START-UP OF A HAZARDOUS WASTE INCINERATOR – IMPACT ON THE PCDD/PCDF-EMISSIONS

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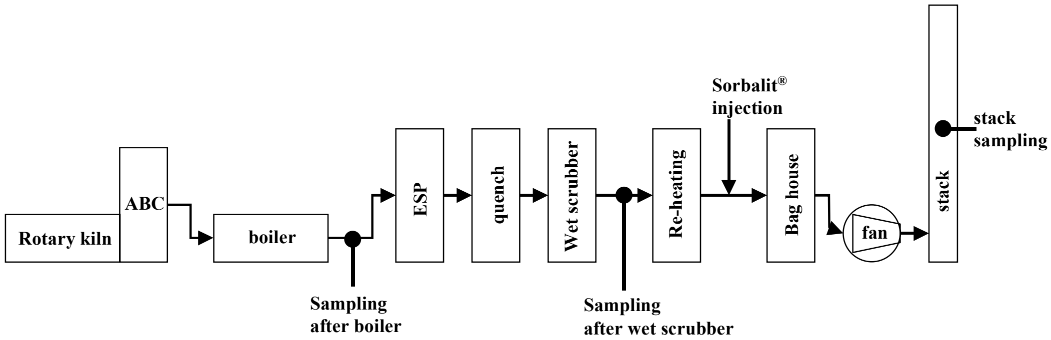
Introduction

GSB operates two hazardous waste incineration lines at the Ebenhausen location with a capacity of about 150000 Mg/y (incinerated amount in 2002). The plants have to fulfill the European emission limits for PCDD/F in waste incinerators (0.1 ng I-TEQ/Nm³ @ 11% O_2). Both lines are equipped with a rotary kiln and an after burning chamber, a horizontal boiler with 13 flues, followed by an electrostatic precipitator (ESP), a quench and a two-stage wet scrubber. After re-heating of the gas, a lime-carbon mixture (Sorbalit®) together with re-circulated material from the bag house is added to remove the PCDD/F and other contaminants in the final cleaning stage, the bag house. Each line is controlled 12 times a year for its dioxin emissions. Usually the emission limit is scooped out to less than 3 %. All dioxin emission data, together with the actual emissions of the continuously monitored parameters are permanently published on the web side of GSB (www.gsb-mbh.de). In December 2002 the results of such an dioxin emission measurement at line 2 showed a slight exceeding of the emission limit for the first time since the start-up of the plant in 1996. Immediate investigations of the potential causes of this elevated value indicated that besides some failures in the additive feeding at the bag house, the start-up process 9 days prior to the measurement could also be one of the sources for it. Recent publications indicate that the use of oil for heating up the furnace in the start-up phase may lead to extra-ordinary emissions after the boiler which may cause long lasting memory effects in the cleaning devices downstream and may cause significant impacts on the stack emissions.[1] Therefore the plant management, supported by the regional environmental agency (LfU Augsburg), decided to investigate and control the emissions of a complete start-up procedure separately for each process phases during the next start-up at one of the incineration lines.

Methods and Materials

The measurements and analysis have been performed strictly according to the EN 1948 by IFU-Institut fuer Umwelt- und Arbeitsplatzanalytik, Burkon GmbH, an accredited institute for PCDD/F sampling, with the exception that the sampling duration had been adapted to the length of the different stages of the start-up process. The sampling was conducted simultaneously at the outlet of the boiler, the outlet of the wet scrubber and the stack. The plant scheme is drawn in figure 1.

figure 1: plant scheme and sampling locations



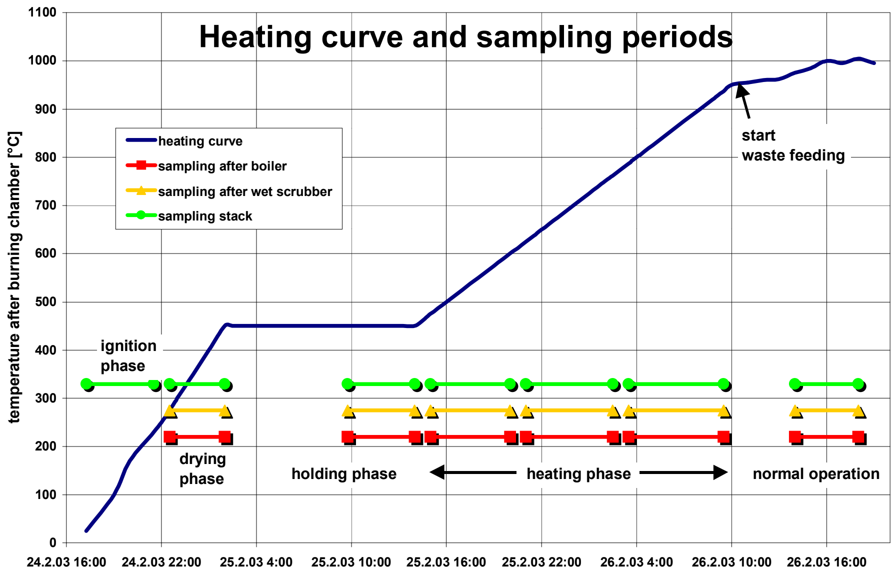
Results and Discussion

Repairs of the refractory during a revision require a precise heating program after start-up to allow a cautious drying and hardening of the refractory material. The detailed demands depend on the material and the supplier. At GSB an oil burner for the heating during the start-up is used. The process can be divided into several phases, which have been sampled separately:

- Ventilation and ignition
- Drying phase
- Holding phase
- Heating phase
- Start waste feeding after reaching the minimum after burning chamber temperature

The heating curve and the sampling periods are shown in figure 2.

figure 2: heating curve and sampling periods



To follow the influence of the start-up further samples have been taken over a period of 5 weeks. Details and the analytical results are shown in table 1.

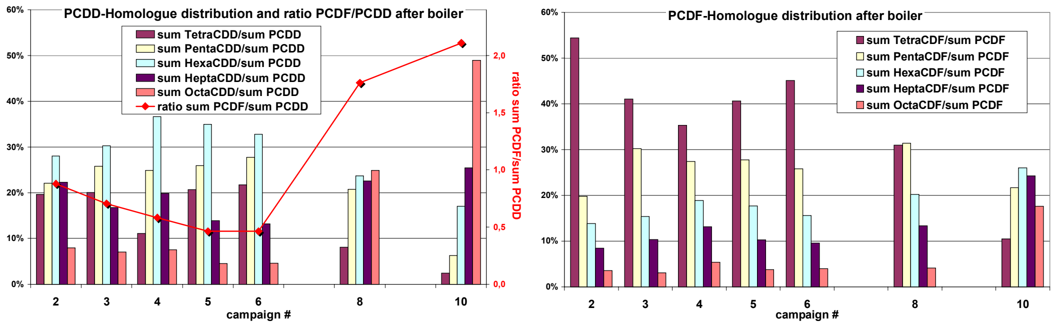
table 1: sampling campaigns, description and results

#	Date	Sampling time	Days after start-up	Phase	PCDD/F after boiler	PCDD/F after wet scrubber (before re-heating)	PCDD/F stack
1	24.2.03	17:00 to 21:30	0	Ventilation, ignition and heating to 250°C in the after burning chamber	----------	----------	**0,0193**
2	24./25.2.03	22:30 to 2:00	0	Drying phase, 250-450°C in the after burning chamber	**7,06**	**19,25**	**0,0170**
3	25.2.03	9:45 to 14:00	0	Holding phase at 450 °C in the after burning chamber	**16,58**	**3,22**	**0,0057**
4	25.2.03	15:30 to 20:00	1	Heating phase 450-950°C in the after burning chamber	**2,18**	**0,53**	No analysis
5	25./26.2.03	21:00 to 1:30	1	Heating phase 450-950°C in the after burning chamber	**1,4**	**0,36**	**0,0037**
6	26.2.03	2:50 to 6:30	1	Heating phase 450-950°C in the after burning chamber	**1,02**	**0,38**	No analysis
7	26.2.03	15:40 to 19:40	2	Waste feeding 1st day, (sampling begin 4h after waste feeding)	----------	----------	**0,0027**
8	27.2.03	10:00 to 16:00	3	Waste feeding 2nd day	**4,55**	**3,51**	**0,0015**
9	1.3.03	8:00 to 14:00	5	Waste feeding 4th day	----------	**1,17**	**0,0016**
10	5.3.03	8:30 to 14:30	9	Waste feeding 8th day	**1,27**	**1,01**	**0,0010**
11	13.3.03	9:30 to 15:30	17	Waste feeding 16th day	----------	**1,46**	**0,0014**
12	20.3.03	9:00 to 15:00	24	Waste feeding 23th day	----------	**2,07**	**0,0011**

all PCDD/F data in: [ng I-TEQ/Nm³ @ 11% O_2]

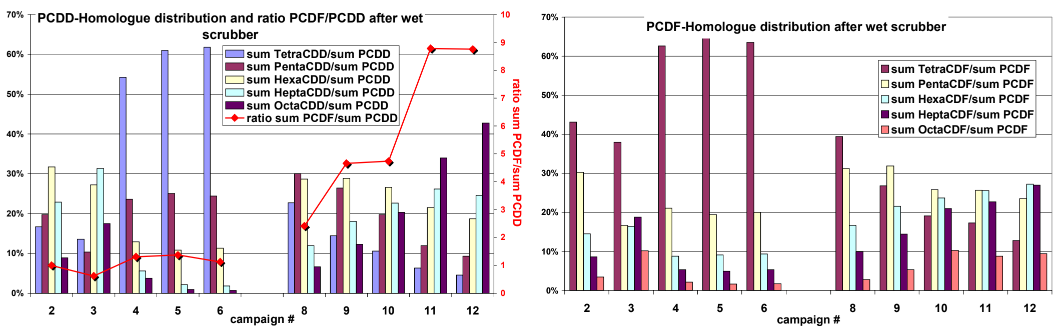
During the very first phases of the start-up significantly elevated PCDD/F-emissions after the boiler can be observed. Most likely this is caused by soot formed during the oil burner operation which is disposed on surfaces within the still cold boiler. The slow increase of the temperature up to the normal operation range will allow to form PCDD/F. A characteristic indicator is the stronger formation of PCDD and the tendency to form lower chlorinated components. Therefore the ratio PCDF/PCDD after the boiler is in the range of 0.5 during the oil burner operation phases and increases to around 2 in the normal operation. Similar observations were made at a municipal waste incinerator that a lower PCDF/PCDD ratio indicates a formation in the boiler section.[2]. Also the homologue distribution pattern changes from the more dominant lower chlorinated PCDD and PCDF during the oil burner phase to a more higher chlorinated dominance in the normal operation (compare figure 3).
But despite those elevated levels in the flue gas before and after the wet scrubber, the stack emissions were clearly below the emission limit at all time.

figure 3: homologue pattern and PCDF/PCDD ratio after boiler



The differences in the homologue distribution and the PCDF/PCDD ratio in the flue gas after the wet scrubber are also clearly different for the start-up phase and the normal operation. Here the impact of the start-up can be observed for more than 2 weeks due to the long lasting memory effect of the wet scrubber.

figure 4: homologue pattern and PCDF/PCDD ratio after wet scrubber



Conclusions

During the oil burner operation within the start-up procedure high PCDD/F emissions after the boiler and after the wet scrubber could be observed. Although the influence of the start-up can be observed for more than 2 weeks due to the memory effect of the wet scrubber, the stack emissions were always clearly below the emission limit.

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References

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