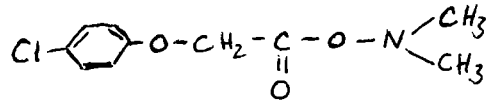
Reduction of PCDD/PCDF Emissions from an Industrial Incinerator

Bernadiner M.N.[a], Sanfirov E.S.[a], Samsonov D.P.[b]
[a] Scientific Industrial Association Techenergochimprom, Moscow, Russia
[b] Institute of Experimental Meteorology, Obninsk, Russia

During production of the herbicide 

at the Industrial Association "Chimprom" (Upha) highly toxic liquid waste is generated in amounts of about 6500 t/y. This waste has the following chemical composition: chlorophenoxyacetic acids 42.0 %, chlorophenols 38.0 %, perchloroethylene 5.0 %, glycolic acid 5.0 %, resins 5.0 %, HCl 1.0 %, NaCl 4.0 %. Combustion heat is equal to 3850 Kcal/kg.

At the factory combustion is used for disposal of the above mentioned waste. The industrial incinerator with aggregate capacity up to 800 kg/h consists of the vertical cyclone reactor (Fig. 1) equipped with refractory having an increased content of Al_2O_3, the horizontal gas duct - postcombustion chamber and a cooling and wet cleaning system of high temperature flue gas by NaOH solution. Over the past three years due to a number of papers in the press - including the central press of Russia - the public has shown concern about significant PCDD/PCDF emissions of chloroorganic compounds from the incinerator. However, up to 1991 no samples were taken and analyzed for these compounds directly at the incinerator. In 1991-1992 Techenergochimprom jointly with the factory performed complex ecological tests including taking representative samples of emissions under different operating conditions. The aim of this test was to determine actual PCDD/PCDF emissions and to develop necessary recommendations for improving the process of waste destruction or for the incinerator's reconstruction (substitution).

Sampling was performed at the outlet of the gas duct - postcombustion chamber and before the stack. About 30 samples were taken in accordance with US EPA Method 23. Sample analyses for PCDD/PCDF were performed by three independent research centres: Institute of Experimental Meteorology (Obninsk), Institute of Bioorganic Chemistry at the Russian Academy of Sciences (Moscow) and Scientific Research Institute of Chemical Plant Protection (Moscow). All of them used an analytical procedure, which was described earlier (1).

The most important parameter, which had impact on PCDD/PCDF emissions, was the temperature level of the combustion controlled by flue gas temperature (T_{fg}) into the gas duct at the cyclone reactor outlet. It was discovered that when the values of T_{fg} were in the range of 900-950°C, the value of PCDD/PCDF concentration after the waste combustion stage was about 4.6 ng/m^3 in terms of 2,3,7,8-TCDD toxic equivalents (I-TEQ).

With increasing flue gas temperature up to 1250-1300°C values of PCDD/PCDF concentrations were reduced down to values which meet the emissions requirements of German regulations (17. BImSchV) (Fig. 2). This fact verified the results of preliminary experiments performed on the bench scale plant of Techenergochimprom experimental/industrial base. Optimum parameters of the chloroorganic waste incineration were found to be the following:

- flue gas temperature - not lower than 1250-1300°C
- excess air ratio - not lower than 1.12
- residence time of gas at mentioned temperature - 1.5-1.8 s.

Special attention must be paid to the reactor start-up and shutdown regulations which would provide raising and lowering temperature level with using autonomous liquid or gas hydrocarbon fuel to exclude PCDD/PCDF formation during transient modes.

At present we have developed a program of further investigations of halogen-containig waste high temperature treatment.

Reference:

1. Samsonov D.P. et al.: Utilization of quartz superfine fibred material for concentrating polychlorinated dibenzo-p-dioxins, dibenzofurans and biphenyls from the atmosphere. Organohalogen Compounds **8**, 139-142 (1992)