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Assessment of Danger of PCDD/PCDF Formation in Accidents

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Abstract

Fire accidents, forest fires, elimination of aftermath of accidents (such as oil spills) by burning may become significant sources of environmental pollution by PCDD/PCDF. As an example we describe several accidents which occurred recently in Russia and caused environmental pollution. Many accidents, especially those which are accompanied by fires, should be closely monitored for contamination by PCDD/PCDF.

Introduction

Major sources of industrial pollution of environment by PCDD/PCDF are well known. Much less attention is paid to formation of dioxins during fire accidents and forest fires. Forest fires remain an urgent problem in Russia where they pose a serious threat of pollution for unstable boreal ecosystems of Siberia and North. It is shown that biota of lake Baikal which is not exposed to industrial pollution contains excessive amounts of PCDD/PCDF.

Amounts of PCDD/PCDF formed when oil spills are eliminated by burning are not well studied. Even less is known about formation of dioxins when chemicals catch fire in traffic accidents. Here we review in retrospect possible ways of environmental contamination by dioxins during elimination of oil spills. We also present ecologo-analytical data on major railway accident in Chuvashia Republic (Volga river region).

Experimental Methods

Dioxin '97, Indianapolis, Indiana, USA

Large amounts of phenol compounds and diesel fuel were spilled in May 1996 in Shumerlinsky region of Chuvashia Republic during major railway accident. The spilled chemicals caught fire. Samples were taken after soil recultivation in epicenter of fire and on the bank of the nearby creek. One of the samples was obtained immediately after the fire. Water for analysis was also sampled from a 5 m deep well.

Chemico-analytical studies were carried out in three Russian laboratories which are accredited for analysis of dioxins (ROSS No. RU.0001 510023 and ROSS No. RU.0001 510020).

Results and Discussion

Problem of formation of PCDD/PCDF during elimination of oil spills by burning lacks investigation in Russia. For example, during pipeline Haryaga-Usinsk accident in Komi Republic in October 1994 100000 thousand tons of oil and 40000 thousand tons of bed water which constitutes solution of calcium chloride were spilled according to the data of World bank. At first oil burning was carried out in winter to prevent pollution of basin of river Pechora. Later oil was burned constantly. During oil burning formation of PCDD/PCDF and pollution of neighboring territories was reported. According to official data estimated number of oil pipeline accidents in 1991-1994 was 20000 per year. In 1995-1996 this number was not decreasing. Hence, oil burning during elimination of spills can be a serious potential source of environmental pollution by dioxins. Contamination by dioxins during oil burning after similar accidents in the sea is also extremely dangerous. Railway accident in Chuvashia Republic resulted in the spill of large amounts of phenol compounds and diesel fuel. The spilled chemicals caught fire. Many investigations showed that burning of organic compounds in the presence of halogen-containing organic and inorganic compounds results in formation of PCDD/PCDF of different spectra and composition. Yield of the most toxic PCDD/PCDF thoroughly depends on combustion conditions: component ratio, temperature, humidity etc. Chemico-analytical study of the polluted territory revealed that environment is mostly contaminated by PCDDs with high degree of chlorination (hepta- and octa-). These chemicals have low total TEQ and therefore pollution exceeds background by small value. However, analysis of water from control well showed

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spread of contamination to significant depth. It is well known that PCDD/PCDF can be naturally dechlorinated. This can result in formation of the most toxic products. Thus it is clear that constant monitoring of environment is necessary near the sites of major accidents and especially those which were accompanied by fires. Such monitoring is important for estimation of threat to people's health and for recultivation and recovery of destroyed biocenosis.