



## Case Study Co-processing Waste Materials in Cement Production

### Test Burns with PCDDs/PCDFs Monitoring

#### The Philippines Examples

##### BACKGROUND

Co-processing in the cement industry is an alternative form of waste disposal. Especially high calorific waste can be disposed of as alternative fuels in the cement kilns to replace fossil fuels. In all incineration processes, special attention must be paid to the formation of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) as unintentional byproducts of chlorine and hydrocarbon precursors from the raw materials.

The formation of dioxins and furans is known to occur by “de novo synthesis” during cooling within the temperature range from 450 to 200°C. This can happen during the co-processing of halogenated waste in a kiln. In order to establish a better understanding of the destruction process in a kiln, a trial burn was proposed to measure the unintentional by products. The test trial was carried out in the Bulacan cement plant of the Union Cement Corporation in the Philippines in November 2004.

##### THE CONDITIONS

The test was done for two reasons:

- to demonstrate that co-processing is a pragmatic and environmentally sound way to treat waste
- to use a batch of 1,200 tonnes of imported pet food, with a calorific value of 4,600 MJ and chlorine content of 1.28 % chloride. The pet food was contaminated with mould toxins.

In comparison, the chloride content of coal used in the Bulacan plant is only in the range of zero to 0.08%. The greater amount of chlorine in the pet food in the cement process increases the probability of the formation of PCDDs/PCDFs. The trial burn in the Bulacan Cement Plant complied with the Clean Air Act of the Philippines.

The Bulacan cement plant is equipped with a semi-automatic facility for co-processing solid, liquid, and sludge wastes as alternative fuels. The units consist of a big feeding hopper and a conveyor, which carries the solid waste directly to the riser duct below the inline calciner (ILC). From there the waste materials are introduced into the kiln on the secondary side.

##### THE TEST TRIAL

All criteria for the test trial for measuring PCDDs/PCDFs emissions in the stack gas has been worked out and defined in a test protocol. According to this protocol, the test trial must be in compliance with international regulations and procedures, like the “US-EPA Codes of the Federal Regulations (CFR) 40” and the “EU Directive 2000/76 EC on the incineration of waste”. The trial included three test runs with the following parameters:

- A blanc test run (without pet food), second test run with a feeding rate of 1.75 tonnes pet food/hour and a third test run with a feeding rate of 3.5 tonnes pet food/hour





*Stack with the monitoring platform and the adjustment of the probe into the kiln*

- The cement kiln did run in the “Compound mode (the normal working conditions)”
- The sampling time of the stack gas took 6 - 8 hours per run. The stack gas sampling started only after all process parameters of the cement kiln were stable
- All standard operating and emission parameters were monitored continuously
- The trial burn and the testing were carried out on three following days.

For the performance of the stack gas sampling and analysis to get reliable results the following qualified test methods of the U.S. Environmental Protection Agency US-EAP Methods 1, 2, 3A, 4, 5, and 23 as well as the European Standard EN 1948-2 were used. The stack gas was collected with a special probe on the stack sampling platform of the cement kiln. The PCDDs/PCDFs were collected in a combined condenser with a XAD-2 resin absorbent trap. In a specialized laboratory in Australia the PCDDs/PCDFs were analyzed by using a high resolution gas chromatography/mass spectrometer in accordance with US-EPA Method 1613A.

The test results of the stack samples of this trial were all below 0.1 ng TEQ/Sm<sub>3</sub>, which is the limit value in the European legislation for hazardous waste incineration plants (Council Directive 2000/76/ EC). The results reveal clearly that the co-processing of the pet food has no effect on the emissions.

### LESSONS LEARNT

Before the start of the co-processing, it is important to study the chemical structure and the decomposition process of the waste under the conditions of cement kilns.

Depending on the outcome of the evaluation, a trial should be carried out to evaluate the emissions in the stack gas of the cement plant as well as to calculate the risks for the environment. Co-processing is playing a more and more a significant role in waste management in developing countries. Test trails are an important tool to get information about the expected emissions and the behavior of the waste during the destruction process.

### GOOD PRACTICE

The decision to start co-processing waste and to carry out a test depends on the chemical composition as well as the quantity of the waste. The relevant national agency should be involved in the planning process in a very early stage. Cement plants should execute co-processing and test trails only if they are able to abide by the national emission standards.



*The semi-automatic co-processing facility for solid waste*

### REFERENCES

[www.coprocem.com](http://www.coprocem.com)