

## **The proposal of evaluation of selected thermal-degradation and environmental characteristics of wood modified treatment**

### **Part 2: Determination of selected environmental characteristics**

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**Abstract:** *The proposal of evaluation of selected thermal-degradation and environmental characteristics of wood modified treatment. Part 2: Determination of selected environmental characteristics. The aim of the paper is to present a specific proposal for a new experimental and laboratory exercises for the environmental evaluation of the wood and wooden products with different coating applied in prediction of their safe application.*

*Key words: wood, surface treatment, environmental characteristics, risk substances*

#### **INTRODUCTION**

The problematic in the second part of the article followed on the first part of article: „The proposal of evaluation of selected thermal-degradation and environmental characteristics of wood modified treatment”. The attention is paid to evaluation of significant environmental characteristics of thermal loading wood treatment wood and wooden products, where creating dangerous aerosols and risk chemical substances (from group of volatile organic compounds -VOC). The presence of VOC in terms of the sectors involved in their creation, is evident in the exterior and consequently in the work environment as a result of the activities of transport, energy and metallurgy, a variety of technologies used in the printing, chemical, petrochemical, pharmaceutical industry, and in the manufacture of plastics, rubber, shoes, adjustment of vegetable oils, lamination, degreasing of surfaces of materials processes using organic solvents, incineration of waste.

As a result of the presence of many building materials, but particularly the agglomerated wooden materials (particleboards) as components of furniture, and fabric (upholstery, decorative, or as components in upholstery furniture) are encumbered and the interiors of the buildings, thereby significantly impairs the quality of the working environment in terms of the required hygiene limits. They are also burdened with the same degree

of residential premises housing units, in which experiencing an increase of emissions of volatile organic compounds, in particular as regards benzene, formaldehyde, toluene, xylene and other chemicals that bind to the surface treatments of various materials (wood, metals, plastics, textiles, paper), and the use of detergents, cosmetics. VOC solvents, diluents, hardeners and are part of the additives that are used in the preparation of many construction and composite materials.

VOC escaping in the use of organic solvents in certain paints and varnishes and vehicle refinishing products, which specifies the maximum content of organic solvents in selected types of coatings and products. The coating substances with a decorative, functional and protective purpose, which are used for adjustment and fitting-out of buildings, their coating and materials used for painting cars or parts for their repair, preservation outside of

the production process. Volatile organic compounds and other harmful substances present in the internal environment contribute to sick building syndrome. VOC are an important factor of toxic and volatile organic compounds, whereas most of the microclimate also reflected the intense smell, even special microclimate. The concentration of individual organic substances of this group is significantly at risk varies depending on the source. VOC sources are in buildings either in the short term in high concentrations (in applications, such as when applying paints, varnishes, flooring, insulation layers), or long term at low concentrations (during the use of products).

#### THE PROPOSAL OF DETERMINATION OF ENVIRONMENTAL CHARACTERISTICS

For the thermal decomposition of wood-based materials, and polymer materials used for the surface treatment of wood products, it is necessary to evaluate the retardants and even the environmental characteristics of these materials and for the prediction of their comprehensive fire-safety and environmental behaviour. in their preparation, but also in the context of LCA in terms of their use in practice, the following materials cycle, but also in the simulation of crisis situations, eg. in case of fire and leakage of flammable liquids, gases, solvents, diluents .

The device detects the concentration of gases and combustible-100 MicroCD RIDGID hazardous substances by using internal sensor TCD during the measurement of the heat. Detection of the device indicates the presence of combustible gases (methane, propane, ethylene, hydrogen, CO, hydrogen sulfide) and hazardous chemicals (volatile organic compounds-groups of the benzene, toluene, xylene, benzene, formaldehyde, etc.) using the Visual, audible and vibration mechanism in 5 levels of sensitivity setting thresholds for the presence of deteged substances. For low concentrations of hazardous gases, for example. What is appropriate to complement the measurement device GassAllert device to measure the concentration or CO/CO<sub>2</sub> model M7722.

In the framework of the evaluation of the environmental characteristics of the thermal degradation of wood can be surface modified wall substances (PUR solvent-with the presence of hazardous and dangerous chemical substances) was evaluated for the presence of selected hazardous chemical substances and combustible gases in four distances from the place of the thermal decomposition of the test bodies using a detection device, RIDGID MicroCD-100 [2]. Detection was carried out in selected locations of measurement: measuring place A – 30 cm (the distance from the source of the radiant 30 cm), measuring place B – 50 cm, measuring place C – 1 m, plôace D – 3 m. (B), (C)-50 cm-1 m, D-3 m. Evaluating of selected hazardous substances and flammable gases are listed in Table 1.

Table 1. Evaluated of combustible gases and selected hazardous chemicals

<b>Fammable gases and risk chemical substances</b>	<b>Measuring place A (ppm)</b>	<b>Measuring place B (ppm)</b>	<b>Measuring place C (ppm)</b>	<b>Miesto merania D (ppm)</b>
<b>Methane</b>	1600...3200	800...1600	400...800	<400
<b>Hydrogen</b>	800...1600	400...800	<400	160...320
<b>Carbon monooxide*</b>	<40	<40	<40	<40
<b>Formaldehyde</b>	160...320	80...160	40...80	<40
<b>Toluene</b>	80...160	<40	<40	<40
<b>Xylene</b>	40...80	<40	<40	<40
<b>Isobutanol</b>	40...80	<40	<40	<40
<b>Benzene</b>	80...160	40...80	<40	<40
<b>Ethylene</b>	160...320	80...160	40...80	<40

It was found that the thermal decomposition of coatings based on polyurethane reactoplastics cross-linked substances, applied to the surface of the wood (diisocyanate-toxic monomers decomposition products such as PUR lacquers)[2], which is further degradation to the benzene, formaldehyde and other undetectable device accompanying products (from a group of chemical substances – VOC) and solvents (BTX) are also present, which have been used in the treatment of the consistency of these coatings on the surface of the wood before applying. Carbon monoxide was not detectable because MicroCD has been used Ridgid device detector CO<sub>2</sub>/CO, model M7722, and also Detector CO Gass Allert Greisinger 100 which has a sensitivity to the concentration of CO below 40 ppm (Fig. 5) and at the same time, it detects the level of CO<sub>2</sub>. Other degradation products of thermal degradation test of radiant heat source, flammable gases: methane and hydrogen also indicated they were in a high concentration, resulting from the degradation of polymeric materials (wood, PUR coating substances).

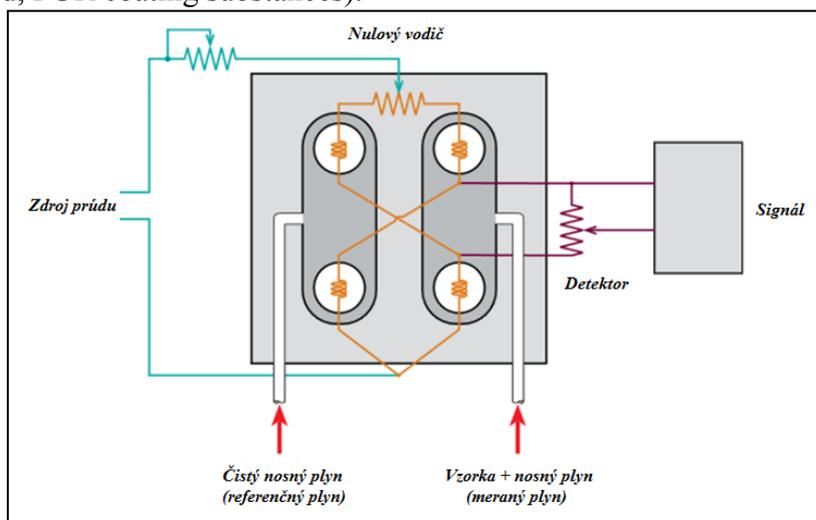


Fig. 1 The scheme of detection equipment RIDGID MicroCD-100



Fig. 2 RIDGID MicroCD-100 Detector



Fig. 3 CO<sub>2</sub>/CO Detector, model M7722



Fig. 4 Detector CO Gass Allert Greisinger 100

## CONCLUSION

For the thermal decomposition of wood-based materials, and polymer materials used for the surface treatment of wood products, it is necessary to evaluate the retardants and even the environmental characteristics of these materials and for the prediction of their comprehensive fire-safety and environmental behaviour (presence of risk chemical substances).

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## REFERENCES

- [1] Ružinská, E. - Krajewski, K.J. - Mitterová, I. - Zachar, M.: Bicomponent fibres for the preparation of a new effective filtration materials for separation of hazardous chemicals in technological processes of wood treatment. *Advanced Materials Research*, Vol. 1001 (2014), pp. 21-26, 2014, ISSN 1662-8985.
- [2] Boruszewski, P. – Mamiński, M.– Ružinská, E.(eds.): *Raw materials and Particleboard– a current status and perspectives*. Monography. WULS SGGW Warsaw Publish., 111 pp. ISBN 978-83-7583-389-8 (2012)
- [3] Ružinská, E. – Danihelová, A. – Jabłoński, M. – Krajewski, K.J.: Environmentally friendly procedures of utilization of hazardous substances in finishing processes in accordance to SR regulations. *Annals of Warsaw University of Life Sciences*, No. 80, pp. 37-49. ISSN 1898-5912 (2012).
- [4] Ružinská, E. – Hagara, V.: Implementation of the Current European Legislation on Chemical Substances to Ensure Protection of Environmental Security Policy of the Slovak Republic (REACH, GHS, VOC). *Journal of Law, Economy and Management*, Vol. 3/2013, No. 2. Publishing STS Centre London, pp. 88-95. ISSN 2048-4186 (2013)
- [5] Ružinská, E. - Mitterová, I. - Osipiuk, J.: Proposal of the experimental determination of selected characteristics of the thermal degradation of wood material modified by coatings with the occurrence of risk substances. *Annals of Warsaw University of Life Sciences – SGGW*, No. 84, p. 116-120. ISSN 1898-5912 (2013)
- [6] Ružinská, E. Mitterová, I. - Zachar, M.: Evaluation of Thermal Degradation of Wood with environmentally problematic application. *Advanced Materials Research*, Vol. 1001, pp. 300-305. ISSN 1662-8985 (2014)
- [7] Ružinská, E. Mitterová, I. - Zachar, M. - Majlingová, A.: Ignability of unprotected and retardants protected samples by spruce wood. *Advanced Materials Research*, Vol. 1001, pp. 330-335. ISSN 1662-8985 (2014)
- [8] Mitterová, I. Ružinská, E., Zachar, M.: The study of selected fire-technical characteristics of special wood products surface treatment by environmentally problematic coatings. *Advanced Materials Research*, Vol. 1001, pp. 373-378. ISSN 1662-8985 (2014)
- [9] Ružinská, E. – Krajewski, K.J.: Analysis of selected factors of the environment in the technological processes of surface treatment of wood. *Annals of Warsaw University of Life Sciences – SGGW*, No. 84, pp. 133-136 ISSN 1898-5912 (2013).
- [10] Ružinská, E. – Krajewski, K.J.: Evaluation the supramolecular structure bicomponent fibers for preparation of filters for efficient reduction of hazardous substances in the processes of surface treatment of wood. *Annals of Warsaw University of Life Sciences – SGGW*, No. 84, pp. 137-141. ISSN 1898-5912 (2013).
- [11] Ružinská, E.: The application of bicomponent polymeric for collection of hazardous chemical substances. *Chemické listy*, Vol. 108, No. 8, pp. 778-779. ISSN 0009-2770 (2014)

- [12] Ružinská, E – Detvaj, J. – Klement, I.: The multifunction recovery of hazardous lignocellulose wastes. *Chemické listy*, Vol. 108, No. 8, p. 812. ISSN 0009-2770 (2014)
- [13] Hybská, H. – Veľková, V. - Ružinská, E.: The multifunction recovery of hazardous lignocellulose wastes. *Chemické listy*, Vol. 108, No. 8, p. 796. ISSN 0009-2770 (2014)
- [14] Sedliačik, J., Ružinská, E.: Adhesive and Coating Materials. *Textbook*. Technical university of Zvolen, 160 pp. ISBN 978-80-228-2500-9 (2013)
- [15] Ružinská, E.: Plastics and coatings in woodworking industry. *Monography*. Technical university of Zvolen, 166 pp. ISBN 80-228-1518-7 (2005)
- [16] Ružinská, E.: Environmental technologies. *Textbook*. Technical university of Zvolen, 150 pp. in press (2014)
- [17] Ružinská, E.: Modification of fibre-forming polymers for preparation of special composite materials. *Chemické listy*, Vol. 104, p. 507 5L-14. ISSN 0009-2770 (2010)
- [18] Ružinská, E.: Analysis of the Environment in the Processes. *Textbook*. Technical university of Zvolen, 150 pp. in press (2014)
- [19] Ružinská, E (editor): Risk substances in environmental technology. Kolokvium ku grantovej úlohe KEGA MŠVVŠ SR 2012: 023-TUZ-4/2012. Technical university Zvolen. 92 pp. ISBN 978-80-228-2422-2 (2012)

**Streszczenie:** *Propozycja oceny degradacji termicznej i oceny środowiskowej. Część I. Wyznaczenie wybranych charakterystyk środowiskowych.* Celem pracy jest prezentacja propozycji nowych metod laboratoryjnych do oceny degradacji i charakterystyk środowiskowych drewna i wyrobów drewnopochodnych z różnymi powłokami.

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