Fly Ash Produced by Hospital and Municipal Solid Waste Incinerators: Presence of PAH, PCB and Toxic Heavy Metals.

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INTRODUCTION

Padua MSW Incinerator plant has a capacity of 150 ton/day on line n. 1 (a second line must be restored to comply with law). In this plant it is possible to treat hospital waste within 20 % of solid waste, expired pharmaceutical within 5 %.
The hospital waste is produced by the 2/3 of the regional hospitals, while the expired medicines come from the whole Veneto Region (4 millions inhabitants).
In the paper are reported the results of analysis of fly ash to determine the content of chlorine, mercury, lead, cadmium, copper, chromium VI, PCDD, PCDF and PCB.

PLANT DESCRIPTION

Combustion Chamber

Combustion chamber is composed of: a feed shaft in which municipal waste is fed with a traveling crane and hospital waste directly introduced; an oleodynamic operating stoker; a moving grid with oleodynamic control.
Combustion air introduced in the chamber is composed by primary air blown undergrid to help combustion of carbon burning on the grid, and secondary air introduced above the grid for combustion of volatile material burning over the grid.

Post-combustion chamber

The flue gas, coming from combustion chamber, passes in the post-combustion chamber. This chamber is equipped with a burner that is automatically started at temperature of fumes goes under 950°C. The Padua incinerator temperature is normally around 1050-1100°C without the necessity of using the burner.

Heat Recovery

Thermoelectric group consists of a vertical superheater working mainly by radiation. Vapour generator is a tube nest type, vertically disposed, operating by convection. Produced vapour is sent to a turbine to produce electric energy.

Dry Scrubbers

Flue gases from the air mixer enter into two reactors designed for dry adsorption of acid gases. Dry scrubbers are composed of two parallel units. Downstream each reactor two cyclones are installed for partial recycling of reagent. The gas control is obtained by injection of sodium bicarbonate through nozzles that realize a chemi-adsorption of acid gases on line, giving as products salts as NaCl, Na_2SO_3, Na_2SO_4, $CaCO_3$. Acid gases removal efficiencies are around 97%.

ESP

Solid particles - dust from combustion chamber, salts produced by reaction between acid gases and lime, and unreacted lime - are directed with the flue gas to an electrostatic precipitator.

WET SCRUBBER

By the end of october '94 a wet scrubber (plate tower) will be installed . The addition of this tower will help to comply with new Emission limits for mercury (50 $\mu g/Nm^3$) and hydrochloric acid (20 mg/Nm^3). Temperature of exhaust gas will be cooled down to 60 °C in the tower.

FLY ASH - EXPERIMENTAL DATA

Fly ash are classified as a toxic waste by Italian law for the high content of lead and cadmium. It has to be sent to a stabilization-solidification plant before landfilling.
Moreover, limit values are set for concentrations of organic micropollutants.

In the present paper we present recent data on fly ash produced by our plant (Table 1 to 5). Just in 2 of the 17 analysed samples of fly ash, detectable concentrations of PCDD and PCDD have been found. In one of the two samples 3 ng g^{-1} of OCDD, 7 ng g^{-1} of HxCDF and 15 ng g^{-1} of HpCDF have been found. In the other sample just 1 ng g^{-1} of OCDD have been found.

The composition of the obtained fly ash is roughly: 50 % of NaCl; 15% of Na_2CO_3; 8 % of Na_2SO_4; 5% of $CaCO_3$; 5% of $MgCO_3$; 1-4 % of Na_2SO_3 ; etc. The fly ash produced in the combustion chamber represents only 10-15 % of the total fly ash collected by the ESP. The remaining 85% in weight of the ash is composed of salts produced in the dry scrubbers. This means that ash is diluted 8-10 times by the salts produced in the gas treatment plant.

Table N. 1 - Fly Ash
Organic micropollutants

Parameter	No. measurements	arithmetic mean ng g^{-1}	std dev.
PCB	16	9	5
PCDD/PCDF	17	< 0.1 TEQ	-

Table N. 2 - PCB in the fly ash
(No. measurements: 16)

Parameter	arithmetic mean ng g^{-1}	std dev.
dichloro	nd	-
trichloro	2.7	2
tetrachloro	5.1	4
pentachloro	1.9	3
hexacloro	1	-
heptachloro	1	-
octachloro	nd	-

Table N. 3 - Fly Ash
chloride and toxic elements

Parameter	No. measurements	unit	arithmetic mean	min-max
Chloride	47	g/kg	209	69 - 360
Cadmium	10	$\mu g\ g^{-1}$	107	56 - 230
Mercury	34	$\mu g\ g^{-1}$	4.9	0.3 - 43
Lead	35	$\mu g\ g^{-1}$	2706	54 - 5449
Copper	34	$\mu g\ g^{-1}$	437	48 - 1062
Chromium (VI)	36	$\mu g\ g^{-1}$	27.5	0 - 86.4

Table N. 4 - Fly Ash leachate in acetic acid

Parameter	No.measurements	arithmetic mean mg/l	std dev.
Lead	21	1.83	1.3
Cadmium	21	0.54	0.8
Chromium (VI)	21	1.38	1.05
Copper	21	0.24	0.2

CONCLUSIONS

Fly ash obtained from the dry treatment of flue gases from MSW combustors are characterised by high contents of cadmium, lead and chromium (VI). EPA test of the waste indicates the presence of this three elements is in a soluble form.
Concentrations of PCB, PCDD and PCDF in the ash (Tables 1 and 2) do not represent - at the present - an environmental problem. The quite low presence of microorganic pollutants is directly connected with high temperatures constantly mantained in the combustion and in the post-combustion chamber (1050-1100 °C) and with the high presence of oxygen (measured downstream the post combustion chamber), always higher than 10% in volume. We do not know of others plants running in these conditions.

The high concentration of sodium chloride (1/2 of the total weigth of the ash) makes it quite difficult to obtain the stabilization and solidification of the ash with the usual cold treatments. Our company has been financed by European Community to install a plant (capacity = 3 t/day) for vitrification of fly ash after a pre-treatment to eliminate sodium chloride. Vitrification, of course, would destroy even the low traces of organic micropollutants, fusion temperature being above 1500° C. A specific research will explore the potential use for the vitrified products. Potentially the "onyx-like" material might be used to produce high resistance tiles or just as a construction fill material.

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