

THE ADSORPTION EFFICIENCY OF PCDDs/PCDFs FROM AQUEOUS SOLUTION ON ACTIVATED CARBONS

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1. Introduction

Activated carbon was widely used in processes of odour filter, colour wiping, removal of inorganic and organic contaminants from drinking water, air, applied in wastewater and waste gases treatment, in chemical, pharmaceutical, beverage and food industries. There were many reports on adsorption of organic compounds having benzene rings, aromatics, phenolic compounds, polychlorophenol [1-6], dyes [7,8], tannic [9], anthrazine, methylene blue [10], trinitrotoluene [11] from aqueous solutions on various activated carbons. Nevertheless researches are still rarely conducted on adsorption capacity of PCDDs/PCDFs from aqueous solution on activated carbons with the aim of applying to water treatment in dioxin contaminated site, for example, in "hot-spot". In Vietnam, there were reports on researches on adsorption efficiency of PCDDs/PCDFs on activated carbons produced from certain domestic raw materials as wood-based carbon, rice husk carbon, coconut shell carbon [12]. This report presents research results on possibility of applying certain domestically produced activated carbons with the aim of water treatment in heavy PCDDs/PCDFs contaminated sites.

2. Materials and methods

2.1. Preparation of activated carbons

Selected domestically produced activated carbons are coconut shell activated carbon T2, wood-based activated carbon T3, coconut shell activated carbon-anthracite T4, bituminous coal-based activated carbons T5, T6 and oxidized coconut shell activated carbons T7, T8. Russian activated carbon BAU-A is used in comparison research. Activated carbons are ground into small granules, those of size < 0,25mm, are chosen, dried at 110°C during 3 hours before the experiment.

2.2. Preparation of solution PCDDs/PCDFs

In order to limit the pollution caused by the spreading of PCDDs/PCDFs following water flows from sites where the soil is heavily contaminated by PCDDs/PCDFs, we used mixed PCDDs/PCDFs contaminated soil samples at high concentration that is previously known. Mixed soil sample was not added any labeled standard, Soxhlet extracted with toluene and cleaned up following US. EPA method 8280A [13]. The final extract was concentrated and dissolved in 36ml of acetone. PCDDs/PCDFs concentration in this solution was determined by HRGC/LRMS Hewlett Packard HP6890/5972A.

2.3. Experimental method

Weighting exactly 50mg of each activated carbon and putting it into each of nine vessels containing 50ml of study solution (2ml of PCDDs/PCDFs solution in acetone and 48ml bidistilled water). The control sample is denoted by DC1. The duration of experiment is 3 days (72h), for each day the study solution is shaken during 8h at the speed of 200 rounds/minute.

2.4. Sample preparation and analysis

Filter to eliminate carbon and obtaining the solution, add labeled standards ^{13}C -PCDDs/PCDFs, extraction by shaking 3 times, each time with 15ml dichloromethane, in 20 minutes, 300 rounds/minute. The extract is cleaned up following [13], PCDDs/PCDFs containing fraction is concentrated to analyze by HRGC/LRMS HP6890/5972A.

3. Results and discussion

Concentration of each 2,3,7,8-substituted isomers, I-TEQ of PCDDs/PCDFs were found in study solutions of eight activated carbons and control sample DC1, the adsorption efficiency of each activated carbon in comparison with control sample were presented in the Table 2 and illustrated in the Figure 1.

Table 2. Concentration of 2,3,7,8-substituted isomers, I-TEQ and adsorption efficiency of investigated samples.

Symbol	DC1	T1	T2	T3	T4	T5	T6	T7	T8
2,3,7,8-substituted	control sample	BAU-A	Type D	Type H2	$\phi 4$	1NBC	2NBC	1H	3H
TCDD	412,69	30,74	269,82	2,67	2,60	9,31	11,73	175,50	245,71
OCDD	109,56	19,02	55,34	1,48	1,82	5,61	5,32	45,66	58,21
I-TEQ	414,18	30,82	270,49	2,68	2,60	9,34	11,75	176,01	246,46
Adsorption efficiency	-	92,6%	34,7%	99,4%	99,4%	97,7%	97,2%	57,5%	40,5%

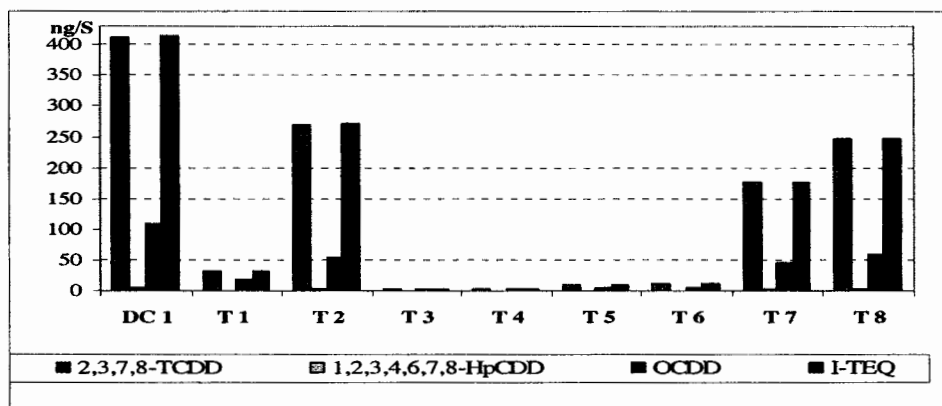


Fig. 1. Concentration 2,3,7,8-TCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, I-TEQ found in investigated samples.

4. Conclusion

Wood-based activated carbon Type H2, coconut shell carbon-anthracite (30-70%) $\phi 4$, bituminous coal-based activated carbon 1NBC, 2NBC of Vietnam are activated carbons that may be very well used as water treatment material in heavy PCDDs/PCDFs polluted sites. The adsorption efficiency on these four activated carbons is between 97.2 and 99.4% in comparison with control sample without activated

carbon and is higher than that of Russian activated carbon BAU-A. Research results shown the possibility of using available, cheap, domestically produced activated carbons as PCDDs/PCDFs polluted water treatment material.

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