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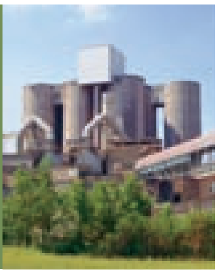
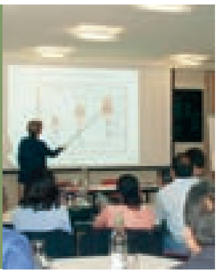
# Case Study
Co-processing Waste Materials in Cement Production




## Aspects of Permitting

### The Example of North Rhine Westfalia, Germany

### Background

In Germany, cement kilns are subject to authorization; their operation is governed by the requirements of the Federal Emission Control Act. This act protects against harmful effects such as air pollution and similar problems. It forms the basis of nationwide, comprehensive laws on air quality, noise abatement and plant safety. The emission limits in exhaust gas from cement plants are regulated by the Technical Instructions on Air Quality Control, and if waste fuels are used, by the Ordinance on Incineration Plants Burning Waste and Similar Substances. This ordinance is based on the EU Directive 2000/76/EC.

### Permit Conditions

The key environmental issues associated with cement production in the licensing procedure are air pollution and the efficient use of energy. The application for a license must give comprehensive specifications for the operating requirements for the cement kiln to ensure safe combustion of the residues, together with a description of the necessary operational measures. The basic principle that is always applied to carcinogens as a requirement for issuing a license states that emissions are to be restricted as far as possible. In addition to maintaining low mass concentrations, it is also important to minimize the mass flows.

### Application Documents

- → Topographical map
- → Constructions documents
- → Diagrammatic section of the plant, Machine site plan
- → Exposition of the plant, of the operation terms of normal working conditions
- → Description of the emission situation and prevention of pollution
- → Secondary fuels: generation, processing, quality assurance system, utilizing installation, supply
- → Air pollution emission prognosis ($NO_x$, $SO_2$, Dioxins/ Furans (PCDD/F), dust, heavy metals),
- → health and safety standards
- → energy saving measures
- → paper for public information.

### Waste Information

A key parameter is the quality of the substituted fossil fuel. A small difference in the burden of pollutants between conventional fuel and waste fuel strengthens the advantage of co-processing-incineration. To compare scenarios between "with and without waste fuel" it is advisable to define an average content of fossil heavy metals in fossil fuels content of heavy metals and use it for benchmarking. It can be used for direct comparison of different types of waste fuel qualities or even serve as the basis for the development of a material specific standard. The standard could be defined as an average content of heavy metals and maximum content in the high calorific waste fuel. The level of calorific value in waste fuel from manufacturing processes is 20 ± 2 MJ/kg, while

| Pollutant | C |
|---|---|
| Total dust | 30 |
| HCl | 10 |
| HF | 1 |
| $NO_x$ | 500[1]/800[2] |
| Cd + Tl | 0.05 |
| Hg | 0.05 |
| Sb, As, Pb, Cr, Co, Cu, Mn,Ni, V | 0.5 |
| Dioxins and Furans | 0.1 |
| $SO_2$ | 50[3] |
| TOC | 10[3] |

Daily average 10% $O_2$, dry all values in mg/m³ dioxins and furnans in ng/m³
1) new plants
2) existing plants
3) exceptions authorized by the competent cases where not result from of waste

*Directive 2000/76/EC incineration of waste*

Continous monitoring of emissions and operating conditions:
- → Total Dust
- → Hg
- → $O_2$ volume concentration
- → $NO_x$
- → TOC
- → CO
- → $SO_2$
- → exhaust volume (Nm³/h)
- → exhaust gas temperature
- → material feed kiln inlet.

the calorific value content for the high calorific part of municipal waste is fixed at 16 MJ/kg.

## Monitoring Emissions

The use various secondary fuels is always accompanied by extensive emissions measurements. A distinction is made between continuous and individual measurement. Another is made between first time- and repeat measurements, measurement for special reasons, calibrations and function tests. The measurement-relevant parameters to be considered in measurement planning derive from regulatory requirements, e.g. the operating permit, information from the technical supervisory body responsible for the plant and from on-site inspection.

## Monitoring Combustion

- → The burning process has to be monitored continuously using modern process technology
- → constantly fixed inspections on arrival Waste materials
- → Liquid media are sampled continuously through trickle tubes for quality control
- → the main parameters of the waste materials must be put into the process control system on a continuous basis
- → regulations of primary energy have to follow in reliance on secondary fuel data
- → waste fuels may only be supplied during normal continuous operation.

## Energy Aspects

The production of clinker is energy-intensive. Theoretically an average of 1.75 MJ of thermal energy is needed to burn 1kg clinker. The actual requirement for thermal energy in modern plants is approximately 2.9 to 3.2 MJ/kg (BREF 2001) depending on the process, up to 4 MJ/kg. Most installations use the dry process, which is the most economical in terms of energy consumption. In practice, fuels with an average net calorific value of at least $h_{u,m}$ 20 – 25 MJ/kg are normally used in a main firing system.

## Lessons Learnt

Past experiences have shown that the cement industry can play an important part in the use of secondary fuels. Key factors include favorable conditions inside rotary tube kilns, optimized process and safety technology, improved exhaust gas cleaning systems and a comprehensive control of the input substances.

## References

www.coprocem.com
coprocem@fbb.ch
richard.bolwerk@bezreg- muenster.nrw.de

| Components (mg/m³) | Emissions (daily average values) from-to | Emission limitss in permits in Germany (daily average values) |
|---|---|---|
| Dust | 1-15 | 14-20 |
| HCl | 0,3-5 | 10 |
| HF | 0,1-2,0 | 1 |
| $SO_2$ | 100-400 | 350 |
| $NO_x$ | 300-500 (600) | 500 |
| Hg | 0,005-0,03 | 0,03-0,05 |
| Cd + Tl, | < 0,001 | 0,05 |
| Sb, As, Pb, Cr, Co, Cu, Mn,Ni, V | < 0,002 | 0,05 |
| PCDD+PCDF (TE) [ng/m³] | 0,001 - 0,01 | 0,05-0,1 |