DIOXIN REMOVAL BY SLURRY WET SCRUBBING

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Introduction

Wet scrubbing (WS) is a highly efficient technique to remove acid gases from the flue gases of an incineration plant. Abatement efficiencies are about one order of magnitude greater than alternatives, like semidry or dry systems. Nevertheless in the last years dry abatement systems were largely preferred new plants, mainly because energy recovery yields are usually higher for dry systems. But WS still offers an enormous improving potential. Especially from an environmental point of view, very low emission levels are possible by optimizing geometry, operating conditions and using special additives.

In the present work, we focused on dioxin/furan removal by the use of slurry made of carbon or polymeric adsorbents in a pilot slurry wet scrubber unit.

Materials and methods

A pilot WS unit was installed and operated on a bypass system of the flue gas of the municipal solid waste (MSW) incinerator plant located in Bolzano, -Italy. The scheme of the incinerator plant described in Figure. 1 . The plant is equipped with a triple stage flue gas cleaning system. It consists in a fabric filter for dust removal, a wet scrubber and a catalytic unit for nitrogen oxides and Dioxin/Furan degradation. Transfer lines from the industrial plant and all components of the experimental unit in contact with the flue gas were made of selected materials to overcome interference of adsorption/ release phenomena.

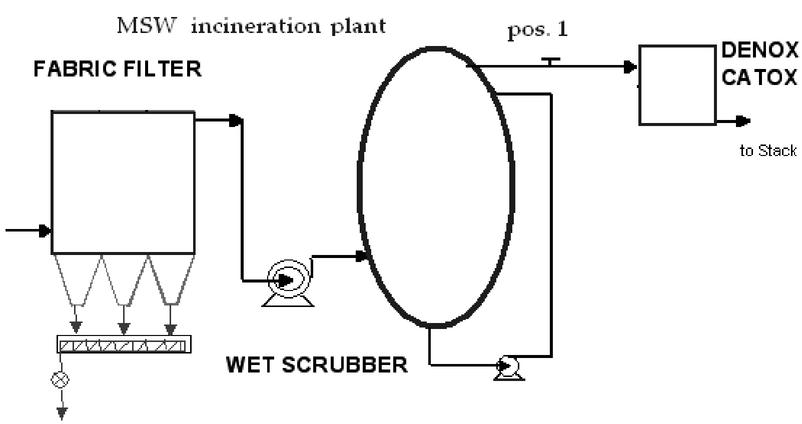

Figure 1. Flue gas cleaning section of the MSW incineration plant add text

Table 1		
H_2O	%V	20
T	°C	62
PCDD/F	ng TEQ/m^3	0,2
Hg	mg/m^3	0,005
HCl	mg/m^3	1
SO_2	mg/m^3	10
Dust	mg/m^3	<1

Table 1. Average flue gas composition at the inlet of the pilot plant

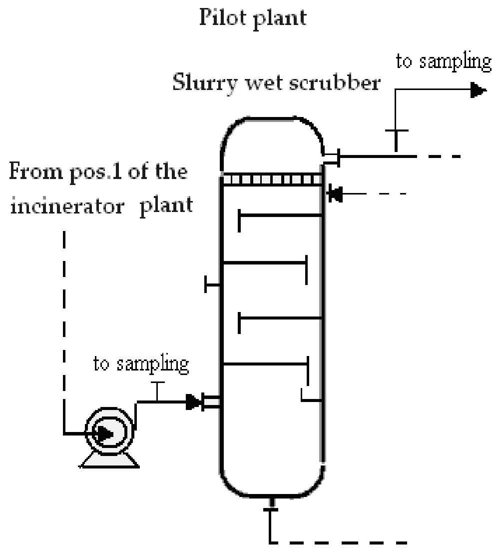

Figure 2. Slurry wet scrubber pilot plant

Operating conditions of the pilot plant, described in Figure 2 , were electronically controlled and adjusted to maximize PCDD/F abatement efficiencies in the wet scrubber . Temperature, gas flow rate, scrubbing water hold up and flow rate, pH, additive concentration were held constant for at least 100 hours to condition the system properly. Then simultaneous sampling was started at the inlet and outlet of the wet scrubbing unit. Sampling by means of silanised glass probes and analysis of PCDD/F were carried out according to EN 1948 method. Analysis of the 17 toxic, 2,3,7,8-substituted congenersi, was performed with HRGC-HRMS.

Results and discussion

The average flue gas composition at the entrance of the pilot plant is resumed in Table 1

The abatement rates are summarized Table 2. By using the pilot plant with two plates we observed abatement rates of about 80 %. By adding two more plates abatement rates raised to 90 %. When the inlet temperature was lowered even a higher abatement was observed. In table 2 the abatement rates with polymeric slurry are reported.

Table 2. Pilot plant performances add correct text

			2 plates		4 plates		4 plates -	
Slurry temperature	65 °C		55 °C		60 °C			
Adsorbent	Carbon		Carbon		Carbon		Polymeric	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
congener	ng/Nm³	ng/Nm³	ng/Nm³	ng/Nm³	ng/Nm³	ng/Nm³	ng/Nm³	ng/Nm³
2378 TCDD	0.0087	0.0011	0.0012	0.0004	0.017	0.0002	0.019	0.010
12378 PCDD	0.027	0.0031	0.041	0.003	0.022	0.0005	0.060	0.020

123478 HxCDD	0.014	0.0027	0.053	0.006	0.016	0.0016	0.039	0.013
123678 HxCDD	0.026	00.065	0.137	0.019	0.040	0.0033	0.082	0.013
123789 HxCDD	0.015	0.0038	0.076	0.007	0.024	0.0019	0.051	0.013
1234678 HpCDD	0.161	0.0326	0.835	0.037	0.191	0.0183	0.498	0.044
OCDD	0.281	0.0429	0.937	0.019	0.330	0.0519	1.639	0.063
2378 TCDF	0.037	0.0058	0.064	0.0002	0.120	0.0063	0.660	0.050
12378 PCDF	0.079	0.0138	0.137	0.011	0.075	0.0026	0.207	0.020
23478 PCDF	0.064	0.0112	0.168	0.014	0.135	0.0041	0.242	0.019
123478 HxCDF	0.51	0.0112	0.163	0.023	0.065	0.0074	0.859	0.056
123678 HxCDF	0.064	0.0013	0.211	0.031	0.090	0.0075	0.347	0.034
234678 HxCDF	0.069	0.0148	0.316	0.035	0.088	0.0065	0.463	0.027
123789 HxCDF	0.016	0.0041	0.089	0.006	0.030	0.0007	0.030	0.020
1234678 HpCDF	0.170	0.0422	0.729	0.063	0.194	0.0303	1.961	0.035
1234789 HpCDF	0.024	0.0057	0.138	0.006	0.041	0.0048	0.481	0.048
OCDF	0.93	0.0182	0.319	0.009	0.123	0.0430	4.445	0.019
ng I-TEQ/Nm^3Ng I-TEQ/Nm^3 I-TEQ or WHO-TEQ?)	0.089	0.016	0.249	0.023	0.152	0.0063	0.469	0.055
abatement (%)		82 %		91 %		96 %		88,3 %

Conclusion

Optimizing scrubber design and using some selected additives WS can effectively remove dioxins and furans from the flue gas. PCDD/F abatements were in the order of 80 % with two plates and over 90 % with four plates. Together with Dioxins also other organic and inorganic contaminants can effectively be removed.

Also relatively older plants equipped with a scrubbing system can easily be upgraded to improve abatement rates, respecting stricter emission limits. This seems to be a very effective alternative to other more sophisticated technologies.

Acknowledgement

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