Polypropylene as Regenerable Absorber for PCDD/F Emission Control

S. Kreisz, H. Hunsinger, H. Seifert
Karlsruhe Research Center
Institute for Technical Chemistry, Thermal Waste Treatment Division
D–76021 Karlsruhe, P.O. Box 3640, Germany

1. Introduction

Based on the findings that the plastics polyethylene (PE) and polypropylene (PP) which are commonly used as structural materials in wet scrubbing systems exhibit a strongly temperature–dependent PCDD/F separation behavior [1], various plastics have been checked for their PCDD/F separation capability under defined experimental conditions. Based on these experiments concepts have been developed to utilize plastics as regenerable systems for PCDD/F abatement in waste incineration [2]. Operability of the system has been demonstrated in a small pilot plant in the bypass of the TAMARA test facility for waste incineration.

2. Experimental

Fig. 1 shows the simplified flow chart of the bypass plant. The system consists of two vessels which are filled with commercially available PP granules. The absorption vessel is passed by the exhaust gas at a temperature of about 80°C, whereas the desorber vessel is passed by air at a temperature of 130°C. By means of adequate transfer units, the PP can be exchanged continuously or intermittently between the vessels. As a result of the strongly temperature–dependent absorption/desorption equilibrium of PCDD/F in PP, gaseous PCDD/F contained in the exhaust gas are retained in the absorber vessel and released again from the PCDD/F–loaded PP at 130°C in the desorber vessel. The plant is designed for a maximum exhaust gas flow of 200 Nm^3/h.

In the bypass system, the desorption gas is fed back into the flue gas cleaning system of TAMARA. In technical scale, the PCDD/F loaded desorption air shall be added to the primary air upstream of the furnace inlet. In the furnace, the PCDD/F are almost destroyed quantitatively and hence no secondary system for cleaning of the desorption gas is needed.

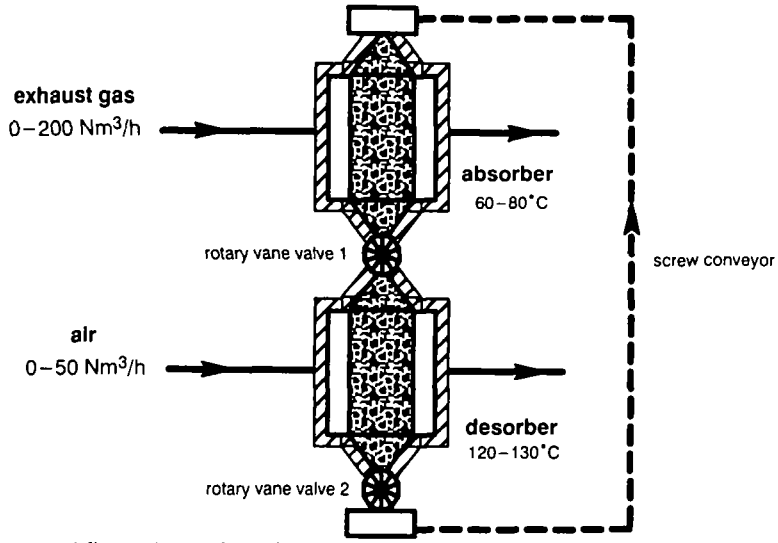

Fig. 1: Simplified flow chart of the bypass plant

Different experiments were carried out by varying the exhaust gas flow and the absorption/desorption cycle time. The temperature in the absorber was 78–80°C.

In the experiments 01–03 the gas flow was varied. The experiments 04–06 repeated the same conditions as experiment 02 in order to verify the reproducibility of the results. Each experiment lasted 24 h, after which the PCDD/F sampling trains were changed and the PP was completely transfered from the absorber to the desorber within 0.5 h. This means that the pilot plant operates as quasi fixed–bed separator. After completion of the PP–exchange PCDD/F sampling was started again.

In the experiment 07 the absorber operated 168 h without any exchange of the PP.

In the experiment 08 the PP was exchanged continuously over the entire experimental time. This means that the plant operates as travelling bed separator.

3. Results

The system operated very well during all experiments. The removal efficiencies in all experiments are listed in Tab. 1. It is evident, that removal efficiency of at least 97 % could be realized. The reproducibility of the results under constant conditions is very good.

As expected, the separation efficiency decreases with increasing gas velocities (Fig 2).

No. of Experiment	Gas volume flow (Nm^3/h dry)	Duration of experiment (h)	PCDD/F removal efficiency (%)
01	67	24	99.6
02	134	24	98.6
03	200	24	97.2
04	134	24	98.9
05	134	24	98.4
06	134	24	98.3
07	134	168	97.8
08	134	120	98.5

Tab.1: Results of the experiments

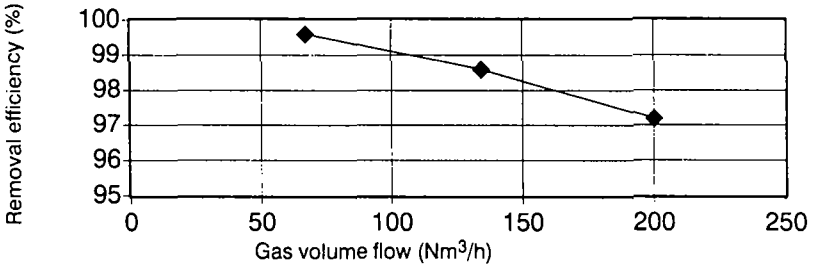

Fig.2: PCDD/F removal efficiency versus gas flow

4. Conclusions

The results of our experiments can be summarized as following:

- The regenerable PCDD/F absorber is a very simple and efficient system
- PCDD/F removal efficiencies of 99 % can be realized
- The operation costs are very low

5. References

1) S. Kreisz, H. Hunsinger, H. Vogg: Chemospere, 32 (1996), 73–8
2) S. Kreisz, H. Hunsinger, H. Vogg: Chemospere, 34 (1997), 1045–52