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PILOT TESTS OF DIOXIN-REMOVING TECHNOLOGIES FOR WATER PLANTS.

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Objectives: High concentrations of dioxins and dioxin-like xenobiotics have been registered in Russia in soil, water and in river-bottom near the cities of Ufa, Chapayevsk and in Archangelsk region. There is also strong probability of dioxin contamination of water sources in other industrial areas in Russia. As a result a special project was launched in Russia in 1992, devoted to the research and development of drinking water treatment technologies to protect population from the hazardous effects of those toxins. The project has been carried out by VODGEO Research Center in Moscow in cooperation with SUNY (USA) and ERGO (BDR). Some of the results have been reported at previous dioxin symposiums. (1,2)

The goal of the given stage of the research was to conduct pilot tests of the technologies for removing dioxins and dioxin-like substances from water and to obtain information for the upgrading of water treatment plants in industrial cities.

Methods: The tests were conducted at a continuously operating pilot water plant with the capacity of 5000 l/day which had the following units:
a) a system to convey water from the Ufa river;
b) a unit where concentrated contaminants were mixed up and spiked into river water;
c) aeration and ozonization of water;
d) preparation and proportioning of powder activated carbons (PAC);
e) filters-adsorbers with granulated activated carbons (GAC).

Water from the Ufa-river was used as initial solution. It was spiked with concentrated solutions of PCDD, PCDF, PCB and other xenobiotics to attain 10-100 maximum permissible concentrations. The experiments were conducted on running water.

Results: The results of the tests are presented in figures 1, 2, and 3. The experiments indicate that:
1. Aeration and ozonization, as well as introduction of coagulators reduced the concentration of PCDD isomers by 3-40%.
2. Introduction of 10 ppm of SPDK-27D powder activated sorbent reduced the amount of PCDF from 10 to 0.5-4 maximum permissible concentrations (2,3,7,8-PCDF is reduced by 50-70%, hexa-PCDF by 85-95%). Introduction of 10-30 ppm of SPDK-27D sorbent into the water, which contained 1000 maximum permissible concentrations of PCDD and PCDF reduced the concentration of dioxins by 93-99%/

3. The filtration of water with 1000 permissible concentrations of PCDD and PCDF through SKD-515 granulated activated carbon reduced PCDF by 93-96% and PCDD by 94-97%. The exit sorption curves demonstrate sequential removal of dioxins by GAC, primarily the adsorption of low-chlorinated isomers of dioxins.

Conclusions:

1. Microparticles of hydroxides of polyvalent metals and organomineral substances, which are produced during coagulation and oxidation of water impurities can adsorb up to 3-40% of dioxins, when their concentration in water is not high.
2. Adsorbability of dioxins by PAC increases ten-fold when the initial concentration of PCDD and PCDF is in the range of 10-1000 maximum permissible concentrations.
3. Sorbtion of dioxins by carbon sorbents decreases with the increase of the dioxin molecules. And it is more effective for low-chlorinated isomers.

Predominantly sorptional mechanism of the removal of PCDD and PCDF enables to work out the design of sorbtion filters for removing dioxins from drinking water.

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References

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2. Smirnov A D., Beljak, A.A., Schecter A., Papke O., Semenov S.Y., Conclusions from Ufa, Russia drlnking water dioxin cleanup experiments involving different treatment technologies. *Organohalogen Compounds, Dioxin'94, Volume 19: 499-502, Kyoto, Japan, November 1994.*

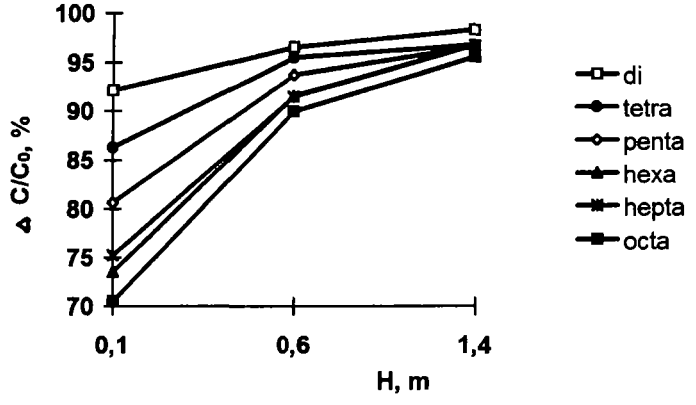
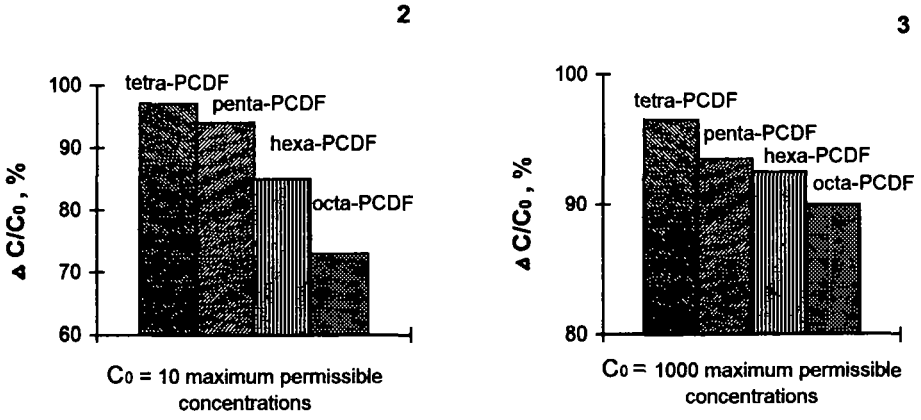


Figure 1: The Efficacy of Removing PCDF-Isomers from Water with Filters Containing SKD-515 Sorbent at Different Levels of Contamination.
($\Delta C/C_0$, % - Treatment efficacy)
(H, m - Layer thickness)



Figures 2 and 3: The Efficacy of Dioxin Removal from Water by Filtration through SKD-515 Activated Carbon.
($\Delta C/C_0$, % - Treatment efficacy)
(0,6 m - Layer thickness)