TITLE OF RESEARCH PROJECT

Identification and decontamination of fluids contaminated with chlorinated and fluorinated persistent organic pollutants sampled from various Indonesian environmental compartments

PROJECT MEMBERS

The following table list names of the project member

Name	Age	M/F	Affiliation	Position	Contribution part
Dwindrata Basuki Aviantara	56	M	BRIN Indonesia	Principal Investigator	Research designing, sampling, report writing, paper manuscript preparation
Agus Sudaryanto	56	M	BRIN Indonesia	Member	Sampling, paper manuscript preparation
Budi Kurniawan	56	M	BRIN Indonesia	Member	Paper manuscript preparation
Fuzi Suciati	42	F	BRIN Indonesia	Member	Research designing, sampling, lab analysis, report writing, paper manuscript preparation
Asep Nugraha Adiwinata	65	M	BRIN Indonesia	Member	Paper manuscript preparation
Dede Falahudin	40	M	Ehime University	Postdoc. Researcher	Lab analysis, paper manuscript preparation
LaMer Faculty member in charge	Prof. Shin Takahashi				

PROJECT PURPOSES

The purposes of the proposed study are:

a. Utilizing solid waste as materials for adsorbent synthesis to remediate wastewater, surface water, travo oil contaminated with PCBs and PFAS
b. Evaluating performance of adsorbent synthesized from solid waste to decontaminate wastewater, surface water, travo oil contaminated with PCBs and PFAS
c. Characterizing adsorbent suitable of decontaminating wastewater, surface water, travo oil contaminated with PCBs and PFAS.

METHODS

Sampling

The collected samples are representing riverine, wastewater, and used travo oil. The riverine samples were collected from Cisadane River. Wastewater samples were collected from industrial park or municipal garbage dump site facilites. Used oil samples were collected from national inventory activities.

Another sampling activities were also carried out to collect solid waste material such as cocofiber, cocopeat, coconut shells, or oil palm empty fruit bunches to be used for adsorbent preparation

Target Chemicals and Analyses

The target of chemicals being analysed are total PCBs with special intention on 12 conformers of dioxin-like PCBs as shown in Table 1. For PFAS, as shown in Table 2, the total number of compunds being analysis is 38.

Table 1. Proposed Dioxin-like PCBs to be analysed

Type	Congener		TEF
	BZ number	IUPAC name	
Non-ortho	77	3,3',4,4'-TCB	0,0005
	126	3,3',4,4',5-PeCB	0,1
	169	3,3',4,4',5,5'-HxCB	0,01
Mono-ortho	105	2,3,3',4,4'-PeCB	0,0001
	114	2,3,4,4',5-PeCB	0,0005
	118	2,3',4,4' ,5-PeCB	0,0001
	123	2',3,4,4',5-PeCB	0,0001
	156	2,3,3',4,4',5-HxCB	0,0005
	157	2,3,3',4,4',5'-HxCB	0,0005
	167	2,3',4,4',5,5'-HxCB	0,00001
	189	2,3,3',4,4' ,5,5'-HpCB	0,0001
Di-ortho	170	2,2' ,3,3',4,4' ,5-HpCB	0,0001
	180	2,2',3,4,4',5,5'-HpCB	0,00001

Table 2. Proposed PFAS compounds to be analysed

Substances	**Abbreviation**	**Number of compounds**
Perfluoroalkylcarboxylic acids	PFCA	13
Perfluoroalkanesulfonates	PFSA	8
Fluorotelomer sulfonates	X:2FTS	3
Perfluoroalkanesulfonamides	FASA	1
Perfluorooctanesulfonamidoacetic acids	FOSAA	1
Per- and polyfluoroalkyl ether carboxylic acids	PFECA	4
Perfluoroalkyl ether sulfonates	PFESA	1
Hexafluoropropylene oxide dimer acid	-	1
Chloroperfluoroalkyl ether sulfonates	Cl-PFESA	2
Fluorotelomer alcohols	X:2FTOH	4

Adsorbent Preparation

The adsorbent preparation will be executed entirely in BRIN labotarory facilities. The preparation included pulverizing followed by pirolysis. The combination of treatments for adsorption preparation can be seen in Table 3.

Table 3. Combination treatment for adsorbent preparation

Treatment	Symbol	Unit	Set Value
Heating	T_H	^oC	600, 650, 700, 750, 800
Duration	Θ_H	hour	1, 2, 3

Adsorbent Characterization

Following the adsorbent preparation, the resulted adsorbent materials were chararacterized for surface area using BET technique, surface morfology using SEM, degree of cristallinity using XRD, and chemical functional group using FTIR. All the characterization of adsorbent were carried out in BRIN laboratory facilities.

Adsorbent Trial

The adsorption trials using Box-Behnken design to decontaminate wastewater, surface water, and travo oil contaminated with PCBs and PFAS will be held entirely in BRIN workshop facilities. Following these trials, few milliliters of extract of treated samples (in solvent of hexane) were analysed for PCBs and PFAS levels. These treated samples were brought to Center of Advanced Technology for the Environment (CATE), Graduate School of Agriculture, Ehime University for total PCBS and PFAS under supervision of Prof. Shin Takahashi.

Data Analysis

Data would be quantitatively evaluated for adsorbent performance and qualitatively assessed for global comparison in river water and wastewater, characterization of their occurrence as well as potential risk to human.

RESULTS

In this LaMer project, both BRIN Indonesia and the CATE, Graduate School of Agriculture, Ehime University were in collaboration to conduct analysis of samples. For PCBs total parameter analysis was done by BRIN researchers following EN61619 method using GC-ECD and fast screening by Dexsil L2000DX. Meanwhile, for dioxin-like PCBs and PFAS analyses were done using GC/MS/MS facility at CATE. As the analyses of dioxin-like PCBs and PFAS are on going process then results of the PCBS total analysis using both GC-ECD and Dexsil L2000DX are presented in this report.

Resume of the results of PCBs analysis of oil transformer samples are shown in Table 4. The PCBs levels detected by GC-ECD were in the range of from 0.7 to

1021 ppm. Meanwhile the detected PCBs levels measured by Dexsil L2000DX were in the range of 1,0 – 4829 ppm. More than halve of oil transformer samples have PCBs levels less than 5 ppm. The regression line between PCBs levels by GC-ECD and Dexsil L2000DX can be seen in Figure 1. The regression line provided correlation coefficient 0.565. As it is expected that GC-ECD and Dexsil L2000DX to have strong positive correlation it is remains unclear the cause of moderate correlation between PCBs results as measured by GC-ECD and Dexsil L2000DX.

Table 4. Quartile data of PCBs measurement

Quartile	GC (*ppm*)	DEX (*ppm*)	DEX/GC
MIN	0,7	1,0	1,1
Q1	2,8	55,7	7,2
Q2	4,8	139,0	15,5
Q3	19,6	299,0	35,8
MAX	1021	4829	1524

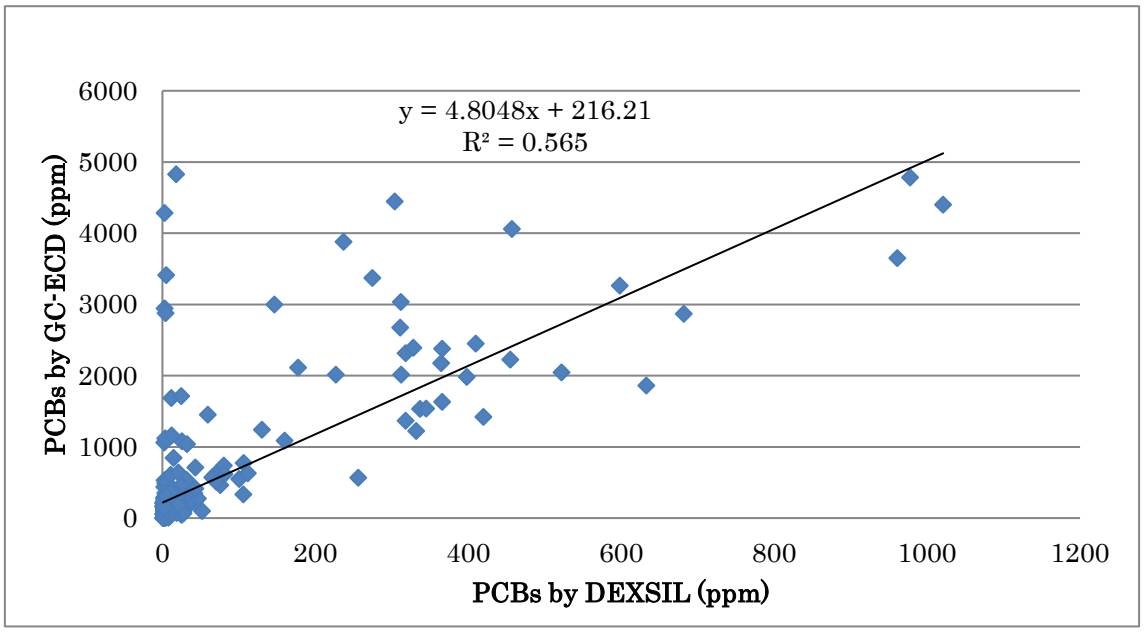

Figure 1. Regression plot of PCBs levels by DEXSIL to GC-ECD

FUTURE CHALLENGES

Up to the present no complete results have been obtained. Further analysis of samples for environmental contaminants proposed in this LaMer project would make enhancement for scientific justification. Low level determination of environmental concentrations, particularly below regulation threshold, still challenging effort. Certainly, sophisticated instruments that are most likely not available in under developed countries such as Indonesia is the real obstacles.