A simple procedure for the determination of PCDD/F, chlorophenols and chlorobenzenes in the stack gas of municipal waste incinerators

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1.Introduction

For the control of gaseous PCDD/F emissions from waste incineration plants various techniques are applied, which after cooling and possible condensation are all based on the use of a fixed-bed adsorber for the retention of the pollutants to be investigated. Above all PU-foam and XAD-2 resin serve as adsorbents. Despite of their high retention efficiency of planar hydrocarbons (e.g. PCDD/F, PCB) activated carbons or cokes are not used as adsorbents during sampling, although the application of carbonized lignite (HOK) has a number of advantages:

- low price
- easy handling
- high adsorption capacity for all three classes of substances

Therefore the aims of the test program described below were:

- to find out, whether HOK can be used as an adsorbent instead of XAD-2 resin or PU-foam and
- to clarify, whether HOK can be directly applied as an adsorbent without prior dilution or condensation in exhaust gases characterized by low dust loads (emission of MSWI)

2.Experimental

Comparative measurements were performed in the clean gas directly downstream of a wet scrubbing system in a full-scale waste incineration plant. The configuration of the different adsorption set-ups is shown in Fig 1. In the case of the dilution method the gas stream is split downstream of the condenser and a constant partial flow is recycled back in front of the adsorber. Thus, cooling and simultaneous reduction of the water content are achieved without the temperature falling below the dew point. For analysis the adsorbent is used exclusively. In the condensation method, the sampling gas is first passed through a condenser and subsequently through the adsorber. Gas is supplied by means of a diaphragm pump. Measurement and control of the gas flow are accomplished using a thermal mass flowcontroller. For analysis the adsorbent and the condensate are applied. The direct HOK method consists in passing the unconditioned sampling gas directly through the adsorber. In the downstream condenser,

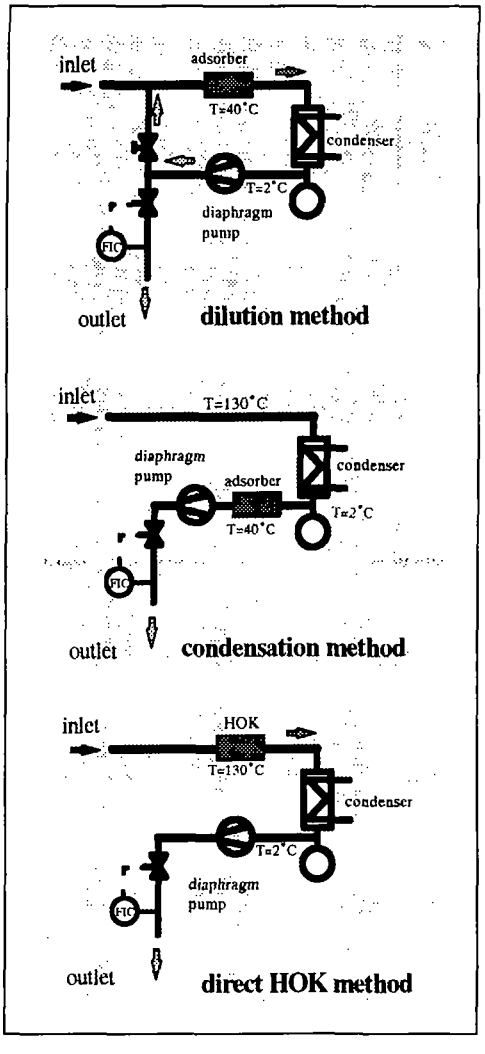

Fig.1 : Schematic flow sheet of measurement configurations

the water is removed from the exhaust gas. Gas supply takes place by means of a diaphragm pump. Gas flow is measured and controlled using a thermal mass flowcontroller. For analysis the adsorbent is used exclusively.

Within the framework of the measurement program, two test series were performed (Fig.2). All samplings were carried simultaneously at the same time and place with an upstream PTFE filter.

Test series 1: In this test series three dilution systems with three adsorbents, namely, PU, XAD-2 and HOK, as well as the direct HOK method were installed. The samples to be analyzed consisted of the four adsorbent samples 1A-D.

Test series 2: The direct HOK method and the condensation method were compared. Downstream of the condenser, the dehydrated gas flow was split and led through three adsorbents

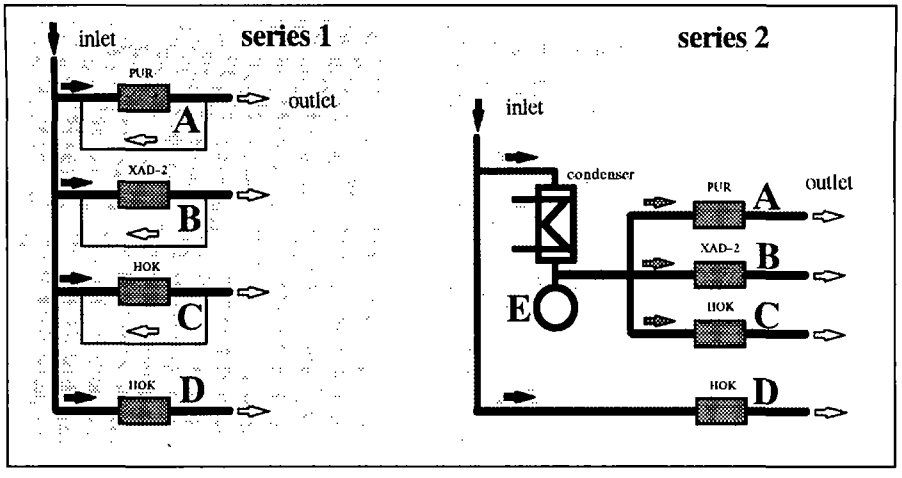

Fig.2: Schematic flowsheet of the measurement program

(PU, XAD-2, HOK) arranged in parallel. The four adsorbent samples 2A–D and the condensate sample 2E were analyzed.

3.Results

Test series 1 was carried out three times, test series 2 twice. The results obtained were consistent. The mean experimental values are represented graphically in Fig.3 and Fig.4 for the individual classes of substances for the dilution method as well as for the condensation method. Considerable deviation of the chlorobenzene values measured on PU-foam is

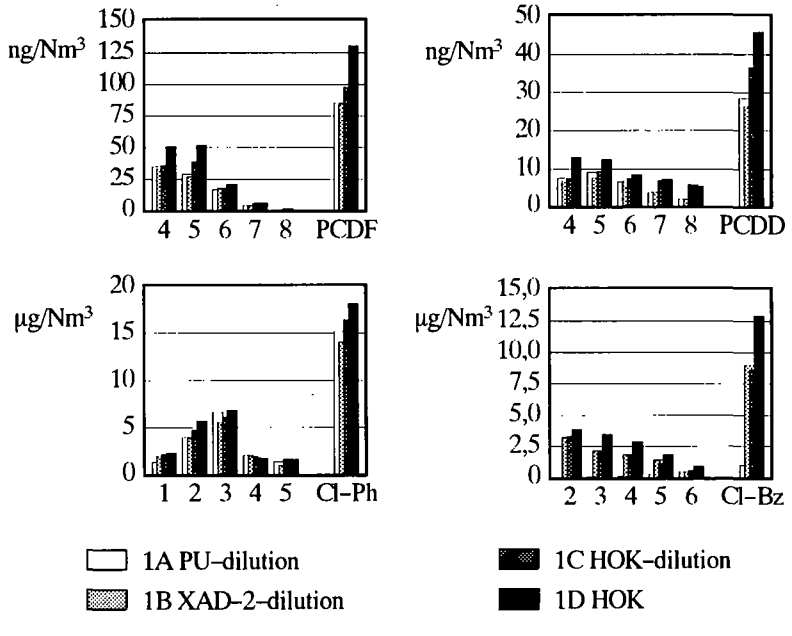

Fig.3: Results of series 1

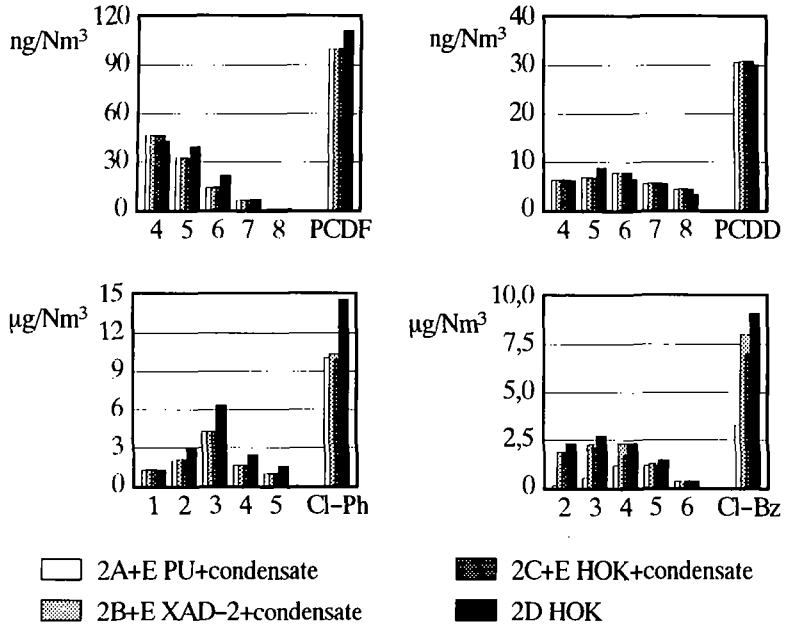

Fig.4: Results of series 2

clearly noticeable. Obviously, the chlorebenzenes penetrate the PU-foam irrespective of the sampling method used. Having a closer look at the results it can be noticed that the direct HOK method tends to yield higher values for all classes of substances compared to the dilution method. Due to the fact that three experiments have been carried out only, this may not be considered significant. In our opinion, however, it is reflected by this result that the direct HOK method tends to produce higher values than the dilution method carried out under our conditions. As far as the condensation method is concerned, these differences do not occur.

4.Conclusions

To sum it up, it can be stated that HOK, XAD-2 resin and PU-foam are equally well suited to be used as adsorbents for PCDD/F and chlorophenols. Chlorobenzenes are trapped quantitatively on HOK and XAD-2 resin only. PU-foam is not suitable for the separation of chlorobenzenes.

It is obvious from the results that HOK can be used for emission control in a simple arrangement consisting of PTFE-filters and HOK-adsorbents. No filtration is needed, if it is ensured that the dust content is < 5 mg/Nm³ and negligible residual amounts of the substances of interest are adsorbed on the dust as in our case. Due to the high HOK adsorption capacity of the substances studied, sampling periods of several weeks are possible at a bed depth of 15 cm. The samples obtained can be divided representatively and easily by means of a partitioner. Thus, an analysis can be carried out several times and a sample can be stored in reserve.