Sent via email: Ron.myers@epa.gov

November 22, 2005

Mr. Ron Myers
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Re: AP42 Section 11.12 Update, Summary of Emission Factors

Dear Mr. Myers:

The Ready Mixed Concrete Research Foundation ("RMCRF") appreciates your support during the compilation of new particulate matter emission factors for central mix and truck mix loading operations at ready mixed concrete operations. As you are aware, RMCRF has previously submitted a comprehensive emission factor test report prepared by RMCRF contractor Air Control Techniques, P.C. These tests were conducted in accordance with EPA reference test methods based on a protocol available on the EPA TTN web site more than 30 days prior to the start of the test program.

Following discussions with you earlier this year, RMCRF and Air Control Techniques, P.C. have integrated the new emission factor data with the emission factor database prepared previously by EPA and included in AP42 Section 11.12 and its associated background support document. I have attached revised versions of both Section 11.12 and the background document. These revisions are consistent with your recommendations during our previous meeting. This letter summarizes the proposed changes in the central mix and truck mix emission factors. Previously, Section 11.12 emission factors for loading operations were based on EPA sponsored tests at one central mix facility and two truck mix facilities. The RMCRF test program developed emission factors from tests on three central mix and three truck mix facilities. All of these data have been combined into data sets for both types of loading operations. All of the run-by-run data were analyzed to identify outlier values. Previously, EPA had rejected one of the test runs applicable to the EPA sponsored tests at the central mix operation (Cheney Enterprises, run #14). RMCRF agrees with the deletion of this run value from the EPA data set. RMCRF

and Air Control Techniques, P.C. have reviewed all of the run-by-run data and identified several other outliers using slightly different criteria than used by EPA. The deletion of these low and high outliers has essentially no impact on the resulting emission factor values. Accordingly, we recommend that all of the test run values with the exception of the previously identified value be included.

As you requested, RMCRF has prepared the loading operation emission factors in two different formats: (1) a general value that represents the average of all of the emission factor test averages and (2) an equation that takes into account site specific factors. The general emission factor values are intended only for use when site specific data necessary for the predictive equation are not available.

The equation was recommended by RMCRF and Air Control Techniques, P.C. (1) to take into account factors that have a direct impact on particulate matter emissions and (2) to make the loading operation emission factors more consistent with other fugitive dust emission factor calculation procedures in AP42. As indicated in the Air Control Techniques, P.C. report, particulate matter emission factors based solely on the quantities of cement and cement supplement loaded (the basis of the previous 11.12 emission factors) are relatively poor predictors of emissions from specific plants. The equation based on site specific factors substantially improves the predicative capability of the emission factors.
The general emission factors for total particulate, PM10, and PM2.5 are provided in Table 1 and Table 2. The PM2.5 data are provided only from the RMCRF test programs. Emission factor data for total particulate and PM10 are provided from both the EPA and RMCRF sponsored test programs. The variability of the updated emission factors is described using the standard deviation and the 90% confidence interval.

Table 1. General Emission Factors, Loading Operations (Controlled)
Emissions, pounds per ton of cement and cement supplement loaded

Type of Loading Operation	Analyte	Average	Standard Deviation	Minimum of 90% Confidence Interval	Maximum of 90% Confidence Interval
Truck Mix	PM	0.0981	0.1049	0.0210	0.1753
	PM10	0.0263	0.0251	0.0078	0.0477
	PM2.5	0.0013	0.0015	0.0	0.0028
Central Mix	PM	0.0184	0.0159	0.0053	0.0315
	PM10	0.0055	0.0030	0.0030	0.0079
	PM2.5	0.0009	0.0004	0.0005	0.0013

Table 2. General Emission Factors, Loading Operations (Uncontrolled) Emissions, pounds per ton of cement and cement supplement loaded					
Type of Loading Operation	Analyte	Average	Standard Deviation	Minimum of 90% Confidence Interval	Maximum of 90% Confidence Interval
Truck Mix	PM	1.122	0.739	0.578	1.665
	PM10	0.311	0.238	0.135	0.486
	PM2.5	0.054	0.041	0.015	0.009
Central Mix	PM	0.524	0.506	0.107	0.940
	PM10	0.156	0.126	0.052	0.259
	PM2.5	0.018	0.008	0.001	0.026

An examination of the loading operation emission factor data indicates that the relationship between particulate matter emissions and the total quantity of cement and cement supplement loaded is extremely weak. This means that the emission factors in the previous version of Section 11.12 and in Tables 1 and 2 (above) are poor predictors of emissions. The two variables that most provide predictive value are (1) the moisture content of the cement and/or cement supplement and (2) the wind speed at the loading point. Emission factors that include these two variables in addition to the quantity loaded have substantially better site specific predictive capability. Furthermore, the inclusion of these two additional process material variables provides incentives to plant operators to take positive efforts to minimize emissions by controlling these variables. RMCRF and Air Control Techniques, P.C. propose to include these variables using the following equation, which is based closely on a similar equation published in AP42 Section 13.2.4.

The particulate matter emissions from truck mix and central mix loading operations are calculated in accordance with Equation 11.12-1.

$$E = k(0.0032)\left[\frac{U^{a}}{M^{b}}\right] \qquad \text{Equation 11.12-1}$$

E	=	Emission factor in lbs./ton of cement and cement supplement
K	=	Particle size multiplier (dimensionless)
U	=	Wind speed, meters per second (m/s) or miles per hour (mph) at the loading operation point
M	=	Minimum moisture (% by weight) of cement and cement supplement
a, b		Exponents

The parameters for Equation 11.12-1 are summarized in Table 3.

Table 3. Emission Factor Predictive Equation Parameters			
Parameter	Parameter Category	Truck Mix Operations	Central Mix Operations
Particle size multiplier (k)	Total PM	1.30	1.30
	PM10	0.35	0.35
	PM10-2.5	0.30	0.30
	PM2.5	0.05	0.05
Exponents (a, b)	a	2	0.3
	b	0.2	0.8

Emissions in units of kilograms per megagram of cement and cement supplement, the emissions calculated by Equation 11.12-1, should be calculated from the English units by dividing by 2.0. As indicated in the Air Control Techniques, P.C. project report, emission factors calculated using

Equation 11.12-1 provide more accurate predictions of the emission factor test results than emission factors based only on the throughput rate.

Metals emission factors for concrete batching provided in the updated AP42 Section 11.12 are similar to those presented in the previous edition. However, an alternative emission factor calculation method has been provided to take into account site specific compositional data for the cement and cement supplement. The site specific metal emission factors from ready mixed plants can be calculated based on (1) the weighted average concentration of the metal in the cement and the cement supplement (i.e. flyash) and (2) on the particulate matter emission factors calculated in accordance with Equation 11.12-3.

$$\text{Metal}_{EF} = \text{PM}_{EF}\left(\frac{aC + bS}{C + S}\right) \qquad \text{Equation 11.12-3}$$

Where:

Metal_{EF}	=	Metal Emissions, Lbs. Metal per Ton of Cement and Cement Supplement
PM_{EF}	=	Controlled Particulate Matter Emission Factor (PM, PM10, or PM2.5) Lbs. per Ton of Cement and Cement Supplement
A	=	ppm (w/w) of Metal in Cement
C	=	Quantity of Cement Used, Lbs. per hour
B	=	ppm (w/w) of Metal in Cement Supplement
S	=	Quantity of Cement Supplement Used, Lbs. per hour

This equation is based on the assumption that 100% of the particulate matter emissions are material entrained from the cement and cement supplement streams.

I have attached an updated version of AP42 Section 11.12 and the associated background document. Both are provided in a Word(r) format. NCRMF requests that EPA review this material and update AP42 Section 11.12 as soon as practicable. NCRMF appreciates your assistance throughout this project.

Regards,

Edward Herbert, III
Director of Environmental Affairs
National Ready Mixed Concrete Association

Enclosures:
AP42 Section 11.12 (Draft)
AP42 Section 11.12, Background Document (Draft)