

VSb TECHNICAL UNIVERSITY OF OSTRAVA | ENERGY AND ENVIRONMENTAL TECHNOLOGY CENTRE | ENERGY RESEARCH CENTRE

Method for indication of municipal waste combustion in households by ash analysis

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Presentation outline

- ❑ Problem of municipal waste combustion in households
- ❑ Existing methods for identifying waste combustion in domestic combustion units
- ❑ Aim of our research
- ❑ Material and methods
- ❑ Results and discussion
- ❑ Conclusions

Problem of municipal waste combustion in households

- Waste incineration in domestic furnaces affects adjacent communities with unpleasant odours and toxic compounds, which can damage human health and property.
- However, proving these impacts to the operators can be difficult.
- Not only a problem in the Czech Republic.
- New Czech legislation (Act on Air Protection, No. 369/2016, 2016): environmental inspectors and local government representatives can enter homes to check which fuel has been used in small-scale combustion units.



Existing methods for identifying waste combustion in domestic combustion units

- Swiss method (Umweltfachstellen 2015)

Limit values of indicators [mg/kg _{dry matter}]	Cr	Cu	Pb	Zn	Cl
EMPA 2001 (Swiss method)	100	150	100	600	2,000
ZUDK 2008 (Swiss method)	150	400	100	800	2,000
ZUDK 2010 (Swiss method)	150	600	100	1,500	2,000

- German standard (VDI 2016)

Reference values for ash pollutant concentrations in mg/kg								
arsenic (As)	lead (Pb)	cadmium (Cd)	chromium (Cr)	copper (Cu)	nickel (Ni)	zinc (Zn)	chlorine (Cl)	titanium (Ti)
30	200	10	400	600	200	2000	2000	1000

- ICHPW method (ICHPW 2017)

- Method of the University of Krakow (Politechnika Krakowska im. Tadeusza Kościuszki), Poland

Aim of our research

- This paper refers to the method for indication of municipal waste combustion in households by ash analysis published as Communication of the Ministry of the Environment of the Czech Republic (MoE 2018).

MoE (2018) Statement by the Ministry of the Environment of the Czech Republic, Department of Air Protection to operation and control of combustion stationary sources with the nominal thermal input of 300 kW and below. Ministry of the Environment of the Czech Republic, Prague.

- The aim of our study was to elaborate the method for determination of municipal waste combustion by ash analysis and to compare this method with existing and published methods.
- The tool was the reference values of ash from the combustion of solid fuels (biomass, lignite, black coal and unspecified fuel).
- These elements were chosen for identification of municipal waste combustion: Sb, Cu, Pb, Sn, Ti, Zn and Cl.

Material and methods

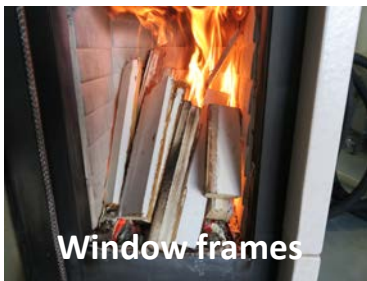
- The description of 73 tests from the combustion tests performed in the Energy Research Center, Ostrava, Czech Republic.
- Ash samples were obtained via the combustion of various solid fuels and their mixtures with municipal waste.
- **Solid fuels:** dry beech logs, wet beech logs, dry spruce logs, wet spruce logs; lignite 20-40 mm, lignite briquettes, Flot, black coal 25-50 mm, black coal 8-25 mm.



- **Municipal waste:**



Furniture chipboard



Window frames



Floor coverings



PET briquettes



Plastics



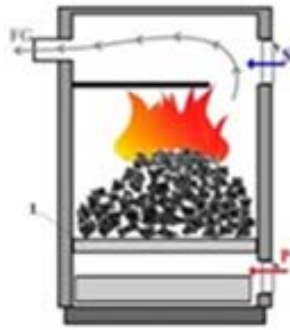
Textiles



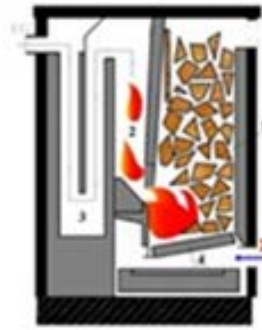
Paper

Material and methods

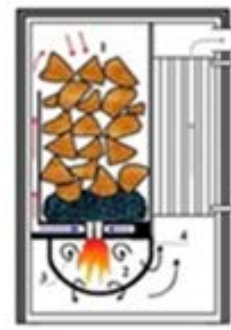
- Household combustion units:



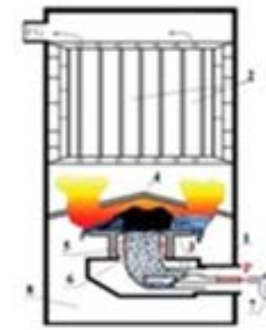
Overfire boiler



Boiler with down
draft combustion



Gasification boiler



Automatic boiler



Stove

- Parameters were chosen according to analytical results and statistical evaluation (Horák et al. 2019).
Horák J, Kuboňová L, Bajer S, Dej M, Hopan F, Krpec K, Ochodek T (2019) Composition of ashes from the combustion of solid fuels and municipal waste in households. Journal of Environmental Management 248:109269.

Results and discussion



Proof of municipal waste combustion = Proven

Combustion of municipal waste cannot be proven or excluded
= Suspicious

No proof of municipal waste combustion = Not proven

Limit values of indicators [mg/kg_{dry matter}]	Sb	Cu	Pb	Sn	Ti	Zn	Cl
Semafor (biomass)	10	390	55	10	1,835	3,070	1,690
Semafor (lignite)	5	300	35	5	x	375	2,015
Semafor (black coal)	10	130	75	10	x	145	1,690
Semafor (lignite + biomass)	10	390	55	10	x	3,070	2,015
Semafor (black coal + biomass)	10	390	75	10	x	3,070	1,690
Semafor (unspecified fuel)	10	390	75	10	x	3,070	2,015

Results and discussion

The proposed method could:

- clearly prove the combustion of floor coverings, textiles and window frames,
- very successfully prove the combustion of furniture chipboard,
- indicate the combustion of PET briquettes and plastics,
- not prove the combustion of paper.

	green	orange	red
floor coverings	0	0	4
furniture chipboard	0	1	3
paper	4	1	0
PET briquettes	0	3	0
plastics	0	3	2
textile	0	0	4
window frames	0	0	3

Sample	Fuel	Semafor method
1	furniture chipboard	proven
3	textile + B1	proven
5	textile + L2	proven
8	window frames	proven
9	floor covering + B1	proven
10	textile + dry beech	proven
11	floor covering + L1	proven
12	floor covering + dry beech	proven
13	paper + B1	not proven
14	paper + dry beech	suspicious
15	paper + L2	not proven
16	PET briquettes + dry beech	suspicious
17	PET briquettes + L2	suspicious
18	plastics + dry beech	proven
19	plastics + B1	suspicious
20	plastics + dry beech	proven
21	plastics + L2	suspicious
22	paper + dry beech	not proven
23	plastics + dry beech	suspicious
24	furniture chipboard	proven
25	PET briquettes + dry beech	suspicious
26	window frames	proven
29	floor covering + dry beech	proven
31	paper + dry beech	not proven
33	textile + dry beech	proven
35	window frames	proven
46	furniture chipboard	suspicious
73	furniture chipboard	proven

Conclusions

- The method Semafor has some drawbacks and currently has been verified.
- Other ways of identification of waste combustion in households are evaluated.
- Project „*Research on the identification of combustion of unsuitable fuels and systems of self-diagnostics of boilers combustion solid fuels for domestic heating*“.



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Thank you for your attention

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