

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.

AP-42 Section	<u>11.6</u>
Reference	<u>7</u>
Report Sect.	_____
Reference	_____



29 September 1993

Mr. Ronald E. Myers
Emission Factors Branch and Methodologies Section
Emission Inventory Branch
United States Environmental Protection Agency
Research Triangle Park, N.C. 27711

Dear Mr. Myers:

ESSROC Materials Inc. (ESSROC), would like to express its appreciation for being allowed to comment on the draft section of 8.6, Portland Cement Manufacturing. This draft relates specifically to updating this section of the *Compilation of Air Pollutant Emission Factors, Volume I : Stationary Point and Area Sources* (AP-42).

ESSROC has performed an extensive review of the document, the proposed changes and the reference data utilized in developing the new emission factors. This review has lead to several comments regarding the validity and representativeness of the proposed emission factors, as well as raising other questions concerning the emission factors.

These comments and questions are included within the attached document. I trust that these responses will provide you with the information requested in your letter to Mr. Robert Crolius of the American Portland Cement Alliance dated, August of 1993.

Sincerely,

A handwritten signature in cursive script that reads "F. L. Streitman".

F. L. Streitman
Manager of Environmental Affairs

General Comments

According to the letter accompanying the draft changes to Section 8.6 of AP-42, several requests for information are necessary. Based on this letter, the following requirements would be of assistance in updating the AP-42 document:

- Assistance in identifying the likely reasons for inconsistencies in data where emission factors are derived from a small amount of reported results.
- Assistance in identifying how to evaluate material and process parameters to develop a more reliable method for estimating sulfur dioxide emissions from portland cement kilns.
- Assistance on how to convert raw material feed rates to clinker production rates.
- Comments regarding the combining of data from all pyroprocess type kilns, whether this approach is sound or should be sorted by the kiln types.
- Comments on the need to develop emission factors based on the fuel type, and the effects that different fuel types may have on emission characteristics.

Likely Reasons for Data Inconsistencies

Data inconsistencies provide an interesting topic which could be discussed at great length. One general comment following a review of the references which are listed as the data systems for development of an emission factor is that a variety of methods have been utilized to determine like parameters. A good example of this can be found within the references listed for sulfur dioxide emissions for preheater and precalciner kilns. The sampling methods range from a Modified Method 17 train, including the last impinger of a Method 5 train, Method 6, Method 8, and CEM systems.

Both the Modified Method 17 and the Method 5 trains are non-standard test methods for sulfur dioxides, both of these methods resulted in the development of an emission factor. One general comment is that data derived by a non-standard test method, which remains as a non-approved method, should not be considered as reliable data. In the instance of the preheater kiln, both of these non-standard test methods were utilized in the development of the emission factor. Additionally, the testing was conducted on a wet kiln process, however this is another issue. Since only a brief description is given to the reference, it is difficult to determine what validity exists. Both the use of a Modified Method 17 train and the Method 5 train for the derivation of sulfur dioxide emissions remains unapproved; it would therefore appear that there is some degree of failure in these methods with regard to sulfur dioxide emissions.

(A)

Another instance where methodology may provide inconsistency within the data set is in the emission factors developed for nitrogen oxides for precalciner kilns. References 53 and 56 both delineate that emission factors were developed; however, the sampling and analytical methodology is not known in these cases. It is difficult at best to accept data on blind faith. There are several references listed for parameters which refer only to summary tables or handwritten notes. This, of course, would be unacceptable in conveying compliance and should be an unacceptable practice in the development of emission factors. Again, in this instance, a variety of kiln types were involved in testing which yielded an emission factor. (B)

These are a few of the obvious inconsistencies in the data derivation. The inconsistencies can be clearly seen by developing tables for each parameter and each type of kiln system. The tables should contain the reference number, the kiln process tested, the testing method, the number of runs, if an emission factor was developed and the data rating. From these tables one can quickly see that several non-standard tests were employed, that a variety of kiln types were used to develop an emission factor for a specific type of kiln, and that in some cases, the data base is much too small to yield anything which provides representative data. Additionally, kiln type does have a bearing on the emissions due strictly to the environment within the kiln and or ancillary equipment.

Material and Process Parameters

Raw feed materials do vary from facility to facility. This variation occurs within the quarry systems and the raw add mixtures which are available to a given facility. Some facilities have quarry systems which have a high degree of calcinated limestone, others have average limestone, and still others have dirty limestone which is blended into the good materials to reduce waste. Some quarry systems yield the pyrites, which have a dramatic effect on sulfur dioxide emissions. Pockets of pyrite deposits may occur within a quarry system, or within shales and clays utilized as raw materials. Often these deposits are not detectable until analysis of the raw mix is determined. INCORPORATE IN MATERIALS

How well these materials are blended in the raw feed is a function of the kiln process. For example, one of the advantages of a wet kiln system lies in the consistency of the raw feed due to the slurry and mixing processes. It is infinitely more difficult to maintain raw feed consistency in the other types of kiln systems. The kiln process itself has some bearing on how raw materials relate to emissions. Wet kilns for example, have lower backend temperatures, which affect the absorption of the sulfur species within the kiln environment. This environment is low temperature, highly alkaline and moisture laden, a good environment for SO2 scrubbing. The sulfur species poses several problems for a wet kiln in that sulfate rings can and do form within the kiln. A good portion of wet kilns insulfflate the captured dust which can lead to sulfur cycles within the kiln. All of these features has some effect on the sulfur dioxide emissions.

Dry type process kilns typically return a portion of captured dust to the system in some fashion, again this process can affect the sulfur oxide emissions. Most kiln operations are analytically sufficient in determining at what point and at what rate this captured dust can be utilized. However, deposits in the raw mix which are not detected may result in the most careful calculations being incorrect.

The kiln environment in dry type kilns varies considerably between process types. For example, preheater and precalciner-type kilns can alter the amount of calcination which takes place outside the kiln in the suspension preheater towers or within the precalciner chamber. The reasons for varying the location and amount of calcination is most generally related to the type of raw feed and fuel used and the type of clinker being produced. These alterations affect kiln emissions by relocating temperature zones and alkalinity percentages within those zones. In the case of a precalciner, fuel is being fired directly to the chamber on the kiln exhaust, sulfur dioxides may increase or decrease dependent on the sulfur content of the fuel. Also in this case, nitrogen oxides may increase or decrease with changes in the temperature profile of the system and the location of combustion air.

There are significant differences between the types of kilns employed by cement manufacturers, most differences relate to the energy efficiency of the system. It should be noted that the environments within the kiln can be dramatically affected by the method of operation for a given kiln. There are a vast amount of parameters which can be altered to provide better energy efficiency, better clinker quality, or improved kiln operation. The emissions from the kiln will change to a certain degree with the operating changes, however the large thermal masses involved tend to delay reactions over time.

It appears that the best means of resolving these issues is to poll the kiln operators which are equipped with CEM systems and, therefore, have a data base which relates specifically to their kiln, for the information relating to kiln emissions versus operating parameters. This is, at best, a difficult task. However an emission factor which does not relate to a specific kiln process is not desirable. With the recent advent of the BIF regulations and the 1990 Clean Air Act Amendments, a majority of kilns have conducted source testing, or have installed CEM systems for compliance purposes. The data base should be well established and certainly more up to date than some of the testing conducted in the 1970's and 1980's. Test methods are more refined and CEM systems are infinitely more accurate and reliable than those of a few years back.

Raw Material Rates/Clinker Rates

The raw material to clinker conversion rates presented in the letter appear to be relatively high in comparison to actuals experienced. Typical losses on ignition range between 31 % and 36 % on the averages. This would equivilate to one ton of raw feed yielding 1320 pounds of clinker. the actual conversion rate should be in the neighborhood of 1.43 to 1 on an average as experienced.

This rate will vary somewhat from facility to facility dependent on the quality of materials obtained from the quarry system. Generally a 34 % loss on ignition is relatively standard to the industry. Some kiln operations are equipped with weigh mechanisms for both the raw materials and the clinker. Typically the clinker production values are more accurate than raw feed rates. A direct reference to this can be found in a book titled *The Rotary Cement Kiln*, Second Edition by Peray. This book also delineates several factors which affect kiln emissions with respect to raw feeds, fuels, and kiln types.

Combining Data From All Kiln Types

This area definitely needs refinement as all kiln types burning the same fuels will not yield the same emissions. This fact is obvious within the references employed for developing emission factors. As referenced previously, a precalciner kiln system in some operating modes may respond to kiln emissions in much the same manner as an afterburner on an incinerator responds. Wet kilns and long dry kilns typically employ chain sections for assistance in heat transfer, trefoils may also be employed, this design feature affects exhaust temperatures and dust carry over. This is not true in suspension preheaters and precalciners. Moisture levels in wet and long dry kilns vary significantly from the other kilns as well. All of these elements affect the internal kiln environment which in turn has some bearing on kiln emissions.

One kiln system that has been totally ignored in AP-42 is the Lepol kiln which is a semidry process which charges raw feed as a pellet approximately 3/4 inch in diameter. It is difficult to logically assume that particulate characteristics and rates are comparable to other kiln systems. The mode of operation of this system when correctly operated may well produce kiln emissions which are significantly different from other kilns simply because of the gas pathway and the feed introduction to a grate.

To clarify this point further, EPA will accept data from one incinerator as being applicable to a second incinerator provided the units are identical in all engineering aspects. Each type of process kiln currently utilized by the cement industry is not identical to any other kiln. The EPA long ago recognized that engineering differences do affect incinerator emissions. The same is true of cement kilns as the internal environments and circuits vary.

There are several differences in convective patterns, material movement patterns, burner locations and insertion lengths from kiln to kiln. The heat transfer mechanisms and locations vary from kiln to kiln. Clinker cooler types vary from kiln to kiln, the cooler provides the secondary air to the kiln for combustion. The method of air entry can vary, as well as temperature and dust loading. There are a vast number of differences from one kiln to another let alone from one process type to another. Operators can vary the amount of calcination which takes place within a preheater or precalciner kiln; this is not possible in wet or long dry kilns. The loadings to the calcining zone can be altered for production or kiln performance, these factors will affect emissions. Precalciner kilns inject fuel into the exhaust stream of the kiln rather than all the fuel being introduced into the kiln proper. This will have a definitive affect on stack emissions which is not comparable to a wet kiln for example.

Based on engineering differences which are designed to affect kiln operation and performance, it just simply is not an acceptable practice to combine all data from all types of processes. To combine all this data would be the same as assuming that all incinerators, regardless of what is being burned, emit the same gaseous pollutants to the atmosphere. This is quite simply a false statement and one which would never be acceptable to the public or EPA. This also brings to point that emission factors for kilns firing hazardous wastes as fuels require some definition of emission factors. For example under the BIF regulation, THC emissions must be less than 20 ppmv or less than baseline

THC emissions for a kiln which emits higher than 20 ppmv when not firing waste. This clearly identifies that VOC emissions must be lower than normal emissions when waste is fired to a cement kiln. This also indicates that fuel type may have a direct relationship to kiln emissions with respect to VOCs.

Fuel Type

Fuel types must be somehow factored into the equations. As referenced above, the BIF regulation demands that, while firing wastes to a kiln, VOC emissions be lower than the VOC emissions are when normal fuels are fired to the same kiln. This requirement clearly demonstrates a belief that kiln emissions are affected by fuel type. This belief is being verified on a daily basis at kilns which are firing wastes and meeting this requirement. Additionally, sulfur loading in the fuels will directly affect sulfur dioxide emissions from the kiln system. It has long been thought that natural gas would yield excessive NOx emissions, it is currently being demonstrated that kilns utilizing natural gas are reducing NOx emissions.

With the recent flurry of testing being conducted at cement kilns in response to both BIF and the 1990 Clean Air Act Amendments is yielding large amounts of data concerning emissions. This data, rather than tests conducted as far back as 1971, should be collected and developed into a usable data base for cement kilns on a process type basis. Additionally, several cement kilns now have CEM systems on line in response to regulatory monitoring requirements, this data would also be of significant value. Certainly this data could provide a more meaningful insight to these kilns than the current draft document is demonstrating.