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INFLUENCE OF NATURE OF CHLORORGANIC COMPONENTS IN WASTES AND AN ALKALI ADDITIVE ON PCDD/PCDF EMISSIONS FROM INCINERATORS

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It is known, that one of the sources of PCDD and PCDF is combustion of industrial and municipal wastes. PCDD/PCDF emissions from waste combustion plants result from the following factors: (1) - the presence of dioxins in the original wastes to be treated by thermal disposal (in PBCs, herbicides 2,4-D and 2,4,5-T; in contaminated soils, in ash and slags of municipal wastes incinerators and so on); (2) - the formation of PCDD/PCDF directly in the process of thermal treatment of the wastes in incinerator resulted from reacting organic carbon (C_{org}) with molecular chlorine (Cl_2), with hydrogen chloride (HCl) or with organic chlorine (Cl_{org}); (3) - the de novo synthesis in low temperature zones of flue gas path in the presence of catalysts.

The present work is devoted to investigation of the influence of chlororganic components nature and an alkali additive on PCDD/PCDF concentrations in flue gases. In the course of the experiments the main parameters of the thermal disposal were maintained at steady levels and their values were the following: the temperature of the flue gases in the incinerator outlet - 1240-1290°C; chlorine quantity fed into the incinerator - 0.8-0.82 kg/h; oxygen content in the flue gases - 1.2-1.4% vol.; residence time of the gases in the incinerator - 0.25 s.

The experiments were carried out on the pilot plant with cyclone reactor which had aggregate feed waste (model mixture) throughout of 100 kg/h. The model mixtures were prepared in the special disintegrator provided for production of homogeneous mixtures with long term stability. The following model mixtures were used: tap water for the control measurement (1); aqueous solution of acetic acid (2); mixtures of carbon tetrachloride with water (3) and with aqueous solution of alkali (4); mixtures of trichloroethylene with water (5) and with aqueous solution of alkali (6); mixtures of dichlorethane with water (7) and with aqueous solution of alkali (8); mixture of dichlorphenol with water (9); mixture of chlorbenzene with aqueous solution of alkali (10).

In the model mixtures with the aqueous caustic the content of the NaOH was about 10% weight above the stoichiometric quantity needed for NaCl formation. At the same time the chlorine concentration in the model mixtures and its flow rate to the incinerator were maintained without variations.

Sampling the flue gases from the outlet of the high temperature zone of the reactor was performed by the water-cooling probe followed by analysis in accordance with the analytical procedure which was described earlier 1).

The results of the analysis of the flue gases for isomers of PCDD/PCDF are shown in the table. As it is evident from the data of the table (runs 1 and 2) during thermal treatment of tap water and aqueous solution of acetic acid, PCDD and PCDF were not detected in the flue gases. In the runs associated with thermal disposal of the mixtures of the chlororganic components with tap water (runs 3,5 and 9) the concentrations of PCDD/PCDF in the flue gases were about at the same level and did not exceed 0.050 ng/m3 of TEQ.

The experiments on disposal of the mixtures of chlororganic components with aqueous caustic (runs 4,6,8 and 10) show the significant decrease of PCDD/PCDF concentrations in the flue gases.

The conclusions from these experiments are: 1. During thermal disposal in the cyclone reactor of the chlororganic wastes the formation of PCDD/PCDF is observed, but when the temperature of the flue gases is 1240-1290°C and the residence time of the flue gases is 0.25 sec, the PCDD/PCDF concentrations do not exceed 0.05 ng/m3 with O_2 content not above 2.5%.

2. The nature of the treated chlororganic wastes has no impact on dioxin emissions.

3. The addition of the alkali reagent to the chlororganic wastes to be treated results in decrease of the PCDD/PCDF concentrations in the flue gases by a factor 1.09-4.3.

Table
Results of the flue gases analysis for PCDD/PCDF, ng/m^3

PCDD/PCDF	RUNS					
ISOMERS	1	2	3	4	5	6
	Tap water	Water+ CH_3COOH	Water+ CCl_4	Aqueous caustic+ CCl_4	Water+ C_2HCl_3	Aqueous caustic+ C_2HCl_3
2,3,7,8-TeCDD	-	-	-	-	-	-
1,2,3,7,8-PeCDD	-	-	0.09	0.074	0.02	-
1,2,3,7,8,9-HxCDD	-	-	-	-	-	-
1,2,3,6,7,8-HxCDD	-	-	0.008	0.004	0.008	0.006
1,2,3,4,7,8-HxCDD	-	-	0.026	0.071	0.011	-
1,2,3,4,6,7,8-HpCDD	-	-	0.035	0.174	0.019	0.104
OCDD	-	-	0.191	0.052	0.062	0.038
2,3,7,8-TeCDF	-	-	-	-	-	-
1,2,3,7,8-PeCDF	-	-	-	-	-	-
2,3,4,7,8-PeCDF	-	-	-	-	-	-
1,2,3,4,7,8-HxCDF	-	-	-	-	0.004	-
1,2,3,7,8,9-HxCDF	-	-	-	-	-	-
1,2,3,6,7,8-HxCDF	-	-	-	-	-	-
2,3,4,6,7,8-HxCDF	-	-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	-	-	0.109	-	0.016	0.11
1,2,3,4,7,8,9-HpCDF	-	-	-	-	-	-
OCDF	-	-	0.158	0.009	0.017	0.081
1-TEQ	-	-	0.050	0.046	0.013	0.003

Continuation of table

PCDD/PCDF	RUNS			
ISOMERS	7	8	9	10
	Water+ C_2H_4 Cl_2	Aqueous caustic+ C_2H_4 Cl_2	Water+ $Cl_2C_6H_3$ OH	Aqueous caustic+ C_6H_5Cl
2,3,7,8-TeCDD	-	-	-	-
1,2,3,7,8-PeCDD	-	-	-	-
1,2,3,7,8,9-HxCDD	-	-	-	-
1,2,3,6,7,8-HxCDD	-	-	-	0.007
1,2,3,4,7,8-HxCDD	-	-	-	0.017
1,2,3,4,6,7,8-HpCDD	0.034	0.016	0.036	0.109
OCDD	0.068	0.176	0.180	0.0076
2,3,7,8-TeCDF	-	-	-	-
1,2,3,7,8-PeCDF	-	-	-	-
2,3,4,7,8-PeCDF	-	-	-	-
1,2,3,4,7,8-HxCDF	-	-	-	-
1,2,3,7,8,9-HxCDF	-	-	-	-
1,2,3,6,7,8-HxCDF	-	-	-	-
2,3,4,6,7,8-HxCDF	-	-	-	-
1,2,3,4,6,7,8-HpCDF	0.122	0.032	0.069	0.09
1,2,3,4,7,8,9-HpCDF	-	-	-	-
OCDF	0.242	0.039	0.172	0.032
1-TEQ	0.002	0.001	0.001	0.012

Reference

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