DIOXIN EMISSION RESULTS FROM RECENT TESTING AT CEMENT KILNS

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An investigative program was contracted by the Cement Kiln Recycling Coalition (CKRC) to compile data from recently completed dioxin testing at member companies.
The goals for compiling the data were two-fold: 1) to determine the current dioxin emission levels and compare them to the EPA proposed limits and the European limits;
2) to determine relationships, if any, between dioxin emissions and controllable kiln operating parameters.

We prepared a general test protocol for the CKRC in an attempt to standardize testing conditions. The testing objectives were as follows: 1) to establish a normal operating condition baseline with coal feed as the only fuel; 2) to evaluate the effect of adjusting the back end temperature and the alkali concentration of the kiln feed; and 3) to determine any relationships between controllable kiln operating parameters and stack gas and cement kiln dust (CKD) dioxin concentrations.

Data for this project have been collected from the following facilities for recent dioxin tests: Ash Grove Cement - Foreman, Arkansas; Continental Cement - Hannibal, Missouri; Essroc - Logansport, Indiana; Holnam Inc. - Holly Hill, South Carolina; Holnam Inc. - Clarksville, Missouri; Lafarge Corporation - Fredonia, Kansas; and Lone Star - Cape Girardeau, Missouri.

In addition to recently completed dioxin tests, we reviewed available Certification of Compliance (COC) trial burn data (from tests conducted in 1992) to supplement the data base.

The data are presented in terms of total dioxins/furans (PCDD/PCDF) and toxic equivalents (TEQ). Total PCDD/PCDF is the sum of all of the tetra- through octa-chlorinated dioxin and furan congeners. TEQ is found by multiplying each of the identified toxic dioxins and furans by its toxic equivalence factor and summing the products[1]. The standard units used for total PCDD/PCDF and TEQ in the stack

gases are ng/dscm corrected to 7% O_2. The standard units for total PCDD/PCDF and TEQ in the CKD are parts per trillion (ppt).

Observations from the data analyzed during the project are presented as follows: 1) the range of total PCDD/PCDF emissions from recently completed dioxin testing is from 0.20 ng/dscm to 369.00 ng/dscm for the average run under normal feed conditions; 2) the range of TEQ emissions from recently completed dioxin testing is from 0.00133 ng/dscm to 3.00 ng/dscm for the average run under normal feed conditions; 3) the APCD exit gas temperature appears to be related to dioxin formation and at higher APCD exit gas temperatures, dioxin concentrations increase (testing was not conducted above 600°F; therefore, a maximum temperature for dioxin formation is not presented); 4) the chain zone temperature appears to be inversely related to dioxin formation and at increased chain zone temperatures, the dioxin concentrations decreased; and 5) nitrous oxide emissions and dioxin emissions appear to be inversely related[2].

The effect of an alkali addition on dioxin formation is seen to be different between kilns. One facility added Na_2CO_3 to the fuel feed zone. Dioxin emissions decreased significantly as the Na_2CO_3 was continually added. Testing at the facility was conducted over a five (5) day period. Test day 1 was conducted under normal operating conditions. Na_2CO_3 was added at a rate of one ton per hour (1 tph) to the fuel feed zone on test days 2 and 3. The average total PCDD/PCDF concentration for the three runs on test day 1 was 76.66 ng/dscm. The average TEQ for test day 1 was 0.95 ng/dscm. The addition of Na_2CO_3 reduced the total PCDD/PCDF concentration to an average of 5.00 ng/dscm, and the TEQ concentration to an average of 0.06 ng/dscm for test day 3. Additional testing is still being conducted to verify the impact of Na_2CO_3 on PCDD/PCDF formation. Table 1 lists the kiln operating conditions and test results. Figures 3A and 3B demonstrate the reduced PCDD/PCDF formation with the addition of Na_2CO_3[3]. Another facility added K_2CO_3 to the raw material feed zone of the kiln. Dioxin emissions were found at the highest level of any test day.

Based upon COC/trial burn data and recently completed dioxin testing, exit gas temperature appears to be the most consistent factor in reducing dioxin emissions. However, individual kiln conditions must be determined on a case by case basis.

REFERENCES

1. U.S. EPA, Code of Federal Regulations, Title 40 Part 266, Appendix IX, Section 4.0. July, 1993.

2. Schreiber, Grana & Yonley, Inc., Report to Cement Kiln Recycling Coalition on dioxin emission results from recent testing. March 31, 1994.

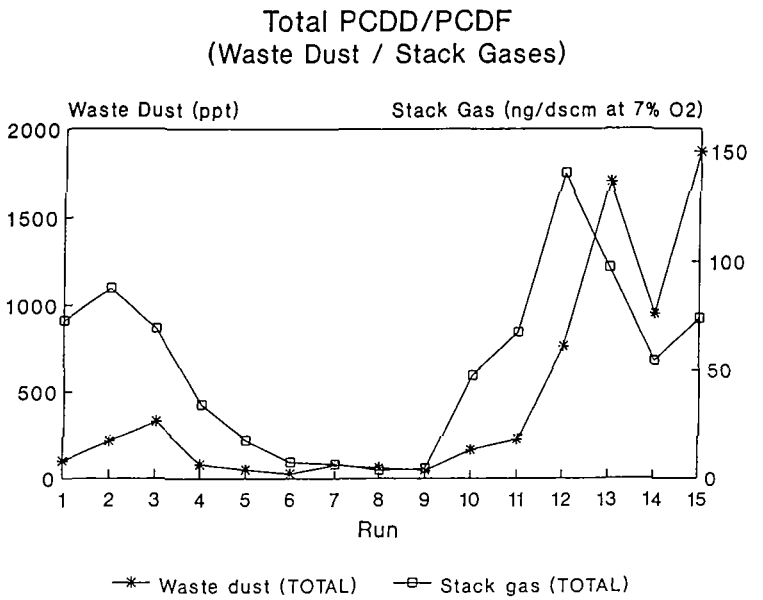
3. Schreiber, Grana & Yonley, Inc., Dioxin testing, waste dust analysis for Continental Cement Company, Hannibal, Missouri. July, 1993.

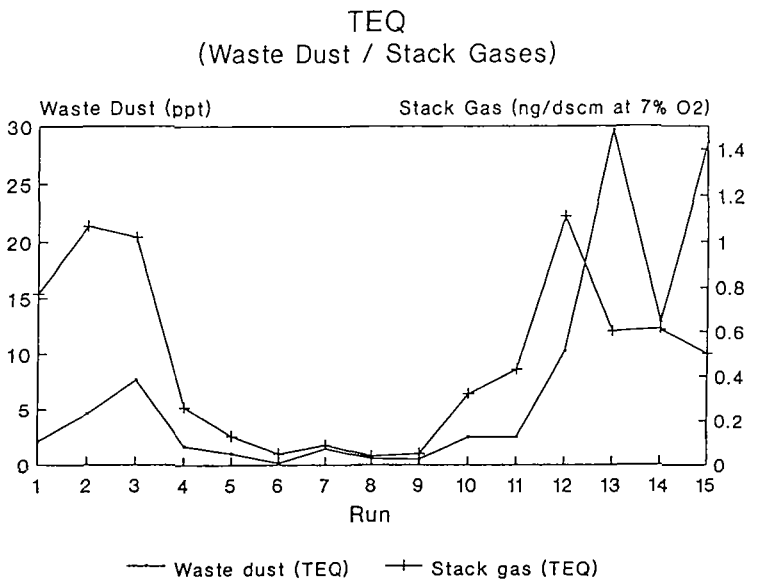
Table 1: Test Conditions/Results[3]

RUN	Fuel	Kiln Conditions	Dust* total	Dust* TEQ	Stack Gas** total	Stack Gas** TEQ
1	Coal + HW	Normal	99.71	2.10	72.89	0.77
2	Coal + HW	Normal	216.00	4.61	87.73	1.07
3	Coal + HW	Normal	330.30	7.67	69.26	1.02
4	Coal + HW	Added Na2CO3	80.57	1.69	34.14	0.26
5	Coal + HW	Added Na2CO3	49.30	1.03	17.63	0.13
6	Coal + HW	Added Na2CO3	26.76	0.18	7.60	0.05
7	Coal + HW	Added Na2CO3 Reduced Exit Gas T	77.16	1.47	6.68	0.09
8	Coal + HW	Added Na2CO3 Reduced Exit Gas T	60.98	0.58	3.74	0.04
9	Coal + HW	Added Na2CO3 Reduced Exit Gas T	46.00	0.51	4.58	0.05
10	Coal + HW	Reduced Exit Gas T	165.00	2.48	47.51	0.32
11	Coal + HW	Reduced Exit Gas T	226.40	2.49	67.60	0.43
12	Coal + HW	Reduced Exit Gas T	761.30	10.20	140.32	1.11
13	Coal	Normal	1704.00	29.67	97.23	0.60
14	Coal	Normal	950.40	12.90	54.42	0.61
15	Coal	Normal	1872.70	28.59	73.84	0.50

* Units are ppt
** Units are ng/dscm

Figure 3[3)]


Total PCDD/PCDF
(Waste Dust / Stack Gases)
Waste Dust (ppt)
Stack Gas (ng/dscm at 7% O2)
2000
1500
1000
500
0
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Run
Waste dust (TOTAL)
Stack gas (TOTAL)


TEQ
(Waste Dust / Stack Gases)
Waste Dust (ppt)
Stack Gas (ng/dscm at 7% O2)
30
25
20
15
10
5
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Run
Waste dust (TEQ)
Stack gas (TEQ)