



Adam Grochowalski

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Preliminary report from the determination of PCDDs/PCDFs, PCBs and HCB/PeCB and HBCDD from:

1. Biomass co-firing with hard coal for power generation in Poland – data for 2008/2009 from the two selected power plants.
2. High chlorine content hard coal and coal briquettes burning for individual house heating facilities – preliminary study in 2009.
3. Dioxins/furans and HCB from the use of copper salt catalyst for soot removal from wood burning in fire places and from hard coal burning in stoves for individual house heating.
4. Dioxins/Furans in hazardous wastes from secondary aluminium smelters
5. Pentachlorobenzene and hexachlorobenzene from waste incinerators and cement kilns in Poland

### Ad 1.

Poland has very favorable technical and economical factors for renewable energy and has begun to experience a shift and political and public support away from traditional fossil fuels and toward the development of renewable energy resources. Poland has established a target of: 7.5 percent of energy production from renewable sources by 2010 (actually – November 2009 it is about 6%).

Table 1: Renewables energetic potential on the example of straw, hay and wood in Poland<sup>1</sup>

Fuel	Total amount (mln ton)	Usage index (%)	Possible USE amounts (mln ton)
Grain straw	21.5	50	8.9
Rape straw	2.4	70	1.4
Hay	18.1	10	1.5
Wood	6.2	60	3.8
Total energetic potential in agriculture and forestry			15.6

<sup>1</sup> Data from Witold Szwaigrun, EC BREC/IEO - Institute for Renewable Energy, Warsaw, Poland  
Association of Polish Energy Actors at Local and Regional Level

Table 2: Dioxin emission from coal firing for power generation in Poland (2007 – 2009)<sup>2</sup>

Facility / Cross-section of the measurement duct	O <sub>2</sub>	CO <sub>2</sub>	Sample volume V <sub>r</sub> <sup>a</sup>	Sample volume V <sub>x</sub> <sup>b</sup>	PCDDs/PCDFs referred to 6% O <sub>2</sub>	PCDDs/PCDFs emission factor
	% (v/v)	% (v/v)	m <sup>3</sup> <sub>n</sub>	m <sup>3</sup> <sub>n</sub>	ng I-TEQ/m <sup>3</sup> <sub>n</sub>	µg I-TEQ/TJ
CHP plant I / 11.95 m <sup>2</sup>	4.5	15.5	18.62	20.50	0.060 ± 0.015 LD = 0.001	46.4 ± 12
CHP plant II / 8.0 m <sup>2</sup>	6.5	13.1	11.15	10.77	0.058 ± 0.005 LD = 0.005	23.4 ± 2.1
CHP plant III / 5.75 m <sup>2</sup>	6.0	14.1	18.97	18.97	0.012 ± 0.003 LD = 0.001	7.51 ± 1.9
CHP plant IV / 8.042 m <sup>2</sup>	3.5	17.0	14.89	17.37	0.045 ± 0.010 LD = 0.001	19.2 ± 4.3
Requirements according to emission standards					No requirements	No requirements

Table 3: Dioxin emission (raw data) from renewable energy resources (wood chips, straw and mixed industrial waste derived alternative fuel) mixed with coal firing for power generation in Poland (2008-2009)

Coal fired (ca) t/h	Flue gas stream m <sup>3</sup> <sub>n</sub> /h (ca)	PCDDs/PCDFs in flue gas	PCDDs/PCDFs	PCDDs/PCDFs	PeCB/HCB	PeCB/HCB	PeCB/HCB	Coal/biomass calority GJ/t
		ng I-TEQ/m <sup>3</sup> <sub>n</sub>	µg I-TEQ/t coal	µg I-TEQ/TJ	ng/m <sup>3</sup> <sub>n</sub>	mg/t coal	mg/TJ	
Fluidized bed unit								
24	330000	0.019	0.26	8.36	425/145	5.84/1..99	187/63.8	31.25
16	200000	0.035	0.44	12.1	270/92	2.25/0.77	62.2/21.2	36.17
Pulverized coal fired unit								
30	400000	0.082	1.09	33.7	550/160	9.19/2.67	282/82.1	32.48
65	750000	0.165	1.90	64.9	330/215	10.3/6.72	351/229	29.35
Stoker unit								
10	360000	0.26	9.36	332	1300/460	19.5/6.90	692/245	28.17
8	120000	0.115	1.73	73.2	780/290	3.90/1.45	166/61.6	23.55

<sup>2</sup> Published in: Grochowalski A., Koniecznyński J., 2008, Chemosphere 73, 97–103

## Ad 2. (raw data)

**Table 4a. Emission of dioxin and peCB/HCB from coal burning – low salt of 0.036 mass%**

Coal fired (ca) kg/h	Flue gas stream m <sup>3</sup> <sub>n</sub> /h (ca)	PCDDs/PCDFs in flue gas	PCDDs/PCDFs	PCDDs/PCDFs	PeCB/HCB	PeCB/HCB	PeCB/HCB	Calorific value GJ/t
		ng I-TEQ/m <sup>3</sup> <sub>n</sub>	µg I-TEQ/t coal	µg I-TEQ/TJ	ng/m <sup>3</sup> <sub>n</sub>	mg/t coal	mg/TJ	
Individual coal stove								
2.5	16.3	0.029	0.19	5.89	186/52	1.21/0.34	37.8/10.6	32.10

**PCDDs/Fs in the bottom ash : 0.36 ng I-TEQ/kg**

**PeCB/HCB: 15 / 40 ng/kg**

**Table 4b. Emission of dioxin and peCB/HCB from coal briquettes burning – low salt of 0.049 mass%**

Coal fired (ca) kg/h	Flue gas stream m <sup>3</sup> <sub>n</sub> /h (ca)	PCDDs/PCDFs in flue gas	PCDDs/PCDFs	PCDDs/PCDFs	PeCB/HCB	PeCB/HCB	PeCB/HCB	Calorific value GJ/t
		ng I-TEQ/m <sup>3</sup> <sub>n</sub>	µg I-TEQ/t coal	µg I-TEQ/TJ	ng/m <sup>3</sup> <sub>n</sub>	mg/t coal	mg/TJ	
Individual coal stove								
3.2	18.4	0.145	0.83	24.6	870/440	5.00/2.53	147/74.5	33.96

**PCDDs/Fs in the bottom ash : 63.5 ng I-TEQ/kg**

**PeCB/HCB: 290 / 620 ng/kg**

**Table 4c. Emission of dioxin and peCB/HCB from coal burning – HIGH salt of 0.67 mass%**

Coal fired (ca) kg/h	Flue gas stream m <sup>3</sup> <sub>n</sub> /h (ca)	PCDDs/PCDFs in flue gas	PCDDs/PCDFs	PCDDs/PCDFs	PeCB/HCB	PeCB/HCB	PeCB/HCB	Calorific value GJ/t
		ng I-TEQ/m <sup>3</sup> <sub>n</sub>	µg I-TEQ/t coal	µg I-TEQ/TJ	ng/m <sup>3</sup> <sub>n</sub>	mg/t coal	mg/TJ	
Individual coal stove								
3.3	16.1	0.062	0.30	10.1	300/365	1.46/1.78	48.7/59.3	30.05

**PCDDs/Fs in the bottom ash : 1.5 ng I-TEQ/kg**

**PeCB/HCB: 25 / 30 ng/kg**

Stove with automatic feeder for coal burning - used for experiment with high salt coal burning



**Coal briquettes**

## BRYKIET Z WĘGLA KAMIENNEGO MEGA KALORYCZNOŚĆ

Parametry:

33,961 MJ/kg 8112 kcal/kg Znikome ilości popiołu, po spaleniu pozostawia bardzo małe ilości osadzającej się sadzy Jedyny taki w Polsce. Opatentowana technologia produkcji.

Pakowany: worki: 25kg, 50kg, BIG-BAG

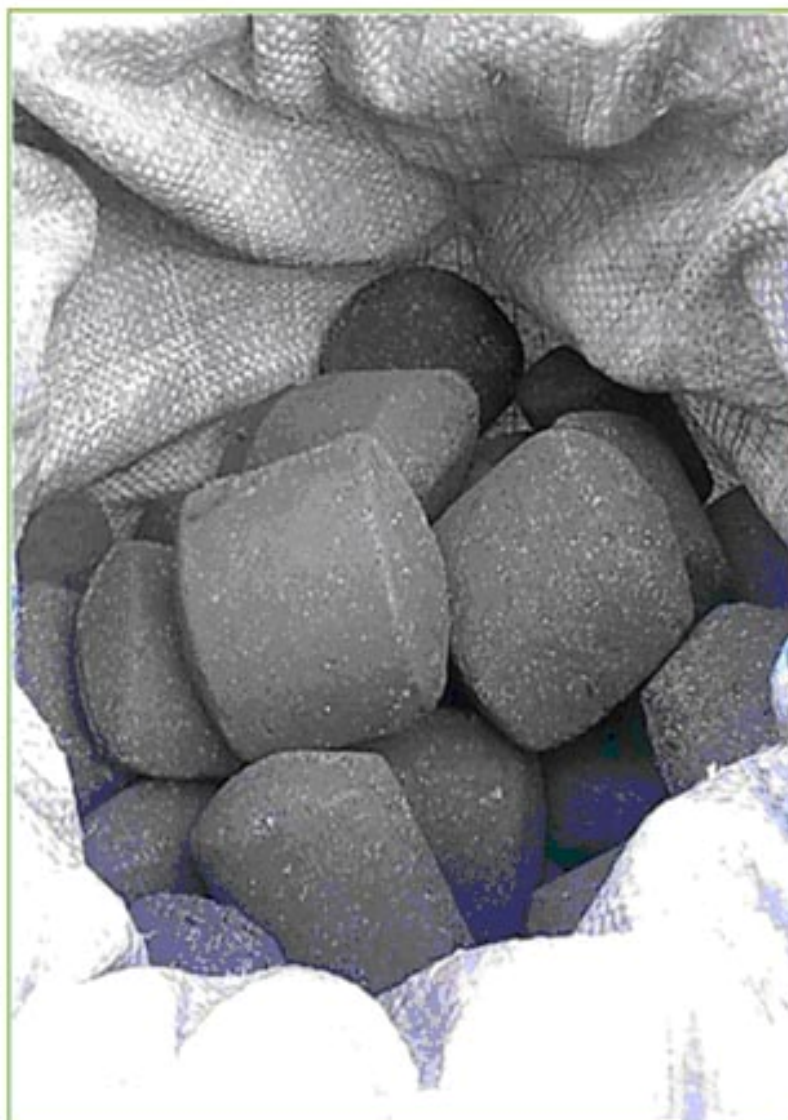
Zastosowanie:

Brykiet z węgla kamiennego przeznaczony jest do spalania w piecach C. O., kominkach, paleniskach oraz kotłach grzewczych na paliwa stałe.

Loco Warszawa

Przy zamówieniach całosamochodowych możliwy transport.

Zapraszamy do zapoznania się z naszą szczegółową ofertą na stronie [www](#).



🔍 BRYKIET Z WĘGLA KAMIENNEGO MEGA KALORYCZNOŚĆ

### Ad 3. Catalyst mixture for removing of soot from stack wall

Copper catalyst used for soot removal from hard coal stoves and from fireplaces.

There are available 50g bags for fireplaces and 100g bags for coal stoves for single use applicable when burning process is finished. The bag of the catalyst is introduced directly to the fire without opening it.

Dioxin concentration from two measurements:

Table 9: Catalyst in 50g bag (16 kg of beech wood burnt + 1 bag of catalyst)

**RESULT in ng/g !**

Sample name		Bottom ash 7.45 g	
Congener PCDDs / PCDFs	I-TEF	Congener mass mi	Partial TEQ
		ng/g	ng I-TEQ/g
<b>2,3,7,8-TeCDD</b>	1	0.067	0.0670
<b>1,2,3,7,8-PeCDD</b>	0.5	0.319	0.1595
<b>1,2,3,4,7,8-HxCDD</b>	0.1	0.915	0.0915
<b>1,2,3,6,7,8-HxCDD</b>	0.1	1.45	0.145
<b>1,2,3,7,8,9-HxCDD</b>	0.1	1.93	0.193
<b>1,2,3,4,6,7,8-HpCDD</b>	0.01	125	1.25
<b>OCDD</b>	0.001	1370	1.37
<b>2,3,7,8-TeCDF</b>	0.1	0.596	0.0596
<b>1,2,3,7,8-PeCDF</b>	0.05	1.29	0.0645
<b>2,3,4,7,8-PeCDF</b>	0.5	5.37	2.685
<b>1,2,3,4,7,8-HxCDF</b>	0.1	6.55	0.655
<b>1,2,3,6,7,8-HxCDF</b>	0.1	12.1	1.21
<b>1,2,3,7,8,9-HxCDF</b>	0.1	2.01	0.201
<b>2,3,4,6,7,8-HxCDF</b>	0.1	48.4	4.84
<b>1,2,3,4,6,7,8-HpCDF</b>	0.01	119	1.19
<b>1,2,3,4,7,8,9-HpCDF</b>	0.01	31.2	0.312
<b>OCDF</b>	0.001	1110	1.11
Summarised result in ng I-TEQ/g			<b>15.6 ± 3.6</b>

**No catalyst - 10.6 pg I-TEQ/g**

Table 10: Catalyst in 100g bag (10 kg of coal burnt from "KWK Piast" coal mine, Poland).

Sample name		Bottom ash - 50.23g	
Congener PCDDs / PCDFs	I-TEF	Congener mass mi	Partial TEQ
		pg/g	pg I-TEQ/g
<b>2,3,7,8-TeCDD</b>	1	2.95	2.95
<b>1,2,3,7,8-PeCDD</b>	0.5	9.11	4.56
<b>1,2,3,4,7,8-HxCDD</b>	0.1	19.8	1.98
<b>1,2,3,6,7,8-HxCDD</b>	0.1	35.9	3.59
<b>1,2,3,7,8,9-HxCDD</b>	0.1	35.8	3.58
<b>1,2,3,4,6,7,8-HpCDD</b>	0.01	784	7.84
<b>OCDD</b>	0.001	90800	90.8
<b>2,3,7,8-TeCDF</b>	0.1	33.6	3.36
<b>1,2,3,7,8-PeCDF</b>	0.05	84.5	4.23
<b>2,3,4,7,8-PeCDF</b>	0.5	185	92.5
<b>1,2,3,4,7,8-HxCDF</b>	0.1	521	52.1
<b>1,2,3,6,7,8-HxCDF</b>	0.1	570	57.0
<b>1,2,3,7,8,9-HxCDF</b>	0.1	49.0	4.90
<b>2,3,4,6,7,8-HxCDF</b>	0.1	918	91.8
<b>1,2,3,4,6,7,8-HpCDF</b>	0.01	9140	91.4
<b>1,2,3,4,7,8,9-HpCDF</b>	0.01	851	8.51
<b>OCDF</b>	0.001	29400	29.4
Summarised result in <b>pg I-TEQ/g</b>			<b>550 ± 45</b>

**No catalyst used - 1.6 pg I-TEQ/g**

**Ad 4.**

Skimmings are obtained in secondary aluminium smelting in rotary kiln.

Scraps consist of: aluminium cans, used electric wires and cables – about 20% plastic wrapped, car engine blocks, used sheet aluminium (partly painted) and scraps etc.

PCDD/F, PeCB and HCB in secondary aluminium waste skimmings:

**116 ± 22 to 960 ± 75** pg I-TEQ/g (ng I-TEQ/kg) - 6 samples

Table 7: Average PCDD/F concentration - congener profile

Sample name		Aluminium skimmings – sample 420a	
Sample mass delivered / analysed:		1280g/ 6,24g	
Congener PCDDs / PCDFs	I-TEF	Congener mass mi	Partial TEQ
		pg/g	pg I-TEQ/g
<b>2,3,7,8-TeCDD</b>	1	3.17	3.17
<b>1,2,3,7,8-PeCDD</b>	0.5	31.2	15.6
<b>1,2,3,4,7,8-HxCDD</b>	0.1	87.5	8.75
<b>1,2,3,6,7,8-HxCDD</b>	0.1	44.9	4.49
<b>1,2,3,7,8,9-HxCDD</b>	0.1	112	11.2
<b>1,2,3,4,6,7,8-HpCDD</b>	0.01	1080	10.8
<b>OCDD</b>	0.001	7700	7.70
<b>2,3,7,8-TeCDF</b>	0.1	35	3.50
<b>1,2,3,7,8-PeCDF</b>	0.05	238	11.9
<b>2,3,4,7,8-PeCDF</b>	0.5	202	101
<b>1,2,3,4,7,8-HxCDF</b>	0.1	417	41.7
<b>1,2,3,6,7,8-HxCDF</b>	0.1	480	48.0
<b>1,2,3,7,8,9-HxCDF</b>	0.1	50	5.00
<b>2,3,4,6,7,8-HxCDF</b>	0.1	700	70.0
<b>1,2,3,4,6,7,8-HpCDF</b>	0.01	5200	52.0
<b>1,2,3,4,7,8,9-HpCDF</b>	0.01	650	6.50
<b>OCDF</b>	0.001	12000	12.0
Summarised result in <b>pg I-TEQ/g</b>			<b>413 ± 32</b>

**Ad 5. (raw data)**



Emission of Pentachlorobenzene and Hexachlorobenzene from Cement kilns and from Hazardous Waste Incinerators (Hospital Waste Incinerators) in Poland 2008-2009

**RAW DATA**

**Table 5: Emission of PCDDs, PCDFs and PeCB/HCB from Cement kilns**

<b>PCDD/F I-TEQ/m<sup>3</sup><sub>n</sub></b>	<b>PeCB ng/ m<sup>3</sup><sub>n</sub></b>	<b>HCB ng/ m<sup>3</sup><sub>n</sub></b>
< 0.001	0.46	0.43
0.005	1.39	3.66
0.022	3.31	2.57
0.005	4.77	2.72
0.010	12.5	3.38
0.030	13.3	10.2
0.028	13.4	46.1
0.055	13.8	25.5
0.008	14.6	7.83
0.015	16.1	10.2
0.089	18.1	3.03
0.160	38.5	77.6
0.375	40.9	20.9

**Table 6: Emission of PCDDs, PCDFs and PeCB/HCB from Hazardous Waste Incinerators**

<b>PCDD/F I-TEQ/m<sup>3</sup><sub>n</sub></b>	<b>PeCB ng/ m<sup>3</sup><sub>n</sub></b>	<b>HCB ng/ m<sup>3</sup><sub>n</sub></b>
0.008	7.5	3.16
0.036	12.2	4.38
0.024	30.2	59.3
0.042	62.4	42.7
0.170	113	32.5
0.115	120	10.9
0.360	124	4.99
0.720	157	590
1.35	222	150
6.40	338	79.8
2.35	454	143
4.70	542	113
15.5	606	121
62	817	233
41	1030	460