

## Earth in a trap? 2018 – Abstracts of Conference Contributions

### Zem v pasci? 2018 – Abstrakty príspevkov z konferencie

#### The influence of modification of spruce wooden sawdust on heavy metal absorption

Magdalena Balintova<sup>a\*</sup> – Stefan Demcak<sup>a</sup>

<sup>a</sup>Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering, Vysokoskolska 4, 042 00 Kosice, Slovakia

##### Abstract

The contamination of wastewater by heavy metal is a world-wide environmental problem. For these purposes low-cost adsorbents obtained from plant wastes or semi-products of various industries as a replacement of costly conventional methods as precipitation, ion exchange, and adsorption are also applied. The removal of heavy metals by adsorption onto low-cost waste materials has recently become the subject of considerable interest. Natural materials that are available in large quantities, or certain waste products from industrial or agricultural operations, can be used as inexpensive adsorbents. The aim of this article is a study of absorption properties of natural and modified spruce wooden sawdust. Modification of spruce sawdust was carried out by sodium hydroxide and potassium hydroxide. The efficiency of heavy metals removal was tested on the model solutions with concentration of 10 mg.L<sup>-1</sup> copper, zinc, and iron, respectively. Changes of the functional groups of sorbents was analysed by infrared spectrometry. Absorption properties of spruce wood sawdust and their two modifications were studied by colorimetric method. Changes of pH values in solutions after the absorption experiments were determined too.

**Keywords:** Biosorption; alkaline treatment; heavy metals removal.

#### Changes of expanded polystyrenes macromolecular characteristics at thermal degradation

Martin Bednár<sup>a\*</sup> – Tatiana Bubeníková<sup>a</sup> – Danica Kačíková<sup>a</sup> – František Kačík<sup>a,b</sup>

<sup>a</sup>Faculty of Wood Sciences and Technology, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovakia

<sup>b</sup>Faculty of Forestry and Wood Sciences, Czech University of Life Sciences in Prague, Kamýcká 1176, Praha 6 - Suchbát, 16521 Czech Republic

##### Abstract

The study of expanded polystyrenes degradation is important because of their possible deterioration at higher temperatures. The influence of thermal loading in the temperature range from 140 °C to 200 °C on the expanded polystyrenes EPS 100F and EPS-Grey Wall (EPS GW) molecular weight changes was investigated. Size exclusion chromatography (SEC) with two PLgel MIXED B columns and tetrahydrofuran as a mobile phase were used for determination of molecular weights, degree of polymerisation (DP), polydispersity index (PDI) and molecular weight distribution (MWD). The degree of polymerisation (DP) decreases at the temperature above 140 °C in EPS 100F, polystyrene EPS GW has relatively good stability up to temperature of 180 °C, then its DP value rapidly drops. At 200 °C, molecular weight dropped by 90% for EPS 100F, and by 73% for EPS GW, respectively. At lower temperatures the polystyrene depolymerisation is slow and chain-end reaction prevails, at higher temperatures (140 °C for EPS 100F, and 180 °C for EPS GW, respectively) the drop of molecular weight is rapid and random cleavage of bonds is dominant.

**Keywords:** SEC; polystyrene.

## Examination of Fuels of Selected Cellulose Materials on the Basis of Determination the Flash Point Ignition Temperature and Self-ignition Temperature

Iveta Coneva<sup>a\*</sup>

<sup>a</sup>*Department of Fire Engineering, Faculty of Security Engineering, University of Žilina, Str. 1. mája 32, 026 01 Žilina, Slovak Republic*

### Abstract

of fires and their consequences, and even in different categories of buildings such as: industrial, manufacturing and technological buildings, warehouses and others. In the technologies of production and processing of cellulosic materials, e.g.: paper - namely tissue paper from basic raw materials, associated with treatment and disposal of unwanted printing dyes belongs, to the most-risky in terms of fire. During bleaching process contact of flammable input raw materials (e.g. waste paper, cellulose) with strong oxidizing agent – hydrogen peroxide takes place. Hydrogen peroxide itself is not flammable but significantly supports burning process and thus increases fire danger in pulping operation at pulp cellulose preparing and in technological process of production tissue paper products: hygienic toilet paper, hygienic napkins and handkerchiefs. Used bleaching agent, hydrogen peroxide, is possible to substitute by other more suitable and more fire safety substance in practice. This substance is an enzyme that causes more effective enzymatic bleaching of waste paper input raw material. The goal of experimental investigation was verification and comparison of effect of bleaching agents (hydrogen peroxide and enzyme) on cellulose material inflammability. Subjects of tests were input raw material samples – waste paper, wood pulp and intermediary product – tissue paper. Namely, following fire technical parameters: flash ignition temperature and self-ignition temperature of selected cellulose materials were determined and compared by method in STN ISO 871:1999 Plastics. Determination of ignition temperature using a hot-air furnace. Theoretical and practical investigations based on experiments concerning combustion of cellulose materials bring new knowledge.

**Keywords:** burning of cellulose materials; waste paper; tissue paper; flash ignition temperature; self-ignition temperature.

## Influence of the temperature on the load-bearing capacity of timber connections with steel fasteners

Tomasz Domański<sup>a\*</sup> – Kamil Kmiecik<sup>a</sup>

<sup>a</sup>*Cracow University of Technology, The Faculty of Engineering, ul. Warszawska 24, Cracow 31-155, Poland*

### Abstract

This paper presents a summary of results from numerical studies on the fire behaviour of timber connections with steel members. The finite element software ANSYS was used to make a three-dimensional thermal model of the connections. Then the FE model was used to analyse the heat flow within the connections under standard ISO-fire exposure. To estimate the load-bearing capacity of the connections exposed to the standard fire, the failure modes from the literature were used. The calculations take into account the reduction of the cross-section caused by charring and the reduction of steel strength at elevated temperatures.

**Keywords:** fire safety; timber joints; thermal analysis; steel plates; fastener.

## The impact of the exterior wall surface finish on the separation distance

Katarína Dúbravská<sup>a</sup> – Jaroslava Štefková<sup>b</sup>

<sup>a</sup>*Department of fire protection, Technical University in Zvolen, T. G. Masaryka 24, Zvolen, Slovakia*

<sup>b</sup>*Institute of foreign languages, Technical University in Zvolen, T. G. Masaryka 24, Zvolen, Slovakia*

### Abstract

Surface finish of the outer side of an external wall is not considered at its classification as a construction member, however it is considered at demining clearances. It is considered when separation distances are determined. It is also taken into account when the size of the partially fire open exterior wall area is determined in case if there is more than 100 MJ heat released from 1 m<sup>2</sup>. The paper discusses the impact of the surface finish of an external wall on the final separation distance. The comparison of five alternatives was evaluated – mineral wool insulating system, 120 mm polystyrene insulation system, 200 mm polystyrene insulation system, exterior siding - wooden and stone veneer placed on a part of the exterior wall. The procedure of determination of separation distances is described in STN 920 0201-4. The standard states that separation distance from the fire compartment is determined on the base of a length and height of the exterior wall due to the fire compartment, the type of construction member, the ratio of the fire open exterior walls and fire risk. It is clear that the lowest values of separation distance were achieved by the alternatives whose surface finish was formed from non-combustible materials (insulation system with mineral wool, exterior cladding from artificial stone). In case of the alternatives where polystyrene was used, the separation distances vary. This insulation material suggests that beside the kind of material used for surface finish, it is necessary to look at its thickness, density, calorific value and heat release per unit area (HRRPUA).

**Keywords:** surface finish; separation distance; heat release per unit area; partial fire open exterior area.

## Investigation of zones of fatigue failure of screws

K. Epifantsev<sup>a\*</sup> – T. Mishura<sup>a</sup>

<sup>a</sup> St. Petersburg State University Aerospace Instrumentation 190000, St. Petersburg, Russia. Bolshaya Morskaya Street 67

### Abstract

In recycling technology screw - the main working element for processing waste machines - extruders. From the quality of its production depends the productivity of the shop and the integrity of the machine body. When refining a multicomponent raw material, which is Refuse Derived Fuel - this is the general name for alternative fuels obtained from recycling. As raw material, almost any organic material is used: cellulose, rubber, plastic, leather, its substitutes. The study used an example based on work with RDF-raw materials of the Janino Refuse Processing Plant. Leningrad region. It is when working with such highly abrasive waste that it becomes necessary to increase the service life of screw augmentedly by using new processing technologies, since metal components and hard-to-break silicates can occur in the composition of this raw material. It research very important, because the priority project of the Russian Government, will be implemented from 2017 to 2025 with the key aim of reducing the environmental footprint from municipal solid waste disposal and mitigating environmental risks of an accumulated environ-mental damage [4]. The priority project involves the construction of five environment-friendly facilities for the thermal processing of municipal solid waste (waste incineration plants), four of them to be built in the Moscow Region and one facility to be built in the Republic of Tatarstan. An alternative to waste incineration is municipal waste recycling by moulding in extrusion machines to make pellets to be further used in the fuel or construction industries. The profitability of a waste recycling facility is dependent on a sound choice of extrusion equipment with the best value for money [5].

**Keywords:** fatigue failure; screw; refuse processing; deflected mode; mode of deformation.

## Thermal analysis as a useful analytical tool in environmental and civil engineering

Adriana Estokova<sup>a\*</sup>

<sup>a</sup> Technical University of Kosice, Faculty of Civil Engineering, Institute of Environmental Engineering,

### Abstract

Thermal analysis is a set of methods that are used for various purposes in a whole range of areas. Recently, its importance and practical application also increase in environmental engineering. This contribution aims to highlight the use of these techniques for research purposes on selected issues in the field of environmental science. The paper presents an application of thermal analysis to study the durability of concrete in aggressive environments, to examine hemp fibers prior to their application to light composites, or to analyze the resistance of polystyrene boards to thermal stress. The results confirm that thermal analysis could be also used in non-traditional areas of research.

**Keywords:** concrete; DSC; TGA; DTA; building materials; durability.

## Compositions of volatile organic compounds emitted from natural and synthetic polymers

Aleš Ház<sup>a\*</sup> – Michal Jablonský<sup>a</sup> – Anton Lisý<sup>a</sup>

<sup>a</sup> Department of Wood, Pulp and Paper, Institute of Natural and Synthetic Polymers, Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava, Radlinského 9, Bratislava 812 37, Slovakia,

### Abstract

Analysis of volatile organic compounds (VOCs) is an important method for understanding the chemical processes involved in polymer degradation and for the identification of materials. Many times is this type of analysis closely connected with thermal degradation during processing or during unwanted conditions. VOCs emitted during thermal treatment of plastics were analyzed to indicate compounds which can cause unpleasant odor. In this work were compared different techniques for analyzing VOCs from lignin and lignin composite. Identification was focused on comparison emitted sulphuric compounds. Screening analysis were made at 80, 160 and 200°C by different atmospheres. To confirm which compounds are emitted from samples, experiments were conducted and volatile organic compounds (VOCs) emitted from samples were trapped by Tenax/Carbograph adsorption tubes and analyzed by TD-GC/MS or directly analyzed by py-GC/MS. In the present study rubber, lignin/PLA/PHB composite and lignin were tested.

**Keywords:** TD-GC/MS; VOC; polymers; thermal desorption.

## Comparison of Forces and Means at the Fire of Selected Petroleum Large-Capacity Tanks

Ján Horváth<sup>a\*</sup> – Jaroslava Štefková<sup>b</sup> – Martin Zachar<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Department of Fire Protection, T. G. Masaryka 24, 960 53 Zvolen, Slovakia

<sup>b</sup> Technical University in Zvolen, Institute of Foreign Languages, T. G. Masaryka 24, 960 53 Zvolen, Slovakia

### Abstract

Fires of petroleum in large-capacity storage tanks belong to the most demanding fire interventions from the viewpoint of deploying the sufficient amount of forces and means. The article deals with forces and means necessary for a successful suppression of such fires for three real bulk storage tanks. The selected tanks are of a similar make but of different dimensions. The forces and means are calculated for the two most complicated scenarios. The calculations were performed according to the Regulation of the President of the Fire and Rescue Corps of the SR No. 39/2003. The results given in the table show that the necessary amount of forces and means grows directly with the dimensions of the tanks. In the present, it is not possible to exclude the risk of a real fire; therefore, it is necessary to consider the necessary deployment of the forces and means already at the beginning of its construction and/or installation.

**Keywords:** fire scenarios; fire suppression; large-capacity storage tank.

## Input factor analysis for the use of special LKT for the transport of water to a forest fire area

Ivan Chromek<sup>a\*</sup> – Richard Hnilica<sup>b</sup> – Michaela Hnilicová<sup>c</sup> – Jaroslav Matej<sup>d</sup> – Valéria Messingerová<sup>c</sup>

<sup>a</sup> Department of Fire Protection, Faculty of Wood Sciences and Technology, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic

<sup>b</sup> Department of Manufacturing Technology and Quality Management, Faculty of Environmental and manufacturing Technology, Technical University in Zvolen, Študentská 26, 960 53 Zvolen, Slovak Republic

<sup>c</sup> Department of Forest Harvesting, Logistics and Ameliorations, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic

<sup>d</sup> Department of Mechanics, Mechanical Engineering and Design, Faculty of Environmental and Manufacturing Technology, Technical University in Zvolen, Študentská 26, 960 53 Zvolen, Slovak Republic,

### Abstract

The forest wheeled skidder has been developed from its beginnings as a single-purpose machine for the needs of skidding in the forest. The paper deals with the analysis of input factors that predispose this type of construction to ensure the transport of water supply in case of fire brigades in forest fires. The input factors for the use of LKT mainly include analysis of the terrain, which is capable of this type of equipment to move, analyze the appropriateness of placing the adapter for the transport of water, the selection of appropriate materials, design and construction solutions. The aim of these analytical procedures is to conservation the original features and to extend the target use of special machines.

**Keywords:** forest wheeled skidder; adapter; duty of water; forest; forest fire fighting.

## Reduction of fire risk indicators at oil and gas industry companies by use modified water-gel compositions for thermal protection of oil products tanks

Alexey Ivanov<sup>a</sup> – Farid Dali<sup>a</sup> – Valeria Mikhaylova<sup>a</sup> – Alexey Smirnov<sup>a</sup> – Grigory Ivakhnyuk<sup>a\*</sup>

<sup>a</sup> University of State Fire Service of Emercom, Moskovskiy Avenue, 149, Saint-Petersburg, 196105, Russia

### Abstract

There are represented the researching physical properties of modified hydrogel, prepared by polymers of acrylic acid marked «Carbopol ETD 2020», in conditions of thermal and electro-physical modification by the variable frequency modulated potential (VFMP). Data on changes of hydrogels density was came into the procession of gelling agent concentration, thermal and electrophysical modification by VFMP. Determined, that comparative time of modified hydro-gels heating increases with increasing gel agent concentration in conditions of VFMP, also the comparative time of heating increases with thermal influence for modified hydrogels near the critical temperature value 4 °C. Concluded, that modified hydrogels may be used to improve the efficiency of the thermal protection of oil products tanks.

**Keywords:** hydrogel; electrophysical and thermal modification; thermal protection; variable frequency modulated potential; oil products fires scenarios; fire suppression; large-capacity storage tank.

## Environmentally Sustainable Access: Research Developments with a Focus on Softwood Bark Waste/By-products

Michal Jablonsky<sup>a\*</sup> – Ales Haz<sup>a</sup> – Jozef Jablonsky<sup>b</sup> – Nikola Chupacova<sup>a</sup>

<sup>a</sup> Department of Wood, Pulp, and Paper, Institute of Natural and Synthetic Polymers, Slovak University of Technology, Radlinského 9, 812 37 Bratislava, Slovak Republic

<sup>b</sup> Central Military Hospital SNP Ruzomberok - Teaching Hospital, Gen. Miloša Vesela 21, 03426 Ružomberok, Slovak Republic

### Abstract

In recent times, focus on waste bark research has increased all over the world and a large number of evidence has collected to show immense potential of bark waste used in various pharmacological, food or protection systems. Over the last few years, researchers have aimed at identifying metabolic plant-derived substances which can be used as drugs or as leads for drug discovery. Phytochemical compounds, particularly polyphenols, are the most active compounds that are naturally present in softwood barks and show a unique combination of chemical, biological, and physiological, antioxidant, antibacterial, antiinflammation, and cytotoxic activities.

**Keywords:** bark; softwood; waste; by-product.

## Effect of aging on reaction-to-fire of fibreboards

Juraj Jancík<sup>a\*</sup> – Linda Makovická Osvaldová<sup>a</sup>

<sup>a</sup> University of Žilina, Faculty of Security Engineering, ul. 1.mája 32, 010 26 Žilina, Slovakia

### Abstract

This paper theoretically describes the observation process of changes in reaction-to-fire of fibreboards as insulation materials exposed under natural conditions of buildings. Samples are modified with flame retardant "Ohňostop", that have proved to enhance their reaction-to-fire. Research focuses on monitoring the ability to preserve this attribute in time.

**Keywords:** Fiberboards; Aging; Insulation; Reaction-to-fire; Flame-retarding.

## Tropical wood facing material under fire conditions

Patricia Kadlicová<sup>a\*</sup> – Linda Makovická Osvaldová<sup>a</sup>

<sup>a</sup> University of Žilina, Faculty of Security Engineering, ul. 1.mája 32, 010 26 Žilina, Slovakia

### Abstract

This article describes the flammability of selected tropical wood. Data required for analysis are outputs of laboratory tested small wood samples. Experimental equipment was non-standardized laboratory equipment using a flame source of higher intensity (flame burner - propane-butane) affecting the test sample in an open environment. The above-mentioned laboratory outputs are presented by numerous clear graphs. Statistical analysis of dependence of important parameters and use of an appropriate analytical method reveals important parameters in assessing the flammability of the test sample.

**Keywords:** tropical wood; relative burning rate; flammability; analyze of dependence.

## Portable Multifunctional Equipment for Control of the Employees Working Activity

Gennady Korshunov<sup>a</sup> – Anatoly Romanov<sup>a</sup> – Andrei Nikulin<sup>a</sup> – Iliya Dolzhikov<sup>a</sup> – Qiang Xu<sup>b</sup>

<sup>a</sup> Saint-Petersburg Mining University, Saint Petersburg, Russian Federation

<sup>b</sup> Nanjing University of Science and Technology, China

### Abstract

The article presents the results of the review of a workplace-related mortality record provided by the International Labour Organisation. More than 240,000 fatalities have been found to be caused by human error. The article contains examples of managerial and engineering solutions aimed at increasing the employee's accountability in the work process and describes the algorithms of interaction between portable multifunctional equipment and various personal protective equipment types used by employees. A universal structure has been determined for the equipment designed to control the use of personal protective equipment with 17 indicators that characterise the possibility of using and implementing a communication system based on portable multifunctional equipment for control of the employees' working activity.

**Keywords:** working activity; PPE; ILO; equipment; working conditions; arrangement of working time; statistics; labour.

## Kettle thermal damage monitoring by thermovision

Ivan Kubovský<sup>a\*</sup> – Peter Lačný<sup>a</sup>

<sup>a</sup> *Technical University in Zvolen, Faculty of Wood Sciences and Technology, T.G.Masaryka 24, Zvolen 960 53, Slovak Republic*

### Abstract

The paper deals with monitoring the temperature of the plastic kettle. The simulated fault has been induced on the kettle thermostat, which has led to its gradual overheating to the state of thermal degradation of its vessel. Non-contact temperature fields measurement and their visualization were performed using the FLIR i7 thermal camera. Monitoring has lasted 17 minutes. The maximum pot surface temperature reached approximately 154 °C.

**Keywords:** kettle; temperature; thermal camera; thermal degradation.

## Current trends in flame-retardant treatment of selected polymers – a review

Andrea Majlingová<sup>a\*</sup> – Danica Kačíková<sup>a</sup> – Qiang Xu<sup>b</sup> – Cong Jin<sup>b</sup>

<sup>a</sup> *Technical University in Zvolen, T.G. Masaryka 24, 960 53 Zvolen, Slovakia*

<sup>b</sup> *Nanjing University of Science and Technology, 200 Xiao Ling Wei, Nanjing 210014, P.R. China*

### Abstract

Polymer based materials are used as in industry as in households. They are rapidly developing. Due to their cost, they often replace the traditional materials. The disadvantage of its use, both natural and synthetic polymers, is their sensitivity to flame because of their main constitute element, i.e. carbon. In general, the flammability of polymer materials depends on their chemical composition. Their flammability can be reduced by interfering the combustion process at any stage. A common approach to improve the flame-retardant properties of polymers is to apply the flame retardants. Those are used to prevent, minimize, suppress or stop the combustion process of polymer materials. They act to break the self-sustaining polymer combustion cycle and consequently reduce the burning rate or extinguish the flame in several ways. This paper compiles current research findings and results related to wood and wood composites, fabrics and PU/PUR foams flammability reduction, applying the flame-retardant treatment.

**Keywords:** fabrics; flammability; flame retardant; PU/PUR foam; wood; wood composite.

## Specification of a representative value for fire load density accumulated in building compartment

Mariusz Maslak<sup>a\*</sup> – Michal Pazdanowski<sup>a</sup>

<sup>a</sup> *Cracow University of Technology, Warszawska 24, 31-155 Cracow, Poland*

### Abstract

Two alternative approaches to the specification of fire load density representative for the considered fire zone are considered in this paper. The first approach is based on the direct inventory of combustible materials stockpiled in the fire zone. Here the nominal value obtained by direct measurements constitutes the measure of sought density. The possible inventory taking methods and the interpretation of results obtained are described in detail. The second approach is based on the statistically justified characteristic value. This measure seems to be more universal in application, though not so individualized as the first one. It is calculated as the appropriate quantile of the fire load density probability distribution, treated as the random variable. Procedure of this type takes into account the statistical variation of densities determined in zones used in the same manner. Thus, the obtained value is interpreted as authoritative for fire zone of particular type, instead of being associated with analyzed zone in a specific building.

**Keywords:** building compartment; fire load density; inventory of combustible materials; nominal value; random variable; probability distribution; quantile; characteristic value.



## Alternative approaches to critical temperature evaluation for axially compressed steel column exposed to fire

Mariusz Maślak<sup>a</sup> – Michał Pazdanowski<sup>a</sup> – Maciej Suchodoła<sup>a</sup>

<sup>a</sup> Cracow University of Technology, Warszawska 24, 31-155 Cracow, Poland

### Abstract

Four alternative procedures used to estimate the critical temperature of axially compressed steel column exposed to the direct action of a fully developed fire with equalized temperature of combustion gases in the nearest vicinity of this column are presented and compared in detail. The first two procedures are based on the recommendations of the code EN 1993-1-2 with application of the so-called degree of utilization, computed for the accidental load combination rule. The difference between the first and the second method lies in the fact, that the critical temperature is determined without and with application of an iterative algorithm. The third procedure, applied by the authors to verify the results obtained by the analytical approaches presented above is based upon the application of nonlinear numerical analysis performed within the ANSYS computational environment for a column model discretized with 3D finite elements. In the last approach a purely bar model of the column is analyzed, but the conventional stability analysis is replaced by a second order bearing capacity analysis conducted for an imperfect element and taking into account the amplification of initially assumed bow imperfections.

**Keywords:** Axially compressed steel column; fully developed fire; critical temperature; degree of utilization; iterative procedure; numerical analysis; bow imperfection; second-order bearing capacity analysis.

## Evaluation of the TETRA K board for the fire protection and safety needs

Iveta Mitterová<sup>a</sup> – Václav Kasan<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Faculty of Wood Sciences and Technology, T.G.Masaryka 24, Zvolen 960 53, Slovak Republic

### Abstract

The process of waste reuse also leads to a significant saving of natural resources, energy and, finally, efforts to ensure a clean environment. An interesting solution in this regard is the recycling and processing of Tetra Pak (beverage cartons) for products that find use in the construction of tile boards, or so-called dry construction products. It is precisely the type of product that has become our study object, to find out what properties of the Tetra Pak boards, such as the Tetra K standard board, have in terms of fire. For this purpose, experiments were carried out, where samples of the material were subjected both to the ignition testing according to STN EN ISO 11925-2 and evaluated for their ability to spread a flame on their surface, as well as a non-standard testing method for the detection of mass loss and ignition time. The work methodology and the results achieved are the content of the paper. When, on the basis of the same evaluation criteria (mass loss, ignition time, flame propagation) and constant testing conditions, we mutually compare the Tetra K boards with e.g. OSB boards, having a similar use, we can say that both materials at the same time of thermal loading have the relative mass loss: Tetra K board of  $70.3 \pm 6.9\%$  and OSB board of  $67.7 \pm 5.6\%$  on average; average ignition time: Tetra K of  $81 \pm 14$  s and OSB of  $63 \pm 11$  s. The both materials, according to STN EN 13501-1 + A1, met reaction to fire classification criterion  $F_s \leq 150$  mm in 60 s. This means that the two materials do not differ significantly from the point of view of the comparison of the fire properties. The advantage of the Tetra K board is probably a lower price.

**Keywords:** Flame spreading; mass loss; one-flame source; radiant source; recycling; Tetra Pak boards.

## Comparison of synthetic and natural sorbents in engine oil spills

Miroslav Mojžiš<sup>a</sup> – Miriama Šuleková<sup>a</sup> – Martin Zachar<sup>a</sup> – Danica Kačíková<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Slovak Republic

### Abstract

The leak of petroleum substances has harmful effects and negative impact on the ecosystem. The most frequent petroleum pollutants with a small range (up to 1 dm<sup>3</sup>.h<sup>-1</sup>) or spills which do not exceed 1 m<sup>2</sup> and thickness of 1 mm, include leakage due to various accidents or negligence. Prevention or intervention that employs sorbents to handle oil leakage situations. The paper is focused on sorbents in bulk state and on their quantitative use by leakage of petroleum substances, especially in traffic accidents on roads. Bulk sorbents were chosen based on their origin: natural and synthetic. Synthetic sorbents include Absodan plus, PeWaS Sorb, Sorp Reo and Spilkleen Plus. Sawdust, leaves residues, needles and mosses were used as natural sorbents. Sorbents were tested for sorption capacity according to standardized method ASTM F 726. Sorbent samples were tested for engine oil 10W 40, which is the most commonly used oil in motor vehicles. According to the sorption properties due to the standard, sorption capacity of adsorbents were measured in the short term. Based on the obtained results, it was found that synthetic sorbents have better sorptive capacity represented by Sorptive Grass Reo with a value of 14.98 g/g. Among natural sorbents, leaves residues of 7.43 g/g have better capacity. In the accordance of obtained results, synthetic sorbents have higher sorption capacity than natural sorbents as they are manufactured for sorption purposes.

**Keywords:** oil spills; natural sorbents; synthetic sorbents; ecosystem.

## Evaluation of selected food dusts from the standpoint of fire safety

Eva Mračková<sup>a\*</sup> – Emília Orémusová<sup>a</sup> – Michal Danek<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, T.G.Masaryka 24, Zvolen 960 53, Slovak Republic

### Abstract

The article deals with dust – air mixtures of selected food dusts and the determination of their selected fire – technical characteristics. The aim of this thesis is to experimentally determine the lower explosive limit of food powder samples consisting of smooth flour, powdered sugar and cocoa using the VK 100 explosion chamber and the gross calorific value measurement using the IKA C5000 calorimeter according to the methodology given in STN ISO 1928. State exams belong analytical methods used in fire and safety engineering. By conducting experiments and evaluating samples, it was concluded that all samples of food dusts examined are explosive and present a high risk of explosion and fire in technologies. The test sample of cocoa showed the most reactive, with the lowest lower explosive limit and the highest gross calorific value. Gross calorific value values contribute to the spread of fire, therefore the manufacturing operations of food products must be assured by the design elements of the explosion protection.

**Keywords:** dust explosion; lower explosion limit; explosion chamber; gross calorific value; calorimetric apparatus.

## A scientific approach to determination of the cause of fire

Miroslava Nejtková<sup>a\*</sup>

<sup>a</sup> Ministry of the Interior – Directorate General Fire Rescue Service Czech republic, Population Protection Institute, Czech republic

### Abstract

The paper deals with a scientific approach to determination of the cause of fire. It focuses on one of the most important tasks – collection of veritable information relevant to proposing versions of the causes of fire. The first part of the paper deals with the tools for documentation and digitization of the fire scene. The second part of the paper focuses on sampling, laboratory investigation and subsequent elaboration of a Fire-Technical Expertise. The also paper mentions non-destructive X-ray testing, which is a great contribution in investigations.

**Keywords:** cause of fire; analysis; documentation; fire scene; sample; investigation.

## Testing of Alginite as a sorbent of heavy metals from soil and above – ground biomass of plants

Jana Oravcová<sup>a</sup> – Martin Dráb<sup>b</sup> – Hana Ollerová<sup>b</sup> – František Kačík<sup>a,c\*</sup>

<sup>a</sup> Technical University in Zvolen, Faculty of Wood Sciences and Technology, Zvolen, Slovakia

<sup>b</sup> Technical University in Zvolen, Faculty of Ecology and Environmental Science, Zvolen, Slovakia

<sup>c</sup> Czech University of Life Sciences in Prague, Department of Wood Processing, Praha, Czech Republic

### Abstract

The aim of the thesis is to determine the content of mercury in soil and in plants grown in contaminated soil with the addition of Alginite. Samples of soil contaminated with mercury were taken from locality of Malachov and then mixed with Alginite in a 1: 3 and 1: 1 ratio. In these substrates, we performed an experiment with Brassica napus L. var. napus. (rape). Plant and soil samples were analyzed on a dedicated spectrophotometer - AMA 254. In the samples of substrates used for growing rape we found a mercury content from 0.0929 mg.kg<sup>-1</sup> to 2.9085 mg.kg<sup>-1</sup>. The mercury content in the above – rape biomass from 0.0425 mg.kg<sup>-1</sup> to 0.3302 mg.kg<sup>-1</sup>. The sorption properties of Alginite were most pronounced in the above – mentioned rape biomass when a drop-in mercury content of 0.2005 mg.kg<sup>-1</sup> was recorded. We compared the resulting values with the limit values that were exceeded in many cases. From the values we have found, we can say that Alginite has confirmed its sorption properties, which can be further used in the treatment of the physical – chemical properties of lighter soils, the decontamination of soils devastated by anthropogenic activity.

**Keywords:** mercury; Alginite; Brassica napus L. var. napus; AMA 254.



## Assessment of biological degradability of agricultural substrates

Juraj Poništ<sup>a</sup> –Dagmar Samešová\*

<sup>a</sup> Department of Environmental Engineering, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen

### Abstract

This work focuses on research of the biological degradation of the agricultural substrates, name-ly the cattle manure and the corn silage. We evaluated the suitability and on the contrary unsuitability of the selected substrates in the process of the biodegradability. Research methods used activated sludge from the wastewater plant to evaluate the potential of selected substrates in the process of the biodegradability. The significant indicators, which include O<sub>2</sub>, CO<sub>2</sub>, BOD<sub>5</sub> and CODCr were used for analysis on biological degradability of agricultural substrates. The corn substrate achieved the highest decomposition rate. Used tests and deviations between them, confirmed the requirements for a combination of the different tests of biodegradation. It was problematic to have only respirometric assays that showed a very similar pattern, although the percentage of biodegradation was different. According to determination of selected indicators, corn silage and cattle manure can be defined as average biodegradable substrates. Addition of the active sludge made degradation faster of both samples.

**Keywords:** manure; anaerobic digestion; biodegradability; corn silage.

## Preliminary results of “Environmental biomonitoring by bees” network at University of Sopron

Tamás Rétfalvia\* – Ferenc Lakatos<sup>b</sup> – Piroska Szabó<sup>a</sup> – Zoltán Kovács<sup>c</sup>

<sup>a</sup>University of Sopron, Faculty for Forestry, Institute of Chemistry, Bajcsy-Zs. 4. Sopron, 9400, Hungary

<sup>b</sup>University of Sopron, Faculty for Forestry, Institute of Sylviculture and Forest Protection, Bajcsy-Zs. 4. Sopron, 9400, Hungary

<sup>c</sup>Forestexpert Ltd, Jókai 7. Bajna, 2525, Hungary

### Abstract

Activity of Honey bees (*Apis mellifera*) has many beneficial properties, which make them particularly suitable for environmental biomonitoring. Examination of vital signs, chemical analysis of collected and stored materials, such as pollen, honey, propolis and wax provide us lots of information for evaluation of environmental status. For this purpose, University of Sopron started a new project in 2015. We are developing an environmental monitoring system based on bee families. Our target is to establish the basic parameters and methods of a novel monitoring network, which is appropriate for fast, reliable indication and detection of contaminants with relatively low costs. Concerning the foregoing results Polycyclic Aromatic Hydrocarbons (PAH) were correlated with the pollution originated from waste combustion, while in case of metal content significant effects of road traffic were found. Our future plans include installation and development of “smart beehives” equipped different measuring instruments in order to implement real-time environmental biomonitoring.

**Keywords:** biomonitoring; bee; honey; propolis; wax; heavy metal content.

## Automatic Control of Using Safety Helmets by Workers

Anatoly Romanov<sup>a</sup> – Andrei Nikulin<sup>a</sup> – Dmitry Ikonnikov<sup>a</sup> – Iliya Dolzhikov<sup>a</sup>

– Stanislav Kovshov<sup>a</sup>

<sup>a</sup> St. Petersburg Mining University, St. Petersburg, Russian Federation

### Abstract

The article addresses ways to automate the process of controlling compliance with the rules for safety helmet use to improve the safety of employees working in harmful or hazardous conditions. Authors have proposed to consider the employee/safety helmet system as a physical object/biotechnical system. It has been shown that in cases when only the information that characterises a physical object is controlled, the information can be imitated by unprincipled workers. It has been resolved that the process should be complemented with the information that characterises the employee's activity (as a biological object). A suggestion has been made that proposed information spaces should be combined to improve the reliability of a control result. The article offers a method to generate a decision rule that integrates the assessment obtained based on the review of information from different sources. A structure of information process interaction has been developed to solve the task. The scope and purpose of main hardware that implement long-term automatic control over compliance with the rules for safety helmet use have been determined.

**Keywords:** occupational safety; Industrial safety helmets; smart PPE; safer equipment; health; safety.

## Emission Modeling of Exhaust Gases from Typical Parking House Operation

Jozef Salva<sup>a</sup> – Miroslav Vanek<sup>a</sup> – Marián Schwarz<sup>a</sup> – Miroslav Dado<sup>b</sup>

<sup>a</sup> Department of Environmental Engineering, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen (Slovakia), jsalva@gmail.com, Tel: (+421) 455 206 830

<sup>b</sup> Department of Manufacturing Technologies and Quality Management, Technical University in Zvolen (Slovakia), dado@tuzvo.sk, Tel: +421 455 206 864

### Abstract

This paper deals with air emissions modeling of exhaust gases associated with a standard parking house during its operation. The dispersion study evaluates the immission load from the mobile sources of air pollution and from stationary sources of air pollution (operating air-conditioning). The pollutants were evaluated as CO, NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub> and benzene. The authors also point to the possible side effects associated with ototoxicity of CO and NO<sub>2</sub> (as a part of a group of asphyxiants within ototoxic substances) and benzene (as part of solvent group within ototoxic substances). Outputs of the modeling software did not detect the exceedance of the limit values under the legislation on human health protection.

**Keywords:** exhaust gases; emissions modeling; MODIM; ototoxicity; parking house.

## Human thermal comfort in miner's overalls

Ilya F. Sidakov<sup>a</sup> – Andrei Nikulin<sup>b</sup> – Lyudmila V. Stepanova<sup>b</sup>  
– Nikulina Anni Yulievna<sup>b</sup>

<sup>a</sup> Kovcheg-Ural LLC, 29-1 Timiryazeva Str., Chelyabinsk 454091, Russian Federation

<sup>b</sup> St. Petersburg Mining University, St. Petersburg, Russian Federation

### Abstract

The article presents the results of the experimental surveys of the thermal conductivity of two types of fabrics used to make special clothes for mine workers (miner's overalls) depending on the degree of clothes contamination with coal dust. Thermographs of the cooling process have been obtained and a thermal conductivity factor has been calculated for each sample. The impact of miner's overall contamination on the miners' thermal comfort has been reviewed.

**Keywords:** human resources; Arctic; special clothes; safety; corporate social responsibility coal dust; thermal comfort; fabric thermal conductivity.

## Comparison of the Gross Caloric Value of the Selected Wood Species

Nikoleta Szirmaiová<sup>a\*</sup> – Danica Kačíková<sup>a</sup> – Martin Lieskovský<sup>b</sup>

<sup>a</sup> Faculty of Wood Sciences and Technology, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic

<sup>b</sup> Faculty of Forestry, Technical University in Zvolen, T.G. Masaryka 24, 960 53 Zvolen, Slovak Republic

### Abstract

The article deals with the defining of the parameter influencing the ignition and the speed of the fire spreading in the woodland area. The aim of this paper is to experimentally define gross caloric value using the calorimeter IKA C200. The procedures of measurements were carried out according to the STN ISO 1928. Spruce wood and beech wood was used for the experiment. Samples from selected tree species were extracted in the area of Zvolen. Roots, trunks and branches were examined. The representative samples were dried at the temperature  $103 \pm 2$  °C before the testing to ensure humidity 0%. The highest gross caloric values were observed with spruce wood branches (21 150 J/g), spruce wood roots (20 939 J/g), and a spruce wood trunk (20 386 J/g). The representative samples of beech wood (root, trunk and branches) showed lower gross caloric values than spruce samples. The results confirm that soft wood (like spruce) shows remarkably higher gross caloric values than hard wood. Based on obtained results, it can be said that spruce wood is easily combustible and shows higher values of gross caloric value and thus more dangerous according to forest fires than beech wood.

**Keywords:** Beech; Forest fires; Gross caloric value; Spruce.

## Reaction to fire of façade heat insulating materials

Ľudmila Tereňová<sup>a</sup> – Emília Orémusová<sup>b\*</sup>

<sup>a</sup> Department of Fire Protection, Faculty of Wood Sciences and Technology, Technical university in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic

### Abstract

Nowadays the most important requirements for construction of buildings are energy economics and heat saving. The market offers many thermal insulation materials used in the external thermal insulation composite systems of buildings which also need to comply with the requirements of the fire safety. In the paper are evaluated two samples of the insulation cork boards and boards from the expanded polystyrene (EPS) from the point of view of the reaction to fire. The reaction to fire is the basic coefficient of their possible use in the external thermal insulation composite systems of renewed buildings. For both thermal insulation materials were used the testing method for evaluation of ignitability according to the standard STN EN 11925-2 and for the determination of the gross calorific value according to the standard STN EN 1716. Based on the results of the test of ignition were both materials ranked in the class of reaction to fire E. With the expanded polystyrene EPS sample appeared extensive deformation of shape. Higher or in other words less favourable values of the gross calorific value were detected with the samples from EPS. Cork insulation boards reached from the overall evaluation of their reaction to fire more favourable results than the boards from the expanded polystyrene. The cork boards had better results also in the regard of the gross calorific value evaluation. The average rate of the gross calorific value of two different cork boards in the reference state i.e. considering actual humidity varied from 25 711 J/g to 29 248 J/g. Meanwhile, the EPS samples had markedly higher average rates of gross calorific value namely from 40 673 J/g to 40 839 J/g.

**Keywords:** reaction to fire, cork boards, expanded polystyrene, ignitability, gross calorific value, external thermal insulation composite systems.

## Effective Prevention of Hazardous Waste Industrial Dusts

Ivana Tureková<sup>a</sup> – Eva Mračková<sup>b\*</sup>

<sup>a</sup> Constantine the Philosopher University in Nitra, Tr. A. Hlinku 1, 949 74 Nitra, Slovakia

<sup>b</sup> Technical University in Zvolen, Masaryka 24, 960 53 Zvolen, Slovakia

### Abstract

Development of new technologies along with the use of new materials also requires new approaches to risk assessment. In practice, it means that by processing new materials, particular types of waste with characteristics involving environmental, as well as health and safety risks emerge. This paper deals with technologies related to the occurrence of abrasive dusts from processing of plastics related to the environmental protection, health protection of workers and explosion protection. These seemingly different fields require common and complex approach to protection solutions. It is proven that only by testing of dust characteristics and by determining their most significant hazards which have shown to be explosion characteristics as well, it is possible to suggest effective technological measures.

**Keywords:** dust clouds; plastic; hazard; safety characteristics.

## METAL flammable dust as dangerous substances

Miroslava Vandlíčková<sup>a</sup>

<sup>a</sup> University of Žilina, Faculty of Security Engineering, 1st May Street 32, 010 01, Žilina, Slovak Republic

### Abstract

A number of industrial technologies are accompanied by the presence of flammable metal dust, which can occur in the seated or whirled state. From the point of view of occupational safety, their fire-technical characteristics, their impact on workers' health and the environment must be taken into account. This article deals with the properties of chosen flammable industrial metal dusts, especially from the point of view of fire safety, anti-explosion protection and environmental risk. The group of toxicological properties of metallic dusts is also included in the article as mankind is also an inseparable part of the environment. The conclusion of this article deals with preventive measures to prevent fire and explosion of such flammable metal dusts as effectively as possible, and also to prevent acute and chronic diseases caused by human exposure to metal dust in factories or at another possible space.

**Keywords:** metal; flammable dust; environmental hazard; fire; explosion; occupational safety; dangerous substances.

## Safecast bGeigie Nano as a tool for teaching students to understand monitoring environmental radioactivity

Jozef Salva<sup>a</sup> – Miroslav Vanek<sup>a</sup> – Marián Schwarz<sup>a</sup> – Miroslav Dado<sup>b</sup>

<sup>a</sup> Technical University in Zvolen, Faculty of Ecology and Environment, Department of Environmental Engineering, T.G. Masaryka 24, 960 53 Zvolen, Slovakia

### Abstract

Safecast is a volunteered geographic information project based on the public participation in data collection and upload to a publicly available online database. This paper provides brief introduction to the Safecast database and bGeigie Nano device, with the detailed information available in the relevant references. While the main purpose of the Safecast database and bGeigie Nano is to provide publicly available data on the environmental radioactivity, we believe, that this concept is also a valuable tool for teaching university students to understand the complex aspects of environmental radioactivity monitoring, through unique personal experience. Proposed activities have a potential to become a part of the education process for the course of Radioecology. We intend to provide the opportunity for students to use the bGeigie Nano device to collect data and participate in the worldwide environmental radioactivity monitoring network. This experience itself would be a valuable asset, besides the obvious benefit of contributing to the database with our own new data.

**Keywords:** Safecast; bGeigie Nano; environmental radioactivity.

## Study of forest fire behaviour under the meteorological conditions changed

Rastislav Veľas<sup>a\*</sup> – Andrea Majlingová<sup>a</sup> – Danica Kačíková<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Faculty of Wood Sciences and Technology, T.G.Masaryka 24, Zvolen 960 53, Slovak Republic

### Abstract

In recent years, the forest fires issue has been addressed by many experts, who contributed a development of knowledge on forest fire behaviour. For forest fire behaviour modelling, it is especially important to have the information on meteorological conditions, weather conditions and the influence of fuel and topography. The main objective of this work is to describe and evaluate the effect of selected meteorological and weather conditions on the area of the fire site. For modelling and simulation, we used the data on forest fire that occurred in the Koč locality, situated in the National Park Slovenský raj, in 2007. In the FARSITE programme, the input data related to the air temperature, wind speed, precipitations totals were changed to study the effect of the increasing values of meteorological factors studied. The forest fire behaviour was modelled for the first 24 h of its duration. The computer modelling results and analyses of the courses of fire site area growth showed that with the increasing wind speed the fire site area grows. However, wind speed had the most significant influence on the development of the fire during the day. During the night the area of fire site was growing very slowly (only few m<sup>2</sup>/h), probably because the fire intensity significantly decreased. There was almost no effect of change in air temperature on forest fire behaviour. When studying the effect of precipitations totals on forest fire spreading, we also considered the impact of the time of precipitations occurrence, either from 5.00 a.m. to 7.00 a.m. or from 12.00 p.m. to 14.00 p.m., before the fire ignition, except the precipitations totals. Larger fire site area occurred in the case of precipitations totals of 0 mm/m<sup>2</sup>/h than 3 mm/m<sup>2</sup>/h and when the precipitations occurred before the fire initiation, i.e. from 12.00 p.m. to 2.00 p.m. When considering the precipitation totals of 8 and 40 mm mm/m<sup>2</sup>/h, the fire was not initiated in FARSITE programme, due to the high moisture content of forest fuel available in the study area. We also performed a correlation analyses between wind speed (precipitations totals) and fire site area to statistically confirm the dependency between the meteorological factors change and the fire site area growth. The results showed the very tight dependence between all the meteorological factors considered and the fire site area growth.

**Keywords:** forest fire; modelling; FARSITE; fire behaviour; meteorological conditions.

## Assessing the adsorbents suitability for removing of solid surface oil pollution

Veronika Veľková<sup>a\*</sup> – Tatiana Bubeníková<sup>a</sup> – Patrik Tajnai<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Faculty of Wood Sciences and Technology, T.G.Masaryka 24, Zvolen 960 53, Slovak Republic

### Abstract

The article is dealing with the assessment of the effectiveness of selected adsorbents to remove oil pollution. In the experiment was simulated leakage of diesel oil and engine oil on a solid surface. On the oil compounds were three kinds of adsorbents (Cansorb, Josyp Plus and Experlit) applicate. Application of selected adsorbents determines the effect of kinematic viscosity on the efficiency of adsorption. The influence of the origin of the adsorbent was also confirmed. It was the most effective adsorbent of organic origin CANSORB applied at leakage of engine oil and even diesel. Adsorbent of natural origin JOSYP PLUS with an efficiency of 55.86% not recommended for use to remove escaped diesel from a solid surface.

**Keywords:** adsorbent; engine oil; diesel oil; solid surface; oil pollution.

## Impact of foaming agents on vegetation

Veronika Veľková\* – Danica Kačíková<sup>a</sup> – Viera Špureková<sup>a</sup>

<sup>a</sup> Technical University in Zvolen, Department of Fire Protection

### Abstract

In the article, we have reported about experimental monitoring of the effects of foaming agents on plant organisms. Three kinds of foaming concentrates (protein, synthetic and AFFF) were used for low-expansion foam production. Prepared low-expansion foam was applicated on grass samples. Visual changes in grass samples and changes that have led to grass samples drying have been observed. The seasonal effects of meteorological factors were also observed in the experiment. We determined massive differences between foam stability of AFFF foam in the summer and winter time (foam was compact in December 20 times longer than in August). Also the impact of AFFF foam on the grass samples was influenced by the surrounding temperature conditions (extinction of grass after 2 days in summertime and 6 days in wintertime)

**Keywords:** aqueous film forming foaming agent; protein foaming agent, synthetic foaming agent, low-expansion foam, grass.

## Research of fabric air permeability for miner's overalls

Oksana A. Vigelina<sup>a</sup> – Irina V. Andreeva<sup>a</sup> – Andrei Nikulin<sup>b</sup> –

Lyudmila V. Stepanova<sup>b</sup> – Anni Yu. Nikulina<sup>b</sup>

<sup>a</sup> St. Petersburg State University of Industrial Technologies and Design, 18, Bolshaya Morskaya Str., St. Petersburg 191186, Russian Federation

<sup>b</sup> St. Petersburg Mining University, St. Petersburg, Russian Federation

### Abstract

The article describes an algorithm of fabric contamination with coal dust and presents the results of the experimental surveys of the air permeability of two types of fabrics used to make special clothes for mine workers depending on the degree of clothes contamination. The peculiarities of coal dust particle distribution in material fibres have been identified and the impact of contamination on fabric physical and hygiene properties has been evaluated.

**Keywords:** human resources; safety; Arctic; corporate social responsibility; PPE; coal dust; fabric air permeability; fabric; OHSAS; labour.

## Agroforestry as a tool for sustainable land use in Central European countries

Andrea Vityi<sup>a\*</sup> – Nóra Kiss Szigeti<sup>a</sup> – Tamás Rétfalvi<sup>b</sup> – Emes Dominkó<sup>b</sup> – Bohdan Lojka<sup>c</sup> – Radim Kotrba<sup>d,e</sup> – Jaroslav Jankovič<sup>f</sup> – Michal Pástor<sup>f</sup> – Robert Borek<sup>g</sup>

<sup>a</sup> University of Sopron, Faculty for Forestry, Institute of Forest and Environmental Techniques., Bajcsy-Zs. 4. Sopron, 9400, Hungary

<sup>b</sup> University of Sopron, Faculty for Forestry, Institute of Chemistry, Bajcsy-Zs. 4. Sopron, 9400, Hungary

<sup>c</sup> Czech University of Life Sciences Prague, Faculty of Tropical AgriSciences, Department of Crop Sciences and Agroforestry, Kamycka 129, Praha 6, 165 00, Prague, Czech Republic

<sup>d</sup> Czech University of Life Sciences Prague, Faculty of Tropical AgriSciences, Department of Animal Science and Food Processing, Kamycka 129, Praha 6- Suchdol, 165 00, Prague, Czech Republic

<sup>e</sup> Institute of Animal Science, Department of Ethology, Pratelstvi 815, Praha- Uhřetěves, 104 00, Prague, Czech Republic

<sup>f</sup> National Forest Centre, Forest Research Institute in Zvolen, Department of Silviculture and Forest Production, T. G. Masaryka 22, 960 92 Zvolen, Slovak Republic

<sup>g</sup> Institute of Soil Science and Plant Cultivation, State Research Institute, ul. Czartoryskich 8, 24-100 Pulawy, Poland

### Abstract

Agroforestry systems can increase resource efficiency, enhance productivity, and improve the overall resilience of agroecosystems. Agroforestry has a long tradition, however their widespread use has been interrupted by introduction of industrial agriculture and in some countries by political changes connected with collectivization and land consolidation. As reflection to unsustainable use of land by post-communist co-operations/enterprises, agroforestry has become a rediscovered practice of mainly family farmers in the countries of Central Europe in the last years. Traditional agroforestry systems in this region represent traditional land use systems with a high environmental and cultural value. This region also has a high potential for establishment of modern agroforestry systems which could be a great source of inspiration to learn about interactions, symbioses, biodiversity and agroforestry strategies and practices in such multifunctional systems under adaptation to climate change. The paper gives a general overlook of the role of agroforestry in Hungary, Slovak Republic, Czech Republic and Poland with special regard on the following issues:



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- the main reasons that make it necessary to investigate the potential of modern agroforestry practices and technologies to alleviate/mitigate the environmental problems in the Central European region
  - the new initiatives with the aim of preserving traditional and establishing modern agroforestry systems
  - main drivers and barriers regarding the adaptability and legalisation of agroforestry systems
  - the potential of agroforestry practices in sustainable land management.

**Keywords:** agroforestry; sustainable land use; efficiency, productivity.

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## Study of thermal degradation of selected materials using ATR-FTIR spectroscopy

Eva Výbohová<sup>a\*</sup> – Veronika Veľková<sup>b</sup>

<sup>a</sup> Department of Chemistry and Chemical Technologies, Technical University in Zvolen, T.G. Masaryka 24, 960 53 Zvolen, Slovakia

<sup>b</sup> Department of Fire Protection, Technical University in Zvolen, T.G. Masaryka 24, 960 53 Zvolen, Slovakia

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### Abstract

This paper focuses on the possibility to use attenuated total reflectance - Fourier transform infra-red (ATR-FTIR) spectroscopy in fire engineering. The key advantages and limitations of this technique are discussed. As examples, the study of thermal degradation of PUR foam, and wood are used. The assignment of characteristic absorption bands in the investigated materials is presented. Additionally, the changes in spectra due to thermal degradation of examined materials were discussed. In the case of PUR foam, the degradation of NCO, formation of new carbonyl groups, loss of CH<sub>2</sub> groups, and the loss of aromatic rings were observed. In samples of wood the structural changes in lignin macromolecule as well as the degradation of polysaccharides, mainly hemicelluloses were occurred.

**Keywords:** ATR-FTIR spectroscopy; thermal degradation; PUR foam; wood.

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## Assessment of possible environmental risks of old dumps

Ivana Knapcová<sup>a</sup> – Dagmar Samešová<sup>a</sup>

<sup>a</sup> Department of Environmental Engineering, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen

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### Abstract

The environmental risk study of the gudron's dump. The technological stream, which is the most environmentally harmful during the refinery production, are wastes from acid refining - gudrons. Gudrons are produced in the processing plant at the treatment and pretreatment of crude oil by the use of sulphonation technologies. In the past, gudrons have been landfilled without security, and the problem of contamination remains as an environmental burden. The risk of contamination spreading has some migration pathways in general: land, surface runoff, groundwater, air. The aim of the paper is to assess the potential risk of dumps by means of ecotoxicological tests (acute toxicity test on daphnias - *Daphnia magna* and the growth inhibition test of the root of the higher cultural crops - *Sinapis alba*) of the aqueous and solid waste phases. There was evaluated the dependence of inhibition and immobilization on the concentration of the oil which was defined as unpolar extractable oil content (NEL). The results show that the waste is toxic to both aquatic and terrestrial organisms. In terrestrial tests, 50% inhibition was confirmed at NEL values of 79 mg.L<sup>-1</sup> for the solid phase and 0.2 mg.l-1 for the aqueous phase. In the aqua test, 50% immobilization was confirmed at NEL concentrations of 5.4 mg.L<sup>-1</sup> (solid phase) and 0.1 mg.L<sup>-1</sup> (aqueous phase).

**Keywords:** ecotoxicity, dump, environmental risks.

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