boilers

EPA's approval of the above FC factors is conditional on the following requirements in paragraphs 1 and 2 below.

1. Eastman must recalculate the above mentioned four F_C values at the end of each calendar year, using the fuel sample data for that year. The accepted F_C value for each fuel must be obtained by selecting the 90th percentile of the collected data. The sampling data set must be large enough to be representative of the waste stream or fuel gas burned. Records of the sampling data and new F_C factors should be maintained by the facility.

2. The emission rate and heat input for each unit must be calculated using Equation F-6 and Equation F-15, respectively as provided in Appendix F of Part 75.

EPA's determination in this letter relies on the accuracy and completeness of the information provided by Eastman in the March 25, 2003 petition, and can be appealed under Part 78. If you have any questions or concerns about this determination, please contact Manuel J. Oliva, at (202) 564-0162.

Sincerely,

Samuel Napolitano, Acting Director
Clean Air Markets Division

cc: Wilson Haynes, EPA Region III
Jeryl Stewart, Tennessee Division of Air Pollution Control
Manuel J. Oliva, EPA CAMD