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Treatment of Organic Pollutants Based on PCB in the River Sediment by Electron Beam

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BACKGROUND OF THE STUDY

Polychlorinated biphenyls (PCBs) belong among the most persistent and bioaccumulative substances. Long-term production of PCBs in the 20th century has resulted in excessive concentrations of this organic pollutant in the environment with about 200,000 inhabitants in the eastern Slovakia. There were evaluated different techniques of removing PCBs in sediments, but none of them has met three requirements of the local authority district:
a) Facility for PCB degradation should be non-static and relatively easy relocatable to other site with PCB contamination.
b) Techniques for destruction of PCBs should be :
- with negligible secondary waste generation,
- with minimum catalysts,
- without PCB burning and
- easy for automation.
c) Adequate investment and operating costs.
The goals of the present work are to justify the method for electron beem degradation of PCB (EBDPCB) in sediments, which so far has not yet been used industrially.

METHODOLOGY

To fulfill the requirements of the local authority district the following method were chosen:
- The relocotable electron accelerator for in site EB processing in environment with shielding corresponding to electron accelerator parameters and dimensions is considered.
- To establish and determine the clean up and remediation levels for PCB mixture, the toxic equivalency factor was used and then the toxic equivalent was determined.
- Adequate investment and operating costs depend on the effectiveness of radiochemical reaction, design and technical parameters of the electron irradiator.

RESULTS

The method EBDPCB demonstrated that ionizing radiation produced by high-energy electron beams (EB) is remarkably effective in transforming PCBs into less problematic species with minimum catalysts.
To increase the efficiency of radiochemmical reaction of the EBDPCB the chemical pretreatment of sediments by using various combinations of isopropanol, K2CO3 and CuSO4, have been tested as well.
An increased efficiency of EBDPCB by using electron energy of 3.6 MeV compared to 5 MeV was found. It was shown that in comparison to other types the accelerator based on DC transformer 50/60Hz has advantage in its reliability (availability), high average beam power (productivity), electrical and beam utilization efficiency (cost of exploitation), beam energy for EBDPCB, transportable shielding and price (investment cost).
Design of transportable DC transformer type 50/60Hz electron accelerator for EBDPCB has been calculated by the Monte Carlo code MCNPX for electron beam irradiators of 2,5MeV/100kW and 3,5MeV/100kW.

CONCLUSIONS

Main source of PCB contamination in the environment of eastern Slovakia are sediments in Channel Strážske. Among several methods for environment remedation, the method of radiation degradation of PCBs in sedi-

ments by electron beam is the most appropriate for application at Channel Strážske. The method of radiation degradation of PCBs is environmentally friendly and the irradiation facility with electron accelerator can be transported directly to the site with PCB contamination. Treated sediments are recyclable as building gravel sand.
The investment and operating costs of proposed technical solution of transportable electron beam irradiator of PCB in sediments are comparable to those ones that did not meet requirements of local authorities at localities contaminated by PCBs.

Country/Organization invited to participate

Slovakia

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